119 Number 1

and February 2008

Entomological News

continued on back cover

USISSN 0013-872X

Mailed March 14, 2008

THE AMERICAN ENTOMOLOGICAL SOCIETY

C-BANDING KARYOTYPES OF TWO SPECIES OF *CHORTHIPPUS* (ORTHOPTERA: ARCYPTERIDAE) FROM CHINA[1]

Na Li,[2] Wenjuan Wei,[3] and Bingzhong Ren[2]

ABSTRACT: Chromosomes and C-banding karyotypes of *Chorthippus brunneus huabeiensis* Xia et Jin and *Chorthippus minutus* Zhang were studied for the first time, which respectively collected in Songhua Lake, Jilin Province China and Daqinggou, Inner Mongolia China. In the males, the chromosome numbers of these two species was found to be 2n (♂) =17, with three metacentric pairs and five telocentric pairs, and X chromosomes are telocentric. This genus has the basic Orthopteran sex determining mechanism XX♀/XO♂. All the chromosomes possess centromeric C-bandings. The differences of these two species are also very remarkable, such as genome formula, terminal bandings, medial bandings and content of heterochromatin.

KEY WORDS: *Chorthippus,* Chromosome, karyotype, C-banding

Chorthippus is a genus of Arcypteridae belonging to Orthoptera, and it is a very common meadow grasshopper. *Chorthippus* is mostly distributed in Palaearctic region, and widely in Asia, Europe, Africa and America. In China, it is mainly distributed in the north to the Changjiang River, and mostly in the northeast and northwest area. *Ch. brunneus huabeiensis* is widely distributed in Northeast China, Jilin, Hebei, Beijing, Shaanxi, Neimenggu, Xinjiang, Qinghai, Tibet, Shanxi, Gansu, and Ningxia. However, *Ch. mimutus* is only distributed in Northeast China.

Acridoid grasshoppers, including the genus *Chorthippus*, are the best known orthopteroid group with regard to chromosome number and C-banding pattern (Hewitt and John, 1968, 1970; Jones et al., 1975; Cabrero and Camacho, 1986; Santos et al., 1983; Gusachenko et al., 1992; Belda et al., 1987; Camacho et al., 1987; Pascual et al., 1987). Recently, there are many reports about the hybrid zone of *Chorthippus* (Buao et al., 1995, Serrano et al., 1996; Bridle et al., 2001, 2002; Bailey et al., 2004; Shuker et al., 2005), but few reports about karyotypes of *Chorthippus* (Bridle et al., 2002; Lin, 2000, 2001).

Ch. brunneus huabeiensis and *Ch. minutus* males are fully winged, and inhabit in grassland. Hitherto, no karyological studies in these two species have been done. In this study, we analyzed and compared the chromosomal differentiation of these two species from Northeast China.

---

[1] Received on January 21, 2007. Accepted on June 3, 2007.

[2] School of Life Sciences, Northeast Normal University, Changchun, 130024, China. E-mails: NL ln433311443@163.com and BR (corresponding author) bzren@sina.com, bzren@163.com, or renbz279@neun.edu.cn.

[3] The ninth Middle School of Beijing, 100041, Beijing, China. E-mail: weiwenjuan@163.com.

METHODS

The males of adult *Ch. brunneus huabeiensis* were collected from Songhua Lake in Jilin and *Ch. minutus* from Daqinggou in Inner Mongolia China in July 2003. The total numbers of these two adult males are 10 and 12 respectively.

Tissues for experiment are testes. They were pretreated with 0.05% colchicine solution 5~8il. After 6~8 h, the tissues were dissected out and put in distilled water for 5~10 min, then fixed in a mixture of methanol and glacial acetic acid (3:1 v/v) about 8~12 h. Then the tissues were transferred to 70% ethanol and stored in deep-freeze for up to several months until use. Subsequently they were squashed in 60% glacial acetic acid, frozen in liquid nitrogen and the cover slip removed with a razor blade. C-banding was induced by BSG method (Webb et al., 1978). The preparations were examined under a light microscope with 100X magnification. Clear and well-distributed chromosomes were photographed. Chromosomes were classified according to Levan et al. (1964).

Some karyotypical characters in a large quantity of cells of each species were measured, absolute and relative length of long arm (q) and short arm (p) of chromosomes and centromeric C-bands. The contrast of the images has been lightly enhanced with PhotoShop.

RESULTS

Chorthippus brunneus huabeiensis

The mitotic chromosomes of *Ch. brunneus huabeiensis* and the data of chromosomal karyotypes and C-bandings are listed in Table 2-3.

This species has a chromosomal number of 2n (♂) =17(16A+X) with the sex-determining mechanism XX♀/XO♂. It shows a more asymmetrical karyotype, mainly consisting of telocentric chromosomes and only three pairs are metacentric chromosomes. The karyotype formula is 2n (♂) =2x=6m+11t. The total absolute length of chromosomes is 65.37±3.84µm. According to their chromosomal relative length value (RL), all chromosomes are divided into four groups; 3 pairs of large chromosomes (L1-3), 4 pairs of middle chromosomes (M4-7), 1 pair of small chromosomes (S8), and the sex chromosome (X). The X chromosome is in the seventh place in chromosomal complement length order. The chromosomal length ratio of this species is 6.30, and the percentage of arm ratio more than 2:1 is zero, therefore the chromosomal karyotype of *Ch. brunneus huabeiensis* belongs to the type of 1C (Table 1).

The chromosomes all possess centromeric C-bandings. Pairs 8 and X chromosome are median dyeing and the others are strong dyeing (Figs. 1 and 2). The total of heterochromatic content (THC) in this species is 18.37±1.03%.

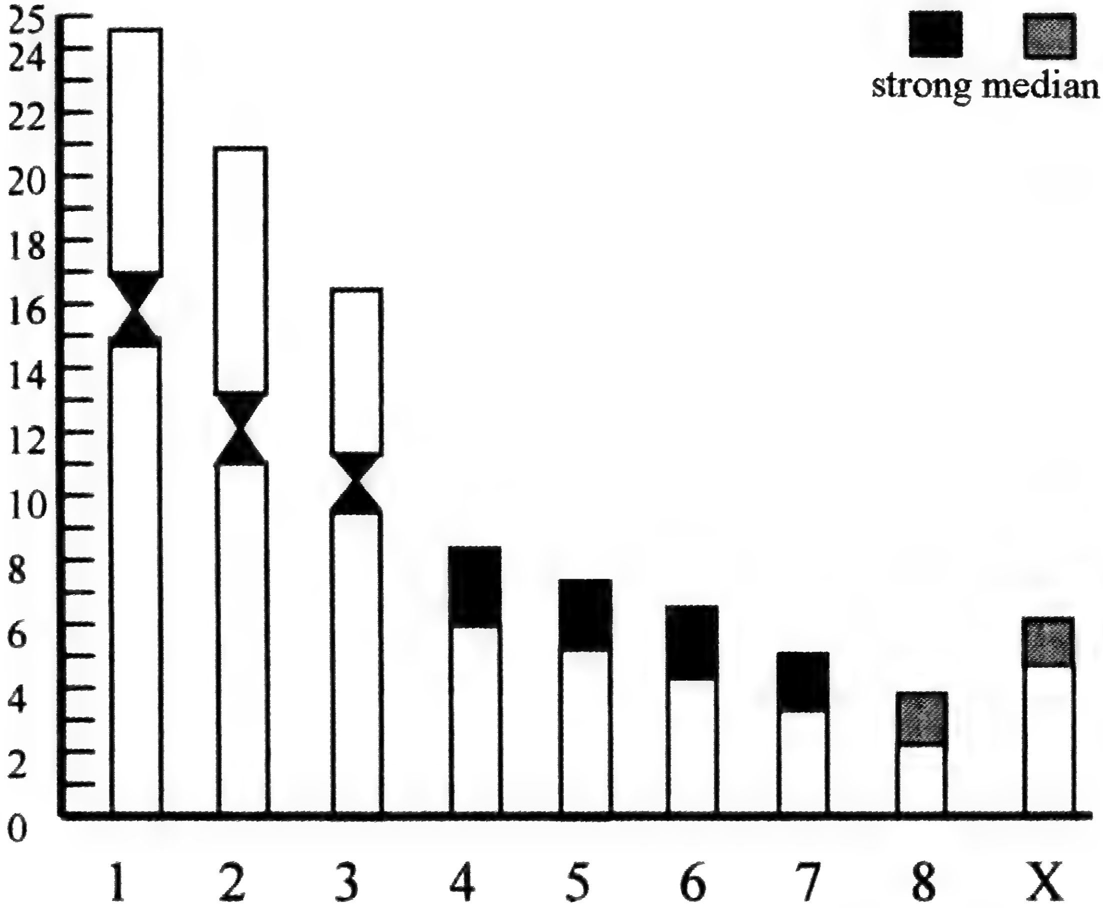


Fig. 1 Idiogram of C-banding karyotype of *Chorthippus brunneus huabeiensis*.

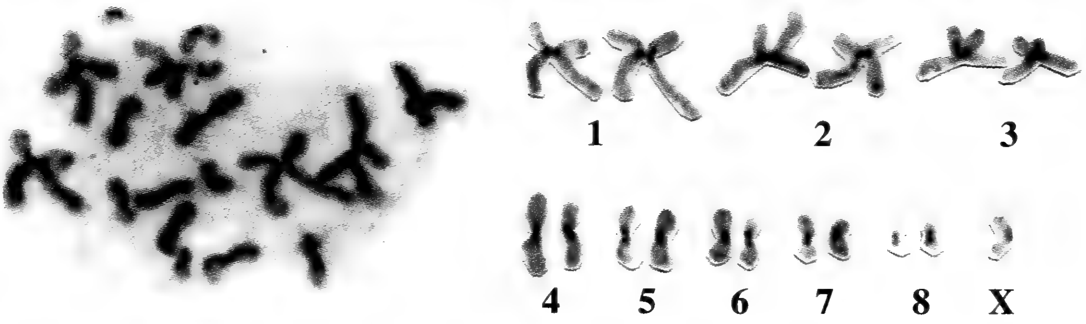


Fig. 2 C-banding karyotype of *Chorthippus brunneus huabeiensis*.

Table 1. Types of asymmetrical karyotypes.

Ratio of chromosomal length	Ratio of chromosomes with arm ratio greater than 2:1			
	0.0 (1)	0.01- 0.5 (2)	0.51- 0.9 (3)	1.0 (4)
<2:1 (A)	1A	2A	3A	4A
2:1 - 4:1 (B)	1B	2B	3B	4B
> 4:1 (C)	1C	2C	3C	4C

Table 2. Chromosomal karyotypes of *Chorthippus brunneus huabeiensis.*

		q		p	
Chromosome Number	Grouping	Absolute Length (μm)	Relative Length (%)	Absolute Length (μm)	Relative Length (%)
1	L	10.44±0.94	15.97±0.97	5.74±0.55	8.78±0.55
2	L	7.91±0.76	12.08±0.60	5.76±0.33	8.82±0.19
3	L	6.71±0.27	10.27±0.24	4.13±0.58	6.30±0.71
4	M	5.70±0.45	8.71±0.26		
5	M	4.69±0.13	7.19±0.26		
6	M	4.35±0.06	6.67±0.33		
7	M	3.34±0.49	5.10±0.51		
8	S	2.57±0.05	3.93±0.16		
9	X	4.03±0.02	6.19±0.34		
Total	9	65.37±3.84			

Table 3. Chromosomal C-banding of *Chorthippus brunneus huabeiensis.*

Chromosome Number	Centromeric C-bands		
	AL (μm)	RL (%)	dyeing
1	1.51±0.03	9.36	strong
2	1.52±0.07	11.17	strong
3	1.26±0.11	11.65	strong
4	1.50±0.04	26.38	strong
5	1.27±0.11	27.02	strong
6	1.43±0.002	32.90	strong
7	1.22±0.02	36.99	strong
8	1.23±0.01	47.82	median
9	1.05±0.001	26.00	median
Total	11.97±0.13		
THC%	18.37±1.03		

Chorthippus minutus

The chromosomes analyzed are meiotic chromosomes of anaphase II. The data of chromosomal karyotypes and C-banding data are listed in Table 4-5.

The results showed some similarities between the two species, such as the chromosomal number [2n (♂) =17(16A+X)], karyotype formula [2n (♂) =2x= 6m+11t] and the sex-determining mechanism (XX♀/XO♂). The total of chromosomal absolute length is 62.05±2.01μm, shorter than that of *Ch. brunneus huabeiensis*. According to their chromosomal relative length value (RL), all chromosomes are divided into four groups; 3 pairs of large chromosomes (L1-3), 2 pairs of middle chromosomes (M4-5), 3 pairs of small chromosomes (S6-8), and the sex chromosome (X). The X chromosome is in the fifth place in chromosomal complement length order. The chromosomal length ratio of this species is 6.23, and the percentage of arm ratio more than 2:1 is zero, therefore the chromosomal karyotype of *Ch. minutus* also belongs to the type of 1C (Table 1).

The C-banding pattern of this species appears to be similar to that of *Ch. brunneus huabeiensis* with centromeric C-bandings on all chromosomes. Pairs 6, 7 and 8 are median dyeing and the others are strong dyeing. In addition, pairs 2 and X show paracentrical interstitial C-bandings with strong dyeing, pairs 4, 5, 6, 7 and 8 show terminal C-bandings with weak dyeing (Figs. 3 - 4). The THC value is 22.84±0.72%.

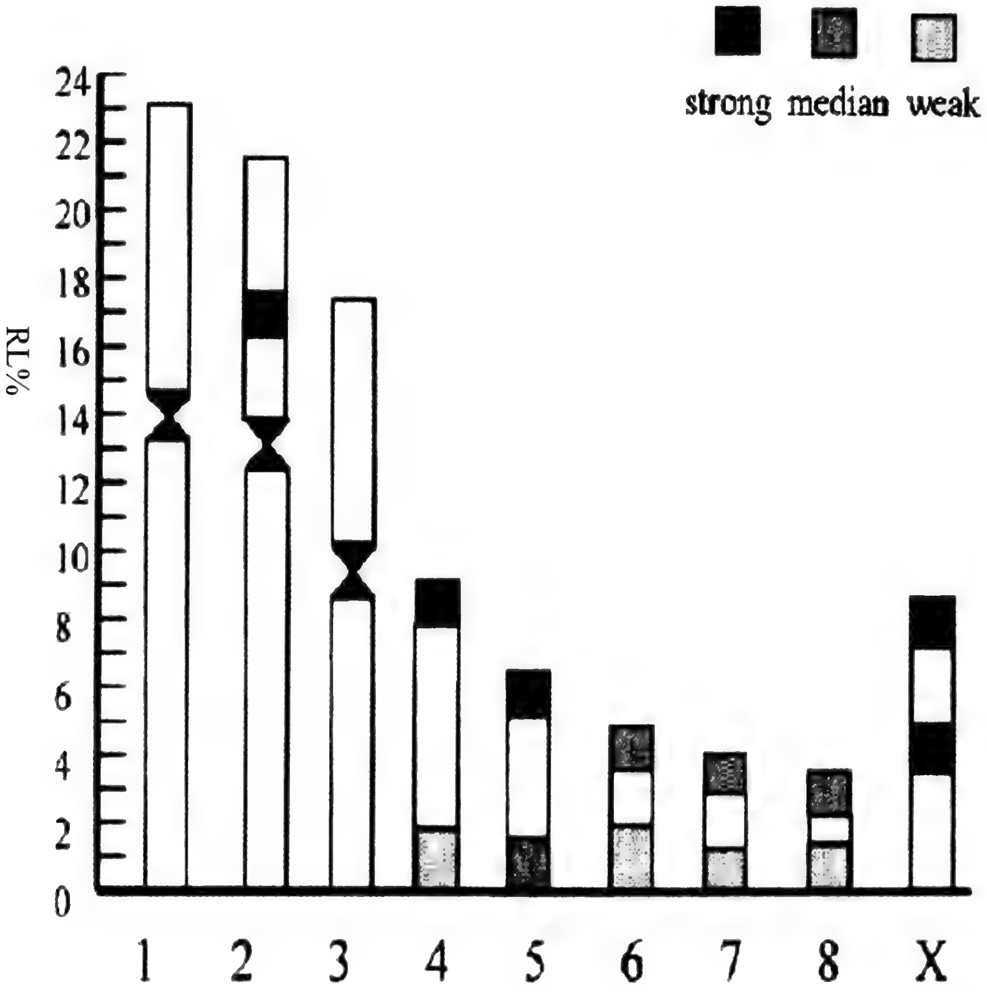


Fig. 3 Idiogram of C-banding karyotype of *Chorthippus minutus*

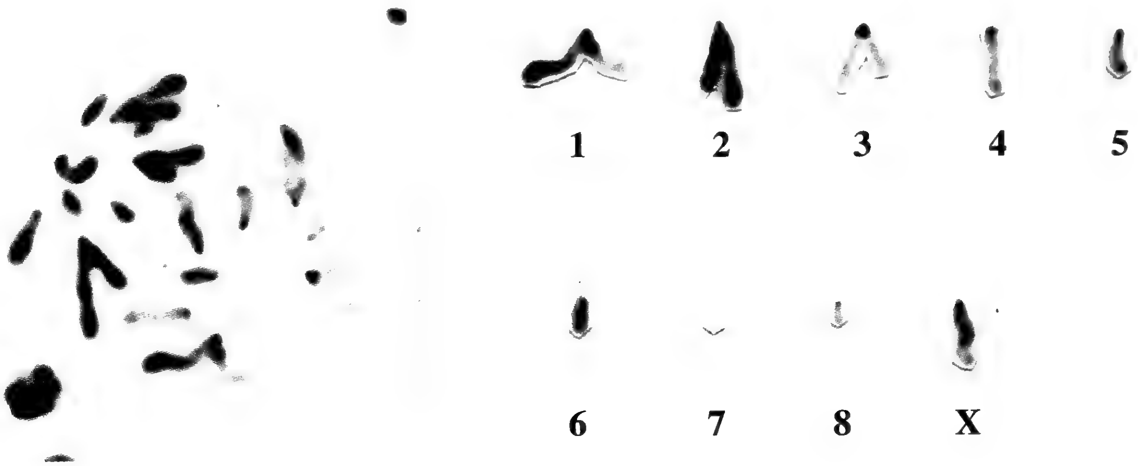


Fig. 4 C-banding karyotype of *Chorthippus minutus.*

Table 4. Chromosomal karyotypes of *Chorthippus minutus.*

		q		p	
Chromosome Number	Grouping	Absolute Length (μm)	Relative Length (%)	Absolute Length (μm)	Relative Length (%)
1	L	8.60±1.13	13.83±1.47	5.74±0.54	9.27±0.91
2	L	8.13±0.75	13.08±0.90	5.39±0.42	8.69±0.77
3	L	6.35±0.89	10.21±1.22	4.50±1.05	7.28±1.81
4	M	5.79±0.26	9.33±0.37		
5	M	4.17±0.40	6.71±0.51		
6	S	3.04±0.22	4.90±0.46		
7	S	2.57±0.17	4.13±0.21		
8	S	2.30±0.19	3.70±0.25		
9	X	5.50±0.12	8.87±0.42		
Total	9	62.05±2.01			

DISCUSSION

The chromosomal C-banding karyotypes of these two *Chorthippus* species in Northeast China were reported for the first time in this article. The results show some common characters of the genus *Chorthippus*. The two species have the same chromosomal number and their chromosomal karyotypes both belong to the type of 1C. Autosomes are divided into two groups; metacentric and telocentric. Sex chromosomes are both telocentric with sex-determining mechanism XX♀/XO♂. However, there are still some differences between them, such as chromosomal complement length order, C-banding pattern and the total heterochromatic content.

Some scholars have studied karyotypes of the genus *Chorthippus*, the chromosomal numbers are mainly 2n (♂) =17 (Jones et al., 1975; Santos et al., 1983; Gusachenko et al., 1992; Belda et al., 1987; Camacho et al., 1987; Pascual et al., 1987). In this study, *Ch. brunneus huabeiensis* and *Ch. minutus* all have chromosomal number of 2n (♂) =17, and the results are consistent with those of above.

Table 5-1. Chromosomal C-banding of *Chorthippus minutus.*

Chromosome Number	Centromeric C-bands		
	AL (μm)	RL (%)	dyeing
1	0.79±0.13	9.36	strong
2	0.86±0.08	11.17	strong
3	0.94±0.19	11.65	strong
4	0.83±0.13	26.38	strong
5	0.81±0.09	27.02	strong
6	0.79±0.09	32.90	strong
7	0.67±0.04	36.99	strong
8	0.74±0.05	47.82	median
9	0.90±0.12	26.00	median
Total	7.33±0.19		
THC%	22.8±0.72		

Table 5-2. Chromosomal C-banding of *Chorthippus minutus.*

Chromosome No.	Interstitial C-bands			Terminal C-bands		
	AL(μm)	RL (%)	Dyeing	AL(μm)	RL(%)	Dyeing
1						
2	0.90±0.07	6.66	strong			
3						
4				1.18±0.11	20.49	weak
5				1.02±0.05	24.52	median
6				1.19±0.08	39.08	weak
7				0.77±0.02	30.07	weak
8				0.88±0.13	38.24	weak
9	0.90±0.04	16.37	strong			
Total	1.80±0.10			5.04±0.15		

Lin (2001) has researched the karyotypes of four *Chorthippus* species; *Ch. brunneus, Ch. qingzangensis, Ch. biguttulus,* and *Ch. fallax.* They all have chromosomal number of 2n (♂) =17, with three metacentric pairs and five telocentric pairs, and the results are the same as those of *Ch. brunneus huabeiensis* and *Ch. minutus* in this study. But in other aspects, they are different. The type of relative chromosomes of *Ch. brunneus, Ch. qingzangensis,* and *Ch. biguttulus* are the same, with three large pairs, three middle pairs and two small pairs. However, *Ch. fallax* is different from these three species and the same as that of *Ch. minutus,* with three large pairs, two middle pairs and three small pairs. The relative lengths of these four *Chorthippus* species are all different. The X chromosomes of these four *Chorthippus* species are quite similar, but have some differences.

Bridle et al. (2002) has researched chromosomal differentiation between the grasshoppers *Ch. brunneus* and *Ch. jacobsi* in northern Spain. The karyotypes of *Ch. brunneus* and *Ch. jacobsi* are similar to those of other species of *Chorthippus* in chromosomal number and morphology. Both species have three pairs of long sub-metacentric chromosomes (L1–L3), four medium acrocentric pairs (M4–M7), one short acrocentric chromosome pair (S8), and the X chromosome is the longest of the acrocentric chromosomes. The results are different from those of *Ch. brunneus huabeiensis* and *Ch. minutus* in this study. Both species show an XO/XX (male/female) sex chromosome system. In both species, C-banding showed the presence of heterochromatic regions. In addition, chromosomes L2 and L3 show interstitial C-positive bands located at the short arm in both species. Closer examination of *Ch. brunneus* individuals revealed a faintly stained C-band at the end of the sex chromosome, which was only detectable at early meiotic prophase. In this study, the chromosomes of two species all possess C-bandings. In chromosomes of *Ch. minutus,* pairs 2 and X show paracentrical interstitial C-bandings with strong dyeing.

The results showed that, as a species of the same genus *Chorthippus,* they have some common cytological characteristics, but as different species they all have their own characteristics.

ACKNOWLEDGEMENTS

This work is supported by Natural Science Foundation of China (No. 30471400). We are extremely grateful to members of our laboratory for collecting materials. This material is based upon work supported by the Center Lab, School of Life Sciences, Northeast Normal University, Changchun, China.

LITERATURE CITED

Bailey, R. I., C. D. Thomas, and R. K. Butlin. 2004. Premating barriers to gene exchange and their implications for the structure of a mosaic hybrid zone between *Chorthippus brunneus* and *C. jacobsi* (Orthoptera Acrididae). Journal of Evolutionary Biology 7(1): 108-19.

Belda, J., J. Cabrero, J. P. M. Camacho, and F. Pascual. 1987. Evolutionary cytotaxonomy in nine species of *Chorthippus* (Orthoptera, Acrididae). Chapter 2:113-123. *In,* Baccetti, B. (Editor). Evolutionary Biology of Orthopteroid Insects. Halsted Press, New York, New York, U.S.A. 612 pp.

Bridle, J. R., S. J. Baird, and R. K. Butlin. 2001. Spatial structure and habitat variation in a grasshopper hybrid zone. International Journal of Organic Evolution 55(9): 1832-43.

Bridle, J. R., J. de la Torre, J. L. Bella, R. K. Butlin, and J. Gosalvez. 2002. Low levels of chromosomal differentiation between the grasshoppers *Chorthippus brunneus* and *Chorthippus jacobsi* (Orthoptera; Acrididae) in northern Spain. Genética 114 (2): 121-127.

Buao, I., C. Lopez-Fernandez, P. L. Mason, and J. Gosalvez. 1995. Brief report: mosaicism for sister chromatid heterogeneity in sex chromosomes from hybrids of two subspecies of *Chorthippus parallelus* (Orthoptera: Acrididae). Hereditas 122: 289-292.

Cabrero, J., J. Navas-Castillo, and J. P. M. Camacho. 1986. Effects of supernumerary chromosome segments on the activity of nucleolus organiser regions in the grasshopper *Chorthippus binotatus*. Chromosoma 93: 375-380.

Camacho, J. P. M., F. Pascual, J. Belda, and J. Cabrero. 1987. Cytological markers for analysing evolutionary relationships between related species of Orthopteroids. pp. 6: 148-156. *In:* Baccetti, B. (Editors). Evolutionary Biology of Orthopteroid Insects. Halsted Press, New York. 612 pp.

Gusachenko, A. M., E. Warchalowska-Sliwa, A. Maryanska-Nadachowska, A. G. Bugrov, and L. V. Vysotskaya. 1992. Cytogenetic Analysis of Populations of *Chorthippus albomarginatus* (De Geer) (Acrididae: Orthoptera). Folia Biologica (Kraków) 40 (No. 1-2): 27-31.

Hewitt, G. M. and B. John. 1968. Parallel polymorphism for supernumberary segments in *Chorthippus parallelus* (Zetterstedt). I. British populations. Chromosoma 25: 319-342.

Hewitt, G. M. and B. John. 1970. Parallel polymorphism for supernumberary segments in *Chorthippus parallelus* (Zetterstedt). IV. Ashurt re-visited. Chromosoma 25: 198-206.

Jones, G. H., W. K. Stamford, and P. E. Perry. 1975. Male and female meiosis in grasshoppers. II. *Chorthippus brunneus*. Chromosoma 52: 381-390.

Levan, A., K. Fredga, and A. A. Sondberg. 1964. Nomenclature for centromeric position of chromosomes. Hereditas 52: 201-220.

Lin, Y. 2000. Cytotaxonomic Studies on 3 *Chorthippus* (Orthoptera: Arcypterteridae) Karny-Comparative Analysis of Chromosome Karyotypes. Qinghai Caoye 9(4): 4-7. (In Chinese)

Lin, Y. 2001. Chromosome karyotype analysis of four species of *Chorthippus* from Qinghai. Entomological Knowledge 38(4): 286-290. (In Chinese)

Pascual, F., J. Belda, J. Cabrero, and J. P. M. Camacho. 1987. Morphological and cytogenetical differentiation between populations of *Chorthippus binotatus* (Charpentier) (Orthoptera, Acrididae). Chapter 34: 396-399. *In,* Baccetti, B. (Editor). Evolutionary Biology of Orthopteroid Insects. Halsted Press, New York, NY, U.S.A. 612 pp.

Santos, J. L., P. Arana, and R. Giraldez. 1983. Chromosome C-banding patterns in Spanish Acrididae. Genetica 61: 65-74.

Shuker, D. M., K. Underwood, T. M. King, and R. K. Butlin. 2005. Patterns of male sterility in a grasshopper hybrid zone imply accumulation of hybrid incompatibilities without selection. Proceedings of Biological Sciences 272(1580): 2491-7.

Serrano, L., C. Garcia de la Vega, J. L. Bella, C. López-Fernández, G. M. Hewitt, and J. Gosálvez. 1996. A hybrid zone between two subspecies of *Chorthppus parallelus*. X-chromosome variation through a contact zone. Journal of Evolutionary Biology 9: 173-184.

Stebbins, G. L. 1971. Chromosomal evolution in higher plants. Edward Arnold, London, England, United Kingdom. 216 pp.

Webb, G. C., M. J. C. White, and N. Contreras. 1978. Cytogenetics of the Parthenogenetic Grasshopper *Warramaba* (formerly *Moraba*) *Virgo* and its Bisexual Relatives. IV. Chromosome banding studies. Chromosoma (Berlin) 67: 309-339.

Zheming, Z. and X. Kailing. 1998. Orthoptera, Acridoidea. pp. 356-489. *In,* Fauna of China, Insecta. Tenth volume. Science Press, Beijing, China. 616 pp. (In Chinese)

SEXUAL DIMORPHISM OF THE FEMORA, TIBIAE, AND HIND TIBIAL SPURS IN THE EASTERN CICADA KILLER, *SPHECIUS SPECIOSUS* DRURY (HYMENOPTERA: CRABRONIDAE) IN THE UNITED STATES[1]

Joseph R. Coelho,[2] Jon M. Hastings,[3] Charles W. Holliday,[4] Gayla Flure,[1] and Kevin Barnes[1]

ABSTRACT: We examined specific leg structures in eastern cicada killers (*Sphecius speciosus*) to determine whether they were sexually dimorphic as a result of adaptation or allometry. Females were on average larger than males by every measure, and female hind tibial spurs were longer than those of males, even independent of body mass. The femora of females were not significantly wider relative to femur length than those of males, but the hind tibiae of females were significantly wider than the respective tibiae of males relative to tibia length. Spurs have concave surfaces that contact the loose soil and brush-like structures where spurs meet the substrate; however, these details are essentially the same in males and females. Enlarged hind tibial spurs in females appear to be an exaptation evolved primarily by increase in spur size relative to body size, without changes in shape or external microstructure.

KEYWORDS: wasp, digging, tibia, femur, spur, sexual dimorphism, cicada killer, Sphecidae, insect, functional morphology

The functions of particular morphological adaptations may be difficult to demonstrate, and their origins difficult to elucidate. One way to explore the evolution of morphological adaptations is to examine the function of sexually dimorphic structures. As Darwin (1871) "described, the males and females of some animals differ in structures related to different habits of life, and not at all, or only indirectly, to the reproductive functions." Rather, the form of such structures may result from natural selection imposed as a consequence of behaviors that one sex performs as part of its life cycle that the other sex does not. Once the function of a structure is established, comparison of the male to the female might provide insight into the evolutionary pathway of adaptation. In this and a companion paper (Coelho and Holliday, 2008) we examine such sexually dimorphic traits in a solitary wasp.

Males are the smaller sex within the genus *Sphecius* (cicada killers), apparently because females require larger body size to carry the cicada prey (Coelho, 1997; Holliday and Coelho, 2006). Males do not carry cicadas. However, another character that appears to be sexually dimorphic is a pair of structures known

---

[1] Received on June 15, 2007. Accepted on July 24, 2007.

[2] Institute for Franciscan Environmental Studies, Biology Program, Quincy University, 1800 College Avenue, Quincy, Illinois 62301 U.S.A. E-mails: (JRC) coelhjo@quincy.edu, (GF) flurega@quincy.edu, and (KB) barneka@quincy.edu.

[3] Department of Biological Sciences. Northern Kentucky University, Highland Heights, Kentucky 41099 U.S.A. E-mail: hastings@nku.edu.

[4] Department of Biology, Lafayette College, Easton, Pennsylvania 18042 U.S.A. E-mail: hollidac@lafayette.edu.

Mailed on March 14, 2008

as spurs arising from the distal hind tibia, those of females being considerably larger (Evans, 1966). While this distinction has been recognized for some time, its function and significance have only recently begun to be investigated. Holliday and Coelho (2006) used the spurs as one means of distinguishing males and females in a dichotomous key. Coelho and Wiedmann (1999) showed that the spurs are biomechanically adapted to be part of the digging apparatus of the female. The spurs act as one-way flaps that increase the surface area for pushing soil backward out of the burrow, which the female uses to house the cicadas and wasp larvae. Males do not dig burrows. Are the large spurs of females simply a result of their larger body size? If so, males will be geometrically similar to females, having approximately the same physical proportions when size is controlled. We examined the spurs morphometrically to determine whether female spurs are disproportionately large or whether their size is simply a result of scaling effects. Analysis of covariance (ANCOVA) was used to demonstrate whether dimorphic characteristics arose by simple geometrical similarity or whether they exhibit complete sexual dimorphism.

Spurs may represent one sexually dimorphic adaptation to digging, but others may be more subtle. Burrowing insects often have short, robust limbs (Chapman, 1971). In vertebrates, the muscles used in the digging process, as well as their origins and insertions, are generally quite large, allowing diggers' musculoskeletal systems to produce large out-forces (Hildebrand, 1974). Fossorial adaptations are not as well studied in insects. Upon visual inspection, female eastern cicada killers appear to have relatively wider femora and tibiae than those of males. This study examines whether female leg segments are more robust than those of males in cicada killers. We also performed scanning electron microscopy on male and female cicada killer spurs in an effort to examine potential structural differences on the microscopic scale.

METHODS

Morphometric Measurements. A sample of eastern cicada killers was collected from populations in Easton (Northampton Co.), PA, USA, stored individually in airtight vials, and frozen. Specimens were collected Aug 1, 2006, to obtain early-season wasps, avoiding possible confounding effects of spurs worn down by digging. By the time mass measurements were taken, some sublimation had occurred, the water condensing inside the vial as ice. Hence, vials were first allowed to come to room temperature, weighed with the insect inside using an analytical balance accurate to ± 0.0001 g, weighed once more after removal of the insect and excess water, and body mass (M_b) determined by subtraction. Spur lengths were measured (described below) before the pair of hind tibial spurs from each side were removed with fine scissors and weighed.

A second sample of eastern cicada killers was collected from the same locality, pinned and dried. All wasps were sexed by counting gastral segments (six for female, seven for male; Holliday and Coelho, 2006). For all specimens, vernier calipers were used to measure head width, length of medial and lateral hind tibial spur, length and width of foreleg, midleg, and hindleg femur and tibia to the nearest 0.05 mm. Note that we use the terms medial and lateral when referring to each member of a pair of spurs, rather than inner and outer or proximal and distal, which also could be used to describe their respective positions. By width, we mean the diameter of a limb, not the distance between contralateral limbs. Unless otherwise mentioned, all data are reported as mean ± standard error of the mean (*N*). Descriptive statistics and *T* tests were performed using Microsoft® Excel 2003, while ANCOVAs were performed using VassarStats (Lowry, 2007). The Bonferroni correction was applied, owing to the large number of ANCOVAs performed. To avoid pseudoreplication in cases where both sides of a specimen were measured (spur lengths), one measurement was randomly assigned for analysis.

Electron Microscopy. All scanning electron microscope (SEM) images were made of Au/Pd sputter-coated samples with an FEI Quanta 200 (FEI Company, Hillsboro, Oregon) environmental SEM under high vacuum. Measurements were taken using ImageJ software (Rasband, 1997-2006). Male and female *S. speciosus* of typical body size, collected on the Northern Kentucky University campus (Highland Heights, Campbell Co., KY, USA), were used as the tissue sources for the SEM images.

RESULTS

Morphometrics. Averages of morphometric measurements were all significantly different ($P < 0.0001$, unpaired Student's *T* test for unequal variances) between the sexes, males being smaller in comparison to females (Table 1). Body mass averaged 2.4 times greater in females, while total spur mass averaged 4.9 times greater. Medial spur length was on average 2.9 times greater, while lateral spur length was 3.3 times greater in females. For all other linear measurements, females were only 1.2-1.5 times larger on average than males.

One-way ANCOVA for two independent samples showed that the mass of male and female spurs were not significantly different when body mass was held constant (Table 2), but length of medial and lateral hind tibial spurs was highly significant between the sexes when tibia length was held constant. Fig. 1 reveals that, even at the same hind tibia length, lateral spur lengths are nonoverlapping between males and females.

The femora of female cicada killers were not significantly wider relative to femur length than those of males according to ANCOVA (Table 2). The foreleg and midleg tibiae of females were also not significantly wider relative to their length than those of males; however, the hindleg tibia of females was significantly wider than the hindleg tibia of males relative to tibia length. The hind tibia width (but no other measurement) of females was significantly greater than that of males relative to head width as well.

Table 1. Morphometric measurements of eastern cicada killers. All means are significantly different between the sexes ($P < 0.0001$, unpaired Student's T test for unequal variances).

Measurement Mass in mg, linear dimensions in mm	**mean**	**Male standard error**	*N*	**mean**	**Female standard error**	*N*
body mass	390.6	25.2	20	937.9	38.9	24
spur mass	2	0.1	19	9	0.8	24
head width	5.49	0.05	24	6.66	0.06	35
foreleg femur width	1.35	0.02	24	1.64	0.04	35
foreleg femur length	4.36	0.06	24	5.45	0.10	20
foreleg tibia width	0.74	0.01	24	1.04	0.02	35
foreleg tibia length	3.54	0.06	24	4.74	0.08	20
midleg femur width	1.47	0.02	24	1.85	0.03	33
midleg femur length	4.87	0.07	24	6.02	0.11	20
midleg tibia width	0.81	0.04	24	1.19	0.04	33
midleg tibia length	4.15	0.10	24	5.65	0.14	20
hindleg femur width	1.47	0.03	24	1.94	0.07	33
hindleg femur length	5.19	0.10	24	6.68	0.12	20
hindleg tibia width	0.96	0.04	24	1.52	0.04	33
hindleg tibia length	5.31	0.16	24	6.67	0.28	20
medial spur length	1.22	0.04	42	3.50	0.07	64
lateral spur length	0.89	0.035	44	2.96	0.07	65

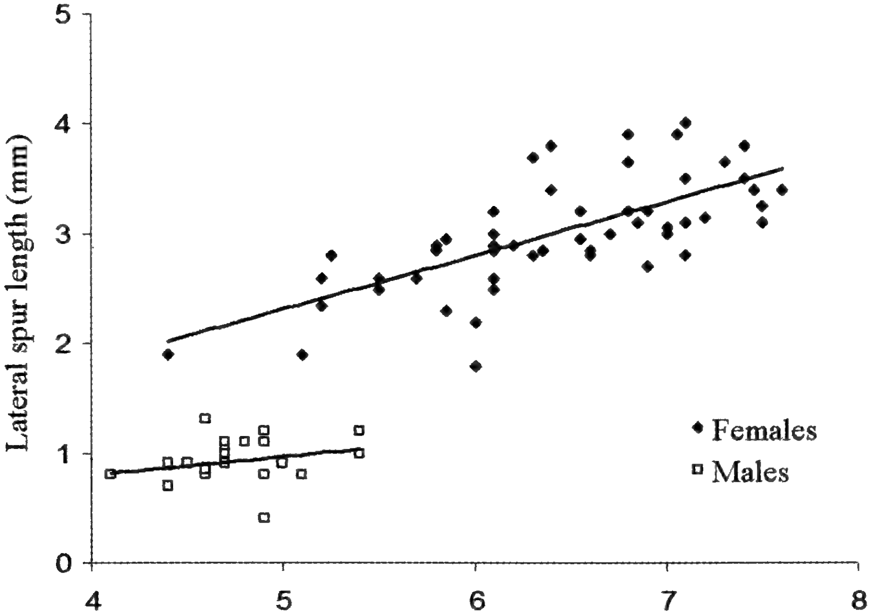


Figure 1. The relationship between hind tibia length and hind tibial lateral spur length in female and male eastern cicada killers. The least-squares regression line is shown for each sex.

Table 2. One-way ANCOVA results for male vs. female eastern cicada killer with the concomitant variable brought under control.

Dependent variable	Concomitant Variable	DF	*F*	*P*
spur mass	body mass	1, 41	3.62	0.064
lateral spur length	tibia length	1, 50	75	< 0.0001*
medial spur length	tibia length	1, 49	51	< 0.0001*
foreleg femur width	foreleg femur length	1, 41	0.67	0.42
midleg femur width	midleg femur length	1, 41	2.04	0.16
hindleg femur width	hindleg femur length	1, 41	3.72	0.061
foreleg tibia width	foreleg tibia length	1, 41	4.25	0.046
midleg tibia width	midleg tibia length	1, 41	4.87	0.033
hindleg tibia width	hindleg tibia length	1, 41	19.8	<0.0001*
hindleg tibia width	head width	1, 54	10.1	0.0024*

*Statistically significant at the Bonferroni-corrected α of 0.005.

Electron Microscopy. Both spurs were predominantly convex and smooth on the dorsal aspect and slightly concave on the ventral surface (Figs. 2A, 2B). In both sexes, the medial spur was the longer of the two, even though it was more curved than the lateral spur. The lateral spur was a straight, fairly blunt spike, though in the female it appeared somewhat more flattened than in the male. Its external ultrastructure was fairly unremarkable, except that the medial edge was serrated in appearance, consisting of a series of heavy, elongate, triangular scales. The lateral edge of the medial spur was serrated, similar to the medial edge of the lateral spur (Fig. 2C). The medial aspect of the medial spur was remarkable for being covered with dense hairlike structures 41 ± 2.8 (11) μm long by 16 ± 0.9 (11) μm wide at the base (Fig. 2D). Some appeared to be blunt, while others were sharply pointed. Again, there was no obvious difference between males and females in the abundance or appearance of these hairs (Figs. 2E, 2F).

DISCUSSION

Female eastern cicada killers were much larger on average than males by every measure. However, the difference between the sexes in mass and length of spurs was greater than for other measures. Although spur size increases with body size, ANCOVA confirmed that the female spurs are larger when size is controlled. Hence, spur size exhibits complete dimorphism: female spurs are larger even when body size is the same as that of a male.

The allocation of tissue to spurs in females is very small, equaling 0.095% of body mass. This investment, though much greater than that of males (0.0032%), is rather small relative to the gain in digging efficacy by having larger spurs (Coelho and Holliday, 2008). Considerable variation exists in spur size, suggesting that the opportunity remains for selection to act upon it if the variation is heritable.

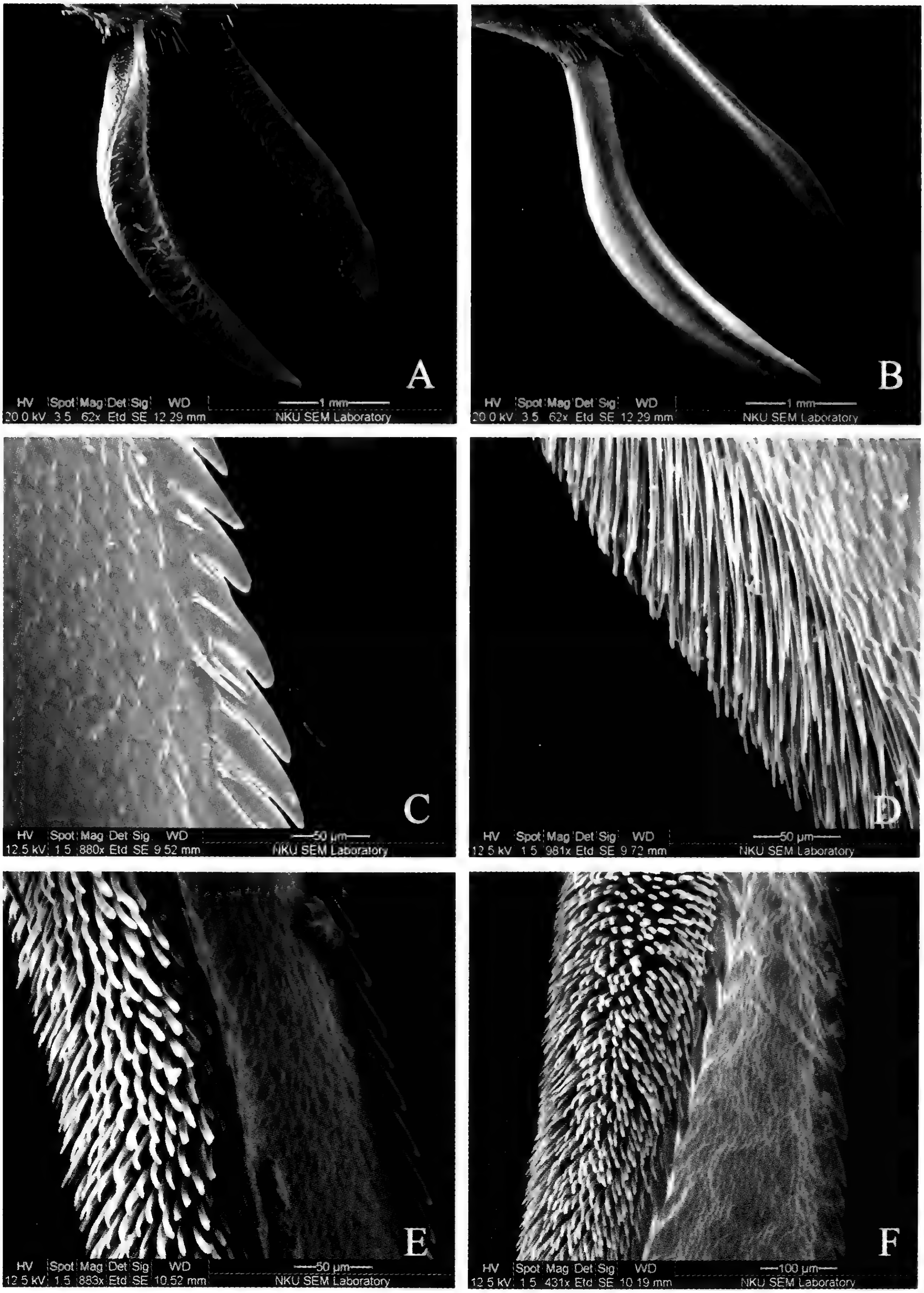


Figure 2. Eastern cicada killer (*Sphecius speciosus*) hind tibial spurs. A. female, right dorsal view showing slightly concave surfaces. B. female, left ventral view showing convex surfaces. C. female, medial spur, ventral view of lateral aspect showing serration. D. female, left medial spur, ventral view of medial aspect showing pubescence. Magnification of the male image (E) is nearly twice that of the female image (F) making the spurs (right dorsal view, medial spur) appear the same size.

Visual examination of female cicada killers reveals impressively robust femora; however, our analysis suggests that this robustness is simply a result of geometrical similarity. Large females have wide femora. Surprisingly, it is the tibiae of the female that are disproportionately wide. The femur houses the tibial levator and tibial depressor muscles, which drive the tibia. In turn, the tibia contains the muscles that drive the tarsus (Chapman, 1971), which appears to be largely passive during the pushing of soil. Hence, it is possible that the greater width of the female hind tibia is not a consequence of greater muscle-housing space, but rather an adaptation to the large forces produced by the femoral muscles. The robustness of female tibiae may compensate for buckling stress incurred during burrowing, but appropriate measurements have not yet been performed. On the other hand, it could be that the wider tibia, much like the spurs, simply provides more surface area for pushing soil.

One might expect that the distal end of the hind tibia must be wider in female cicada killers to accommodate the larger spur origins. However, Cane (1979) shows that the apical tibial articulations of the spurs occupy but a small portion of this area. Furthermore, the spurs arise from one corner of an essentially rectangular corium, the unsclerotized region that closes the end of the tibia. Hence, the distal end of the tibial does not appear to be encumbered by the spurs.

The external ultrastructure of the hind tibial spurs is consistent with their digging function in female cicada killers. The concavo-convex shape of the spurs is adaptive. The concave ventral surface should provide a scooping action against loose soil as the leg is extended backward, and the smooth, convex dorsal surface should provide low frictional resistance on the recovery stroke. The brush-like structure of the medial edge of the medial spur should help move soil along the substrate, much like a broom. The hairs might also provide sensory information about the substrate. However, these characteristics are essentially identical between males and females, and are unlikely to represent original adaptations to digging. The presence of spurs at the junction of the hind tibia and tarsus is apparently widespread, occurring in Orthoptera (personal observations), Hemiptera (Fletcher, 1999), Coleoptera (Paulsen, 2007) and Hymenoptera (Farish, 1972; Cane, 1979). In fossorial apoid wasps, the medial spur is normally considerably longer than the lateral spur, and both function in various grooming behaviors (Farish, 1972). Brushing particles of soil from a limb may not be a very different action from moving particles of soil over the substrate; therefore, the ultrastructure and shape of the spurs did not change substantially in the evolution of the larger female version. Greater size was all that was required to provide a substantial improvement in digging efficacy (Coelho and Holliday, 2008). Hence, the large spurs of females appear to represent an exaptation, a modification of a previously existing structure that happened to approximate the characteristics required for a new function.

ACKNOWLEDGMENTS

This work was supported in part by grants from the Quincy University Faculty Development and Welfare Committee (JRC), the Northern Kentucky University Center for Integrative Natural Sciences and Mathematics (JMH) and the Lafayette College Academic Research Committee (CWH). We thank Sharon DeWitt, Paula Edgar, and four anonymous reviewers for critical comments on the manuscript.

LITERATURE CITED

Cane, J. H. 1979. The hind tibiotarsal and tibial spur articulations in bees (Hymenoptera: Apoidea). Journal of the Kansas Entomological Society 52:123-137.

Chapman, R. F. 1971. The Insects: Structure and Function, 2nd edition. American Elsevier, New York, New York, U.S.A. 820 pp.

Coelho, J. R. 1997. Sexual size dimorphism and flight behavior in cicada killers (*Sphecius speciosus*). Oikos 79:371-375.

Coelho, J. R. and C. W. Holliday. 2008. The effect of hind-tibial spurs on digging rate in female eastern cicada killers. Ecological Entomology 33: (in press).

Coelho, J. R. and K. Wiedman. 1999. Functional morphology of the hind tibial spurs of the cicada killer (*Sphecius speciosus* Drury). Journal of Hymenoptera Research 8:6-12.

Darwin, C. R. 1871. The Descent of Man, and Selection in Relation to Sex. John Murray, London, England, U.K. Volume 1. 423 pp.

Evans, H. E. 1966. The Comparative Ethology and Evolution of the Sand Wasps. Harvard University Press, Cambridge, Massachusetts, U.S.A. 542 pp.

Farish, D. J. 1972. The evolutionary implications of qualitative variation in the grooming behaviour of the Hymenoptera (Insecta). Animal Behaviour 20:662-676.

Fletcher, M. J. 1999. Identification key and checklists for the planthoppers of Australia and New Zealand (Superfamily Fulgoroidea). http://www.raa.nsw.gov.au/Hort/ascu/fulgor/fulg0.htm

Hildebrand, M. 1974. Analysis of Vertebrate Structure. John Wiley & Sons, Inc., New York, New York, U.S.A. 728 pp.

Holliday, C. W. and J. R. Coelho. 2006. Improved key to New World species of *Sphecius* (Hymenoptera: Crabronidae). Annals of the Entomological Society of America 99:793-798.

Lowry, R. 2007. VassarStats: web site for statistical computation. http://faculty.vassar.edu/lowry/VassarStats.html

Paulsen, M. J. 2007. Scarabs of the University of Nebraska-Lincoln's Cedar Point Biological Station and Arapaho Prairie, Keith and Arthur Counties, Nebraska. http://www-museumunl.edu/research/entomology/CPBS/CPBSscarabs.html

Rasband, W. S. 1997-2006. ImageJ, U.S. National Institutes of Health, Bethesda, Maryland, U.S.A. http://rsb.info.nih.gov/ij/.

NATURAL PARASITISM RATE OF *TRICHOGRAMMA EVANESCENS* WESTWOOD (HYMENOPTERA: TRICHOGRAMMATIDAE) AND ITS RELEASE EFFICACY AGAINST THE COTTON BOLLWORM, *HELICOVERPA ARMIGERA* HÜBNER (LEPIDOPTERA: NOCTUIDAE) IN THE CUKUROVA REGION, TURKEY[1]

Sevcan Oztemiz[2]

ABSTRACT: The natural parasitism rate and effectiveness of the egg parasitoid, *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae), was studied for the first first time in Turkey in 2002 by rearing and releasing it against the cotton bollworm, *Helicoverpa armigera* Hübner (Lepidoptera: Noctuidae). Releases of *T. evanescens* were made twice against the three generations of *H. armigera* during June, July, and August in the Cukurova region. Four replicates were used in both the *Trichogramma* release (without insecticides) treatments and the control (without *Trichogramma* and without insecticides). In each *Trichogramma* release, approximately 120,000 parasitoids ha^{-1} (a total of 720,000 parasitoids ha^{-1}) were released. The parasitization rate on *H. armigera* averaged 52.5% in the release plots and only 28.5% in the control plots. Compared to the control plots, the reduction in the number of *H. armigera* larvae averaged 33.3% and the reduction in the number of damaged bolls averaged 42.8% in the release plots. Compared to the control plots, in fields where only insecticides were used, the number of *H. armigera* larvae was reduced by 68.0% and the number of damaged bollworm was reduced by 71.4%. In adjacent cotton fields treated with insecticides and excluded from the experimental area the natural parasitization rate of *T. evanescens* was low. Of the 241 *H. armigera* eggs of those collected on cotton, only 14 were parasitized (5.8%) by *T. evanescens*. Perhaps, pesticides used to control the cotton pests had non-target side effects on the parasitoids, and many *T. evanescens* could have been destroyed. Bollworm egg parasitism could be substantially increased with augmentative releases of *T. evanescens* wasps in cotton. *Trichogramma evanescens* has potential in the biological control of *H. armigera*.

KEY WORDS: Cotton, *Helicoverpa armigera*, Lepidoptera, Noctuidae, *Trichogramma evanescens*, Hymenoptera, Trichogrammatidae, parasitization rate, biological control

Cotton (*Gossypium hirsitum* L., Malvaceae) is one of the most important commercial crops as it plays a key role in economic and social affairs worldwide. This important fiber-producing crop is cultivated in more than 80 countries. However, about 30 species of insects and mites have been recorded as causing damage to the cotton plant worldwide (Layton, 2002; Anonymous, 2007). One of those pests is the cotton bollworm, *Helicoverpa armigera* Hübner (Lepidoptera: Noctuidae), a serious herbivore in many areas of the world (Scott et al., 2004; Zimmermann, 2005). *Helicoverpa armigera* is a polyphagous pest that directly affects yield due to feeding on the generative organs. Larvae of *H. armigera* feed on flowers, combs, and bolls. After flowering, the first stage of the fruit is known as a comb. In time, combs are followed by bolls. Damaged combs fall, and damaged bolls do not open and ultimately wither and decay. Combs and bolls damaged by *H. armigera* larvae are also attacked by diseases that cause rotting. Hence, *H. armigera* may cause a considerable amount of yield loss if not controlled.

---

[1] Submitted on March 19, 2007. Accepted on May 20, 2007.

[2] Plant Protection Research Institute, 01321, Adana, Turkey. E-mail: s_oztemiz@hotmail.com

Mailed on March 14, 2008

Helicoverpa armigera produces a different number of generations depending on climatic conditions. For example, *H. armigera* produces 2-6 generations in Iran, 2 generations in Bulgaria, and 3 generations in France (OEPP/EPPO, 1981). In Turkey, *H. armigera* has up to five generations per year. One of the generations occurs on weeds such as *Malva sylvestris* Zebrina (Malvaceae), *Coronilla varia* L. (Fabaceae), *Cannabis sativa* (LINN.) (Urticaceae), *Solanum* sp (Solanaceae), *Chenopodium album* L. (Chenopodiaceae), *Amaranthus retroflexus* L. (Amaranthaceae), *Portulaca oleracea* L. (Portulacaceae) in the world (Stadelbacher, 1981; Sarode, 1999; Jallow et al., 2001); A. *retroflexus* L. (Amaranthaceae), *Malva* sp. (Malvaceae), *Sinapis arvensis* L. (Brassicaceae), *Silybum marianum* Daisy (Asteraceae), *P. oleracea* L. (Portulacaceae), *Solanum* sp (Solanaceae) in Turkey (Yabas and Ozer, 1983; Buyuk et al., 2002), another on maize, and the other three generations live on cotton. Interestingly, although the host plants do not affect the number of generations, they do affect the population density of pest (Karban, 1993; Pires et al., 2000; Jallow et al., 2001), suggesting that different host plants differ in quality for *H. armigera*. In the Cukurova Region of Turkey, *H. armigera* has three generations in cotton, where it has been traditionally controlled using pesticides. In the first generation (June), the egg population of *H. armigera* is low and chemical control against this generation is neither economically nor biologically sound as it kills natural enemies (Goodell et al., 2001; van Lenteren, 2005). Besides the destruction of natural enemies, the use of pesticides has resulted in several risk factors to human health (IPPC, 1997), ecological imbalance (Shine et al., 2000; Genovesi and Shine, 2003), development of resistance to pesticides in pests (van Lenteren, 2005), resurgence of pests (Kogan, 1998; Trumper and Holt, 1998), and environmental pollution (Bigler et al., 2006). For these reasons, alternative control methods need to be sought and implemented. Biological control, a major factor in integrated pest management (IPM) programs, relies significantly on parasitoids, such as *Trichogramma* wasps, and predators.

Species of *Trichogramma* are the most widely used as biocontrol agents in the world (Li, 1994; van Lenteren, 2000) and they are effective against bollworms of cotton (van Lenteren, 2000), such as the noctuid, *Helicoverpa*. *Trichogramma* larvae hatch, consume the *Helicoverpa* embryos, and about 10 days later emerge as adults and parasitise more lepidopteran eggs (Kelly, 2003). *Trichogramma* offers a lower cost and a more effective plant protection option than insecticides (Bournier and Vaissayre, 1977; Amaya, 1982; Cai et al., 1997; Kogan et al., 1999). However, preventing further increases in pesticide resistance and replacing insecticide use with inoculative or inundative releases of *Trichogramma* is complicated by the fact that often crops are sprayed with many chemicals. For this reason, biological control is often used in more limited integrated pest management (IPM) approaches, where pest populations are also kept in check with chemicals. In such programs, efforts are made to reduce the use of pesticides, to test and use less pesticides that are toxic to beneficial species, and to release beneficial organisms as far as possible from spray applications (Thomson et al., 2000). In fact, several researchers report higher parasitoid activity and better control of pests without the use of pesticides (Scholz et al., 1998; Neuenschwander and Markham, 2001; van Lenteren and Bueno, 2003; Heydari and Gharedaghli, 2007). A lot more insecticidal options that do not disrupt parasitoids, such as *Trichogramma*, especially in early season (Udayagiri et al., 2000; Kelly, 2003; Rossiter et al., 2003) are now available.

The objective of this study was to determine natural parasitization rate and release efficacy of *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae) in the biological control of *H. armigera* and its potential use as a tool in cotton IPM in the Cukurova located in the Mediterranean region of Turkey.

METHODS

Study Site and Experimental Design

The study was conducted in one cotton field in the Cukurova region of Turkey. There were three different treatments: released treatment (without insecticides), control treatment (without wasps and without insecticides), and insecticide treatment (without wasps, Table 1). The first two types of plots were replicated randomly four times (eight different plots total, each plot 0.125 ha). The distance between wasp release and non-release plots was at least 50 m. The third type of plots were placed 1,000 m away from the release and the non-release plots to minimize adverse effects of many insecticides on natural enemies. Insecticides treatment took into consideration that the other two treatments (release treatment and control) were made only at harvest to compare the grain yields. Insecticides-applied plots were arranged 1000 m away from release and non-release plots due to the adverse effects of insecticides on natural enemies.

Table 1. List of insecticides applied to test plots in 2002.

Active Ingredient	Trade-name	Dose
Thiodicarb %80	Larvin 80 DF	90 g da^{-1}
Profenofos + Cypermethrin 400+40 g l^{-1}	Flambo 440 EC	250 ml da^{-1}
Bifenthrin 100 g l^{-1}	Talstar 100 EC	100 ml da^{-1}

Parasitoid Production

The production of laboratory host, *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) and the egg parasitoid, *T. evanescens* were conducted in acclimatized rooms adjusted to conditions of 25±1°C and 65±10% relative humidity, and darkness for *E. kuehniella,* and light for 16 hours and dark for 8 hours for *T. evanescens* (Hassan, 1981; Kayapinar, 1991; Oztemiz, 2001).

Parasitoid Releases

The first and second *Trichogramma* releases, conducted during the first, second and third *H. armigera* generations, respectively, were applied simultaneously in the four, plots.

The bollworm adult population of *H. armigera* was monitored weekly in pheromone traps to determine the parasitoid release time. When the first *H. armigera* adult was caught in a trap, egg sampling of *H. armigera* was carried out by examining all parts of 50 randomly chosen cotton plants at the center of each of the eight plots (Knutson, 1996; Suh et al., 2000). After the first egg was seen, 80 *T. evanescens* bags, each containing approximately 1,500 parasitized *E. kuehniella* eggs were released. Approximately 120,000 parasitoids per hectare were released (Huo et al., 1988; Suh et al., 2000). Each release plot (0.125 ha) was designed leaving a margin of 7 m from the edge of the cotton field and 10 m between each release point. There were five parasitoid release points in each release plot. In each release plot, 20 bags containing approximately 30,000 parasitoids, were released. The second release was conducted using the same protocol method a week later. Six releases (a total of 720,000 parasitoids ha-1) were implemented twice against the first *H. armigera* generation, two releases against second generation, and two releases against third generation (Nasretdinov, 1978; Huo et al., 1988; Suh et al., 2000).

Data Collection and Statistical Analyses

Three days after each release, a visual egg count of *H. armigera* was conducted. The eggs that were found were marked using a coloured ribbon and observed twice per week until *Helicoperva eggs* began hatching. The number of damaged generative organs and the number of *Helicoperva* larvae were recorded by examining all parts of the cotton plants in four randomly selected cotton lines 3 m long in every replication. The counts were conducted weekly. Similar counts were also conducted in the control (no insecticide, no wasp) plots. Every week, 100 plants in each of 12 plots were checked for the number of larvae and the number of damaged bolls. These data were transformed (arcsin square root) and analyzed using the Student's t-test (two tails, homoscadacity or similar variance) to compare the parasitization rate between treatments (Table 2). At harvest, the counts of damaged bolls and larvae were conducted in randomized plots experimental design and analyses of variance (ANOVA) analysis done.

Rate of Parasitism

Helicoverpa armigera eggs are mostly laid singly in the upper part of the canopy (leaves and buds) of cotton plants. All leaves and buds of 50 plants per plot [8 plots for parasitization rate in released plots (without insecticides) and control (without wasps and insecticides)] were examined. Leaves and buds were carefully examined for eggs. Parasitized and non-parasitized eggs of bollworm were collected with the plants parts on which they were found. To retard deterioration, the samples were placed in plastic boxes, put inside ice boxes, and brought to the laboratory. Each plant sample was placed in glass tubes and kept in the climatic rooms, in 25±1°C temperature, 65±10% relative humidity, and 16:8 L:D (light:dark) regime. Samples were observed daily until eggs hatched. Parasitized and non-parasitized eggs were recorded to determine parasitism rates.

The percent efficacy of parasitism was evaluated using Abbott's formula (Abbott, 1925) for two cases: first, number of larvae, second, number of damaged bolls, against *H. armigera* larvae.

1) % efficacy of control against *H. armigera* larvae = $[(a-b)/a] \times 100$

where a = number of larvae in the release treatment, and b = number of larvae in the control.

2) % efficacy of control in damage in bolls = $[(a-b)/a] \times 100$

where a = number of damaged bolls in the *Trichogramma* release treatment and b = number of damaged bolls in the control.

The counts of damaged bolls and larvae were conducted in a randomized plots experimental design and analyses of variance were done. The LSD (Least Significant Difference) test was performed to determine differences among averages.

Also, the results of larval counts were evaluated on the basis of Henderson-Tilton method (Karman, 1971). We used this method to calculate the reduction in the number of larva and the number of damaged bolls in the wasp release plots and insecticide treatment plots with respect to the control (without wasps and insecticides). This formula used in the Henderson-Tilton method is:

$$\text{Efficacy (\% reduction)} = 100\ [1 - Ta.cb/Tb.ca]$$

where Ta is the number of live larvae after insecticides were applied, Tb is the number of live larvae before insecticides were applied, cb is the number of live larvae in the control treatment at the same time as Ta, and ca is live larvae at the same time as Ta in control.

Trichogramma wasps were identified by Bernard Pintureau (UMR 0203 INRA/INSA de Lyon Bâtiment Villeurbanne, France). Voucher specimens have been deposited in the Insect Museum of the Plant Protection Reserch Institute in Adana, Turkey.

RESULTS AND DISCUSSION

The effectiveness of the egg parasitoid, *T. evanescens* was determined for the first time in this study in Turkey. The results of this study are valuable for the Integrated Pest Management approach in cotton production in Turkey.

Release Efficacy

Observations of bollworm adult populations were made by pheromone traps to determine the best release time (Fig. 1). In pheromone traps, the first bollworm adult was seen on June 10; egg sampling was conducted the same day (two eggs were found on the release plots and one egg on the control plots). The first wasp release was applied against the first generation of the pest (Figures 1 and 2).

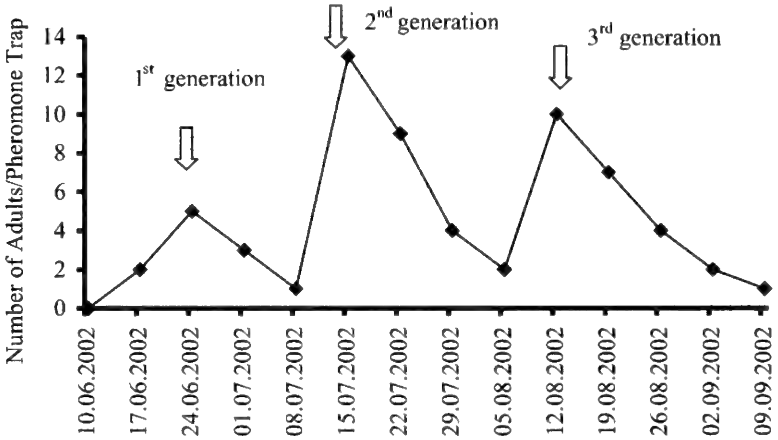


Figure 1. Population development of adult bollworm, *Helicoverpa armigera* Hübner using pheromone traps in the Cukurova region of Turkey during 2002.

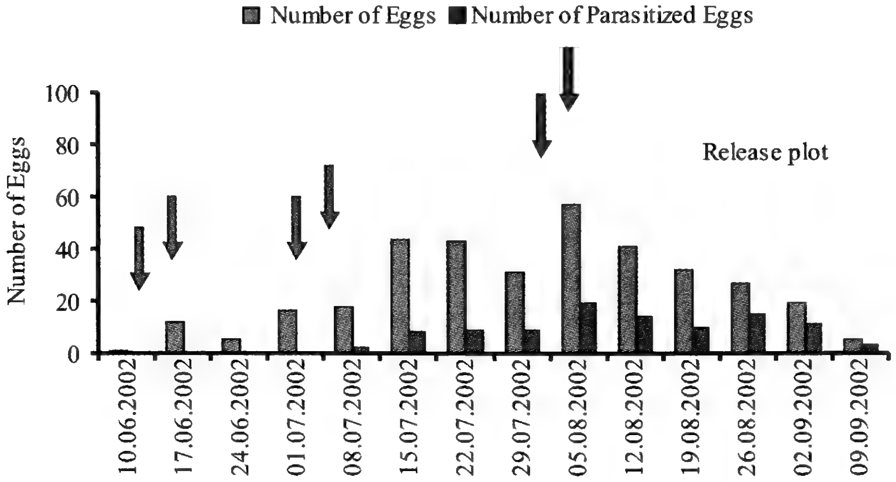


Figure 2. Parasitism rate of *Trichogramma evanescens* Westwood against the cotton bollworm, *Helicoverpa armigera* Hübner, in release and control plots in the Cukurova region of Turkey during 2002. Vertical arrow indicates release times.

In pheromone traps, the first bollworm adult was seen on June 10, and egg sampling was conducted on the same day, two eggs were found on the release plots and one egg on the control plots, and then first release was applied against first generation of the pest (Figure 1 and 2). Three days after first release, the parasitoidism rate of the pest ranged from 33.3 to 40.0%. Similar results were also published by Kovalenkov (1980) as two days after the release in which 100,000 parasitoids fell per hectare, 45.0% parasitation occurred in *H. armigera* eggs. Scholz et al. (1996) released the north American *Trichogramma pretiosum* (Riley) found that T. *pretiosum* parasitized 42.5% of eggs two days after release. The second release was done against first generation of pest after one week from first release (Figure 2). The parasitoidism rates of the pest were between 50.0 and 55.6%, three days after second release.

The parasitoidism rate of the pest varied between 0.0-55.6% in the 1st generation (an average 22.5%), 52.2-56.8% (an average 53.8%) in the 2nd generation and 53.4-58.5% (an average 54.0%) in the 3rd generation. The highest rate of parasitation occurred in the 3rd generation, and followed by the 2nd and 1st generations, respectively. Jones et al. (1977) reported 55-84% parasitation with *Trichogramma* sp. release so that 112.000-178.000 parasitoids fell per hectare against *H. armigera* in cotton. The same parasitoidism rate with *Trichogramma* on the bollworm eggs were found in the other release studies in China (Wang and Zhang, 1991), and in the USA (Knutson, 1996; Davies and Martin, 2005). The fact that the developmental period of *T. evanescens* is as short as 10 days and it multiplies by producing three generations against one generation of the pest, and that the oviposition of the pest lasts long and as a consequence of this, the parasitoid continues its existence throughout the vegetation period leads to an increase in its effectiveness in the field. The parasitoidism rate was found to be high at the end of the season, especially, since the generations got mixed up with each other after the releases performed against the first generation because the parasitoids released in the second and third generations reproduced in the field and the supporting releases were continued.

In our study, the same counts were conducted in the control plots (without wasps and insecticides) as parasitoid released plots on the same dates. It was found that the parasitoidism rate was 28.4% (Figure 2). Likewise, in the other *Trichogramma* release studies, parasitization rate was 33.0% in the control plot in Australia (Scholz and Murray, 1994) and 18-69% in North Carolina (Suh et al., 1997, 2000). It is also known that in other studies of release conducted with the parasitoid in question, the distance between the control plot and the release plot varied between 50 to 100 meters (Hassan, 1981; Bigler and Brunetti, 1986; Tran and Hassan, 1986). The conclusion was drawn that the reason for the low parasitoidism rate in the control plot, although the control plot was at a certain distance from the release plot, might be the passive but high spreading power of the parasitoid due to the wind. Similarly, Yu et al. (1984) reported that the prevalent winds were effective in the spread of species of *Trichogramma* from the location of release.

When the plot where the *T. evanescens* release and the control plot were compared statistically, a significant difference was found with respect to the parasitoidism rate (t value calc: 2.97, df = 26; $p < 0.01$; Table 2).

Table 2. Parasitoidism rate of *Trichogramma evanescens* against the cotton bollworm, *Helicoverpa armigera* Hübner in release and control plots in the Cukurova region of Turkey during 2002.

Treatments	Parasitization Rate (%)
Release*	52.52±5.04 a
Control*	28.49±5.83 b

*Means followed by a different letter differ significantly at $p \leq 0.01$ (t- test).

In addition, to determine the effect of parasitoid release on yield, the number of *H. armigera* larvae and the number of damaged generative organs were recorded in the release plots (without insecticides) and in the insecticide use plots (without wasps). The decrease in the number of *H. armigera* larvae in the field where release performed was 33.3%, whereas in the insecticide-used plot, it was 68.0%. On the other hand, the decrease in the number of damaged bolls was 42.8% in the release plot and 71.4% in the insecticides-used plot.

Biological control by species of *Trichogramma* against the cotton bollworm has been studied by many authors, and the reduction in the number of larvae and damaged bolls recorded (Jones et al., 1977; Kovalenkov and Mescheryakova, 1986; Zhou, 1988; Suh et al., 1997). These authors have used similar methods yielding parallel results to those of mine. Kelly (2003) showed that *Helicoverpa* egg mortality increased from 30% to 90% following the release of *Trichogramma* resulting in a reduction in insecticide applications in the field.

When the effects of parasitoid release were analyzed statistically, no significant differences were observed between the plot where *T. evanescens* release performed and the insecticides used to control the number of larvae (F: 108.0, LSD:1.532, df:11) or the number of damaged bolls (F: 38.0, LSD:1.876, df:11, P:0.000). However, the difference among these two plots and the control plot was found to be statistically significant (Table 3).

Table 3. The number of larvae and damaged bolls in the release, control and insecticide-applied plots in the Cukurova region of Turkey during 2002.

Number	n	Release*	Control*	Chemicals Only*
Larvae	4	3.00±0.408b	9.00±0.408a	3.00±0.000b
Damaged Bolls	4	4.00±0.408b	7.00±0.408a	2.00±0.408b

*Means followed by a different letter, differ significantly at P=0.01 (LSD).

The yield of cotton was 3760 kg ha^{-1} in the plot where wasp releases were performed, 4150 kg ha-1 in the insecticides-used plot, and 3570 kg ha^{-1} in the control plot. The yield was increased by 10.5% in *T. evanescens* in the release plot and 11.6% in the insecticides plot. Similar results were obtained by King et al. (1986) that obtained a parasitization rate of 60 to 80% (average 35%) with release of 120,000 *T. pretiosum* ha^{-1} against *H. armigera*, 16.5% yield increase in *T. pretiosum* release plot and 5.9% in the plot where insecticides were used in cotton in Arkansas, U.S.A.

The average rate of parasitation in *H. armigera* eggs in cotton where *T. evanescens* were released was 52.5% and only 28.5% in the control plot. The reduction in the number of larvae and damaged bolls was 33.3% and 42.8% in the release plot, respectively. Although, yield was higher in the insecticides plots than in the releasing plots, the cost of three chemical control treatments against the pest was uneconomical (US$144.1-US$154.4 hectare^{-1}, 2002 dollars), and considering their harmful effects on the environment and human health, *Trichogramma* release within the framework of integrated control principle seems viable in cotton.

Trichogramma offers a lower cost and a more effective plant protection option than insecticides (Bournier and Vaissayre, 1977; Amaya, 1982; Cai et al., 1997; Kogan et al., 1999). Likewise, most researches working on cotton biocontrol suggest that there are significant decreases in pest control cost with *Trichogramma* release. For example, Shamuratov et al. (1981) reported that the cost of 3 or 4 *Trichogramma* releases were 33% more economical than chemical control. Smith and Bellotti (1996) reported that the number of applications decreased from 22 to 2 per crop cycle by releasing *Trichogramma* spp. in Colombia, and estimated pest control costs decreased 96%.

It was established with this study that *Trichogramma* species has potential in the biological control of *H. armigera*. In the former Soviet Union, *T. euproctidis* Girault are used for the control of *H. armigera* with a resulting parasitism of 66-90%. This procedure provides complete protection of the crop. *Helicoverpa* in IPM program primarily relied on releases of *Trichogramma* to reduce the number of applications of insecticides. The parasitoid, which was successfully used in the biological control of the European corn borer in maize in the Mediterranean region, can also be used in the cotton against bollworm in IPM program.

Biological control in Integrated Pest Management (IPM) has been successfully implemented in many cotton-growing countries including Asia and North Africa, for example: Syria, India, Pakistan, Uzbekistan, Egypt, and Tajikistan (Heydari and Gharedaghli, 2007). These countries have been able to control and manage their pest problems in cotton fields with minimum environmental risks by using nonchemical methods. For example, Syria has achieved the second highest cotton yield in the world with almost no application of pesticides using IPM strategies. In Pakistan, bollworm infestation levels remained lower throughout the season in biological control plots as compared with farmer practices plots by releasing of *Trichogramma chilonis* in cotton. The infestation rate of bollworm ranged from 1.7 % to 6.2% in released plot; from 8.3% to 22.0% in farmer's plot. In Egypt, release of *Trichogramma pretiosum* is an effective tool in reducing the densities of different bollworms in cotton fields. The cotton IPM program in Uzbekistan is highly dependent on biological control and major strategy to control pests in many crops including cotton. Release thresholds in Tadjikistan against *H. armigera* are such that only 50% parasitization efficiency is sufficient for economic control (Voronin 1982). Besides, other countries mentioned above have also implemented IPM strategies and have achieved some promising results in controlling and management of cotton pests (Heydari and Gharedaghli, 2007).

Natural parasitization rate

In cotton, *H. armigera* developed three generations in the Cukurova Region of Turkey. The first, second and third generation of *H. armigera* occurred in June, July and August, respectively. The population of first generation was lower than the others. Of 241 eggs of *H. armigera* collected on cotton, and only 14 were parasitized (5.8%) by *T. evanescens*. In our region, most farmers used insecticides intensively against the pest, for this reason we found low parasitized eggs of *H. armigera* and a low parasitoidism rate. Many parasites may be destroyed by the chemical sprays that are widely applied. Hence, different natural parasitoidism rate was obtained in various areas by many authors such that Johnson (1985) reported as much as 59% of bollworm eggs in cotton parasitized by natural populations of *Trichogramma* wasps, and early season parasitoidism reached 60 to 80% but sharply declined once insecticide treatments began. Similarly, natural egg parasitoidism rates by *Trichogramma* spp. ranged from 1-20% on the bollworm eggs in cotton (Kring and Smith, 1995; Negeri, 2000).

CONCLUSION

If we support the natural parasitoidism rate by releasing *Trichogramma*, the levels of egg parasitoidism will be increased. Alternatively, natural populations should simply be allowed to build up by using selective insecticides and other *Trichogramma* conservation practices, such as the use of trap crops (Okra, *Hibiscus esculentus* L. (Malvaceae); alfa alfa, *Medicago sativa* L. (Leguminosae); Thontadanya et al., 1978) conservation-tillage systems, and avoiding the use of broad-spectrum insecticides. In the Cukurova Region, the natural parasitoidsm rate of *Trichogramma* was increased by releasing parasitoids. After three pairs of *T. evanescens* releases, the parasitoidism rate was increased and finally the rate of parasitoidism reached the highest level at the end of the season in cotton fields around the releasing plot. Several studies (e.g., Stinner et al., 1974; Jones et al., 1977, 1979; King et al., 1986; Lopez and Morrison, 1985; Suh et al., 1998) demonstrated that bollworm egg parasitoidism in cotton could be substantially increased with augmentative releases of *Trichogramma* wasps. Similar results were obtained in other release studies (Scholz and Parker, 2002, 2004; Bastos et al., 2004).

If no chemical control was performed in the fields where wasp releases were made, an increase in the number of natural enemies was observed. The combination of parasitoids and predators could be one approach in IPM programs of *H. armigera* in organic cotton farms. El-Wakeil and Vidal (2005) found that combining *Trichogramma* species and *Chrysoperla carnea* Stephans (Neuroptera: Chrysopidae) for controlling *H. armigera* eggs resulted in higher mortality rates than *Trichogramma* or *C. carnea* alone.

The objectives of this study were to come up with a solution for effective management of cotton pests with minimum risks to the environment, reduction of pest damage and yield loss, reduction of pesticide use, maximizing the density of natural enemies. The use of natural enemies in cotton fields in IPM strategy will result in the reduction of pesticide use and protection of the environment in Turkey. The pest management based on chemical use has been losing its efficiency mainly due to its adverse effect on natural enemies present in nature and the rising problem of insecticide resistance. For example, at the seedling and vegetative growth stages of cotton, if the chemical control is not used or biological control is supported, natural enemies will be increased.

As a result, the development of an integrated crop production system for cotton in Turkey appears possible, based on this study. In developing strategies for augmentatively releasing *Trichogramma* into cotton for bollworm suppression, one needs to examine how these wasps interact with plants, among many other factors, regulating the use and effectiveness of *Trichogramma* releases. Releases should be appropriately timed to minimize interaction with toxic pesticides or else relatively harmless pesticides must be chosen in IPM programs. *Trichogramma* releases could be one approach in the IPM program of *H. armigera* in cotton farms in Turkey and perhaps other countries.

Insecticide applications are treated frequently in cotton fields, and *Helicoverpa* has become resistant to many insecticides. Among all insect pests, *Helicoverpa* is the most serious pest to cotton and it is no longer affected much by pesticides. Resistance is always there in some form, but where it typically becomes a problem is when the same pesticide is used too often or relied on too heavily, as in our region. The overuse of insecticides has led to the development of resistance to pesticides, widespread killing of natural enemies leading to resurgence of secondary pests, and increased number of pest control failures. We need to manage pests and move towards integrated crop management strategies. Biological control agents are the primary method of controlling cotton insect pests in Integrated Pest Management (IPM) programs. Parasitoids can often prevent a pest population from reaching treatable levels, and the control they provide is often cheaper, better, and longer lasting than that provided by insecticides. So, if biological control measures were applied for a few years, the use of insecticides would decrease, and the problem of insecticide resistance may decrease.

We were applying against all three generations in cotton. We applied the general rule of the parasitoid-releasing method against *H. armigera* in cotton. The results obtained in this study showed that population of first generations of pest was low, and we do not need to release parasitoid, this reality appeared after this study's results.

LITERATURE CITED

Anonymous. 2007. The cotton pest and beneficial guide. Cotton Catchment Communities (CRC), Cooperative Research Centre, Annual Report 2005-2006. Narrabri, Australia. 62 p. http://www.cotton.crc.org.au.

Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. Journal of Economic Entomology 18: 265-267. http://www.ehabsoft.com/ldpline/Habbott.htm

Amaya, A. M. 1982. Investigation, utilization and results obtained in different cultivations with the aid of *Trichogramma* in South America Colombia. pp. 201-207. *In,* Les *Trichogrammes,* Ier Symposium International Colloques d l'INRA (Institut National de la Recherche Agronomique). Paris, France. 307 pp.

Bastos, C. S., F. A. Suinaga, D. E. B. Araujo, V. L. Menezes, and A. J. S. Lira. 2004. Potential use of *Trichogramma* as a tool in cotton IPM in Mato Grosso, Brazil. Egg Parasitoid News (Darmstadt, Germany) 16:24.

Bigler, F. and R. Brunetti. 1986. Biological Control of *Ostrinia nubilalis* Hbn. by *Trichogramma maidis* Pint et Voeg. on corn for seed production on southern Switzerland. Journal of Applied Entomology 102: 303-308.

Bournier, J. and M. Vaissayre. 1977. Phytosanitary activity of the cotton and exotic textiles Research Institute in Madagascar. Cotton et Fibres Tropicales 32: 211-228.

Buyuk, M., E. Sedat, B. Baran, and A. Demir. 2002. Plant protection problems and solution possibilities in cotton production in the Southeastern Anatolian Region. Proceedings of V. Cotton Textile Symposium of Turkey, 28-29 April. Diyarbakır,Turkey. 176-184.

Cai, Q. N., Q. W. Zhang, H. S. Li, X. Z. Sun, and M. S. Cheo. 1997. The influence of Avermectin to natural enemies in cotton fields. Chinese Journal of Biological Control 13: 86-89.

Davies, A. and C. Martin. 2005. The role of IPM (Integrated Pest Management) in sustainable cotton farming systems in the NT. Technical Annual Report. The Crops. Forestry and Horticulture 243. http://www.nt.gov.au/dpifm/Primary_Industry/index.cfm

El-Wakeil, N. and S. Vidal. 2005. Using of *Chrysoperla carnea* in combination with *Trichogramma* species for controlling *Helicoverpa armigera*. Egg Parasitoid News (Darmstadt, Germany) 17: 24.

Goodell, P. B., L. D. Godfrey, E. E. Grafton-Cardwell, N. Toscano, and S. D. Wright. 2001. Insecticide and Miticide resistance management in San Joaquin Valley cotton for 2001. University of California, Division of Agriculture and Natural Resources (ANR). Publication ANR 8033, California, USA. 23 pp.

Hassan, S. A. 1981. Mass production and utilization of *Trichogramma*: 2. Four years successful biological control of the European corn borer. Medical Faculty Landbouww Rijksuniv Gent, Belgium). Darmstadt-Germany 46: 417-427.

Heydari, A. and A. Gharedaghli. 2007. Integrated Pest Management on cotton in Asia and North Africa. Inter-regional Network on Cotton in Asia and North Africa (INCANA). Tehran, Iran. 8: 76 pp.

Huo, S. T., Z. G. Wei, W. Ji, and Y. Zhang. 1988. Studies on the strains of *Trichogramma chilonis* Ishii. in the middle area of Sharanxi Province. Colleques de I'INRA (Institut National de la Recherche Agronomique; Paris, France) 43: 45-55.

Jallow, M., M. Matsumura, and Y. Suzuki. 2001. Oviposition preference and reproductive performance of Japanese *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae). Applied Entomology and Zoology 36: 419-426.

Johnson, S. J. 1985. Low-level augmentation of *Trichogramma pretiosum* and naturally occurring *Trichogramma* spp. parasitism of *Heliothis* spp. in cotton in Louisiana. Environmental Entomology 14: 28-31.

Jones, S. L., R. K. Morrison, J. R. Ables, and D. L. Bull. 1977. A new and improved technique for the field release of *Trichogramma pretiosum.* Southwestern Entomology 2: 210-215.

Jones, S. L., R. K. Morrison, J. R. Ables, L. F. Bouse, J. B. Carlton, and D. L. Bull. 1979. New technique for the field release of *Trichogramma pretiosum*. Southwestern Entomology 4: 14-19.

Karban, R. 1993. Induced resistance and plant density of a native shrub, *Gossypium thurberi,* affect its herbivores. Ecology 74: 1-8.

Karman, M. 1971. General knowledge on plant protection researches. The Principles of Establishment and Evaluation of Experiments. General Directorate of Plant Protection and Quarantine Publications. Plant Protection Research Institute, Bornova-Izmir. 279 pp.

Kayapinar, A. 1991. Determination of natural enemies of corn pest, *Ostrinia nubilalis* Hübner (Lep., Pyralidae) and investigation on the relationship between European corn borer and egg parasitoid, *Trichogramma evanescens* Westwood (Hym.; Trichogrammatidae) in Cukurova Region. Institute of Natural and Applied Sciences. PhD Thesis. University of Cukurova. Cukurova, Turkey. 165 pp.

Kelly, D. G. 2003. *Trichogramma* Wasps. Central Queensland Cotton Tales. Department of Primary Industries Queensland Government. Cotton C.R.C. IPM Guidelines. October 3, 2003. 1 p.

King, E. G., L. F. Bouse, D. L. Bull, R. J. Coleman, W. A. Dickerson, W. J. Lewis, J. D. Lopez, R. K. Morrison, and J. R. Phillips. 1986. Management of *Heliothis* spp. in control by augmentative releases of *Trichogramma pretiosum* Ril. Journal of Applied Entomology 101: 2-10.

Knutson, A. 1996. Commercially reared *Trichogramma pretiosum* to control *Helicoverpa zea. Trichogramma* News (Texas, USA) 9: 16.

Kogan, M., D. Gerling, and J. V. Maddox. 1999. Enhancement of biological control in transient agricultural environments. *In,* Bellows, T. S., Jr. and T. W. Fisher, (Editors). Handbook of Biological Control: Principles and Applications. Academic Press. San Diego, California, U.S.A. 1080 pp.

Kovalenkov, V. G. 1980. *Trichogramma* on cotton-growing farms. Zashchita Rastenii (Moskva, Russia) 11: 38-39.

Kovalenkov, V. G. and T. V. Meshcheryakova. 1986. Diapause conditions and the activity of *Trichogramma*. Zashchita Rastenii (Moskva, Russia) 3: 35.

Kring, T. J. and T. B. Smith. 1995. *Trichogramma pretiosum* efficiency in cotton under Bt-insecticide combinations. Proceedings Beltwide Cotton Production Research Conference. National Cotton Council, Memphis, Tennessee, U.S.A. 856-857.

Layton, M. B. 2002. Cotton insect control guide. Mississippi State University Extention Service Publication. 343: 35 pp.

Lopez, J. D. Jr. and R. K. Morrison. 1985. Parasitization of *Heliothis* spp. eggs after augmentative releases of *Trichogramma pretiosum* Riley. Southwestern Entomology 8: 110-137.

Li-Ying, Li. 1994. Worldwide use of *Trichogramma* for biological control on different crops: A survey, pp. 37-53. *In* E. Wajnberg and S. A. Hassan (Editors). Biological control with egg parasitoids. International Organization for Biological Control, Wallingford, U.K. 286 pp.

Nasretdinov, K. 1978. The Biomethod in the Field of Andizhan. Zashchita Rastenii (Moskva, Russia) 6: 34.

Negeri, M. 2000. Detection of *Trichogramma* parasitoids with the aim of their further use for biological control of insect pests. Parasitoid News (Darmstadt, Germany) 12: 17.

OEPP/EPPO. 1981. Data sheets on quarantine organisms No. 110. *Helicoverpa armigera.* Bulletin OEPP/EPPO Bulletin 11 (1). 6 pp.

Oztemiz, S. 2001. Determination of the effects of some factors on parasitization rate of European corn borer [(*Ostrinia nubilalis* Hübner Lepidoptera: Pyralidae)] by *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae) in Cukurova Region. Institute of Natural and Applied Sciences. Ph. D. Thesis. University of Cukurova, Turkey. 172 pp.

Oztemiz, S. and S. Kornoşor. 2005. Effects of some pesticides on *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae). GAP 4th Agriculture Congress. September 21-23. Harran University, Agriculture Faculty. Sanlıurfa, Turkey. 1: 269-275.

Pires, C. S. S., P. W. Price, and E. G. Fontes. 2000. Preference performance linkage in the neotropical spittlebug *Deois flavopicta,* and its relation to the phylogenetic constraints hypothesis. Ecological Entomology 25: 71-80.

Sarode, S. 1999. Survival potential of *Heliothis armigera* (Hüb.) on various weeds. Journal of Entomological Research 23: 243-246.

Scholz, B. C. G. and D. A. H. Murray. 1994. Evaluation egg parasitoids for integrated pest management in Australian raingrown cotton. Les Colleques de I'INRA (Institut National de la Recherche Agronomique; Paris, France) 73: 133-136.

Scholz, B., D. Murray, and R. Lloyd. 1996. The use of *Trichogramma* against *Heliothis* on the Darling Downs. pp. 269-272. *In,* Proceedings of the 8th Australian Cotton Conference. Broadbeach (Queensland, Australia) 174 pp.

Scholz, B. C. G., C. J. Monsour, and M. P. Zalucki. 1998. An Evaluation of Selective *Helicoverpa armigera* Control Options in Sweet Corn. Australian Journal of Experimental Agriculture 38: 601-607.

Scholz, B. and N. Parker. 2002. Utilising Egg Parasitoids in Cotton Farming Systems. Egg Parasitoid News (Darmstadt, Germany) 14: 38.

Scholz, B. C. G. and N. R. R. Parker. 2004. The Establishment and Utilisation of *Trichogramma pretiosum* Riley Against *Helicoverpa* spp. in Australian Cotton Farmscapes. Egg Parasitoid News (Darmstadt, Germany) 16: 27.

Scott, K. D., L. L. J. Lange, and G. C. Scott. 2004. Graham isolation and characterization of microsatellite loci from *Helicoverpa armigera* Hübner (Lepidoptera: Noctuidae). Molecular Ecology Notes (Queenysland, Australia) 4: 204-205.

Shamuratov, A., T. Turdiev, and S. A. Abdumazhidov. 1981. According to Expert Opinion. Zashchita Rastenii (Moskva, Russia) 9: 10-11.

Smith, L. and A. C. Bellotti. 1996. Successful Biocontrol Projects with Emphasis on the Neotropics. Cornell Community Conference on Biological Control. April 11-13. Cali, Colombia.

Stinner, R. E., R. L. Ridgway, J. R. Coppedge, R. K. Morrison, and W. A. Dickerson. 1974. Parasitism of *Heliothis* Eggs After Field Releases of *Trichogramma pretiosum* in Cotton. Environmental Entomology 3: 497-500.

Stadelbacher, E. A. 1981. Role of early-season wild and naturalized host plants in the buildup of the F1 generation of *Heliothis zea* and *H. virescens* in the Delta of Mississippi. Environmental Entomology 10: 766-770.

Suh, C. P., D. B. Orr, and J. W. Van Duyn. 1997. Evaluation of a *Trichogramma exiguum*-based Management System for Heliothine Pest Suppression in Cotton. Poster Presentation, Southeastern Branch of Entomological Society of America. Asheville, North Carolina, U.S.A. March 2-5.

Suh, C. P., D. B. Orr, and J. W. Van Duyn. 1998. Reevaluation of *Trichogramma* Releases for Suppression of Heliothine Pests in Cotton, pp. 1098-1101. *In,* Proceedings, Beltwide Cotton Production Research Conference. National Cotton Council, Memphis, Tennessee, U.S.A. 258 pp.

Suh, C. P., D. B. Orr, and J. W. Van Duyn. 2000. *Trichogramma* Releases in North Carolina Cotton:Why Releases Fail to Suppress Heliothine Pests. Biological and Microbial Control. Journal of Economic Entomology 93: 1137-1145.

Thomson, L. J., D. C. Glenn, and A. A. Hoffmann. 2000. Effects of sulfur on *Trichogramma* egg parasitoids in vineyards: measuring toxic effects and establishing release windows. Australian Journal of Experimental Agriculture 40: 1165-1171.

Thontadarya, T. S., M. Hanumanna, and K. J. Rao. 1978. Record of *Trichogramma australicum* Girault on the Eggs of *Heliothis armigera* (Hubner) Infesting Bhendi (Abelmoschus esculentus (H.) Moench), Current Research. 7: 206 pp.

Tran, L. C. and S. A. Hassan. 1986. Preliminary results on the utilization of *Trichogramma evanescens* West. to control the Asian Corn Borer, *Ostrinia furnacalis* Guenee in the Philippines. Journal of Applied Entomology 101: 18-22.

van Lenteren, J. C. 2000. Success in biological control of arthropods by augmentation of natural enemies. pp. 77-103. *In,* Biological Control: Measures of Success (G. Gurr and S. Wratten, Editors). Kluwer Academic Publishers. Dordrecht, The Netherland. 118 pp.

van Lenteren, J. C. and V. H. P. Bueno. 2003. Augmentative biological control of arthropods in Latin America. Biocontrol 48: 123-139.

Voronin, K. 1982. Biocenotic aspects of *Trichogramma* utilization in integrated plant protection control. *In,* Les Trichogrammes, Ier Symposium International Colloques d l'INRA (Institut National de la Recherche Agronomique). Paris, France. 9: 269-274.

Wang, F. C. and S. Y. Zhang. 1991. *Trichogramma pintoi* (Hym.; Trichogrammatidae): deuterotoky, laboratory multiplication and field releases. Colloques de I'INRA (Institut National de la Recherche Agronomique, Paris, France) 56: 155-157.

Yabas, M. N. and M. Ozer. 1983. Investigation on bio-ecology of *Heliothis armigera* (Hbn) in Cukurova region. TUBITAK VII. Scientific Congress. Reports of Agriculture and Forestry Research Group, 6-10 October 1980. Adana, Turkey. 75-79.

Yu, D. S. K., E. A. C. Hayley, and J. E. Laing. 1984. Biology of *Trichogramma minutum* Riley collected from apples in Southern Ontario. Environmental Entomology 13 (5): 1324-1329.

Zhou, L. T. 1988. Study on parasitizing efficiency of *Trichogramma confusum* Viggiani in controlling *Heliothis armigera* Hübner and its modelling. Colleques de I'INRA (Institut National de la Recherche Agronomique; Paris, France) 43: 640-644.

Zimmermann, O. 2005. Which indigenous beneficial can control the Cotton Bollworm? - A selection of suitable *Trichogramma* species to control *Helicoverpa armigera* in green houses Egg Parasitoid News (Darmstadt, Germany) 17: 22.

TWO NEW SPECIES OF *CUBRASA* FROM HISPANIOLA (HEMIPTERA: CICADELLIDAE; CICADELLINAE)[1]

Paul H. Freytag [2]

ABSTRACT: Two new species of *Cubrasa* from the Dominican Republic are described, *C. brevida* and *C. longula.*

KEY WORDS: *Cubrasa,* new species, Hemiptera, Cicadellidae, Cicadellinae, Dominican Republic, Strepsiptera

The genus *Cubrasa* was described by Young (1977) for a single species, *C. cardini* (Metcalf and Bruner) from Cuba. This species has been the only species known for this genus since that time. Two new species have now been discovered from the Dominican Republic and are described at this time. Both species are similar to *C. cardini* in overall characters, but can be separated both on color pattern and male genitalia.

Acronyms for institutions in which material is housed are: CMNH – Carnegie Museum of Natural History, Pittsburgh; FSCA – Florida State Collection of Arthropoda, Gainesville; MHND – Museo Nacional de Historia Natural, Santo Domingo, Dominican Republic; and UKYC – University of Kentucky Collection, Lexington.

Cubrasa brevida Freytag, NEW SPECIES
(Figures 1-5)

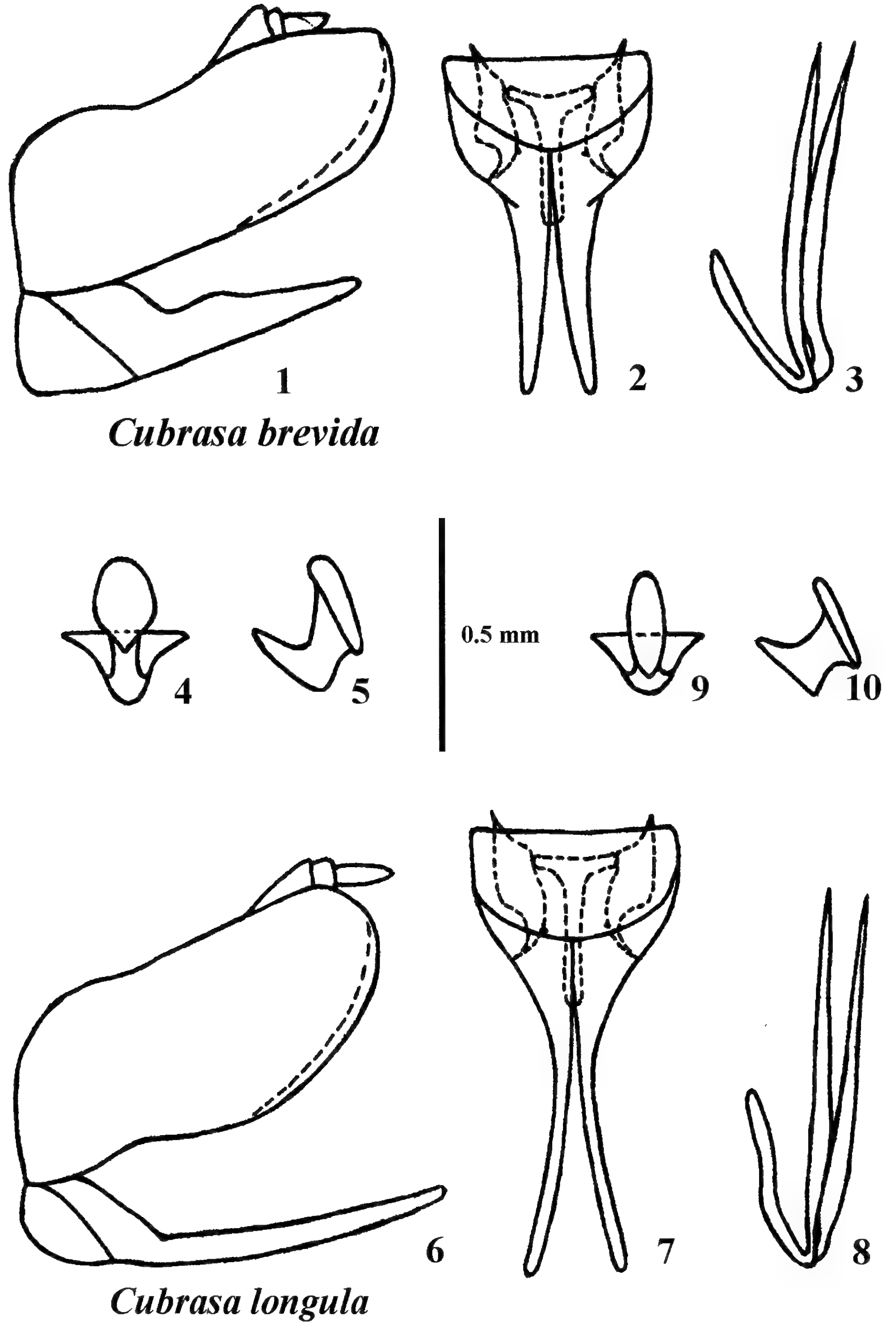
Description: Length of males 6.9-7.1 mm., females 7.4-7.5 mm. Similar to *C. cardini* in general appearance, but darker in color of head, pronotum, and scutellum. Color of head uniformly shiny black dorsally to a point on face at level of antennal sockets, a median band of yellow from anterior margin to the mostly yellow face. Pronotum and scutellum shiny black with a narrow longitudinal band of yellow down median. Front wings brownish red, with two bands of brownish black (sometimes with a blue tinge), one length of claval suture, other along costa; appendix and inner apical cell membranous. Legs and ventral surface yellowish brown. Male genitalia: Pygofer (Fig. 1) long, rounded at apex, thickened along ventral posterior margin, with only a few setae near apex. Subgenital plate (Figs. 1-2) shorter than pygofer, thickened at base, narrow and finger-like at apex, with a couple of setae near base. Style (Fig. 2) claw-like with a bluntly pointed apex. Paraphysis (Fig. 3) with two long thin processes which are slightly asymmetrical. Aedeagus (Figs. 4-5) short, nearly rounded in posterior view. Female seventh sternum with rounded posterior margin.

---

[1] Received on March 10, 2006. Accepted on June 3, 2007.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 40546-0091 U.S.A. E-mail: freytag2104@windstream.net

Mailed on March 14, 2008



Figures 1-5. *Cubrasa brevida* n. sp. Figures 6-10. *Cubrasa longula* n. sp. Figs. 1 and 6. Male genital capsule, lateral view, setae not shown. Figs. 2 and 7. Male valve, subgenital plates, styles and connective, ventral view, setae not shown. Figs. 3 and 8. Paraphysis, lateral view. Figs. 4 and 9. Aedeagus, posterior view. Figs. Aedeagus, lateral view. All drawn to the same scale.

Type Data: Holotype male: Dominican Republic: Pedernales, 3.3 km NE Los Arroyos, 18°15' N 71°45' W, 1450 m., 16-18-VII-1990, L. Masner, J. Rawlins, C. Young, wet montane forest, sweep samples (CMNH). Paratypes: 13 males, 5 females, same data as holotype (10 males, 2 females, CMNH; 1 male, 1 female, FSCA; 1 male, 1 female, MHND; 1 male, 1 female, UKYC).

Remarks: This species is only known from this single locality. One female was parasitized by Strepsiptera.

Etymology: This species is named for the short subgenital plate.

Cubrasa longula Freytag, NEW SPECIES

(Figures 6-10)

Description: Length of males 6.5-7 mm., females 7-7.5 mm. Similar to *C. cardini* in overall appearance. Head, pronotum and scutellum marked similar to *C. cardini*, except the yellow markings smaller, represented by thin lines, with the brownish black the predominant color. Front wings as in *C. cardini*, with the appendix and inner apical cell membranous, remainder of apical cells marked with black; reddish color dull in specimens on hand. Male genitalia: Pygofer (Fig. 6) similar to *C. brevida*. Subgenital plate (Figs. 6-7) long, nearly as long as pygofer, apical two-thirds thin, finger-like, only a couple setae near base. Style (Fig. 7) short, sharply pointed at apex. Paraphysis (Fig. 8) similar to *C. brevida*. Aedeagus (Figs. 9-10) short, stocky, elongate in posterior view. Female seventh sternum similar to *C. brevida*.

Type Data: Holotype male: Dominican Republic: Pedernales, 3.3 km NE Los Arroyos, 18°15' N 71°45' W, 1450 m., 16-18-VII-1990, L. Masner, J. Rawlins, C. Young, wet montane forest, sweep samples (CMNH). Paratypes: 12 males, 15 females, same data as holotype (9 males, 12 females CMNH: 1 male, 1 female FSCA; 1 male, 1 female MHND: 1 male, 1 female UKYC).

Notes: One other female has been seen from Pedernales, Upper Los Abejas, 38 km NNW Cabo Rojo, 18°09' N 71°38' W, 1350 m., 22-VII-1990, L. Masner, mesic deciduous forest, sweeping (CMNH). This locality is very close to the type locality. Four males and four females from the type series were parasitized by Strepsiptera.

Etymology: This species is named for the very long subgenital plate.

ACKNOWLEDGMENT

Sincere thanks to Chen Young, Carnegie Museum of Natural History for making this material available for this study.

LITERATURE CITED

Young, D. A. 1977. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 2. New World Cicadellini and the genus *Cicadella*. North Carolina Agricultural Experiment Station Technical Bulletin 239. 1135 pp.

A NEW GENUS OF GRASSHOPPER (ORTHOPTERA: ACRIDOIDEA: CATANTOPIDAE: CYRTACANTHACRIDINAE) FROM CHINA[1]

Hong Yin[2] and Xiang-Chu Yin[3]

ABSTRACT: This paper reports a new genus i.e. *Parapachyacris* gen. nov and a new species *Parapachyacris taiwanensis* sp. nov in Cyrtacathacridinae. The new genus is similar to *Pachyacris* Uvarov, 1923 and differs from the latter in: 1) foveolae lacking; 2) hind tibiae with 10 spines on inner side and 8 spines on outer side; 3) basal part of prosternal process thickened; 4) cross veins right angled with longitudinal veins in apical part of tegmina and 5) the back of body with yellow longitudinal stripe in middle. The new genus is also similar to *Patanga* Uvarov, 1923 and differs from the latter in: 1) foveolae lacking; 2) basal part of prosternal process thickened; 3) upper side of hind femora with three dark bands and 4) black spots of tegmina lacking. Type specimen is deposited in the National Museum of Natural Science (NMNH), Taichung, Taiwan, China.

KEY WORDS: Orthoptera, Catantopidae, Cyrtacanthacridinae, new genus, new species, China

The grasshopper subfamily Cyrtacanthacridinae is a small taxon, in which there are some genera and species distributed over the whole world. Characteristics for this subfamily are: body large; antennae filiform, with more than 18 segments; foveolae indistinct or absent; prosternal process conical or cylindrical; pronotum without lateral carinae; dorsal basal lobe of hind femur longer than ventral one, medial area with fishbone-pattern on outside; tegmina developed, extending over end of the hind femora.

When examining specimens of grasshoppers from Taiwan China, we discovered a genus and a species of Cyrtacanthacridinae as new to science. The descriptions are given as below. Type specimen is deposited in the National Museum of Natural Science (NMNH), Taichung, Taiwan, China.

SYSTEMATIC ENTOMOLOGY

Parapachyacris gen. nov.

Figs. A-D

Body large in size. Head large and shorter than length of pronotum. Face slightly oblique. Foveolae lacking. Head and pronotum with yellow longitudinal stripe in middle. Antennae filiform, longer, extending to base of hind femora. Prosternal process nearly cylindrical, slightly sloping backward, basal part thick-

---

[1] Received on March 6, 2007. Accepted on May 20, 2007.

[2] College of Life Sciences, Hebei University, Baoding 071002, China. E-mail: yinhongyin@yahoo.com.cn

[3] Northwest Plateau Institute of Biology, Chinese Academy of Sciences, Xining 810001 China.

[4] College of Plant Protection, Shandong Agricultural University, Taian 271018, China. E-mails: yxch34@yahoo.com or yxch@sdau.edu.cn (Corresponding Author).

Mailed on March 14, 2008

ened, apex acuter. Pronotum cylindrical, hind margin curved in middle, lateral carinae lacking, median keel raised in prozona and low in metazona, distinctly cut by three transverse sulci. Prozona equal to metazona in length. Mesosternal lobes longer than width. Lateral lobes of metasternum slightly separated in apical part. Tegmina and wings developed, without black spots, extending over middle of hind tibiae, cross veins right angled with longitudinal veins in apical part of tegmina. Hind femur with three dark bands on upper side, upper keel serrated, with end of lower knee lobes rounded. Hind tibiae with 10 spines on inner side and 8 spines on outer side, external apical spine absent. Second joint of hind tarsus shorter than the first one. Tympanum distinct. Ovipositor valves short, distinctly hooked in the end, outer margin smooth.

Type Species: *Parapachyacris taiwanensis* sp. nov.

Diagnosis: The new genus is similar to *Pachyacris* Uvarov, 1923 and differs from the latter as listed in Table 1.

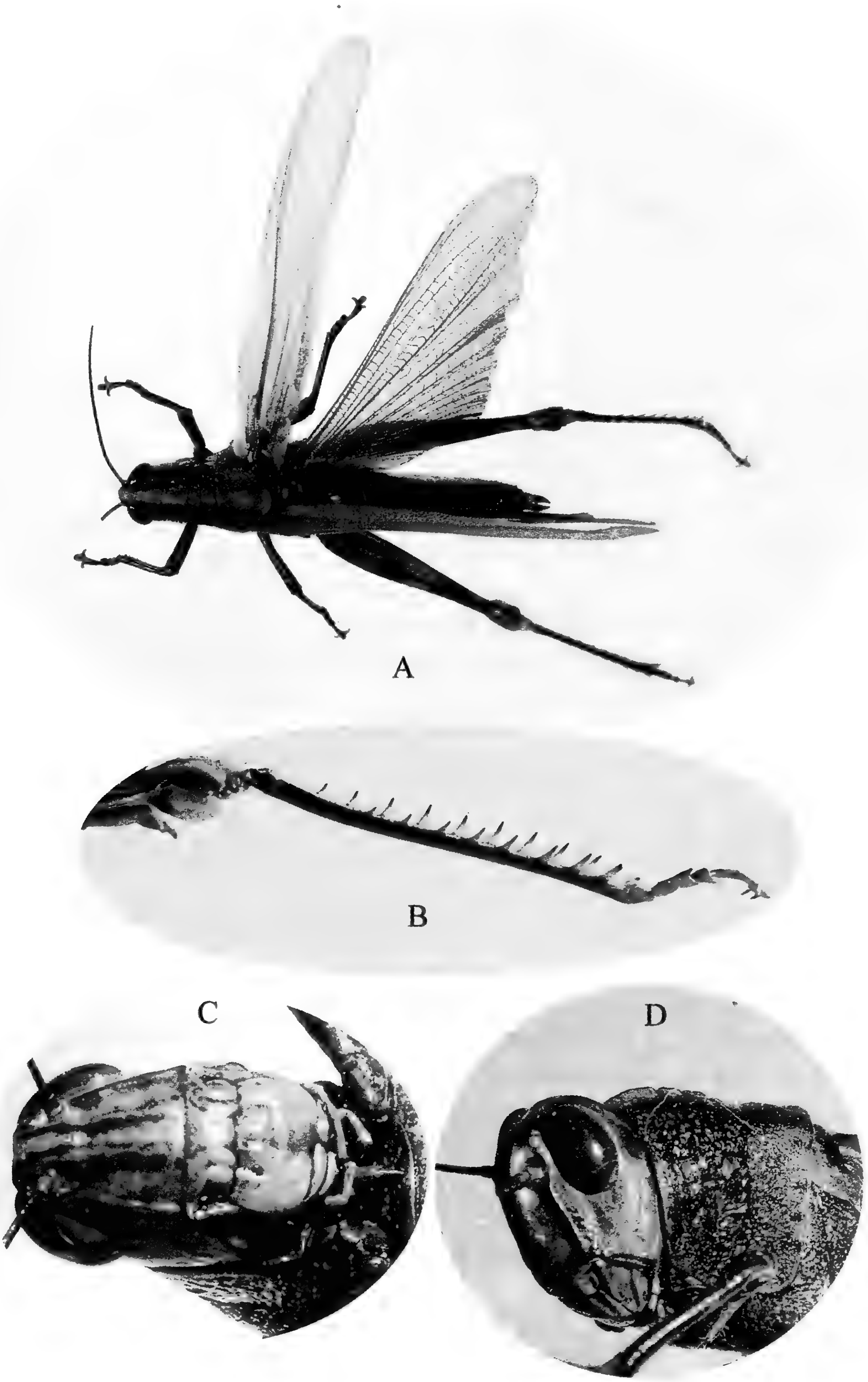
Table 1. Comparison of new genus *Parapachyacris* and *Pachyacris* Uvarov, 1923

	Parapachyacris gen. nov.	*Pachyacris*
foveolae	lacking	indistinct
spines of hind tibiae	inner side 10, outer side 8	inner side 8, outer side 7
prosternal process	basal part thickened	basal part not thickened
apical part of tegmina	cross veins right angled with longitudinal veins	cross veins oblique angled longitudinal veins
head and pronotum	with yellow longitudinal stripe in middle	without yellow longitudinal stripe in middle

The new genus is also similar to *Patanga* Uvarov, 1923 and differs from the latter as listed in Table 2.

Table 2. Comparison of new genus *Parapachyacris* and *Patanga* Uvarov, 1923

	Parapachyacris gen. nov.	*Patanga*
foveolae	lacking	indistinct
Prosternal process	basal part thickened	basal part not thickened
upper side of hind femora	with three dark bands	with a black longitudinal stripe
black spots of tegmina	lacking	present



Figures A-D. Photographs of *Parapachyacris taiwanensis* sp. nov. A. Dorsal view of holotype. B. Hind tibia. C. Head and prosternal process. D. Head and pronotum lateral view.

Etymology: Name of the genus is derived from its sister genus *Pachyacris* Uvarov, 1923, Para- in Latin means derivation.

Parapachyacris taiwanensis sp. nov. (Figs. A-D)

Type Data. Holotype: Female, China: Taiwan Taichung, Hoping, Paileng, (21°11'N, 120 °54'E), (G. S. Tung & M. M. Yang), 3. August, 1996 (**NMNH**).

Description of Female (Figs. A-D). Body large in size. Head larger and shorter than length of pronotum. Face slightly oblique in profile. Antennae filiform, 27 segments, distinctly surpassing over posterior margin of pronotum, middle segment 2.5 times as long as its width. Eyes globose, longitudinal diameter 1.7 times as long as horizontal diameter and 1.8 times subocular furrow. Pronotum cylindrical, hind margin curved in middle, lateral carinae lacking, median keel raised in prozona and low in metazona, distinctly cut by three transverse sulci. Prozona equal to metazoan in length. Interspace of mesosterum narrowed backward, 1.5 times as long as minimum width, lateral lobes of metasternum slightly separated, almost contiguous. Tegmina and wings developed, extending over middle of hind tibiae, cross veins right angled with longitudinal veins in apical part of tegmina. Upper keel of hind femur serrated, well proportioned, 4.6 times as long as its maximum width, end of lower knee lobes rounded. Hind tibia with 10 spines on inner side and 8 spines on outer side, external apical spine absent. Second joint of hind tarsus shorter than first one, arolium large, longer than claw. Tympanum distinct. Epiproct with longitudinal groove in middle. Cercus conical, not reaching to tip of epiproct. Subgenital plate oblong, hind margin acute angled in middle. Ovipositor valves short, apex hooked, outer margin smooth.

Coloration: Body darkish-brown. Antennae darkish-brown. Head and pronotum with yellow longitudinal stripe in middle. Tegmina yellowish-brown, without black spots. Wing darkish-brown, red at base. Hind femur yellowish-brown, with three dark bands on upper side, upper kneelobe dark, lower one yellow. Hind tibia darkish-brown, spines yellow, apex black. Abdomen and subgenital plate darkish-brown.

Measurements: Length of body, female 58.2 mm. Length of tegmen: female 58.1 mm. Length of hind femur: female 33.9 mm.

Male: Unknown.

ACKNOWLEDGEMENTS

This study is financially supported by the grants of National Natural Sciences Foundation of Peoples Republic of China (No. 30630010) and Chinese Academy of Sciences (No. KSCX2-YW-Z). We are grateful to Prof. Yien-Shing Chow, the former Director of National Museum of Natural Science, Taichung, for his kind invitation to visit Taiwan, China. We are also grateful to Mr. G. S. Tung and M. M. Yang for collecting specimen.

LITERATURE CITED

Bei-Bienko, G. J. (Ya.) and L. L. Mishchenko. 1951. Acridoidea of the fauna of the Union of Soviet Socialist Republics and neighbouring countries. Pts. 1 and 2. [In Russian.] Opred. Faune the Union of Soviet Socialist Republics, Moscow 38: 246, 247, figs. 207-208. [In Russian]

Bi, Dao-Ying. 1986 Notes on five new species of grasshoppers from China. Contributions of the Shanghai Institute of Entomology 5:197-199, figs. 6-9. [In Chinese with English summary]

Huang, Chun-Mei. 1982. *Patanga* Uvarov and one new species (Orthoptera: Acrididae). Sinozoologia No. 2: 35-37. [In Chinese with English summary]

Johannson, B. 1763. CXXI. Centuria insectorum quam praeside D. D. Car. von Linné proposuit Boas Johansson, Calmariensis. pp. 384-415. *In,* Amoenitates academicae; seu dissertationes variae physicae, medicae, botanicae, antehac seorsim editae, nunc collectae et auctae cum tabulis aeneis. Tomus 6. G. Kiesewetter. Holmiae [= Stockholm]. 486 pp. 2nd Edition. 1789. Erlanger, Sweden. p. 398, no. 36.

Jiang, Guo-Fang and Z.-M. Zheng. 1998 Grasshoppers and locusts from Guangxi. pp. 135-138, figs. 389-401. [In Chinese with English summary]

Kirby, W. F. 1914. The fauna of British India, including Ceylon and Burma. Orthoptera (Acrididae). London, England. pp. I-X, 193, 224-226.

Li, Hong-Chang and Kai-Ling Xia. 2006 Fauna Sinica Insecta Volume 32 Orthoptera Acridoidea Catantopidae. Sciences Press. Beijing, China. pp. 468-479, figs. 244-248. (In Chinese with English summary)

Liu, Ju-Peng. 1995. Studies on Acridoids of Hainan Island. Tianze Publishing House pp. 63-64, figs. II.91-93. [In Chinese with English summary]

Mishchenko, L. L 1952. Fauna of the Union of Soviet Socialist Republics. Insects: Orthoptera 4 no. 2. Acrids (Catantopinae). Zoological Institute of the Union of Soviet Socialist Republics Academy of Sciences, Moscow 54: 487, 493-494, figs. 142-143. [In Russian]

Tinkham, E. R. 1940. Taxonomic and biologieal studies on the Cyrtacanthacrinae of South China. Lingnan Science Journal, Canton 19: 341.

Tsai, Pang-Hwa. 1929. Description of three new species of Acridiids from China, with a list of the species hitherto recorded. Journal College Agriculture, Tokyo 10: 149.

Uvarov, B. P. 1923. A Revision of the Old World Cyrtancanthacrini (Orth. Acrididae). Annals & Magazine of Natural History (9)11: 143, 473.

Walker, F. 1870. Catalogue of the specimens of Dermaptera Saltatoria in the collection of British Museum. London, England. British Museum 4: 588.

Willemse, C. 1957 Synopsis of the Acridoidea of the Indo-Malayan and adjacent regions (Insecta, Orthoptera). (Continued). Publishing Natuurhistorisch Genootschap Limburg 10: 245-246, figs.

Xia, Kai-Ling. 1958. Taxonomic essentials of Acrididae from China. Science Press. Biejing, China. pp. 57, 187. Plate IV. fig. 12. [In Chinese]

Yin, X.-C., J.-P. Shi, and Z. Yin. 1996. A synonymic catalogue of grasshoppers and their allies of the world. China Forestry Publishing House. Beijing, China. p. 492 and p. 529.

Zheng, Z.-M. 1985. Grasshoppers from Yunnan, Guizhou, Sichuan, Shaanxi and Ningxia. Sciences Press. Beijing, China. p. 74, figs. 362-371. (In Chinese with English summary)

Zheng, Z.-M. 1993. Taxonomy of Acridoidea. Shaanxi Normal University Press. Xi'an, China. p. 156, figs. 558-561. (In Chinese)

THE AMERICAN ENTOMOLOGICAL SOCIETY

APPLICATION FOR MEMBERSHIP

Membership coincides with the calendar year running from January 1 to December 31. If joining midyear, back issues will be mailed. Unless requested otherwise, membership application received after October 1 will be credited to the following year.

DUES FOR 2008:

Regular: $ 20
Student: $ 12 $ ______
Students must provide proof of student status

Paid membership dues are required for the following member's subscription rates:

☐ **ENTOMOLOGICAL NEWS**
Vol. 118 @ $15.00 per year: $ ______

☐ **TRANSACTIONS OF TAES**
Vol. 133 @ $15.00 per year: $ ______

______

Total: $ ______

NAME

ADDRESS

CITY STATE ZIP

E-MAIL (PLEASE PRINT CLEARLY)

TELEPHONE

☐ Check or money order (in US currency through a US bank) payable to *The American Entomological Society.*

Credit card: ☐ VISA ☐ Discover ☐ MasterCard ☐ AmEx

CREDIT CARD NUMBER EXPIRATION DATE

NAME ON CARD SIGNATURE

AES Federal ID No.: 23-1599849

MAIL FORM & PAYMENT TO:

The American Entomological Society
at The Academy of Natural Sciences
1900 Benjamin Franklin Parkway
Philadelphia, PA 19103-1195

Telephone: (215) 561-3978
E-mail: aes@acnatsci.org

www.acnatsci.org/hosted/aes

A NEW SPECIES OF *PALLIDUPHANTES* FROM TURKISH CAVES (ARANEAE: LINYPHIIDAE)[1]

Hakan Demir,[2] Aydın Topçu,[3] and Osman Seyyar[4]

ABSTRACT: A new species of *Palliduphantes* Saaristo and Tanasevitch in 2001 is described from Turkey. Differences between the new species and related species are discussed.

KEY WORDS: Araneae, Linyphiidae, new species, Turkey, caves

The genus *Palliduphantes* Saaristo and Tanasevitch, 2001, is represented with 55 species throughout the world (Bosmans, 2006; Platnick, 2007). As the fauna of Turkey is concerned, Linyphiidae must be regarded as an insufficiently studied family. The linyphiid fauna of Turkey consists of 56 species (7 of them inhabit the caves), and has recently been a subject of intensive taxonomic and faunistic studies (Topçu et al., 2005, 2006). In the present study, a new species from Turkey is described.

METHODS

All illustrations were made with a Nikon SMZ-U stereomicroscope with drawing tube. Abbreviations used in the text and in the figures are as follow: Fm, femur; Pt, patella; Tb, tibia; Mt, metatarsus; Tr, tarsus; Tm, position of metatarsal trichobothrium; NUAM, Arachnology Museum of the Niğde University, Niğde, Turkey. Terminology of genitalia and chaetotaxy follow Saaristo and Tanasevitch (2001). All measurements are in millimeters.

SYSTEMATIC ARANEOLOGY

Palliduphantes bayrami sp. n.

Figs. 1–9

Type Data. Holotype ♂ (NUAM), TURKEY: Karaman Province, Ermenek District, Manaspoli Cave (36°38′N, 32°51′E) 11.VII.2006, leg. Hakan Demir and Aydın Topçu. Paratypes 4 ♀, (NUAM), together with holotype, leg. Hakan Demir and Aydın Topçu.

Etymology. The new species is named in honor of the Turkish arachnologist Prof. Dr. Abdullah Bayram.

Diagnosis. *Palliduphantes bayrami* sp. n. belong to the insignis group (Saaristo and Tanasevitch, 2001), closely related to *P. minimus* (Deeleman-Rein-

---

[1] Received on April 2, 2007. Accepted on June 3, 2007.

[2] Department of Biology, Faculty of Science and Arts, Gazi University, TR-06500 Ankara, Turkey. Corresponding Author: E-mail: hakandemir@gazi.edu.tr.

[3] Department of Biology, Faculty of Science and Arts, Niğde University, TR-51200 Niğde, Turkey. E-mail: atopcu3msn.com.

[4] Department of Biology, Faculty of Science and Arts, Erciyes University, TR-96532 Kayseri, Turkey. E-mail: osmanseyyar@hotmail.com.

Mailed on March 14, 2008

hold, 1985), *P. byzantinus* (Fage, 1931) and *P. pillichi* (Kulczyn'ski, 1915). The male of *P. bayrami* sp. n. is similar to *P. minimus* (Deeleman-Reinhold, 1985) (cf. Deeleman-Reinhold, 1985: fig 35a,b), but can be distinguished easily from this and all other species by the apical part of the lamella characteristica divided into four sharp pointed branches and it is stronger and wider. The paracymbium is bigger and wider. The females resemble *P. byzantinus* (Fage, 1931) and *P. pillichi* (Kulczyn'ski, 1915) (cf. Deltshev, 1980: figs. Plate 1.5-8, Plate 2.1-6), but can be separated from them by the anterior part of scape, rather elongated, and the longer lateral lobes.

Description. Measurements (holotype♂/paratype♀). Total length: 2.03/2.52. Carapace; 0.92/1.11 long, 0.81/0.92 wide. Clypeus: 0.15/0.13 height. Chelicerae: 0.42/0.54 long, 0.23/0.43 wide. Sternum: 0.51/0.54 long, 0.52 wide. Abdomen: 1.12/1.51 long, 0.81/0.62 wide. Leg measurements are summarized in Table 1.

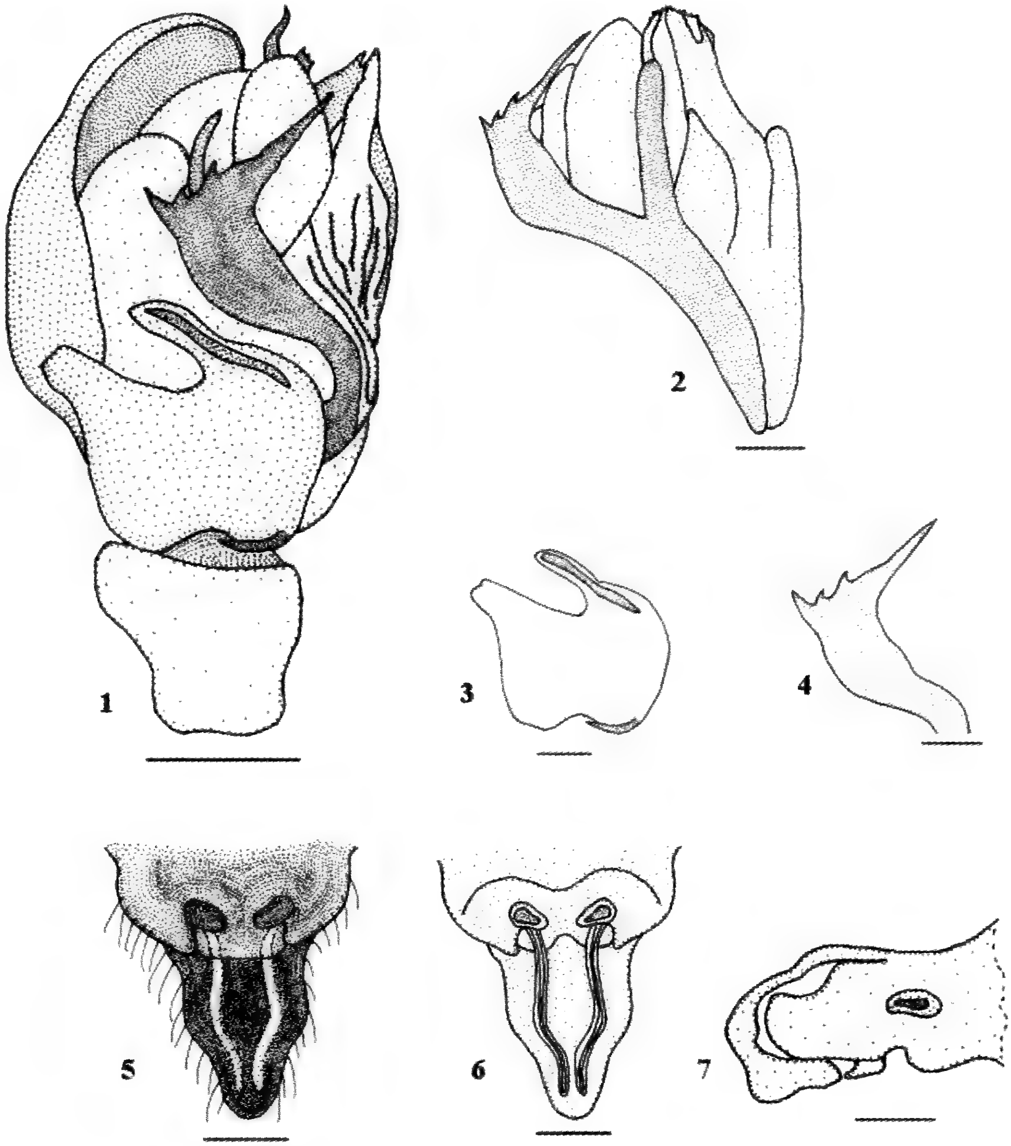
Table 1. Leg measurements of *Palliduphantes bayrami* holotype♂/paratype♀.

	Fm	Pt	Tb	Mt	Tr	Total
I	1.49 / 1.51	0.26 / 0.31	1.24 / 1.26	0.49 / 1.43	0.49 / 0.51	4.86 / 5.02
II	1.30 / 1.28	0.26 / 0.31	1.12 / 1.15	0.68 / 1.30	0.68 / 0.72	4.62 / 4.76
III	1.10	0.26 / 0.31	0.98 / 1.00	0.53 / 1.02	0.53 / 0.56	3.87 / 3.99
IV	1.22 / 1.49	0.26 / 0.31	1.20 / 1.38	0.75 / 1.38	0.75 / 0.83	4.77 / 5.28

Male. Carapace yellow. Eyes well developed, surrounded by a narrow black strip. Posterior row, median eyes distant approximately 1 diameter and distant approximately less than 1 diameter from laterals. Anterior row, median eyes almost approached, approximately 1 diameter from laterals. Clypeus concave. Chelicerae, armed with 3 well developed teeth on outer row and 5 denticles on inner row. Abdomen, greyish. All legs yellow to brownish. Fm I: 0-1-0-0, Tb I-II: 2-1-1-1, Tb III-IV: 2-0-0-0, Mt I-IV: 1-0-0-0. Tm I: 0.21. Paracymbium is big and flat. Lateral edge of the paracymbium has a prominent curved finger-like posterior extension. Lamella characteristica is long, wide, forked an S-shaped. Apical part of the lamella characteristica divided four sharp pointed branches; first three branches small, ventral branch approximately 5 times longer than other branches and directed upwards. Terminal apophyses narrow and prominently serrated. Palpal structure as in Figs. 1-4, 8-9.

Female. Body and leg coloration, chaetotaxy as in male. Scape is long, narrow and S-like, with a revolving entrance groove. Epigyne structure as in Figs 5-7.

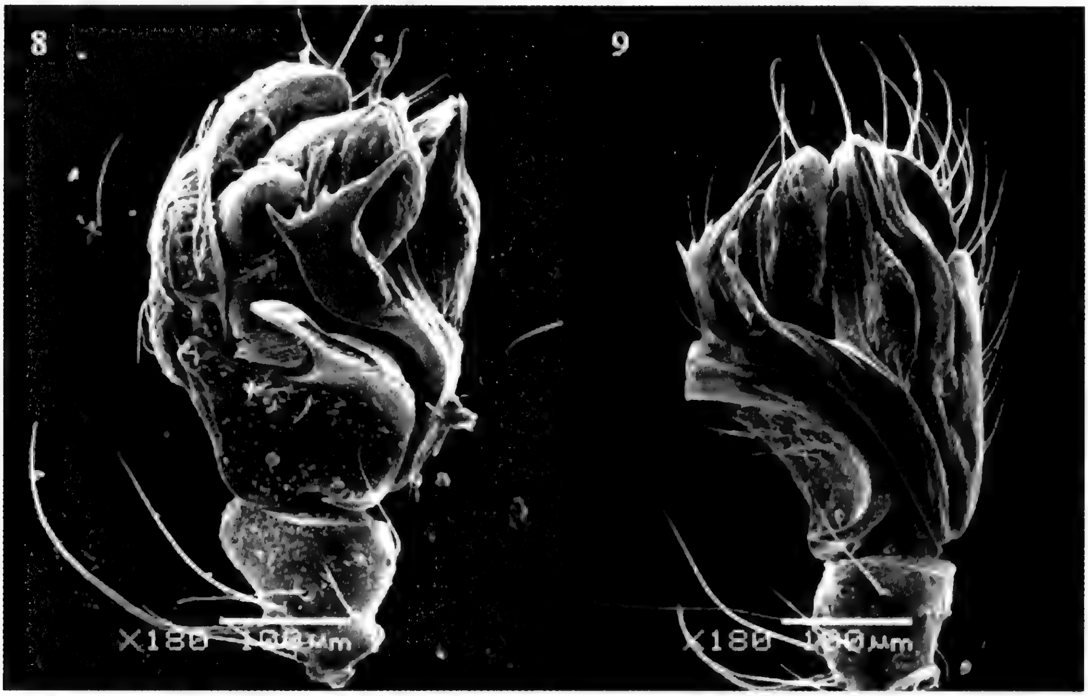
Natural History and Distribution. *Palliduphantes bayrami* sp. n. inhabits humid and clayish places in cave, where it builds its webs among loose stones. Only known from that type locality.



Figures 1–7. *Palliduphantes bayrami* sp. n., 1. left male palp; 2. embolic division; 3. paracymbium; 4. lamella characteristica; 5. epigyne, ventral view; 6. dorsal view; 7. lateral view. Scale bars = 0.1 mm.

ACKNOWLEDGEMENTS

We are very grateful to Dr. Andrei V. Tanasevitch (Russia) for his advice and valuable comments, and acknowledge the Scientific and Technological Research Council of Turkey (TUBITAK) for financial support of this work (Project No. 106T133).



Figures 8-9. *Palliduphantes bayrami* sp. n., 8. left male palp external view, 9. internal view.

LITERATURE CITED

Bosmans, R. 2006. Contribution to the knowledge of the Linyphiidae of the Maghreb. Part X. New data on *Lepthyphantes* Menge (*sensu lato*) species (Araneae, Linyphiidae). Belgian Journal of Zoology 136 (2): 173-191.

Deeleman-Reinhold, C. L. 1985. Contribution à la connaissance des *Lepthyphantes* du groupe *pallidus* (Araneae, Linyphiidae) de Yougoslavie, Grece et Chypre. Mémoires de Biospéologie 12: 37-50.

Deltshev, C. D. 1980. A contribution to the taxonomical study of *pallidus* group of genus *Lepthyphantes* Menge (Araneae, Linyphiidae) in Bulgaria. Acta Zoologica Bulgarica 16: 44-56.

Platnick, N. I. 2007. The world spider catalog, version 7.0. American Museum of Natural History. Available from: http://research.amnh.org/entomology/spiders/catalog/LINYPHIIDAE.html.

Saaristo, M. I. and A. V. Tanasevitch. 2001. Reclassification of the *pallidus-*, *insignis-*, and *spelaeorum*-groups of *Lepthyphantes* Menge, 1866 (sensu lato) (Arachnida: Araneae: Linyphiidae: Micronetinae). Reichenbachia 34 (1): 5-17.

Topçu, A., H. Demir, and O. Seyyar. 2005. A checklist of the spiders of Turkey. Serket 9(4): 109-140.

Topçu, A., H. Demir, and O. Seyyar. 2006. Cave dwelling spiders (Araneae) of Turkey. Serket 10(1): 18-24.

TWO NEW GENERA OF IDIOCERINAE (HEMIPTERA: CICADELLIDAE) FROM SOUTH AMERICA, INCLUDING THE DESCRIPTION OF TEN NEW SPECIES[1]

Paul H. Freytag[2]

ABSTRACT: Two new genera are described that are closely related to the genus *Luteobalmus*. The new genus *Barolineocerus* contains nine new species, including *B. bispinus* (type of genus), *B. chiasmus, B. acius, B. furcatus, B. elongatus, B. declivus, B. apiculus, B. spinosus,* and *B. ornatus*. The new genus *Isolineocerus* contains one new species *I. pusillus*. Both genera are from northern South America.

KEY WORDS: Hemiptera, Cicadellidae, Idiocerinae, leafhoppers, South America, *Barolineocerus, Isolineocerus*

Two new genera of Idiocerinae are described from northern South America. Both genera are closely related to the genus *Luteobalmus* Maldonado-Capriles in both general color pattern and distribution (Maldonado-Capriles 1979, and Freytag 2006), however, both new genera are more robust, have a much brighter color pattern, and different male genitalia.

The acronyms for institutions where specimens are deposited are as follows: MNHN – Muséum National d'Histoire Naturelle, Paris, France; IHVL – Instituto von Humboldt, Villa de Leyva, Colombia; MUSM – Museo Nacional de Historia Natural, Lima, Peru; USNM – National Museum of Natural History, Washington, DC; FSCA – Florida State Collection of Arthropods, Gainesville, Florida; and UKYL – University of Kentucky Collection, Lexington, Kentucky.

Barolineocerus Freytag, NEW GENUS

Description: Length usually from 4 to 6 mm. Head wider than pronotum, ocelli about equal distance from eyes to each other, a setae on each side below eye as in *Optocerus* Freytag. Forewings with four apical cells and two anteapical cells. Hind femoral setal formula 2-0. Male anal tube with basal pair of spines or processes. Color pattern distinct, head mostly yellow to white, face with lateral margins brown. Pronotum with median area yellowish white bordered with white then thick black line on posterior margin, remainder brown. Forewings with color of basal area yellow to yellow green with white borders, a thick black line on posterior border, remainder brown.

Type of Genus: *Barolineocerus bispinus* Freytag n. sp.

Remarks: This genus can usually be recognized by the bold color pattern in combination with the male genitalia, which is different from any of then

---

[1] Received on February 14, 2007. Accepted May 20, 2007.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 40546-0091 U.S.A. E-mail: freytag2104@windstream.net.

Mailed on March 14, 2008

described genera in the subfamily from South America. The males have a pair of ventrally produced processes on the anal tube, long styles, simple aedeagus with ventral spine or subapical spines, and subgenital plates narrow, usually longer than pygofer, and often pointed. This genus is named for the heavy black lines bordering the posterior margin of the light areas on the pronotum and forewings.

Key to the species of *Barolineocerus* (males)

1. Pygofer without a caudal process (Figs. 8 and 11) 2
1'. Pygofer with a caudal process (Figs. 29 and 32) 7

2. Subgenital plate short and rounded at apex (Figs. 9 and 15) 3
2'. Subgenital plate usually pointed (Figs. 12 and 24) 4

3. Aedeagus with a pair of small spines at apex (Fig. 10)............*bispinus* n. sp.
3'. Aedeagus without spines at apex (Fig. 16) ....*declivus* n. sp.

4. Subgenital plate longer than pygofer, sharply pointed at apex (Fig. 12) 5
4'. Subgenital plate shorter than pygofer, not sharply pointed at apex (Fig. 21) 6

5. Anal tube with a stout basal process that is truncate at apex. (Fig. 11); aedeagus with a ventral spine about halfway to apex (Fig. 11) ....*longatus* n. sp.
5'. Anal tube with a sharply pointed process (Fig. 17); aedeagus with a ventral spine near apex (Fig. 17) ....*acius* n. sp.

6. Anal tube with process thick to near apex (Fig. 20); subgenital plate without a subapical spine (Fig. 20) ....*apiculus* n. sp.
6'. Anal tube with process narrowing to a sharp point (Fig. 23); subgenital plate with a subapical spine (Fig. 23) ....*spinosus* n. sp.

7. Pygofer with a short thick bifurcate process (Fig. 26) ....*furcatus* n. sp.
7'. Pygofer with a longer thin ornate or pointed process (Figs. 29 and 32) 8

8. Pygofer with an ornate process (Fig. 29) ....*ornatus* n. sp.
8'. Pygofer with a sharply pointed process (Fig. 32) ....*chiasmus* n. sp.

Barolineoscerus bispinus Freytag, NEW SPECIES

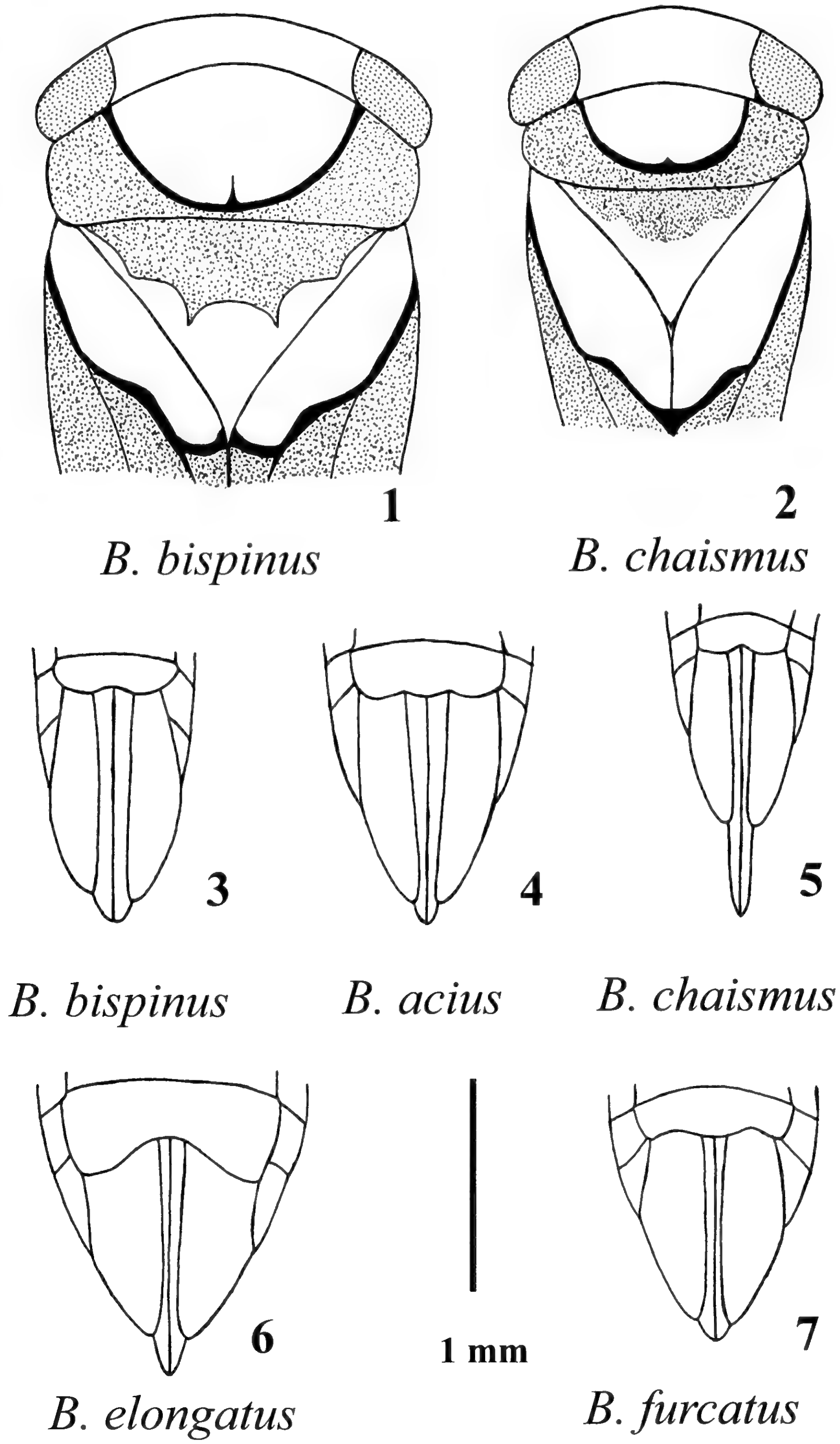
(Figures 1, 3 and 8-10)

Description: Length of males 4.4-4.5 mm., females 4.5-4.6 mm. Dorsal surface of head, pronotum and scutellum (Fig. 1), with color pattern of head yellow white, face same color with lateral margins below eyes brown; pronotum medially yellow white, bordered with black, with lateral margins brown; scutellum anteriorly brown with apical half yellow white. Forewings with base yellow white, posteriorly bordered by black, remainder of wing brown. Male genitalia: Pygofer (Fig. 8) short, rounded at apex. Subgenital plate narrow and long in lateral view (Fig. 8), rounded at apex in ventral view (Fig. 9). Anal tube with pair of long pointed ventral processes. Style (Figs. 8 and 10) long, about half length of subgenital plate, hooked at apex. Connective (Fig. 10) y-shaped with short stem. Aedeagus (Fig. 10) long, bluntly pointed at apex, with pair of very small spine-like processes near apex. Female genitalia (Fig. 3) with seventh sternum convexly rounded, with shallow median emargination, ovipositor extending just beyond apex of pygofer.

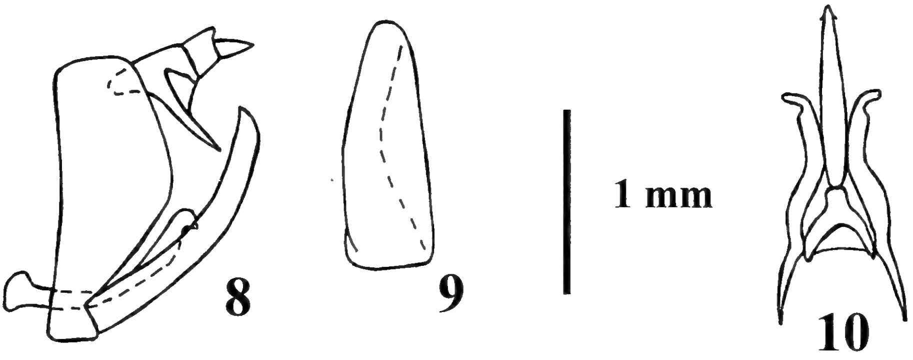
Type Data: Holotype male: French Guiana, 13 km W of Risquetout, 8-VI-2005, J. E. Eger and M. T. Messenger, 04°54'028"N 52°34'494"W, MV light (MNHM). Paratypes: Two males, two females, same data as holotype (one female, MNHN, one male and one female, UKYL, one male, FSCA).

Other specimens examined: Four females, French Guiana, 33 km SE Roura on Kaw Rd., 1-2-VI-2005, J. E. Eger and M. T. Messenger, 04°34'135"N 52°11' 150"W, 227 m., MV light (FSCA); one female, French Guiana, 41 km SE Roura on Kaw Rd., 5-7-VI-2005, J. E. Eger and M. T. Messenger, 04°32'214"N 52°07' 420"W, 272 m., MV light (FSCA).

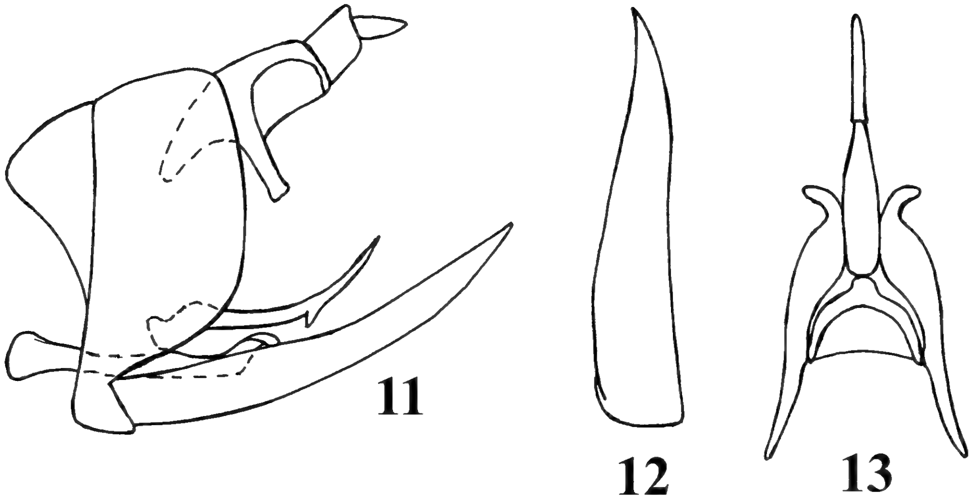
Remarks: This species is named for the pair of ventrally produced spines on the male anal tube. It can be separated from the other species of the genus on the basis of the spines on the male anal tube along with the small subapical spines on the aedeagus.



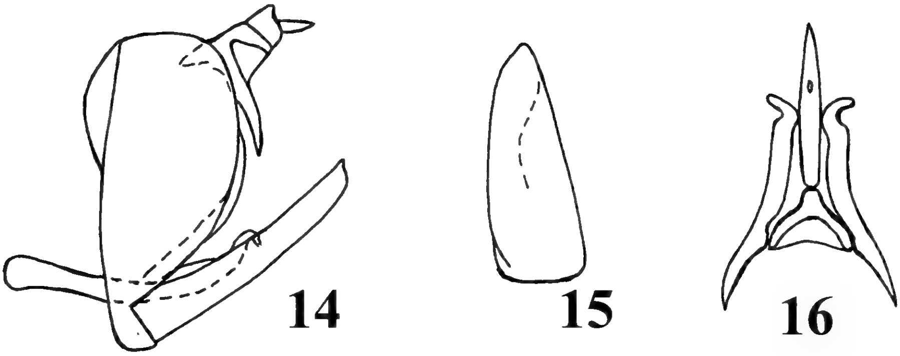
Figures 1-2. Dorsal view of head, pronotum, scutellum and basal part of forewings. Fig. 1. *Barolineocerus bispinus* n. sp. Fig. 2. *B. chiasmus* n. sp. Figures. 3-7. Female apical end of abdomen, ventral view. Fig. 3. *B. bispinus* n. sp. Fig. 4. *B. acius* n. sp. Fig. 5. *B. chiasmus* n. sp. Fig. 6. *B. elongatus* n. sp. Fig. 7. *B. furcatus* n. sp. All drawn to the same scale.



B. bispinus



B. elongatus



B. declivus

Figures 8-16. Male genitalia. Figs. 8-10. *Barolineocerus bispinus* n. sp. Figs. 11-13. *B. elongatus* n. sp. Figs. 14-16. *B. declivus* n. sp. Figs. 8, 11, and 14, genital capsule, lateral view (setae not shown). Figs. 9, 12, 15, subgenital plate, ventral view (setae not shown). Figs. 10, 13, and 16, styles, connective and aedeagus, ventral view. All drawn to the same scale.

Barolineocerus elongatus Freytag, NEW SPECIES

(Figures 6 and 11-13)

Description: Length of male 4.9 mm, female 5.0 mm. Similar to *bispinus* in overall color pattern, but slightly larger in size. Male genitalia: Pygofer (Fig. 11) truncate in lateral view, with a pair of large internal apodemes on anterior dorsal margin. Subgenital plate (Figs. 11 and 12) very long, pointed at apex. Anal tube (Fig. 11) with a pair of ventral processes, truncate at apex. Style (Figs. 11 and 13) long, less than half length of subgenital plate, hooked at apex. Connective (Fig. 13) y-shaped, with short stem. Aedeagus (Figs. 11 and 13) long, pointed at apex, with ventral spine near middle of shaft. Female genitalia (Fig. 6) with posterior margin of seventh sternum widely concave, with pygofer robust, ovipositor extending just beyond pygofer apex.

Type Data: Holotype male: Colombia, Vaupés, R. N. Mosiro Itajura (Caparú) Igapo, 01°04'S 69°31'W, 60 m., 3-18-III-2003, Malaise, L. Benarides, M 3625 (IHVL). Paratypes: one female, same data as holotype, except 1-9-II-2003, J. Pinzón, M 3637(IHVL); one female, same data, except Centro Ambiental, 20-I-1-II-2003, M. Sharkey and D. Arias, M 3386 (UKYL).

Remarks: This species is named for the very long male subgenital plates. It can be recognized from the other species by the truncate processes of the male anal tube, and the prominent ventral spine on the aedeagus.

Barolineocerus declivus Freytag, NEW SPECIES

(Figures 14-16)

Description: Length of males 4.4-4.5 mm., females 4.5-5.0 mm. Overall color pattern same as *bispinus,* and nearly the same size. Male genitalia: Pygofer (Fig. 14) rounded on posterior margin, with a pair of small apodemes on anterior dorsal margin. Subgenital plate (Figs. 14 and 15) stout, with bluntly pointed apex. Anal tube (Fig. 14) with a pair of ventral processes, pointed at apex. Style (Figs. 14 and 16) long, half length of subgenital plate, hooked at apex. Connective (Fig. 16) y-shaped with short stem. Aedeagus (Fig.16) pointed at apex, without processes. Female genitalia similar to elongatus.

Type Data: Holotype male: Brazil, Sao Felix, Do Xincu, 1-4-X-1975, Moycn Xingu (Brésil) Mission, M. Boulard, P. Jauffret et P. Pompanon, Muséum Paris (MNHN). Paratype female, same data as holotype (MNHN).

Other specimens examined: One male, French Guiana, 41 km SE Roura on Kaw Rd., 8-XII-2002, J. E. Eger, 04°32'-214"N 52°07'420"W, 272 m., MV light (UKYL); one female, French Guiana, 12 km W of Risquetout, 10-XII-2002, J. E. Eger, 04°54'673"N 52°11'150"W, 58 m., MV light (UKYL).

Remarks: This species is named for the processes of the male anal tube being bent downward. It can be separated from other species of the genus by the processes of the male anal tube and the rather plain aedeagus.

Barolineocerus acius Freytag, NEW SPECIES

(Figures 4 and 17-19)

Description: Length of male 4.4-4.5 mm., female 5.1 mm. Overall color pattern same as *bispinus,* and nearly same size. Male genitalia: Pygofer (Fig. 17) rounded on posterior margin, with a pair of wide apodemes on anterior dorsal margin. Subgenital plate (Figs. 17 and 18) long, narrowing to pointed apex. Anal tube (Fig. 17) with ventral processes, pointed at apex. Style (Figs. 17 and 19) long, about half length of subgenital plate, hooked at apex. Connective (Fig. 19) y-shaped, with stem short. Aedeagus (Figs. 17 and 19) narrowing to apex which is hook-like. Female genitalia (Fig. 4), with posterior margin of seventh sternum sinuate, pygofer narrowing to apex, ovipositor extending just beyond apex of pygofer.

Type Data: Holotype male: Peru, Madre de Dios, nr Puerto Maldonado, Posadas Amazonas Lodge, at Rio Tambopata, 185 m., 12°48'115"S 69°18' 019"W, 7-10-X-2004, C. R. Bartlett (MUSM). Paratypes: One female, same data as holotype (MUSM); three males, same data, except 30-IX-3-X-2004 (one male, USNM, two males UKYL).

Remarks: This species is named for the barb-shaped apex of the aedeagus. This species can be separated from other species of the genus by the aedeagus and the rather sharply pointed male subgenital plate.

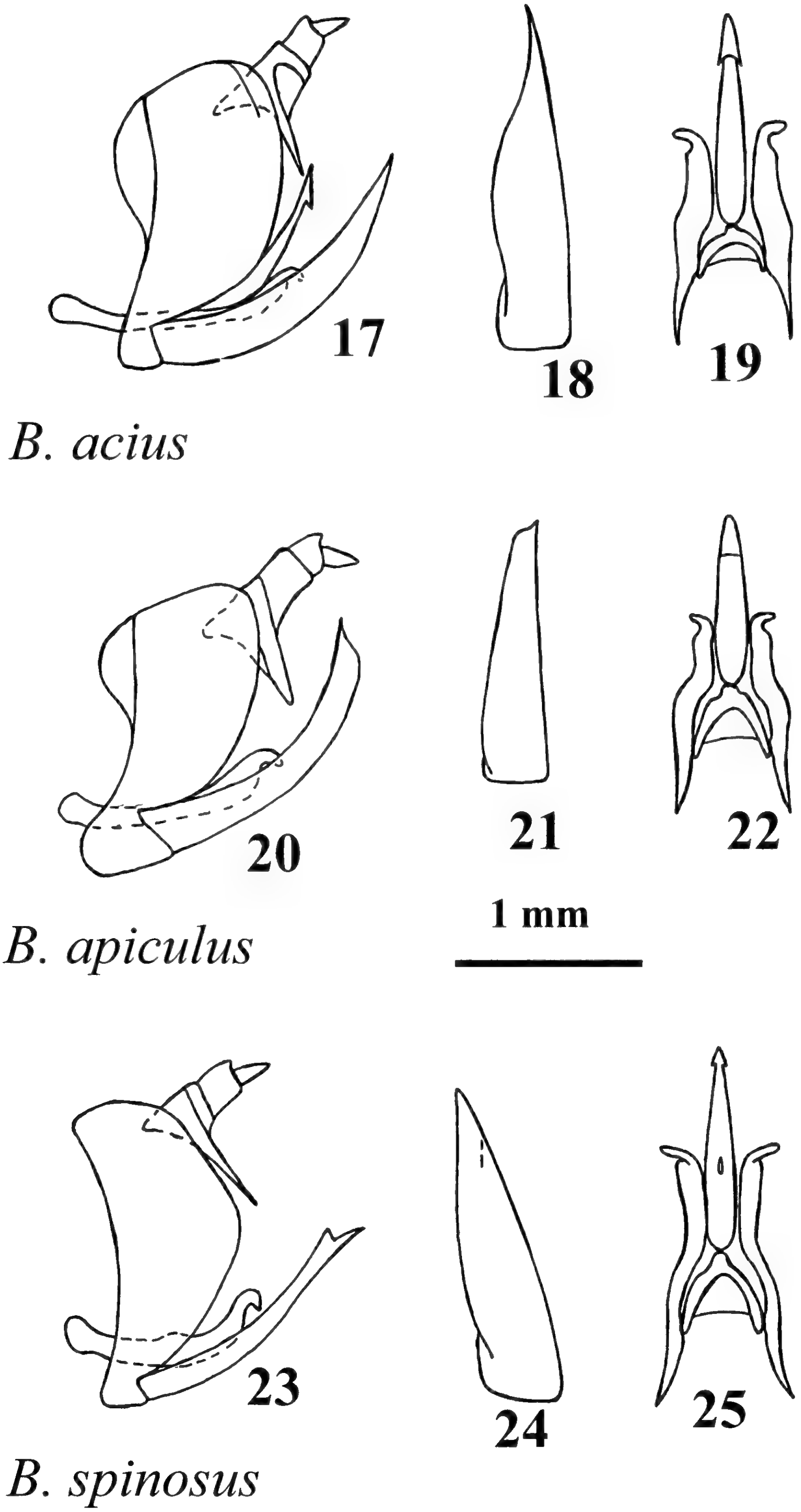
Barolineocerus apiculus Freytag, NEW SPECIES

(Figures 20-22)

Description: Length of male 4.5 mm., females 4.6-4.9 mm. Overall color pattern same as *bispinus.* Male genitalia: Pygofer (Fig. 20) rounded on posterior margin, slightly longer on dorsal margin than ventral margin. Subgenital plate (Figs. 20 and 21) long, narrowing at apex to a pointed apex. Anal tube (Fig. 20) with a pair of ventral processes which are bluntly pointed at apex. Style (Figs. 20 and 22) long, somewhat twisted, hooked at apex. Connective (Fig. 22) y-shaped, with short stem. Aedeagus (Fig. 22) stout, bluntly pointed at apex, without processes, but with a ventral ridge near apex. Female with posterior margin of seventh sternum evenly concave.

Type Data: Holotype male: French Guiana, 41 km SE Roura on Kaw Rd., 5-7-VI-2005, J. E. Eger and M. T. Messenger, 04°32'214"N 52°07'420"W, 272 m., MV light (MNHN). Paratypes: One female, French Guiana, 33 km SE Roura on Kaw Rd., 1-XII-2002, J. E. Eger, 04°34'135"N 52°11'150"W, 227 m., MV light (MNHN); one female, French Guiana, 41 km SE Roura on Kaw Rd., 8-XII-2002, J. E. Eger, 04°32'214"N 52°07'420"W, 272 m., MV light (UKYL).

Remarks: This species is named for the rather unusual apex of the male subgenital plate. It can be separated from the other species of the genus by the unusual male subgenital plate, the bold processes of the anal tube and the thickened aedeagus.



Figures 17-25. Male genitalia. Figs. 17-19. *Barolineocerus acius* n. sp. Figs. 20-22. *B. apiculus* n. sp. Figs. 23-25. *B. spinosus* n. sp. Figs. 17, 20, and 23, genital capsule, lateral view (setae not shown). Figs. 18, 21, and 24, subgenital plate, ventral view (setae not shown). Figs. 19, 22, and 25, styles, connective and aedeagus, ventral view. All drawn to the same scale.

Barolineocerus spinosus Freytag, NEW SPECIES
(Figures 23-25)

Description: Length of male 4.5 mm., female unknown. Overall color pattern same as *bispinus.* Male genitalia: Pygofer (Fig. 23) with posterior margin rounded, widest in middle. Subgenital plate (Figs. 23 and 24) narrowing to pointed apex, with slight dorsal notch near apex. Anal tube (Fig. 23) with pair of ventral, long, sharply pointed processes. Style (Figs. 23 and 25) long, hooked at apex. Connective (Fig. 25) y-shaped, with short stem. Aedeagus (Fig. 25) narrowing to pointed apex, with pair of short spines near apex.

Type Data: Holotype male: Colombia, Amazonas, Amacayacu Nat. Pk., Matamata Station, Tierra Firma, 8-12-III-2000, Malaise trap, M. Sharkey (IHVL)

Remarks: This species is named for the unusual inner spine on the male subgenital plate. It can be separated from the other species of the genus by the subgenital plate.

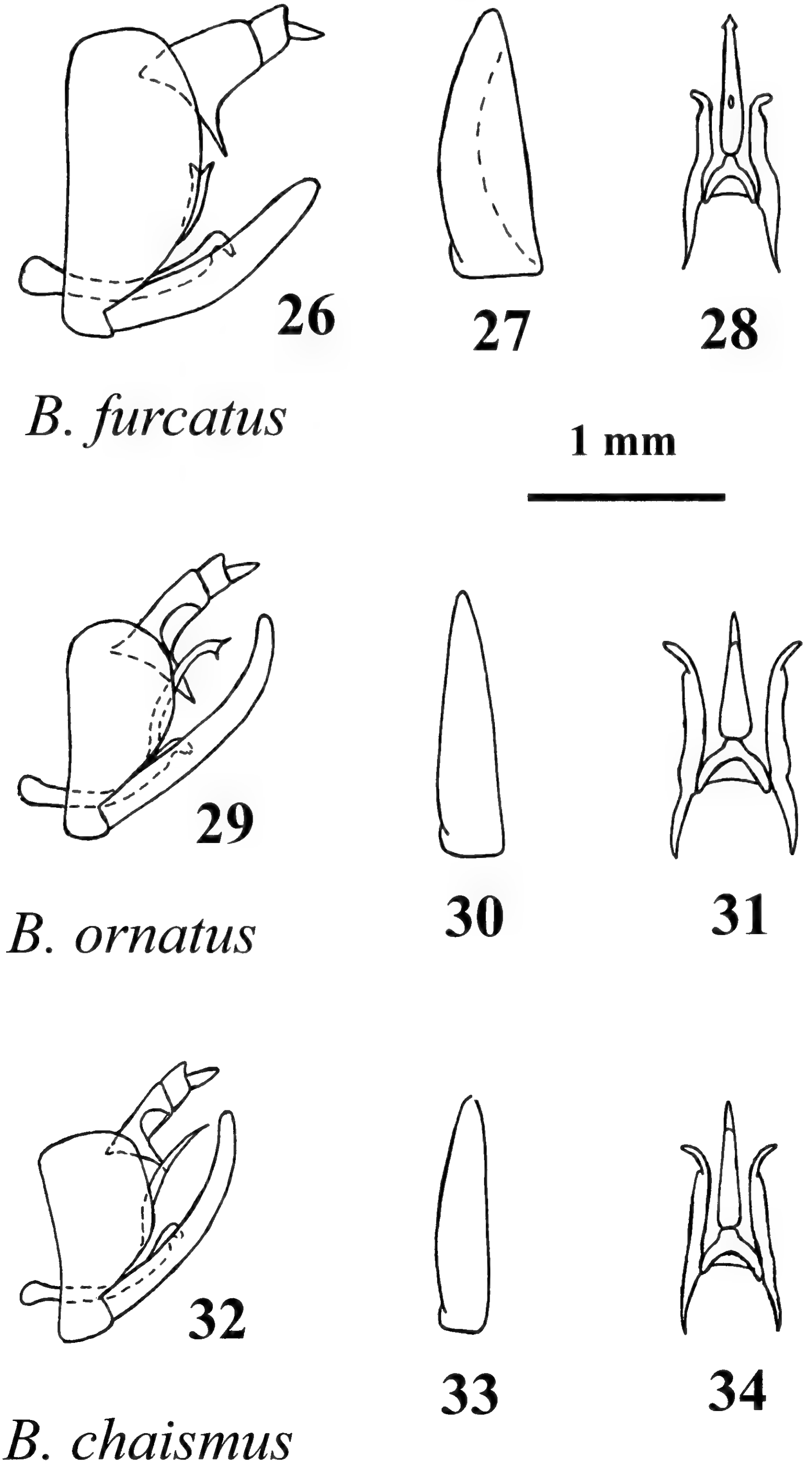
Barolineocerus furcatus Freytag, NEW SPECIES
(Figures 7 and 26-28)

Description: Length of males 5.0-5.1 mm, females 5.0-5.1 mm. Overall color pattern similar to *bispinus,* but size large. Male genitalia: Pygofer (Fig. 26) with posterior margin evenly rounded, with process on ventral part which is bifurcate at apex. Subgenital plate (Figs. 26 and 27) short, stout, with bluntly pointed apex. Anal tube (Fig. 26) with pair of short ventral processes, which are sharply pointed. Style (Figs. 26 and 28) long, with hooked apex. Connective (Fig. 28) y-shaped, with short stem. Aedeagus (Fig. 28) short, narrowing to pointed apex, with very small pair of spines near apex. Female genitalia (Fig. 7) robust, with posterior margin of seventh sternum sinuate; ovipositor extending just beyond apex of pygofer.

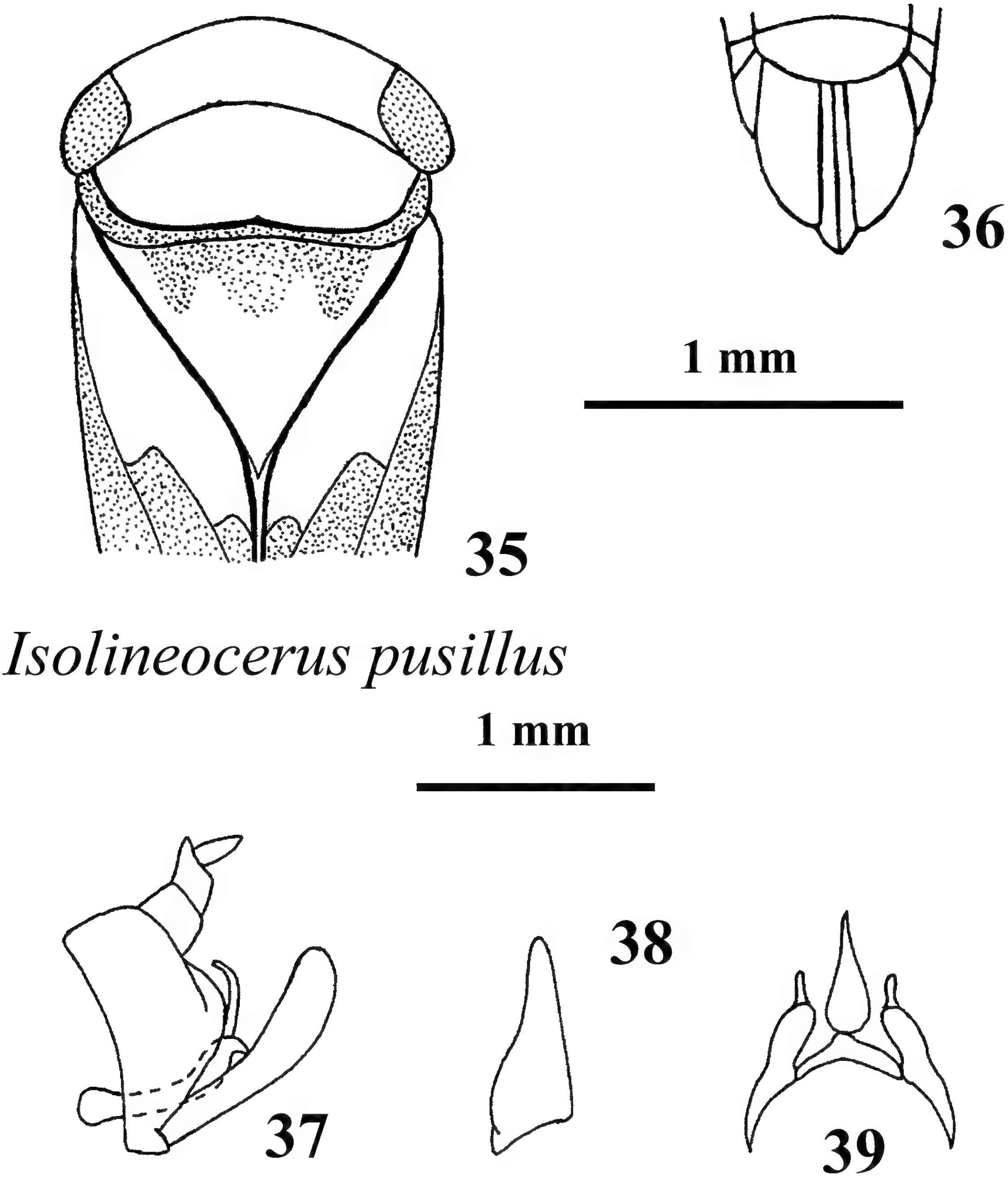
Type Data: Holotype male: Colombia, Vaupés, RN Mosiro-Itajura (Caparú) Igapo, 01°04'S 69°31'W, 60 m., 4-11-III-2003, Malaise, J. Pinzón, M 3623 (IHVL). Paratypes: One female, same data as holotype (IHVL); two males, same data as holotype, except 9-25-II-2003, M 3628 (one male, IHVL, one male, UKYL); one female, same data, except 1-9-II-2003, M 3637 (UKYL); one female, same data, except 3-18-III-2003, L. Benavides, M 3625 (IHVL).

Other specimens examined: Three males, four females, Brazil, Rondonia, 62 km SW Ariquemes, nr Fzda Rancho Grande, 4-16-XI-1997, J. Eger, MV and UV lights (one male, one female UKYL, two males, three females, FSCA).

Remarks: This species is named for the unusual inner process on the male pygofer which is bifurcate at the apex. It can be separated from other species of the genus on the process of the male pygofer.



Figures 26-34. Male genitalia. Figs. 26-28. *Barolineocerus furcatus* n. sp. Figs. 29-31. *B. ornatus* n. sp. Figs 32-34. *B. chiasmus* n. sp. Figs. 26, 29, and 32, genital capsule, lateral view (setae not shown). Figs. 27, 30, and 33, subgenital plate, ventral view (setae not shown). Figs. 28, 31, and 34, styles, connective and aedeagus, ventral view. All drawn to the same scale.



Figures 35-39. *Isolineocerus pusillus* n. sp. Fig. 35. Head, pronotum, scutellum and base of forewings, dorsal view. Fig. 36. Female apex of abdomen, ventral view. Fig. 37. Male genital capsule, lateral view (setae not shown). Fig. 38. Male subgenital plate, ventral view. Fig. 39. Male styles, connective and aedeagus, ventral view. Figures 35-36 drawn to the same scale, and figures 37-39 drawn to the same scale.

Barolineocerus ornatus Freytag, NEW SPECIES
(Figures 29-31)

Description: Length of males 4.0-4.1 mm., females 4.2-4.3 mm. Overall color pattern like *bispinus,* but size slightly smaller. Male genitalia: Pygofer (Fig. 29) with posterior margin rounded, with long, narrow process on inner margin which is bifurcate at apex. Subgenital plate (Figs. 29 and 30) long, narrow, with bluntly rounded apex. Anal tube with a pair of ventrally produced processes, pointed at apex. Style Figs. 29 and 31) long, with hooked apex. Connective (Fig. 31) y-shaped, with short stem. Aedeagus (Fig. 31) short, narrowing to pointed apex, without processes, but with small ventral ridge near apex. Female with posterior margin of seventh sternum evenly, shallowly concave.

Type Data: Holotype male: French Guiana, Saul, 28-X-1969, Piège Lumineux, Guyane-Mission, Balachowsky-Gruner, Oct.-Nov. 1969 (MNHN). Paratypes: One male, French Guiana, Massikiri-Oyapock, Guyane, 15-XI-1969, Piège Lumineux, Guyane-Mission, Balachowsky-Gruner, Oct.-Nov. 1969 (UKYL): one female, French Guiana, Antécumepata (Saut Kialo), 22-XI-1975, Itani (Guyanes) Mission, M. Boulard, P. Jauffret et P. Pompanon, Musém Paris (MNHN); one female, French Guiana, Embouchure de la Crique Oyaricoulet, 23-XI-1975, Itani (Guyanes) Mission, M. Boulard, P. Jauffret et P. Pompanon, Muséum Paris (UKYL).

Remarks: This species is named for the unusual long process on the male pygofer, which is bifurcate at the apex. It can be separated from the other species of the genus by the process on the male pygofer.

Barolineocerus chiasmus Freytag NEW SPECIES
(Figures 2, 5, and 32-34)

Description: Length of males 4.0-4.1 mm., females 4.2-4.3 mm. overall color pattern (Fig. 2) similar to *bispinus.* Male genitalia: Pygofer (Fig. 32) nearly truncate, with an inner process which is long, narrow, sharply pointed. Subgenital plate (Figs. 32 and 33) long, narrow, with rounded apex. Anal tube (Fig. 32) with a short ventral pair of processes, which are sharply pointed. Style (Figs. 32 and 34) long, with hooked apex. Connective (Fig. 34) y-shaped, with short stem. Aedeagus (Fig. 34) similar to *ornatus,* but narrower at base. Female genitalia (Fig. 5) with posterior margin of seventh sternum convexly rounded, median with an emargination. Pygofer long, narrow, with ovipositor extending beyond apex by three times its width.

Type Data: Holotype male: French Guiana, 33 km SE Roura on Kaw Rd., 1-XII-2002, J. E. Eger, 04°34'135"N 52°11'150"W, 227 m., MV light (MNHN). Paratype female: French Guiana, 14 km E on N2 on Rd. to Dégrad Corrèze, 6-XII-2002, J. E. Eger, 04°29'964"N 52°20'260"W, 108 m., MV light (MNHN).

Other specimens examined: One male, three females, French Guiana, 1 km S Amazon Nature Lodge, 30 km SE Roura on Kaw Rd., 3-4-VI-2005, J. E. Eger and M. T. Messenger, 04°32'961"N 52°12'830"W, 288 m., MV light (one male and one female, UKYL, two females, FSCA): one female, French Guiana, 33 km SE Roura on Kaw Rd., 1-2-VI-2005, J. E. Eger and M. T. Messenger, 04°34' 135"N 52°11'150"W, 227 m., MV light (FSCA).

Remarks: This species is named for the thin, sword-like process on the male pygofer, by which it can be separated from the other species of the genus.

Isolineocerus Freytag, NEW GENUS

Description. Length 4.0 to 4.5 mm. Head wider than pronotum, without seta in lateral area below eye. Forewing with four apical and two subapical cells, appendix large. Femoral setal formula 2-0. Color similar to that of *Barolineocerus,* except the black lines are thinner and less noticeable, head entirely yellowish white, pronotum with very large yellowish white area covering most of area, and basal yellowish white area of forewings larger. Male subgenital plates paddle shaped, anal tube without processes, and aedeagus without processes.

Type species of the genus: *Isolineocerus pusillus* Freytag n. sp.

Isolineocerus pusillus Freytag NEW SPECIES

(Figures 35-39)

Description: Length of male 4.1 mm., females 4.0-4.4 mm. Color pattern (Fig. 35), with head entirely yellowish white fading to white on face. Pronotum mostly yellowish white, bordered on posterior margin by thin black line, then lateral and posterior margin brown. Scutellum mostly yellowish white, with triangles and anterior median brown. Forewings basally yellowish white, remainder brown. Male genitalia: Pygofer (Fig. 37) small, truncate, with posterior margin folded near middle. Subgenital plate (Figs. 37 and 38) paddle-shaped in lateral view, triangular in ventral view. Anal tube without processes. Style (Figs. 37 and 39) stout, with apex reduced, hooked. Connective (Fig. 39) Y-shaped, but reduced to a bar with short stem. Aedeagus (Fig. 37 and 39) expanded at base, narrowing to nearly pointed apex which is bent dorsad. Female genitalia (Fig. 36) with posterior margin of seventh sternum evenly convex; pygofer short, robust, with ovipositor extending just beyond apex of pygofer.

Type Data: Holotype male: Colombia, Amazonas, PNN Amacayacu, Matamata, 03°41'S 70°15'W, 150 m., Malaise, 8-12-III-2000, M. Sharkey and B. Brown, M 3270 (IHVL). Paratypes: One female, same data as holotype, except 03°23'S 70°06'W, 7-28-V-2001, D. Chota, M 1858 (IHVL); one female, same data, except 28-V-11-VI-2001, M 1859 (UKYL).

Additional specimens examined: Two males, two females, Ecuador: Orellana Reserva Ethica Waorani, 1 km S Onkonegare Camp, 00°39'105"S 76°26' 00"W, T. L. Erwin, et al., 25-VI-1994, fogging terre fima forest (one male, one female USNM; one male, one female UKYL).

Remarks: This species is named for its small size. It can be separated from other species described in this paper by its small size, color pattern and male genitalia.

ACKNOWLEDGEMENTS

Thanks are extended to Michael J. Sharkey, Department of Entomology, University of Kentucky, who made it possible to study the Colombian specimens through his National Science Foundation Grant No. DEB 0205982. Also thanks to Michel Boulard, Museum National d'Histoire Naturelle, Paris, for the loan of their specimens, and Joe Eger, Dow Chemical, Tampa, Florida, and Charles Bartlett, University of Delaware for the loan of the specimens they collected.

LITERATURE CITED

Freytag, P. H. 2006. Two new species of *Luteobalmus* leafhoppers (Hemiptera: Cicadellidae: Idiocerinae) from South America. Entomological News 117(4):391-394.

Maldonado-Capriles, J. 1979. Studies on Idiocerinae leafhoppers, XVIII: Four new genera and species from Guyana, South America (Homoptera: Cicadellidae). Proceedings of the Entomological Society of Washington 79(3):358-366.

UHLER TYPES OF APHROPHORIDAE NEWLY FOUND IN THE NATURAL HISTORY MUSEUM, LONDON (HEMIPTERA: CERCOPOIDEA)[1]

Ai-Ping Liang,[2] Guo-Mei Jiang,[2] and Zhi-Shun Song,[2]

ABSTRACT: Paralectotypes of three *Aphrophora* species, *A. flavipes* Uhler, 1896, *A. intermedia* Uhler, 1896, and *A. major* Uhler, 1896 (Hemiptera: Cercopoidea: Aphrophoridae), described by P. R. Uhler (1896) from Japan, recently found in the Natural History Museum in London are documented. The dorsal habitus images, taxonomic notes, host plant and distribution information of the three *Aphrophora* species are provided.

KEY WORDS: *Aphrophora*, Aphrophoridae, types, Uhler, BMNH, Hemiptera, Cercopoidea

Uhler (1896) described eight new species (seven species in three genera from Aphrophoridae and one species from Cercopidae) of Cercopoidea (Hemiptera: Auchenorrhyncha) from Japan. The great majority of Uhler's type specimens were kept in the U.S. National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C., USA. Liang (2000) studied the syntypes of Uhler's (1896) Japanese cercopoid species in the USNM and made necessary lectotype designations. However, Liang (2000) only found part of the original syntypes used by Uhler (1896) and many syntypes of each type series were missing from the USNM. In the same paper, Liang (2000) also reported the depository of the syntypes of four Uhler species, *Lepyronia grossa* Uhler, 1896, *Philagra albinotata* Uhler, 1896, *Aphrophora indentata* Uhler, 1896 and *Aphrophora obliqua* Uhler, 1896, found in the Natural History Museum, London.

During a recent visit to the Natural History Museum [formerly the British Museum (Natural History) BMNH], London, U.K., the senior author found three additional paralectotypes of three *Aphrophora* species described by Uhler (1896). The BMNH collection contains authentic Uhler specimens as evidenced by Uhler's handwritten determination and type labels. Their authenticity as paralectotypes was also verified by comparing the label data on the specimens with the original descriptions. The deposition of the Uhler material in London might be the result of the acquisition of part of the G. W. Kirkaldy collection by the BMNH since one label in these paralectotypes was printed with "Kirkaldy Coll." While he was a research entomologist at the Hawaii Sugar Planters' Association, Kirkaldy possibly obtained some of Uhler's cercopoid types, and those types were later obtained by the BMNH from Kirkaldy.

The purpose of this paper is to fully report and document this existing Uhler paralectotype material newly found in the BMNH. The dorsal habitus of the

---

[1] Received on April 13, 2007. Accepted on May 16, 2007.

[2] P. O. Box 71, Department of Entomology, Institute of Zoology, Chinese Academy of Sciences, No. 5 Datun Road, Chaoyang District, Beijing 100101 P.R. China. Also, Key Lab of Insect Evolution & Environmental Changes, Capital Normal University, Beijing 100037 P.R. China. E-mails: (A-PL) liangap@ioz.ac.cn, (G-MJ) jianggm@ioz.ac.cn, and (Z-SS) songzs@ioz.ac.cn.

Mailed on March 14, 2008

paralectotypes of these three Uhler's *Aphrophora* species are also provided for their identification.

To document the historical status of the paralectotypes, label data associated with each specimen were recorded exactly by the following format: (1), (2), (3), etc., indicating the sequence of labels on the pin from top to bottom. Lastly, the senior author's hand printed yellow paralectotype label is attached to each specimen so recognized.

SYSTEMATIC ENTOMOLOGY

FAMILY APHROPHORIDAE

Aphrophora flavipes Uhler

Fig. 1

Aphrophora flavipes Uhler, 1896: 289; Liang, 1998: 246; 2000: 268. Lectotype male, designated by Liang, 2000: 268, Japan (USNM) [examined].

Tilophora flavipes (Uhler); Matsumura, 1942: 88; Metcalf, 1962: 532; Ishihara, 1965: 114, pl. 57, fig. 16; Lee et al., 1976: 52; Lee & Kwon, 1977a: 16, fig. 7-A, B; 1977b: 58.

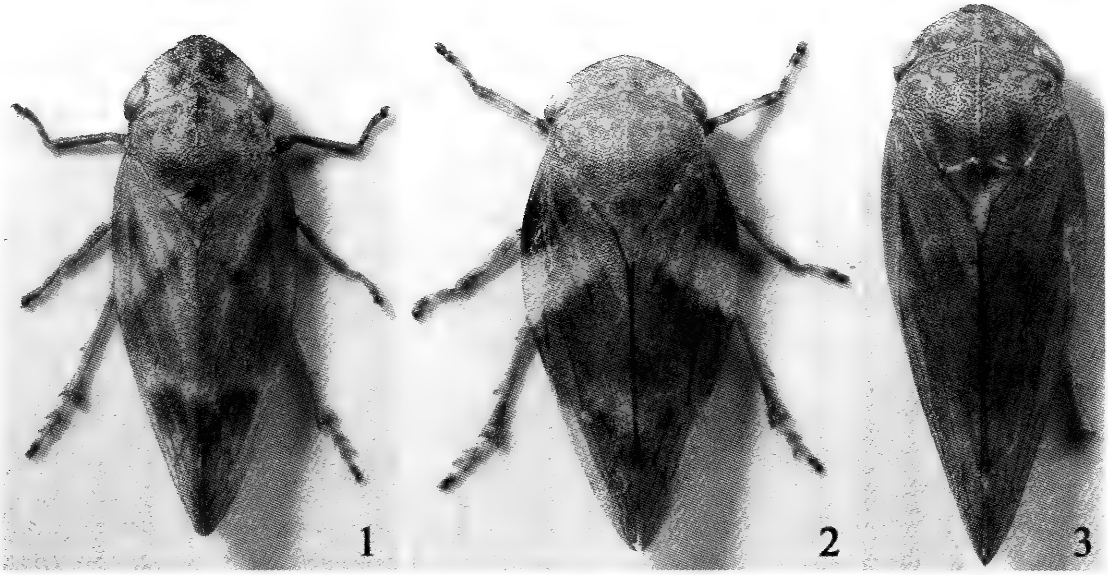
Taxonomic Notes. This species was described from twelve specimens (sex not stated) from Japan (Uhler, 1896). Liang (2000) reported two male and two female syntypes at the USNM and the male lectotype of this species was designated by Liang (2000), the remaining male and two females in USNM thereby gaining paralectotype status. Liang (2000) also established a new synonym of this species, i.e. *Aphrophora flavipes* Uhler, 1896 = *Aphrophora impressa* Metcalf & Horton, 1934. One additional male paralectotype of this species was recently found in the Natural History Museum, London (Fig. 1).

Matsumura (1942) established the new genus *Tilophora* for *Aphrophora flavipes* Uhler. *Tilophora* was synonymised with *Aphrophora* by Nast (1972).

Specimen Examined. Paralectotype 1 male (1) [red square label] Type / No. 3137 / U.S.N.M. [underside] 25,17,19 Gifu [In Japanese]; (2) Japan, Gifu, 13.vii.1892 / Dr. K. Mitzukuri; (3) [underside] Kirkaldy Coll. / Brit. Mus. / 1912-513; (4) [Uhler's handwriting] *Aphrophora* / *flavipes* / Uhl. (BMNH).

Host Plant. *Pinus* spp. (Pinaceae).

Distribution. Japan, China, Korea, Russia (Maritime Territory).



Figures 1-3. Paralectotypes of Uhler aphrophorid species newly found in the Natural History Museum, London, dorsal habitus. 1. *Aphrophora flavipes,* male; 2. *Aphrophora intermedia*, male; 3. *Aphrophora major*, male.

***Aphrophora intermedia* Uhler**

Fig. 2

Aphrophora intermedia Uhler, 1896: 288; Komatsu, 1997: 87, figs. 1C-D, 2C-E, 4. Lectotype male, Japan (USNM), designated by Liang, 2000: 269 [examined].

Obiphora intermedia (Uhler); Matsumura, 1942: 63; Metcalf, 1962: 536; Ishihara, 1965: 114, pl. 57, fig. 13; Kim & Kim, 1971: 150; Kim et al., 1975: 210; Lee et al., 1976: 52; Lee & Kwon, 1977a: 15, fig. 6-A, B; 1977b: 58; Liang, 1998: 246.

Taxonomic Notes. This species was described on the basis of ten syntypes (sexes not stated) (Uhler, 1896). Liang (2000) reported two male and two female syntypes at the USNM and the male lectotype was designated by Liang (2000), the remaining one male and two female specimens in USNM thereby gaining paralectotype status. One additional male paralectotype of this species was recently found in the Natural History Museum, London (Fig. 2).

Matsumura (1942) erected the new genus *Obiphora* for *Aphrophora intermedia* (type species) and five other species. *Obiphora* was synonymised with *Aphrophora* by Nast (1972), who also reinstated the original combination *Aphrophora intermedia.*

Specimen Examined. Paralectotype 1 male (1) [red square label] Type / No. 3136 / U.S.N.M. [underside] 25,7,29 / Mt. Ibuki [In Japanese]; (2) Japan: / Mt. Ibuki / 29.vii.1892 / Dr. K. Mitzukuri; (3) [underside] Kirkaldy Coll. / Brit. Mus. / 1912-513; (4) [Uhler's handwriting] *Aphrophora* / *intermedia* / Uhl. (BMNH).

Host plants. *Solidago altissima* L. (Compositae) (Ushijima, 1977), *Artemisia* spp. (Compositae), *Helianthus tuberosus* L. (Compositae), *Rudbeckia laciniata* L. (Compositae), *Arctium lappa* L. (Compositae), *Rosa rugosa* Thunberg (Rosaceae), *Salix* spp. (Salicaceae), *Populus* spp. (Salicaceae), and *Vitis* spp. (Vitaceae) (Komatsu, 1997). Some adults of this species were also collected from the following plants but whether they are their host plants is not certain: *Wisteria floribunda* (Willd.) (Thunb.) Steud. (Betulaceae), *Betula maximowicziana* Regal (Betulaceae), *Cercidiphyllum japonicum* Sieb. Et Zucc. (Cercidiphyllaceae), *Tilia maximowicziana* Shirasawa (Tiliaceae), *Acer mono* Maxim. (Aceraceae) (Komatsu, 1997).

Distribution. Japan, China, Korea, Russia (Maritime Territory, Kurile Is., Sakhalin).

Aphrophora major Uhler

Fig. 3

Aphrophora major Uhler, 1896: 287; Komatsu, 1997: 505, Figs. 1C-D, 2C-E, 4; Liang, 1998: 247. Lectotype male, Japan (USNM), designated by Ushijima, 1981: 217 [examined].

Yezophora major (Uhler); Matsumura, 1942: 97; Ishihara, 1965: 113, pl. 57, fig. 8.

Europhora major (Uhler); China, 1951: 279; Metcalf, 1962: 541.

Taxonomic Notes. This species was described on the basis of twenty syntypes (sexes not stated) (Uhler, 1896). The lectotype male was designated by Ushijima (1981) and the remaining two male and one female specimens in USNM thereby gaining paralectotype status. Liang (2000) documented two male and five female paralectotypes at the USNM. One additional male paralectotype of this species was recently found in the Natural History Museum, London (Fig. 3).

Originally described as *Aphrophora major,* the species was subsequently transferred to the genus *Yezophora* Matsumura by Matsumura (1942) and *Europhora* Matsumura by China (1951). *Yezophora* was synonymised with *Aphrophora* by Kwon and Lee (1979) and *Europhora* was synonymised with *Aphrophora* by Nast (1972) who reinstated the original combination *Aphrophora major.*

Specimen Examined. Paralectotype 1 male – (1) [red square label] Type / No. 3134 / U.S.N.M.; [underside] 25,7,29 / Mt. Ibuki [In Japanese] ♂; (2) Japan / Mt. Ibuki / 29.VIII.1892 / Dr. K. Mitzukuri; (3) [underside] Kirkaldy Coll. / Brit. Mus. / 1912-513; (4) [Uhler's handwriting] *Aphrophora / major* / Uhl. (BMNH).

Host Plants. *Salix* spp. (Salicaceae), *Artemisia* spp. (Composiae) (Komatsu, 1997). According to Nickel (2003), most adults are found on birch and willow, and nymphs feed mainly on various dicotyledonous herbs. Some adults of this species were also collected from the following plants but whether they are their host plants is not certain: *Wisteria floribunda* DC. (Leguminosae), *Ulmus davidiana* Planch. (Ulmaceae), *Alnus japonica* Steud. (Betulaceae), *Betula maximowicziana* Regal, *B. platyphylla* Sukatchev (Betulaceae), *Elaeagnus* sp. (Elaeagnaceae), *Angelica* sp. (Umbelliferae), *Pinus strobes* L. (Pinaceae), *Picea jezoensis* Carr. (Pinaceae) and *Abies* sp. (Pinaceae) (Komatsu, 1997).

Distribution. Japan, northern China, Korea, Russia (Maritime Territory).

ACKNOWLEDGMENTS

We are grateful to Mr. Mick Webb, Department of Entomology, The Natural History Museum, London, UK, for his support during APL's visit to the BMNH from September to December in 2005. The work on which this paper is based was supported by the following sources: a key project from the National Natural Science Foundation of China (grant numbers 30530110 and 30770269), the Hundred Talent Program from the Chinese Academy of Sciences (grant number A2903077), and the National Science Fund for Fostering Talents in Basic Research (NSFC-J0030092).

LITERATURE CITED

China, W. E. 1951. A note on Matsumura's recent paper on the Palaearctic Cercopoidea (Homoptera). Entomological Monthly Magazine 87: 279.

Ishihara, T. 1965. Homoptera: Auchenorrhyncha, pp. 109-136; pls. 55-68 *In,* Iconographia Insectorum Japonicorum Colore Naturali Edita. Hokuryukan, Tokyo. Volume 3. [In Japanese]

Kim, C. W. and J. I. Kim. 1971. Insect fauna of Mt. Sohgumgang and Mt. Odae. Rep. Prelim. Surv. Mt. Sohgumgang, Chunghak-dong. The Report of Korean Association for Conservation of Nature 4: 139-173.

Kim, C. W., J. I. Kim, J. K. Oh, Y. T. Noh, and Y. H. Shin. 1975. Faunistic study of insects near the DM Z. The Report of Korean Association for Conservation of Nature 7: 182-257.

Komatsu, T. 1997. A revision of the froghopper genus *Aphrophora* Germar (Homoptera, Cercopoidea, Aphrophoridae) from Japan, Parts 1-3. Japanese Journal of Entomology 65: 81-96, 369-383, 502-514.

Kwon, Y. J. and C. E. Lee. 1979. Morphological and phylogenetic studies on the male genitalia of the Korean Cercopoidea (Homoptera: Auchenorrhyncha). Nature & Life (Kyungpook Journal of Biological Sciences) 9(1): 1-31. [In English with Korean summary.]

Lee, C. E. and Y. J. Kwon. 1977a. Revision of the Cercopoidea of Korea with the special reference to the faunistic notes (Homoptera, Auchenorrhyncha). Korean Journal of Entomology 7(2): 11-27.

Lee, C. E. and Y. J. Kwon. 1977b. Studies on the spittlebugs, leafhoppers and planthoppers (Auchenorrhyncha, Homoptera, Hemiptera). Nature & Life (Kyungpook Journal of Biological Sciences) 7: 55-111.

Lee, C. E., S. M. Lee, and Y. J. Kwon. 1976. An insect list of the Auchenorrhyncha preserved in the National Science Museum of Korea. Nature & Life (Kyungpook Journal of Biological Sciences) 6: 51-64.

Liang, A.-P. 1998. Oriental and eastern Palaearctic aphrophorid fauna (Homoptera: Aphrophoridae): taxonomic changes and nomenclatural notes. Oriental Insects 32: 239-257.

Liang, A.-P. 2000. Lectotype designations and taxonomic notes on P. R. Uhler's Japanese Cercopoidea (Homoptera) in the U.S. National Museum of Natural History. Journal of the New York Entomological Society 108(3-4): 268-272.

Matsumura, S. 1942. New species and new genera of Palaearctic Superfamily Cercopoidea with a tabular key to the classification. Insecta Matsumurana 16: 44-70, 71-106.

Metcalf, Z. P. 1962. General Catalogue of the Homoptera. Fascicle VII, Cercopoidea. Part 3. Aphrophoridae. Waverly Press. Baltimore, Maryland, United States of America. 600 pp.

Nickel, H. 2003. The Leafhoppers and Planthoppers of Germany (Hemiptera, Auchenorrhyncha): Patterns and Strategies in a Highly Diverse Group of Phytophagous Insects. Pensoft Publishers, Sofia, Bulgaria. 460 pp.

Uhler, P. R. 1896. Summary of the Hemiptera of Japan presented to the United States National Museum by Professor Mitzukuri. Proceedings of the United States National Museum 19: 255-297.

Ushijima, K. 1977. An interesting food plant, *Solidago altissima* L., of 3 species of Cercopidae. Rostria 28: 229-230.

Ushijima, K. 1981. Notes on the Aphrophoridae from Japan. I. Lectotype designation for *Aphrophora major* Uhler (Hemiptera: Homoptera). Transactions of Shikoku Entomological Society 15: 215-219.

RECENTLY PUBLISHED BOOKS[1]

Amazing Rare Things. 2007 by David Attenborough, Susan Owens, Martin Clayton, and Rea Alexandratos. Royal Collections Publications. Royal Collections Enterprises Ltd. St. James's Palace, London, England, United Kingdom. 223 pp.

Beautiful Evidence. 2006 by Edward Tufte. Graphics Press LLC. Cheshire, Connecticut, U.S.A. 213 pp.

Creationism's Trojan Horse. The wedge of Intelligent Design 2004 by Barbara Forrest and Paul R. Gross, with a Foreword by Barry Lynn. Oxford University Press. Oxford, England, United Kingdom. 432 pp.

Doubting Darwin? Creationist designs on evolution. 2007 by Sahotra Sarkar. Blackwell Publishing. Malden, Massachusetts, U.S.A. 214 pp.

Island Colonization. The origin and development of island communities 2007 by Ian Thornton (Tim New, Editor). Ecological Reviews. Cambridge University Press. Cambridge, England, United Kingdom. 287 pp.

The Earth Machine. The science of a dynamic planet 2004 by Edmond A. Mathez and James D. Webster. Columbia University Press. New York, New York, U.S.A. 335 pp.

The Humboldt Current. Nineteenth-century exploration and the roots of American environmentalism. 2006 by Aaron Sachs. Viking. Published by the Penguin Group (USA) Inc. New York, New York, U.S.A. 496 pp.

The Virginia Naturalist. 2006 by John Trott, Jr. Illustrated by Nicky Staunton. Virginia Native Plant Society and Middleburg Garden Club. Middleburg, Virginia, U.S.A. 447 pp.

---

[1] Jorge A. Santiago-Blay, Department of Paleobiology, MRC-121, National Museum of Natural History, Smithsonian Institution, Washington, District of Columbia 20013-7012 U.S.A. E-mail: blayj@si.edu.

Mailed on March 14, 2008

FOUR NEW SPECIES OF THE GENUS *NEMOURA* (PLECOPTERA: NEMOURIDAE) FROM CHINA[1]

Yu-Zhou Du,[2*] Pei Zhou,[2,3] and Zhi-Jie Wang[2]

ABSTRACT: Four new species of the genus *Nemoura* from China are described: *N. cocaviuscula* Du and Zhou, sp. nov., *N. lui* Du and Zhou, sp. nov., *N. magnispina* Du and Zhou, sp. nov., and *N. rotundprojecta* Du and Zhou, sp. nov.

KEY WORDS: Plecoptera, Nemouridae, *Nemoura,* new species, China

The genus *Nemoura* is distributed in the Holarctic and Oriental regions. The species of *Nemoura* from China were studied mainly by Wu (1938, 1962, 1973), Zhu and Yang (2003), Li and Yang (2006, 2007) and Wang et al. (2006) with the following 27 known species; *Nemoura securigera* Klapalek, 1907, *N. brevilobata* (Klapálek), 1912, *N. papilla* Okamoto, 1922, *N. nankinensis* Wu, 1926, *N. needhamia* Wu, 1927, *N. geei* Wu, 1929, *N. hangchowensis* Wu, 1929, *N. matangshanensis* Wu, 1935, *N. janeti* Wu, 1938, *N. arlingtoni* Wu, 1939, *N. spinosa* Wu, 1939, *N. yunnanensis* Wu, 1940, *N. manchuriana* Uéno, 1941, *N. cochleocercia* Wu, 1962, *N. furcocauda* Wu, 1973, *N. formosana* Shimizu, 1997, *N. klapperichi* Sivec, 1981, *N. jilinensis* Zhu and Yang, 2003, *N. miaofengshanensis* Zhu and Yang, 2003, *N. basispina* Li and Yang, 2006, *N. floralis* Li and Yang, 2006, *N. guangdongensis* Li and Yang, 2006, *N. perforata* Li and Yang, 2006, *N. sichuanensis* Li and Yang, 2006, *N. oculata* Wang and Du, 2006, *N. atristrigata* Li and Yang, 2007, *N. meniscata* Li and Yang, 2007. This study describes four new species of *Nemoura: N. cocaviuscula* Du and Zhou, sp. nov., *N. lui* Du and Zhou, sp. nov., *N. magnispina* Du and Zhou, sp. nov., and *N. rotundprojecta* Du and Zhou, sp. nov. Types of the new species are deposited in the Insect Collection of Yangzhou University, Jiangsu province, China.

---

[1] Received on July 11, 2006. Accepted on July 16, 2007.

[2] Institute of Applied Entomology, Yangzhou University, Yangzhou, Jiangsu 225009, China. Y-ZD is the corresponding author. E-mails: Y-ZD, yzdu @yzu.edu.cn; PZ, peipei78900@163.com; ZJW, wangzhijie5219@yahoo.com.cn.

[3] Zhangjiagang Entry-Exit Inspection and Quarantine Bureau, Zhangjiang 215600 China.

Mailed on March 14, 2008

SYSTEMATIC ENTOMOLOGY

Nemoura cocaviuscula Du and Zhou, sp. nov.

Figs. 1-5

Adult Habitus: Antennae dark brown, head and thorax tergum brown, and head slightly wider than pronotum; wing hyaline, brown, veins brown; legs brown.

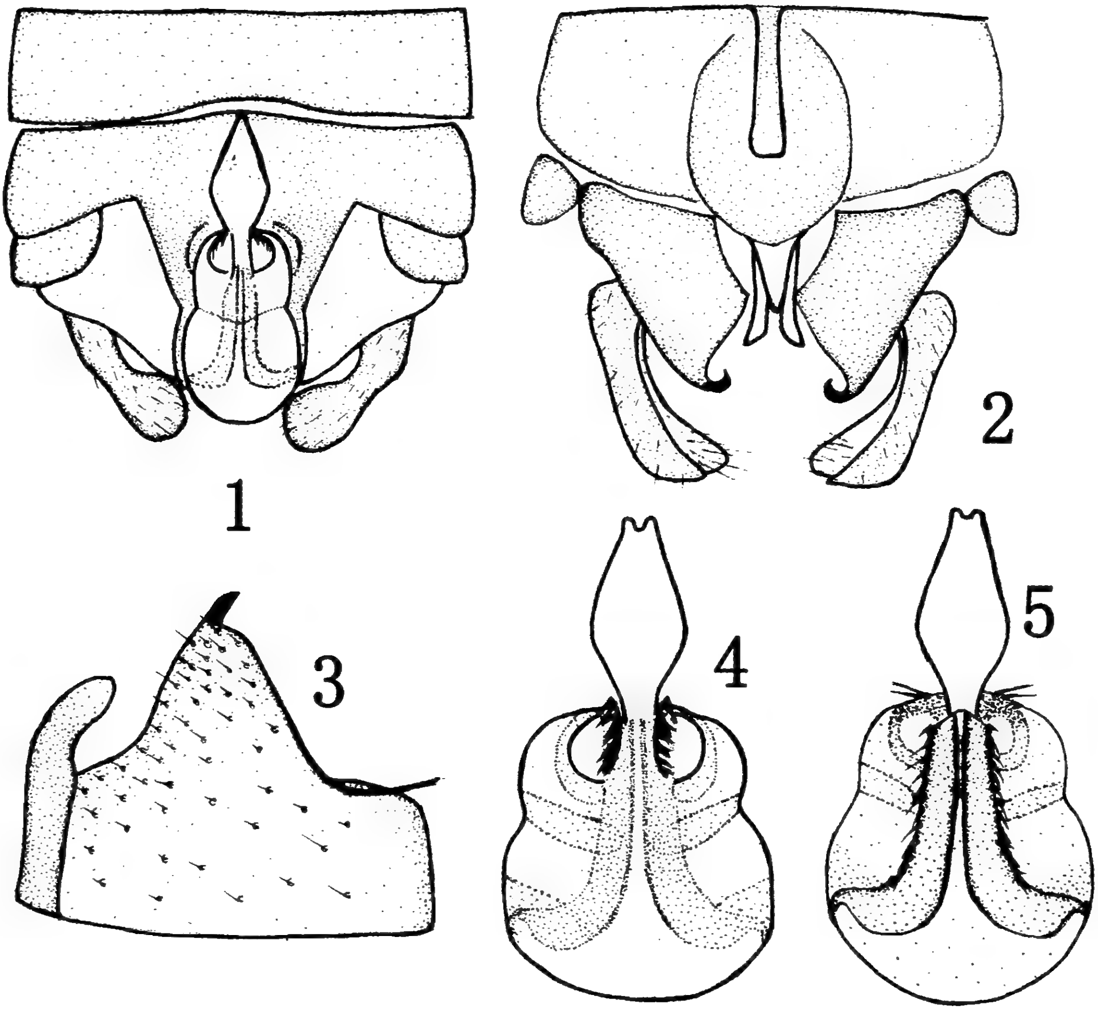
Male: Forewing length 7.3-7.6 mm, hind wing length 6.1-6.3 mm. Abdomen pale at anterior segments and brown at posterior segments. Tergum 9 slightly sclerotized, bearing several slender spins at hind margin; tergum 10 sclerotized and dark brown, forming a large concave area anterior to base of epiproct, which has a small membrane patch in medial; subgenital plate rounded, with a tapering small triangular apex, extending distally but not completely covering inner lobes of paraprocts. The plate gently brown but the hind margin dark brown; vesicle pale and slender but slightly enlarged at base, terminated straight; paraprocts consisting of 2 lobes; inner lobes sclerotized, slender, slightly turned outward at apex; outer lobes sclerotized, broad rectangle at base and extending to a tapering triangle which is terminated by a curved outward, dark sclerotized hook, outside margin forms a dark sclerotized strip surrounding base of cerci, the lobe covered with a few hairs; epiproct calabash-shaped in dorsal aspect, elongated and forming a long white rhombic membranous projection at middle of anterior margin, and at base of the projection, sclerotized prong absent but forming a pair of sclerotized strips which bear a row of spines; dorsal sclerite calabash-shaped, slightly sclerotized, subhyaline and broad, slightly concaved laterally in middle, not bearing spines; ventral sclerite sclerotized, pairs ridges wider than other species in the genus, bearing two rows of spines; cerci outside dark sclerotized, lateral portion forms sclerotized strip, spines or hooks entirely absent end; gently swollen at end and bearing several long hairs.

Female. Unknown.

Type Material: Holotype ♂, Laodian, Tianmu Mountain, Zhejiang Province, 1185m, 10 May 1998, Leg. DU Yu-Zhou. Paratypes, 5 ♂♂, same data as the holotype.

Diagnosis: This new species is similar to *N. geei* in having a long protrusion extending from apex of epiproct, but can be separated from the latter by the calabash-shaped dorsal sclerite and rows of spines on ventral sclerite of epiproct.

Etymology: The name refers to the epiproct slightly concaved laterally in middle part. Latin "*cocaviuscul-*" meaning to be slightly concaved.



Figures 1-5. *Nemoura cocaviuscula* Du and Zhou, sp. nov. 1. Male terminalia, dorsal; 2. Male terminalia, ventral; 3. Male paraproct; 4. Male epiproct, dorsal; 5. Male epiproct, ventral.

Nemoura lui Du and Zhou, sp. nov.

Figs. 6-11

Adult Habitus: Antennae and head dark brown; head slightly wider than pronotum; wing hyaline, brown, veins dark brown; legs brown.

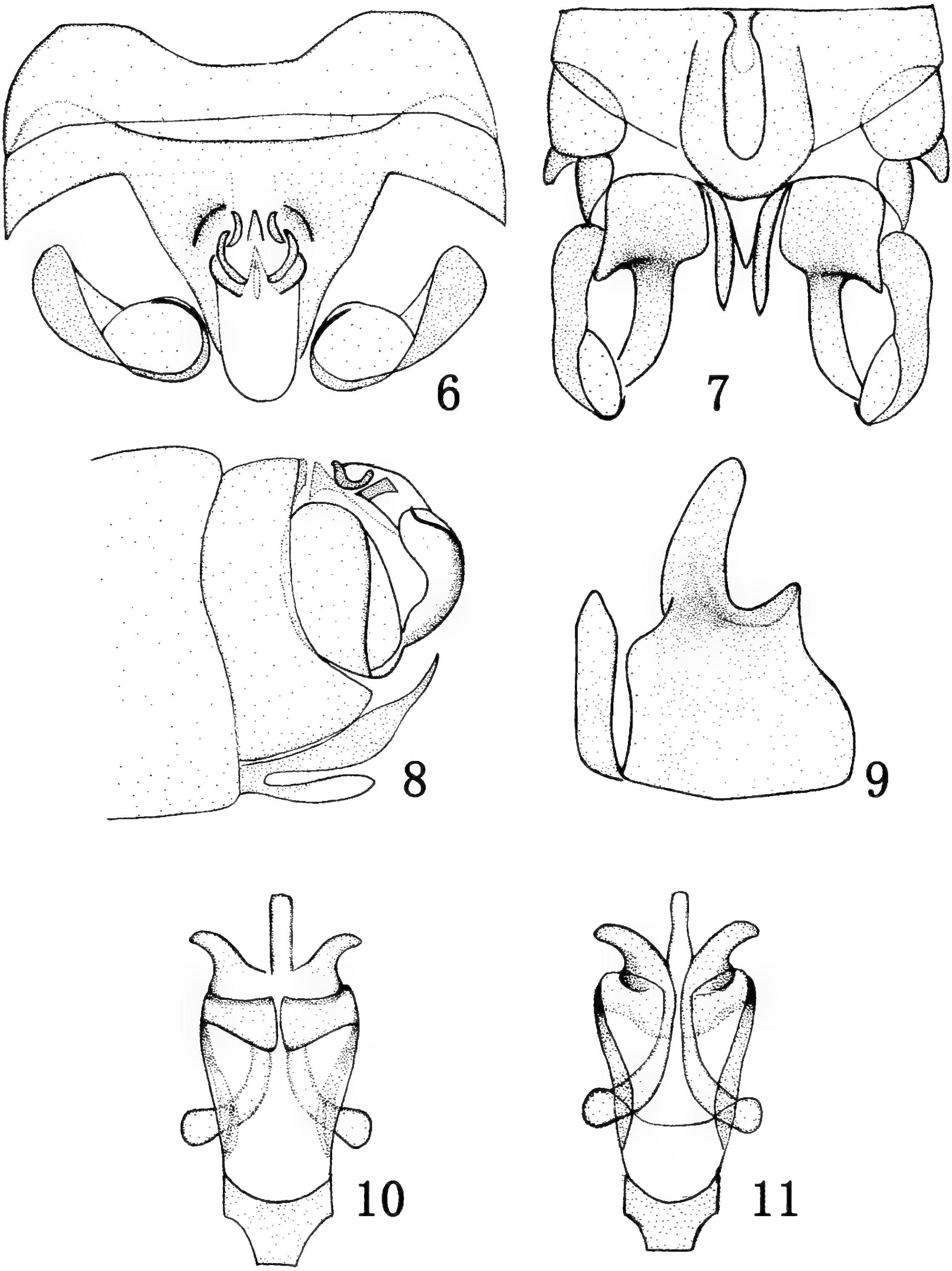
Male: Forewing length 6.0-7.0 mm, hind wing length 5.2-6.1 mm. Tergum 9 sclerotized, but not produced bearing thin hairs and spines, the tergum concaved backward at middle of the anterior margin. Tergum 10 also concaved backward at middle of the anterior margin, the segment mostly sclerotized forming a large concave area anterior to base of epiproct, which is longitudinally membranous in median, is elevated postero-mesally, forming a pair of dark sclerotized arc ridges; subgenital plate broad, tapering with a small narrow apex, extending distally to base of paraprocts, not covering inner lobes, sclerotized and the hind margin dark brown, vesicle pale, broad but thin at base; paraprocts consisting of 2 lobes; inner lobes sclerotized, moderate width and length, slightly turned inward, not hidden by hypoproct; outer lobes sclerotized, broad at base and extending postero-mesally to forming a tapering sclerotized bar; epiproct partial sclerotized, bilaterally symmetrical, base narrow and end broad, it elongated antero-mesally and forms a slender membranous finger-shaped projection; on either side base of the projection forming two conical sclerotized projections; dorsal sclerite sclerotized, narrow at base and broad at end, forming a pair of sclerotized rectangle portions at anterior margin, the sclerite not bears spines; basal sclerites is a membranous, hyaline, colorless patches, with sclerotized lateral margin located at base of epiproct; ventral sclerite darkly sclerotized, parallel ridges not bearing spines, extending outward and upward to dorsal surface and forming a pair of projections near the apex which turning outward, not bearing spines or hooks; cerci outside of cerci dark sclerotized, lateral portion forms sclerotized strip and is terminated by a sclerotized hook, spines are entirely absent; membranous inner region swollen at end and bearing small hairs.

Female: Unknown.

Type Material: Holotype ♂, South Tributary of Source of Jialing River, Tiantai Mountain, Qinling Mountain Range, Shaanxi Province, 1800m, 10 Jun. 1998, Leg. DU Yu-Zhou. Paratypes 4 ♂♂, same data as the holotype; 16 ♂♂, East tributary of Source of Jialing River, Tiantai Mountain, Qinling Mountain Range, Shaanxi Province, 1900-2050m, 8 Jun. 1998, Leg DU Yu-Zhou; 3 ♂♂, Huodigou, Huoditang, Qinling Mountain Range, Nigshaan County, 1900m, 5 Jun. 1998, Leg. DU Yu-Zhou.

Diagnosis: This new species appears similar to *N. spinosa* in dorsal view of the epiproct, but can be separated from the latter by the tapering sclerotized bar extending from outer lobes of paraprocts (Fig. 8).

Etymology: The name in honor of Professor Zi-Qiang Lu, for his assistance with our research.



Figures 6-11. *Nemoura lui* Du and Zhou, sp. nov. 6. Male terminalia, dorsal; 7. Male terminalia, ventral; 8. Male terminalia, lateral; 9. Male paraproct; 10. Male epiproct, dorsal; 11. Male epiproct, ventral.

Nemoura magnispina Du and Zhou, sp. nov

Figs. 12-17

Adult Habitus: Antennae dark brown, head and thorax tergum dark brown, and head slightly wider than pronotum; wing hyaline, brown, veins brown. Legs brown.

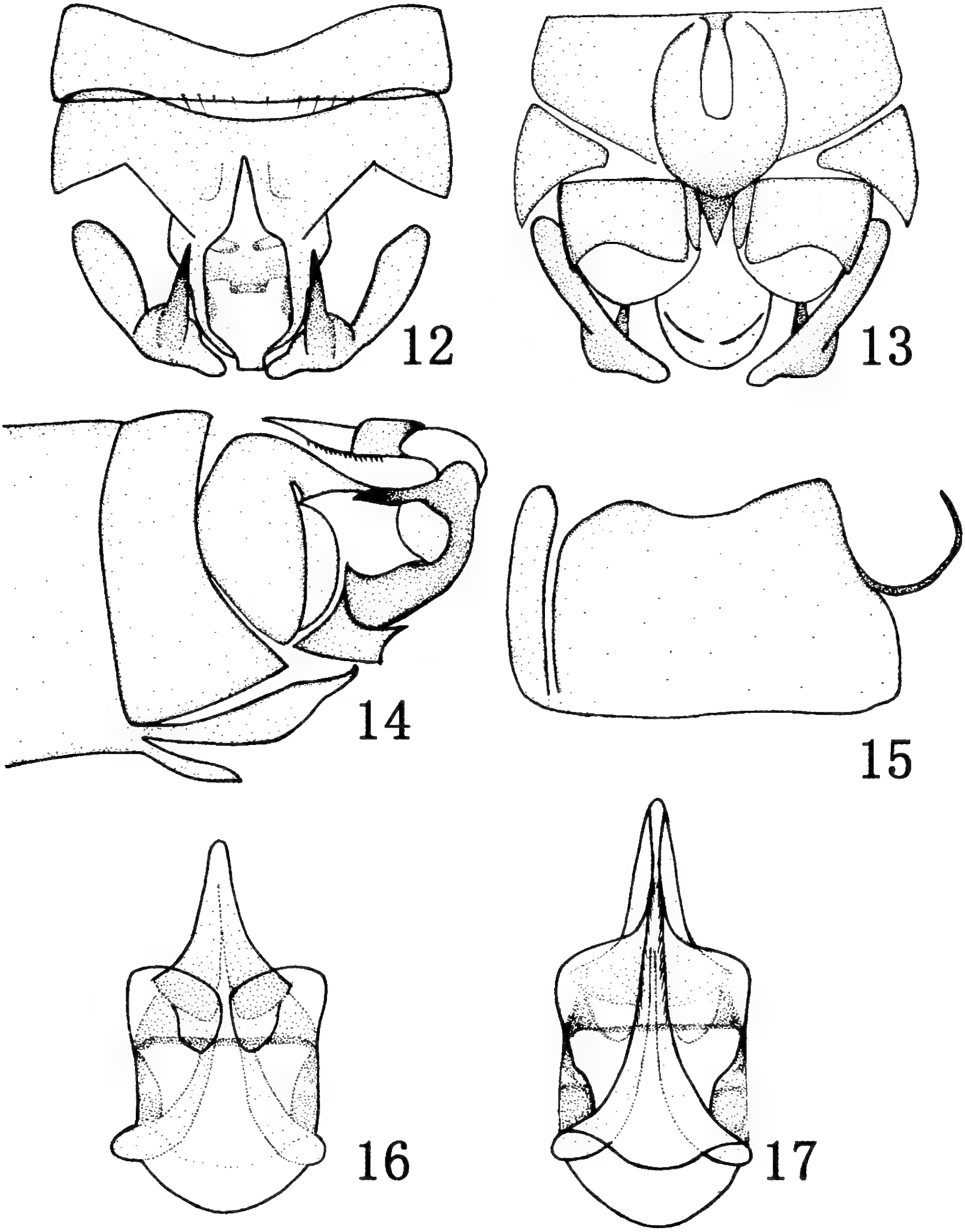
Male: Forewing length 8.2-9.0 mm, hind wing length 7.2-8.0 mm. Pale at anterior segments and brown at posterior segments. Tergum 9 slightly sclerotized, bearing thin hairs at hind margin and concave backwards at middle of anterior margin. Tergum 10 is not concave at middle of the anterior margin but bearing a little of spines and hairs. The segment sclerotized forming a large concave area anterior to base of epiproct, which has a small membrane patch in medial, forming a pair of dark sclerotized hook-shaped ridge at anterior of epiproct. Subgenital plate rounded, and forms a tapering with a small triangular apex, not covering inner lobes of paraproct, the hind margin dark brown; vesicle does not reach half of subgenital plate, it is pale except lateral margin which is brown, broad except at base which is thin. Paraprocts consisting of 2 lobes; inner lobes sclerotized, slender, nearly equally as long as outer lobes; outer lobes sclerotized, broad rectangle and not forming sclerotized bar; outside margin of outer lobe forms a turned outward slender sclerotized strip which around base of cerci. Epiproct sclerotized and elongated antero-mesally forming a long conical membranous projection, but not forming sclerotized projections on either side base of the projection; dorsal sclerite sclerotized, short and broad, not bearing spines; ventral sclerite sclerotized, broad at base and narrow at apex, ridges bearing two rows spines near apex; cerci outside dark sclerotized, extending distally inward and upward, terminated by a large sclerotized spine; membranous inner region swollen at end and bearing small hairs.

Female: Unknown.

Type Material: Holotype ♂, Huodigou, Huoditang, Nigshaan County, Qinling Mountain Range, Shaanxi Province, 1900-1950m, 5 Jun. 1998, Leg. SUN Chang-Hai and YANG Lian-Fang. Paratype 10 ♂♂, same data as the holotype; 2 ♂♂, East tributary of Source of Jialing River, Tiantai mountain, Qinling Mountain Range, Shaanxi Province, 1900-2050m, 8 Jun. 1998, Leg DU Yu-Zhou.

Diagnosis: There are no closely related species among other described *Nemoura* species known from China and adjacent countries. Characteristic shape of cerci (Fig. 14) clearly separates this species from all other *Nemoura* species.

Etymology: The name refers to the cercus forming a large sclerotized spine. Latin "magni-" means large and "spina" means spine.



Figures 12-17. *Nemoura magnispina* Du and Zhou, sp. nov. 12. Male terminalia, dorsal; 13. Male terminalia, ventral; 14. Male terminalia, lateral; 15. Male paraproct; 16. Male epiproct, dorsal; 17. Male epiproct, ventral.

Nemoura rotundprojecta Du and Zhou, sp. nov

Figs. 18-23

Adult Habitus: Antennae light brown, head and thorax tergum brown, and head slightly wider than pronotum; wing subhyaline, fumose, veins dark and distinct; legs light brown, but joints of femur and tibia brown.

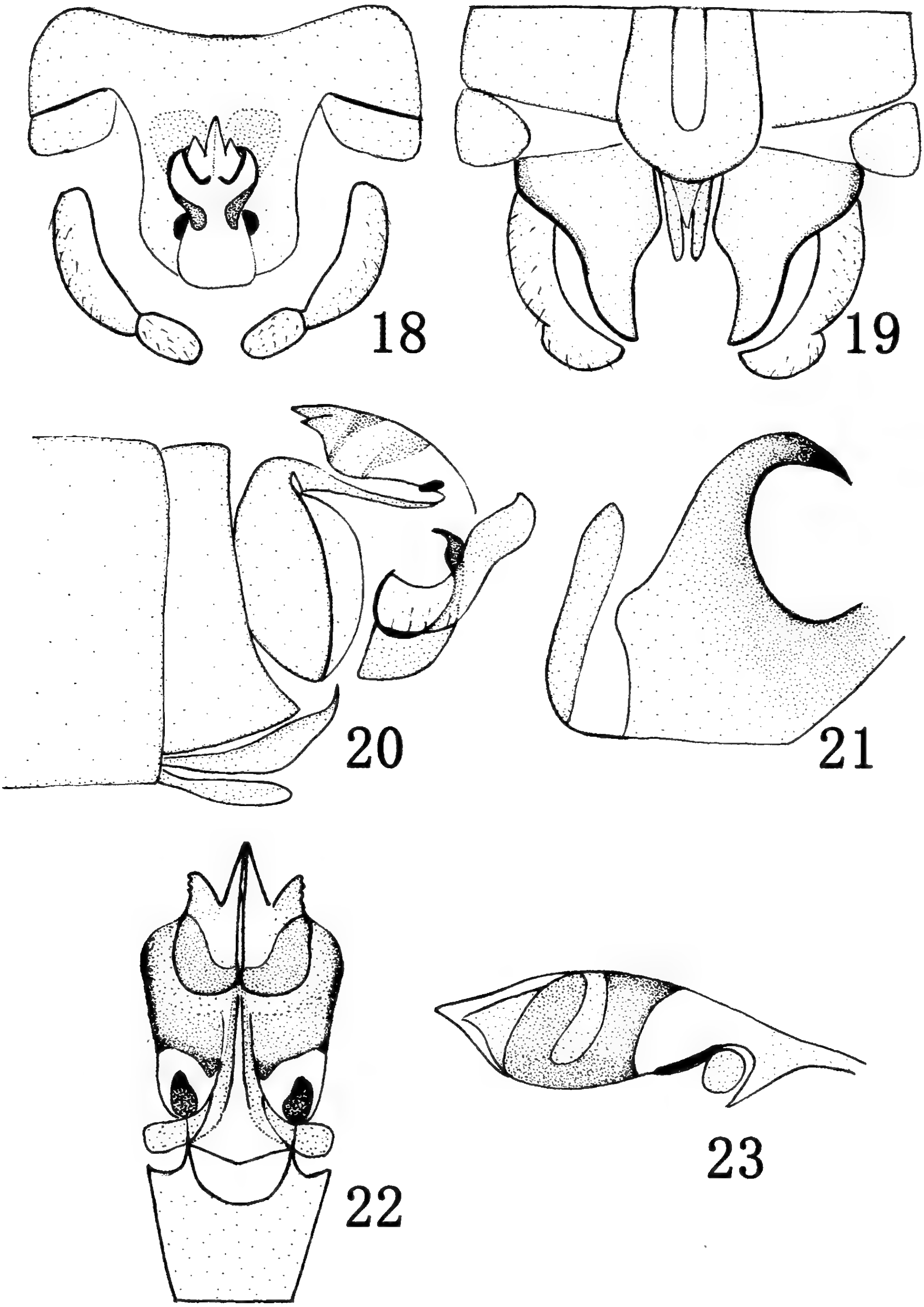
Male: Forewing length 6.5-7.3 mm, hind wing length 5.4-6.0 mm. Tergum 9 membranous, and not produced. Tergum 10 lightly sclerotized, forming a concave area anterior to base of epiproct, bearing a few small spines; the concave area highly sclerotized and dark brown below epiproct forming pair of dark brown patches, except the linear membrane along midline. Subgenital plate broad with rounded hind margin, extending distally to form an acute small triangular tip which is covering a part of inner lobes of paraproct; vesicle is about two-thirds as long as subgenital plate, membranous but sclerotized at base and margin which is brown; paraprocts consisting of 2 lobes; inner lobe sclerotized, narrow and reaching over half of outer lobes, turning inward and incompletely hidden by subgenital plate; outer lobes sclerotized, broad at base then abruptly tapering and forming a hook-shaped apex which turned outward, outside margin is highly sclerotized and dark brown. Epiproct projected antero-mesally, which have longitudinal dark areas in the midline; ventral sclerite forming two conical sclerotized prongs on either side at base of the projection dorsal sclerite short and broad, lightly recurved, sclerotized, bilaterally symmetrical, extending dorsolaterally, dorsal sclerite largely sclerotized; basal sclerites is one broad, trapeziform, slightly sclerited patch located on base of epiproct; ventral sclerite sclerotized, with black spheriform sclerotized lobes at basolateral corners, parallel ridges not bearing a row of small spines, not bearing spines or hooks; cerci slightly sclerotized on the outside extending inward, lateral portion as sclerotized strip that have no spines or hooks, but have long and thin hairs. Body of cercus elongate and of moderate width with swollen apex.

Female: Unknown.

Type Material: Holotype ♂, Baishui River of Bottom of Snow Mountain of Yulong, Lijiang City, Yunnan Province, 2880m, 9 May 1996, Leg. DU Yu-Zhou. Paratypes 4 ♂♂, same data as the holotype.

Diagnosis: This new species is similar to *N. floralis* in having hook-shaped tip of outer lobes and swollen tip of cerci, but can be separated from the latter species by the dorsal view of the epiproct apex and the two black spheriform sclerotized lobes located on basolateral corners of ventral sclerite of epiproct (Fig. 20).

Etymology: The name refers to the epiproct forming two black spheriform sclerotized lobes at basolateral corners. Latin "rotund" means rounded, spheriform.



Figures18-23. *Nemoura rotundprojecta* Du and Zhou, sp. nov. 18. Male terminalia, dorsal; 19. Male terminalia, ventral; 20. Male terminalia, lateral; 21. Male paraproct; 22. Male epiproct, dorsal; 23. Male epiproct, lateral.

ACKNOWLEDGEMENTS

This research was supported by the National Natural Science Foundation of China (No. 30470207; 30070098).

LITERATURE CITED

Baumann, R. W. 1975 Revision of Stonefly Family Nemouridae(Plecoptera): A Study of the World Fauna at the Generic Level. Smithsonian Contributions to Zoology 211: 1-74.

Li, W. H. and D. Yang. 2006. New species of *Nemoura* (Plecoptera: Nemouridae) from China. Zootaxa 1137: 53-61.

Li, W. H. and D. Yang. 2007. Two new species of *Nemoura* (Plecoptera: Nemouridae) from Henan, China. Zootaxa 1511: 65-68.

Shimizu, T. 1997. The species of the *Nemoura ovocercia* Group (Plecoptera: Nemouridae). Aquatic Insects 19 (4): 193-218.

Wang, Z. J., Y. Z. Du, I. Sivec, and Z. Z. Li. 2006. Records of some Nemouride species (Order: Plecoptera) from Leigong Mountain, Guizhou Province, China. Illiesia 2(7): 50-56.

Wu, C. F. 1973. New species of Chinese stoneflies (Order Plecoptera). Acta Entomologica Sinica 16(2): 97-118.

Wu, C. F. 1938. Plecopterorum Sinensium: a nonograph of stoneflies of China (Order Plecoptera) Peiping, China. 225 pp.

Wu, C. F. 1962. Results of the Zoologico-Botanical expedition to southwest China, 1955-1957 (Plecoptera). Acta Entomologica Sinica 11 (Supplement): 139-153.

Zhu, F. and D. Yang. 2003. Two new species of *Nemoura* from China (Plecoptera, Nemouridae). Acta Zootaxonomica Sinica 28(3): 474-477.

THE CONTINUING DISPERSION OF *PERISTENUS DIGONEUTIS* LOAN (HYMENOPTERA: BRACONIDAE), AN INTRODUCED PARASITE OF THE TARNISHED PLANT BUG, *LYGUS LINEOLARIS* (PALISOT) (HEMIPTERA: MIRIDAE) IN NORTHEASTERN U.S.A. AND SOUTHEASTERN CANADA[1]

W. H. Day,[2] R. F. Romig,[3] H. H. Faubert,[4] and K. M. Tatman[2]

ABSTRACT: *Peristenus digoneutis* Loan, a European species, was first established by USDA-ARS in New Jersey for the biological control of the tarnished plant bug, which damages many crops. This parasitic wasp has steadily dispersed since its establishment in 1984, and it is now present in 11 states, a 38% increase since our last report in 2003, and has been found in 69 counties in the United States. *Peristenus digoneutis* is now present in all of the northeastern states, is moving westward along the southern edge of Lake Erie, and is well established in at least three Canadian provinces.

The tarnished plant bug, *Lygus lineolaris* (Palisot) is an important insect pest of many crops in North America (Day et al., 2003, Liu et al., 2003). Its wide host range, economic importance, and lack of effective natural enemies made it a candidate for classical biological control (Day et al., 1990); and European parasites were ultimately released in the U.S.A.

Once an exotic natural enemy of this pest had been established, it was desirable to conduct field surveys to determine its range expansion over a number of years. Such geographic distribution data are necessary to estimate dispersion rates, to determine where the climatic limits of the beneficial species have been reached, and to learn where the introduced species is abundant, so effectiveness studies can be initiated (Day et al., 1998).

In previous reports (Day et al., 1990, 1998, 2000, 2003) we documented the initial establishment of *Peristenus digoneutis* Loan by the USDA in northwestern New Jersey, its subsequent dispersion into 62 counties and eight states, and its reduction of tarnished plant bug [*Lygus lineolaris* (Palisot)] populations in the northeastern U.S. (Day 1996, Day et al., 2003). In this paper, we report additional range expansions of this parasite into three additional states, for a total of eleven states, and list five new county records.

METHODS

Sweep net samples were taken in alfalfa and weedy fields, and the tarnished plant bug nymphs obtained were reared in the laboratory, to produce the adult

---

[1] Received on February 12, 2007. Accepted on May 20, 2007.

[2] USDA-BIRL, 501 S. Chapel Street, Newark, Delaware 19713 U.S.A. E-mails: WHD, william.day@ars.usda.gov (corresponding author); KMT, kathleen.tatman@ars.usda.gov.

[3] 13 Linda Lane, Fleetwood, Pennsylvania 19522 U.S.A. E-mail: rfromig@aol.com.

[4] University of Rhode Island, Kingston, Rhode Island 02881 U.S.A. E-mail: hhf@uri.edu.

Mailed on March 14, 2008

parasites required for identification. Rearing and collection methods are in Day et al. (2000). Adult parasites were identified to species by the first author using characters that are now in the comprehensive keys by Goulet and Mason (2006). Voucher specimens are in the USDA collection at Newark, Delaware, and in the Canadian National collection at Ottawa, Ontario, Canada. Because unmated female *P. digoneutis* produce only male progeny, but mated females produce both sexes, collection sites that produced only male parasites have not been regarded as proof that a mating population was present, so these locations are listed separately from positive establishment locations.

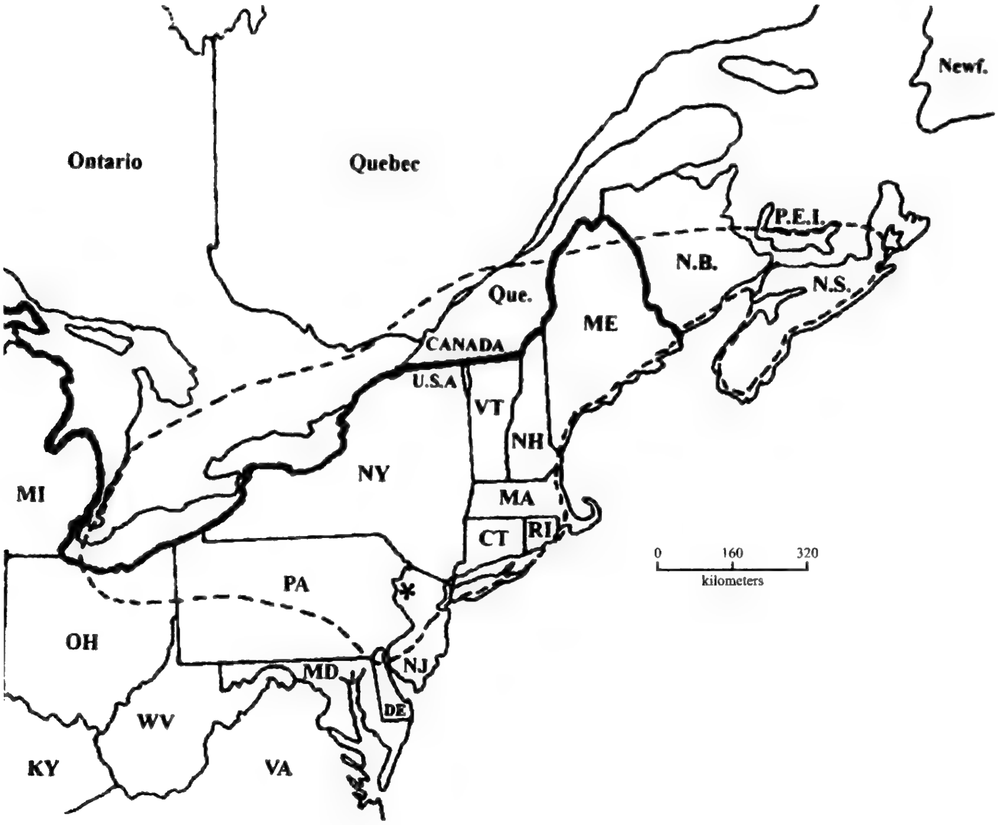


Fig. 1. The known and estimated distribution of *Peristenus digoneutis* (dashed line) in eastern North America in 2005. The asterisk indicates its initial establishment point. Abbreviations, as follows: In Canada, Que. = Quebec, N.B. = New Brunswick, P.E.I. = Prince Edward Island, N.S. = Nova Scotia, and Newf. – Newfoundland. In the U.S.A. ME = Maine, NH = New Hampshire, VT = Vermont, MA = Massachusetts, RI = Rhode Island, CT = Connecticut, NY = New York, PA= Pennsylvania, NJ = New Jersey, DE = Delaware, MD = Maryland, VA = Virginia, WV = West Virginia, KY = Kentucky, OH = Ohio, and MI = Michigan.

RESULTS AND DISCUSSION

Table 1 provides three new state establishment records and five new county records for *P. digoneutis*. These bring the total known range of this species to 11 states and 69 counties in the northeastern United States. In addition, the presence of *P. digoneutis* in northeastern Ohio indicates that this species is dispersing westward around the Great Lakes, as predicted for "cool summer" locations in both the northeastern United States and adjacent Canada (Day et al., 2000).

Peristenus digoneutis is also clearly established in adjacent Canada; females were recovered in Quebec in 1999 (at St. Clothilde), in Ontario in 2002 (at Mountain), and females were collected in Nova Scotia in 2006 (near Kentville, H. Goulet, personal communication). This species has also recently been established in California (Pickett et al., 2007). The approximate distribution of *P. digoneutis* in eastern North America is shown in Fig. 1.

Table 1. New county and state detection records for *P. digoneutis*, 2003-2005. New records are represented in **bold type**, and are based on female parasites reared from *Lygus* nymphs. Numbers to the left of the state represent chronological state ranking in the dispersion of *P. digoneutis* in the U.S.A. For example, Rhode Island is the ninth state in the U.S.A. where *P. digoneutis* has been reported.

	State	County	Year	Collector
9.	**Rhode Island**	**Washington**	2003	Faubert
	Pennsylvania	**Lehigh**	2003	Romig
		Schuykill	2004	Romig
10.	**Ohio**	**Portage**	2004	Romig
11.	**Delaware**	**New Castle**	2005[a]	Tatman

[a] A few *P. digoneutis* were reared from nymphs collected in both 2005 and 2006 in Delaware. If this population persists [it had been collected here in 1992 and 1993, but not in 1994-1995 (Day et al., 1998)], this will be the most southern establishment location for this species.

Possible additional records are in Table 2. These are tentative because although no females were reared from these counties, parasitism rates in dissected subsamples were much higher (20-32%) than is typical for native parasite species (13-18%: Day, 1996) suggesting that *P. digoneutis* is likely established. In addition, because our surveys were terminated in 2004, it is probable that the range of this parasite is now considerably larger than the 69 counties noted above.

Table 2. Probable[a] new distribution locations for *P. digoneutis*: 2004 collections.

State	County	% Parasitism	Notes
New York	Erie	30%	
Ohio	Geauga	32%	a male was also reared[c]
Pennsylvania	Berks	20%	a male was also reared[c]
	Erie, field #8	22%	
	Erie, field #9	20%	
	Warren	23%	

[a] "Probable" because these records are based on parasite larvae detected in dissections of Lygus nymphs (the sex of parasite larvae cannot be visually determined).

[b] Rates higher than the average maximum (13%: Day et al., 1990) by the native *Peristenus pallipes* (Curtis) in dissected *L. lineolaris* nymphs are probable evidence that the introduced *P. digoneutis* is present in a sample.

[c] However, only females are proof of a reproducing population (Day et al., 1990).

ACKNOWLEDGEMENTS

We thank B. R. Holmes for typing, many farmers for allowing us to sample their fields, K. A. Hoelmer and the reviewers for suggestions to improve the manuscript, and H. Goulet for furnishing the Canadian collection dates and locations.

LITERATURE CITED

Day, W. H. 1996. Evaluation of biological control of the tarnished plant bug (Hemiptera: Miridae), in alfalfa by the introduced parasite *Peristenus digoneutis* (Hymenoptera: Braconidae). Environmental Entomology 25: 512-518.

Day, W. H., R. C. Hedlund, L. B. Saunders, and D. Coutinot. 1990. Establishment of *Peristenus digoneutis* (Hymenoptera: Braconidae), a parasite of the tarnished plant bug (Hemiptera: Miridae), in the United States. Environmental Entomology 19: 1528-1533.

Day, W. H., J. M. Tropp, A. T. Eaton, R . F. Romig, R. G. van Driesche, and R. J. Chianese. 1998. Geographic distribution of *Peristenus conradi* and *P. digoneutis* (Hymenoptera: Braconidae), parasites of the alfalfa plant bug and the tarnished plant bug (Hemiptera: Miridae) in the northeastern United States. Journal of the New York Entomological Society 106: 69-75.

Day, W. H., K. J. Tilmon, R. F. Romig, A. T. Eaton, and K. D. Murray. 2000. Recent range expansions of *Peristenus digoneutis*, a parasite of the tarnished plant bug, and high temperatures limiting its geographic distribution in North America. Journal of the New York Entomological Society 108: 326-331.

Day, W. H., A. T. Eaton, R. F. Romig, K. J. Tilmon, M. Mayer, and T. Dorsey. 2003. *Peristenus digoneutis*, a parasite of *Lygus lineolaris* in northeastern alfalfa, and the need for research on other crops. Entomological News 114: 105-111.

Goulet, H. and P. G. Mason. 2006. Review of the Nearctic species of *Leiophron* and *Peristenus* (Hymenoptera: Braconidae: Euphorinae) parasitizing *Lygus* (Hemiptera: Miridae: Mirini). Zootaxa 1323: 1-118.

Liu, H., M. Skinner, B. L. Parker, and W. H. Day. 2003. Recognizing tarnished plant bug damage: vegetables, fruits, herbs. University of Vermont/USDA-ARS color brochure. 10 pp.

Pickett, C. H., R. Rodriguez, J. Brown, K. A. Hoelmer, U. Kuhlmann, H. Goulet, M. Schwartz, and P. Goodell. 2007. Establishment of *Peristenus digoneutis* and *P. relictus* (Hymenoptera: Braconidae) in California for the control of *Lygus* spp. (Hemiptera: Miridae). Biocontrol Science and Technology 17: 261-272.

TWO NEW RECORDS OF ODONATA (GOMPHIDAE) FOR TURKEY, *GOMPHUS FLAVIPES* (CHARPENTIER, 1825) AND *OPHIOGOMPHUS CECILIA* (GEOFFROY IN FOURCROY, 1785), WITH DISTRIBUTIONAL NOTES ON *G. FLAVIPES* AND *G. UBADSCHII* SCHMIDT, 1953[1]

Nurten Hacet[2] and Nihat Aktaç[2]

ABSTRACT: In this paper, we demonstrate the occurrence of *Gomphus flavipes* in Turkey. The single European Turkish record of this taxon was until now confused with the closely related Asiatic species *Gomphus ubadschii*, therefore it could be said that *G. flavipes* is new to Turkey. The distribution of the two species in Turkey is evaluated. Besides, *Ophiogomphus cecilia*, a species which was previously reported from Anatolia based on a misidentification, now for the first time is recorded for Turkey, in the Turkish Thrace.

KEY WORDS: New records, Gomphidae, *Gomphus, Ophiogomphus*, Turkish Thrace, Turkey, misidentifications

Gomphus flavipes is a Palearctic species whose distribution range was first believed to extend from Central Europe to the Balkans, Iran, Kazakhstan, and Amur (Steinmann, 1997). Populations from Asia Minor to Afghanistan were considered a distinct subspecies, formerly known as *G. flavipes lineatus* Bartenef, 1929 (an invalid homonym of *G. lineatus* Selys, 1850, now *Paragomphus lineatus*). Recently, Dijkstra and Lewington (2006) pointed out that both taxa were sufficiently distinct and they moved *G. flavipes lineatus* to the full species rank, under the single available binomen *Gomphus ubadschii* Schmidt, 1953. According to the current knowledge, *G. flavipes* extends from France to Eastern Siberia, whereas *G. ubadschii* is a southwest Asiatic endemic species, extending from Anatolia to Armenia, Georgia, Azerbaijan, Kazakhstan, Tajikistan, Syria, Lebanon, Northern Iraq, Iran, and Afghanistan (Suhling and Müller, 1996). Both *G. flavipes* and *G. ubadschii* are closely related species. However the only known record of *G. flavipes* from the Turkish Thrace has not been ascribed to either taxon (Yazıcıoğlu, 1982). Neither the true identity nor the distribution of this taxon is known.

Ophiogomphus cecilia is a Palearctic species extending from Finland to France, Italy, Northern Balkans, Russia, Central Asia (Steinmann, 1997; Dijkstra and Lewington, 2006). All records from the Iberian Peninsula (Cortes et al., 1986; Picazo and Alba-Tercedor, 1992) and Turkey (Selys, 1887) have been proved to be erroneous and resulting from a confusion with *Onychogomphus forcipatus* and *Ophiogomphus reductus*, respectively (Kalkman et al., 2003; Ferreira et al., 2006). As a consequence, there are no true records of *O. cecilia* for Turkey.

---

[1] Received on May 14, 2007. Accpted on June 16, 2007.

[2] Trakya University, Faculty of Arts and Sciences, Department of Biology, Tr-22030 Edirne, Turkey. E-mails: (NH) nhacet@hotmail.com; (NA) nihata@trakya.edu.tr

Mailed on March 14, 2008

Both *O. cecilia* and *G. flavipes* are expected to be found in the Turkish Thrace, which is part of the European continent, as they are found in Greek and Bulgarian localities. In this paper, both *G. flavipes* and *O. cecilia* are added as new records to the Odonata fauna of Turkey based on specimens already collected and new ones.

METHODS

Adults and larvae of *Gomphus* cf. *flavipes* (i.e. either *G. flavipes* or *G. ubadschii*) and adults of *O. cecilia* were identified from the Turkish Thrace based on the material kept in the collections of the Biological Department of Trakya University, Edirne, Turkey (TU) as well as from field studies carried out during the years 1995, 2001, 2002, and 2006. We focused on the region around the town of Edirne, particularly the larger rivers Tunca and Meriç. All collecting sites are mapped and a short characterization of each of them is provided. The latter is based upon Camur-Elipek et al. (2006).

Collecting sites in the Turkish Thrace

The Tunca River originates in Bulgaria and most of its length passes through there. It enters the Turkish Thrace passing the Suakacağı village near the Bulgarian border (Fig. 1). Only a small part of the river is located in the Turkish Thrace. There, it is quite large with sandy banks. It joins the Meriç River to form the border between Greece and Turkey (Camur-Elipek et al., 2006). Figure 1 shows all collecting localities for G. cf. *flavipes* and *O. cecilia* in the Turkish Thrace.

1. Suakacağı village, Tunca River where it enters Turkey from Bulgaria (41°85'N 26°56'E), 29 iv 1995, 30 ix 1995, 28 x 1995; the bottom of the river is covered with sandy sediment.

2. Değirmenyeni village, Tunca River surrounded by rice fields (41°75'N 26°55'E), 29 iv 1995, 20 vii 1995, 28 x 1995, 20 xii 1995; its bottom has sand and organic detritus.

3. Sarayiçi, Tunca River just before it enters Edirne (41°41'N 26°32'E), 29 iv 1995, 27 v 1995, 23 vi 1995, 30 ix 1995, 24 xii 1995, 06 vi 2002; its bottom is constituted of a dark mud. Both larvae and adults of G. cf. *flavipes* were obtained from this station. The landscape is characterized by mixed forest. The specimens were collected from the inner parts of the forest along the river. The other odonatan species co-occurring with G. cf. *flavipes* in this locality are *Platycnemis pennipes* (Pallas, 1771), *Coenagrion puella* (Linnaeus, 1758), *Ischnura elegans pontica* Schmidt, 1938, *Aeshna affinis* Vander Linden, 1823, *A. isoceles antehumeralis* (Schmidt, 1954), *Gomphus vulgatissimus* (Linnaeus, 1758), *Libellula depressa* Linnaeus, 1758, *L. fulva* Müller 1764, *Orthetrum cancellatum* (Linnaeus, 1758), *O. albistylum* (Selys, 1848).

4. Gazimihal, Tunca River at the place where the sewage system of Edirne enters into the river (41°40'N 26°32'E), 23 vi 1995; the bottom is covered by a bad-smelling mud.

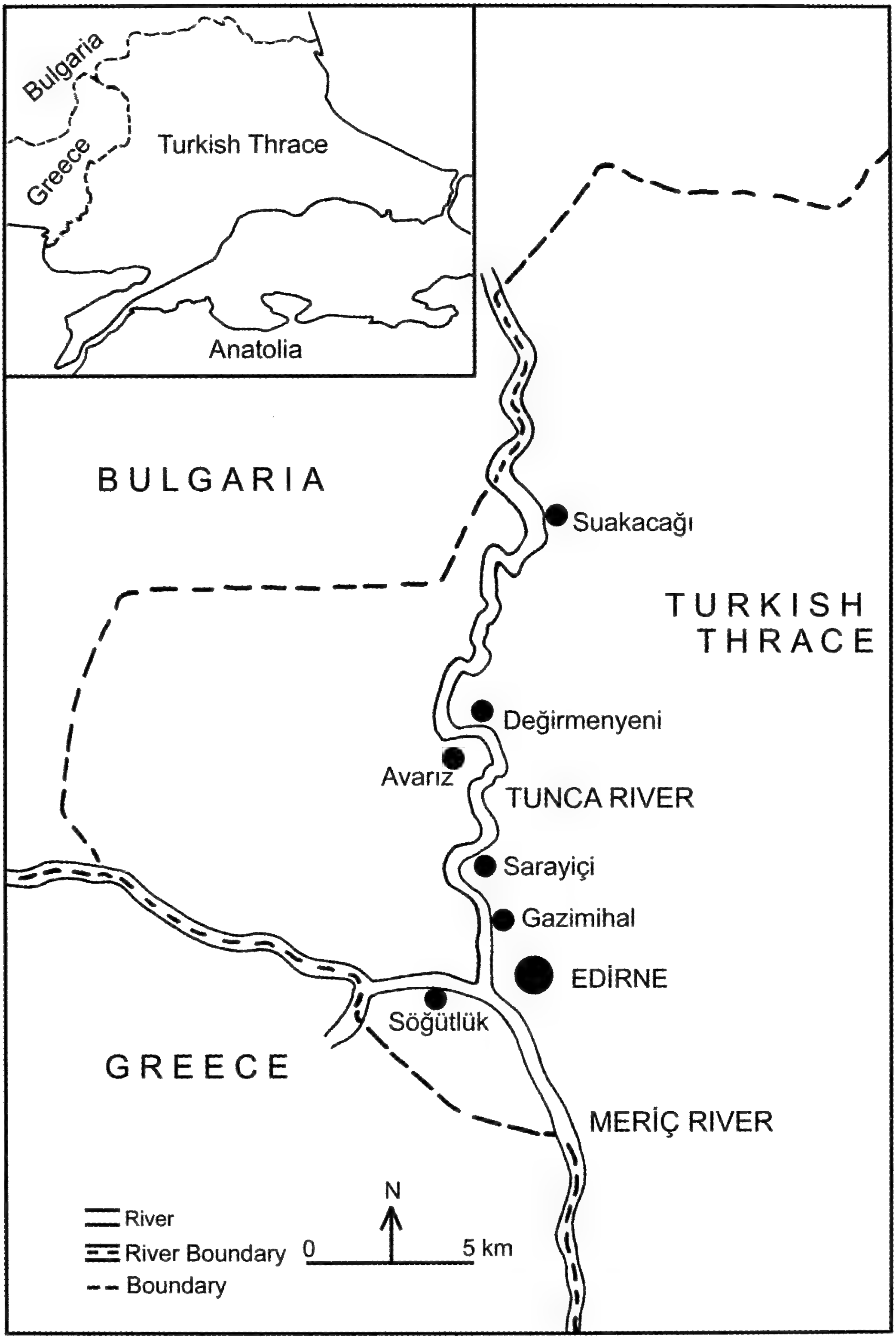


Fig. 1. Collecting sites of *Gomphus* cf. *flavipes* and *Ophiogomphus cecilia* in the Turkish Thrace.

5. Avarız village, Tunca River near the bridge situated just at the exit of the village (41°73'N 26°55'E), 30 vi 2001, 09 vii 2006; cultivated *Populus* (Salicaceae) trees surround the river. Adults of *G.* cf. *flavipes* were caught along the river.

6. Söğütlük, Meriç River, between Karaağaç and Edirne city center (41°39'N 26°31'E), 30 v 1985, 10 vii 2006; the Meriç River, which passes through Söğütlük, is similar to the Tunca River as far as its sandy bottom and its banks are concerned. This locality is the only place where *O. cecilia* was found. Specimens were found in Söğütlük forest, towards which the river forms small ponds filled with stagnant water. The dominant plant species in this area are *Salix alba* L., *Xantium strumarium* L. (Asteraceae), *Robinia pseudoacacia* L. (Fabaceae), *Ulmus minor* Mill. (Ulmaceae), and *Sambucus nigra* L. (Caprifoliaceae). Other odonatan species found together with *O. cecilia* in this locality are *Calopteryx splendens* (Harris, 1782), *Aeshna affinis* Vander Linden, 1823, *Gomphus* cf. *flavipes* (i.e. either *G. flavipes* (Charpentier, 1825) or *G. ubadschii* Schmidt, 1953), *G. vulgatissimus* (Linnaeus, 1758) and *Onychogomphus forcipatus forcipatus* (Linnaeus, 1758).

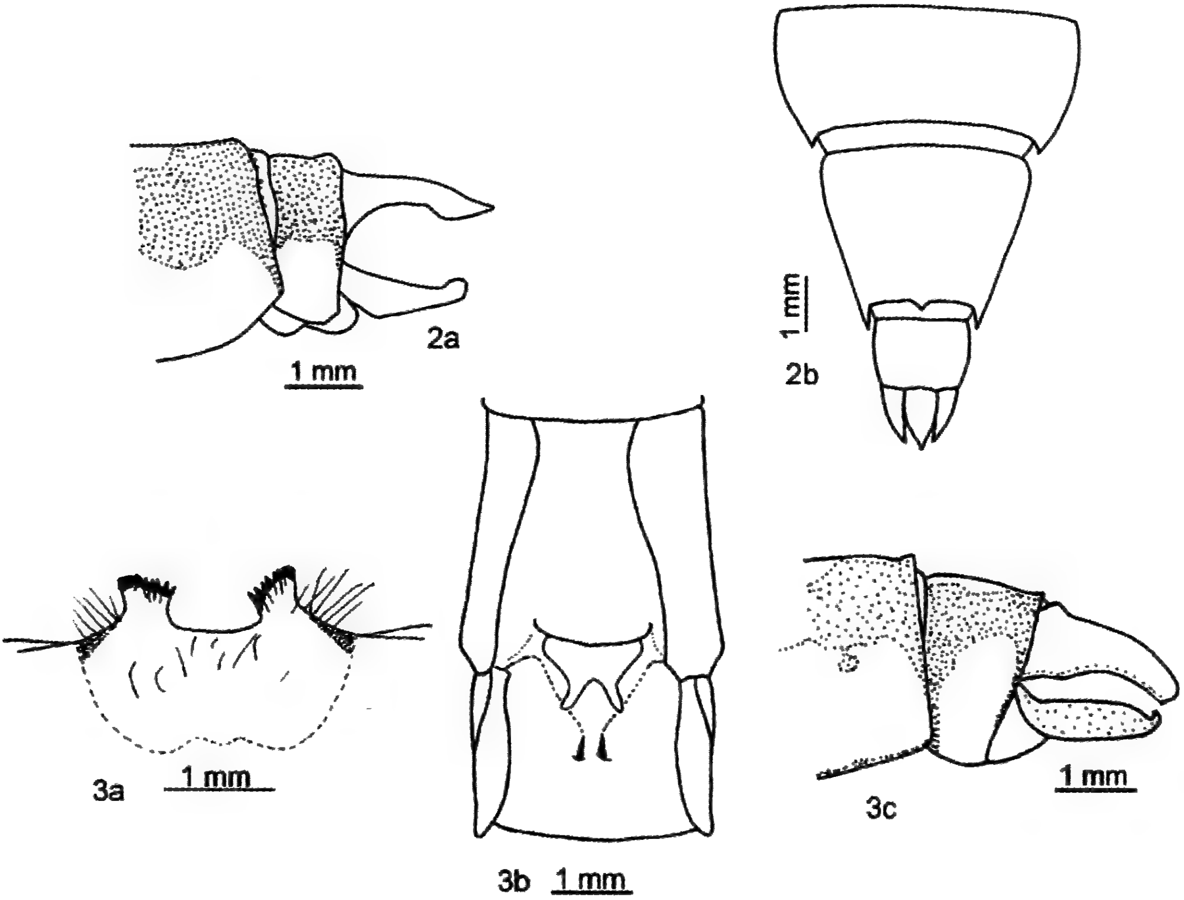
SYSTEMATIC ENTOMOLOGY - NEW RECORDS

Gomphidae

Gomphus flavipes (Charpentier, 1825)

Material Examined: Larval specimens: Loc. 1, 29.iv.1995, one ♀; 30.ix.1995, one ♂, two ♀; 28.x.1995, one ♀; Loc. 2, 29.iv.1995, one ♂, one ♀; 20.vii.1995, one ♂; 28.x.1995, one ♀; 20.xii.1995, one ♂; Loc. 3, 29.iv.1995, one ♂; 27.v.1995, one ♂; one ♀; 23.vi.1995, one ♂; 30.ix.1995, one ♀; 24.xii.1995, one ♀; Loc. 4, 23.vi.1995, one ♂. Adult specimens: Loc. 3, 06.vi.2002, one ♀; Loc. 5, 30.vi.2001, three ♂, two ♀; 09.vii.2006, one ♂; Loc. 6, 10.vii.2006, four ♂, one ♀.

Comments: The overall black/yellow pattern of both *G. flavipes* and *G. ubadschii* is similar but the anterior "**O**" thorasic black markings are quite distinctive from other *Gomphus*. Both species can be reliably differentiated by structural features only. Adult males of *G. flavipes* are reliably identified thanks to the shape of their abdomen, which is less clubbed and less widened on segments 7-9 in comparison with *G. ubadschii*. Besides, their inferior appendage is regularly thickened up to a post basal sharp ventral angulation (Fig. 2a), whereas in *G. ubadschii* it thickens more abruptly in a post basal "tooth" in *G. ubadschii* (Dijkstra and Lewington, 2006). Viewed from above, superior appendages are slightly angled laterally on their outer side before their tip, that does not occur in *G. ubadschii* (Dijkstra and Lewington, 2006; Kalkman, 2006). In both species female's vulvar scale is very short and divided up to its basis into two triangular lobes and that does not allow any separation between both species (Suhling and Müller, 1996; Kalkman, 2006). The feature of our specimens fit *G. flavipes* well but not *G. ubadschii*. Our larvae show the feature of *G. flavipes* given by Suhling and Müller (1996), and differ clearly from that indicated for *G. ubadschii*. They differ from *G. lineatus* from Anatolia by a small spin on distal margin of the dorsal surface of 9th abdominal segment (Fig. 2b).



Figs. 2 and 3. 2. *Gomphus flavipes*: a. Male anal appendages, lateral view; b. Distal part of abdomen of larva, dorsal view. 3. *Ophiogomphus cecilia*: a. female occipital crest, posterodorsal view; b. female vulvar scale, ventral view; c. male anal appendages, lateral view.

Ophiogomphus cecilia (Geoffroy in Fourcroy, 1785)

Material Examined: Loc. 6, 30.v.1985, one ♀; 10.vii.2006, two ♂, one ♀. The patterning of the only European species of the genus, *O. cecilia*, is similar to those of *Gomphus* species, however the pale ground-colour on the thorax and two anterior abdominal segments is vivid green in mature specimens. The abdomen is widened in males from the 7th to the 9th segments.

Comments: Some structural features allow a precise identification of both males and females. Our female specimens are definitely ascribed to *O. cecilia* thanks to their two remarkable toothed tubercular crests on the occiput, that lacks in *O. reductus,* which is the nearest species of the genera in Southwest and Central Asia, that has been said to be collected in the past from East Anatolia

(Fig. 3a). Besides, their vulvar scale is deeply divided to very fine and weakly divergent branches, that is quite distinctive from the parallel branches of *O. reductus'* vulvar scale (Suhling and Müller, 1996) (Fig. 3b). The males from the Turkish Thrace are ascribed to *O. cecilia* thanks to their superior appendages, which are hardly longer than the inferior appendage and than the 10th abdominal segment, are weakly down-curved, and end bluntly and bear small black subapical ventral teeth. They are decidedly shorter than in *O. reductus* (Suhling and Müller, 1996; Kalkman, 2006) (Fig. 3c). Two branches of their inferior appendage are slightly convergent towards their tips.

DISCUSSION

Until now, *Gomphus* cf. *flavipes* was known from Turkish Thrace through two males from only one locality-Tekirdağ in the vicinity of Çorlu (Yazıcıoğlu, 1982). However, these specimens were not precisely ascribed to the "European" or the "Asiatic" members of the *flavipes/ubadschii* complex and could not be safely preserved. Slow-flowing large rivers with sandy banks are preferred sites of such gomphids. In the Turkish Thrace, both the Tunca River and the Meriç River provide suitable habitats and both the adults and the larvae of *G.* cf. *flavipes* collected along the Tunca River were ascribed to *G. flavipes*. This strengthens the possibility of the occurrence of the species in other localities in the Turkish Thrace. Straits separating the Turkish Thrace from Anatolia form an effective barrier for both land and freshwater animals which do not disperse (Demirsoy, 1996). Although dragonflies are actively flying animals, distributional records of *G.* cf. *flavipes* throughout the region support the hypothesis that straits, including different ecological conditions and water types in both sides, may serve as a barrier for several species, such as *G. flavipes* (restricted to the Turkish Thrace) and *G. ubadschii* (restricted to Asia Minor, Central Asia and the Middle-East, Schmidt, 1954; Dumont, 1977; Yazıcıoğlu, 1982; Demirsoy, 1982; Kazancy, 1995; Salur and Kıyak 2000; Salur and Özsaraç, 2004; Kalkman et al., 2004a, b; Dijkstra and Lewington, 2006; Kalkman and Van Pelt, 2006; Salur and Kıyak, 2006, 2007). Other well known cases of such a distribution related to the barrier effects of straits can also be found (e.g. *Onychogomphus forcipatus albotibialis* in Anatolia and *O.f. forcipatus* in the continental Turkish Thrace). In Turkey, the Istanbul and Çanakkale Straits are the two points where Turkish Thrace and Anatolia are nearest to each other and are separated by only 0.5 to 1.5 km. We could not find any suitable habitat for *G. flavipes* in the Istanbul and Çanakkale Straits areas until now (Hacet and Aktaç, 2004). A record of the easternmost location of the species in the Turkish Thrace was given by Yazıcıoğlu (1982) and no other has been given since then. The record of the nearest location in Anatolia is quite old from Bursa (Nilüfer Çay; Schmidt 1954). The other records reported southwards of western Anatolia are Denizli (Dumont, 1977), Muğla/(Köyceğiz-Dalyan) (Kazancı, 1995), Muğla-Dalaman Çay (Kalkman et al., 2004a); Kütahya (Kalkman et al., 2004b; Kalkman and Van Pelt, 2006); Aydın/ (Söke, Nazilli) (Salur and Kıyak, 2007) (Fig. 4).

Gomphus cf. *flavipes* was also reported by Werner (1938) from Limnos Island in the Aegean Sea, located between Greece and Anatolia. The presence of this taxon, under *G. ubadschii*, in the Aegean in modern papers was based on this single record (Dumont, 1977; Lopau and Wendler 1995; Lopau, 1999), but no recent discoveries could be obtained for confirmation.

Both *G. flavipes* and *O. cecilia* were considered endangered species in many areas of Europe and were found only regionally in central Europe in the last decades (Suhling and Müller, 1996; Dijkstra and Lewington, 2006). We searched for *O. cecilia* along the Tunca River for the last three years and we found it only in a restricted area in Söğütlük. Although the villages of Avarız and Suakacağı, where we found *G. flavipes*, posses suitable habitats for *O. cecilia*, we could not find it. Probably, dam-building activities continuing in the latter village are negatively affecting its growth.

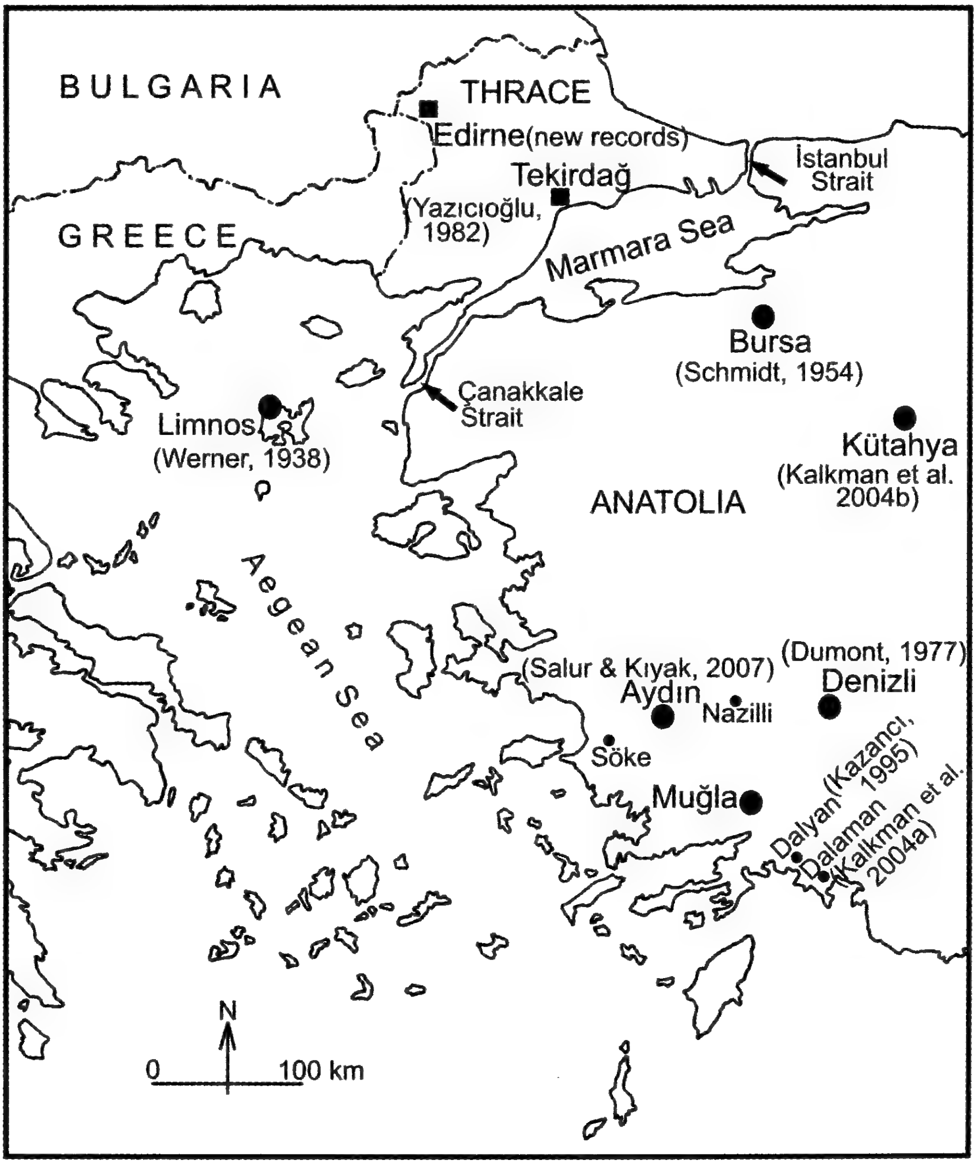


Fig. 4. Distribution of *Gomphus flavipes* ■ and *G. ubadschii* ● in the Turkish Thrace (European part of Turkey), in western Anatolia (Turkey), and in the Aegean Islands.

ACKNOWLEDGEMENTS

We thank J.-Pierre Boudot, Milen Marinov and Gert Jan van Pelt for helpful suggestions and comments on an earlier version of the manuscript.

LITERATURE CITED

Camur-Elipek, B., N. Arslan, T. Kirgiz, and B. Oterler. 2006. Benthic macrofauna in Tunca River (Turkey) and their relationships with environmental variables. Acta Hydrochimica et Hydrobiologica 34: 360-366.

Cortes, M. V., K. de Tjarda, and M. A. Simoes Graca. 1986. Estudio de un rio de montana de una zona granitica del norte de Portugal. Limnetica 2: 197-204.

Demirsoy, A. 1982. Odonata. Türkiye faunası. TÜBITAK Yayınları (VIII) 4(8), Ankara. 155 pp. (In Turkish.)

Demirsoy, A. 1996. Genel ve Türkiye Zoocoğrafyası "Hayvan Coğrafyası." Meteksan A.Ş, Maltepe, Ankara, Turkey. 630 pp.

Dijkstra, K.-D.B. and R. Lewington. 2006. Field guide to dragonflies of Britain and Europe including western Turkey and North-western Africa. British Wildlife Publishing. Milton on Stour, Dorset, England, U.K. 320 pp.

Dumont, H. J. 1977. A review of the dragonfly fauna of Turkey and adjacent Mediterranean islands (Insecta Odonata). Bulletin et Annales de la Société royale belge d'Entomologie 113: 119-171.

Ferreira, S., J. M. Grosso-Silva, M. Lohr, F. Weihrauch, and R. Jödicke. 2006. A critical checklist of the Odonata of Portugal. International Journal of Odonatology 9: 133-150.

Hacet, N. and N. Aktaç. 2004. Considerations on the odonate fauna of Turkish Thrace, with some taxonomic notes. Odonatologica 33: 253-270.

Kalkman V. J. 2006. Key to dragonflies of Turkey, including species known from Greece, Bulgaria, Lebanon, Syria, the Trans-Caucasus and Iran. Brachytron 10: 3-82.

Kalkman V. J., M. Wasscher, and G. J. Van Pelt. 2003. An annotated checklist of the Odonata of Turkey. Odonatologica 32: 215-235.

Kalkman, V. J., A. Kop, G. J. Van Pelt, and M. Wasscher. 2004a. The dragonflies of the surroundings of Lake Köyceğiz and the River Eşen, Muğla province, SW Turkey (Odonata). Libellula Supplement 5: 39-63.

Kalkman, V. J., W. Lopau, and G. J. Van Pelt. 2004b. Hitherto unpublished records of dragonflies from Turkey (Odonata). Libellula Supplement 5: 65-166.

Kalkman V. J. and G. J. Van Pelt. 2006. The distribution and flight period of the Dragonflies of Turkey. Brachytron 10: 83-153.

Kazancı, N. 1995. Odonata of the Köyceğiz-Dalyan nature reserve area, south-western Turkey, with *Lindenia tetraphylla* (Vander L.), new to the Turkish fauna (Anisoptera: Gomphidae). Notulae Odonatologicae 4: 105-106.

Lopau, W. 1999. Die Libellenfauna der griechischen Inseln Thássos, Samothráki und Límnos. Libellula Supplement 2: 43-61.

Lopau, W. and A. Wendler. 1995. Arbeitsatlas zur Verbreitung der Libellen in Griechenland und den umliegenden Gebieten. Naturkundliche Reiseberichte 5: 1-109.

Picazo, J. and J. Alba-Tercedor. 1992. First records of *Ophiogomphus cecilia* (De Fourcroy) in Spain (Anisoptera: Gomphidae). Notulae Odonatologicae 3: 171-172.

Salur, A. and Ö. Özsaraç. 2004. Additional notes on the Odonata fauna of Çiçekdağı (Kırşehir), Turkey. Journal of the Institute of Science and Technology of Gazi University 17: 11-19.

Salur, A. and S. Kıyak. 2000. On the systematic and faunistic studies of Anisoptera species (Insecta: Odonata) of Kızılırmak River basin (Kayseri Province). Journal of the Institute of Science and Technology of Gazi University 13: 829-840.

Salur, A. and S. Kıyak. 2006. Additional records for the Odonata fauna of East Mediterianean region of Turkey. Munis Entomology & Zoology 1: 239-252.

Salur, A. and S. Kıyak. 2007. Additional records for the Odonata fauna of South-Western Anatolia-Part I: Anisoptera. Munis Entomology & Zoology 2: 63-78.

Schmidt, E. 1954. Auf der Spur von Kellemisch. Entomologische Zeitschrift 64: 49-62, 65-72, 74-86, 92-93.

Selys-Longchamps, M. De. 1887. Odonates de l' Asie mineure et revision de ceux des autres parties de la faune dite européenne. Annales de la Société entomologique Belgique 31: 1-85.

Steinmann, H. 1997. World Catalogue of Odonata (Volume II, Anisoptera). Walter de Gruyter, Berlin, Germany. 636 pp.

Suhling, F. and O. Müller. 1996. Die Flußjungfern Europas (Gomphidae). Die Neue Brehm-Bücherei 628. Westarp, Magdeburg, Spektrum, Heidelberg, Germany. 237 pp.

Werner, F. 1938. Ergebnisse der achten zoologischen Forchungsreise nach Griechenland (Euboea, Tinos, Skiathos, Thasos usw.). Sitzungsberichte der Akademie der Wissenschaften in Wien, mathematisch-naturwissenschaftliche Klasse. Abteilung I. 147: 151-173.

Yazıcıoğlu, T. 1982. Dragonflies from the Ergene river basin, Thrace, Turkey. Notulae Odonatologicae 1: 148-150.

FIRST RECORD FOR THE BIOLOGICAL CONTROL AGENT *RHINOCYLLUS CONICUS* (COLEOPTERA: CURCULIONIDAE) IN A THREATENED NATIVE THISTLE, *CIRSIUM HILLII* (ASTERACEAE), IN WISCONSIN, U.S.A.[1]

Scott A. Sauer[2] and Kate L. Bradley[3]

ABSTRACT: The occurrence of the biological control weevil *Rhinocyllus conicus* is documented for the first time on the non-target thistle species, *Cirsium hillii*, in Wisconsin. *Rhinocyllus conicus* was released locally twice in Wisconsin before studies showed non-target compatibility with the rare *C. hillii* and the federally threatened *C. pitcheri*. These previously unpublished studies from the Wisconsin Department of Agriculture, Consumer, and Trade Protection prevented further releases of *R. concnicus* in Wisconsin during the early 1980s. Despite only localized releases, data from state collection records indicate that *R. conicus* has spread at least 80 miles from the initial release location. While *R. conicus*'s effects on other non-target *Cirsium* species are well documented, the lack of information on the biology of *C. hillii* precludes understanding the effects of *R. conicus* on this species' conservation.

KEYWORDS: *Cirsium hillii*, *Rhinocyllus concicus*, bio-control, endangered species, non-target effects

Biological control is aimed at reducing the population size of targeted non-native pest species by importing natural enemies that do not exist in the invaded habitats (Marshall et al., 2004, Louda et al., 2003). In the continental United States and Hawai'i, 153 insects have been released against 53 targeted species (Louda et al., 2003). Before biocontrol agents are released, extensive host specificity tests are carried out under quarantine to reduce the likelihood of non-target effects on native species. Despite preventive efforts, non-target effects have been documented on 41 native species by 15 of the 112 established insects in the continental United States, Hawai'i and the Caribbean (Louda et al., 2003).

The weevil *Rhinocyllus conicus* Froelich (Coleoptera: Curculionidae: Cleoninae) was introduced to North America in 1968 (Zwöelfer and Harris, 1984, Louda et al., 2003) to control musk thistle (*Carduus nutans* L.). Musk thistle is an exotic thistle that has become widespread since its introduction to North America in the 1800s (Brinkman et al., 2001). *Rhinocyllus conicus* oviposits into thistle flower heads in early summer, where the larva feed on the flower parts, and eventually, the seeds within the ovary (Louda et al., 1997). Research that occurred before and after the release of *R. conicus* indicated a preference for oviposition on *Carduus* spp. and slow larval growth on *Cirsium* spp. (Zwöelfer

---

[1] Received on May 17, 2007. Accepted on June 16, 2007.

[2] Science Operations Center, 2801 Progress Road, Madison, Wisconsin 53716-3339 U.S.A. E-mail: Scott.Sauer@Wisconsin.gov.

[3] Ecosystem Science Center, School of Forest Resources and Environmental Science, Michigan Technological University, 1400 Townsend Drive, Houghton, Michigan 49931, U.S.A. E-mail: klbradle@ mtu.edu.

Mailed on March 14, 2008

and Harris, 1984). Given these results, considerable transfer to native North American *Cirsium* spp. was not predicted (Zwöelfer and Harris, 1984).

Since the initial release, *R. conicus* has been reared from a third of California's native *Cirsium* spp., 3 of 6 *Cirsium* spp. in Rocky Mountain National park, and from *C. undulatum* in Colorado, Nebraska, South Dakota, and Montana (Louda, 1998). Although *R. concicus* was removed from the list of pre-approved insects for interstate movement in 2000, it continues to negatively impact North American *Cirsium* spp. (Louda et al., 2003). *Rhinocyllus conicus* has been shown to limit the reproductive capabilities and lifetime fitness of two western prairie species, *Cirsium canescens* (NE) and *C. undulatum* (NE) by feeding on the developing seeds in flower heads (Rose et al., 2005). It can reduce seed production in *C. canescens* by up to 85% and is hypothesized to be driving this once common species towards extinction (Louda and Rand 2006). Here we report the first known occurrence of *R. concicus* on a Midwestern thistle, *Cirsium hillii.*

METHODS

On August 1, 2004, while collecting seed from *Cirsium hillii* on a dry-mesic remnant hill prairie near Arena, Wisconsin (Figure 1), Sauer also collected an unknown grub within one of the dried seed heads. The grub was isolated and placed in a clear aspirator vial. The grub pupated, and by August 18, had emerged as an adult weevil. The beetle was frozen, and mounted along with the pupae casing. Steve Krauth of The University of Wisconsin-Madison Insect Research Collection identified the specimen as *R. conicus* in October 2006. This collection location is approximately 80 miles from the original release locale (Figure 1).

Following this 2004 collection on *C. hillii,* we searched for information about the distribution and abundance of *R. concicus* in Wisconsin. We were able to obtain the original release records for the state of Wisconsin, unpublished host specificity tests by the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP), and specimen records for *R. concicus* from the University of Wisconsin Insect Research collection (S. Krauth, personal communication).

Host Specificity Testing Methods

In 1980 and 1981, Julie Nara of DATCP conducted host specificity tests on three native *Cirsium* species (Nara, 1980, 1981, 1982). In April 1980, seven *Cirsium pitcheri* plants were collected from Point Beach State Forest and planted in sand in papier-mâché pots (48 cm diameter x 33 cm tall) (J. Nara, 1980). They were kept in open air at the General Laboratory of the State DATCP. By June 1980, one plant had bolted with three unopened flowers. Twenty-five gravid *R. concicus* individuals were caged on the bolting plant (9 June 1980). Within 24 hours egg masses were observed on flower heads and leaf petioles. Three flower heads were collected July 8. Seventeen adult *R. conicus* emerged from these heads. Germination tests with seed from these heads indicated it was not viable (Nara, 1980).

In April 1981, *C. hillii* and *C. altissimum* plants were collected near Spring Green, Wisconsin and transplanted to papier-mâché pots (48 cm diameter x 33 cm tall) (Nara, 1982). They were kept in open air at the General Laboratory of the State DATCP. On June 1, 1981 twelve gravid *R. concicus* individuals were caged on a single flowering *C. hillii* and two flowering *C. pitcheri* plants (collected in 1980). In July 25 adult weevils were caged with a flowering *C. altissimum* plant. Flower heads of *C. hillii* and *C. pitcheri* were collected June 30, 1981, while *C. altissimum* heads were collected August 10, 1981. Sixteen adults emerged from two *C. hillii* flowerheads, but no adult weevils emerged from *C. pitcheri* or *C. altissimum* heads. There was evidence of feeding injury on *C. pitcheri.* Seeds of *C. hillii* from infested heads were shriveled, while seeds from non-infested heads appeared normal (Nara, 1982).

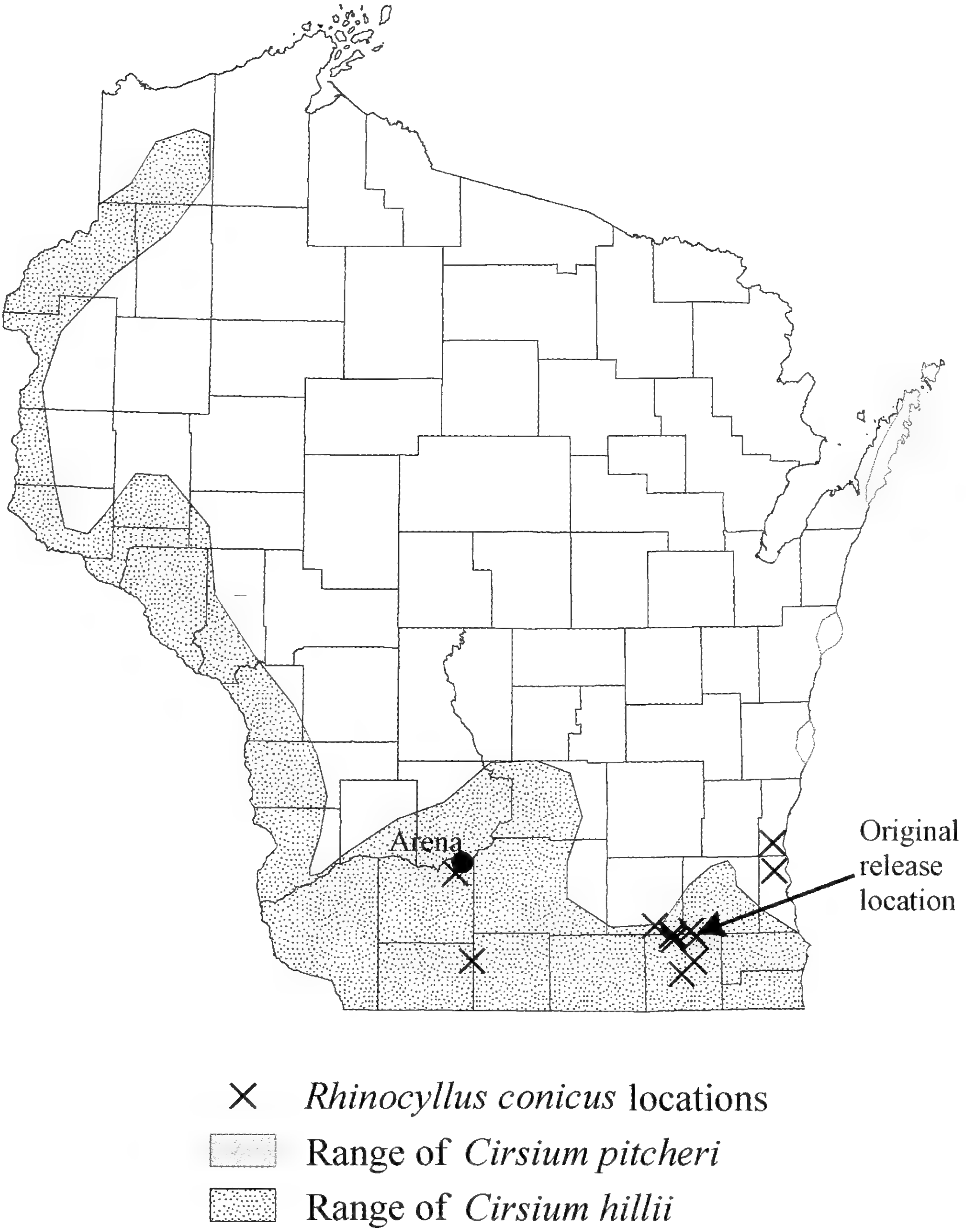
RESULTS AND DISCUSSION

Rhinocyllus conicus was first introduced to Wisconsin in 1975 in Walworth County (Doll, 2004), with a second release in Waukesha County in 1978. (Figure 1). Nara's host specificity studies led to DATCP's determination in 1980 that *R. conicus* could oviposit and complete its life-cycle on Wisconsin's threatened *C. hillii* and the federally threatened Dune's Thistle, *C. pitcheri* (Nara, 1980, 1981, 1982) and plans for additional releases in Wisconsin and new releases in Michigan were abandoned. It has since been collected in Jefferson, Green, Lafayette, Iowa, Milwaukee and Ozaukee Counties in Wisconsin (Figure 1), with the records outside of the release area largely coming since 2000 (S. Krauth, pers. comm.). Although several collections of *R. conicus* have been made within the range of *C. hillii* (Figure 1), populations of the thistle are relatively isolated from each other, and the density, spatial distribution, and utilization of *C. hillii* by *R. conicus* across the state remain unknown.

Cirsium hillii is a midwestern endemic, ranging from Ontario to Minnesota and Iowa (Cochrane 2000, Gleason and Cronquist 1991, Penskar, 1997) with a range wide conservation status of vulnerable (G3, Natureserve, 1997). In Wisconsin, where it is formally considered threatened (S3, Wisconsin DNR Vascular Plant Working List, 2006), it is found mostly on dry-mesic hill prairies with and without histories of grazing and on sandy prairie remnants (R. A. Henderson, Wisconsin DNR and S. R. Hill, Illinois Natural History Survey, personal communications, 2006). The species is largely confined to the southwestern half of the state in relatively small, isolated populations (Cochrane 2000). It is often found in active or former pastures, and light grazing seems to be of some benefit to the species. Although listed as threatened species in Wisconsin, the state has the second highest number of occurrences (55 existent, Wisconsin DNR 2006) outside of Michigan (Penskar, 1997). It is also listed as critically imperiled (S1) in Indiana and Iowa, and until as recently as 2005 was also listed as imperiled in Illinois (S. R. Hill, personal communication). It is considered vulnerable (S3) in the remainder of its range.

There is little published information on the ecology of *C. hillii* (Penskar 1997). It is short of stature, usually less than 0.5 m tall, flowers from mid-June into July, and is often found in very localized groupings of a few flowering ramets, with

Figure 1. Known distribution of *Rhinocyllus conicus* in relation to ranges of *Cirsium hillii* and *Cirsium pitcheri* in Wisconsin.



many more non-flowering rosettes. *Cirsium hillii* is closely related to *C. pumilum*, but unlike *C. pumilum,* which is biennial, *C. hillii* is described as perennial (Gleason and Cronquist 1991, Cochrane 2000, Natureserve 1997). *Cirsium hillii* may in fact be more accurately described as a monocarpic perennial where each ramet usually blooms only once, often after many years of growth. The rosettes surrounding flowering ramets grow within a few cm of the main stem, and some hypothesize that these rosettes grow from rhizomes (S. R. Hill and R. Henderson, personal communications). Each localized cluster could be viewed as being either a single genet, or only a few genets, with many ramets. Demographic and genetic marker work by Fant (2007) shows that *C. hillii* populations are indeed composed largely of a few individuals, but that sexual recruitment also takes place.

The phenology of *C. hillii* and the other *Cirsium* species overlap with the egg-laying activity of *R. conicus*, although the synchrony of flowering and oviposition vary with the *Cirsium* species. *Rhinocyllus concicus* lays its eggs on developing thistle flowerheads in May and June (Louda et al., 2005). Given that *C. hillii* blooms between June and July, it is likely that many of its flowerheads will have been initiated during the period of *R. conicus* activity and will be highly susceptible to attack. Much uncertainty remains concerning the importance of sexual recruitment in sustaining healthy *C. hillii* populations. Given this uncertainty, it is not known if the adverse effect of seed predation by *R. conicus* could have adverse affects on remaining *C. hillii* populations. Native herbivores feed on developing seed heads and limit the lifetime fitness of other *Cirsium* species (Louda et al., 1995, Louda et al., 2005), and it is possible that population growth of *C. hillii* is also seed-limited. However, there is little information about the abundance and spatial distribution of *R. conicus* in the state of Wisconsin. Its utilization and demographic effects on the remaining populations of *C. hillii* are unknown. Further, if *R. conicus* spreads to the costal dune systems of the Great Lakes, it has the potential to severally inhibit the recovery of the federally threatened *C. pitcheri* because this species does rely heavily upon seedling recruitment for population sustainability (Louda et al., 2005).

LITERATURE CITED

Brinkman, M. A., W. A. Gardner, and G. D. Butin. 2001. Effect of red imported fire ant (Hymnetoptera: Formicidae) on *Rhinocyllus conicus* (Coleoptera: Curculinonidae), a biological control agent of musk thistle. Environmental Entomology 30: 612-616.

Cochrane, T. S. and H. H. Iltis. 2000. Atlas of the Wisconsin Prairie and Savanna Flora. Technical Bulletin No. 191, Wisconsin Department of Natural Resources, Madison, Wisconsin, U.S.A. 227 pp.

Doll, J. 2004. Thistles in Pastures and Beyond. Agronomy Advice. University of Wisconsin Madison. 5 pp.

Fant, J., S. Masi, J. M. Keller, and R. Mann. 2007. Investigating the Reproductive Health of Hill's Thistle (*Cirsium hillii*) Populations in the Chicago Region. Chicago Wilderness Journal 5: 29-40.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd Edition. New York Botanical Garden. New York, New York, U.S.A. 910 pp.

Louda, S. M. 1998. Population Growth of *Rhinocyllus conicus* (Coleoptera: Curculionidae) on two Species of Native Thistles in Prairie. Environmental Entomology 27: 834-841.

Louda, S. M., R. W. Pemberton, M. T. Johnson, and P. A. Follett. 2003. Non-target effects-The Achilles' heel of biological control? Retrospective analyses to reduce risk associated with biocontrol introductions. Annual Review of Entomology 48: 365-396.

Louda, S. M. and M. A. Potvin. 1995. Effect of inflorescence-feeding insects on the demography and lifetime fitness of a native plant. Ecology 76: 229-245.

Louda, S. M., T. A. Rand, A. E. Arnett, A. S. McClay, K. Shea, and K. McEachern. 2005. Evaluation of ecological risk of a threatened plant from an invasive biocontrol insect. Ecological Applications, 15: 234-249.

Nara, J. 1980. Musk Thistle Weevil (*Rhinocyllus conicus*). Memorandum. State of Wisconsin, Department of Agriculture, Trade and Consumer Protection. 1 p.

Nara, J. 1981. Preliminary environmental assessment for the release of the weevil *Rhinocyllus conicus* as a biological control agent against the musk thistle (*Carduus nutans*) and the plumeless thistle (*Carduus acanthoides*) in Wisconsin. State of Wisconsin, Department of Agriculture, Trade and Consumer Protection. 12 pp.

Nara, J. 1982. Host range study of *Rhinocyllus concicus*. Memorandum. State of Wisconsin, Department of Agriculture, Trade and Consumer Protection. 1 p.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: January 12, 2007.)

Penskar, M. R. 1997. Rangewide Status Assessment of Hill's Thistle (*Cirsium hillii* (Canby) Fern.) Prepared by Michigan Natural Features Inventory for U.S. Fish and Wildlife Service Region 3.

Rose, K. E., S. M. Louda, and M. Reese. 2005. Demographic and evolutionary impacts of native and invastive insect herbivores on *Cirsium canescens*. Ecology 86: 453-465.

Zwöelfer, H. and P. Harris. 1984. Biology and host specificity of *Rhinocyllus conicus* (Froelich) (Coleoptera: Curculionidae) a successful agent for the biological control of the thistle, *Carduus nutans* L. Zeitschrift für angewandte Entomologie 97: 36-62.

A NEW *HILARA* MEIGEN (DIPTERA: EMPIDIDAE) SPECIES FROM THE EASTERN MEDITERRANEAN REGION OF TURKEY[1]

Mustafa Cemal Çiftçi,[2] Corneliu Pârvu,[3] and Abdullah Hasbenli[2]

ABSTRACT: *Hilara bolkarensis* sp. n. is described from the eastern Mediterranean region of Turkey (Bolkar Mountains). Male and female are described, compared with related species and male genitalia as well as fore leg illustrated. A key to the species related to *H. bolkarensis* sp. n. is provided.

KEY WORDS: new species, *Hilara*, Empididae, Diptera, Turkey

Hilara Meigen is a complex genus of the family Empididae (Diptera). There are 215 species from the Palaearctic Region in the recent Palaearctic Catalogue (Chvála and Wagner, 1989), but since then many new *Hilara* species have been described and some of them synonymized (Chvála, 1997, 1999, 2000, 2005b, Pârvu, 1991, 1992, 1994). Distinctions between species of *Hilara* are scarce and hard to perceive, making species recognition difficult, often leading to misunderstandings and misidentifications (Chvála 1997, 2000, 2005a). Until Collin's (1961) revisionary work, many authors studied *Hilara* in a far-from-ideal fashion. Straka (1975) and Engel (1941) incorrectly identified some species causing many problems for subsequent authors. Owing to the studies and systematic revisions made by Chvála in the last few decades, confusions within the Palaearctic species of *Hilara* have been largely removed.

The Empididae is a poorly known family of flies in Turkey, with just a few records made and new species described by Loew, Collin (see Chvála and Wagner 1989), Chvála (1994), and more recently by Barták (2006) and Barták et al (2007). Up to now, there has been no study on *Hilara* from Turkey. High numbers of *Hilara* species are likely to be found in Turkey because of its zoogeographical position, variable altitudes, and habitats favor the evolution of numerous species.

METHODS

This study is based mainly on 31 males and 23 females, specimens collected from the Bolkar Mountains in 2005. For examination, male genitalia and legs were dissected and cleared in the 10% KOH for 24 hours at 30°C. All figures were drawn using a binocular microscope with an ocular grid. Before drawing the thickened fore basitarsus, the leg was first macerated to illustrate the true shape. After the drawing, all dissected parts were stored in small plastic capsules

---

[1] Received on May 2, 2007. Accepted on May 16, 2007.

[2] Gazi University, Faculty of Art and Science, Department of Biology, 06500, Teknikokullar, Ankara, Turkey. E-mails: (MCC) empididae@gmail.com; (AH) hasbenli@gazi.edu.tr.

[3] Muzeul National de Istorie Naturala "GrigoreAntipa" Sos.Kiselef 011341 Bucuresti 2, Romania. E-mail: cparvu@antipa.ro.

Mailed on March 14, 2008

with glycerol and pinned along with the specimens. Sinclair and Cumming (2006) terminology was followed, with a few modifications.

SYSTEMATIC ENTOMOLOGY

Hilara bolkarensis sp. n.

Figs. 1-8

Etymology: The species is named after the Bolkar Mountains where the materials were collected.

Diagnosis: Completely black, body length about 3.7-4.5 mm, subshining, grey and brown pruinose species with black halter. Acrostichals biserial, dorsocentral bristles uniserial. Wings black clouded with black costal stigma and veins dark brown. Legs black, fore basitarsus longer than tibia, very swollen and dorsally with 2-4 serial black, rather long and thick bristles. Abdomen blackish brown with brownish grey pruinose. Terminalia moderately large, slightly brown pruinosity.

Description of the male: Head black, in posterior view with brown pruinosity. Occiput black with black bristles as long as postpedicel. A pair of ocellar and frontal bristles long, black and subequal in length. Eyes separated on frons, frons black and middle part slightly grey pruinosity. Face grey pruinosity with lower edge shining black. Antenna black, style half as long as postpedicel. Palpus black, stout and long, ventrally with black hairs and 2 long and black preapical bristles. Proboscis short, slightly curved forward.

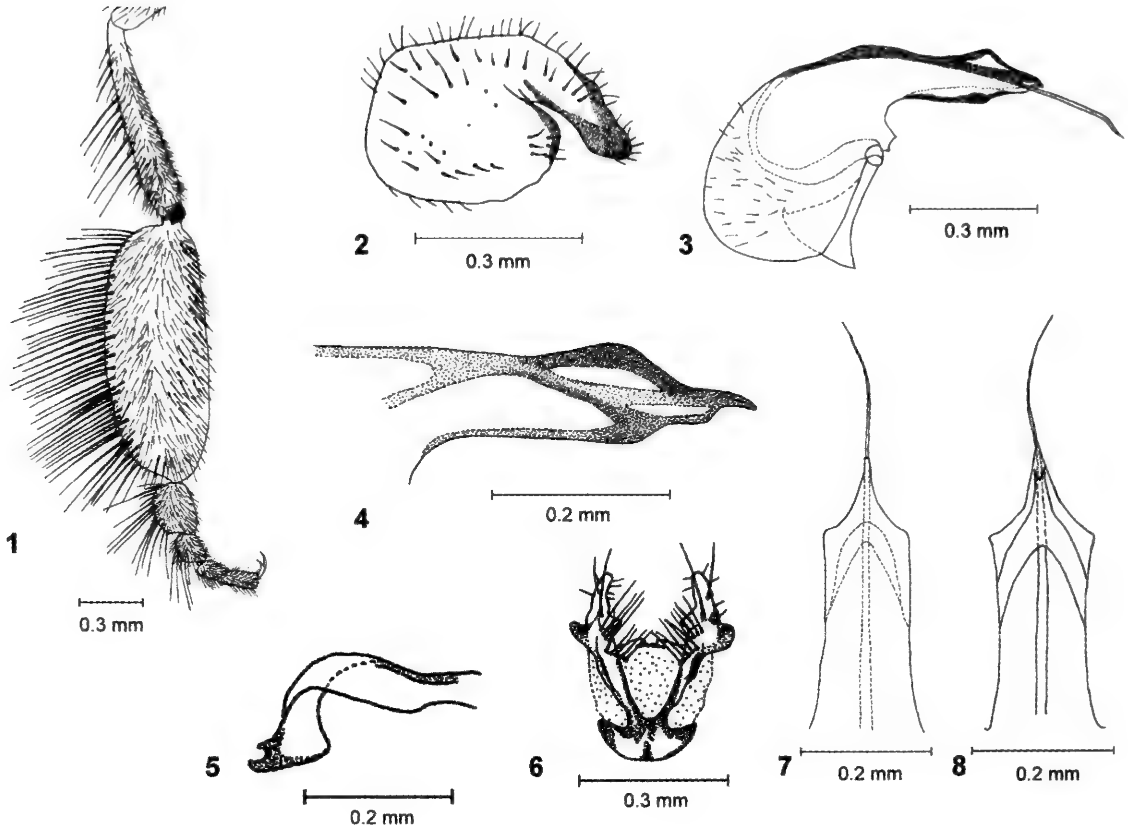
Thorax black. Scutum subshining, brown pruinosity with 2 slightly visible stripes between lines of acrostichal and dorsocentral bristles, stripes end at prescutellar depression. Lateral margins of scutum subshining black. Pleura grey pruinosity. Prothoracic collar with single strong black bristle on each side. Acrostichals and dorsocentral bristles black and hair-like. Acrostichals biserial, dorsocentral bristles uniserial ending with 2 rather long prescutellar pairs. Strong thoracic bristles black; 1 humeral, 1 posthumeral, 3 notopleurals, 1 supra-alar, 1 postalar and 2 pairs of scutellar bristles. Front half of notopleural depression with black bristle-like hairs as long as acrostichals and postpronotum with numerous short black hairs.

Wings black clouded with black costal stigma. Veins dark brown. Costal bristle long and black, as long as postpedicel. Squamae black with pale fringes, halter black with lighter stem.

Legs short, completely black and slightly grey pruinosity. All femora with short black hairs, only hairs on hind femur a little longer. Mid femur on basal half with 3 black anterior bristles longer than width of mid femur. Fore tibia thickened apically, posterodorsally with row of long black bristles, ventrally with 1 apical bristle. Mid tibia on apical half anteroventrally with 2-3 black hairs as long as width of mid tibia. Hind tibia on apical half anteroventrally and dorsally with 3 black hairs as long as width of hind tibia. All tarsal segments with ventrally short, slightly stout black and dorsally longer but fine, yellow and black hairs. Fore basitarsus (Fig. 1) longer than fore tibia, very swollen and dorsally with 2-4 serial black, rather long and thick bristles. Second and third tarsomeres on fore legs also swollen and dorsally with long bristles.

Abdomen blackish brown with brownish grey pruinosity. Abdominal hairs black, only on anterior 4 segments with yellow and black hairs. Hind marginal abdominal bristles short fine and not very distinct. Posterior margin of anterior 3 tergites with greyish white stripe more visible in lateral view. Terminalia moderately large, slightly brown pruinosity, epandrial lamella (Fig. 2) and tip of hypandrium (Fig. 4) subshining. Apical projection of epandrial lamella a little long, postgonite (Fig. 5) forked at tip.

Holotype male, body length: 3.9 mm, wing length: 4.7 mm.



Figures 1-8. *Hilara bolkarensis* sp. n.: 1- fore leg, 2- epandrial lamella, lateral view, 3- hypandrium and phallus, 4- tip of hypandrium in lateral view, 5- postgonite, 6- cerci, 7- tip of hypandrium in dorsal view, 8- tip of hypandrium in ventral view.

Description of the female: All bristles and hairs fine. Fore basitarsus simple not swollen, lacking long bristles. Bristles and hairs on legs short and hind tibia swollen towards tip and middle part slightly curved. Body length 4.0-4.5mm, wing length 4.7-5.0mm.

Differential Diagnosis: On the basis of the long black bristled male fore tibia and tarsi, *Hilara bolkarensis* sp. n. needs to be compared with related species, *H. clavipes*, *H. macedonica* and *H. curtisi*. *Hilara clavipes* has yellowish brown legs, scutum with grey pruinosity but in *H. bolkarensis* sp. n. all legs are black with slightly grey pruinose and scutum with brown pruinosity. *Hilara bolkarensis* sp. n. clearly differs from *H. clavipes* according to the shape of the epandrium. In *H. macedonica* the antennal stylus is as long as the postpedicel, the scutum has light grey pruinosity with 2 darker silky stripes, whereas in *H. bolkarensis* sp. n. the antennal stylus is half the length of the postpedicel, the scutum is subshining, with brown pruinosity and 2 slightly visible stripes. *Hilara bolkarensis* sp. n. much more resembles *H. curtisi* than the latter two species. *Hilara curtisi* possess black legs but the front coxae and base of femora are slightly yellowish, also front trochanters and all knees narrowly yellowish, scutum slightly grey pruinose, whereas in *H. bolkarensis* sp. n. the legs are completely black and scutum with brown pruinosity. The main differences of *H. bolkarensis* sp. n. from the other species are the shape of the fore basitarsus and number of dorsal bristles on the fore basitarsus. The fore basitarsus of *H. clavipes* is not longer than the fore tibia, dorsally with one row of bristles and also second and third tarsomeres with dorsal bristles. The fore basitarsus of *H. macedonica* is also not longer than the fore tibia, with dorsally 4-5 bristles in 2 rows and also the second tarsomere dorsally with 1-2 bristles. The fore basitarsus of *H. curtisi* is very similar to *H. clavipes* but the second tarsomere is slightly longer and third tarsomere bare. The fore basitarsus of *H. bolkarensis* sp. n. is longer than the fore tibia, with 2-4 serial long bristles and the second and third tarsomeres with more dorsal bristles.

Specimens Examined: Holotype male (spn15131): Turkey, Karaman, Ayrancı, Küçük Koraç village, 1852m, 15.06.2005, leg M. Çiftçi and A. Hasbenli; Allotype (spn15132) and 30 male and 22 female paratypes (spn15133-15184) are from same locality and date. Holotype, allotype and 28 male and 20 female paratypes are deposited in the Zoological Museum of Gazi University (ZMGU), 2 male and 2 female paratypes (spn15181-15184) are deposited in Antipa Museum.

Key *Hilara bolkarensis* sp. n. and related species

This key is arranged according to the key of *Hilara* made by Engel (1941).

1. Occiput black 2
- Occiput clearly grey pruinosity 3

2. Occiput black in dorsal view. Scutum slightly grey pruinosity with two bright stripes between the acrostichal and dorsocentral bristles. Fore basitarsus on male almost as long as fore tibia and dorsally with long black bristles in one row. Third tarsomere on fore leg bare. Halter completely brown .... *H. curtisi* Collin
- Occiput black. Scutum subshining, brown pruinose with two slightly visible stripes between the lines of acrostichal and dorsocentral bristles, stripes end at prescutellar depression. Male fore basitarsus longer than fore tibia and dorsally with long black bristles in two to four rows. Third tarsomere on fore leg dorsally with bristles. Halter black with lighter stem..... *H. bolkarensis* sp. n.

3. Mid tibia only with long pubescence and ventrally with some bristly hairs. Dorsal bristles of male fore basitarsus at most two times more strongly than biserial dorsal bristles on fore tibia. Biserial acrostichals longer than the diameter of the postpedicel. Light grey species with two darker silky stripes at scutum. Abdomen with grey pruinosity. Male length 4.5-5mm .... *H. macedonica* Engel
- Mid tibia on apical half with dorsal bristles two times longer than the diameter of mid tibia; also mid basitarsus with long bristles. Male fore basitarsus three times broader than fore tibia, fore tibia apically with long bristles, basally with short bristles. Scutum brownish grey pruinose with two shining black stripes between rows of bristles. Abdomen on tergites with brownish, on sternites with grey pruinose. 4-5mm .... *H. clavipes* Harris

ACKNOWLEDGEMENT

We thank Dr. Milan Chvála for his opinions and confirmation.

LITERATURE CITED

Barták, M. 2006. Three new West Palaearctic species of *Rhamphomyia* subgenus *Lundstroemiella* (Diptera, Empididae). Biologia, Bratislava 61(5): 503-508.

Barták, M., M. C. Çiftçi, and A. Hasbenli. 2007. A new species of *Rhamphomyia* (s. str.) Meigen (Diptera, Empididae) from southern Anatolia, Turkey. Entomological News 118(2): 143-148.

Chvála, M. 1994. The Empidoidea (Diptera) of Fennoscandia and Denmark. III Genus *Empis*. Fauna Entomologica Scandinavica 29: 1-187.

Chvála, M. 1997. Eleven new synonymies in European species of *Hilara* (Diptera: Empididae). Acta Universitatis Carolinae Biologica 41: 293-322.

Chvála, M. 1999. Three new *Hilara* species (Diptera, Empididae) from north-western Europe. Studia Dipterologica 6(1): 135-147.

Chvála, M. 2000. Five new synonymies in western Palaearctic *Hilara* species (Diptera: Empididae). Acta Universitatis Carolinae Biologica 44(3-4): 237-242.

Chvála, M. 2005a. The Empidoidea (Diptera) of Fennoscandia and Denmark. IV Genus *Hilara*. Fauna Entomologica Scandinavica 40: 1-234.

Chvála, M. 2005b. Descriptions of three new *Hilara* species (Diptera: Empididae) from the Central European and Balkan mountains. Acta Universitatis Carolinae Biologica 49(2005): 99-110.

Chvála, M. and R. Wagner. 1989. Family Empididae. pp. 228-336. *In,* Á. Soós and L. Papp. (Editors). Catalogue of Palaearctic Diptera. Volume 6. Therevidae - Empididae Akademiai Kiadó, Budapest, Hungary. 435 pp.

Collin, J. E. 1961. Empididae. *In,* British Flies. 6. University Press. Cambridge, England, U.K. 782 pp.

Engel, E. O. 1941. Empididae (Gattung *Hilara*). pp. 205-272. *In,* Lindner E. (Editor), Die Fliegen der Palaearktischen Region. Stuttgart, Germany. 639 pp.

Pârvu, C. 1991. *Hilara regnealai* (Diptera, Empididae), a new species from the South-East Europe (Romanian Carpathian Mountains). Review Roumain de Biologie Animale 36 (1-2): 21-25.

Pârvu, C. 1992. A synthesis on the distribution of Empididae (Diptera) in Romania with the description of a new species of *Hilara* Meigen, 1822. Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa» 32: 95-120.

Pârvu, C. 1994. *Hilara deltiaca* n.sp. from the Danube Delta and other Data on some *Hilara* species (Diptera, Empididae) of Romania. Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa», 34: 57-68.

Sinclair, B. J. and J. M. Cumming. 2006. The morphology, higher-level phylogeny and classification of the Empidoidea (Diptera). Zootaxa 1180: 1-172.

Straka, V. 1975. A study of the genus *Hilara* Meig. (Diptera: Empididae) in Czechoslovakia, Vydavatelstvo Slovenskej Akadémie Vied. Bratislava, Czechoslovakia. 156 pp.

SCIENTIFIC NOTE

BULL NETTLE (*CNIDOSCOLUS TEXANUS*) AS ENEMY FREE SPACE FOR ORTHOPTERANS IN TEXAS, U.S.A.[1]

John A. Stidham[2] and Thomas A. Stidham[3]

Orthopterans use a wide variety of mechanisms in order to avoid and deter predators. They ingest toxic chemicals to become distasteful or toxic (Sword 1999), utilize camouflage (Belwood 1990, Nickle and Castner 1995), excrete toxic or distasteful chemicals (Idowu and Modder 1998), and utilize antipredatory spines and behaviors (Nickle and Castner 1995), all to avoid becoming a meal. Orthopterans also occupy certain toxic or spiny plants in order to reduce the chance of predation. Enemy-free space is the concept that there are methods species use to reduce or eliminate the effect of their natural enemies (Jeffries and Lawyon, 1984) such as occupation of a hole in the ground or a toxic plant. It is an old concept that can be applied broadly to many aspects of the environment and an organism's behavior (Fryer, 1986). We have observed orthopterans use a particular plant, bull nettle (also called spurge nettle), as enemy-free space. These are initial observations and suggest further research into the association of orthopterans and this species of plant.

We have made field observations of orthopteran use of *Cnidoscolus texanus* (Müll. Arg.) Small (bull nettle) in spring and summer for several years south of San Antonio, Bexar County, Texas, and near Buffalo, Leon County, Texas. There are many potential predators of orthopterans that occupy the sandy areas where bull nettle is common, including a wide variety of birds (including woodpeckers, flycatchers, and warblers) and lizards (including *Cnemidophorus sexlineatus, Holbrookia maculata,* and *Cophosaurus texanus*). It was after years of observation that we came to see the apparent choice of this particular plant as a refuge. We subsequently took notes on what species utilize this spiny plant.

Cnidoscolus texanus is a member of the Euphorbiaceae and is common to sandy soils through much of Texas, Oklahoma, Louisiana, and adjacent Mexico (Pollard 1986). It grows to approximately 50 to 60 cm in height, has white flowers, and is covered with thin, stinging trichomes, 3 to 8 mm in length on the stems, fruits, and leaves (Pollard 1986). The trichomes contain serotonin and possibly other toxins (Lookadoo and Pollard 1991) that can cause allergic reactions and significant swelling in people. Internally, bull nettle has a latex which may contain the toxins b-amyrin, linamarin, and flavonol glycosides (Seigler and Bloomfield 1969, Kalterman and Brekon 1982). These trichomes and toxins

---

[1] Received on December 20, 2001. Accepted on November 11, 2003.

[2] 301 Pebblecreek Drive, Garland, Texas 75040 U.S.A. E-mail: johnstidham@acceleratedmarket.com

[3] Department of Biology, Texas A&M University, 3258 TAMU, College Station, Texas 77843-3258 U.S.A. E-mail: furcula@mail.bio.tamu.edu. Corresponding author.

Mailed on March 14, 2008

make bull nettle an excellent refuge from predators. As a result, numerous insects, especially orthopterans, utilize bull nettle.

OBSERVATIONS

Our observations show that the orthopterans that use bull nettle are taxonomically diverse (Table 1), and that they exhibit two patterns of use of bull nettle. Several species spend much or even most of their time occupying bull nettle. These species include *Neobarrettia spinosa* (Caudell) (Fig. 1, back cover), *Amblycorypha hausteca* (Saussure), *Pediodectes haldemani* (Girard), *Pediodectes nigromarginatus* (Caudell), *Dichopetala gladiator* Rehn and Hebard, *Dichopetala seeversi* Strohecker (Fig. 2, back cover), *Scudderia* spp., *Melanoplus* spp., and *Aulocara elliotti* (Thomas). Other insects (including moth caterpillars, plant bugs, and flies) and spiders (black widows and garden spiders) also spend large amounts of time on bull nettle. The other pattern of bull nettle use is occasional or opportunistic use. The orthopterans that exhibit this pattern will jump or fly into bull nettle when confronted by a predator or are otherwise disturbed. These opportunists include *Conocephalus strictus* (Scudder), *Arethaea phantasma* Rehn and Hebard, *Arethaea ambulator* Hebard, *Melanoplus femurrubrum* (DeGeer) (and other *Melanoplus* species), *Paraidemona* spp., *Schistocerca americana* (Dury), oedipodine grasshoppers, and grasshoppers in other subfamilies. At least 16 species of ensiferan and caeliferan orthopterans regularly use bull nettle as enemy-free space in Texas. Both sexes, as well as juveniles and adult orthopterans, appear to use bull nettle subequally. Exceptions to this pattern are the decreased use of bull nettle by adult *Amblycorypha hausteca* and the abandonment of bull nettle by adult *Neobarrettia spinosa.* As adults, these species are found in nearby trees and shrubs. Their changes in use may relate to a decreased need for predator deterrence by adults or another change in behavior such as the search for mates or oviposition sites.

Despite the significant utilization of bull nettle by a large number of orthopterans, bull nettle does not appear to be used by them as a host plant. It is apparently almost solely used for predator avoidance or deterrence. However, species of *Amblycorypha* and *Pediodectes* may consume some bull nettle pollen and flower parts. Some African grasshoppers are known to consume other species of *Cnidoscolus* (Idowu and Modder 1998), possibly to obtain defensive toxic chemicals. In contrast, no vegetative parts of bull nettle appear to be consumed by orthopterans, but likely are eaten by other insects. One possible exception to this bull nettle use pattern is that by *Neobarrettia spinosa. Neobarrettia spinosa* is an insect predator of orthopterans (Cohn 1965), as are other listroscelidine tettigoniids (Rentz 1995). It is likely that *N. spinosa* inhabits bull nettle both as enemy-free space, and because bull nettle is a prime microhabitat that attracts potential orthopteran prey. The occupation of bull nettle by *N. spinosa* parallels its occupation of other thorny plants such as mesquite trees (*Prosopis* spp.), and it may use those plants for the same reason that other insect predators occupy other species of nettles (Davis 1983).

Table 1. Orthopterans observed using *Cnidoscolus texanus* (Euphorbiaceae)

- Caelifera – Acrididae
  - Cyrtacanthacridinae
    - *Schistocerca americana*
  - Gomphocerinae
    - *Aulocara elliotti*
  - Melanoplinae
    - *Melanoplus femurrubrum*
    - other *Melanoplus* species
    - *Paraidemona* spp.
  - Oedipodinae spp.
- Ensifera – Tettigoniidae
  - Conocephalinae
    - *Conocephalus strictus*
  - Decticinae
    - *Pediodectes haldemani*
    - *Pediodectes nigromarginatus*
  - Listroscelidinae
    - *Neobarrettia spinosa*
  - Phaneropterinae
    - *Amblycorypha hausteca*
    - *Arethaea ambulator*
    - *Arethaea phantasma*
    - *Dichopetala gladiator*
    - *Dichopetala seeversi*
    - *Scudderia* spp.

LITERATURE CITED

Belwood, J. J. 1990. Anti-predator defences and ecology of neotropical forest katydids, especially the Pseudophyllinae. pp. 8-26. *In,* Bailey, W. J. and D. C. F. Rentz (Editors). The Tettigoniidae: biology, systematics and evolution. Springer-Verlag, New York, NY. U.S.A. 395 pp.

Cohn, T. J. 1965. The arid-land katydids of the North American genus *Neobarrettia* (Orthoptera: Tettigoniidae): their systematics and a reconstruction of their history. Miscellaneous Publications of the Museum of Zoology at the University of Michigan126:1-179.

Davis, B. N. K. 1983. Insects on nettles. Cambridge University Press. New York, NY, U.S.A. 65 pp.

Fryer, G. 1986. Enemy-free space: a new name for an ancient ecological concept. Biological Journal of the Linnean Society 27:287-292.

Idowu, A. B. and W. W. D. Modder. 1998. Preliminary chemical analyses of the repellent secretion of the African variegated grasshopper *Zonocerus variegatus.* Insect Science and Applications 18:129-137.

Jeffries, M. J. and J. H. Lawton. 1984. Enemy free space and the structure of ecological communities. Biological Journal of the Linnean Society 23:269-286.

Kolterman, D. A. and G. J. Breckon. 1982. Chemotaxonomic studies in *Cnidoscolus* (Euphorbiaceae). I. flavonol glycosides of the *C. tubulosus* complex. Systematic Botany 7:178-185.

Lookadoo, S. E. and A. J. Pollard. 1991. Chemical contents of stinging trichomes of *Cnidoscolus texanus.* Journal of Chemical Ecology 17:1909-1916.

Nickle, D. A. and J. L. Castner. 1995. Strategies utilized by katydids (Orthoptera: Tettigoniidae) against diurnal predators in rainforests in Northeastern Peru. Journal of Orthoptera Research 4:75-88.

Pollard, A. J. 1986. Variation in *Cnidoscolus texanus* in relation to herbivory. Oecologia 70:411-413.

Rentz, D. C. F. 1995. Do the spines on the legs of katydids have a role in predation? (Orthoptera: Tettigoniidae: Listroscelidinae). Journal of Orthoptera Research 4:199-200.

Seigler, D. S. and J. J. Bloomfield. 1969. Constituents of the genus *Cnidoscolus.* Phytochemistry 8:935.

Sword, G. A 1999. Density-dependent warning coloration. Nature 397:217.

SCIENTIFIC NOTE

A NEW SPIDER FAMILY RECORD FOR TURKEY (ARANEAE: ANYPHAENIDAE)1

Aydın Topçu,[2] Tuncay Türkeş,[2] Hakan Demir,[3] and Osman Seyyar[4]

ABSTRACT: The spider *Anyphaena pontica* Weiss, 1988 (Araneae, Anyphaenidae) and Anyphaenidae family are recorded from Turkey for the first time.

KEY WORDS: *Anyphaena,* new record, Anyphaenidae, Turkey

Members of the family Anyphaenidae, which resemble wolf spiders, are generally found in the foliage of trees and shrubs. The family Anyphaenidae is characterized by the particularly well-developed tracheal system, externally evident by the wide, advanced tracheal spiracle, and by claw-tufts composed of 2–8 rows of spatulate hairs (Levy, 2003).

Within Anyphaenidae, 508 species belonging to 56 genera have been described worldwide (Platnick, 2007). Although most species are found in the New World, a few species are known from the Old World (Levy, 2003; Platnick, 2007). Thus far, 613 species and 2 subspecies of spiders belonging to 43 families have been recorded in Turkey, however none of these belong to the genus *Anyphaena* Sundeval, 1833 (Topçu et al., 2005), the only genus in the family distributed in northwestern Europe (Roberts, 1995). In this paper, we add a new species to a family and a species belonging to this family to the spider fauna of Turkey.

METHODS

Spiders were collected from rolled leaves in different areas of Anatolia, Turkey. Voucher specimens, preserved in 70% ethanol, are deposited in the Arachnology Museum of Niğde University (NUAM). All illustrations were made with a Nikon SMZ-U stereomicroscope with a drawing tube. All measurements are in millimeters. General distribution of all species is given following Platnick (2007). The chorotype, or zoogeographical characterization for the species, follows Taglianti et. al. (1999).

---

[1] Received on February 8, 2007. Accepted on May 16, 2007.

[2] Nigde University, Sciences and Arts Faculty, Department of Biology, 51200-Nigde, Turkey. E-mails: (AT) aydintopcu@nigde.edu.tr, (TT) tuncayturkes@nigde.edu.tr, respectively.

[3] Gazi University, Science and Arts Faculty, Department of Biology, TR, Turkey. E-mail: hakandemir @gazi.edu.tr

[4] Erciyes University, Science and Arts Faculty, Department of Biology, TR-38039, Kayseri, Turkey. E-mail: osmanseyyar@hotmail.com

Mailed on March 14, 2008

SYSTEMATIC ARANEOLOGY

Anyphaena pontica Weiss, 1988

Figs. 1-2

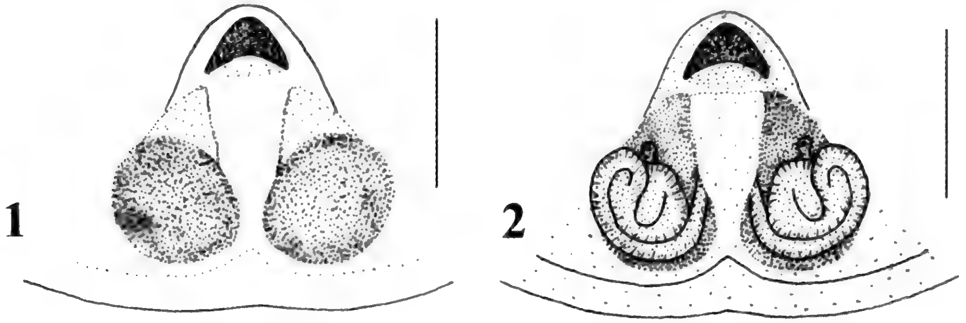
Material Examined: Turkey: 1♀ (NUAM), Ankara province, Çubuk district, Yıldırımevci village, (32° 52' E, 40° 30' N), 29.05.2003. Specimen was collected from rolled leaves.

General Distribution. Romania.

Remarks. New to Turkey. It may be distributed in southwest and central part of Anatolia. As seen above, the species mainly distributes from Romania and also occurs in southwest and central part of Turkey (the new record). The first record of this species in Romania was given by Weiss (1988). It is secondly reported throughout the world by our record.

Chorotype. This species has the European chorotype.

The morphometric measurements and other characteristic features of this species are not different from European specimens.



Figs. 1-2. *Anyphaena pontica* Weiss, 1988, 1. epigyne dorsal view, 2. vulva ventral view.

LITERATURE CITED

Levy, G. 2003. Spiders of the families Anyphaenidae, Hahniidae, Ctenidae, Zoridae, and Hersiliidae (Araneae) from Israel. Israel Journal of Zoology 49: 1-31.

Platnick, N. I. 2007. The world spider catalog. American Museum of Natural History (on-line).– http://research.amnh.org/entomology/spiders/catalog/ANYPHAENYDAE.html.

Roberts, M. J. 1995. Spiders of Britain and Northern Europe, Harper Collins Publishers, London, England, United Kingdom 383 pp.

Topçu, A., H. Demir, and O. Seyyar. 2005. A checklist of the spiders of Turkey. Serket 9(4): 109-140.

Taglianti, A. V., P. A. Audisio, M. Biondi, M. A. Bologna, G. M. Carpaneto, A. De Biase, S. Fattorini, E. Piattella, R. Sindaco, A. Venchi, and M. Zapparoli. 1999. A proposal for a chorotype classification of the Near East fauna, in the framework of the Western Palaearctic Region. Biogeographia 20: 31-59.

Weiss, I. 1988. *Anyphaena pontica* n. sp. aus Rumänien (Arachnida: Araneae: Anyphaenidae). Berichte des Naturwissenschaftlich-Medizinischen Vereins in Innsbruck 75: 143-145.

SCIENTIFIC NOTE

A REPLACEMENT NAME FOR A SUBSPECIES OF DERICORYTHINAE (ORTHOPTERA: DERICORYTHIDAE) FROM AFRICA[1]

Michael D. Maehr[2]

The intent of this note is to briefly describe the objective circumstances associated with a primary homonym, making a nomenclatural change necessary. A new name is proposed for a subspecies of grasshopper (Acridoidea: Dericorythidae: Dericorythinae) from Africa. The name *Dericorys escalerai descampsi,* **nom. nov.** is proposed as a replacement name, in honor of the work of the eminent orthopterist, Marius Descamps.

Acridoidea: Dericorythidae: Dericorythinae

Dericorys Serville 1838: 638. Type species: *Dericorys albidula* Serville 1838: 639 by original monotypy.

Dericorys escalerai descampsi, nom. nov.

Dericorys was originally described by Serville 1838: 638 for a single species. Although not figured, the female specimen described was named *Dericorys albidula* (p. 639), having a type locality and depository of "Egypte. Mont-Liban. Det la collection du Museum d'histoire naturelle et de la miene" (p. 640). It is worth noting that the subsequent type designation by Kirby (1910: 382-383) and followed by others (e.g. Dirsh 1965: 181) is invalid, with the type species by original monotypy taking precedence (ICZN, 1999, Art. 68.3).

In 1936, Bolivar established a new genus and single new species (p. 412) *Corystoderes escalerai,* closely related to *Dericorys.* In 1970, Descamps (p. 25) synonomized *Corystoderes* under *Dericorys* listing *D. escalerai* (Bolivar) as a new combination. He also split the species into subspecies based on the presence of blue vs. honey-yellow posterior tibiae, giving the new subspecies the name *D. escalerai luteipes* and designating it as a new subspecies both in the key (p. 26) and when describing it more fully on the following page (p. 27). Unfortunately, the new subspecies *Dericorys escalerai luteipes* Descamps, 1970 (nec *Dericorys lobata luteipes* Uvarov, 1938) is a primary homonym, a subspecies with the same name being described by Uvarov over 30 years earlier. *Dericorys*

---

[1] Submitted on May 17, 2007. Accepted on June 3, 2007.

[2] Illinois Natural History Survey, Division of Biodiversity & Ecological Entomology, 1816 S. Oak Street, Champaign, Illinois 61820 U.S.A. E-mail: maehr@uiuc.edu.

Mailed on March 14, 2008

lobata luteipes Uvarov, 1938 is also listed by Descamps on page 26, as part of a key for *Dericorys* species from Northern Africa (type locality Fuertaventura), with the earlier subspecies described by Uvarov having priority (ICZN, 1999, Art. 57).

Therefore, the name *Dericorys escalerai descampsi,* **nom. nov.** is provided for the subspecies described by Descamps based on a male holotype from Zouaouia in Saharan Morocco, and deposited at the Paris Museum.

ACKNOWLEDGEMENTS

I would like to thank the colleagues and reviewers who commented on earlier versions of this note, although any errors remain my full responsibility.

LITERATURE CITED

Bolivar, I. 1936. Apuntes para la fauna entomológica de Ifni (Ortópteros). Eos, Revista Española de Entomologia. 11:395-426, plates XVII-XXI.

Descamps, M. 1970. Bulletin de la Societe Entomologique de France. 75:24-36.

Dirsh, V. M. 1965. African Genera of Acridoidea. Cambridge University Press. London, England, U.K. 579 pp.

International Commission on Zoological Nomenclature. 1999. International Code of Zoological Nomenclature. 4th Edition. The International Trust for Zoological Nomenclature. London, England, U.K. 306 pp.

Kirby, W. F. 1910. Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, Locustidae vel Acridiidae). Volume 3. The Natural History Museum. London, England, U.K. 674 pp.

Serville, J. G. A. 1838 [1839]. Histoire naturelle des insectes. Orthoptères. Libraire Encyclopèdique de Roret. Paris, France. 776 pp.

Uvarov, B. P. 1938. Annals and Magazine of Natural History, London (Series 11 1938-1947) 11(2): 599-606.

continued from front cover

SCIENTIFIC NOTES

Fig. 1. Female *Dichopetala seeversi* Strohecker on Bull Nettle.

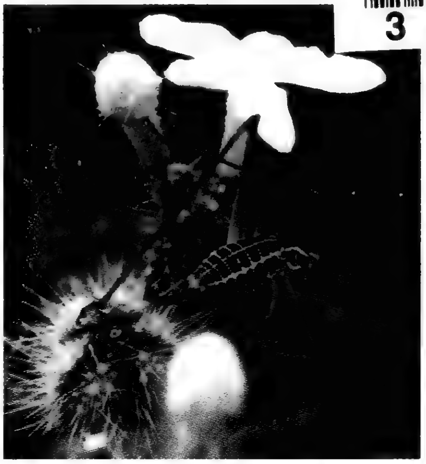


Fig. 2. Immature male *Neoberrettia spinosa* (Caudell) on Bull Nettle.

See article on page 102 for additional information about the two pictures above.

THE AMERICAN ENTOMOLOGICAL SOCIETY

www.acnatsci.org/hosted/aes

ne 119 Number 2

n and April 2008

Entomological News

SCIENTIFIC NOTES

continued on back cover

USISSN 0013-872X

Mailed May 14, 2008

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS

ISSN 0013-872X

Entomological News is a fully refereed scientific international journal published by The American Entomological Society (AES). Manuscripts on systematics, ecology, evolution, morphology, physiology, behavior, biodiversity, conservation, paleobiology, and other aspects of insect and terrestrial arthropod life as well as nomenclature, biographies and history of entomology, among others, are appropriate topics for papers submitted to *Entomological News*. Papers on applied, economic, and regulatory entomology or on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields. In accordance with the spirit and letter of international codes of biological nomenclature, the Editor of *Entomological News* recommends that name-bearing types and representative (voucher) specimens be deposited in collections where such specimens are well curated and available to qualified researchers.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February, and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pennsylvania (U.S.A.), while the October and March meetings are held at the Department of Entomology of the University of Delaware in Newark, Delaware (U.S.A.). Society members who reside in southeastern Pennsylvania, southern New Jersey, and Delaware are urged to attend the meetings whenever possible. Members outside this area as well as guests are cordially invited and welcomed. Information on the Calvert Award for insect-related study by a young person in the Delaware River Valley region sponsored by The American Entomological Society can be found at: http://www.udel.edu/chem/white/Odonata/CalvertAwd.html.

Membership (http://www.ansp.org/hosted/aes/Acrobat/Membership_Form.pdf): Membership to the AES is open to anyone. Annual dues are US$20.00 (regular members) and US$12.00 (student members).

United Stated Postal Service (USPS) Identification Statement: *Entomological News* (ISSN 0013-872X) is published bimonthly, except July-August, by The American Entomological Society. The subscription is not included with the annual dues. The subscription price is US$15.00 per year, prepaid, for members, US$30.00 per year, prepaid for institutional library subscribers located in the U.S.A. and US$34.00 per year, prepaid for institutional library subscribers located out of the U.S.A. Periodicals Postage Paid at Philadelphia, Pennsylvania 19103 U.S.A. and additional mailing offices. The known **Office of Publication** is: Office Manager, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 United States of America. **POSTMASTER:** Send address changes to the Office of Publication.

Subscriptions to current issues, back issues, and microforms of *Entomological News*. Please send inquiries or send completed membership form to the Office of Publication, e-mail: aes@acnatsci.org, or call (215) 561-3978. *Entomological News* is available in microform from ProQuest Information and Learning. Call toll-free (800) 521-3042, (800) 521-0600, (734) 761-4700. Mail inquiry to: ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106-9866 U.S.A. The webpage of ProQuest is: www.proquest.com.

Any author may submit papers. Manuscripts will be accepted from any author, although, papers from members of the American Entomological Society are given priority. Authors are urged to read the guidelines to the authors carefully (http://www.geocities.com/entomologicalnews/intructions.htm) and contact the Editor for any changes that may not have been uploaded. It is suggested that all prospective authors join the AES.

Send manuscripts, books for review, and all editorial correspondence to the Editor. All manuscripts, including scientific notes and book reviews, submitted for publication in *Entomological News* as well as all associated editorial communications must be sent electronically to the Editor, Jorge A. Santiago-Blay at: blayjorge@gmail.com. E-mail is the preferred way to contact the Editor and the fastest way to get a reply. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible.

Previous Editors of *Entomological News*: 1(1) January 1890 and 1(2) February 1890, Eugene Murray Aaron (1852-1940); 1(3) March 1890 to 21(10) December 1910, Henry Skinner (1861-1926); 22(1) January 1911 to 54(9) November 1943, Phillip P. Calvert (1871-1961); 54(10) December 1943 to 57(10) December 1946, Editorial Staff with A. Glenn Richards (1909-1993) and R. G. Schmieder (1898-1967) as co-Editors; 58(1) January 1947 to 79(7) July 1968, R. G. Schmieder; 79(8) October 1968 to 83(10) to December 1972, Ross H. Arnett, Jr. (1919-1999); 84(1) January 1973 to 85(4) April 1974, R. W. Lake; 85(5-6) May & June 1974 to 113(3) May & June 2002, Howard P. Boyd; 113(4) September & October 2002 to 113(5) November & December 2002, F. Christian Thompson and Michael Pogue.

Cover Design by Jane Spencer

Mailed on May 14, 2008

A GIGANTIC BIOLUMINESCENT STARWORM (COLEOPTERA: RHAGOPHTHALMIDAE) FROM NORTHWEST YUNNAN, CHINA[1]

Xue-Yan Li[2] and Xing-Cai Liang[2*]

"Starworm" is the common name for larvae and larviform females of the rhagophthalmid genus *Diplocladon* (Haneda, 1950; 1985). Such a name results from their three longitudinal rows of lights, one dorso-central and two laterals, produced by three spot-like light organs located on contiguous body segments (Harvey, 1952; Braham and Wenzel, 2001; Ohba, 2004). Although *Diplocladon* was erected by Gorham in 1883, only two species (*D. hasseltii* Gorham, 1883, and *D. haplocladon indicum* Gorham, 1903) have been reported from India and Indonesia (Wittmer, 1944). *Diplocladon hasseltii* is known from both sexes (Haneda, 1950), but *D. haplocladon indicum* Gorham known only from the male. In addition, Harvey (1952) thought that luminous larvae or larviform females of a few unidentified species of *Diplocladon* (some up to 5 cm long) lived in Hangzhou (Zhejiang Province, China, Waterhouse, 1889) and Malaya (Gahan, 1924). Ridley (1934) also dealt with some *Diplocladon* larva from Singapore and pointed out the large (also circa 5 cm long) luminous insects of Clark (1865) from India belonged in this genus. Because *Diplocladon* males are nonluminous, they are less commonly collected and correctly associated with the conspecific females. Females and larvae are usually edaphic and relatively cryptic, making them also difficult to collect. Perhaps, the scarcity of specimens has made the systematics of *Diplocladon* problematic. For instance, *Diplocadon* has been placed in the Drilidae (Gorham, 1883; Olivier, 1910; Wittmer, 1944; Harvey, 1952), Phengodidae (Crowson, 1972), or Rhagophthalmidae (Lawrence et al., 2000; Branham, 2000). Herein, we follow Lawrence et al. (2000).

Having been woken up by his barking dog at midnight, Mr. Guojian Liao, a coal worker at the Tongda Coal Company, found a luminous object on a slope about 50 meters from his home [Baiguhe Village, Tongda Township, Huaping County, Lijiang Prefecture, Yunnan Province, China (N26.75541°, E101.10284°; 2234 m)] on June 6, 2006. The object turned out to be a gigantic (circa 9 cm long) luminous worm. At first sight, its body shape and coloration are very similar to those of larvae and larviform females of the luminous beetle genus *Rhagophthalmus* (Rhagophthalmidae). *Rhagophthalmus* larvae are predatory but larviform females rarely feed (Ohba, 1997). The luminous worm was kept in a bottle

---

[1] Received on May 12, 2007. Accepted on August 14, 2007.

[2] Kunming Institue of Zoology, The Chinese Academy of Sciences, 32 Jiaochang Donglu, Kunming, Yunnan, 650223 China. E-mails: lixy@mail.kiz.ac.cn; liangxc@mail.kiz.ac.cn, respectively. Author X-CL is the corresponding author.

ENTOMOLOGICAL NEWS 119 (2): 109, March and April 2008
Mailed on May 14, 2008

with some soil and litter, and on June 16, 2006, it was given to author Li who reared it in a box with soil and litter. After one day, it dug a hole and stayed inside almost all the time. Because at first, we could not tell whether this luminous worm was a larva or a larviform female or whether its feeding traits were like those of *Rhagophthalmus*, some *Eisenia fetida* Savigny earthworms and some unidentified snails bought from a market, which we often use as food for firefly larvae, were added into the box. The earthworms and snails, however, were not eaten by the luminous worm.

We suspected this luminous worm was not a larva but a larviform adult female. The female died on July 10, 2006. The specimen is deposited in Kunming Institute of Zoology (KIZ), of the Chinese Academy of Sciences, Kunming,Yunnan, China. The authors and their colleagues returned to the collection site in July 13, 2006, to collect more larvae and adults but they were unsuccessful. Thereafter, we compared the starworm with descriptions of *Diplocladon* as well as *Rhagophthalmus* and consulted with Dr. N. Ohba (formerly in Yokosuka City Museum, now retired) during his visit to our institute. We believe that this luminous worm belongs in the genus *Diplocladon* and is definitely a female adult. This is only the second starworm found in China, and it is possibly the largest starworm ever reported in the world. Herein, we briefly describe this *Diplocladon* sp., as follows.

DESCRIPTION OF THE GIGANTIC LARVIFORM FEMALE

Body length 90 mm (Fig. 1, back cover). Yellowish when alive; head capsule brown; mandibles dark brown. Head small (ca. 3.5 mm in length and 4.8 mm in width); compound eyes absent; antennae borne on raised tubercles, filiform, 6-segmented; clypeo frontal area deeply emarginated distally; mandibles well developed, narrow, elongate, mandibular apex curved mesally; maxillary palp 4-segmented; labial palp 3-segmented. Pronotum trapezoid, with medial sulcus; meso- and metanotum sub-rectangular, both with medial sulcus; legs 5-segmented. Abdomen 10-segmented; 1-8 similar in shape and size, and each with a pair of spiracles on the middle of each pleurite; 9th narrow, without spiracles; 10th columnar, without spiracles. Luminous organs uniformly distributed in almost all segments. Dorsally, pronotal luminous organ vestigial anteriorly; from mesonotum to abdominal segment 8, luminous organs found in almost all-over nota with dorsocentral and two lateral of each notal posterior edge highly concentrated (Fig. 1, back cover); segment 9 with only two small spots laterally; segment 10 lacking obvious organs. Mesotharax to abdominal segment 8 pleurite with luminous organs. Ventrally, irregular, vestigial luminous organs found from prothorax to abdominal segment 8.

Because this larviform female lacks highly developed luminous organs on sternite 7, it is excluded from *Rhagophthalmus* which it resembles morphologically and biogeographically. As it has three longitudinal rows of strong lights (Haneda, 1950; 1985), we place it in *Diplocladon*. Ohba et al. (1996) showed three longitudinal rows of lights from mesonotum to tergite 8, though very weak, also exist in larviform adult females of *Rhagophthalmus*.

At night or in a dimmed room during the daytime, the luminous organs produce three beautiful longitudinal rows of continuous yellowish green lights (one dorsally and one on each side) from the mesothorax to abdominal segment 8 (Fig. 2, back cover). The lights on the pronotum, on abdominal segments 9-10, and ventrally were not observed in the dimmed room during daytime, possibly due to their relatively undeveloped luminous organs. Our recent observations on typical *Rhagophthalmus* larviform females (Fig. 3, back cover) collected in Gaoligong Mountains of northwest Yunnan further indicate that, except for strong lights on sternite 7 and weak lights from mesonotum to abdominal segment 8, *Rhagophthalmus* females can produce two light spots on the lateral edges of abdominal segment 9 (Fig. 4, back cover) similar to those of *Diplocladon*. Biogeographically, *Diplocladon* and most species of *Rhagophthalmus* occur in India, southeast Asia, and the East Indies (Lawrence et al., 2000; Li et al., 2007). The Oriental region is possibly the center of distribution of the Rhagophthalmidae because other confamilial genera, such as *Dioptoma* Pascoe, 1862, *Mimochotyra* Pic, 1937 and *Menghuoius* Kawashima, 2000, are also endemic to this region. Further studies on *Diplocladon* and other genera of the Rhagophthalmidae, especially in the Himalayas, may provide insights into the phylogeny of these luminous coleopterous insects.

ACKNOWLEDGEMENTS

We are grateful to Mr. Guojian Liao for giving us this interesting starworm and to Mr. Xiaofeng Ma and Mr. Qingpai Hou for preparing the illustrations.

LITERATURE CITED

Branham, M. A. and J. W. Wenzel. 2001. The evolution of bioluminescence in Cantharoids (Coleoptera: Elateroidea). Florida Entomologists 84(4): 565-586.

Clark, R. H. 1865. (Larva of *Lampyris.*) Proceedings of the Entomological Society of London 1865: 101-102. No title found in original of this artricle. The bibliographic rendering of Ridley (1934) has been followed.

Crowson, R. A. 1972. A review of the classification of Cantharoedea (Coleoptera), with the definition of two new families, Cneoglossidae and Omethidae. Revista de la Universidad de Madrid 21 (82): 35-77.

Gahan, J. C. 1924. Living fireflies from Argentina. Proceedings of the Entomological Society of London 1924: 5-7.

Gorham, H. S. 1883. Description of a new genus and species of the colopterous family Drilidae. Notes from the Leyden Museum 5: 5-6.

Gorham, H. S. 1883. A new subgenus of the coleopterous family Drilidae. Notes from the Leyden Museum 5: 249-250.

Gorham, H. S. 1903. On Coleoptera collected in India. Families Malacodermata, Erotylidae, Endomychidae and Coccinellidae. Annales de la Société Entomologique de Belgique 47: 323-347.

Haneda, Y. 1950. Starworm in Singapore. Shin-Konchû, Tokyo 3: 2-5 (In Japanese).

Haneda, Y. 1985. Luminous Organisms. Kôseisha-Kôseikaku Publishing Company. Tokyo, Japan. 318 pp.

Harvey, E. N. (Editor). 1952. *Bioluminescence.* Academic Press. New York, N.Y. U.S.A. 649 pp.

Kawashima, I. 2000. A redescription of *Rhagophthalmus ingens* Fairmaire (Coleoptera, Rhagophthalmidae) from northern Vietnam, with establishment of a new genus in the family. Elytra, Tokyo 28: 131-140.

Lawrence, J. F. and A. F. Newton Jr. 1995. Families and sub-families of Coleoptera (with selected genera, notes references and data on family-group names), pp. 849-861. *In,* J. Pakaluk and S. A. Slipinski (Editors). Biology, phylogeny, and classification of Coleoptera. Papers Celebrating the 80th Birthday of Roy A. Crowson. Muzeum i Instytut Zoologii Polska. Akademia Nauk ul. Wilcza, Warszawa, Poland. 1092 pp.

Lawrence, J. F., A. M. Hastings, M. J. Dallwitz, T. A. Paine, and E. J. Zurcher. 2000. Onwards. Elateriformia (Coleoptera): descriptions, illustrations, identification and information retrieval for families and subfamilies. http://biodiversity.uno.edu/delta/

Li, X. Y., M. Xie, and X. C. Liang. 2008. Rhagophthalmid - one special kind of fireflies. Entomological Knowledge (in press). (In Chinese)

Ohba, N., Y. Goto, and I. Kawashima. 1996. External morphology and behavior of *Rhagophthalmus ohbai* Wittmer, 1994 (Coleoptera; Rhagophthalmidae) and its habitat. Science Report of the Yokosuka City Museum 44: 1-19.

Ohba, N. 1997. Breeding of the firefly, *Rhagophthalmus ohbai* (Coleoptera: Rhagophthalmidae). Science Report of the Yokosuka City Museum 45: 51-55.

Ohba, N. (Editor). 2004. Mystery of Fireflies. Yokosuka City Museum. Kanagawa, Japan. 199 pp.

Olivier, E. 1910. Rhagophthalmidae, Drilidae. *In,* W. Junk and S. Schenkling (Editors). Coleopterorum Catalogus. Pars 10, W. Junk. Berlin, Germany. 10 pp.

Ridley, H. N. 1934. Further observations made in Singapore, upon Geckos and distasteful moths and upon a luminous Coleopterous, probably Rhagophthalmid, Larva. Proceedings of the Royal Entomological Society of London 9: 58-60.

Waterhouse, C. O. 1889. (Larva of *Phengodes.*) Proceedings of the Entomological Society of London 1889: 30. No title found in original of this artricle. The bibliographic rendering of Harvey (1952) has been followed.

Wittmer, W. 1944. Catalogue des Drilidae. E. Oliv. (Coleoptera-Malacodermata). Revista de la Sociedad Entomolológica Argentina 12: 203-221.

TWO NEW SPECIES OF *DELIA*, WITH A KEY TO THE MALES OF THE WORLD SPECIES OF THE *INTERFLUA* GROUP (DIPTERA: ANTHOMYIIDAE)[1]

Wan-qi Xue[2] and Jing Du[3]

ABSTRACT: Two new species of the *Delia interflua* group are described, *Delia absidata* Xue and Du, sp. nov., and *Delia subinterflua* Xue and Du, sp. nov. The group is briefly discussed and a key to all the known species is presented.

KEY WORDS: Diptera, Anthomyiidae, *Delia, interflua* group, new species

The genus *Delia* was established by Robineau-Desvoidy (1830) (as a subgenus of *Hylemyia*) and *Delia floricola* was designated as type species by Coquillett (1910). It is essentially Holarctic in distribution. The Nearctic species have been listed by Griffiths (1991) and the Palaearctic species by Dely-Draskovits Á. (1993). Since then, many species have been described from China, which have been summarized by Xue (in Xue and Chao, 1996).

Delia is one of the largest genera of Anthomyiidae. Since the primary subdivision of *Delia* is still unclear, it seems premature and unwise to formally recognize the subgenera. Griffiths (1991) recognized a series of eight sections occurring in the Nearctic Region, including the *D. interflua* section. Eleven of the twelve previously described species are Palaearctic, viz. *D. interflua* (Pandellé), *D. kullensis* (Ringdahl), *D. kumatai* Suwa, *D. pansibirta* Jin and Fan, *D. fulviposticrus* Li and Deng, *D. spicularis* Fan, *D. brevipalpis* Xue and Zhang, *D. nemostylata* Deng and Li, *D. duplicipectina* Fan, *D. conjugata* Deng and Li, *D. stenostyla* Deng and Li. In addition, the descriptions of two new Palaearctic species of this section are given, viz *D. absidata* Xue and Du, sp. nov., *D. subinterflua* Xue and Du, sp. nov. A single Nearctic member of this section is *D. abstracta*. The biology of *D. kullensis* is different from *D. abstracta*. The paper is well characterized by constitutive modification of some abdominal and postabdominal structures: the apices of the processes of the 5th sternite widen and rounded, cercal plate with long setae, surstyli elongated except for *D. kullensis*, and mostly the acrophallus (more or less longitudinally directed) is supported by a sclerotized bridge between the bases of the free paraphallic processes, the sclerotized bridge is prolonged downwards, forming a membranous process.

The species of the *D. interflua* group are essentially Palaearctic in distribution. They are found in bright and dry weather, but also adapt to low temperature conditions. All Chinese species were collected on the Tibetan Plateau which is located

---

[1] Received on June 3, 2007. Accepted on September 12, 2007.

[2] Institute of Entomology, Shenyang Normal University, Shenyang, 110034, China. E-mail: xwqfly@sina.com.

[3] Institute of Entomology, Shenyang Normal University, Shenyang, 110034, China. E-mail: fangsong1206@163.com.

Mailed on May 14, 2008

between 26°12'41" and 39°46'50"N, 73°18'52" and 104°46'59"E. With an average elevation of 4900 m above sea level the Tibetian Plateau is the highest region on earth and on the basis of the special features of its natural conditions, it was termed as "the third pole of the world" (Xue et al., 2007). The species of the group in China may fully reflect the unique geological, geographical and biological features of the Tibetan Plateau. The species in other regions are distributed in the similiar natural condition.

METHODS

The morphological terminology is given according to McAlpine (1981). Abbreviations for morphological terms used in this study are: *acr,* acrostichal setae; *ad,* anterodorsal setae; *av*, anteroventral setae; *dc,* dorsocentral setae; *ial*, intra-alar setae; *p,* posterior setae; *pd,* posterodorsal setae; *post acr,* postsutural acrostichal setae; *post dc*, postsutural dorsocentral setae; *pra,* prealar setae; *prst acr,* presutural acrostichal setae; *prst dc,* presutural dorsocentral setae; *pv,* posteroventral setae; and R_{4+5}, branch of Radius. Other abbreviations used are: fig., figure; and mt., mountain.

The type specimens of the two new species described herein were deposited in the dipterological collection of Institute of Entomology, Shenyang Normal University, China. (IESNU).

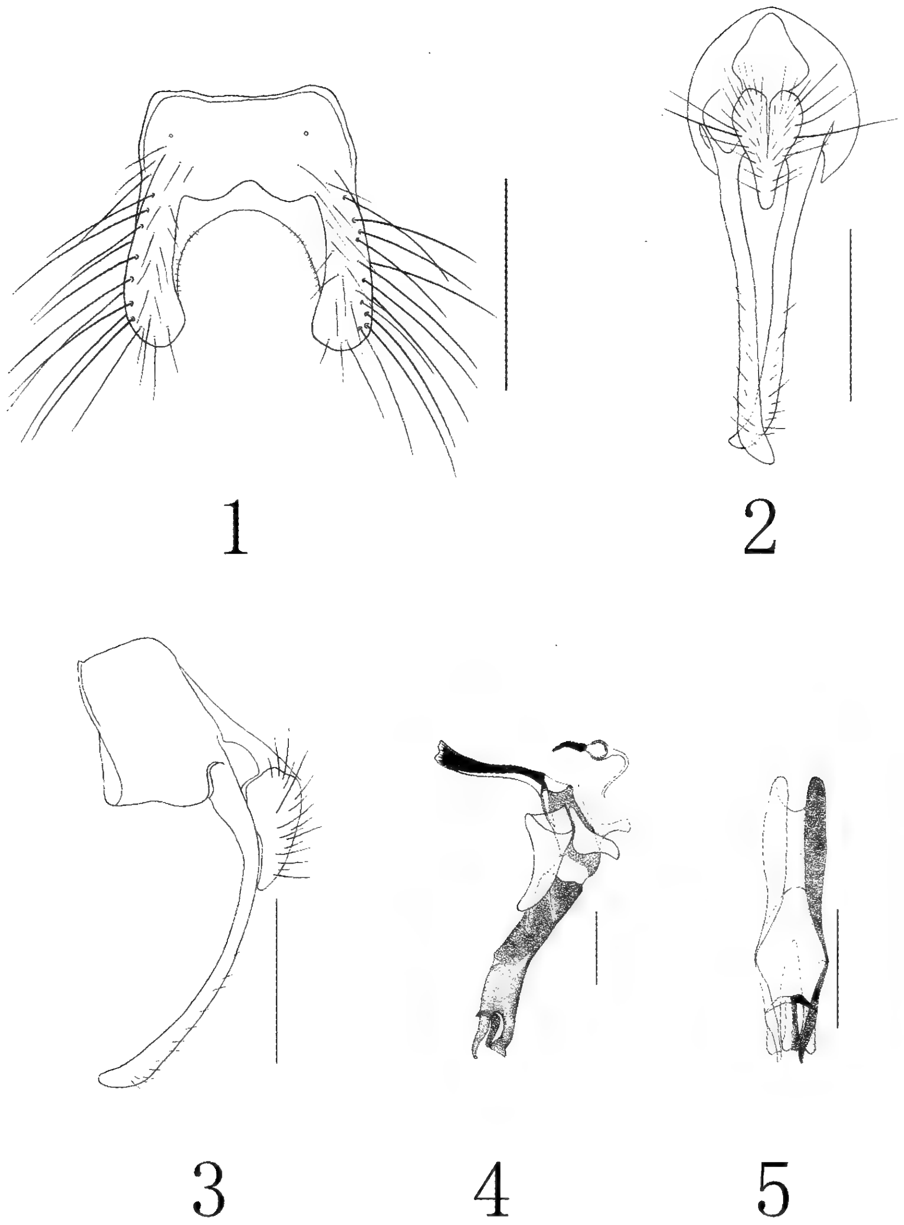
SYSTEMATIC ENTOMOLOGY

Delia absidata **Xue and Du, sp. nov.**

(Figs. 1–5)

Description: Male. Body length 7.5 mm. Eye bare; frontal vitta black, obliterated in upper half; frons about equal or shorter than width of anterior ocellus; frontal vitta with a pair of interfrontal setae; without orbital setae; frontal setae 6 pairs; fronto-orbital plate and parafacial with silver white pruinosity, parafacial wider than postpedicel; antenna black, postpedicel about twice as long as broad; arista short ciliated, the longest aristal hairs equal to its basal diameter; facial ridge low and flat, lower facial margin not projecting, vibrissal angle placed behind frontal angle in profile; gena with light gray pruinosity, genal height about 2/9 of eye height; anterior margin of gena with 2 rows of upcurved subvibrissal setulae; postocular setae extending to ventral surface, epicephalon haired; palpus slender and black, about 3/5 length of prementum, prementum black and shiny, at most with fine pruinosity, about 4.0 times as long as broad.

Thorax. Black in ground color, with brownish-gray pruinosity; scutum with 3 distinct black vittae; *prst acr* 1(2) distinct, only 1 pair of *post acr* developed which are placed in front of scutellum, *dc* 2+3, *ial* 0+2, with 1 pair of weak outer posthumeral setae; *pra* developed, about 1.5 times as long as posterior notopleural seta; scutellum without spots, ventral margins with some long pale hairs apically; anterior anepisternal setae absent; notopleuron, basisternum of prosternum, anepime-



Figs. 1–5. *Delia absidata* Xue and Du, sp. nov. (male). 1. Sternite 5 in ventral view, scale bar = 0.5 mm. 2. Terminalia in posterior view, scale bar = 0.5 mm. 3. Terminalia in profile, scale bar = 0.5 mm. 4. Aedeagus in profile, scale bar = 0.2 mm. 5. Distal part of aedeagus in anterior view, scale bar = 0.2 mm.

ron, meron and katepimeron all bare; anterior and posterior spiracles fuscous, posterior spiracle short; katepisternal seta 1+2.

Wing. Base and basicosta brown, vein fuscous; Costa setulose only basally on ventral surface; costal spine shorter than length of crossvein r-m; radial node bare, calypteres brownish-yellow, lower calypter not projecting, equal or smaller than upper; halter yellow.

Legs. Entirely black; fore tibia with 1 medial *pv*, without distinct *ad*; mid femur without *av* row, a row of *pv* in basal half, 2–3 pre-apical *pd*; mid tibia without *av* or *ad*, 2 *pd* and 1 *pv*; mid tarsomere 1 with row of long *pd*, at least 1.5 times as long as its diameter; hind femur with a complete row of *av*, becoming long apically, with 1 *pv* in basal part, and 2–3 *pv* in distal part; hind tibia with 7–8 *av*, 6–7 *ad*, 4 *pd*, and a row of hairlike *pv* from sub-basal to pre-apical, becoming short apically, without apical *pv*; all tarsi shorter than tibiae, claws subequally long as pulvilli.

Abdomen. Black, elongated cone-shaped, slightly flat, sparsely with blue gray pruinosity; all tergites with T-shaped spots, medial vitta narrower than width of hind tibia; tergite 6 bare; sternite 1 with long hairs, 3rd and 4th sternites without dense and long setae; sternite 5 processes narrow in most specimens, and wide in several; cercal plate with 1 pair of strong setae, surstyli slender medially distal part not swollen anteriorly in lateral view, posterior margin and apical part with distinct setae, postgonite without short hairs on anterior margin; acrophallus supported by a sclerotized bridge between bases of free paraphallic processes, this bridge without membranous process.

Female. Unknown.

Type Data: Holotype, male, CHINA: Yunnan Province, Shangri-La, Bita Sea, 3700m, 2. vii. 2006 (Bai-feng Wang) (IESNU). *Paratypes,* CHINA: 5 males, same data as holotype.

Remarks: This new species is morphologically similar to *Delia abstracta* (Huckett 1965), but differs from the latter in having legs entirely black; hind femur with a complete row of *av* and 1 *pv* in basal part.

Etymology: The specific name is from the Latin word *absidata,* bow, referring to the surstyli being bowed in lateral view.

***Delia subinterflua* Xue and Du, sp. nov.**

(Figs. 6–17)

Description: Male. Body length 4.0–5.5 mm. Eye bare; frontal vitta red brown in lower part, remaining black, about equal to width of fronto-orbital plate; frons about 1.5 times as wide as anterior ocellus; frontal vitta with a pair of distinct interfrontal setae; without orbital setae; frontal setae 6–7 pairs, situated in lower 3/5 of frons; fronto-orbital plate, parafacial with fuscous pruinosity, parafacial about 1.5 times as wide as postpedicel; antenna black, postpedicel about 1.7–2.0 as long as broad; arista short ciliated, the longest aristal hairs shorter than its basal diameter; facial ridge low and flat, lower facial margin not projecting, vibrissal angle placed behind frontal angle in profile; gena with gray pruinosity, genal height about 1/4 of eye height; anterior margin of gena with 1 row of upcurved subvibrissal setulae; postocular setae extending to ventral surface, epicephalon haired; para-occipital and postgenal hairs black; palpus fuscous, about 1/2-3/4 length of prementum, prementum shining, about 5.0 times as long as broad.

Thorax. Black in ground color, scutum black, only postpronotal lobe with gray pruinosity, scutum distinctly with 3 black vittae; 2 rows of hairlike *prst acr*, *dc* 2+3, *ial* 0+2, *pra* about 1.4 times as long as posterior notopleural seta; scutellum without spots, ventral margins with some brown hairs apically, basal scutellar setae and apical scutellar setae developed; notopleuron, basisternum of prosternum, anepimeron, meron and katepimeron all bare; both anterior and posterior spiracles small and fuscous; katepisternal seta 1+2.

Wing. Base fuscous, basicosta fuscous; costa setulose only basally on ventral surface; costal spine short; radial node bare; calypteres brownish-yellow, marginal hairs long and light yellow, lower calypter not projecting, only about 1/3 length of upper; halter brownish-yellow.

Legs. Entirely black; fore tibia with 1 medial *pv*, preapical *d* short; mid femur without distinct *av*, with a row of long *pv* in basal half; mid tibia with 2(1) *pd* and 2 *pv*; hind femur with complete rows of *av* and *pv*, *av* row becoming long apically; hind tibia with 5–6 *av*, 3–4 *ad*, a row of *pd* (3 developed), and a row of pectinated *pv* (about 20), becoming short apically, forming 2 rows in basal 1/3, without apical *pv*; all tarsi shorter than tibiae, claws and pulvilli large, subequal to of 5th tarsomere in length.

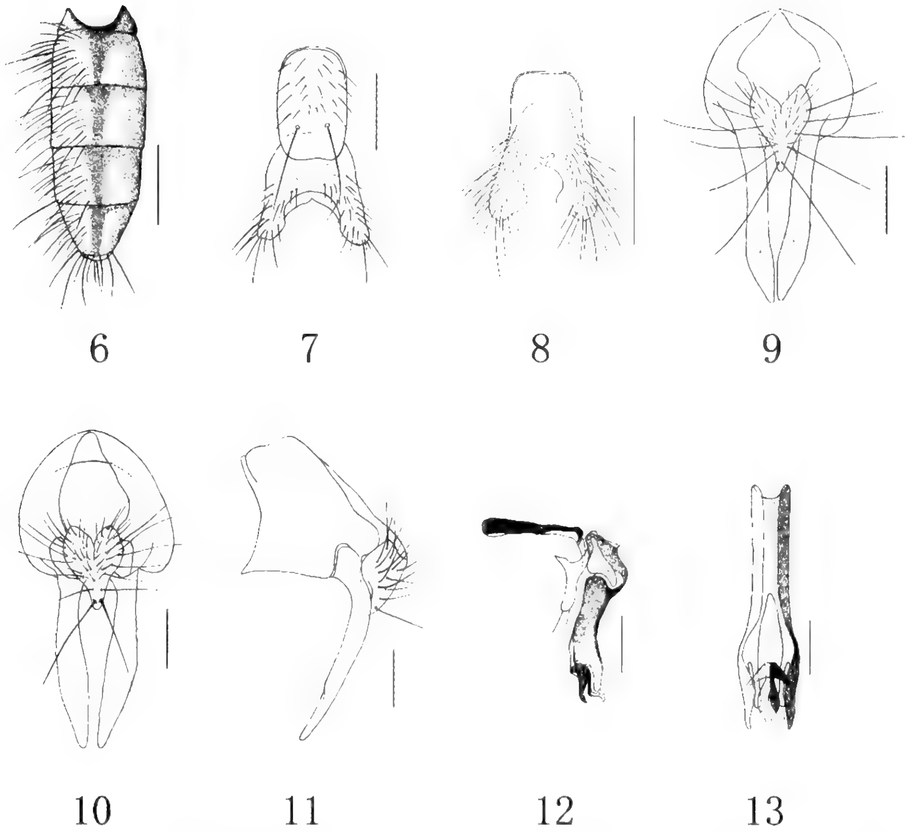
Abdomen. Slender, columniform, with blue-gray pruinosity, body hairs long and dense; all tergites with T-shaped spots, tergite 6 bare; sternite 1 with long dense fringe, sternite 4 sometimes with a pair of long setae, inner margin of distal part of sternite 5 processes projecting; pregonite with 2 setae, cercal plate broad at basal half, trianglular, surstyli slender and slightly curved, becoming broad apically in posterior view, aedeagus strongly sclerotized; acrophallus supported by sclerotized bridge between bases of free paraphallic processes, this bridge prolonged downwards, forming a membranous process.

Female. Body length 5.0–5.5mm. Frons about 0.4 times as wide as head; frontal vitta about 2.2–2.6 times as wide as fronto-orbital plate; frontal triangle reaching the middle part of frons; frontal setae 3 pairs and orbital setae 3 pairs; fronto-orbital plate, parafacial with brownish-gray pruinosity; genal height about 1/3 of eye height; scutum with fuscous pruinosity; basicosta fuscous; fore tibia with 1 medial *ad*; mid tibia with 1 pre-apical *av* and 2 *ad*; hind tibia with 3–4 *av* and a row of seta-like *pv* in middle part, about 8–9; all claws and pulvilli small; all abdominal tergites with badly developed medial vittae. The other characters are the same as in male.

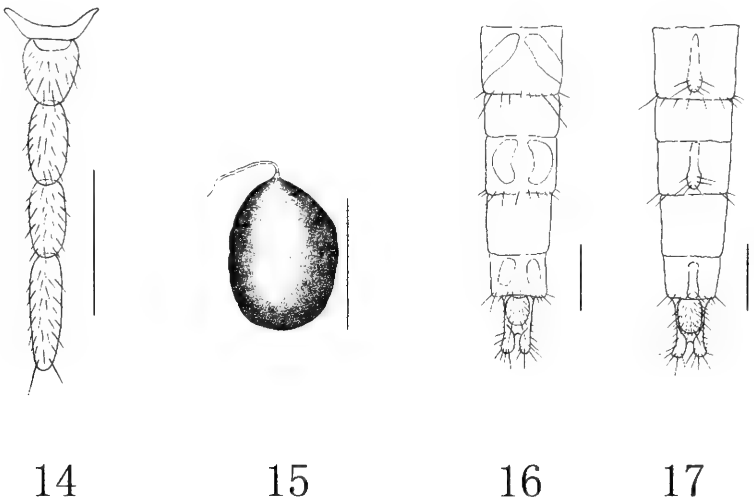
Type Data: Holotype, male, CHINA: Yunnan Province, Yulong Snowberg, Big ropeway, 4571 m, 29. vi. 2006 (Ming-fu Wang) (IESNU). *Paratypes,* CHINA: 2 male, Yunnan Province, Baimang Snowberg, 4000–4300m, 4. vii. 2006 (Liang Chang) (IESNU); 1 male, Sichuan Province, Mt. Balang, 4600m, 3. viii. 2005 (Hu Ao) (IESNU); 7 females, same data as holotype.

Remarks: This new species is morphologically similar to *Delia interflua* (Pandellé, 1900), but differs from the latter in having bare eyes; anterior margin of gena with 1 row of upcurved subvibrissal setulae; calypteres and halter brown-yellow; cercal plate broad at basal half.

Etymology: This new species is similar to *Delia interflua* (Pandellé, 1900). Hence, its epithet is derived to reflect this relationship.



Figs. 6–13. *Delia subinterflua* Xue and Du, sp. nov. Male: 6. Abdomen in dorsal view, scale bar = 1 mm. 7. 4th and 5th sternites in ventral view (species in Sichuan Province), scale bar = 0.5 mm. 8. 5th sternite in ventral view (species in Yunnan Province), scale bar = 0.5 mm. 9. Terminalia in posterior view (species in Yunnan Province), scale bar = 0.2 mm. 10. Terminalia in posterior view (species in Sichuan Province), scale bar = 0.2 mm. 11. Terminalia in profile, scale bar = 0.2 mm. 12. Aedeagus in profile, scale bar = 0.2 mm. 13. Distal part of aedeagus in anterior view, scale bar = 0.1 mm.



Figs. 14–17. *Delia subinterflua* Xue and Du, sp. nov. Female: 14. Sternites 1 to 5, scale bar = 1 mm. 15. Spermatheca, scale bar = 0.1 mm. 16. Ovipositor in dorsal view, scale bar = 0.5 mm. 17. Ovipositor in ventral view, scale bar = 0.5 mm.

Delia fulviposticrus Li and Deng, 1981 Supplemental Description

(Figs. 18–24)

Description. Male. Body length 8–9 mm. Eye bare; frontal vitta red brown, obliterated at middle part; frons narrower than anterior ocellus; frontal vitta with a pair of interfrontal setae; without orbital setae; frontal setae 6–7 pairs, situated on lower half; fronto-orbital plate and parafacial brown in ground color, with silver gray pruinosity, parafacial slightly wider than postpedicel; antenna black, postpedicel about 1.5–2.0 times as long as broad; arista pubescent, the longest aristal hairs shorter than its basal diameter; in profile vibrissal angle slightly placed behind frontal angle; gena with gray pruinosity, genal height about 1/5 of eye height; anterior margin of gena with a row of upcurved subvibrissal setulae; postocular setae extending to ventral surface, epicephalon haired; prementum shiny, about 3.5 times as long as broad, palpus slender and black, about 2/3 length of prementum.

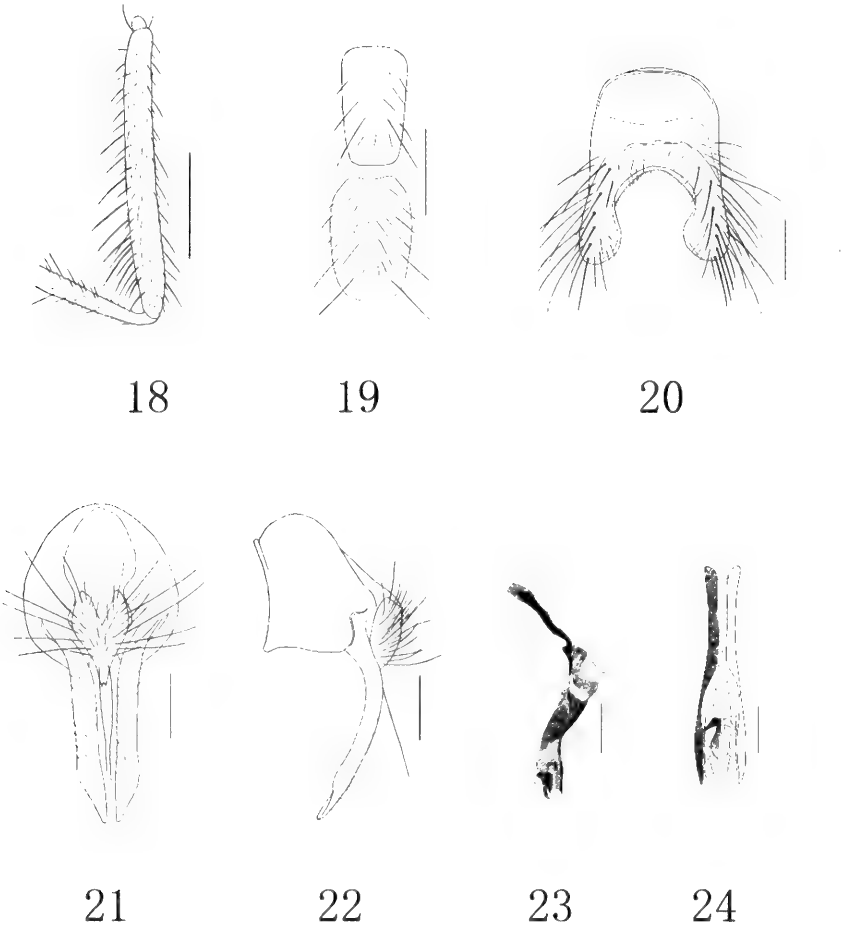
Thorax. Ground color black with gray to brownish-gray pruinosity; scutum with three indistinct dark vittae, extended to scutoscutellar suture; with 2 rows of hairlike *prst acr*, only one pair of distinct *post acr* in front of scutoscutellar suture, *dc* 2+3, *ial* 0+2; with outer posthumeral seta; *pra* longer than posterior notopleural seta; lateral surface of scutellum bare, lower surface with some light hairs apically; anterior anepisternal setae absent; notopleuron, basisternum of prosternum, anepimeron, meron and katepimeron all bare; both anterior and posterior spiracles small and fuscous; katepisternal seta 1+2 (3).

Wing. Base and basicosta brownish-yellow; Costa setulous near its base on ventral surface only; costal spine short; radial node bare; calypteres brownish-yellow, lower calypter not projecting, about 2/3 length of upper; haltere yellow.

Legs. All coxae, tarsi and femora mostly black, mid and hind femoral base brown, trochanter and fore tibia fuscous, mid tibia brown, hind tibia yellow; fore tibia with 1 median *pv*; mid femur with seta-like *av* row, 2–3 *pv* in basal part, the longest setae about 1.3–1.4 times as long as its diameter, 2 pre-apical *pd*; mid tibia with 2 *pd* and 2 *pv*; hind femur with a complete row of *av*, becoming longer toward apex, *pv* row discontinuous in the middle part, seta-like in basal half (distinctly shorter than its diameter) and long in distal 1/4 (equal to or slightly longer than its diameter); hind tibia with a row of *av* (about 8–9), a row of about 7–8 *ad* (2 strong), a row of *pd*, 3 long, becoming shorter toward apex, *pv* row complete, becoming 2 irregular rows in basal part, without apical *pv*; fore tarsus longer than tibiae, all claws and pulvilli large, longer than 5th tarsomere.

Abdomen. Black, long cone-shaped, slightly flattened; with blue gray pruinosity, anterior margin stripes of all tergites narrow, the medial black vittae distinct, tergite 6 bare, sternite 1 with dense and long hairs, 3rd and 4th sternites without dense and long setae; lateral process of sternite 5 obtuse basally; cercal plate with long setae, apex narrow and slightly branch off, with 1 hair on branch base, surstyli slightly straight; acrophallus supported by sclerotized bridge between bases of free paraphallic processes, sclerotized bridge prolonged downwards, forming a spindly sclerotized process.

Material Examined: 2 males, CHINA: Sichuan Province, Mt. Huanglong, 3850m, 30. v. 2006 (Dandan Wang) (IESNU).



Figs. 18–24. *Delia fulviposticrus* Li and Deng, 1981 (male). 18. Hind femur in posterior view, scale bar = 1 mm. 19. 3rd and 4th sternites in ventral view, scale bar = 0.5 mm. 20. Sternite 5 in ventral view, scale bar = 0.2 mm. 21. Terminalia in posterior view, scale bar = 0.2 mm. 22. Terminalia in profile, scale bar = 0.2 mm. 23. Aedeagus in profile, scale bar = 0.2 mm. 24. Distal part of aedeagus in anterior view, scale bar = 0.1 mm.

Key to species of the males of the *Delia interflua* group

1. Legs wholly black 4
— Legs at least partly yellow or brownish-yellow 2

2. Frontal setae 11–12 pairs; katepisternal setae 2+2; posthumeral setae 1+0 ....*D. spicularis* Fan in Fan et al., 1984
— Frontal setae not exceeding 8 pairs; katepisternal setae 1+2(3); posthumeral setae 1+2 3

3. Legs more or less uniformly dark orange-brown to dark brown; mid femur without *av*; mid tibia with 1–2 *ad* ....*D. abstracta* (Huckett, 1965)
— All coxae, tarsi and femora mostly black, base of mid and hind femora brown, trochanter and fore tibia fuscous, mid tibia brown, hind tibia yellow; mid femur with a row of *av* in basal 1/3; mid tibia without *ad*.. ....*D. fulviposticrus* Li and Deng, 1981

4. Frontal setae 17–18 pairs ....*D. pansihirta* Jin and Fan in Jin et al., 1981
— Frontal setae not more than 10 pairs 5

5. Mid tibia without *av* 8
— Mid tibia with *av* 6

6. Mid tibia with 2–3 *av* ....*D. kumatai* Suwa, 1977
— Mid tibia with 1 *av* 7

7. Parafacial about twice as wide as postpedicel; mid tibia with 1 *ad*, 2 *pd*; hind tibia with 2–3 *av*, 5 *ad*, 5–7 *pd*....................*D. nemostylata* Deng and Li, 1984
— Parafacial about 1.25 times as wide as postpedicel; mid tibia with 3 *ad*, 3 *pd*; hind tibia with 4 *av*, 6 *ad*, 3 *pd* ....*D. duplicipectina* Fan in Fan and Zheng, 1993

8. Mid tarsomere 1 without row of long *pd* 10
— Mid tarsomere 1 with a row of long *pd* 9

9. Hind tibia without *pv* ....*D. brevipalpis* Xue and Zhang, 1996
— Hind tibia with *pv* ....*D. absidata* Xue and Du, sp. nov.

10. Hind femur with a row of *pv* 12
— Hind femur without *pv* 11

11. Fore tibia with 2 *pv* ....*D. conjugata* Deng and Li, 1994
— Fore tibia with 1 *pv* ....*D. stenostyla* Deng and Li, 1994

12. Hind tibia only with 1–3 *pv* ....*D. kullensis* (Ringdahl, 1933)
— Hind tibia with a row of *pv* 13

13. Eyes with hairs; anterior margin of gena with 2 rows of upcurved subvibrissal setulae; calypteres and halter yellow; cercal plate narrow at distal half ....*D. interflua* (Pandellé, 1900)
— Eyes bare; anterior margin of gena with 1 row of upcurved subvibrissal setulae; calypteres and halter brownish-yellow; cercal plate broad at distal half............ ....*D. subinterflua* Xue and Du, sp. nov.

ACKNOWLEDGMENTS

This study was supported by the National Nature Science Foundation of China (No. 30270166), The Ministry of Science and Technology of the People's Republic of China (MOST grant no. 2006FY 110500) and the Foundation of Experimental Centre of Shenyang Normal University (No. SY200609). We are very grateful to Mr D. M. Ackland, Oxford University Museum of Natural History, Parks Road, Oxford OX1 3PW, UK, for his reading of this manuscript and valuable suggestions; to Dr. A. C. Pont, of the same museum for his invaluable help over many years; to Dr. J. E. O'Hara, Invertebrate Biodiversity, Agriculture and Agri-Food Canada, for his reading of this manuscript and valuable suggestions; and to Ming-fu Wang, Bai-feng Wang, Hu Ao, Dandan Wang, and Liang Chang for providing the type specimens.

LITERATURE CITED

Coquillett, D. W. 1910. The type-species of the North American genera of Diptera. Proceedings U.S. National Museum 37: 499–647.

Dely-Draskovits Á. 1993. Family Anthomyiidae. *In,* So.s, ç. and Papp, L. (Editors). Catalogue of Palaearctic Diptera. Akadémiai Kiadó, Budapest, Hungary. 13: 37–51.

Deng, A. X. and R. Li. 1984. Description of the *Delia nemostylata* sp. nov. Sichuan Journal of Zoology 3: 5–6.

Deng, A. X. and R. Li. 1994. Descriptions of three new species of the genus *Delia*, Anthomyiidae, Diptera in Sichuan, China. Journal of West China University of Medical Sciences 25: 18–21.

Fan, Z. D., Z. Z. Chen, S. Y. Ma, and Y. Wu. 1984. New species of the family Anthomyiidae (Diptera) from Qinghai Province, China, I. Contributions from Shanghai Institute of Entomology, 4: 239–253.

Fan, Z. D. and S. S. Zheng. 1993. Anthomyiidae. *In,* Chen, S. X. (Editor). Insects of the Hengduan Mountains Region. Volume 2. Science Press. Beijing, China. 1129–1130 pp.

Griffiths, G. C. D. 1991. Anthomyiidae. *In,* Griffiths, G. C. D. (Editor). Flies of the Nearctic Region, Volume VIII. E. Schweizerbart'sche Verlagsbuchhandlung (Nägele u. Obermiller). Stuttgart, Germany. pp 953–2635.

Huckett, H. C. 1965. The Muscidae of Northern Canada, Alaska, and Greenland (Diptera). Memoirs of the Entomological Society of Canada 42: 36–73.

Jin, Z. Y., F. X. Ge, and Z. D. Fan. 1981. Descriptions of five new species of Anthomyiidae from south Gansu, China (Diptera). Entomotaxonomia 3: 87–92.

Li, R. and A. X. Deng. 1981. Notes on Anthomyiidae from mountain Emei, China, I. Description of 5 species. Acta Academiae Medicinae Sichuan 12: 125–131.

McAlpine, J. F. 1981. Morphology and terminology – adults. *In,* McAlpine, J. F., Peterson, B. V., Shewell, G. E., Teskey, H. J., Vockeroth, J. R. and Wood, D. M. (Editors). Manual of Nearctic Diptera. Volume 1. Agriculture Canada Monograph 27: 9–63.

Pandellé, L. 1900. Études sur les Muscides de France. III^{e} partie. Revue d'Entomologie. Caen, France, 19 (special pagination): 262 [cont.].

Ringdahl, O. 1933. Översikt *av* i Sverige funna Hylemyia-arter. Entomologisk Tidskfirt 54: 1–35.

Robineau-Desvoidy, J. B. 1830. Essai sur les Myodaires. Mémoires présentés par divers savans à l'Académie Royale des Sciences de l' Institut de France 2: 482.

Suwa, M. 1977. Anthomyiidae collected by the Hokkaido University Expeditions to Nepal Himalaya, 1968 and 1975 (Diptera). Insecta Matsumurana 10: 17–51.

Xue, W. Q. and C. M. Chao. 1996. Flies of China. Volume 1. Liaoning Science and Technology Press. Shenyang, China. pp. 706–808.

Xue, W. Q., D. D. Wang, X. Z. Zhang, and C. Q. Xiang. 2007. Five new species of *Drymeia* Meigen from the Tibet Plateau, China (Diptera: Muscidae). Zootaxa 1444: 35–51.

Xue, W. Q. and X. Z. Zhang. 1996. Anthomyiidae. Pp. 174-175. *In,* S. G. Wu and Z. J. Feng (Editors). The biology and human physiology in the Hoh xil region. Science Press. Beijing, China.

OBSERVATION OF SPERMATOPHORE TRANSFER IN *STAVSOLUS JAPONICUS* (PLECOPTERA: PERLODIDAE) IN JAPAN[1]

Mayumi Yoshimura[2]

ABSTRACT: Behavior patterns associated with spermatophore transfer have been studied in several species of insects, but in stoneflies, even the existence of a spermatophore has been uncertain. This study aimed to confirm the existence of spermatophores in *Stavsolus japonicus* (Plecoptera: Perlodidae) and to determine the manner of spermatophore transfer. The male bent its body into an S-shape and inserted its abdominal caudal tip between the sternites and the subgenital plate of the female to open the female's subgenital plate. After approximately one hour, the male started to stroke the female's eighth and ninth genital segments with its epiproct. Next, the aedeagus was extruded between the male's eighth and ninth sternites and a spermatophore-like mass was extruded from the aedeagus. The mass contained sperm and was thus considered to be a spermatophore. The spermatophore was placed directly under the female's subgenital plate by the aedeagus and the male then patted the spermatophore with his cerci.

KEY WORDS: stonefly, spermatophore, copulation, cerci, subgenital plate, Plecoptera, perlodidae, *Stavsolus*, Japan

Sperm transfer of insects is accomplished in several ways and the methods of sperm transfer from males to females can be divided into two types: (1) direct transfer of sperm into the female duct, and (2) transfer to the female as a spermatophore. The first method, direct sperm transfer, is common in the Neoptera. The second method, spermatophore transfer, is an indirect mode of sperm transfer, and is regarded as a primitive but common method of insemination (Davey, 1960; Proctor, 1998). In the primitive hexapods, such as the Collembola, Diplura and Thysanura, spermatophore transfer is a simple process: the male deposits the spermatophore on a substrate that is subsequently recovered by the female (Schaller, 1971). In other group of insects, the males convey the spermatophore directly to the female. The transferred spermatophore remains outside the female genital duct in most cases, and in ensiferan Orthoptera only the neck of the spermatophore penetrates the female genital duct. In some Megaloptera, female eat the spermatophore, during which time the sperm migrates to the female (Hayashi 1999). Although in Blattodea the transferred spermatophore also remains outside the female genital duct, it is protected by the female's enlarged subgenital plate (Khalifa, 1950).

Sperm transfer in Plecoptera was previously described by Brink (1956). He divided plecopterans into two categories: (1) the species with a ventral penis or penial organ functioning as a direct sperm conveyor through copulation with internal deposition, and (2) the species without a ventral penis, aedeagus, or

---

[1] Received on April 23, 2007. Accepted on May 21, 2007.

[2] Forest Biodiversity Group, Kansai Research Center, Forestry and Forest Products Research Institute, Nagaikyutaro 68, Momoyama, Fushimi, Kyoto 612-0855, Japan. E-mail: yoshi887@ffpri.affrc.go.jp

Mailed on May 14, 2008

penial organ, the conveyance of the sperm is undertaken by the epiproct. Brink (1956) also indicated that all the males of Plecoptera pass the sperm directly into the female duct rather than producing spermatophores. In 1969, Stewart et al., described copulation behavior in *Perlesta placida* (Hagen) (Perlidae). In these insects, sperm insertion is accomplished by hooking the paraprocts and the male then seals off the female genitalia using the expanded copulatory organ, indicating a direct sperm transfer. However, Stewart and Stark (1977) reported that a mucoid sperm mass is deposited in *Hydroperla crosbyi* (Needham and Claassen) (Perlodidae), and suggested three possible methods of sperm transfer in Plecoptera. Since this supposition was reported in 1997, no subsequent observations about spermatophore have been published. The purposes of this study are to confirm the existence of a spermatophore in stoneflies and to determine the method of spermatophore transfer in *Stavsolus japonicus* (Okamoto) (Plecoptera: Perlodidae).

METHODS

From March 31 to April12, 2005, newly emerged adults of *S. japonicus* males (n = 14) and females (N = 16) were collected in the morning from the Shigo River at Aritoshi, Nara Prefecture, Japan (34°23'N, 136°00'E). All individuals emerged the morning they were collected. The stoneflies were brought to the laboratory and kept individually in plastic vials (diameter x height: 3 x 6.5 cm) at 15 ± 1°C. They were fed diluted honey (honey: water, 1:10) almost every day using soaked cotton.

Two weeks after the date of collection, a female and a male were put together in a plastic vial (diameter x height: 3 x 6.5 cm) at 11:00 once every two or three days for copulation. Copulation behavior and duration were recorded. If they did not copulate, pairs were separated at 16:00. Females that copulate once were not used for other experiments. Females that did not copulated were used in later copulation experiments with other males. Males, however, were allowed to copulate during their lifetime. Ten of sixteen females copulate. Dead individuals were preserved in 80% ethanol.

After copulation, a spermatophore-like mass transferred to females was carefully removed either immediately after copulation, or at 15, 30, or 45 minutes after completion of copulation (the masses were removed from two females for each interval) using fine forceps. The spermatophore-like masses were placed on a glass microscope slide with an eosin stain. After a cover slip was placed on it, the mass was examined microscopically for sperm. The spermatophore-like masses on two remaining females were left undisturbed and were monitored to determine the time required for the spermatophore-like mass to disappear from sight. All the females were kept at 15 ± 1°C in plastic vials and were observed to determine whether or not oviposition occurred.

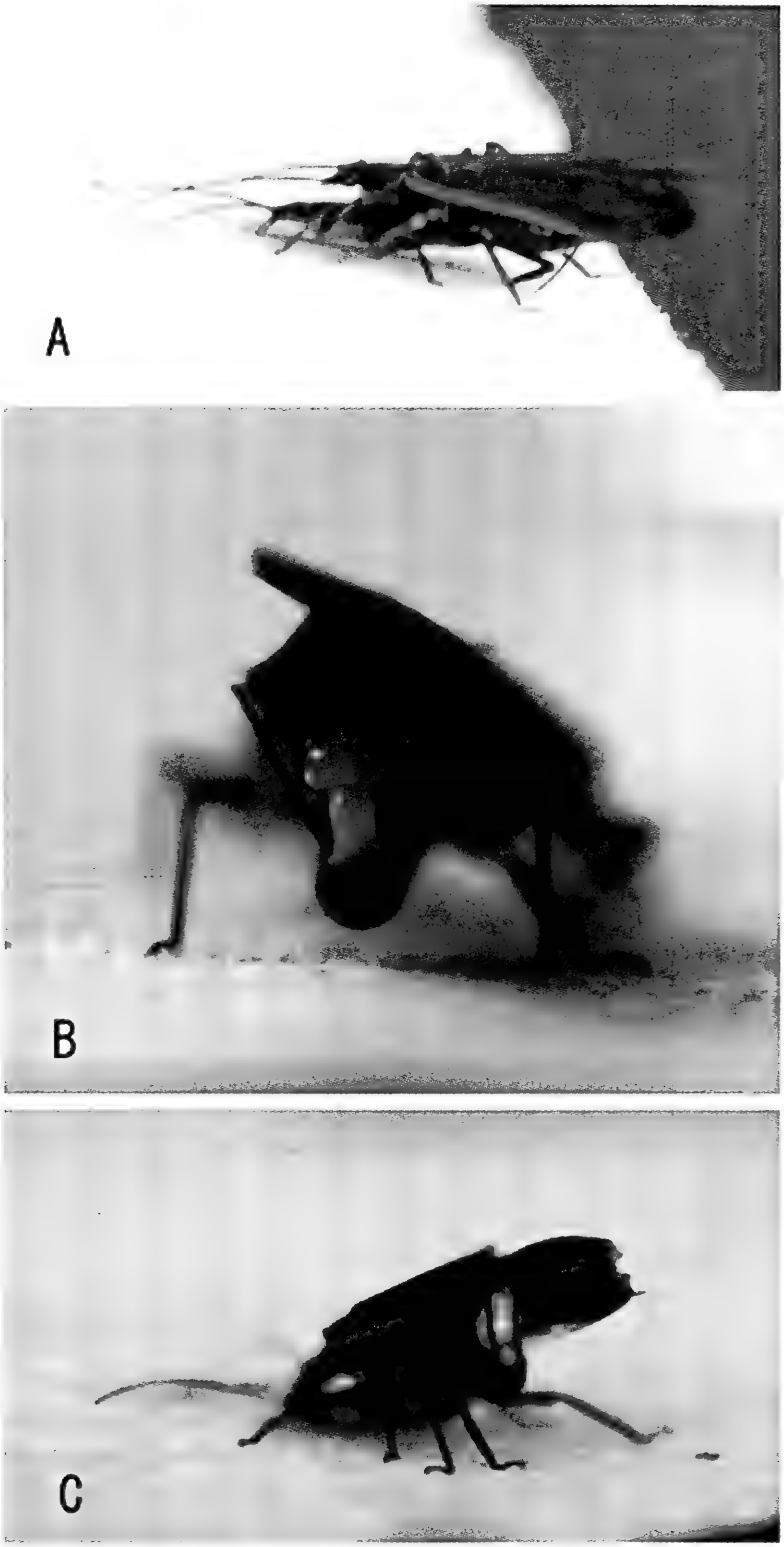


Fig. 1. Copulation behavior in *S. japonicus*. A. Before the spermatophore transfer. B. Spermatophore transfer. C. After the spermatophore transfer.

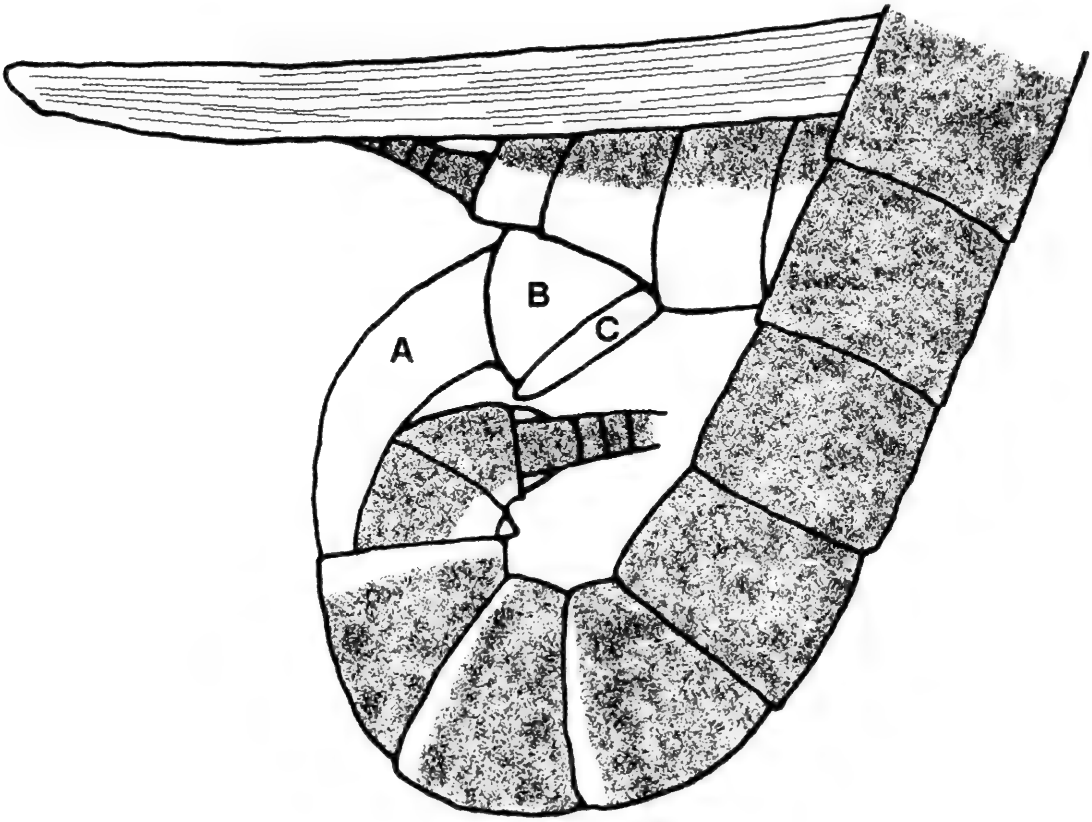


Fig. 2. Diagram of spermatophore transfer. A. Aedeagus, B. Spermatophore. C. Subgenital plate.

RESULTS

When a male found a female of the stonefly *Stavsolus japonicus*, he approached and tried to mount her back without drumming. When mounting was successful, the male bent his body into an S-shape and attempted copulation (Fig. 1A). Females of this species have a large subgenital plate on the eighth sternite and the edge of the plate extends to the middle of the tenth sternite. The male opened the female's subgenital plate with his abdominal caudal tip and inserted his genitalia or abdominal caudal parts between the female's eighth and ninth sternites and the subgenital plate. The male then thrust his abdominal caudal parts into the female as continuing to gently wave his abdomen. Once the male and female genitalia were linked, the female did not move around and the male did not pull out his abdomen. If, however, the connection was not complete, the male sometimes retracted his abdomen from the female's genitalia. In this case, the female sometimes began to move around, which is a reason to prolong the copulation period. This stage of copulation lasted between 40 and 90 minutes. Next, the male stopped pushing his abdominal caudal tip and stroke (ca. twice / s) the female's eighth and ninth genital segments under the subgenital plate using his epiproct for approximately two minutes. After that, the male's aedeagus was extruded between the eighth and the ninth sternites and was extended nearer to the female space between sternites and subgenital plate, and then a white and translucent mass that looked like a spermatophore was extruded from the aedeagus. The spermatophore-like mass was inserted directly under the female's subgenital plate by male's aedeagus (Fig. 1B, Fig. 2). After the insertion of the mass-like spermatophore, the male patted the spermatophore-like mass by moving his cerci up and down (Fig. 1C). Even if the female began to move around, the male continued this patting for approximately five minutes and then dismounted from the female. The male did not show any interest in the female after copulation. Total time for copulation ranged from 55 to 105 minutes (74 min ± 19 min, mean ± S.D.; n = 10).

The spermatophore-like mass was sticky and contained sperm in a gelatinous mass. Thus, this mass was, in fact, a spermatophore. The transferred spermatophore was protected by the female's comparatively large subgenital plate and was absorbed in approximately two hours. When the spermatophore was artificially removed immediately after copulation, the female did not oviposit. However, when the spermatophore was removed 15, 30 or 45 minutes after completion of copulation, the females did oviposit, despite the fact that the removed spermatophore contained sperm.

DISCUSSION

Sperm of *S. japonicus*, Perlodid stonefly, was transferred as a spermatophore by male's aedeagus and the spermatophore was directly inserted under the female's subgenital plate. Male's aedeagus was not directly inserted into the female genital organ in this study. This shows that *S. japonicus* does not fit into either of the categories defined by Brink (1956). The fact of external deposition of spermatophore observed in this study was similar to that observed in *H. crosbyi,* where the spermatophore-like mucoid sperm mass is deposited directly under the female's subgenital plate (Stewart and Stark, 1977). Although Brink (1956) divided the Plecoptera into two categories, he mentioned the "loose fix" of copulation, which is due to the lack of any fixing hooks in the genera *Diura* and *Perlodes* (Perlodidae) that were categorized as having direct sperm transfer. Based on the supposition of three different types of sperm transfer in Plecoptera by Stewart and Stark (1977), the mention of "loose fix" of copulation by Brink (1956), and the result of this study, some perlodids might transfer the sperms as spermatophores. Although the type of sperm conveyed in *S. japonicus* of this study is similar to that seen in *H. crosbyi* (Stewart and Stark, 1977), it has not been previously reported in any other plecopteran group. It will be very interesting when this method is restricted only in Perlodidae of Perloidea. Surdick (1985) reported the absorption of liquid sperm in *Sweltsa* (Chloroperlidae), although Yoshimura et al. (2003) observed a spermatophore-like object after copulation in *Sweltsa* sp. Further studies are needed to confirm the type of sperm conveyance in Perloidea.

A reduced epiproctal apparatus is widespread among Perloidea, but the role of the epiproct in Perloidea mating is not well understood (Zwick, 2000). In this study, the male stroked the female's eighth and ninth genital segments under the subgenital plate with the epiproct before extruding the spermatophore. This behavior may serve to clean and stimulate the female's genital segment. Spermatophore was extruded just after stroking; therefore, this behavior would be indispensable in their courtship copulation and the epiproct might probably play an important role for sperm conveyance.

The male of *H. crosbyi* engages in a side to side brushing or a delicate tapping with his cerci on the female cerci. Then, the female begins a rhythmic telescoping action of her abdominal segments behind the genital opening (Stewart and Stark, 1977). In contrast, the behavior of *S. japonicus* after deposition of spermatophore was different. The males of *S. japonicus* patted the spermatophores up and down with their cerci for a few minutes before dismounting, indicating that the cerci may play a certain role in copulatory courtship.

In *Calliptamus* (Orthoptera), the shape of cerci is different between males and females, and in *Idioembia* (Embioptera) the cerci of males are asymmetric. Some insects use the cerci for holding the female during copulation. Besides, the cerci seem to have some contact chemoreceptors and olfactory receptors (Merritt and Rice, 1984). Therefore, males may receive some stimulation from female cerci in *H. crosbyi* and from the spermatophore in *S. japonicus* of this study. The females of *S. japonicus* did not show obvious abdominal telescoping action in this study; thus, male's patting on the spermatophore with his cerci might lead the male to know the various conditions about spermatophore by receiving some signals and lead the female to stimulate the sperm absorption.

In Blattodea, female's long subgenital plate protects the spermatophore and males do not display patting behavior. Tapping behavior on the spermatophore in Plecoptera might be used to ensure the spermatophore not to drop off of the female after spermatophore transfer. Female crickets sometimes attempt to remove the inserted spermatophores. And the males of *Teleogryllus natalensis* and *Gryllus bimaculatus* have to guard the females against this removal (Sakaluk, 1991; Hockham and Vahed, 1997; Wynn and Vahed, 2004). On the other hand, the males of *Cycloptiloides canariensis* do not display guarding behavior. Although the females detach the spermatophores about 30 seconds after the transfer, sperm in the spermatophores are emptied within 35 seconds, so the postcopulatory guarding may be unnecessary (Dambach and Beck, 1990). Postcopulatory guarding was not observed in *S. japonicus* in this study. Sperm transfer from the spermatophore would start within fifteen minutes from the completion of copulation, since oviposition occurred when the spermatophore was removed fifteen or more minutes after completion of copulation. By using the male's cerci for pushing the spermatophore further onto the female's comparatively larger subgenital plate, it might be difficult for the female to drop the spermatophore and be unnecessary for males to guard the females after copulation.

In the cricket *Gryllus bimaculatus,* bodily movement ceases during copulation except for the antennae and cerci before the spermatophore is inserted into the female genitalia. This immobility appears to be due to a vibratory stimulus from the male's thrusting movements underneath the female (Sakai and Kumashiro, 2004) and may enable safe transfer of the spermatophore. Copulation lasts only a few minutes in this cricket (Sakai and Kumashiro, 2004), so it is presumably easy for the male to induce paralysis in the female by abdominal vibrations for short periods. In this study, the copulation period of *S. japonicus* varied from 55 minutes to 1 hour 45 minutes, and the longer copulation period was the result of a longer period of thrusting and waving of the male's abdomen. In order to transfer the spermatophore safely, the male needs the female to be immobile. The thrusting and abdominal waving might be used by the male to induce paralysis in the female, in a fashion similar to that observed in the cricket. Stroking the membranous segment with his epiproct may function to confirm that the female is paralyzed before the spermatophore is inserted. Alternatively, the male may perform this copulatory behavior to clean the female genital organ and to make it easier for sperm from the spermatophore to be absorbed. In the cricket, the male's first act during copulation is to stimulate some receptors, which in turn elicit another act and so on (Sakai and Kumashiro, 2004). A similar chain reaction system might also exist in stoneflies. Further examination of the connected genitalia could clarify the significance of these copulatory behaviors in *S. japonicus*, and would help further advance our knowledge of sperm conveyance in Perloidea and our understanding of the copulation strategies in Plecoptera and Insecta.

LITERATURE CITED

Brinck, P. 1956. Reproductive system and mating in Plecoptera. Opuscula Entomologica 21: 57-127.

Dambach, M. and U. Beck. 1990. Mating in the scaly cricket *Cycloptiloides canariensis* (Orthoptera: Gryllidae: Mogoplistinae). Ethology 85: 289-301.

Davey, K. G. 1960. The evolution of spermatophores in insects. Proceedings of the Royal Society of London. Series A 35: 107-113.

Hayashi, F. 1999. Rapid evacuation of spermatophore contents and male post-mating behaviour in alderflies (Megaloptera: Sialidae). Entomological Science 2: 49-56.

Hockham, L. R. and K. Vahed. 1997. The function of mate guarding in a field cricket (Orthoptera: Gryllidae; Teleogryllus natalensis Otte and Cade). Journal of Insect Behavior 10: 247-256.

Khalifa, A. 1950. Spermatophore production in *Blattella germanica* L. (Orthoptera: Blattidae). Proceedings of the Royal Society of London. Series A 25: 53-61.

Merritt, D. J. and M. J. Rice. 1984. Innervation of the cercal sensilla on the ovipositor of the Australian sheep blowfly (*Lucilia cuprina*). Physiological Entomology 9: 39-47.

Proctor, H. C. 1998. Indirect sperm transfer in arthropods: Behavioral and evolutionary trends. Annual Review of Entomology 43: 153-174.

Sakai, M. and M. Kumashiro. 2004. Copulation in the cricket is performed by chain reaction. Zoological Science 21: 705-718.

Sakaluk, S. K. 1991. Post-copulatory mate guarding in decorated crickets. Animal Behavior 41: 207-216.

Schaller, F. 1971. Indirect sperm transfer by soil arthropods. Annual Review of Entomology 16: 407-446.

Stewart, K. W. and B. P. Stark. 1977. Reproductive system and mating of *Hydroperla crosbyi*: a newly discovered method of sperm transfer in Insecta. Oikos 28: 84-89.

Stewart, K. W., G. L. Atmar, and B. M. Solon. 1969. Reproductive morphology and mating behavior of *Perlesta placida* (Plecoptera: Perlidae). Annals of the Entomological Society of America 62: 1434-1438.

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). Illinois Biological Monographs 54: 1-146.

Wynn, H. and K. Vahed. 2004. Male *Gryllus bimaculatus* guard females to delay them from mating with rival males and to obtain repeated copulations. Journal of Insect Behavior 17: 53-66.

Yoshimura, M., Y. Isobe, and T. Oishi. 2003. The relation among emergence date, days until first effective mating, fecundity and adult longevity in *Isoperla aizuana* and *Sweltsa* sp. (Plecoptera). Zoological Science 20: 471-479.

Zwick, P. 2000. Phylogenetic System and Zoogeography of the Plecoptera. Annual Review of Entomology 45: 709-746.

SOCIETY MEETING OF OCTOBER 19, 2005

Insect and Mushroom Interaction in a Colombian Andean Oak Forest

Eduardo Amat, Jessup Fellow
The Academy of Natural Sciences, Philadelphia, Pennsylvania 19103 U.S.A.

Insect and Mushroom interaction in a Colombian Andean Oak forest were discussed. From November to July 2001, insects were collected across the developmental stages of five families of macrofungi. The individual insects collected, both adults and reared specimens, were sorted into three orders: Diptera 65%, Coleoptera 34% and Hymenoptera 4%, representing 21 families and 48 morphospecies from 309 host fruiting bodies. Insects ranged in their feeding habits. For instance, primary mycophagous constituted 80% of the individuals (e.g. Drosophilidae); secondary mycophagous, 18% (e.g. Chloropidae); detritivorous, 1% (e.g. Scarabaeidae); predators and parasitoids, 1% (e.g. Tachinidae). Insects considered primarily generalists (e.g. Drosophilidae) were associated with all the mushroom families studied, but several taxa were also specialists (e.g. Endomychidae and Derodontidae were associated primarily with Russulaceae).

Insect colonization was related to mushroom developmental stage, type of mushroom, and the insect's life history. The total number of insects, or insect abundance, was affected by mushroom availability, size, and mushroom developmental stage. High availability of fungi correlated with lots of insects. Insect communities inhabiting mushrooms were high in species richness or total number of species numbers. Species richness was affected by mushroom developmental state. A decomposing mushroom releasing spores, as well as the third and the penultimate mushroom developmental stage, resulted in the greatest insect diversity. It was emphasized that the Neotropical insect fauna is little known.

In response to a question, Mr. Amat mentioned that poisonous mushrooms are not found in Colombian oak forests, but tend to be associated with native grasslands. Fungi that live in grasslands have likely evolved chemical defenses against grazers. Finally, of the five groups of mushrooms encountered in the study, the Gomphales differed from the usual pedestal and cap morphology – they look like coral.

Notes of entomological interest. The Brown Marmorated Stink Bug, *Halysomorpha halys,* has been reported from New Castle County, Delaware, U.S.A. This introduced heteropteran from Asia frequently enters houses to overwinter. The AntWorks Ant Habitat was displayed by Dr. Susan Whitney King and discussed as a potential termite enclosure. Insects can be observed tunneling through a clear gelatin nutrient. Dr. Paul Schaefer shared specimens of an ectoparasitic Lepidopteran reared from cocoons he collected while mowing his lawn at his Cecil County, Maryland, U.S.A. home. *Fulgoraecia exigua* larvae (Epipyropidae) attach under the wings of planthoppers and suck bodily fluids. Prior to the meeting coming to order, Dr. Jon Gelhaus collected adult crane flies, adults and pupal exuvia from the lawn outside the meeting room building. It seems that two introduced European species of *Tipula* (Tipulidae) are turf grass pests. Also, a native species, *Tipula paterifera,* may be becoming a lawn pest, although it has not been reported as such before. Changing lawn care practices and weather conditions are likely implicated. Twenty-three attendees were present at the meeting.

Greg Cowper, Corresponding Secretary
The American Entomological Society
E-mail: gwcowper@popflymag.com

Mailed on May 14, 2008

REVIEW OF THE GENUS *OSBORNELLUS* BALL (HEMIPTERA: CICADELLIDAE: DELTOCEPHALINAE) FROM HISPANIOLA, INCLUDING FIFTEEN NEW SPECIES[1]

Paul H. Freytag[2]

ABSTRACT: The genus *Osbornellus* is reviewed for Hispaniola. Seventeen species are now known from this island, two described species, *bimarginatus* (DeLong) and *fasciatus* Metcalf, and fifteen new species from the Dominican Republic. The new species are: *dipilus*, *bellus*, *coloritubus*, *brevitubus*, *tubus*, *eccritus*, *dicellus*, *proximus*, *arcus*, *venustus*, *hispanus*, *sagarus*, *parvus*, *eratus*, and *tetrus*. A key to all species is included.

KEY WORDS: Hemiptera, Cicadellidae, Deltocephalinae, *Osbornellus*, Hispaniola

The genus *Osbornellus* has been poorly known for the Caribbean Region. Linnavuori (1959) reviewed this genus placing the species from this region in the subgenus *Nereius*, and included 5 species. None of the five species described at that time were known from Hispaniola. Since that time two of the species have now been found on the Island, *bimarginatus* (DeLong, 1923) described from Puerto Rico, and *fasciatus* Metcalf (1954) described from the Bahama Islands. Also, 15 new species have now been found in the Dominican Republic and are described in this paper. A key to all 17 species is given below.

All species found on Hispaniola belong to the subgenus *Nereius* Linnavuori (1956). This subgenus is separated from other members of the genus by the male styles being hook-like, and the head usually with anterior transverse bands. This subgenus is only known from the Caribbean Region.

Most specimens used in this study were collected into alcohol, so the colors, especially the reds and reddish oranges, have disappeared. Where they are usually retained and not missing this character is used in the following key. Otherwise, the male genitalia appear to be more reliable for identification of species. Additional species could be found as females are known which have a color pattern different from the ones covered here.

The acronyms used in this paper are: CMNH= Carnegie Museum of Natural History, Pittsburg, PA; FSCA= Florida State Collection of Arthropods, Gainesville, FL.; UKYL= University of Kentucky Insect Collection, Lexington, KY; MHND= Museo Nacional de Historia Natural, Santo Domingo, Dominican Republic.

SYSTEMATIC ENTOMOLOGY

Key to the Hispaniola species of *Osbornellus*

1. Transverse bands on anterior of head present (Figs. 2-8) 2
1' Transverse bands on anterior of head absent (Fig. 1) ....*dipilus* n. sp.

2. Aedeagus tubular, usually without processes (Fig. 13) 3
2' Aedeagus with a pair of prominent processes (Fig. 32) 6

---

[1] Received on February 13, 2007. Accepted on May 20, 2007.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 40546 U.S.A. E-mail: freytag 2104@windstream.net.

Mailed on May 14, 2008

3. Overall color straw-colored to brown 4
3' Head, pronotum and forewings with reddish markings 5

4. Male light brown, less than 4.5 mm. Aedeagus small (Fig. 13) ..*brevitubus* n. sp.
4' Male dark brown, more than 5.0 mm. Aedeagus large (Fig. 15)........*tubus* n. sp.

5. Aedeagus C-shaped, short (Fig. 17); red dashes on pronotum long (Fig. 2)........ ....*bellus* n. sp.
5' Aedeagus longer, similar to *brevitubus* (Fig. 13); red dashes on pronotum short, near anterior margin.......................................*coloritubus* n. sp.

6. Overall length greater than 6.0 mm...*eccritus* n. sp.
6' Overall length less than 5.5 mm..7

7. Aedeagus with processes separate to base, spine-like, longer than shaft (Figs. 23) ....*dicellus* n. sp.
7' Aedeagus with processes from middle of shaft, or subbasally, usually blade-like (Fig. 32)...8

8. Aedeagus with processes closely pressed to shaft (Fig. 26).........*proximus* n. sp.
8' Aedeagus with processes not closely pressed to shaft (Fig. 32) 9

9. Pronotum with a median arch of red or orange red (Fig. 4)...............*arcus* n. sp.
9' Pronotum with a different color pattern, or no reddish markings.....................10

10. Aedeagus with processes nearly same length as shaft (Fig. 32) 11
10' Aedeagus with processes distinctly longer than shaft (Fig. 44)........................12

11. Aedeagus with processes converging at apex, in ventral view (Fig. 33)............. ....*bimarginatus* (DeLong)
11' Aedeagus with processes diverging at apex, in ventral view (Fig. 36)................ ....*fasciatus* Metcalf

12. Aedeagus with processes diverging at apex, in ventral view (Fig. 39).............13
12' Aedeagus with processes parallel, or nearly so, in ventral view (Fig. 45) 14

13. Pygofer short, rounded; subgenital plate as long as pygofer (Fig. 37) ....*venustus* n. sp.
13' Pygofer long, pointed at apex; subgenital plate shorter than pygofer (Fig. 40).... ....*hispanus* n. sp.

14. Aedeagus with processes sinuate, in lateral view (Fig. 44) 15
14' Aedeagus with processes not sinuate, in lateral view (Fig. 50) 16

15. Pygofer extending dorsad apically (Fig. 43); aedeagal processes extending beyond apex of subgenital plates (Fig. 45) ....*sagarus* n. sp.

15' Pygofer oval (Fig. 46); aedeagal processes same length as subgenital plates (Fig. 48) .... *parvus* n. sp.

16. Aedeagus with processes curving dorsad, parallel to shaft, and nearly same length as subgenital plates (Fig. 50) .... *eratus* n. sp.

16' Aedeagus with processes straight, not parallel to shaft, and extending beyond apex of subgenital plates (Fig. 53) .... *tetrus* n. sp.

Osbornellus (Nereius) dipilus **Freytag, NEW SPECIES**

(Figures 1, 9-11, and 55)

Description: Length of males 3.8 mm., females 4-4.2 mm. Similar to *bimarginatus*, except without the transverse bands on anterior part of head. Head (Fig. 1) nearly same width as pronotum, crown with median length same as width between eyes. Color generally yellow brown. Head with posterior two-thirds darker brown. Pronotum and scutellum yellow brown with speckles of darker brown. Forewings mostly transparent yellow brown, with darker brown spots at apex of claval veins, claval suture and two veins reaching costal margin, costal cells with median dash of darker brown. Male genitalia: Pygofer (Fig. 9) narrowing to nearly pointed apex. Subgenital plates (Figs. 9 and 11) narrow, nearly as long as pygofer. Style (Fig. 11) short, bluntly hooked. Connective (Fig. 11) Y-shaped. Aedeagus (Fig. 11) shorter than subgenital plates, shaft bluntly rounded at apex, with a pair of subapical hairlike processes, divergent at apex. Female seventh sternum (Fig. 55) short, with posterior margin narrowing to bluntly pointed median.

Type Data: Holotype male: Dominican Republic, Pedernales, Cabo Rojo, Alcoa Headquarters, 20-24-VI-1999, blacklight trap, R. E. Woodruff and R. Baranowski (FSCA).

Additional Specimens: One female, Pedernales, 23 km N Cabo Rojo, 18-06N 71-38W, 540 m., 13-19-VII-1990, L. Masner, J. Rawlins, C. Young, deciduous forest, intercept trap (CMNH); one female, Pedernales, 21 km N Cabo Rojo, 1-2-VII-1998, blacklight trap, R. E. Woodruff and R. Baranowski (FSCA); one female, Pedernales, 24 km N Cabo Rojo, 23-VI-1999, blacklight trap, R. E. Woodruff and R. Baranowski (FSCA).

Remarks: This species can be separated from the other species by the lack of the anterior bands on the crown, and the male styles being bluntly hooked at apex. This species is named for the two small hairlike processes on the male aedeagus.

Osbornellus (Nereius) bellus **Freytag, NEW SPECIES**

(Figures 2, 16-18, and 56)

Description: Length of male 4.8-5 mm., female 5.2-5.7 mm. Similar to *bimarginatus*, but with red bands and quite different male genitalia. Head (Fig. 2) nearly same width as pronotum, median length slightly shorter than width between eyes. Pronotum with anterior margin acute. Color generally yellow brown. Head with two black transverse bands above ocelli on crown, two below ocelli on face, with red band behind anterior bands on crown. Pronotum (Fig. 2) with a pair of longitudinal bands of red, one each side of median. Male genitalia: Pygofer (Fig. 16) with rounded apex. Subgential plates (Figs. 16 and 18) wide at base, narrowing to thin long apex. Style

(Fig. 18) short, with sharply pointed hook-like apex. Connective (Fig. 18) short, Y-shaped. Aedeagus (Fig. 17) short, finger-like, without processes. Female seventh sternum (Fig. 56) short, posterior margin rounded, with a spot of dark pigment medially.

Type Data: Holotype male: Dominican Republic, Barahona, Eastern Sierra Bahoruco, Reserva Cachote, 12.8 km NE Paraiso, 18-05-58N 71-11-26W, 1219 m., 22-23-XI-2004, J. Rawlins, C. W. Young, V. Verdecia, C. Nunez, disturbed cloud forest on road, UV light, sample 44115 (CMNH). Paratypes: Three males, same data as holotype (one each, CMNH, FSCA, UKYL).

Additional Specimens: Dominican Republic, Barahona, four males, 1 female, same data as holotype, except 18-05-52N 71-11-19W, 1198 m., 21-23-III-2004, J. Rawlins, C. Young, R. Davidson, C. Nunez, M. Rial, semi-disturbed wet broadleaf, UV light, sample 44313 (CMNH); three males, three females, same data, except 18-05-54N 71-11-21W, 1230 m., cloud forest with tree ferns, sample 44213 (CMNH); one female, same data, except yellow pan trap, sample 44263 (CMNH); six males, 4 females, same data, except 18-05-58N 71-11-26W, 1219 m., disturbed cloud forest on road, sample 44113 (CMNH); one male, two females, same data, except 18-05-52N 71-11-19W, 1198 m., 22-23-XI-2004, J. Rawlins, V. Verdecia, C. Young, C. Nunez, W. Zanol, semi-disturbed wet broadleaf, UV light, sample 44315 (CMNH); twenty males, eight females, same data, except 18-05-58N 71-11-26W, 1219 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, disturbed cloud forest on road, UV light, sample 44114(eighteen males, six females CMNH, two males, two females UKYL); three males, two females, same data, except 18-05-54N 71-11-21W, 1230 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, cloud forest with tree ferns, UV light, sample 44214 (CMNH); seven males, five females, same data, except 18-05-52N 71-11-19W, 1198 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, semi-disturbed wet broadleaf, UV light, sample 44314 (CMNH); one female, same data, except 18-05-58N 71-11-26W, 1219 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, disturbed cloud forest on road, canopy trap, sample 44194 (CMNH); one female, same data, except 18-05-52N 71-11-19W, 1198 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, semi-disturbed wet broadleaf, canopy trap, sample 44394 (CMNH); and two males, Independencia, Sierra de Bahoruco, north slope,13.5 km SE Puerto Escondido, 18-12-24N 71-30-54W, 1807 m., 24-26-III-2004, R. Davidson, J. Rawlins, C. Young, C. Nunez, M. Rial, broadleaf *Pinus* dense woodland, UV light, sample 41213 (CMNH).

Remarks: This species has only been found in this one area on the island. The color pattern and male genitalia are quite distinct and will identify this species from all others. It is named for the beautiful color pattern.

Osbornellus (*Nereius*) *brevitubus* Freytag, NEW SPECIES

(Figures 3, 12-14, and 57)

Description: Length of male 4-4.6 mm., female 4.5-5.2 mm. Similar to *bimarginatus* but smaller, darker, with quite different male genitalia. Color generally yellow brown with darker brown cross veins along costal margin and apical veins. Head with two black transverse bands above ocelli on crown, two bands below ocelli on face. Male genitalia: Pygofer (Fig. 12) small, nearly truncate. Subgenital plate (Figs.

12 and 14) triangular, but elongate. Aedeagus (Fig. 13) C-shaped, about half length of subgenital plates. Style (Fig. 14) small, with thin, sharply pointed apex. Connective (Fig. 14) short, Y-shaped. Female seventh sternum (Fig. 57) nearly rounded on posterior margin, with dark spot in middle.

Type Data: Holotype male: Dominican Republic, Barahona, Filipinas, Larimar Mine, 1006 m., 12-IV-1997, blacklight trap, R. E. Woodruff (FSCA). Paratypes: 15 males, 24 females, same data as holotype (two males, two females CMNH; two males, two females UKYL; eleven males, twenty females FSCA).

Additional Specimens: One male, five females, Dominican Republic, Barahona, Filipinas, Larimar Mine, at light, 16-17-XII-1995, 1006 m., R. E. Woodruff (FSCA); one male, Barahona, 5 km SE Palo, slopes of Loma La Torre, 18-03N 71-16W, 980 m., 18-VII-1992, disturbed forest with coffee, C. Young, R. Davidson, S. Thompson, J. Rawlins (CMNH); one female, Barahona, 4 km NE Polo, 1260 m., 9-VII-1987, R. Davidson, J. Rawlins (CMNH); one female, Baoruco, Sierra de Neiba, Los Guineos on upper Rio Colorado, 18-35N 71-11W, 630 m., 11-12-VIII-1990, J. Rawlins, S. Thompson, Mesic riparian woodland (CMNH); one female, Monseñor Nouel, 25.6 km ESE Maimon, 18-49-30N 70-03-13W. 110 m., 20-XI-2002, W. A. Zanol, C. W. Young, C. Slaresinic, J. Rawlins, disturbed forest along stream, hand collected, sample 50649 (CMNH); one female, Hato Mayor, Parque los Haitises, near Cueva de Arena, 19-04N 69-28W, 10 m., 7-9-VII-1992, C. Young, R. Davidson, S. Thompson, J. Rawlins, costal vegetation on limestone (CMNH); one female, Pedernales, 26 km N Cabo Rojo, 760m., 17-VII-1987, J. Rawlins, R. Davidson (CMNH); one male, one female, Pedernales, La Abeja, 38 km NNW Cabo Rojo, 18-09N 71-38W, 1160 m., 13-VII-1987, J. Rawlins, R. Davidson (CMNH); three males, eleven females, Pedernales, 23.5 km N Cabo Rojo, 18-06N 71-38W, 540 m., 13-19-VII-1990, L. Masuer, J. Fawlins, C. Young, Deciduous forest, intersept trap (CMNH); three males, three females, same data, except 20-VII-1990, C. W. Young, J. E. Rawlins, S. Thompson (CMNH); four males, six females, same data, except 26 km N Cabo Rojo, 730 m., 20-VII-1990, C. W. Young, J. E. Rawlins, S. Thompson (CMNH); four males, one female, same data, except 30 km N Cabo Rojo, 18-07N 71-39W, 1070 m., 23-24-VII-1990, C. Young, J. E. Rawlins, S. Thompson (CMNH); one female, one without abdomen, same data, except 23.5 km N Cabo Rojo, 18-06N 71-38W, 540 m., 13-25-VII-1990, C. Masner, J. Rawlins, C. Young, Deciduous Forest, intercept trap (CMNH): one male, one female, same data, except 26 km N Cabo Rojo, 18-06N 71-38W, 730 m., 19-25-VII-1990, L. Masner, J. Rawlins, C. Young, wet deciduous forest, intercept trap or sweep sample (CMNH); one female, same data, except, 30 km N Cabo Rojo, 18-07N 71-39W, 1070 m., 27-IX-1991, R. Davidson, C. Young, S. Thompson, J. Rawlins, Reservoir, pine woods (CMNH); one male, same data, except, Sierra de Baoruco, Aceitillar, 25.2 km ENE Pedernales, 18-05-29N 71-31-16W, 1272 m., 14-VI-2003, C. Young, J. Rawlins, C. Nunez, R. Davidson, P. Acevedo, M. de la Cruz, dense broadleaf forest, pine, hand sampled 42242 (CMNH); one male, Pedernales, 24 km N cabo Rojo, 2-VI-1998, beating at night, R. E. Woodruff (FSCA); one male, same data, except 23-VI-1998, blacklight, R. E. Woodruff and R. baranowski (FSCA); one male, one female, same data, except 21 km N. Cabo Rojo, 1-2-VII-1998, blacklight trap, R. E. Woodruff and R. Baranowski

(FSCA); one female, same data, except 24 km N Cabo Rojo, 10-VI-1998, P. H. Freytag, B. K. Dozier and R. E. Woodruff (UKYL); and one male, seven females, same data as last except, 11-VI-1998 (UKYL).

Remarks: This is a very common species on the island. It can be recognized by the smaller size and uniform brown color, with the smaller tubular aedeagus in the male. It is named for the smaller tubular aedeagus.

***Osbornellus* (*Nereius*) *tubus* Freytag, NEW SPECIES**

(Figures 15 and 58)

Description: Length of male 5.4-5.7 mm., female 5.9-6.0 mm. Similar to *brevitubus* but larger and somewhat darker in color. Overall color darker yellowish brown, with brown veins and apical veins. Head with two transverse bands above ocelli on crown, and two bands below ocelli on face. Male genitalia: Pygofer similar to *brevitubus* but larger. Subgenital plates triangular, elongate. Aedeagus (Fig. 15) tubular, larger, longer than *brevitubus*. Style and connective similar to *brevitubus*. Female seventh sternum (Fig. 58) with posterior margin almost evenly rounded.

Type Data: Holotype male: Dominican Republic, Barahona, Eastern Sierra Bahoruco, Reserva Cachote, 12.8 km NE Paraiso, 18-05-52N 71-11-19W, 1198 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, semi-disturbed wet broadleaf, UV light, sample 44314 (CMNH). Paratype female: Same data as holotype (CMNH).

Additional Specimens: Dominican Republic, one female, same data as holotype, except 18-05-54N 71-11-21W. 1230m., 22-23-XI-2004, J. Rawlins, C. Young, V. Verdecia, C. Nunez, W. Zanol, cloud forest with tree ferns, sample 44215 (CMNH); two male, same data, except 21-23-III-2004, J. Rawlins, C. Young, R. Davidson, C. Nunez, M. Rial, sample 44213 (CMNH); one male, same data, except 18-05-52N 71-11-19W, 1198 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, semi-disturbed wet broadleaf, malaise trap, sample 44384 (CMNH); two males, same data, except 18-05-58N 71-11-26W, 1219 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, disturbed cloud forest on road, UV light, sample 44114 (CMNH); two males, same data, except 18-05-54N 71-11-21W, 1230 m., 19-21-V-2004, C. Young, C. Nunez, J. Rawlins, J. Fetzner, cloud forest with tree ferns, sample 44214 (CMNH); one male, one female, La Vega, Cordillera Central, 4.1 km SW El Couvento, 18-50-37N 7-42-48W, 1730 m., 31-V-2003, J. Rawlins, R. Davidson, C. Young, C. Nunez, P. Acevedo, dense secondary evergreen forest with pine, UV light, sample 22212 (CMNH); one female, same data, except 18-50-33N 70-42-44W, 1729 m., sample 22312 (CMNH); one female, Elías Piña, Sierra de Neiba, 9.0 km WSW Hondo Valle, 18-41-34N 71-46-52W, 1843 m., 25-VI-2003, J. Rawlins, C. Young, R. Davidson, C. Nunez, P. Alevedo, M. de la Cruz, disturbed montane woodland with pine, UV light, sample 31312 (CMNH); and three females, same data, except 18-41-31N 71-47-03W, 1901 m., montane forest with *Podocarpus*, sample 31112 (CMNH).

Remarks: This species is larger than *brevitubus* and somewhat darker brown. The male aedeagus is larger also. It is named for the large tubular aedeagus.

Osbornellus (*Nereius*) *coloritubus* Freytag, NEW SPECIES

Description: Length of male 4.2 mm., female unknown. Similar to *bellus* in color pattern, but with male genitalia closer to *brevitubus*. Head with two transverse bands on crown behind ocelli, one band below ocelli on face, behind bands on crown mostly red. Pronotum with pair of red marks, one on each side of median on anterior margin. Scutellum with a red patch on each side. Forewings mostly yellow brown with brown veins. Male genitalia: Similar to *brevitubus*, except aedeagus tubular with small closely appressed processes near middle of shaft.

Type Data: Holotype male: Dominican Republic, Duarte, Reserva Loma Quita Espuela El Cadillar, 6.7 km NE San Francisco de Macoris, 19-20-12N 70-08-59W, 280 m., 5-V-2004, R. Davidson, J. Rawlins, C. Young, weedy regrowth with coffee, cacao, UV light, sample 50313 (CMNH).

Remarks: This species looks similar to *bellus* except smaller, and the red bands on the pronotum are much shorter and the male aedeagus is longer and with nearly hidden processes on the shaft. Many females are on hand that could be this species but the color patterns are somewhat different, and the specimens are larger, and from different areas, and therefore not included at this time.

Osbornellus (*Nereius*) *eccritus* Freytag, NEW SPECIES

(Figures 5, 19-21, and 61)

Description: Length of male 6-6.2 mm., female 6.5-6.6 mm. Similar to *bimarginatus*, but larger, with two transverse bands above ocelli on crown, one band below ocelli on face. Generally yellow brown with few darker brown markings. Male genitalia: Pygofer (Fig. 19) large, nearly truncate at apex. Subgenital plate (Figs. 19 and 21) triangular, elongate. Aedeagus (Figs. 20 and 21) stout, shaft bent dorsad at apex, with pair of processes from middle of shaft, extending beyond shaft, thickened in ventral view and deviating at apex. Style (Fig. 21) stout, bluntly pointed at apex. Connective (Fig. 21) Y-shaped. Female seventh sternum (Fig. 61) with posterior margin roundedly extended in median.

Type Data: Holotype male: Dominican Republic, La Vega, Loma del Casabito, 19-03N 70-31W, 1390 m., 3-XI-2002, W. A. Zanol, C. W. Young, C. Staresinic, J. Rawlins, wet cloud forest, UV light, sample 24119 (CMNH). Paratypes: Three males, 2 females, same data as holotype (one male, one female CMNH; one male FSCA; one male UKYL).

Additional Specimens: Dominican Republic: One male, La Vega, 15 km E. El Rio, 26-V-1978, C. W. and L. B. O'Brien and Marshall (FSCA); one female, same data, except 19 km E El Rio, 3-VIII-1979, L. B. O'Brien (FSCA); one female, same data, except 24 km E El Rio (UKYL); one female, same data, except 18 km E El Rio, 4-VIII-1979, G. B. Marshal (UKYL); three females, same data, except 10-VIII-1979, crest, cloud forest (UKYL); one male, La Vega, 53 km SE Constanza, 9-VIII-1979, C. W. O'Brien (UKYL); one female, same data, except L. B. O'brien; one male, La Vega, Cordillera Central, Loma Casabito, 16.0 km NW Bonao, 19-02-21N 70-31-05W, 1487 m., 28-V-2003, J. Rawlins, C. Young, R. Davidson, C. Nunez, P. Acevedo, evergreen cloud forest at summit, Malaise trap, sample 21182 (CMNH); one male, one female, same data, except 15.8 km NW Bonao, 19-02-12N 70-31-08W, 1455 m., east slope, UV light, sample 21212 (CMNH); two females, same data, except yellow pan trap, sample 21262 (CMNH); four males, Duarte, Reserva Loma Quita Espuela Cauelo, 13.2 km NNE San Francisco de Macoris, 19-24-46N 70-09-52W, 515 m., 6-IV-2004, C. Young, R. Davidson, J. Rawlins, edge of wet broadleaf forest, UV light, sample 11213 (three males CMNH, one male UKYL); and one male, same data, except canopy trap, sample 11293 (CMNH).

Remarks: This is one of the largest species of this genus on Hispaniola. It is easily separated from the others by size, color and male genitalia. It is named for the fact that it is fairly easy to separate from the other known species.

Osbornellus (*Nereius*) *dicellus* Freytag, NEW SPECIES

(Figures 22-24)

Description: Length of male 4.6 mm., female unknown. Overall looks similar to *bimarginatus*, except with quite different male genitalia. Male genitalia: Pygofer (Fig. 22) long with narrowed rounded apex. Subgenital plate (Figs. 22 and 24) long, triangular. Aedeagus (Fig. 23) with shaft short, pair of long processes from base extending at least half their length beyond shaft. Style (Fig. 24) normal, with sharply hooked apex. Connective (Fig. 24) Y-shaped.

Type Data: Holotype male: Dominican Republic, La Altagracia, Nisibon, 3-V-1978, blacklight, R. E. Woodruff and G. B. Fairchild (FSCA).

Remark: This species is separated from *bimarginatus* by the quite different male aedeagus. It is named for the long tine-like processes of the aedeagus.

Osbornellus (*Nereius*) *proximus* Freytag, NEW SPECIES

(Figures 25-27)

Description: Length of male 4.4-5.2 mm., female 5 mm. Similar to *bimarginatus* in overall looks. Forewing with a cross vein between second claval vein and claval suture. Color overall yellow brown with few markings. Head with area between transverse bands, yellow. Forewings transparent yellow brown with dark brown patch over apical vein and two cross veins reaching costal margin. Male genitalia: Pygofer (Fig. 25) elongate, with rounded apex. Subgenital plate (Figs. 25 and 27) triangular, elongate, same length as pygofer. Aedeagus (Fig. 26) U-shaped, tubular, with pair of processes closely apprised to and same length as shaft. Style (Fig. 27) normally hooked, sharply pointed. Connective (Fig. 27) Y-shaped. Female seventh sternum similar to *tubus*, with posterior margin evenly rounded.

Type Data: Holotype male: Dominican Republic, Independencia, Sierra de Neiba, south slope near summit, 40 km N Angel Felex, 18-40-21N 71-46-05W, 1825 m., 1-2-IV-2004, J. Rawlins, C. Young, R. Davidson, broadleaf cloud forest without pine, UV light, sample 34213 (CMNH). Paratypes: Three males, same data as holotype (one each CMNH, FSCA, UKYL).

Additional Specimens: One male, Dominican Republic, Pedernales, 30 km N Cabo Rojo, 18-07N 71-37W, 1070 m., 31-VII-1990, C. W. Young, J. E. Rawlins, S. Thompson; one male, same data, except 71-39W, 23-24-VII-1990 (CMNH); two males, Duarte, Reserva Loma Quita Espuela, Canelo, 13.2 km NNE San Francisco de Macoris, 19-24-46N 70-09-52W, 515 m., 6-IV-2004, C. Young, R. Davidson, J. Rawlins, edge of wet broadleaf forest, UV light, sample 11213 (CMNH); two males and four females, same as last except, El Cadillar, 6.7 km NE San Francisco de Macoris, 19-20-12N 70-08-59W, 280 m., 5-IV-2004, weedy regrowth with coffee, cacao, sample 50313 (one male and three females CMNH, one male and one female UKYL); one male, same data, except hand collected, sample 50343 (CMNH); two males and 2 females, Azua, East side of crest, Sierra Martin Garcia, 7 km WNW Barrero, 18-21N 70-58W, 860 m., 25-26-VII-1992, C. Young, R. Davidson, S. Thompson, J. Rawlins, cloud forest adjacent to disturbed forest. (one male and one female CMNH, one male and one female UKYL).

Remarks: This species is separated from the other species by the male having the aedeagus with the very closely appressed processes. This species is named for these closely appressed processes.

Osbornellus (*Nereius*) *arcus* Freytag, NEW SPECIES

(Figures 4, 28-30, and 60)

Description: Length of male 4.5-5.5 mm., female 4.8-6.0 mm. Head with anterior margin nearly foliate. Forewings with venation nearly reticulate and 4-6 cross veins along costal margin. Generally yellow brown with markings of red and dark brown. Head (Fig. 4) yellow brown with one transverse band above and one below anterior margin; anterior margin between bands, yellow; crown also with red transverse band across middle. Pronotum (Fig. 4) yellow brown with transverse red arch just behind middle. Scutellum (Fig. 4) yellow brown with slight orange patch in median area. Forewings yellow brown with claval veins reticulate, red; corium with basal veins red changing to yellow brown near middle and outlined with dark brown. Male genitalia: Pygofer (Fig. 28) long with rounded apex. Subgenital plates (Figs. 28 and 30) triangular, nearly same length as pygofer. Aedeagus (Fig. 29) with shaft curving dorsad, blunt at apex, pair of processes coming off median of shaft, extending beyond apex of aedeagus, diverging at apex. Style (Fig. 30) with hooked, bluntly pointed apex. Connective (Fig. 30) Y-shaped. Female seventh sternum (Fig. 60) with posterior margin triangularly produced on median third.

Type Data: Holotype male: Dominican Republic, La Vega, 18 km E El Rio, 10-VIII-1979, crest, cloud forest, C. W. O'Brien (FSCA) Paratypes: One male, same data as holotype, except G. B. Marshall (CMNH); one male, same data as last, except 4-VIII-1979 (UKYL); one female, La Vega, 24 km SE Constanza, 4-VIII-1979, C. W. O'Brien (FSCA), one female, La Vega, La Nevera, Constanza, 16-VIII-1979, Marcano-Abud (MNHN).

Additional Specimens: Dominican Republic, 3 males, 2 females, La Vega, Cordillera Central, 4.1 km SW El Convento, 18-50-37N 70-42-48W, 1730 m., 31-V-2003, J. Rawlins, R. Davidson, C. Young, C. Nunez, P. Acevedo, dense secondary evergreen forest with pine, yellow pan trap, sample 22262 (two males, one female CMNH, one male, one female UKYL); one male, one female, La Vega, Cordillera Central, Loma Casabito, 15.8 km NW Bonao, 19-02-12N 70-31-08W, 1455 m., 28-V-2003, J. Rawlins, C. Young, R. Davidson, C. Nunez, P. Acevedo, evergreen cloud forest, east slope, yellow pan trap, sample 21262 (CMNH); one male, same data as last, except 16.0 km NW Bonao, 19-02-21N 70-31-05W, 1487 m., at summit, canopy trap, sample 21192 (CMNH); one male, La Vega, Cordillera Central, Reserva Valle Nuevo, La Nevera, 15.1 km SE Valle Nuevo, 18-41-47N 70-35-30W, 2252 m., 3-VI-2003, R. Davidson, C. Young, C. Nunez, J. Rawlins, P. Arevedo, M. de la Cruz, montane meadow in cloud forest, pine, yellow pan trap, sample 24462 (CMNH); one female, Elías Piña, Sierra de Neiba, 9.1 km WSW Hondo Valle, 18-41-38N 71-46-56W, 1856 m., 25-VI-2003, J. Rawlins, C. Young, R. Davidson, C. Nunez, P. Azevedo, M. de la Cruz, wet montane forest with pine, yellow pan trap, sample 31262 (CMNH); one male, one female, Independencia, Sierra de Neiba, south slope near summit, 4.0 km N Angel Feliz, 18-40-21N 71-46-05W, 1825 m., 1-2-IV-2004, J. Rawlins, C. Young, R. Davidson, broadleaf cloud forest without pine, yellow pan trap, sample 34263 (CMNH); two males, San Juan, Sierra de Neiba, 9.4 km SSW El Cercado, 18-39-18N 71-31-51W, 1975 m., 18-19-XI-2004, C. Young, J. Rawlins, C. Nunez, V. Verdecia, W. Zanol, meadow near mature pine forest, yellow pan trap, sample 32265 (CMNH); and one male, San Juan, Sierra de Neiba, Sabana del Silencio, 10.0 km SSW El Cercado, 18-39-07N 71-33-21W, 2009 m., 20-VI-2003, J. Rawlins, C. Nunez, R. Davidson, C. Young, P. Acevedo, M. de la Cruz, cloud forest along *Danthonia* savannah, yellow pan trap, sample 33262 (CMNH).

Remarks: This species is quite easily separated by its different body shape and color pattern. It is named for the arch of reddish orange on the pronotum.

Osbornellus (Nereius) bimarginatus (DeLong)
(Figures 6 and 31-33)

Scaphoideus bimarginatus DeLong 1923, p. 261.
Osbornellus bimarginatus Caldwell 1952, p. 51.
Osbornellus bimarginatus Linnavuori 1959, p. 218.

Redescription: Length of male 3.8-4.0 mm., female 4.0-4.7 mm. Head (Fig. 6) with two transverse bands on crown behind ocelli, and two bands on face below ocelli. Overall yellow brown with brown veins on forewings. Male genitalia: Pygofer (Fig. 31) elongate, with rounded apex. Subgenital plate (Figs. 31 and 33) triangular, with narrowed apical two-thirds. Aedeagus (Figs. 32 and 33) with shaft curving dorsad, pair of processes from median of shaft, extending just beyond apex of shaft, curving in ventral view (Fig. 33). Style (Fig. 33) short, with curving, sharply pointed apex. Connective (Fig. 33) short,Y-shaped. Female seventh sternum with posterior margin evenly convexly curved.

Specimens Studied: Dominican Republic, four males, Hato Mayor, Parque Los Haitises, near Cueva de Arena, 19-04N 69-28W, 10 m., 7-9-VII-1992, C. Young, R. Davidson, S. Thompson, J. Rawlins, costal vegetation on limestone (CMNH); fifteen males, La Altagracia, Parque del Este, 2.9 km SW Boca de Yuma, 18-21-51N 68-37-05W, 11 m., 28-V-2004, J. Rawlins, C. Young, C. Nunez, J. Fetzner, semihumid dry forest, limestone, UV light, sample 52114 (ten males CMNH, five males UKYL).

Remarks: This species appears to occur at lower elevations where little collecting has been conducted.

Osbornellus (*Nereius*) *fasciatus* Metcalf
(Figures 7, 34-36, and 59)

Osbornellus fasciatus Metcalf 1954, p. 31.
Osbornellus fasciatus Linnavuori 1959, p. 219.

Redescription: Length of male 4.3-4.5 mm., female 4.9-5.0 mm. Head (Fig. 7) with two black transverse bands above ocelli on crown, two bands below ocelli on face. Overall dark yellow brown, with brown veins on forewings. Male genitalia: Pygofer (Fig. 34) short, wide, with apex narrowly rounded. Subgenital plate (Figs. 34 and 36) triangular, elongate. Aedeagus (Fig. 35) with shaft curving dorsad, with pair of processes from median of shaft, extending just beyond shaft, flaring at apex in ventral view. Female seventh sternum (Fig. 59) with posterior margin truncate, with tab-like, darkly pigmented median.

Specimens Studied: Dominican Republic, one male, Pedernales, 21 km N Cabo Rojo, 1-2-VII-1998, blacklight trap, R. E. Woodruff and R. Baranowski (FSCA); one female, Pedernales, 23.5 km N Cabo Rojo, 18-06N 71-38W, 540m., 13-19-VII-1990, L. Mesner, J. Rawlins, C. Young, deciduous forest, intercept trap (CMNH); one male, one female, Azua, East side of crest, Sierra Martin Garcia, 7 km WNW Barrero, 18-21N 70-58W, 860 m., 25-26-VII-1992, C. Young, R. Davidson, S. Thompson, J. Rawlins, cloud forest adjacent to disturbed forest (CMNH); and one female, La Altagracia, Parque del Este, 2.9 km SW Boca de Yuma, 18-21-51N 68-37-05W, 11 m., 28-V-2004, J. Rawlins, C. Young, C. Nunez, J. Fetzner, semihumid dry forest, limestone, UV light, sample 52114 (CMNH).

Remarks: This species also occurs mostly at lower elevations. It is the only species at this time with the extra cross vein reaching the costal margin.

Osbornellus (*Nereius*) *venustus* Freytag, NEW SPECIES
(Figures 37-39)

Description: Length of male 3.9-4.1 mm., female unknown. Similar to *bimarginatus*, but with different male genitalia. Head with two black transverse bands on crown behind ocelli, and two bands below ocelli on face. Male genitalia: Pygofer (Fig. 37) truncate, nearly square. Subgenital plate (Figs. 37 and 39) triangular, elongate. Aedeagus (Fig. 38 and 39) with shaft curving dorsad, pair of processes from middle of shaft extending just beyond apex of shaft, diverging at apex in ventral view. Style (Fig. 39) with apex bluntly pointed. Connective (Fig. 39) Y-shaped.

Type Data: Holotype male: Dominican Republic, Pedernales, 24 km N Cabo Rojo, 11-VI-1998, blacklight trap, P. H. Freytag, B. K. Dozier and R. E. Woodruff (CMNH). Paratypes: One male, same data as holotype (UKYL); one male, same data, except 21 km N Cabo Rojo, 1-2-VII-1998, R. E. Woodruff and R. Baranowski (FSCA).

Remarks: This species has a rather truncate male pygofer, and aedeagus with the processes flaring at the apex. It is named for its overall charming looks.

Osbornellus (*Nereius*) *hispanus* Freytag, NEW SPECIES
(Figures 40-42)

Description: Length of male 4.0-4.2 mm., female unknown. Similar to *bimarginatus*, but with different male genitalia. Head with two black transverse bands on crown behind ocelli, and two bands below ocelli on face. Male genitalia: Pygofer (Fig. 40) elongate, with apex narrowing, pointed. Subgenital plate (Figs. 40 and 42) triangular, elongate. Aedeagus (Figs. 41 and 42) similar to *venustus*, but more elongate, not greatly curved. Style (Fig. 42) elongate, thinner than in *venustus*. Connective (Fig. 42) Y-shaped.

Type Data: Holotype male: Dominican Republic, La Altagracia, Parque del Este, 2.9 km SW Boca de Yuma, 11 m., 18-21-51N 68-37-05W, 28-V-2004, J. Rawlins, C. Young, C. Nunez, J. Fetzner, semi-humid dry forest, limestone, UV light, sample 52114 (CMNH). Paratypes: Four males, same data as holotype (two males, CMNH; one male, FSCA; one male UKYL).

Remarks: This species is similar to *venustus*, but the male pygofer is more elongate and somewhat pointed at apex. It is named for its Spanish origin.

Osbornellus (*Nereius*) *sagarus* Freytag, NEW SPECIES

(Figures 43-45)

Description: Length of males 4.5-4.9 mm., female 5.0 mm. Overall similar to *hispanus*, but larger. Head with two bands on anterior of crown behind ocelli, and two bands on face just below ocelli. Overall color yellow brown, with brown veins on forewings. Male genitalia: Pygofer (Fig. 43) large with narrow rounded apex. Subgenital plate (Figs. 43 and 45) triangular, long, broad at base in lateral view. Aedeagus (Fig. 44) with shaft curving dorsad, pair of processes from near base, stout, extending half their length beyond shaft, parallel (Fig. 45) in ventral view. Female seventh sternum with posterior margin evenly, convexly curved.

Type Data: Holotype male: Dominican Republic, Peravia, 13 km NW Bani, 8-VII-1979, C. W. O'Brien (FSCA). Paratypes: One female, same data as holotype (FSCA); one female, same data, except 12-VII-1979, L. B. O'Brien (UKYL); one male, Peravia, Cruce de Ocoa, Bani, 22-VIII-1979, Dquez-Mota (MHND).

Additional Specimens: One male, Dominican Republic, Pedernales, 15 km N Cabo Rojo, 21-VI-1998, blacklight, R. E. Woodruff and R. Baranowski (FSCA): two males La Altagrecía, Parque del Este, Caseta Guaraguae, 4.4 km SE Baychibe, 18-19-59N 68-48-42W, 3 m., 26-27-V-2004, C. Young, J. Rawlins, J. Fetzner, C. Nunez, semihumid forest near sea, limestone, UV light, sample 51114 (CMNH).

Remarks: The three male specimens not in the type series are smaller than the holotype but have the same male genitalia. This species is similar to *hispanus*, but is larger in size and has different male genitalia which will separate the two species at this time. It is named for the sword-like processes on the male aedeagus.

Osbornellus (*Nereius*) *parvus* Freytag, NEW SPECIES

(Figures 46-48)

Description: Length of male 4.3 mm., female unknown. Overall look similar to *bimarginatus*, but with quite different male genitalia. Male genitalia: Pygofer (Fig. 46) short, broadly rounded at apex. Subgenital plate (Figs. 46 and 48) long, triangular. Aedeagus (Figs. 47 and 48) with shaft tubular curving dorsad, pair of processes off middle of shaft, extending beyond shaft, slightly divergent at apex in ventral view. Style (Fig. 48) elongate, not greatly curved at apex. Connective (Fig. 48) Y-shaped.

Type Data: Holotype male: Dominican Republic, La Romana, 2 km N La Romana, 15-VI-1998, blacklight trap, P. H. Freytag, B. K. Dozier, and R. E. Woodruff (FSCA).

Remarks: The male aedeagus has processes that gradually flare to the apex. This species is named for its small size.

Osbornellus (*Nereius*) *eratus* Freytag, NEW SPECIES

(Figures 49-51)

Description: Length of male 4.4 mm., female unknown. Overall appearance as in *bimarginatus*, with nearly transparent forewings, and different male genitalia. Male genitalia: Pygofer (Fig. 49) short, broadly rounded at apex. Subgenital plate (Figs. 49 and 51), triangular, elongate, narrowed near base. Aedeagus (Figs. 50 and 51) with shaft tubular curving dorsad, pair of processes from near middle of shaft, extending just beyond shaft, following curve of shaft, nearly parallel in ventral view. Style (Fig. 51) normal, with short sharply pointed apex. Connective (Fig. 51) Y-shaped.

Type Data: Holotype male: Dominican Republic, Pedernales, 24 km N Cabo Rojo, 2-VI-1998, beating at night, R. E. Wodruff (FSCA).

Remarks: The male aedeagus is quite different from the other species, and will identify this species. This species is named for its overall nice looks.

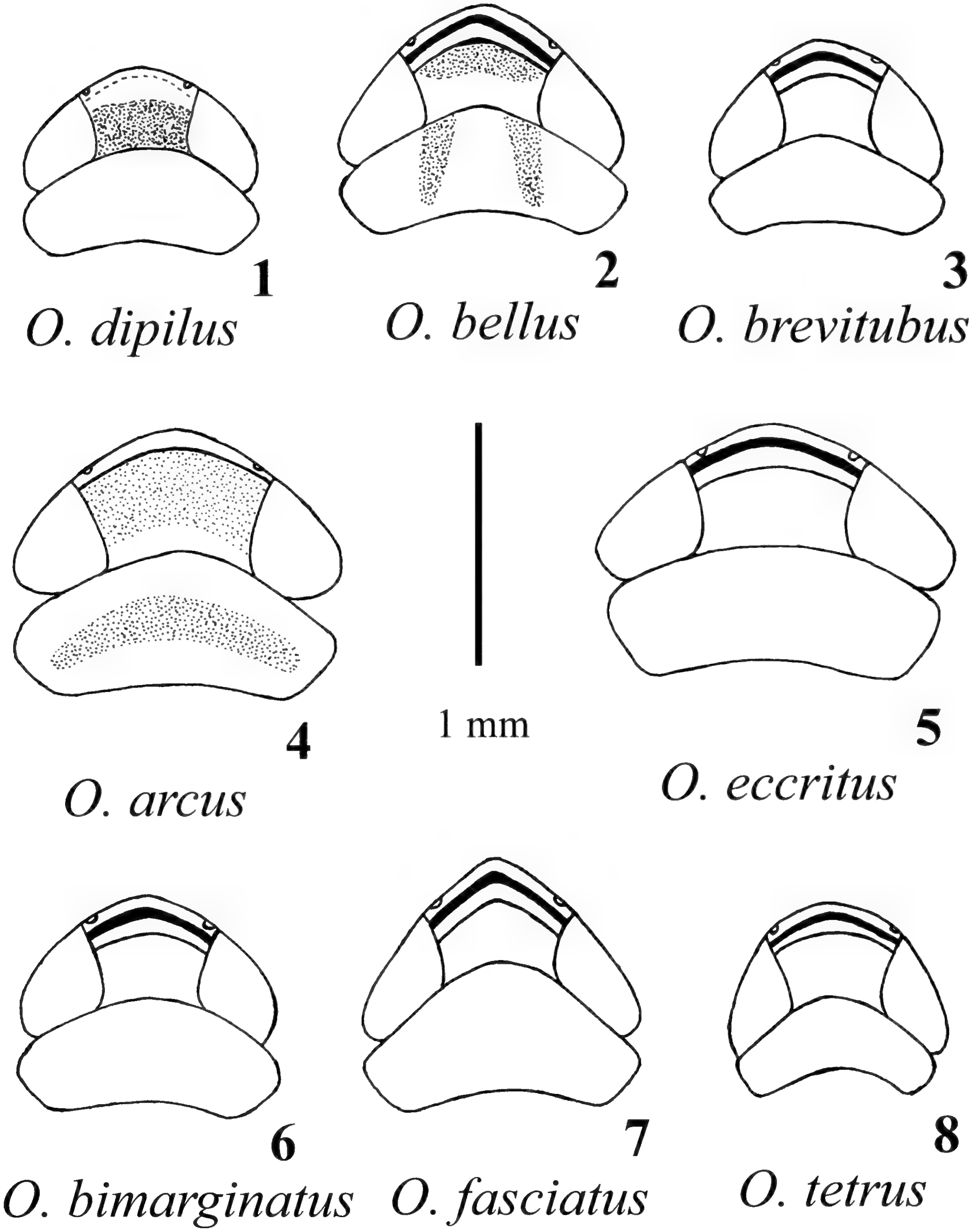
Osbornellus (*Nereius*) *tetrus* Freytag, NEW SPECIES

(Figures 8 and 52-54)

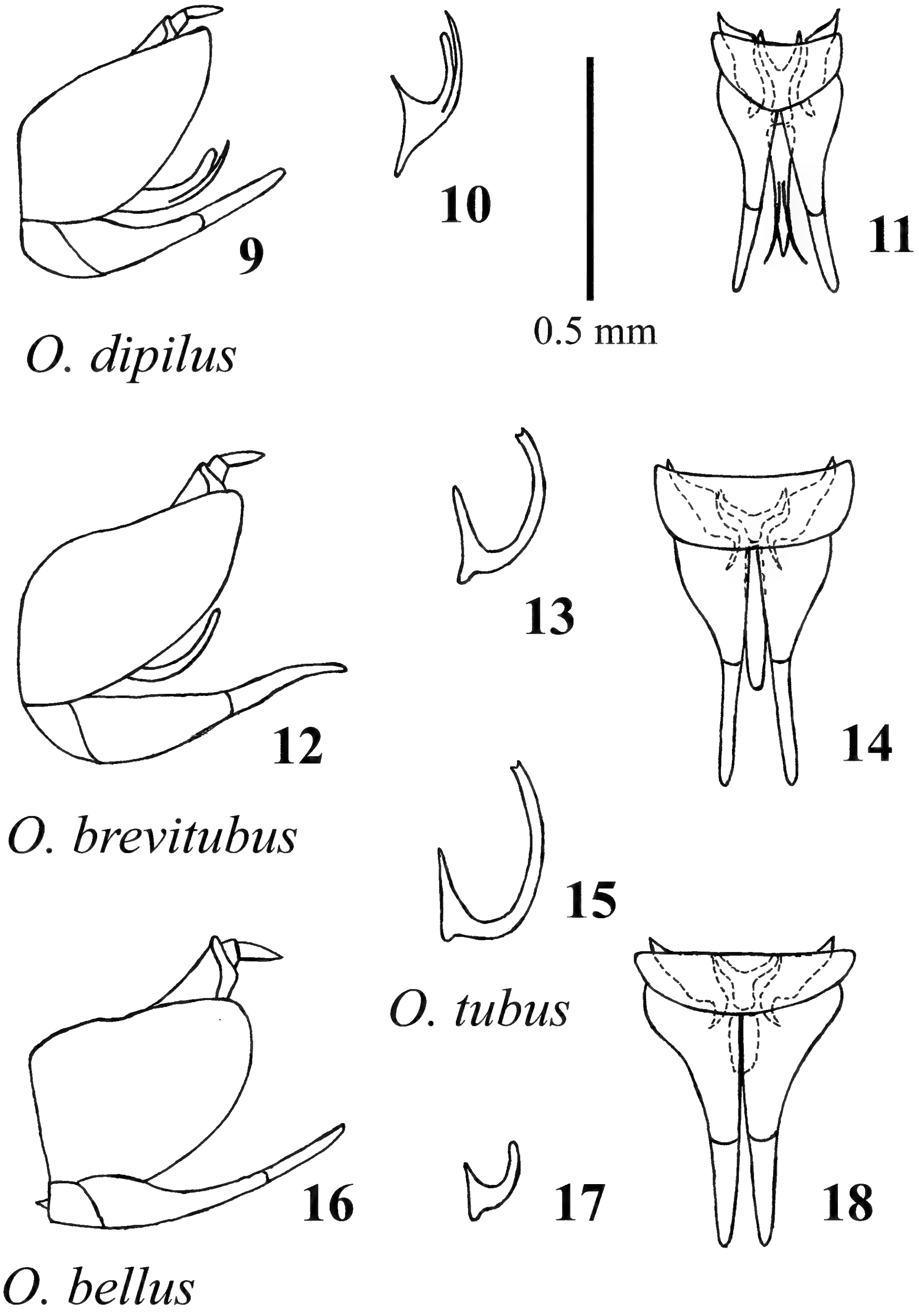
Description: Length of male 3.5 mm., females 3.5 mm. Similar to *bimarginatus*, but smaller and with different male genitalia. Head with two black transverse bands behind ocelli on crown, two bands below ocelli on face. Male genitalia: Pygofer (Fig. 52) small, nearly oval with rounded apex. Subgenital plate (Figs. 52 and 54) triangular, same length as pygofer, Aedeagus (Figs. 53 and 54) small, with shaft curving dorsad, pair of narrow, sharply pointed processes from beyond middle of shaft, extending beyond shaft, and nearly parallel in ventral view. Style (Fig. 54) short, bluntly pointed at apex. Connective (Fig. 54) Y-shaped. Female seventh sternum with posterior margin roundly produced.

Type Data: Holotype male: Dominican Republic, Pedernales, 15 km N Cabo Rojo, 21-VI-1998, blacklight, R. E. Woodruff and R. Baranowski (FSCA). Paratypes: one female, same data as holotype (FSCA); one female, Pedernales, 12 km N Cabo Rojo, 13-VI-1998, blacklight trap, P. H. Freytag, B. K. Dozier, and R. E. Woodruff (UKYL).

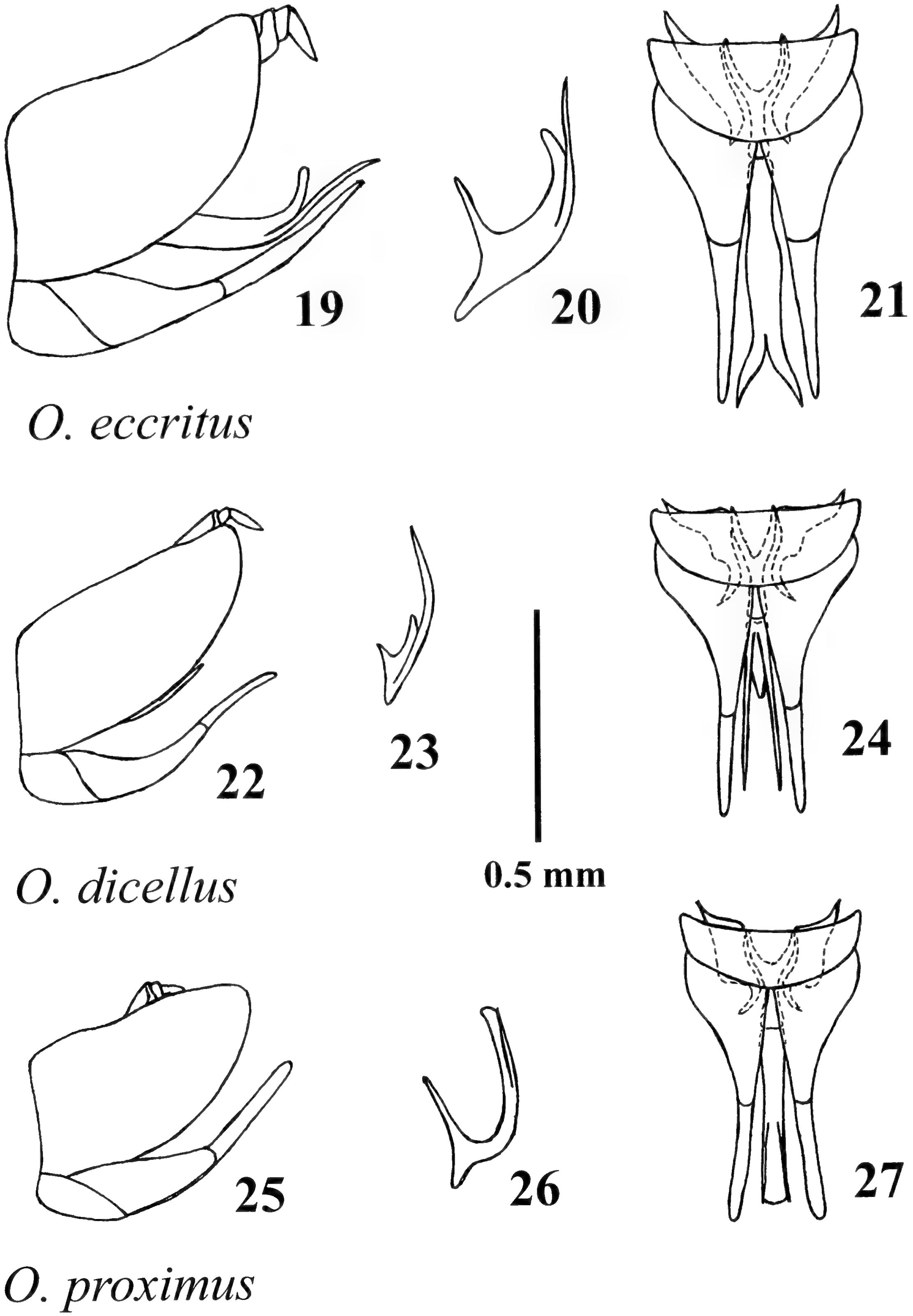
Remarks: The female paratype with the same data as the holotype is the only specimen seen with the color pattern in good condition. The other two specimens have little of the reddish orange color, as they were collected into alcohol. This species is however, very small, usually brightly colored, with a distinct male aedeagus, and is therefore easily separated from the other known species. This species is named for the four bands on the anterior part of the head.



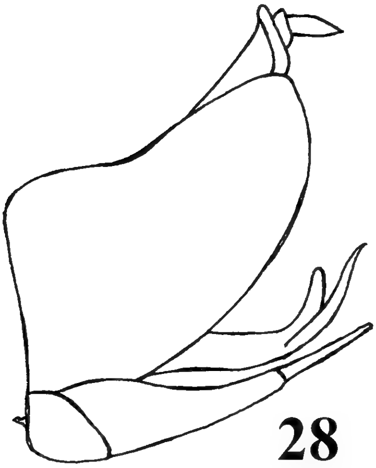
Figures 1-8. Head and pronotum, dorsal view. Fig. 1. *Osbornellus* (*Nereius*) *dipilus* n. sp. Fig. 2. *O.* (*N.*) *bellus* n. sp. Fig. 3. *O.* (*N.*) *brevitubus* n. sp. Fig. 4. *O.* (*N.*) *arcus* n. sp. Fig. 5. *O.* (*N.*) *eccritus* n. sp. Fig. 6. *O.* (*N.*) *bimarginatus* (DeLong). Fig. 7. *O.* (*N.*) *faciatus* Metcalf. Fig. 8. *O.* (*N.*) *tetrus* n. sp. All drawn to the same scale.



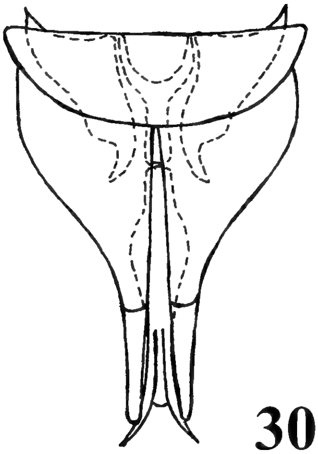
Figures 9-18. Male genitalia. Figs. 9-11 *Osbornellus* (*Nereius*) *dipilus* n. sp. Figs. 12-14. *O.* (*N.*) *brevitubus* n. sp. Figs. 15. *O.* (*N.*) *tubus* n. sp. Figs. 16-18.).*O.* (*N.*) *bellus* n. sp. Figs. 9, 12, and 16, genital capsule, lateral view (setae not shown). Figs. 10, 13, 15, and 17, aedeagus, lateral view. Figs. 11, 14, and 18, valve and subgenital plates, ventral view (also showing internal genitalia). All drawn to the same scale.



Figures 19-27. Male genitalia. Figs. 19-21. *Osbornellus* (*Nereius*) *eccritus* n. sp. Figs. 22-24. *O.* (*N.*) *dicellus* n. sp. Figs. 25-27. *O.* (*N.*) *proximus* n. sp. Figs. 19, 22, and 25, genital capsule, lateral view (setae not shown). Figs. 20, 23, and 26, aedeagus, lateral view. Figs. 21, 24, and 27, valve and subgenital plates, ventral view (also showing internal genitalia). All drawn to the same scale.

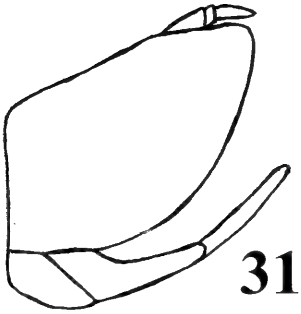

28


29

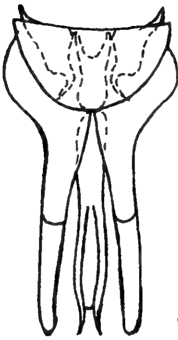

30

O. arcus

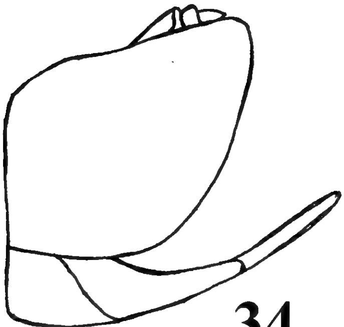
0.5 mm

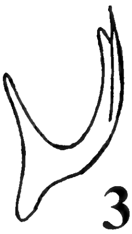

31

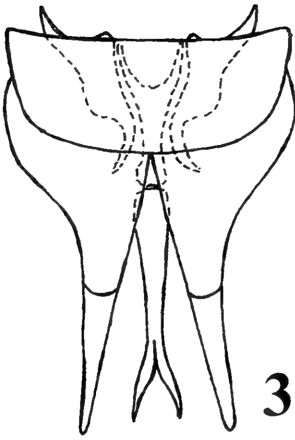

32


33

O. bimarginatus

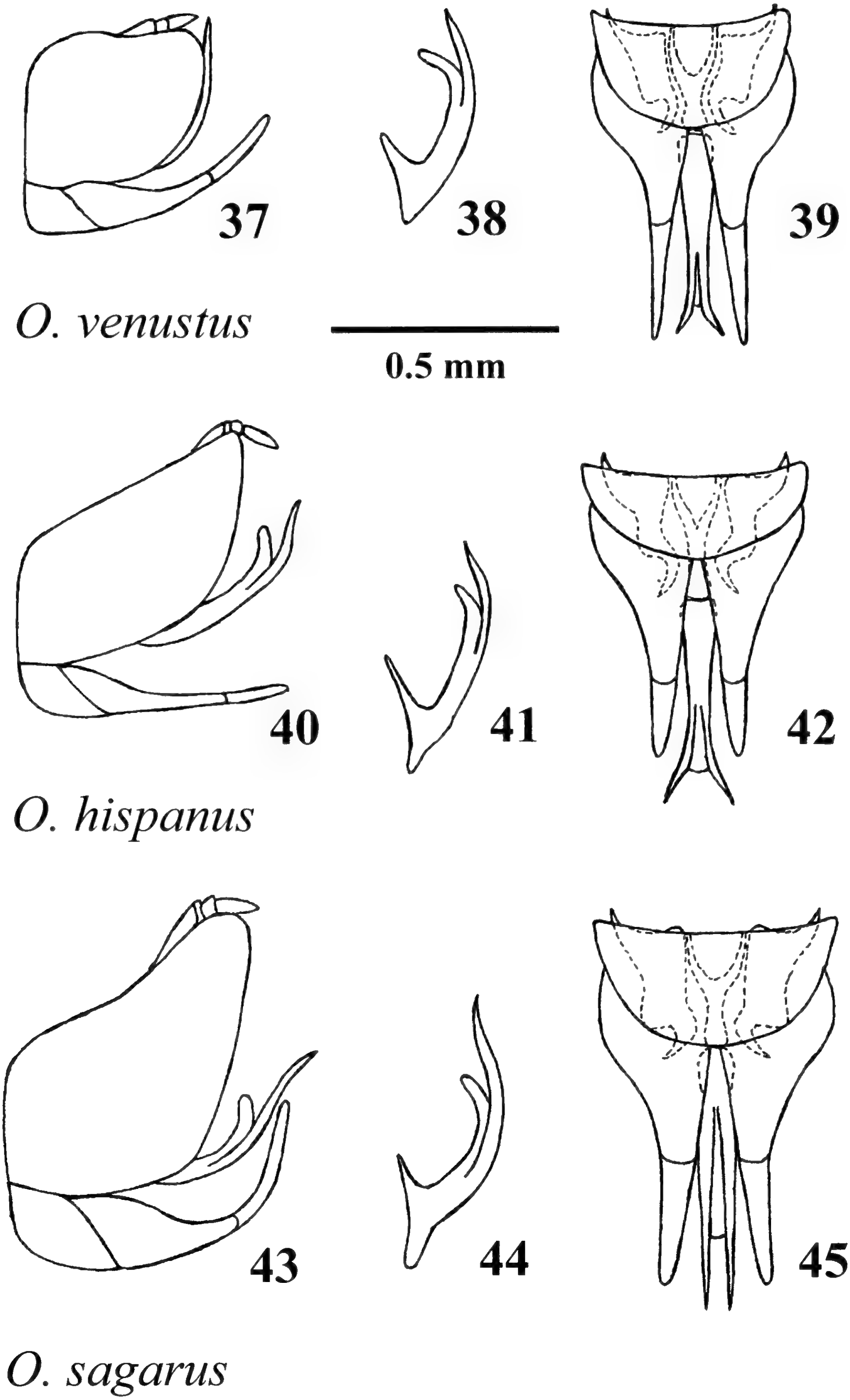

34


35

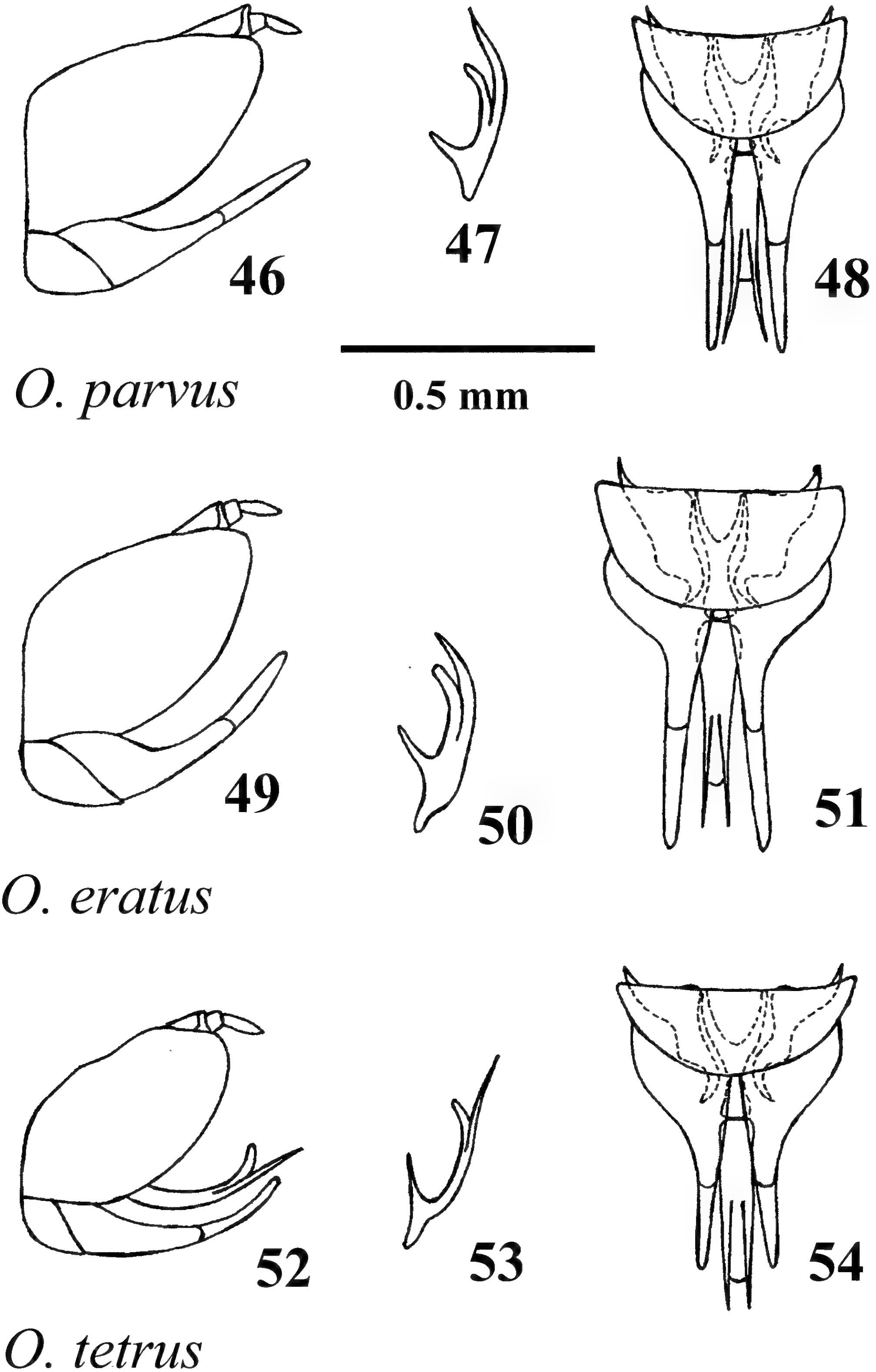

36

O. fasciatus

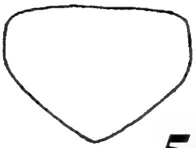
Figures 28-36. Male genitalia. Figs. 28-30. *Osbornellus* (*Nereius*) *arcus* n. sp. Figs. 31-33. *O.* (*N.*) *bimaculatus* (DeLong). Figs. 34-36. *O.* (*N.*) *fasciatus* Metcalf. Figs. 28, 31, and 34, genital capsule, lateral view (setae not shown). Figs. 29, 32, and 35, aedeagus, lateral view. Figs. 30, 33, and 36, valve and subgenital plates, ventral view (also showing internal genitalia). All drawn to the same scale.



Figures 37-45. Male genitalia. Figs. 37-39. *Osbornellus* (*Nereius*) *venustus* n. sp. Figs. 40-42. *O.* (*N.*) *hispanus* n. sp. Figs. 43-45. *O.* (*N.*) *sagarus* n. sp. Figs. 37, 40, and 43, genital capsule, lateral view (setae not shown). Figs. 38, 41, and 44, aedeagus, lateral view. Figs. 39, 42, and 45, valve and subgenital plates, ventral view (also showing internal genitalia). All drawn to the same scale.

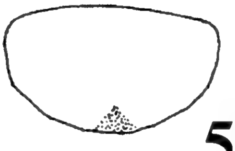


Figures 46-54. Male genitalia. Figs. 46-48. *Osbornellus* (*Nereius*) *parvus* n. sp. Figs. 49-51. *O.* (*N.*) *eratus* n. sp. Figs. 52-54. *O.* (*N.*) *tetrus* n. sp. Figs. 46, 49, and 52, genital capsule, lateral view (setae not shown). Figs. 47, 50, and 53, aedeagus, lateral view. Figs. 48, 51, and 54, valve and subgenital plates, ventral view (also showing internal genitalia). All drawn to same scale.



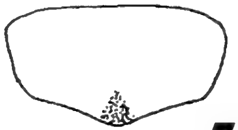
55

O. dipilus



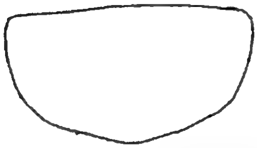
56

O. bellus



57

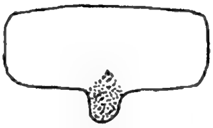
O. brevitubus



58

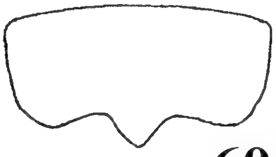
O. tubus

1 mm



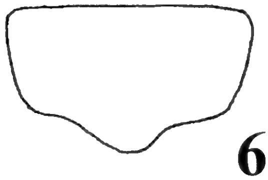
59

O. fasciatus



60

O. arcus



61

O. eccritus

Figures 55-61. Female seventh sternum, ventral view. Fig. 55. *Osbornellus* (*Nereius*) *dipilus* n. sp. Fig. 56. *O.* (*N.*) *bellus* n. sp. Fig. 57. *O.* (*N.*) *brevitubus* n. sp. Fig. 58. *O.* (*N.*) *tubus* n. sp. Fig. 59. *O.* (*N.*) *fasciatus* Metcalf. Fig. 60. *O.* (*N.*) *arcus* n. sp. Fig. 61. *O.* (*N.*) *eccritus* n. sp. All drawn to the same scale.

LITERATURE CITED

Caldwell, J. S. 1952. *In,* J. S. Caldwell and L. F. Martorell (Editors). Review of the Auchenorynchous Homoptera of Puerto Rico. Part I. Cicadellidae. The Journal of Agriculture of the University of Puerto Rico 34(1): 1-132.

DeLong, D. M. 1923. *In,* Wolcott, G. N. Insectae Portoricensis. A preliminary annotated check-list of the insects of Porto Rico, with descriptions of some new species. Journal of Agriculture of the University of Puerto Rico 7(1): 1-313.

Linnavuori, R. 1959. Revision of the Neotropical Deltocephalinae and some related subfamilies (Homoptera). Suomalaisen Elain-ja Kasvitieteelisen Seuran Vanamon Elaintieteelisia Julkaisuja 20: 1-370.

Metcalf, Z. P. 1954. Homoptera from the Bahama Islands. American Museum Novitates Number 1698, pp. 1-46.

SOME CARABINAE (COLEOPTERA: CARABIDAE) FROM KAHRAMANMARAŞ AND SURROUNDING TOWNS, IN SOUTH CENTRAL TURKEY[1]

Sakine Serap Avgın[2] and Iskender Emre[2]

ABSTRACT: Fourteen species and subspecies of Turkish Carabinae belonging in the family Carabidae were examined in detail. This represents about 15% of the Carabinae fauna of Turkey. This study is based on material collected from different altitudes and climatic conditions and from localities of different vegetation, between 2004 and 2005 from Kahramanmaraş and the surrounding towns located in south central Turkey. Adult length/width body ratios, photographs of the adults, detailed descriptions of the male genital organs and photographs, collecting localities, distribution in Turkey and in the world, as well as chorotypes are given for each species.

KEY WORDS: Carabidae, Carabinae, Kahramanmaraş and the surrounding towns, Turkey, altitudinal zonation

Ground beetles (Carabidae) have long been recognized as one of the most ecologically and economically important edaphofaunal groups (Neculiseanu and Matalin, 2000). The Carabidae has approximately 40,000 described species (Larsen et al., 2003); 18 subfamilies are present in Europe (Trautner and Geigenmüller, 1987). In Turkey, more than 1,100 species have been recorded; 41.1% of these are endemic (Casale and Vigna Taglianti, 1999).

There are approximately 94 species in the subfamily Carabinae reported for Turkey. The Carabinae include extra-oral digestion predators (Hurka, 1996) often specialized in various invertebrate phyla (e.g. molluscs, annelids, arthropods). The Carabinae tend to be large and generally differ from species in other subfamilies by their body shape, having well developed compound eyes, elytra without basal margins, separate or joiningly rounded at apex, or sometimes incurved before (Fig. 1); protibia without deep prolateral incision or with only flat apical incision (Trautner and Geigenmüller, 1987).

Several researchers have worked on Turkish Carabinae, including Breuning (1964), Schweiger (1962a; 1962b; 1964), Casale and Vigna Taglianti (1999), Cavazzuti (1986; 1989; 1999; 2002) as well as Cavazzuti and Rapuzzi (1998). This study contributes to the taxonomy of the Carabinae in Turkey by providing the adult length/width body ratios, photographs of the adults, brief descriptions and photographs of the male genital organs, collecting localities, distribution in Turkey and in the world, as well as chorotypes for the 14 selected species. Although most of the species herein reported are endemic to Anatolia (most of Turkey is considered Anatolia, or a western peninsula of Asia) or are widespread in Europe, Africa, or Asia, we document a distinct distributional zonation for some Carabinae from Kahramanmaraş and the surrounding towns of south central

---

[1] Received on March 12, 2007. Accepted on June 3, 2007.

[2] Çukurova University, Art and Science Faculty, Department of Biology, Balcalı, Adana, Turkey. E-mails: (SSA) serapavgin@hotmail.com; (IE) iemre@cu.edu.tr.

Mailed on May 14, 2008

Turkey. This study will facilitate biological pest control studies in agriculture and forest ecosystems.

METHODS

Specimens were collected in Kahramanmaraş and surrounding towns (Malatya, Gaziantep, Sivas, Adıyaman, Adana, Kayseri, Osmaniye) that are not completely isolated completely from Kahramanmaraş by rivers and mountains. The climate of this area is Mediterranean, with dry summers as well as warm and rainy winters (Akman, 1990). In this region, the mean annual temperature is 16.5°C, the maximum mean temperature is 35.9°C during August, and the minimum mean temperature is 1.2°C in January (Varol, 2003). Collecting localities covered a broad span of altitudes (approximately 650 to over 1800 m above sea level), and vegetation ecological types (steppes, forests, and plantations of apples, poplars, wheat, grapes, as well as olives). Our main collecting devices were plastic pitfall traps placed in the ground with 25% ethylene glycol. The 10-15 traps placed at each locality were emptied monthly (Armstrong and Mc Kinlay, 1997; Magura et al., 2000). From time to time, specimens were hand collected elsewhere (e.g. under rocks).

The collecting localities, including coordinates and altitude above sea level (in meters) follow: 1) Adıyaman-Azaplı, 37° 45' 34" N; 37° 32' 59" E, 920 m; 2) Kahramanmaraş-Başkonuş, 37° 34' 12" N; 36° 34' 58" E, 1321 m; 3) Kahramanmaraş-Başkonuş, 37° 33' 54" N; 36° 34' 57" E, 1312 m; 4) Kahramanmaraş-Başkonuş-Sersem, 37° 33' 26" N; 36° 34' 14" E, 1403 m; 5) Kahramanmaraş-Bulutoğlu, 695 m; 6) Kahramanmaraş-Elbistan-Iğdeköy, 1210 m; 7) Kahramanmaraş-Ekinözü-Akpınar (apple plantation), 38° 05' 32" N; 37° 13' 17" E, 1380 m; 8) Kahramanmaraş-Göksun-Çardak, 38° 03' 02" N; 36° 38' 34" E, 1365 m; 9) Kahramanmaraş-Göksun-Çardak (forest), 38° 01' 47" N; 36° 33' 10" E, 1354 m; 10) Kahramanmaraş-Göksun-Çardak Küçüksu (poplar plantation), 38° 03' 25" N; 36° 39' 28" E, 1316 m; 11) Kahramanmaraş-Göksun-Çardak-Karaahmet, 38° 01' 42" N; 36° 34' 17" E, 1342 m; 12) Kahramanmaraş-Göksun-Çardak-Kuzutepesi, 38° 03' 52" N; 36° 42' 01" E, 1362 m; 13) Kahramanmaraş-Göksun-Çardak-Küçüksu, 38° 03' 37" N; 36° 40' 30" E, 1358 m; 14) Kahramanmaraş-Göksun-Gölpınar, 38° 58’ 50" N; 36° 30' 07" E, 1340 m; 15) Kahramanmaraş-Göksun-Kireçköy, 38° 59’ 48" N; 36° 31' 10" E, 1334 m; 16) Kahramanmaraş-Göksun-Mehmetbey, 38° 05' 54" N; 36° 27' 54" E, 1413 m; 17) Kahramanmaraş-Göksun-Mehmetbey (reservoir), 38° 06' 15" N; 36o 26' 40" E, 1441 m; 18) Kahramanmaraş-Nurhak, 38° 00' 15" N; 37° 19' 24" E, 1373 m; 19) Kahramanmaraş-Üngüt (wheat field) 37° 36' 07" N; 36° 02' 51" E, 695 m; 20) Kahramanmaraş-Üngüt (forest) 37° 36' 07" N; 36° 50' 39" E, 673 m; 21) Kahramanmaraş-Üngüt (grapeyard), 36° 30' 23" N; 33° 07' 51" E, 682 m; 22) Kahramanmaraş-Üngüt (olive plantation), 37° 36' 04" N; 36° 50' 40" E, 654 m; 23) Kahramanmaraş-Yavşan, 37° 28' 54" N; 37° 16' 51" E, 1591 m; 24) Kahramanmaraş-Yavşan, 37° 28' 45" N; 36° 41' 55" E, 1574 m; 25) Kahramanmaraş-Yavşan, 37° 28' 29" N; 36° 42' 38" E, 1535 m; 26) Kahramanmaraş-Yavşan, 37° 29' 15" N; 36° 42' 42" E, 1500 m; 27) Kahramanmaraş-Yeniköy (forest), 1150 m; 28) Kayseri-

Pınarbaşı, 38° 43' 22" N; 36° 24' 28" E, 1560 m; 29) Kayseri-Sarız, 38° 33' 28" N; 36° 27' 02" E, 1810 m; 30) Kayseri-Sarız-Uzunahmet, 38° 36' 29" N; 36° 25' 59" E, 1663 m; 31) Osmaniye-Bahçe-Hodur, 37° 21' 34" N; 36° 40' 11" E, 1320 m.

Approximately, 950-1,000 specimens of Carabinae were collected of which, as much as possible, 10♂ and 10♀ from each of 14 species and subspecies were measured. A few specimens were dissected in the laboratory. Specimens were identified by using the keys in Müller (1926), Breuning (1964), Trautner and Geigenmüller (1987) as well as Hurka (1996). Some unidentified species were identified by Professor Augusto Vigna Taglianti who also verified all of our identifications. The specimens were measured with a milimetric ocular. The male genitalia was prepared and, together with the adults, digitally imaged. Detailed descriptions of the male genital structure are also given. The distribution of the species herein discussed as well as their chorotypes come from Vigna Taglianti et al. (1999) and Casale and Vigna Taglianti (1999), respectively. All specimens are deposited in the Biology Department of Çukurova University.

SYSTEMATIC ENTOMOLOGY

Subfamily Carabinae

Calosoma sycophanta (Linné, 1758)

Fig. 1

Measurements: Body metallic black or metallic green, length ♂ 22-30 mm, ♀ 24-32 mm; pronotum ♂ 1.75-1.80 times as wide as long and ♀ 1.60-1.80 times as wide as long; elytra ♂ 1.46-1.50 times as long as wide and ♀ 1.38-1.50 times as long as wide; body ventral black (Figure 1 a, b).

Male Genitalia: Aedeagus in lateral view strongly curve towards ventral, weakly wide towards medial and weakly narrow towards basal, wide in basal, apical plate short; in dorsal view wide towards medial and narrow in proximal, apical plate short and weak towards apex; same large parameres (Figure 1 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Widespread in the Palearctic including Asia, North Africa, and Europe as well as in the Nearctic region (Müller, 1926; Trautner and Geigenmüller, 1987; Gueorguiev and Gueorguiev, 1995; Kryzhanovskij et al., 1995; Hurka, 1996; Löbl and Smetana, 2003). In Turkey, it has been found in Anatolia (no locality, Casale and Vigna Taglianti, 1999); Ankara (Kocatepe and Mergen, 2004). Material Examined: Adıyaman-Azaplı: 26.VI.2004 1♂; Kahramanmaraş-Başkonuş: 29.VI.2004 2♂♂; Kahramanmaraş-Göksun-Çardak-Karaahmet: 12.VII.2004 1♂; Kahramanmaraş-Üngüt (forest): 05.IV.2004 3♀♀; 21.IV.2004 12♂♂, 16♀♀; 07.V.2004 1♀; 27.V.2005 1♀; Kahramanmaraş-Yavşan: 7.VII.2004 1♂. Approximate Altitudinal Range: 900-1600 m above sea level. Chorotype: Palearctic (Holarctic).

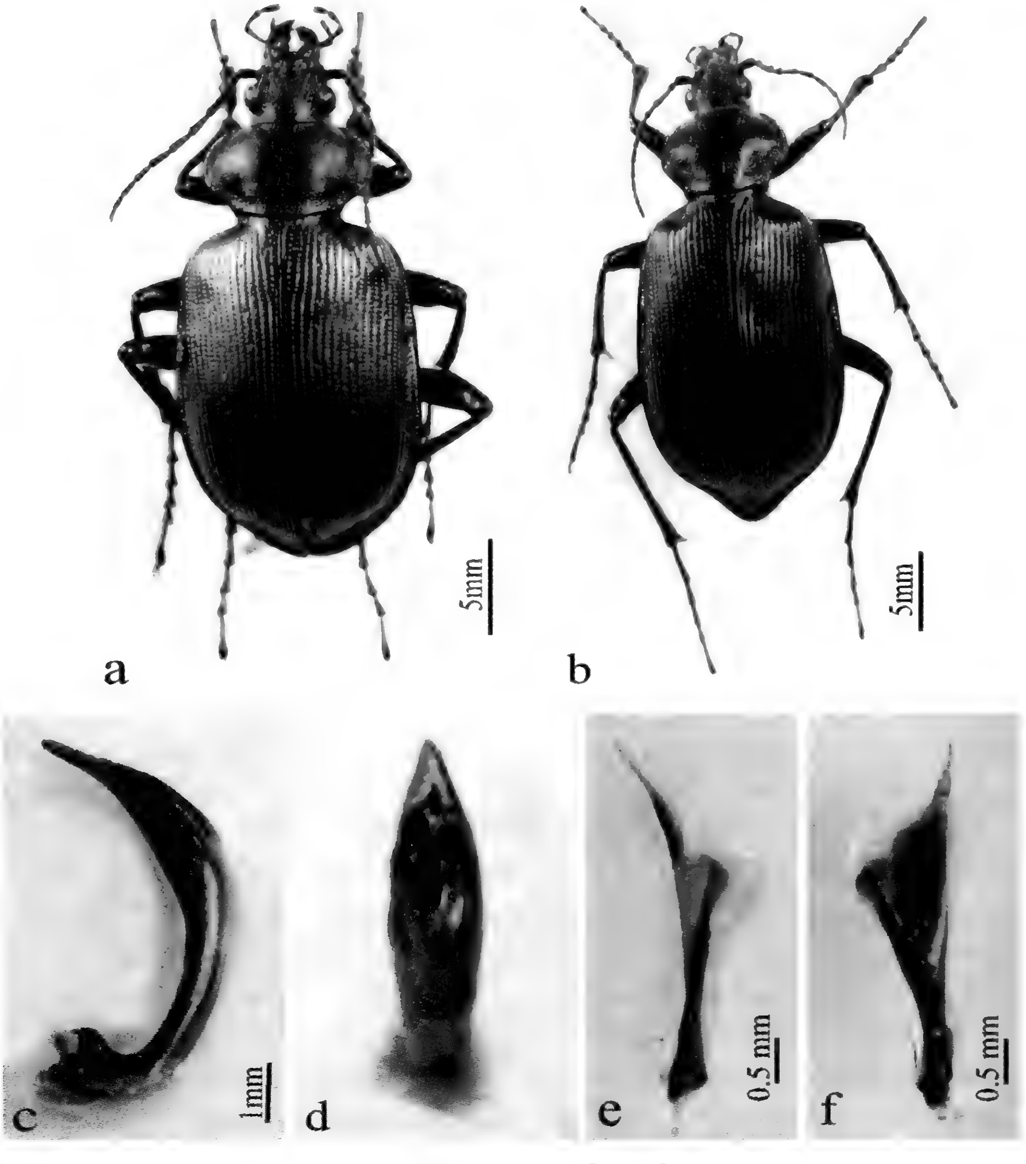


Figure 1. *Calosoma sycophanta* (Linné, 1758). a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere. Note elytra rounded at apex.

***Carabus* (*Mimocarabus*) *maurus paphius* L. Redtenbacher, 1843**
Fig. 2

Measurements: Body black, length ♂ 15–20 mm, ♀ 19–20 mm; pronotum ♂ 1.50–1.67 times as wide as long and ♀ 1.25–2.00 times as wide as long; elytra ♂ 1.50–1.75 times as long as wide and ♀ 1.63–1.67 times as long as wide; body ventral black (Figure 2 a, b).

Male Genitalia: Aedeagus in lateral view strongly curve towards ventral, wide towards medial and narrow towards basal, wide in basal, apical plate rounded on apex; in dorsal view wide towards medial, short apical plate and weak towards apex and latero-ventral sinuated; same large parameres (Fig. 2 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Asia (Kryzhanovskij et al., 1995; Löbl and Smetana, 2003). In Turkey, it has been found in Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Üngüt (wheat field): 27.II. 2004 10♂♂, 6♀♀; 23.III.2004 3♂♂; 5.IV.2004 11♂♂, 8♀♀; 21.IV.2004 2♂♂, 1♀; Kayseri-Sarız: 11.VII.2004 2♀♀; Kayseri-Sarız-Uzunahmet: 11.VII.2004 1♂. Approximate Altitudinal Range: 700-1700 m above sea level. Chorotype: Anatolian.

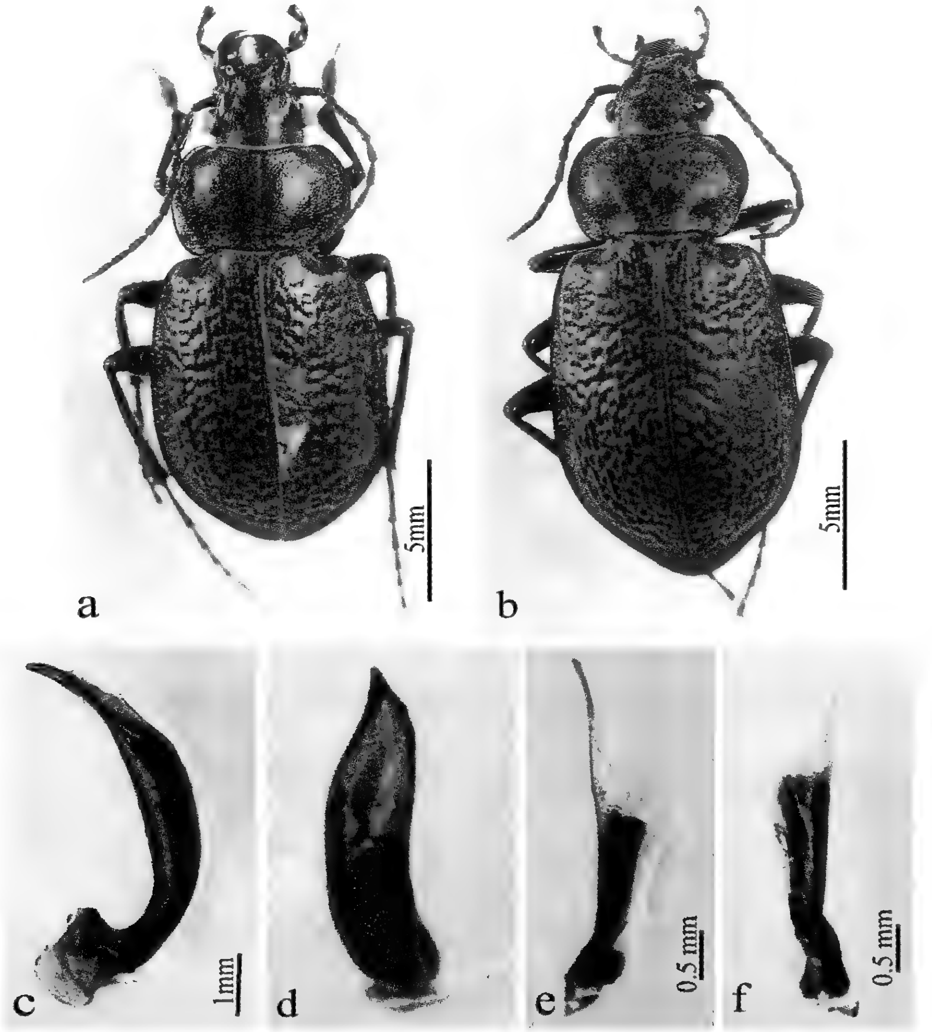


Figure 2. *Carabus* (*Mimocarabus*) *maurus paphius* L. Redtenbacher, 1843. a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Carabus (*Archicarabus*) *gotschi caramanus* Fairmaire, 1886

Fig. 3

Measurements: Body black, length ♂ 19–21 mm, ♀ 18–19 mm; pronotum ♂ 1.50 times as wide as long and ♀ 1.50–1.75 times as wide as long; elytra ♂ 1.33 times as long as wide and ♀ 1.44–1.63 times as long as wide; body ventral black (Figure 3 a, b).

Male Genitalia: Aedeagus in lateral view curve towards ventral, latero-ventral sinuated, wide in medial and narrow towards basal, wide in basal, apical plate rounded on apex; in dorsal view wide in medial, narrow towards proximal, apical plate short and weak towards apex and weakly in ventral sinuated; same large parameres (Figure 3 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Endemic to Anatolia, Turkey (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Başkonuş: 29.VI.2004 1♂, 1♀; 10.VII.2004 2♂♂, 1♀; 21.VIII.2004 1♂, 1♀; 05.IX.2004 3♀♀; Kahramanmaraş-Başkonuş-Sersem: 21.VII.2005 2♂♂; 12.XI.2004 1♂; Osmaniye-Bahçe-Hodur: 20.VIII.2004 3♀♀. Approximate Altitudinal Range: 1300-1400 m above sea level. Chorotype: S-Anatolian.

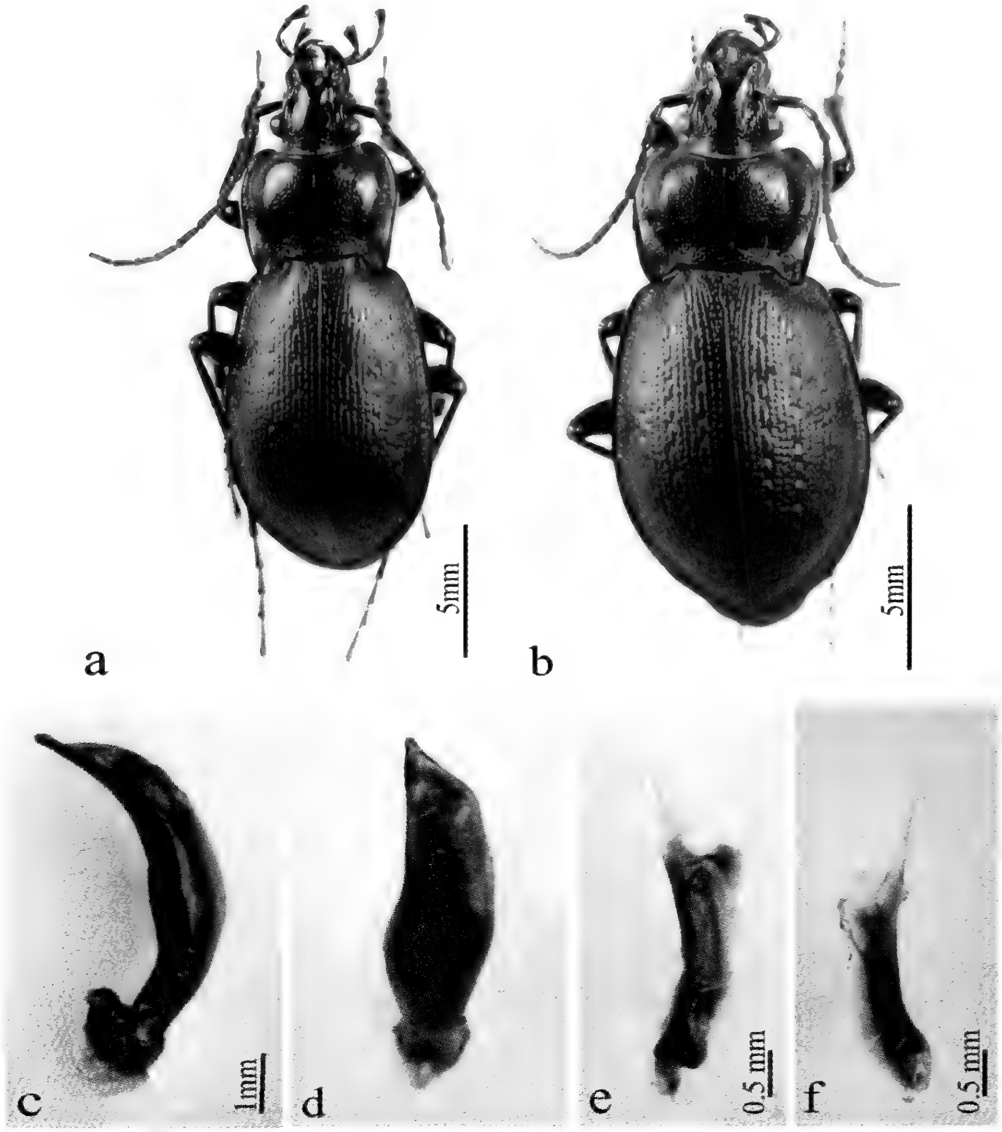


Figure 3. *Carabus* (*Archicarabus*) *gotschi caramanus* Fairmaire, 1886. a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere

Carabus (*Archicarabus*) *gotschi goeksunensis* Breuning, 1966

Fig. 4

Measurements: Body black, length ♂ 17–19 mm; pronotum ♂ 1.25–1.50 times as wide as long; elytra ♂ 1.50–1.57 times as long as wide; body ventral black (Fig. 4).

Male Genitalia: Because the definitions of aedeageus and parameres have been given in former subspecies, they haven't been given in here again.

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Endemic to Turkey. Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Göksun-Çardak: 12.VII. 2004 2♂♂; Kayseri-Sarız-Uzunahmet: 11.VII.2004 1♂. Approximate Altitudinal Range: 1400-1700 m above sea level. Chorotype: S-Anatolian.

Figure 4. *Carabus (Archicarabus) gotschi goeksunensis* Breuning, 1966, ♂.

Carabus (*Tomocarabus*) *rumelicus rumelicus* Chaudoir, 1867

Fig. 5

Measurements: Body black, length ♂ 11–12 mm, ♀ 12–17 mm; pronotum ♂ 1.67 times as wide as long and ♀ 1.25–1.67 times as wide as long; elytra ♂ 1.71 times as long as wide and ♀ 1.38-1.50 times as long as wide; body ventral black-red (Figure 5 a, b).

Male Genitalia: Aedeagus in lateral view weakly curve towards ventral, sinuated in ventral side, wide in medial and narrow towards basal, short apical plate, apical plate rounded on apex and apical plate strongly curve towards ventral; in dorsal view wide towards medial and narrow towards proximal, apical plate short and rounded towards apex; same large parameres (Figure 5 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Endemic to Turkey (Löbl and Smetana, 2003). Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Göksun-Çardak (forest): 12.VII.2004 1♂, 2♀♀; Kahramanmaraş-Yavşan: 7.VII.2004 6♂♂, 2♀♀; 20.VIII.2004 5♂♂, 2♀♀; 07.VII.2005 3♂♂, 9♀♀; Kayseri-Sarız: 25.IV.2004 1♂; Osmaniye-Bahçe-Hodur: 28.VI.2005 1♂ 1♀; 07.VII.2005 2♀♀. Approximate Altitudinal Range: 1300-1800 m above sea level. Chorotype: Anatolian.

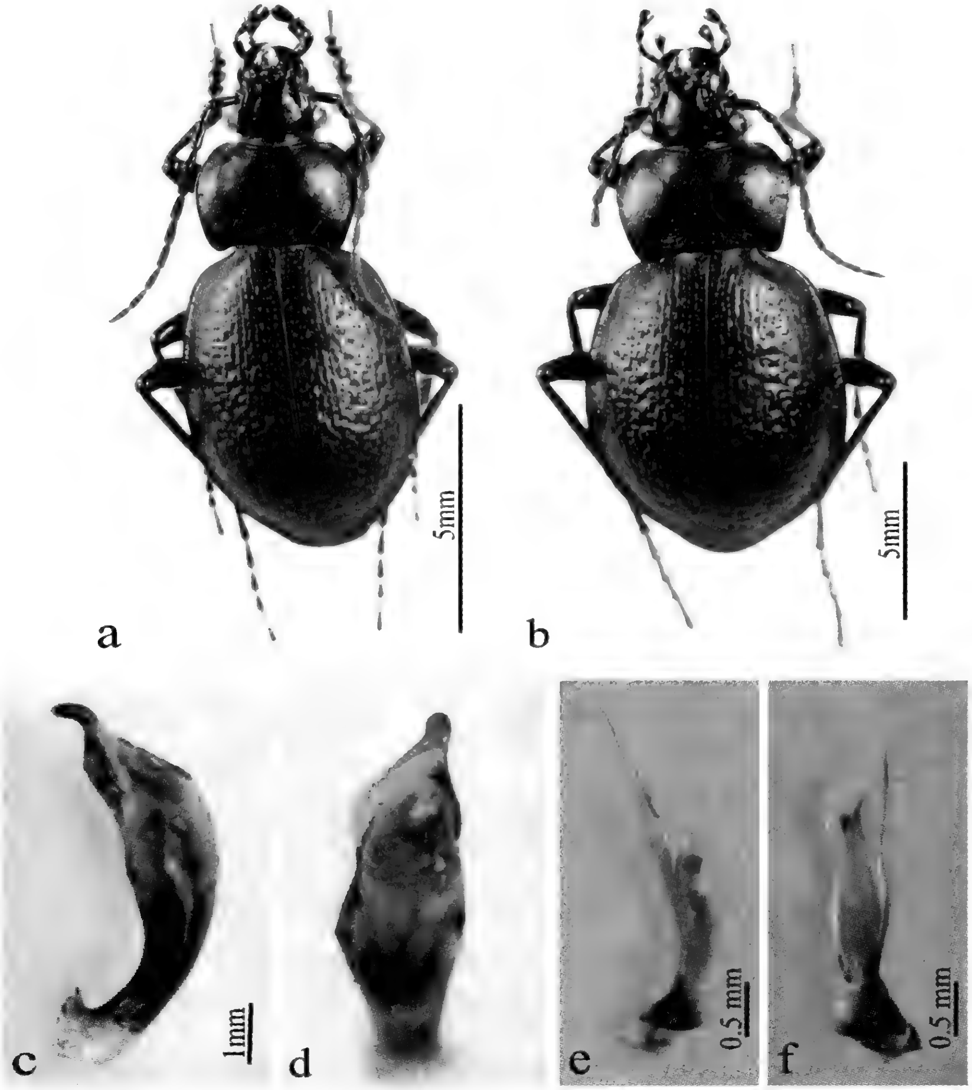


Figure 5. *Carabus* (*Tomocarabus*) *rumelicus rumelicus* Chaudoir, 1867, a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

***Carabus* (*Pachystus*) *graecus morio* Mannerheim, 1830**

Fig. 6

Measurements: Body black, length ♂ 22–25 mm, ♂ 24–25 mm; pronotum ♂ 1.33–1.75 times as wide as long and ♀ 1.40–1.56 times as wide as long; elytra ♂ 1.72–1.76 times as long as wide and ♀ 1.60–1.65 times as long as wide; body ventral black (Figure 6 a, b).

Male Genitalia: Aedeagus in lateral view weakly curve towards ventral, ventral side sinuated, strongly wide in medial and narrow towards basal, wide in basal, apical plate short and rounded on apex and apical plate curve towards ventral; in dorsal view wide towards medial and narrow towards proximal, apical plate short and rounded towards apex, apical plate strongly curve towards apex in lateral; same large parameres (Figure 6 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Balkan Peninsula, Europe, as well as in Asia (Gueorguiev and Gueorguiev, 1995; Löbl and Smetana, 2003). In Turkey, it has been found in Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Ekinözü-Akpınar (apple plantation): 11.V.2004 1♂; 11.VII.2004 1♂; 27.X. 2004 2♀♀; 25.VIII.2005 2♂♂; Kahramanmaraş-Elbistan-Iğdeköy: 09.IV.2004 1♀; Kahramanmaraş-Göksun-Çardak: 19.VI.2004 3♂♂, 3♀♀; 26.VIII.2004 2♂♂, 1♀; 10.X.2004 1♂, 1♀; 13.VI.2005 5♂♂, 2♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu (poplar plantation): 13.IX.2004 5♂♂, 3♀♀; 10.X.2004 4♂♂, 6♀♀; 28. VIII. 2005 5♂♂, 3♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu: 19.VI.2004 3♂♂, 2♀♀; 13.IX.2004 2♂♂, 5♀♀; 10.X.2004 9♂♂, 4♀♀; 28.VIII.2005 5♂♂, 3♀♀; Kahramanmaraş-Göksun-Gölpınar: 19.VI.2004 2♂♂, 1♀; 25.VIII.2004 2♂♂, 1♀; 10.VI.2005 1♂, 4♀♀; Kahramanmaraş-Göksun-Mehmetbey: 19.VI.2004 1♂; 10.X.2004 2♂♂. Approximate Altitudinal Range: 1200-1400 m above sea level. Chorotype: Anatolian.

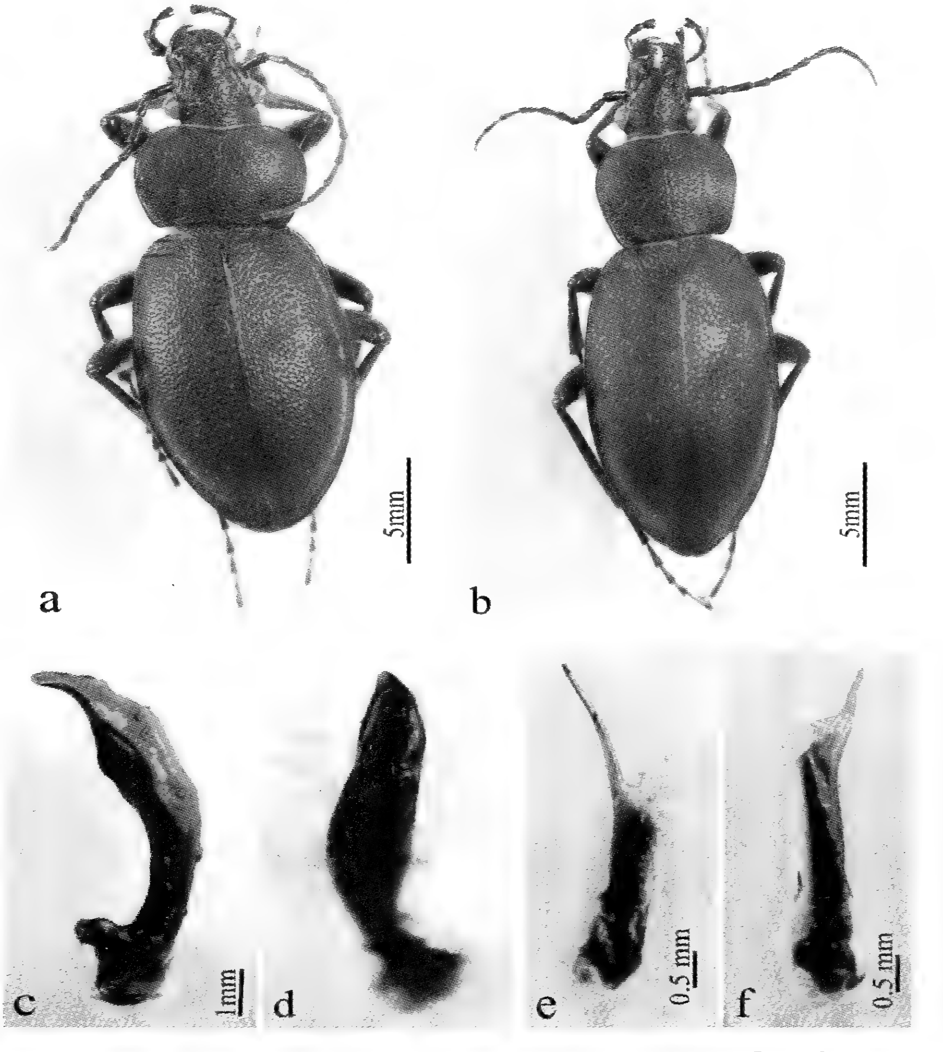


Figure 6. *Carabus* (*Pachystus*) *graecus morio* Mannerheim, 1830. a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Carabus (*Oreocarabus*) *cribratus cribratus* Quensel, 1806

Fig. 7

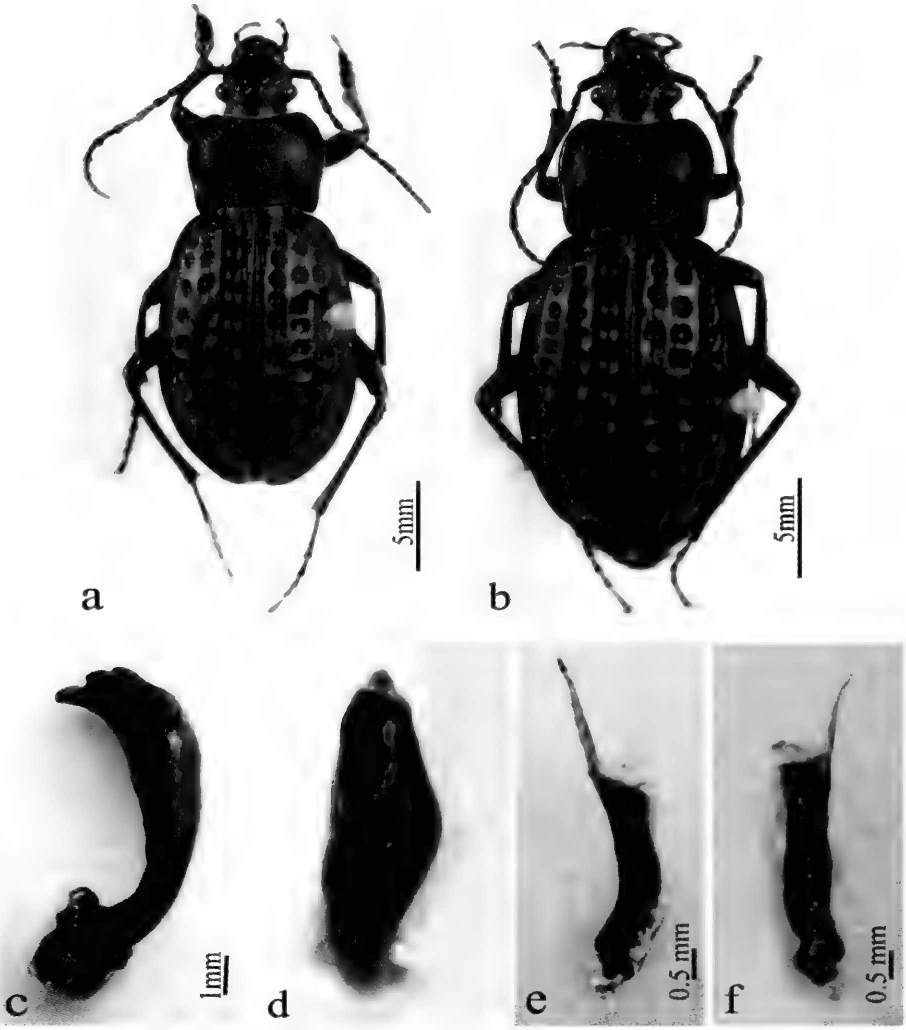


Figure 7. *Carabus* (*Oreocarabus*) *cribratus cribratus* Quensel, 1806. a) ♂, b) ♂, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Measurements: Body black, length ♂ 24–26.5 mm, ♂ 26–28 mm; pronotum ♂ 1.44–1.60 times as wide as long and ♀ 1.40–1.50 times as wide as long; elytra ♂ 1.52–1.60 times as long as wide and ♀ 1.64–1.90 times as long as wide; body ventral black (Figure 7 a, b).

Male Genitalia: Aedeagus in lateral view strongly curve towards ventral, wide in medial and narrow towards basal, wide in basal, short apical plate, apical plate wide and rounded on apex; in dorsal view wide towards medial and narrow towards proximal, apical plate short and rounded towards apex, apical plate weakly curve towards apex in lateral; same large parameres (Figure 7 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Palearctic, including Europe and Asia (Kryzhanovskij et al., 1995; Löbl and Smetana, 2003), Caucasus, Armenia (Kryzhanovskij et al., 1995); Europe:

Armenia, Georgia, Russia: South European Territory (Kavkaz); Asia: Turkey (Löbl and Smetana, 2003); Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kayseri-Pınarbaşı: 25.VIII.2004 3♂♂, 5♀♀; Kayseri-Sarız: 18.VI.2004 4♂♂, 2♀♀; 11.VII.2004 14♂♂, 11♀♀; 25.VIII.2004 15♂♂, 10♀♀; 10.X.2004 10♂♂, 13♀♀; Kayseri-Sarız-Uzunahmet: 25.VIII.2004 4♂♂, 5♀♀; 12.IX.2004 9♂♂, 13♀♀; 10.X.2004 4♂♂, 7♀♀. Approximate Altitudinal Range: 1500-1800 m above sea level. Chorotype: Anatolian.

***Carabus* (*Chaetomelas*) *morawitzi montesamanus* Mandl, 1967**

Fig. 8

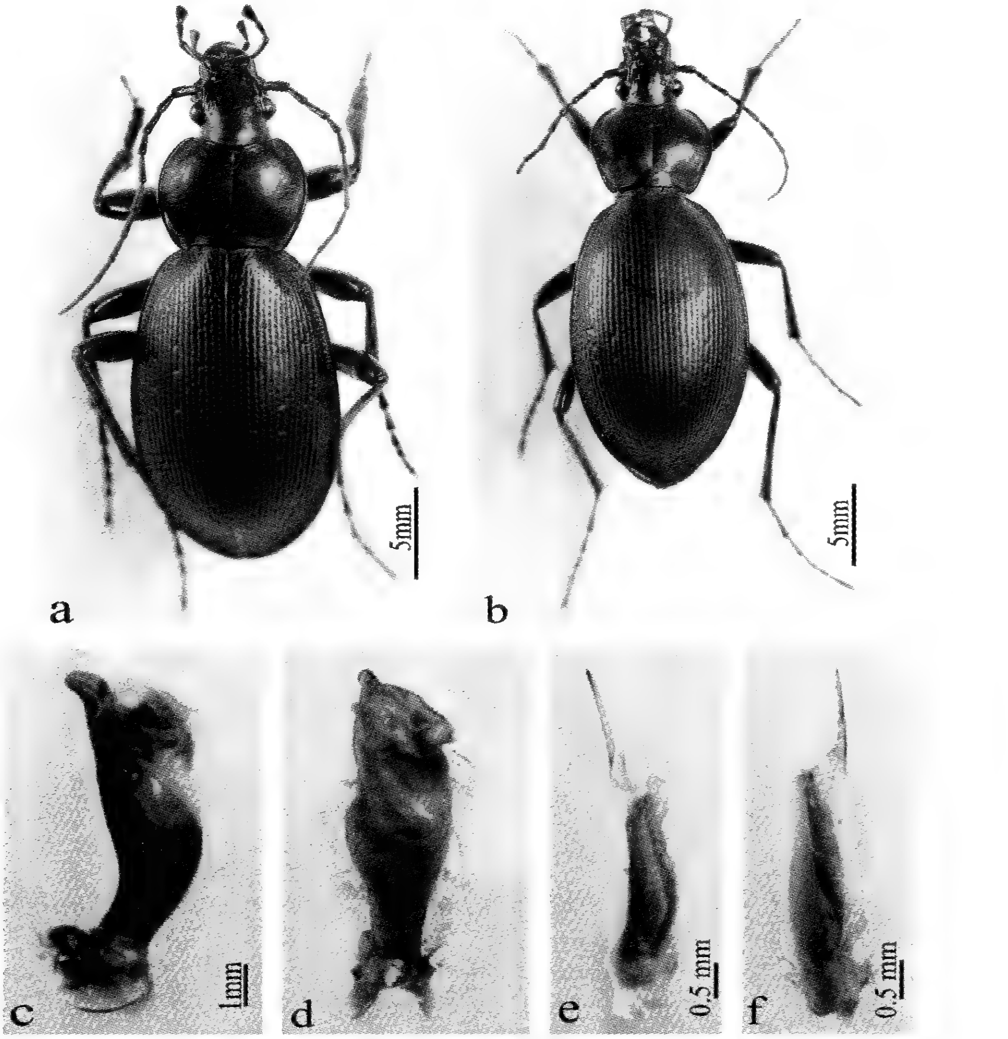


Figure 8. *Carabus (Chaetomelas) morawitzi montesamanus* Mandl, 1967. a) ♂, b) ♂, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Measurements: Body black, length ♂ 25–29 mm, ♀ 29–30 mm; pronotum ♂ 1.40 times as wide as long and ♀ 1.30–1.50 times as wide as long; elytra ♂ 1.68–1.80 times as long as wide and ♀ 1.80–1.82 times as long as wide; body ventral black (Figure 8 a, b).

Male Genitalia: Aedeagus in lateral view weakly curve towards ventral, ventral side sinuated, wide in medial and narrow towards basal, wide in basal, short apical plate, apical plate wide and rounded on apex; in dorsal view strongly wide medial and narrow towards proximal, apical plate short and sharp towards apex; same large parameres (Figure 8 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: This subspecies is endemic to Turkey. Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Üngüt (forest): 21.IV.2004 2♂♂, 1♀; 22.V.2004 1♂. Approximate Altitudinal Range: 700 m above sea level. Chorotype: SE-Anatolian.

Carabus (Lamprostus) mulsantianus bernhauerorum Heinz, 1977

Fig. 9

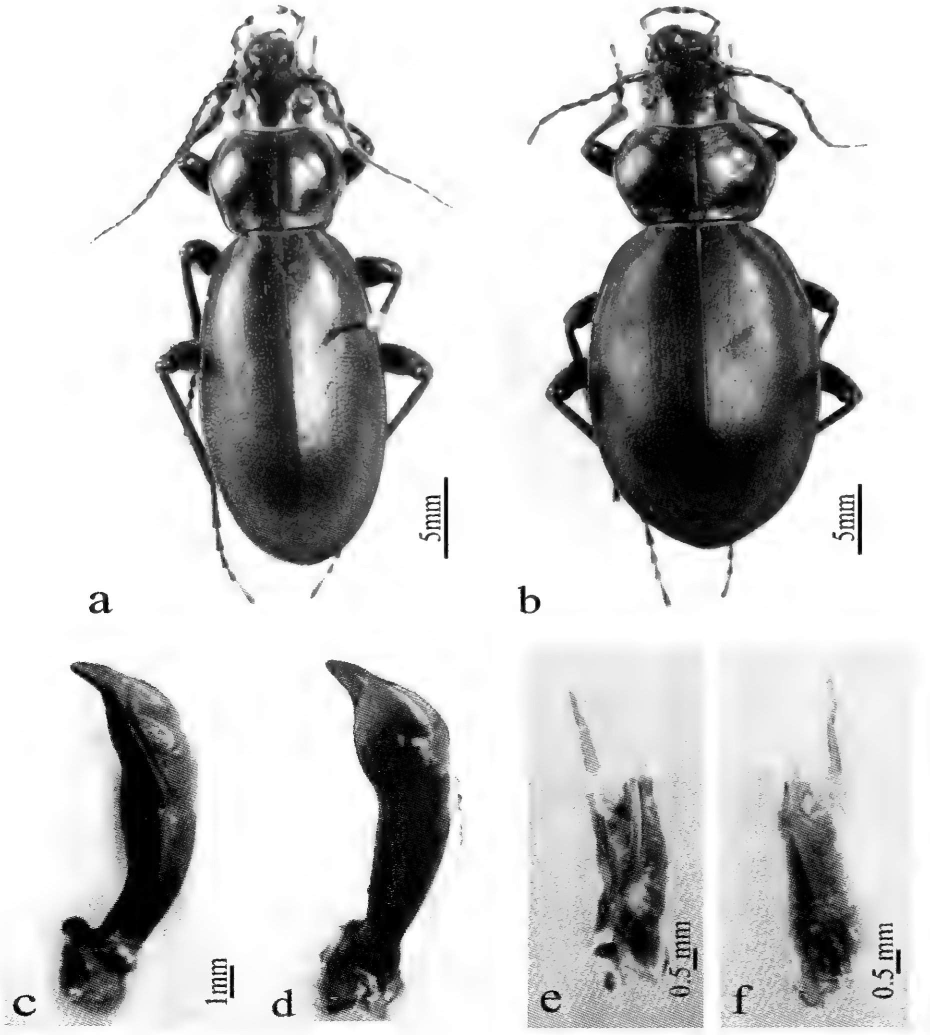


Figure 9. *Carabus* (*Lamprostus*) *mulsantianus bernhauerorum* Heinz, 1977. a) ♂, b) ♂, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Measurements: Body black, length ♂ 30.5–34 mm, ♀ 32–38 mm; pronotum ♂ 1.42–1.55 times as wide as long and ♀ 1.50–1.55 times as wide as long; elytra ♂ 1.81–1.83 times as long as wide and ♀ 1.75–1.78 times as long as wide; body ventral black (Figure 9 a, b).

Male Genitalia: Aedeagus in lateral view curve towards ventral, ventral side weakly sinuated, strongly wide in medial and weakly narrow towards basal, wide in basal, apical plate strongly wide and rounded on apex; in dorsal view strongly wide in medial and narrow towards proximal, latero-ventral sinuated, apical plate rounded towards apex, apical plate weakly curve towards lateral; same large parameres (Figure 9 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: This subspecies is endemic to Turkey. Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Göksun-Çardak: 02.VI.2004 1♂; 19.VI.2004 1♀; Kahramanmaraş-Göksun-Çardak-Karaahmet: 18.VI.2004 3♂♂, 4♀♀; 19.VI.2004 1♀; 13.IX.2004 2♂♂, 4♀♀; 10.X.2004 2♂♂, 1♀; 30.VIII.2005 3♂♂, 4♀♀; Kahramanmaraş-Göksun-Kireçköy: 02.VI.2004 2♂♂, 1♀; 18.VI.2004 3♂♂, 1♀; 19.VI.2004 2♂♂ 1♀; 26.VIII.2004 1♂, 1♀; 10.X.2004 3♂♂, 1♀; Kahramanmaraş-Göksun-Çardak-Kuzutepesi: 02.VI.2004 1♂, 1♀; 18.VI.2004 1♂; 19.VI.2004 2♂♂, 2♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu: 28.VIII.2005 2♂♂, 5♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu (poplar plantation): 10.X.2004 3♂♂, 1♀; 28.VIII.2005 2♂♂, 2♀♀; Kahramanmaraş-Nurhak: 18.X.2004 1♂, 3♀♀. Approximate Altitudinal Range: 1300-1400 m above sea level. Chorotype: SE-Anatolian.

Carabus (Lamprostus) mulsantianus mulsantianus Morawitz, 1886

Fig. 10

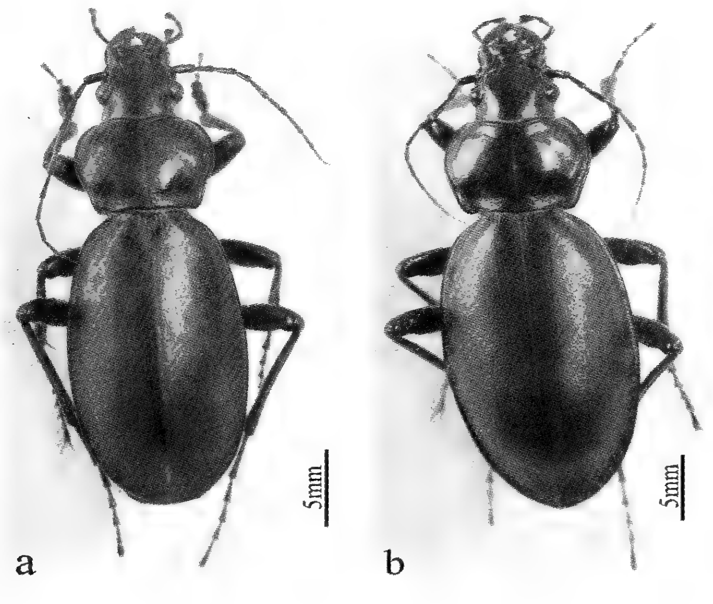


Figure 10. *Carabus (Lamprostus) mulsantianus mulsantianus* Morawitz, 1886. a) ♂, b) ♀.

Measurements: Body black, length ♂ 31 mm, ♂ 37–38 mm; pronotum ♂ 1.38 times as wide as long and ♀ 1.27–1.43 times as wide as long; elytra ♂ 1.71 times as long as wide and ♀ 1.79–1.85 times as long as wide; body ventral black (Fig. 10 a, b).

Male Genitalia: Because the definitions of aedeageus and parameres have been given in former subspecies, they haven't been given in here again.

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: This subspecies is endemic to Turkey. Turkey (Löbl and Smetana, 2003). Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Başkonuş: 12.VI.2004 1♂, 2♀♀; 05.IX. 2004 2♀♀; Kahramanmaraş-Başkonuş-Sersem: 21.VII.2005 1♂, 1♀. Approximate Altitudinal Range: 1300-1400 m above sea level. Chorotype: SE-Anatolian.

Carabus (*Lamprostus*) *mulsantianus nurdagensis* Blumenthal, 1967

Fig. 11

Measurements: Body black, length ♂ 29–32 mm, ♀ 28–31 mm; pronotum ♂ 1.40–1.42 times as wide as long and ♀ 1.38–1.45 times as wide as long; elytra ♂ 1.73–1.89 times as long as wide and ♀ 1.74–1.85 times as long as wide; body ventral black (Figure 11 a, b).

Male Genitalia: Because the definitions of aedeageus and parameres have been given in former subspecies, they haven't been given in here again.

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: This subspecies is endemic to Turkey. Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kahramanmaraş-Bulutoğlu: 12.VI.2004 1♂; Kahramanmaraş-Üngüt (wheat field): 05.IV.2004 2♂♂, 1♀; 21.IV.2004, 1♀; 07.V.2004 1♀; 22.V.2004 1♂; Kahramanmaraş-Üngüt (forest): 1.XII.2003 2♂♂, 1♀; 21.IV.2004 2♂♂, 1♀; 07.V.2004 3♂♂, 2♀♀; 22.V.2004 1♀; 18.VIII.2004 2♂♂; Kahramanmaraş-Üngüt (grapeyard): 07.V.2004 2♀♀; 11.VI.

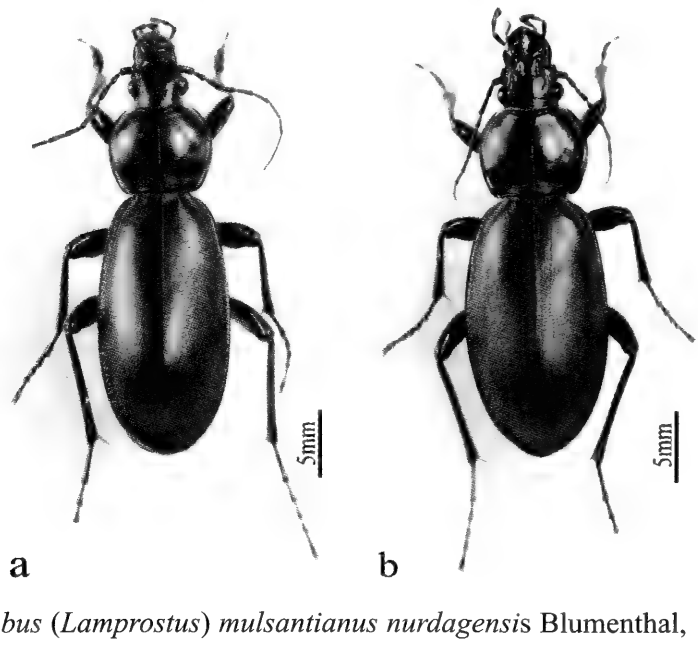


Figure 11. *Carabus* (*Lamprostus*) *mulsantianus nurdagensis* Blumenthal, 1967. a) ♂, b) ♀.

2004 1♂; Kahramanmaraş-Üngüt (olive plantation): 07.V.2004 1♂, 2♀♀; 21.V.2005 1♂; Kahramanmaraş-Yeniköy (forest): 12.VI.2004 5♂♂, 6♀♀. Approximate Altitudinal Range: 700-1100 m above sea level. Chorotype: SE-Anatolian.

Carabus (Lamprostus) torosus jani Géhin, 1885

Fig. 12

Measurements: Body black, length ♂ 28 mm; pronotum ♂ 1.60 times as wide as long; elytra ♂ 1.64 times as long as wide; body ventral black (Figure 12 a).

Male Genitalia: Aedeagus in lateral view weakly curve towards ventral, ventral side weakly sinuated, wide in medial and weakly narrow towards basal, wide in basal, apical plate curve in ventral and apical plate rounded on apex; in dorsal view weakly wide in medial and narrow towards proximal, apical plate rounded towards apex; same large parameres (Figure 12 b, c, d, e).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Bulgaria and Turkey (Löbl and Smetana, 2003). It has been reported for Anatolia (no locality, Casale and Vigna Taglianti, 1999). Material Examined: Kayseri-Sarız: 18.VI.2004 1♂. Approximate Altitudinal Range: 1800 m above sea level. Chorotype: N-Anatolian.

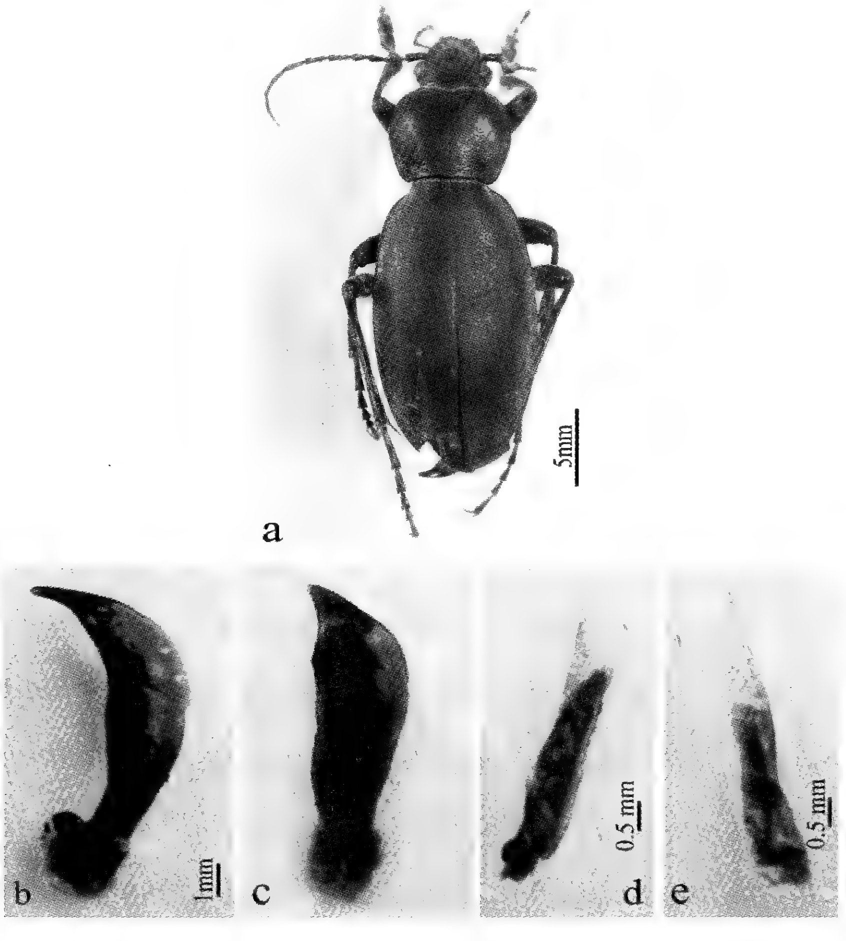


Figure 12. *Carabus* (*Lamprostus*) *torosus jani* Géhin, 1885. a) ♂, b) Aedeagus in lateral view, c) Aedeagus in dorsal view, d) Right paramere, e) Left paramere.

Carabus (Procrustes) chevrolati chevrolati De Cristoforis and Jan, 1837

Fig. 13

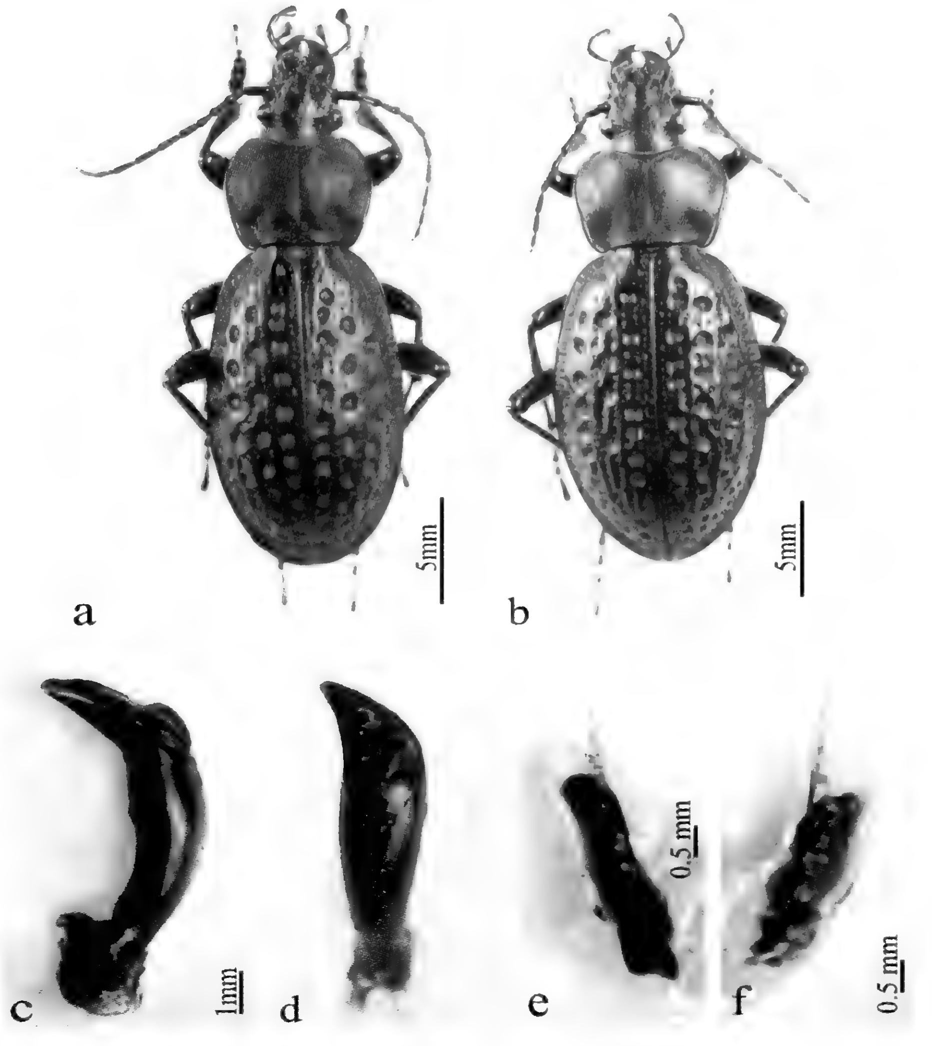


Figure 13. *Carabus* (*Procrustes*) *chevrolati chevrolati* De Cristoforis and Jan, 1837. a) ♂, b) ♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Measurements: Body black, length ♂ 23–26 mm, ♀ 24–28 mm; pronotum ♂ 1.44–1.50 times as wide as long and ♀ 1.50–1.63 times as wide as long; elytra ♂ 1.60–1.88 times as long as wide and ♀ 1.55–1.72 times as long as wide; body ventral black (Figure 13 a, b).

Male Genitalia: Aedeagus in lateral view curve towards ventral, ventral side weakly sinuated, wide in medial and weakly narrow towards basal, wide in basal, short apical plate, apical plate wide and rounded on apex; in dorsal view wide in medial and narrow towards proximal, apical plate short and sharp towards apex, apical plate weakly curve towards lateral; same large parameres (Figure 13 c, d, e, f).

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: Asia: Turkey (Löbl and Smetana, 2003). Kastamonu, Ilgaz Dağı (Schweiger 1962a; 1962b); Kuzey Batı Anadolu (Breuning, 1964); Eskişehir (Türktan, 1998); Anatolia (no locality, Casale and Vigna Taglianti, 1999); Ankara (Kocatepe and Mergen, 2004). This subspecies is endemic to Turkey. Material Examined: Kayseri-Sarız: 11.V.2004 1♀; 27.V.2004 2♀♀; 18.VI.2004 5♂♂, 3♀♀; 25.VIII.2004 5♂♂; 12.IX.2004 3♂♂, 6♀♀; 10.X.2004 3♂♂, 2♀♀; 23.VI.2005 4♂♂, 13♀♀; Kayseri-Sarız-Uzunahmet: 11.VII.2004 4♂♂, 7♀♀; 12.IX.2004 2♂♂, 1♀. Approximate Altitudinal Range: 1800-1700 m above sea level. Chorotype: N-Anatolian.

Carabus (*Procrustes*) *coriaceus mopsucrenae* Peyron, 1858

Fig. 14

Measurements: Body black, length ♂ 23–30 mm, ♀ 25–29 mm; pronotum ♂ 1.33–1.56 times as wide as long and ♀ 1.36–1.44 times as wide as long; elytra ♂ 1.67 times as long as wide and ♀ 1.77–1.83 times as long as wide; body ventral slightly red (Figure 14 a, b).

Male Genitalia: Aedeagus in lateral view curve towards ventral, ventral side weakly sinuated, wide in medial and weakly narrow towards basal, wide in basal, apical plate wide and rounded on apex; in dorsal view strongly wide in medial and narrow towards proximal, apical plate weakly sharp towards apex; same large parameres (Figure 14 c, d, e, f).

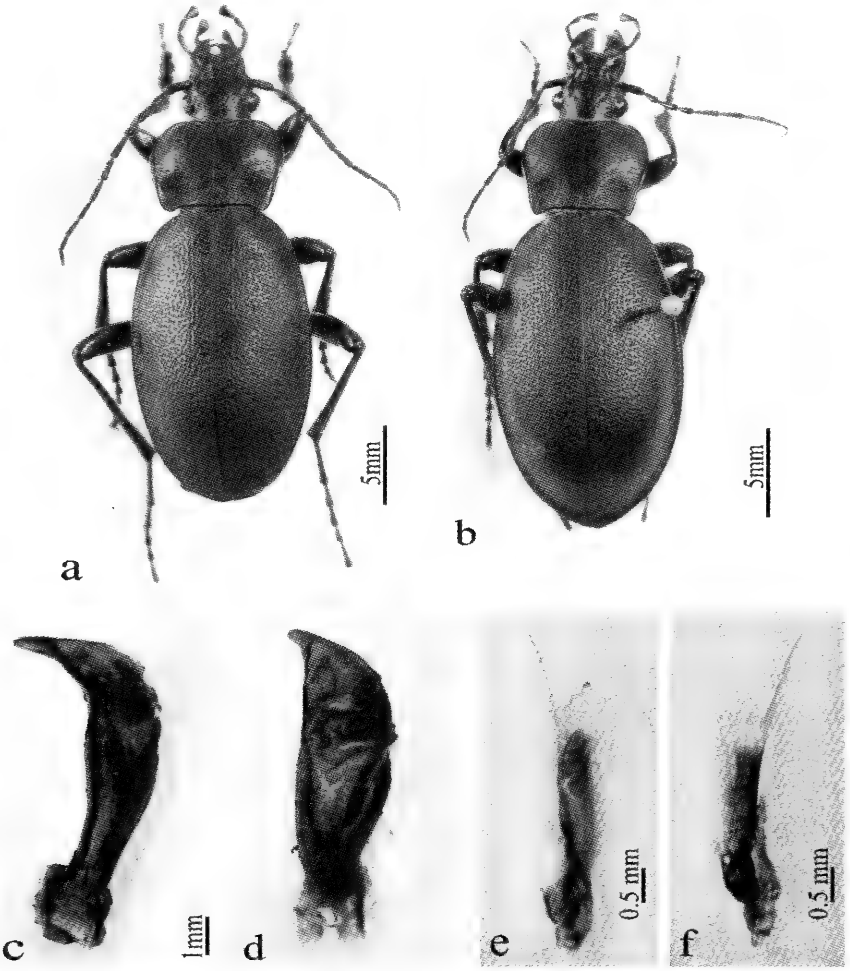


Figure 14. *Carabus (Procrustes) coriaceus mopsucrenae* Peyron, 1858. a) ♀, b)♀, c) Aedeagus in lateral view, d) Aedeagus in dorsal view, e) Right paramere, f) Left paramere.

Distribution, Material Examined, Approximate Altitudinal Range, and Chorotype: Distribution: This subspecies is endemic to Turkey. Asia Minor (Müller, 1926), Anatolia (no locality, Casale and Vigna Taglianti, 1999), Asia: Turkey (Löbl and Smetana, 2003). Material Examined: Kahramanmaraş-Başkonuş: 14.V.2004 2♂♂, 2♀♀; 01.VI.2004 1♂, 3♀♀; 12.VI.2004 6♂♂, 1♀; 21.VIII.2004 2♂♂, 5♀♀; 05.IX.2004 6♂♂, 2♀♀; 30.X.2004 9♂♂, 7♀♀; 12.XI.2004 4♂♂, 2♀♀; Kahramanmaraş-Başkonuş-Sersem: 21.VII.2005 5♂♂, 8♀♀; Kahramanmaraş-Ekinözü-Akpınar (apple plantation): 18.VI.2004, 3♀♀; Kahramanmaraş-Göksun-Çardak: 02.VI.2004 1♀; 10.X.2004 4♂♂, 7♀♀; 13.VI.2005 2♂♂, 6♀♀; Kahramanmaraş-Göksun-Çardak (forest): 19.VI.2004 4♂♂, 2♀♀; 26.VIII.2004 2♂♂, 3♀♀; Kahramanmaraş-Göksun-Çardak-Karaahmet: 18.VI.2004 5♂♂, 4♀♀; 19.VI.2004 6♂♂, 1♀; Kahramanmaraş-Göksun-Kireçköy: 02.VI.2004 3♂♂, 1♀; 18.VI.2004 5♂♂, 9♀♀; 19.VI.2004 2♂♂, 1♀; 26.VIII.2004 5♂♂, 7♀♀; 13.IX.2004 6♂♂, 9♀♀; 10.X.2004 8♂♂, 5♀♀; 02.VI.2005 1♂, 1♀; 19.VI.2005 2♂♂, 1♀; Kahramanmaraş-Göksun-Çardak-Kuzutepesi: 02.VI.2004 2♂♂; 18.VI.2004 2♂♂, 1♀; 19.VI.2004 4 ♂♂; 12.VI.2005 2♂♂; Kahramanmaraş-Göksun-Çardak-Küçüksu: 02.VI.2004 8♂♂, 8♀♀; 19.VI.2004 4♂♂, 5♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu: 02.VI.2004 5♂♂, 2♀♀; 13.IX.2004 5♂♂, 6♀♀; 10.X.2004, 5♂♂ 5♀♀; 19.VI.2005 21♂♂, 5♀♀; 28.VIII.2005 2♂♂, 3♀♀; Kahramanmaraş-Göksun-Çardak-Küçüksu (poplar plantation): 19.VI.2004 1♂, 1♀; 13.IX.2004 4♂♂, 1♀; 28.VIII.2005 3♂♂, 6♀♀; Kahramanmaraş-Göksun-Gölpınar: 02.VI.2004 8♂♂, 5♀♀; 19.VI.2004 1♀; 10.VI.2005 5♂♂, 7♀♀; Kahramanmaraş-Göksun-Mehmetbey (reservoir): 19.VI.2004 1♂; Kahramanmaraş-Ekinözü-Akpınar (apple plantation): 11.V.2004 1♂; 21.VI.2005 1♀; 26.VI.2005 1♂; 30.VII.2005 1♂. Approximate Altitudinal Range: 1300-1500 m above sea level. Chorotype: SE-Anatolian.

ZOOGEOGRAPHICAL REMARKS

Most Carabinae herein reported were found in higher elevations (1200-1800 m, Thiele, 1977), and it appears that these species exhibit zones of elevational distribution, at least in the Kahramanmaraş and the surrounding towns located of south central Turkey. For instance, *Calosoma sycophanta* and *Carabus* (*Mimocarabus*) *maurus paphius* seem to have a broad altitudinal distribution (900-1600, 700-1700 m respectively). In contrast, *Carabus* (*Chaetomelas*) *morawitzi montesamanus* and *C.* (*Lamprostus*) *mulsantianus nurdagensis* appear to be restricted to lower altitudes (700, 700-1100 m, respectively). *C.* (*Archicarabus*) *gotschi caramanus, C.* (*Archicarabus*) *gotschi goeksunensis, C.* (*Tomocarabus*) *rumelicus rumelicus, C. (Pachystus) graecus morio, C. (Lamprostus) mulsantianus bernhauerorum*, *C.* (*Lamprostus*) *mulsantianus mulsantianus, C.* (*Procrustes*) *coriaceus mopsucrenae* seem to live on intermediate elevations (1300-1400, 1400-1700, 1300-1800, 1200-1400, 1300-1400, 1300-1400, 1300-1500 m respectively). Lastly, *C.* (*Oreocarabus*) *cribratus cribratus, C.* (*Lamprostus*) *torosus jani,* and *C.* (*Procrustes*) *chevrolati chevrolati* seem to thrive at 1500-1800, 1800, 1800-1700 m respectively. The chorotypes of 93% (13 species) are Anatolian; 7% (1 species) are Palearctic (Holarctic), respectively.

ACKNOWLEDGEMENTS

We would like to thank Professor Dr. Augusto Vigna Taglianti (Italy) as well as Daniel Prunier (France) for their valuable help and advice. The Scientific and Technical Research Council of Turkey (TUBITAK) and the Research and Application Centre of Çukurova University are thanked for their financial support of this research.

LITERATURE CITED

Akman, Y. 1990. Iklim ve Biyoiklim. Palme Yayınevi. Ankara, Turkey. 320 pp.

Armstrong, G. and R. G. McKinlay. 1997. Vegetation management in organic cabbages and pitfall catches of carabid beetles. Agriculture, Ecosystems and Environment 64: 267-276.

Breuning, S. 1964. *Procrustes chevrolati* Crist. ve Jan. (Coleoptera, Carabidae)' nin Türkiye'deki yayılışı. Istanbul Üniversitesi Fen Fakültesi Mecmuası XXIX, 3 (4): 139-142.

Casale, A. and A. Vigna Taglianti. 1999. Caraboid beetles (excl. Cicindelidae) of Anatolia, and their biogeographical significance (Coleoptera, Caraboidea). pp. 277-406. *In*, G. Aymonin, A. Azzaroli, F. Garbari, W. Greuter, H. Janetschek, M. La Greca, A. Minelli, E. Nevo, F. Pedrotti, R. Pichi Sermolli, Ch. Remington, S. Ruffo, V. Sbordoni, A. Vigna Taglianti (Editors). Biogeographia. Parte I. Biogeografia Dell'Anatolia. Pubblicato Sotto Gli Auspici Del Ministero Dei Beni Culturali Ed Ambientali. Siena, Italy. 406 pp.

Cavazzuti, P. 1986. Description de trois sous-especes nouvelles de *Carabus* D'Anatolie (Coleoptera, Carabidae). Bulletin de la Sociėtė Sciences Nat http://www.insects.demon.co.uk/revuebullsn.html 50: 3-8.

Cavazzuti, P. 1989. Monografia del genere *Procerus* (Coleoptera, Carabidae, Carabini). Associazione Naturalistica Piemontese, Memorie 1: xii + 200 pp.

Cavazzuti, P. 1999. Nuovi *Cychrus* F. Della Cina E Un nuovo *Carabus* L (*Lamprostus*) dell'Anatolia (Coleoptera, Carabidae). Lambillionea XCIX: 402-409.

Cavazzuti, P. 2002. Carabini Della Turchia. Descrizione di tre nuove sottospecie del genere *Carabus* e una di *Cychrus* dell'Anatolia occidentale e settentrionale (Coleoptera, Carabidae). Coléoptères 9 (2): 9-17.

Cavazzuti, P. and I. Rapuzzi. 1998. Una nuova sottospecie di *Carabus* (*Pachystus*) *pisidicus* Peyron dell'Anatolia meridionale (Turchia) (Coleoptera, Carabidae). Lambillionea XCVIII (3): 398-400.

Gueorguiev, V. B. and B. V. Gueorguiev. 1995. Catalogue of the ground-beetles of Bulgaria (Coleoptera: Carabidae). Pensoft. Sofia, Bulgaria. 279 pp.

Hurka, K. 1996. Carabidae of the Czech and Slovak Republics. Zlin, Czech Republic. 565 pp.

Kocatepe, N. and O. Mergen. 2004. Ankara Ili Carabidae (Coleoptera) Familyası Türleri Üzerinde Faunistik Araştırmalar. Türk Entomoloji Dergisi. 28 (4): 295-309.

Kryzhanovskij, O. L., I. A. Belousov, I. I. Kabak, B. M. Kataev, K. V. Makarov, and V. G. Shilenkov. 1995. A checklist of the ground beetles of Russia and adjacent lands (Insecta, Coleoptera, Carabidae). Pensoft, Sofia, Bulgaria. 271 pp.

Larsen, J. K., T. W. Work, and F. F. Purrington. 2003. Habitat use patterns by ground beetles (Coleoptera: Carabidae) of Northeastern Iowa. Pedobiologia. 47: 288-299.

Löbl, I. and A. Smetana. 2003. Catalogue of Palaertic Coleoptera. Volume I. Archostemata-Myxophaga-Adephaga. Apollo Books. Stenstrup, Denmark. 819 pp.

Müller, D. G. 1926. I Coleotteri Della Venezia Giulia. Catalogo Ragionato. Parte I. Adephaga. Trieste, Italy. 304 pp.

Magura, T., B. Tothmeresz, and Zs. Bordan. 2000. Effects of nature management practice on carabid assemblages (Coleoptera: Carabidae) in A Non-Native Plantation. Biological Conservation. 93: 95-102.

Neculiseanu, Z. Z. and A.V. Matalin. 2000. A catalogue of the ground beetles of the Republic of Moldova (Insecta, Coleoptera: Carabidae). Pensoft, Sofia, Bulgaria. 164 pp.

Schweiger, H. 1962a. Neue und wenig bekannte *Carabus*-Formen aus der Turkei, (Coleoptera, Carabidae). Istanbul Üniversitesi Fen Fakültesi Mecmuası, XXVII: 159-167.

Schweiger, H. 1962b. Küçük Asyanın Yeni ve Az Tanınmış *Carabus* Nevileri, Neue und wening Bekannte Carabiden aus Kleinasien (Ergebnisse Der Österreichisch–Türkischen Anatolienexpeditionen). Istanbul Üniversitesi Fen Fakültesi Mecmuası. 137-154.

Schweiger, H. 1964. *Carabus* L., Genusunun Sektio: *Oxycarabus* Sem. (Coleoptera, Carabidae) Türleri. Istanbul Üniversitesi Fen Fakültesi Mecmuası, Seri B, XXIX, 3 (4): 107-139.

Thiele, H. U. 1977. Carabid beetles in their environments. Springer-Verlag. Berlin, Germany. 369 pp.

Türktan, H. 1998. Eskişehir Çevresi Carabidae (Insecta: Coleoptera) Üzerine Faunistik Araştırmalar. Yüksek Lisans Tezi, Eskişehir. 34 pp.

Trautner, J. and K. Geigenmüller. 1987. Tiger beetles, ground beetles, illustrated key to the Cicindelidae and Carabidae of Europe. Josef Margraf Publisher. Gaimersheim, Germany. 488 pp.

Varol, Ö. 2003. Flora of Başkonuş Mountain (Kahramanmaraş). Turkish Journal of Botany. 27: 117-139.

Vigna Taglianti, A., P. A. Audisio, M. Biondi, M. A. Bologna, G. M. Carpaneto, A. D. Biase, S. Fattorini, E. Piattella, R. Sindaco, A. Venchi, and M. Zapparoli. 1999. A proposal for a chorotype classification of the Near East fauna, in the framework of the Western Palearctic Region. pp. 31-59. *In,* G. Aymonin, A. Azzaroli, F. Garbari, W. Greuter, H. Janetschek, M. La Greca, A. Minelli, E. Nevo, F. Pedrotti, R. Pichi Sermolli, Ch. Remington, S. Ruffo, V. Sbordoni, A. Vigna Taglianti (Editors). Biogeographia. Parte I. Biogeografia Dell'Anatolia. Pubblicato Sotto Gli Auspici Del Ministero Dei Beni Culturali Ed Ambientali. Siena, Italy. 406 pp.

A NEW SPECIES OF THE GENUS *AUSTRALOBIUS* CHAMBERLIN, 1920 (LITHOBIOMORPHA: LITHOBIIDAE) FROM TIBET, CHINA[1]

Huiqin Ma,[2,3] Da-Xiang Song,[2,4] and Mingsheng Zhu[2]

This paper is dedicated to the memory of Doctor, Professor Da-Xiang Song, Academician of the Chinese Academy of Sciences, who passed away on January 25, 2008. We thank him for his contributions to zoology, for his generosity to colleagues as well as students, and for his teachings.

ABSTRACT: The present paper describes a new species of the genus *Australobius* Chamberlin, 1920 (Lithobiomorpha: Lithobiidae) recently discovered in Tibet, China. *Australobius anamagnus* from Lhünze County, Shannan City. The cephalic shield, tergites, coxosternum and certain other diagnostic characters of the new species are illustrated.

KEY WORDS: Lithobiidae, *Australobius*, new species, Tibet, China

Australobius Chamberlin, 1920 is a genus of centipedes, distributed chiefly in southeast Asia. The most northerly record is from the border between Assam (India) and Burma. This genus also occurs at the Wallace Line in New Guinea and in northern Queensland (Eason, 1989; 1992). Currently, this genus contains 30 species (Zapparoli, 2006). The lithobiomorph fauna of China is poorly known and this also holds true in Tibet; 57 species and subspecies of lithobiomorph have been described from China (Attems, 1938; 1953; Takakuwa, 1939; 1940; Takakuwa and Takashima, 1949; Chamberlin and Wang, 1952; Wang, 1959; Loksa, 1960; Zalesskaja, 1978; Wang and Mauriès, 1996; Eason, 1997; Chao, 2005; Zapparoli, 2006; Ma et al., 2007), of which only two species has been previously found in China, none in Tibet. Upon examining our collections from Tibet, we came across a new species belonging to the genus *Australobius*, the description of which is given below.

METHODS

All the material was collected by hand or with forceps from under stones. All centipedes examined were preserved in 75% ethanol. Species identifications and drawings of some taxonomically important characters were made with the aid of a Motic-C stereoscope. All material is now preserved in the College of Life Sciences, Hebei University, Baoding, China.

The following abbreviations are used in the text and tables: T, TT – tergite, tergites, S, SS –sternite, sternites, C – coxa, Tr – trochanter, P – prefemur, F – femur, T – tibia, a – anterior, m – median, p – posterior.

---

[1] Received on June 18, 2007. Accepted on July 13, 2007.

[2] College of Life Sciences, Hebei University, Baoding, Hebei 071002 P.R. China. E-mails: HM, mhq008@yahoo.com; MZ, mingshengzhu@263.net; DS, dxsong2002@yahoo.com.cn (deceased).

[3] Scientific Research Office, Hengshui College, Hengshui, Hebei 053000 P. R. China.

[4] Jiangsu Key Laboratory for Biodiversity and Biotechnology, College of Life Sciences, Nanjing Normal University, Nanjing, Jiangsu 210097, P. R. China.

Mailed on May 14, 2008

SYSTEMATIC ENTOMOLOGY

Chilopoda Latreille, 1817
Lithobiomorpha Pocock, 1895
Lithobiidae Newport, 1844
Australobius Chamberlin, 1920

Australobius anamagnus, new species

Figs. 1–7

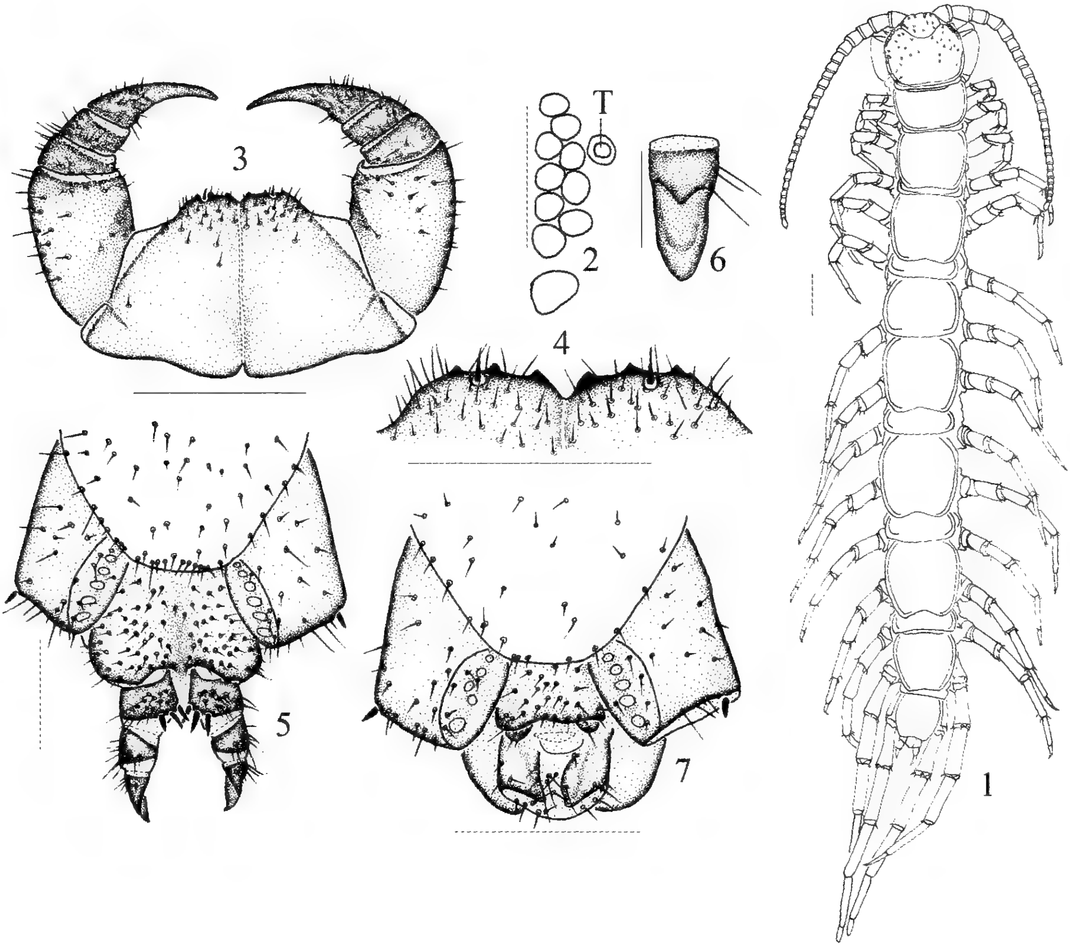
Type Data: Holotype: Female (Fig. 1), body length 26.6 mm, cephalic shield length 2.41 mm, breadth 2.62 mm, antennae composed of 26+26 antennomeres, 10 ocelli on each side, 3+3 prosternal teeth, 5676 coxal pores arranged into a irregular row; the first article of the gonopods bearing 3+3 coniform spurs (Fig. 5); 18 moderately long setae on the ventral side of the first article, arranged into four irregular rows, 10 moderately long setae on the ventral side of the second article, arranged in three irregular rows; 5 moderately long setae on the ventral side of the third article, arranged in an irregular row; distal claw broad, simple (Fig. 6), without bulge at base. China, Lhünze County, Shannan City, Tibet, 28°04'N 92°03'E, altitude 4960 m, 8 August 2006, leg. Mingsheng Zhu, Long Liu, Xiaofeng Yang. **Paratypes:** 3 females and 2 males, same data as holotype.

Diagnosis: Maximum length of body (from anterior margin of the cephalic shield to posterior end of telson) up to 26.6 mm, antennae composed of 25+26 or 26+26 antennomeres, 10 ocelli on each side, the last one comparatively large; Tömösváry's organ moderately small, rather smaller than the adjoining ocelli; 3–4 prosternal teeth; porodonts stout and well developed, situated between the two outer teeth; posterior angles of all tergites rounded and without projection; tarsus-metatarsus articulation moderately well-defined on legs 1–13, well-defined on legs 14 and 15; anterior and posterior accessory claws in legs 1–13, no accessory claws on legs 14 and 15; coxal pores 4–9, arranged in a row on the last four pair of legs; female gonopods with 3–4 conical spurs and a simple claw; male gonopods moderately large and stout.

Description: Body length 15.9–26.6 mm, the cephalic shield length 1.72–2.41 mm, breadth 1.79–2.62 mm (based on preserved specimens).

Colour (based on specimens in 75% ethanol): antennae yellow-brown, tergites yellow-brown, the cephalic shield, TT 1, 14 and 15 yellow-brown, the cephalic shield and T 15 darker; yellow from the anterior margin to the clypeus furrow, posterior margin darker; pleural region pale grey to lavender; sternites pale yellow-brown, with slightly reddish hue; distal region of forcipules blackish brown, maxillipeds, coxosternum, S 15, and genital sternite yellow-brown; the last two SS yellow-brown to beige; all legs lightly gray, distitarsus of maxillipeds black; legs 1–13 pale yellow-brown to yellow-brown, with slightly grayish hue; legs 14 and 15 and tarsi of all legs yellow-brown.

Antennae usually composed of 26+26 antennomeres, rarely 25+26; basal antennomere slightly longer than wide, the second markedly longer than wide, succeeding antennomeres typically longer than wide; terminal antennomere 2.2–3.0 times as long as wide; abundant setae on antennal surface, the density of setae more or less constant.



Figures 1–7. *Australobius anamagnus* new species. 1. Holotype, female, dorsal view, scale 1 mm. 2. Holotype, ocelli and Tömösváry's organ, ventral view, scale 250 μm. 3. Holotype, maxilliped coxosternum, ventral view, scale 500 μm. 4. Holotype, dental margin of maxilliped coxosternum, ventral view, scale 250 μm. 5. Holotype, female, posterior segments and gonopods, ventral view, scale 500 μm. 6. Holotype, female, claw of gonopods, inboard view, scale 250 μm. 7. Paratype, male, posterior segments and gonopods, ventral view, scale 500 μm.

Cephalic shield smooth, posterior region ridged, with close netlike veining; tiny setae inserted in pores scattered very sparsely over the surface; frontal marginal ridge with shallow median furrow; posterior margin of cephalic shield slightly concave; cephalic shield slightly longer than wide; short to moderately long setae, scattered sparsely along its border.

Ten ocelli (Fig. 2) on each side, oval to round, arranged in two irregular rows, the terminal ocellus comparatively larger, near to the ventral comparatively small, other ocelli about equal in size, overhanging lateral margin of head; ocelli moderately domed, translucent.

Tömösváry's organ (Fig. 2-T) moderately small, nearly round, smaller than the adjoining ocelli, and lying on ventral margin of the head immediately ventral to the ocelli; moderately broad sclerotised region around the Tömösváry organ. Maxilliped coxosternite trapezoidal (Fig. 3), dental margin moderately broad, convex, median notch moderately deep, V-shaped; dental margin with 3+3 or 3+4 teeth, one specimen with 4+4 teeth; teeth moderately small and blunt (Fig. 4), roughly triangular, dental margin with an obvious shoulder; porodonts comparatively thick and strong, situated between the outer two teeth, in one specimen they were situated between the second and third; some moderately long setae scattered on the surface of the maxillipede coxosternite, comparatively long and thick setae near the dental margin.

All tergites moderately smooth, unwrinkled, posteriorly slightly ridged; T 1 generally trapeziform, posterolaterally narrower than anterolaterally, slightly wider than T 3 and slightly narrower than the cephalic shield; tiny setae inserted in pores scattered very sparsely over the surface, with a few moderately long setae near the marginal ridge; lateral marginal ridge of all tergites continuous, short setae scattered sparsely along the lateral borders, more densely on the anterior, with 4–6 moderately long setae in the anterior angles, 3–4 moderately long setae in the posterior angles; posterior marginal ridge of T 1 continuous, posterior margin ridge of TT 3, 5, 8, 10, 12, and 14 discontinuous; posterior margin of the TT 1 and 3 slightly concave, posterior margin of TT 5, 8, 10, and 12 deeply concave, T 14 slightly concave; posterior angles of all tergites rounded, without projection.

All sternites more or less trapeziform, moderately smooth, setae scattered very sparsely on the surface, 4–8 comparatively long bristles scattered sparsely on the surface of each sternite, among them a pair of bristles approximately symmetrical; having remarkably dense setae on the surface of the S 14 and S 15; some short to moderately long setae on the posterior margin of each sternite.

Tarsus-metatarsus articulation of legs more or less well-defined on legs 1–13, well-defined on legs 14 and 15; anterior and posterior accessory claws on legs 1–13, anterior accessory claws slender and sharp, forming relatively small angles with the tarsal claws; posterior accessory claws rather more broad and longer than the anterior, forming relatively large angles with the tarsal claws; no accessory claws on the 15th legs; abundant glandular pores on the prefemur, femur, tibia and tarsus of legs 14 and 15; short to moderately long setae sparsely scattered on the surface of legs 1–13; having more setae on the tarsus, some moderately thicker setae among them, thicker setae arranging in a row on the anterior side of tarsus, two rows thick setae on the ventral side of tarsus; both sexes having fewer setae on legs 14 and 15, without thick setae on the tarsus; legs 14 and 15 moderately longer than anterior legs in both sexes, metatarsus 67%–79% length of tarsus of legs 15, tarsus 6.2–6.6 times as long as wide of legs 15 in female; metatarsus 75%–77% length of tarsus of legs 15, tarsus 6.3–8.5 times as long as wide of legs 15 in male; legs spinulation in Table 1 (letters out brackets indicate the spinulation of the type female).

Coxal pores slightly ovate to round, size of coxal pores variable; 4–9 coxal pores arranged into an irregular row, 5676, 5777, 6776, 6787, 6797 in females, 6785, 6775, 4565, 5665 in males in the specimens examined; coxal pore field set in a shallow groove, the edge of the coxal pore field with weakly apophysis, bearing short to moderately long setae.

Female S 15 almost trapezoidal, posterior angles rounded, straight or slightly concave posteromedially, approximately semicircular; long and slender setae scattered sparsely over the surface and lateral edge of the S 15; sternite of the genital segment slightly wider than long, usually well sclerotised, posterior margin concave between the condyles of the gonopods except for a small median approximately quadrangular bulge, terminal of bulge lightly sclerotised; setae evenly and moderately densely scattered on the sternite of the genital segment, comparatively sparse adjacent to the S 15; gonopods divided into three articles, the first bearing 3+4, 3+3 (one specimen 4+4) moderately small, coniform spurs (Fig. 5), inner spur very much smaller than the outer; about 18–20 moderately long setae on the ventral side of the first article, arranged into four irregular rows, 10–12 moderately long setae on the ventral side of the second article, arranged in three irregular rows; 5–6 moderately long setae on the ventral side of the third article, arranged in an irregular row, without setae and bristles on all dorsal articles of the gonopods; distal claw broad, simple (Fig. 6), without bulge at base.

Male S 15 straight posteromedially, both posterior angles rounded, posterior margin semicircular, commonly yellow-brown; long and slender setae scattered sparsely over the surface and lateral edges of the S 15; sternite of genital segment moderately smaller than in the female, wider than long, usually well sclerotised; lateral and posteromedian sides sloping backwards, medial hunched; long slender setae scattered sparsely over the surface of the sternite of the genital segment, a regular fringe of longer setae along the posterior margin; posterior margin superficially concave between the condyles of the gonopods, without a medial bulge; gonopods are seen as only a small hemispherical protuberance, with a single long seta, the distal region slightly sclerotised (Fig. 7).

Etymology: The specific name refers to the characteristic of the type specimen resembles *A. magnus* (Trotzina, 1894).

Habitat: The type series was collected in mixed coniferous-broad leaved forest of low mountainside.

Distribution: Tibet, Shannan City.

Remarks: The new species resembles *A. magnus* (Trotzina, 1894), but can be easily distinguished from the latter by the different Legs spinulation; T 14 slightly concave rather than deeply concave in the latter; a protuberance on the terminal of the tibia of legs 15 in male, whereas it is normal in *A. magnus*; there are abundant setae in SS 14 and 15 instead of normal in *A. magnus*.

Key to Chinese species of the genus *Australobius* Chamberlin, 1920

To assist in the identification of species described in this work and other recorded Chinese species of *Australobius*, the following key is offered. This key emphasizes characters that can be examined without much dissection or high-magnification microscopy.

1. Having remarkable dense setae on the surface of the S 14 and S 15 2
   No remarkable dense setae on the surface of the S 14 and S 15 ....
   ....*Australobius anamagnus* new species
2. Four ocelli on each side, Tömösváry's organ larger than the adjoining ocelli
   ....*A. tetrophthalmus* (Loksa, 1960)
   Eight to ten ocelli on each side, Tömösváry's organ smaller than the adjoining ocelli ....*A. magnus* (Trozina, 1894)

Table 1. Legs spinulation of *Australobius anamagnus* new species

Legs	ventral					dorsal				
	C	Tr	P	F	T	C	Tr	P	F	T
1			mp	amp	amp			mp	amp	a
2			mp	amp	amp			mp	amp	a(p)
3			mp	amp	amp			mp	amp	ap
4-10			mp	amp	amp			amp	ap	ap
11			mp	amp	amp			amp	ap	ap
12			amp	amp	amp	(a)		amp	ap	ap
13			amp	amp	amp	a		amp	ap	ap
14	a	m	amp	amp	am	a		amp	p	p
15	a	m	amp	amp	a	a		amp	p	

NB: Letters in brackets indicate variable spines.

ACKNOWLEDGEMENTS

This study was supported by the Key Project of the National Natural Science Foundation of China (NSFC Key Project-30630010). We are grateful to Dr. Gregory D. Edgecombe, Principal Research Scientist on Myriapoda of the Australian Museum, Sydney, Australia, and Dr. Pavel Stoev, Curator of Myriapoda of the National Museum of Natural History in Sofia (Bulgaria) for their hospitality, everlasting help during our research, as well as advice and comments on the manuscript, respectively. We thank Professor Alessandro Minelli, whose suggestions improved the manuscript. We wish also to thank Professor Marzio Zapparoli, Department of Plant Protection, University of Tuscia, Viterbo (Italy), Dr. Rowland M. Shelley, curator of Terrestrial Invertebrates of North Carolina Museum of Natural Sciences, Raleigh, North Carolina (USA), and Dr. His-Te Shih, Assistant Professor of Department of Life Science, National Chung-Hsing University, Taichung (China), for providing us with invaluable literature. Thanks must go to Dr. Zi-Zhong Yang and Dr. Zhi-Sheng Zhang for their help in preparing the paper.

LITERATURE CITED

Attems, C. 1938. Myriopoden von Hawaii. Proceedings of the Zoological Society of London. B. 108: 365-387.

Attems, C. 1953. Myriopoden von Indochina. Expedition von Dr. C. Dawydoff (1938-1939). Mémoires du Muséum National d'Histoire Naturelle Paris. Série A. Volume 5, 3: 133-230.

Chamberlin, R. V. and Y. H. M. Wang. 1952. Some records and descriptions of Chilopods from Japan and other oriental areas. Proceeding of the Biological Society of Washington 65: 177-188.

Chamberlin, R. V. 1920. The Myriopoda of the Australian region. Bulletin of the Museum of Comparative Zoology, Harvard College 64: 1-269.

Chao, J. L. 2005. Review and development of study on Chilopoda of Taiwan. Journal of Endangered Wild Animal. Volume 9, 4: 33-41.

Eason, E. H. 1989. Lithobiidae from the Nepal Himalayas with descriptions of ten new species of *Lithobius* and *Australobius* (Chilopoda: Lithobiomorpha). Zoologische Jahrbücher, Abteilung für Systematik 116: 335-372.

Eason, E. H. 1992. On the taxonomy and geographical distribution of the Lithobiomorpha. *In,* Meyer, E., K. Thaler, and W. Schedl (Editors). Advances in Myriapodology. Berichte des naturwissenschaftlich-medizinischen Vereins in Innsbruck. Supplement 10. pp. 1-9.

Eason, E. H. 1997. On some Lithobiomorpha from the mountains of Kirghizia and Kazakhstan (Chilopoda). Arthropoda Selecta. Volume 6, 1-2: 117-121.

Loksa, I. 1960. Einige neue Diplopoden-und Chilopoden-Arten aus Chinesischen Höhlen. Acta Zoologica Academiae Scientiarum Hungaricae 6: 135-148.

Ma, H. Q., D. X. Song, and M. S. Zhu. 2007. A new genus and two new species of Lithobiid Centipedes (Chilopoda: Lithobiomorpha) from China. Zootaxa 1460: 25-34.

Takakuwa, Y. and H. Takashima. 1949. Myriapods collected in Shansi, North China. Acta Arachnologica. Volume 11, 1-2: 51-69.

Takakuwa, Y. 1939. 9 *Bothropolys*-Arten aus Japan. Transactions of the Natural History Society of Formosa. Volume 29, 188: 103-110.

Takakuwa, Y. 1940. Class Chilopoda, Epimorpha, Lithobiomorpha. *In,* Fauna Nipponica. Sanseido Book Store, Tokyo. Volume 9, Fascicle 8, Number 3. 104 pp.

Wang, D. Q. and J. P. Mauriès. 1996. Review and perspective of study on Myriapodology of China. Acta Myriapodologica 169: 81-99.

Wang, Y. H. M. 1959. On Chilopoda from Taiwan with a new Lithodid. Quarterly Journal of the Taiwan Museum 12: 195-199.

Zalesskaja, N. T. 1978. Identification book of the lithobiomorph centipedes of the USSR (Chilopoda: Lithobiomorpha) [in Russian]. Moscow, USSR. 212 pp.

Zapparoli, M. 2006. Lithobiidae. *In,* Minelli A. (Editor). A World Catalogue of Centipedes (Chilopoda). http://chilobase.bio.unipd.it/docs/chilobase.php

Zhang, C. Z. 1996. Chilopoda: Lithobiomorpha. pp. 244-251. *In,* The biology and human physiology in the Hoh Xil region. Science Press. Peking, China. 357 pp.

EIGHT NEW SPECIES OF *CHIASMODOLON* FROM SOUTH AMERICA (HEMIPTERA: CICADELLIDAE: IDIOCERINAE)[1]

Paul H. Freytag[2]

ABSTRACT: Eight new species are added to the genus *Chiasmodolon, C. infraspina, C. lozadai,* and *C. guttatus* from Peru; *C. guianae* from French Guiana; and *C. anchylus, C. nodus, C. eluphus* and *C. circulus* from Colombia.

KEY WORDS: *Chiasmodolon,* leafhoppers, Hemiptera, Cicadellidae, Idiocerinae

The genus *Chiasmodolon* Dietrich contains 33 species at the present time (Dietrich and McKamey 1990, Lozada 2001 and Freytag 2006). This paper adds eight more species to this genus.

As stated in Freytag (2006), the species of this genus look very much alike and the characters found in the male genitalia are the best to use to separate the species. The females have seemingly good characters using the seventh sternum, but at this time the association with the male can not be made. Also, the distribution of many of the species is questionable as many of the species are only known at the present time from a single locality.

Codons used for this paper are the following: IHVL = Instituto von Humboldt, Villa de Leyva, Colombia; MUSM = Musco Nacional de Historia Natural, Lima, Peru; MNHN = Museum National D'Histoire Naturelle, Paris, France; and UKYL = University of Kentucky Collection, Lexington, KY 40546.

Chaismodolon nodus Freytag, NEW SPECIES
(Figures 1-3)

Description: Length of male 6 mm., female unknown. Similar to *camarus,* but larger and with different male genitalia. Overall color yellow brown with a large faint brown spot on each side of the pronotum. Male genitalia: Pygofer (Figs. 1 and 2) triangular in lateral view, with narrow, curved, sharply pointed process at apex (setae not shown). Subgenital plate (Fig. 1) longer than pygofer, truncate in lateral view, with small, dorsally pointed spine at apex. Style and connective normal type. Aedeagus (Fig. 3) robust, with large basal process, apex nearly straight, pointed.

Type Data: Holotype male: Colombia: Vaupés, RN Mosiro-Itajura (Caparú), Igapo, 1°4'S 69° 31'W, 60 m., Malaise, 22-IX-7-X-2002, L. Benavides, M 3394 (IHVL).

---

[1] Received on November 8, 2006. Accepted on June 3, 2007.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 50546-0091 U.S.A. E-mail: freytag2104@windstream.net

Mailed on May 14, 2008

Remarks: This species is closely related to *camarus,* but has a different apex to the pygofer of the male, as well as a much different aedeagus. This species is named for the large process on the aedeagus.

Chiasmodolon lozadai Freytag, NEW SPECIES

(Figures 4-6)

Description: Length of male 5.5 mm., female unknown. Similar to *cornutus,* but smaller and with different male genitalia. Overall color yellow brown with no markings. Male genitalia: Pygofer (Figs. 4 and 5) triangular, but wider dorsally in lateral view, process on dorsal margin not extending much beyond pygofer apex (setae not shown). Subgenital plate (Fig. 4) widest and curved dorsad at apex, with a sharp spine at apex on caudal side. Style and connective of normal type. Aedeagus (Fig. 6) long, bent at right angle half distance from base, in lateral view, with spine-like process in middle on caudal side of basal half of shaft.

Type Data: Holotype male: Peru: Madre de Dios, Tambopata Res. Zone, Tambopata Res. Cntr. On Rio Tasmbopata, 13°08'305"S 69°36'502"W, 190 m., 3-7-X-2004, C. R. Bartlett (MUSM).

Remarks: This species is closely related to *cornutus,* but has a shorter process on the pygofer and a much different aedeagus. This species is named for Pedro W. Lozada, Curator of Hemiptera, Musco Nacional de Hostoria Natural, Lima, Peru for his work on species of this genus.

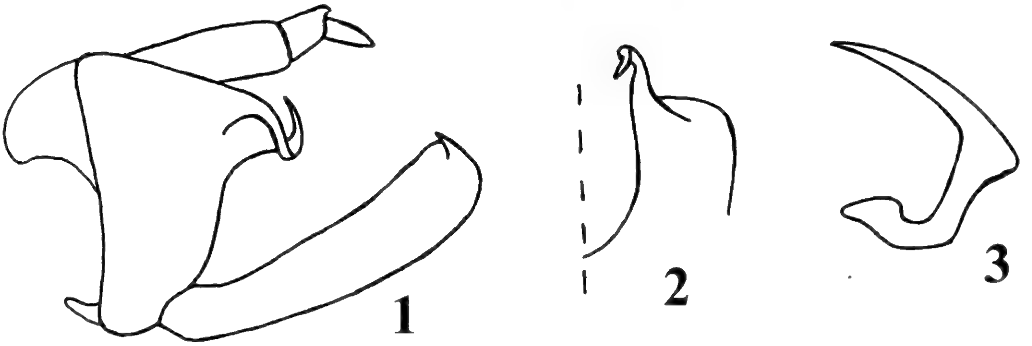
Chiasmodolon infraspina Freytag, NEW SPECIES

(Figures 7-9)

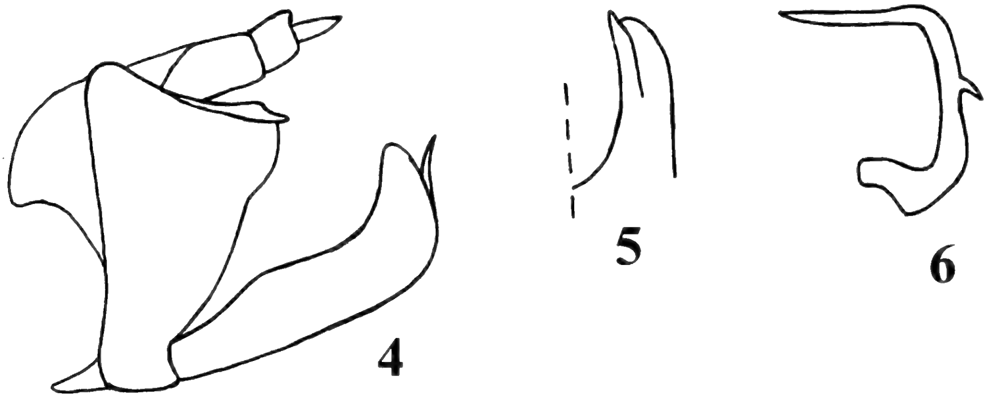
Description: Length of male 5.8 mm., female unknown. Similar to *torrus,* but with slightly different male genitalia. Overall color yellow brown with no markings. Male genitalia: Pygofer (Figs. 7 and 8) triangular, with a small spine on inner margin of dorsal margin (setae not shown). Subgenital plate (Fig. 7) long, nearly pointed, in lateral view, with a spine near apex on inner margin. Style and connective of the normal type. Aedeagus (Fig. 9) evenly curved, narrow, sharply pointed, in lateral view, with short, sharp spine on caudal margin near base.

Type Data: Holotype male: Peru: Madre de Dios, Tambopata Res., 30 km (air) SW Puerto Maldonado, 290 m., 12°51'S 69°17"W, Smithsonian Institution Canopy Fogging Project, T. L. Erwin et al, 30-IV-1984, 03/02/087 (MUSM)

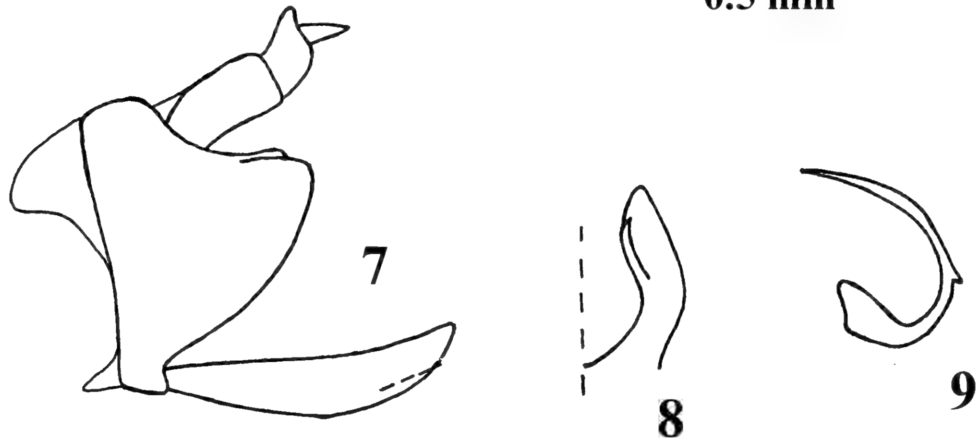
Remarks: This species is close to *torrus,* but the process of the male pygofer is not hooked, and the aedeagus has a sharper spine on caudal margin. This species is named for the short spine of the male pygofer on the inner dorsal margin.



Chiasmodolon nodus



Chiasmodolon lozadai



Chiasmodolon infraspina

Figures 1-3. *Chiasmodolon nodus* n. sp. Figures 4-6. *C. lozadai* n. sp. Figures 7-9. *C. infraspina* n. sp. Figs. 1, 4, and 7. Male genital capsule, lateral view (setae not shown). Figs. 2, 5, and 8. Left side of pygofer, dorsal view (dotted line indicates midline of body). Figs. 3, 6, and 9. Aedeagus, lateral view. All drawn to the same scale.

Chiasmodolon guttatus Freytag, NEW SPECIES
(Figures 10-12)

Description: Length of male 5.9 mm., female unknown. Similar to *latidens*, but smaller and with different male genitalia. Overall color yellow brown with no markings. Male genitalia: Pygofer (Figs. 10 and 11) triangular, in lateral view with curved, pointed apex (setae not shown). Subgenital plate (Fig. 10) thick, curving dorsad at apex, pointed. Style and connective normal. Aedeagus (Fig. 12) with basal half of shaft straight to bump-like area on caudal margin, then curving dorsad to pointed apex.

Type Data: Holotype male: Peru: Madre de Dios, nr Puerto Maldonado, Posadas Amazonas Lodge, at Rio Tambopata, 186 m., 12°48'115"S 69°18'019'W, 7-10-X-2004, C. R. Bartlett (MUSM).

Remarks: This species is close to *latidens* in most aspects, except the aedeagus has a curved apical part of the shaft, which is nearly straight in *latidens.*This species is named for this bend in the apical part of the aedeagus.

Chiasmodolon eluphus Freytag, NEW SPECIES
(Figures 13-15)

Description: Length of male 6.5 mm., female unknown. Similar to *acutus,* but smaller and with different male genitalia. Overall color yellow brown, with a dark brown dash at base of forewing. Male genitalia: Pygfofer (Figs. 13 and 14) triangular, in lateral view, but with a long spine on dorsal margin near base, also long irregular spine at apex (setae not shown). Subgenital plate (Fig. 13) same width to rounded apex. Style and connective of normal type. Aedeagus (Fig. 15) bent from base with bump-like process on caudal margin of shaft one third from base, apical two-thirds of shaft bent in half, nearly same width to pointed apex.

Type Data: Holotype male: Colombia: Valle del Cauca, Farallenes de Cali, Cgto. La Meseta, 3°34'N 76°40'W, 196 m., Malaise, 24-XII-2003-24-I-2004, S. Sarria and M. Losso, M 4545 (IHVL). Paratype male: Same data as holotype, except 27-VIII-9-X-2003, M 4549 (UKYL).

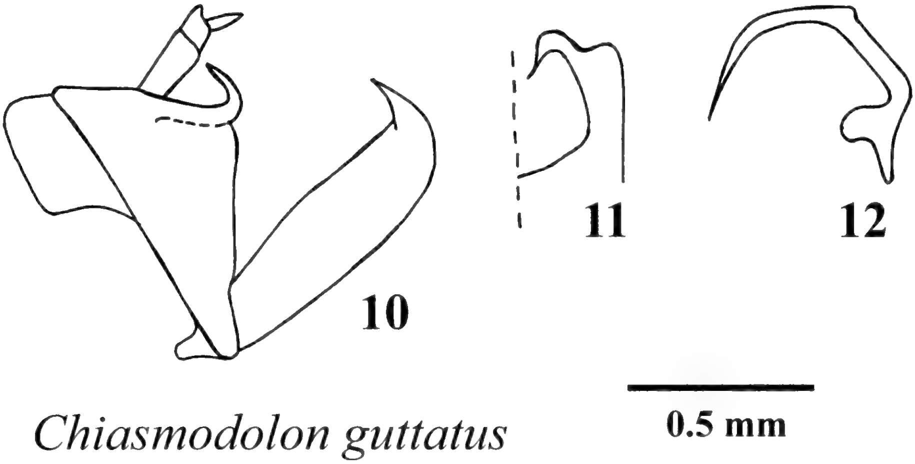
Remarks: This species is close to *acutus* in most aspects, however the aedeagus is quite different, and the pygofer processes are also distinctly different. This species is named for the unusual processes on the pygofer.

Chiasmodolon guianae Freytag, NEW SPECIES
(Figures 16-18)

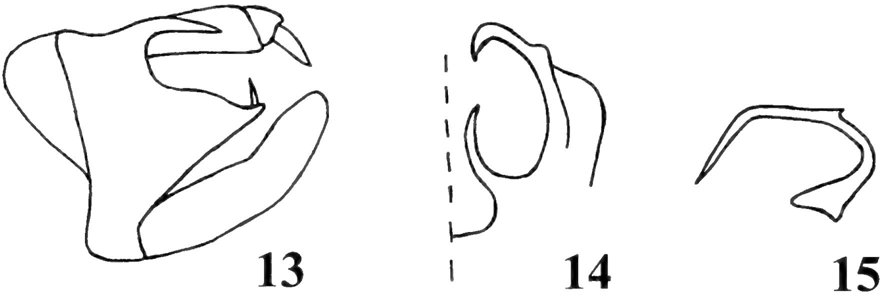
Description: Length of male 5 mm., female unknown. Similar to *lobatus,* but smaller and with different male genitalia. Vertex of head, pronotum and scutellum uniformly orange. Face yellow brown. Forewings brown with darker veins. Male genitalia: Pygofer (Figs. 16 and 17) triangular, in lateral view, with a thumb-like process on dorsal margin (setae not shown). Subgenital plate (Fig. 16) paddle-shaped, in lateral view, widest in apical half. Style and connective of normal type. Aedeagus (Fig. 18) short, bent abruptly at base, in lateral view, with a sharply pointed spine half length of shaft oncudal margin, then curving to pointed apex.

Type Data: Holotype male: French Guiana: 13 km W of Risquetout, 8-VI-2005, J. E. Eger and M. T. Messenger, 4°54' 028"N 52°34' 494"W, M. V. light (MNHN).

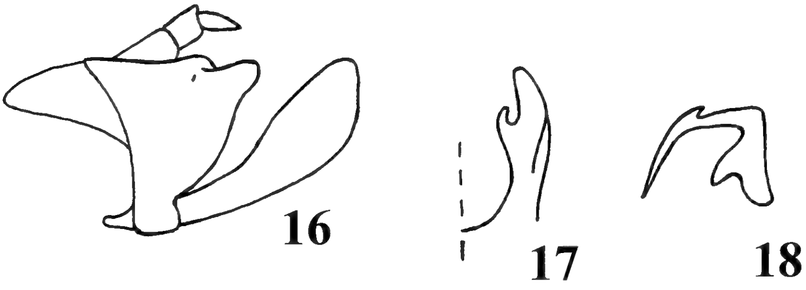
Remarks: This species is close to *lobatus*, but the process on the pygofer is not seen in lateral view, where it is in *lobatus,* and the process on the aedeagus is sharply pointed and the basal bend is nearly at right angle to the base. This species is named for the area from which it was collected.



Chiasmodolon guttatus



Chiasmodolon eluphus



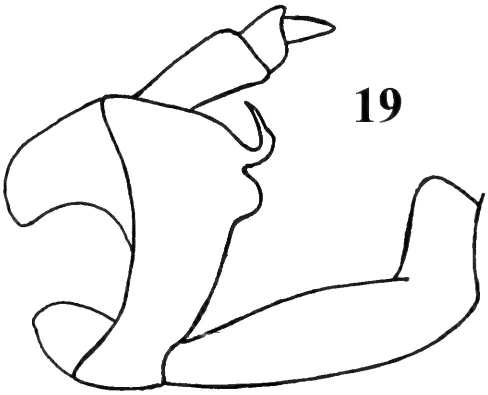
Chiasmodolon guianae

Figures 10-12. *Chiasmodolon guttatus* n. sp. Figures 13-15. *C. eluphus* n. sp. Figures 16-18. *C. guianae* n. sp. Figs. 10, 13, and 16. Male genital capsule, lateral view (setae not shown). Figs. 11, 14, and 17. Left side of pygofer, dorsal view (dotted line indicates mid-line of body). Figs. 12, 15, and 18. Aedeagus, lateral view. All drawn to the same scale.

Chiasmodolon anchylus Freytag, NEW SPECIES
(Figures 19-22)

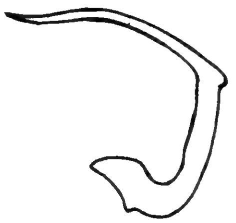
Description: Length of male 6 mm., female unknown. Similar to *flavotinctus,* but with different male genitalia. Overall color yellow brown without markings. Male genitalia: Pygofer (Figs. 19 and 20) short, rounded at apex, with a recurved, sharply pointed process at apex of dorsal margin (setae not shown). Subgenital plate (Fig. 19) nearly same width to apical third which is bent dorsad, truncate, with a small spine on caudal apex. Style and connective of normal type. Aedeagus (Fig. 21) long, in lateral view, bent from base, basal third of shaft stout, same width to bump-like process on caudal margin, then apical two-thirds long, nearly straight, pointed at apex.

Type Data: Holotype male: Colombia, Amazonas, PNN Amacayacu, Matamata, 3°41'S 70°15'W, 150 m., 23-X-2000, Red, A. Parente, M 3552 (IHVL).



19

20

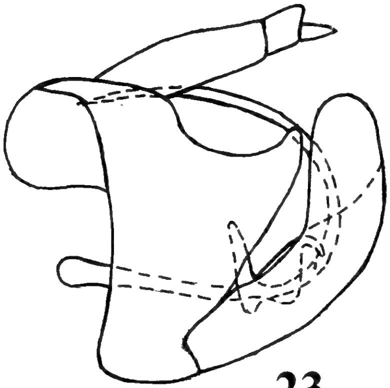


21

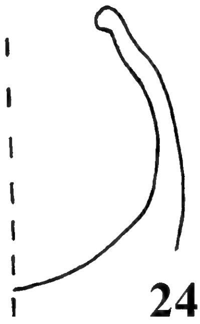
Chiasmodolon anchylus

0.5 mm

22



23



24

Chiasmodolon circulus

Figures 19-22. *Chiasmodolon anchylus* n. sp. Figures 23-24. *C. circulus* n. sp. Figs. 19 and 23. Male genital capsule, lateral view (setae not shown). Figs. 20 and 24. Left side of pygofer, dorsal view (dotted line indicates midline of body). Fig. 21. Aedeagus, lateral view. Fig. 22. Apical part of aedeagus, dosal view. All drawn to same scale.

Remarks: This species is close to *flavotinctus,* except it has a more distinct process on the male pygofer, the aedeagus is longer and straight at apex, and the subgenital plate is bent abruptly at apex and has a small spine at apex. It is named for the crooked subgenital plate.

Chiasmodolon circulus Freytag, NEW SPECIES

(Figures 23-25)

Description: Length of male 6 mm., female unknown. Similar to *lautus,* but smaller and with different male genitalia. Male genitalia: Pygofer (Figs. 23 and 24) triangular, in lateral view, apex curving toward median, in dorsal view (setae not shown). Subgenital plate (Fig. 23) nearly same width to apex, in lateral view, curving dorsad at half length, rounded at apex. Style (Fig. 23), long, hooked at apex. Connective normal. Aedeagus (Fig. 23) very long, in lateral view, curving dorsad, nearly same width to pointed apex.

Type Data: Holotype male: Colombia: Cauca, PNN Gorgona, El Helechal, 2° 58'N 78°11'W, 30 m., Malaise, 28-IX-22-X-2001, H. Torres, M 2459 (IHVL).

Remarks: This species is near *lautus,* but the apex of the male pygofer is not pointed, and the aedeagus is longer and not curved as much at apex. It is named for the curved male aedeagus.

ACKNOWLEDGMENTS

I thank Michael J. Sharkey, Department of Entomology, University of Kentucky, who made it possible to study specimens from Colombia through his National Science Foundation Grant No. DEB 0205982. Also, thanks to Joe E. Eger and Charles R. Bartlett for the loan of material they collected.

LITERATURE CITED

Dietrich, C. H. and S. H. McKamey. 1990. Three new idiocerine leafhoppers (Homoptera: Cicadellidae) from Guyana with remarks on ant-mutualism and subsociality. Proceedings of the Entomological Society of Washington 92(2):214-223.

Freytag, P. H. 2006. Twenty-six new species of *Chiasmodolon* from South America (Hemiptera: Cicadellidae: Idiocerinae). Journal of the Kansas Entomological Society 79(1):55-77.

Lozada, P. W. 2001. Revisión del género *Chiasmodolon* Dietrich, 1990 (Homoptera: Cicadellidae: Idiocerinae). Revista Peruana de Entomologia 42:1-8.

CULICOIDES PARAENSIS (DIPTERA: CERATOPOGONIDAE) INFESTATIONS IN CITIES OF THE ITAPOCÚ RIVER VALLEY, SOUTHERN BRAZIL[1]

Maria Luiza Felippe-Bauer[2] and Ulises Sebastian Sternheim[3]

ABSTRACT: *Culicoides paraensis* (Goeldi), a vector of the human viral disease Oropouche, is reported as a pest from five cities in the Itapocú River Valley, southern Brazil. Adults likely emerge from rotting banana plants and are common enough to cause skin problems and allergies.

KEY WORDS: Diptera, Ceratopogonidae, *Culicoides paraensis*, infestations, pest, southern Brazil

Culicoides paraensis (Goeldi, 1905) is the most important species of Ceratopogonidae with medical importance in the Neotropical Region. It is a vector to humans of the nematode *Manzonella ozzardi*, in Argentina (Shelley and Coscarón, 2002) and Oropouche (ORO) virus infections in Panama, Peru and Brazil (Tesh, 1994). Over a half million persons have been infected with ORO virus. This makes this viral disease a serious public health threat in tropical and subtropical areas of Central and South America (Pinheiro et al., 2004).

In Brazil, ORO epidemics have been reported from 1960 to 1980 in the northern state of Para where the most important epidemics occurred in Belem. During the last two decades, ORO virus has spread to neighboring states of Amazonas, Amapa, Acre, Rondônia, Maranhão and Tocantins (Nunes et al., 2005).

Culicoides paraensis is the most widespread species in the New World. It occurs in the southeastern United States as far north as Pennsylvania and Wisconsin, and south through Central and South America to Uruguay (Salto) (Felippe-Bauer et al., 2003). Despite its widespread distribution in the states of the north, northeast and south of Brazil, this species is poorly collected and infestations were mainly reported in the northern states where it is associated with ORO in endemic sites. Only Sherlock (1963) previously mentioned *C. paraensis* as a pest in Salvador, Bahia, causing allergic dermatitis in the local residents.

METHODS

Between February and September 2002, representatives of the cities' governments of Jaragua do Sul, Corupa, Schroeder, Guaramirim and Massaranduba in the Itapocu River Valley (1723 km^2) in northeast Santa Catarina (Fig.1), sent us samples of *Culicoides*, collected from schools, day-care centers, and residences where females were biting exposed parts of the body (legs, arms, face) of local residents. Some people developed eczema, mainly on the legs, due to allergic reactions caused by the bite of these insects. The collections were made in different day's hours due to the availability of the local agents at 91 rural, periurban, and urban

---

[1] Received on June 26, 2007. Accepted on September 1, 2007.

[2] Laboratório de Diptera, Instituto Oswaldo Cruz-Fiocruz, Av. Brasil 4365, Manguinhos, 21040-900 Rio de Janeiro, RJ, Brasil. E-mail: mlfbauer@ioc.fiocruz.br.

[3] Coordenadoria de Defesa Civil, Prefeitura Municipal de Jaraguá do Sul, Santa Catarina, Brasil. E-mail: fauna@jaraguadosul.com.br.

Mailed on May 14, 2008

sites described in Table 1. Infested sites were signaled in Jaragua do Sul (533 km²) and Corupa (405 km²), the two cities with the biggest claims (Fig. 2). The species were identified based in the Atlas of *Culicoides* (Wirth et al., 1988) and in the key and diagnostic characters of *Culicoides* of the *paraensis* species group that can be found in Felippe-Bauer et al. (2003).

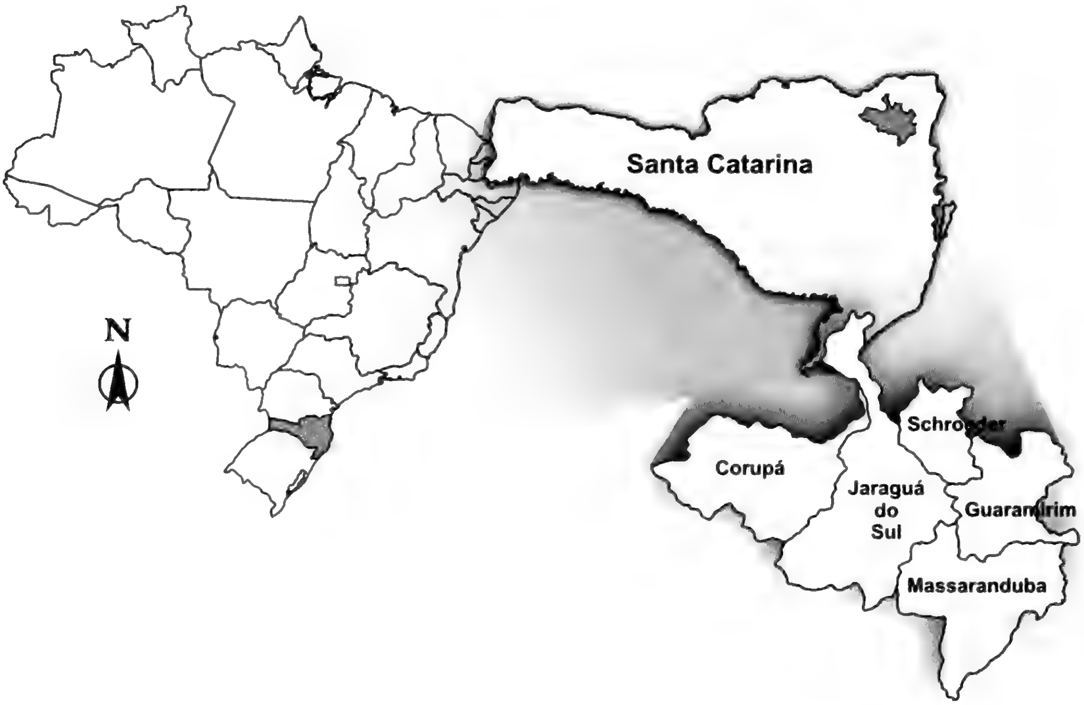


Figure 1. Map of the Itapocu River Valley, Santa Catarina State, Brazil, with indication of the cities infested by *Culicoides paraensis* (Goeldi, 1905).

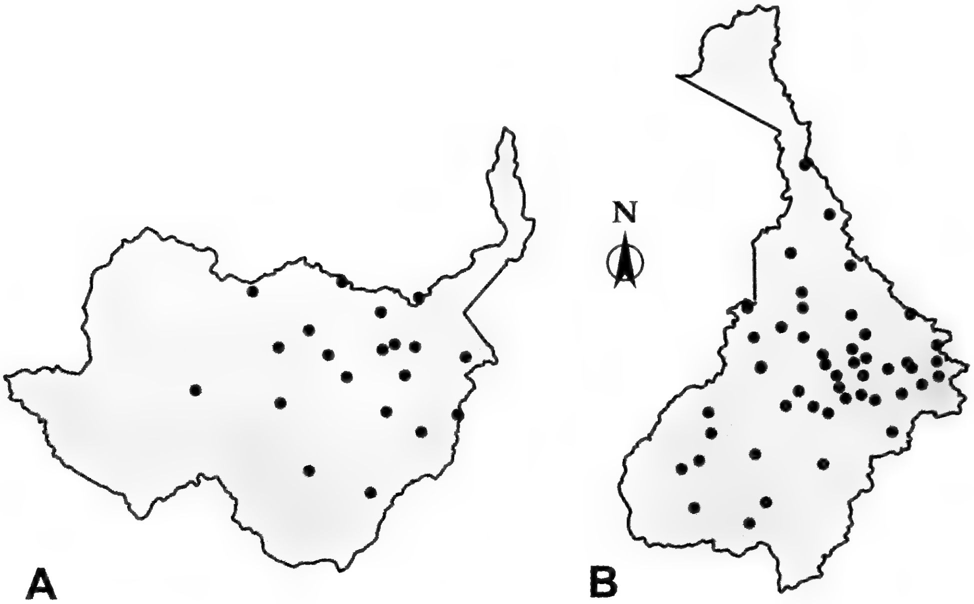


Figure 2. Map of Corupa (A) and Jaragua do Sul (B) with indication of infested sites by *Culicoides paraensis* (Goeldi, 1905). Scale 1: 534,000 for Corupa and 1: 657,000 for Jaragua do Sul.

Table 1. Collection sites of *Culicoides paraensis* in the cities of Jaragua do Sul, Corupa, Guaramirim, Schroeder and Massaranduba, Santa Catarina State, Brazil, February-September 2002.

City	**Date**	**Site (Quarter)**	**Description**
JARAGUA DO SUL	18/03/2002	Nereu Ramos	Urban, banana and irrigated rice plantation, secondary forest distant
	26/04/2002	Rio Molha	Urban, surrounded by secondary forest
	03/05/2002	Vila Lenzi	Urban, surrounded by secondary forest
	30/04/2002	Três Rios do Norte	Periurban, banana and irrigated rice plantation, secondary forest distant
	03/05/2002	Ilha da Figueira	Periurban, irrigated rice plantation and secondary forest distant
	09/05/2002	Vila Lalau	Urban center near residences
	26/04/2002	Vieiras	Periurban, neighbor to banana plantation
	17/05/2002	Barra do Rio Cerro	Urban center
	03/05/2002	Vila Rau	Urban center
	12/04/2002	Czerniewicz	Urban center
	22/05/2002	Ilha da Figueira	Periurban, close secondary forest
	03/04/2002	Água Verde	Urban center
	21/03/2002	Jaragua 99	Periurban, near banana plantation and secondary forest
	18/04/2002	Alto Garibaldi	Rural, adjacent to banana plantation and secondary forest
	17/04/2002	Jaraguá Esquerdo	Urban center
	28/03/2002	Nereu Ramos	Rural, neighbor to banana and irrigated rice plantation, surrounded by secondary forest
	22/05/2002	Ilha da Figueira	Periurban, close secondary forest
	01/04/2002	Chico de Paulo	Rural, close secondary forest
	14/03/2002	Garibaldi	Rural, near banana plantation, chicken creation and surrounded by secondary forest
	21/05/2002	Barra do Rio Cerro	Periurban, surrounded by secondary forest
	13/03/2002	Jaragua 84	Periurban, neighbor to banana plantation and secondary forest

JARAGUA DO SUL	17/04/2002	Tifa Martins	Periurban, surrounded by secondary forest
	12/04/2002	Amizade	Periurban, surrounded by secondary forest
	21/03/2002	João Pessoa	Periurban, near banana plantation
	03/05/2002	Estrada Nova	Urban center, surrounded by secondary forest
	30/04/2002	Tifa Martins	Urban center, surrounded by secondary forest
	02/04/2002	Três Rios do Norte	Rural, near secondary forest
	21/05/2002	Rio da Luz	Rural, banana plantation, chicken creation, secondary forest distant
	03/04/2002	Tifa Monos	Periurban, secondary forest distant
	30/04/2002	São Luis	Urban center
	30/04/2002	Nereu Ramos	Rural, close to banana and irrigated rice plantation, secondary forest
	03/04/2002	Rio Molha	Rural, near secondary forest
	19/04/2002	Rio Cerro I	Rural, irrigated rice plantation distant
	17/05/2002	Rio da Luz	Rural, adjacent to cattle and chicken creation
	21/05/2002	Rio da Luz	Rural, adjacent to cattle and chicken creation
	22/05/2002	Vila Lalau	Urban center
	13/03/2002	Garibaldi	Periurban, neighbor to banana plantation
	25/03/2002	Vila Chartres	Rural, near irrigated rice plantation
	30/04/2002	Três Rios do Norte	Periurban with variated cultivation
	25/03/2002	Vieiras	Periurban, next banana plantation
	16/04/2002	Centro	Urban center
	25/03/2002	Santa Luzia	Periurban, irrigated rice plantation and secondary forest distant
	18/04/2002	Jaraguazinho	Rural, near banana plantation
	18/04/2002	Ribeirão Grande do Norte	Rural, near banana plantation
	28/05/2002	Grota Funda	Rural, adjacent to secondary forest
	06/06/2002	Ribeirão das Pedras	Rural, neighbor to banana plantation
	16/08/2002	São Pedro	Rural, near banana plantation and cattle creation

CORUPA	24/07/2002	Ano Bom	Periurban, adjacent to river and secondary forest
	15/07/2002	Center	Urban, next to residences, river and secondary forest
	30/06/2002	Bomplandt	Rural, neighbor to river, secondary forest, cattle creation and banana plantation
	13/07/2002	Caminho do Morro	Rural, near river, secondary forest, cattle creation and banana plantation
	13/07/2002	Isabel Alto	Rural, next to cattle creation and river, surrounded by secondary forest
	07/07/2002	Escola Felipe Schmidt	Rural, near river, cattle creation and banana plantation, secondary forest,
	02/07/2002	Center	Urban, neighbor to river, surrounded by secondary forest
	21/07/2002	Guarajuva	Rural, near pig creation, banana plantation and secondary forest
	21/07/2002	Itapocu	Rural, near pig creation, banana plantation and secondary forest
	24/07/2002	Isabel Alto	Rural, close to river, secondary forest, cattle creation and banana plantation
	25/07/2002	Center	Urban, adjacent to river, factory, surrounded by secondary forest
	14/07/2002	Osvaldo Amaral	Rural, next to river and banana plantation
	25/07/2002	Faxinal	Rural, near cattle creation, banana plantation and secondary forest
	02/07/2002	Pedra de Amolar	Rural, close to river, surrounded by banana plantation and secondary forest
	15/07/2002	Poço D'Anta	Rural, near river, cattle and chicken creation and banana and irrigated rice plantation
	13/07/2002	Rio Correias	Rural, neighbor to river, secondary forest and banana plantation
	17/07/2002	Rio Novo Alto	Rural, next to river, cattle creation, banana plantation and secondary forest,
	12/07/2002	Rio Paulo	Rural, adjacent to river, cattle creation, banana plantation and secondary forest
	18/07/2002	Tifa dos Milhões	Rural, near river, cattle creation, banana plantation and secondary forest
	19/07/2002	Center	Urban, close to residences
GUARAMIRIM	07/09/2002	Brüderthal	Rural, irrigated rice plantation distant
	06/02/2002	Brüderthal	Rural, near banana plantation, irrigated rice plantation and secondary forest
	10/04/2002	Brüderthal	Rural, next to banana plantation and secondary forest
	18/04/2002	Brüderthal	Rural, close to banana plantation and secondary forest
	29/04/2002	Brüderthal	Rural, near banana plantation and secondary forest
	14/05/2002	Bylaardt	Rural, neighbor to banana plantation
	24/04/2002	Bylaardt	Rural, neighbor to banana plantation
	10/09/2002	Ilha da Figueira	Urban, near irrigated rice plantation and secondary forest
	09/09/2002	Jacu-Açú	Rural, adjacent to irrigated rice plantation and secondary forest
	18/09/2002	Jacu-Açú	Rural, irrigated rice plantation and secondary forest distant

SCHROEDER	03/2002	Centro	Urban, closet to by banana plantation
	03/2002	Centro	Periurban, near banana plantation
	03/2002	Duas Mamas	Rural, adjacent to banana plantation and secondary forest
	03/2002	Duas Mamas	Rural, near banana plantation and cattle creation
	03/2002	Duas Mamas	Rural, next to banana plantation
	03/2002	Rio Hern	Periurban, neighbor to banana plantation
	03/2002	Rio Hern	Periurban, near banana plantation
	03/2002	Bracinho	Periurban, adjacent to banana plantation
	03/2002	Bracinho	Rural, closet to banana plantation and fish creation
MASSARANDUBA	11/06/2002	Guarani Mirim	Periurban, closet to banana plantation, irrigated rice, pasture
	20/7/2002	Guarani Mirim	Periurban, near banana and irrigated rice plantation, pasture
	13/7/2002	Ribeirão Gustavo	Periurban, adjacent to irrigated rice plantation, pasture, palms and secondary forest
	25/6/2002	Ribeirão Wilde	Periurban, next to banana and irrigated rice plantation, pasture and secondary forest
	28/8/2002	Alto Guarani Açu	Periurban, near banana plantation, chicken creation, palms and secondary forest

RESULTS

A total of 3,640 specimens of *Culicoides* were captured during this study: 1,254 from Jaragua do Sul, 1,344 from Corupa, 611 from Guaramirim, 363 from Schroeder and 68 from Massaranduba. Of these, 3,516 specimens were *C. paraensis* and 124 *C. insignis* Lutz. The latter species was found only in one collection made in a rural site from the city of Guaramirim near an irrigated rice plantation, whereas in all other sites only *C. paraensis* was captured. *Culicoides* adult populations in the cities of the Itapocu River Valley are therefore due nearly entirely to the high incidence of *C. paraensis.*

DISCUSSION

The economies of the cities of the Itapocu River Valley are based mainly on the intensive culture of banana (Musaceae) (Table 1). As observed in other areas with the same cultural practices, after felling of banana trees, the stems, stumps and other banana plant residues are left in the environment for decomposition. Several authors (e.g. Winder and Silva, 1972; Winder, 1977; Hoch et al., 1987; Mercer et al., 2003) have shown that *C. paraensis* emerge from decaying vegetation. The change of the forest environment to agricultural sites, like banana plantations, provides an increase in the incidence of this species due to the greater availability of breeding substrates.

In order to identify the preferred larval development sites of *C. paraensis* in areas of banana monoculture, studies have been started in Jaragua do Sul. This information may provide knowledge toward development of an alternative management regime of banana plantations. Changes to the cultivation methods of this important crop will likely contribute to future *Culicoides* control programs in the cities of the Itapocu River Valley.

In Brazil, the ORO virus was restricted to the areas with occurrence of ORO fever, especially those in the Amazon Basin. Recently, Nunes et al. (2005) isolated the genotype III of ORO virus from monkeys (*Callithrix*) in the Arinos region of the state of Minas Gerais, a genotype reported previously only in Panama.

The record of the ORO virus outside the states of the Amazon Basin, in sylvatic areas of southeastern Brazil and the report of established populations of *C. paraensis* in urban areas of Santa Catarina demands special attention. Unlike that in the Amazon region of Brazil, banana culture in southern Brazilian states is extensively cultivated in populous urban areas. The potential of transportation of this arbovirus from natural habitats to urban areas and the risk of spreading ORO fever to susceptible populated regions of southeastern and southern Brazil must be addressed by government health agencies. Clearly, additional studies regarding the bioecological aspects of the vector, as well as the spatial distribution of the ORO virus and its vectors are needed to better understand the potential risk of spreading this epidemic arboviral disease in Brazil.

ACKNOWLEDGEMENTS

We are grateful to the Associação dos Municípios do Vale do Rio Itapocu (AMVALI) and the city governments of Jaraguá do Sul, Corupa, Guaramirim, Schroeder and Massaranduba for financial support. We thank Maria Teresa Nora Amorim for her prompt assistance, Arnaldo Kersten for his technical support with field collections, Enaly Silva Ribeiro and Lina Lane Ferreira for counting the specimens, Art Borkent and William Grogan for critical review of the manuscript, and to the many collectors and residents for their assistance.

LITERATURE CITED

Felippe-Bauer, M. L., A. G. Cáceres, C. S. Silva, W. Valderrama-Bazan, and A. Gonzales-Perez. 2003. Two new *Culicoides* of the *paraensis* species group (Diptera: Ceratopogonidae) from the Amazonian region of Peru. Memórias do Instituto Oswaldo Cruz 98: 1051-1058.

Hoch, A. L., D. R. Roberts, and F. P. Pinheiro. 1987. Criaderos de *Culicoides paraensis* y opciones para combatirlos mediante el ordenamiento del medio. Boletín de la Oficina Sanitaria Panamericana 103: 10-20.

Mercer, D. R., G. R. Spinelli, D. M. Watts, and R. B. Tesh. 2003. Biting rates and developmental substrates for biting midges (Diptera: Ceratopogonidae) in Iquitos, Peru. Journal of Medical Entomology 40: 807-812.

Nunes, M. R. T., L. C. Martins, S. G. Rodrigues, J. O. Chiang, R. S. S. Azevedo, A. P. A. Travassos da Rosa, and P. F. C. Vasconcelos. 2005. Oropouche virus isolation, southeast Brazil. Emerging Infectious Diseases 11: 1610-1613

Pinheiro, F. P., A. P. A. Travassos da Rosa, and P. F. C. Vasconcelos. 2004. Oropouche fever. *In,* R. D. Feigin (Editor). Textbook of pediatric infectious disease. W. B. Saunders Co., Philadelphia, Pennsylvania, U.S.A. pp. 2418-2423.

Shelley, A. J. and S. Coscarón. 2002. Simuliid blackflies (Diptera:Simuliidae) and ceratopogonid midges (Diptera:Ceratopogonidae) as vectors of *Mansonella ozzardi* (Nematoda:Onchocercidae) in Northern Argentina. Memórias do Instituto Oswaldo Cruz 96: 451-458.

Sherlock, I. A. 1963. O problema do *Culicoides* em Salvador, Bahia. Revista Brasileira de Malariologia e Doenças Tropicais 15: 567-591.

Tesh, R. B. 1994. The Emerging Epidemiology of Venezuelan hemorrhagic Fever and Oropouche fever in Tropical South America. Annals New York Academy of Sciences 740: 129-137.

Winder, J. A. 1977. Field observations on Ceratopogonidae and other Diptera: Nematocera associated with cocoa flowers in Brazil. Bulletin of Entomological Research 67: 57-63.

Winder, J. A. and P. Silva. 1972. Cacao pollination: Microdiptera of cacao plantations and some of their breeding places. Bulletin of Entomological Research 61: 651-655.

Wirth, W. W., A. L. Dyce, and G. R. Spinelli. 1988. An atlas of wing photographs, with a summary of numerical characters of the Neotropical species of *Culicoides* (Diptera: Ceratopogonidae). Contributions of the American Entomological Institute 25: 1-72.

FOUR NEW SPECIES OF SHARPSHOOTER LEAFHOPPERS FROM COLOMBIA (HEMIPTERA: CICADELLIDAE: CICADELLINAE)[1]

Paul H. Freytag[2]

ABSTRACT: Four new species are described from Colombia. All belong in the Cicadellini in three different genera. They are: *Hadria colombiana*, *Coronigonalia litterata*, *Coronigonalia gorgonensis*, and *Stephanolla spina*.

KEY WORDS: *Hadria*, *Coronigonalia*, *Stephanolla*, leafhoppers, Hemiptera, Cicadellidae, Cicadellinae, Colombia

Four new species are described from Colombia that belong to the sharpshooter leafhopper group (Cicadellidae, Cicadellinae, Cicadellini). These species belong to three different genera that are all closely related. One species of *Hadria* is described that is quite far from the known distribution of that genus (Cuba and Hispaniola). The other two genera, *Coronigonalia* and *Stephanolla*, are mostly known from Costa Rica and Panama, and extend the distribution of these two genera into South America.

Acronyms used in this paper are the following: IHVL = Instituto von Humboldt, Villa de Leyva, Colombia; and UKYL = University of Kentucky Collection, Lexington, Kentucky, USA.

Hadria colombiana Freytag, new species
(Figures 1-5)

Description: Length of males 5-5.6 mm., females 5.5-5.7 mm. Color pattern (Fig. 1) similar to *haitiensis*, but male genitalia similar to *conciliata*. Femoral setal formula 2-1-1. Antiapical cells two large cells. Head with crown grayish green, mottled with black speckles and spots, with u-shaped orange band along anterior margin and beside eyes, also onto antennal ledges, face yellow with lateral margins of clypeus black with bright yellow spot at base, as well as small, square, black median area. Pronotum grayish green with some black markings along anterior margin, three longitudinal bands of orange, one down median, one on each lateral margin, plural area black. Scutellum with median longitudinal orange band, outlined with bold black line on each side, lateral areas yellow marked with black spots. Forewing grayish green, with orange bands, one narrow band from scutellum along commisure to apex of second claval vien, second wide band along length of claval suture, third covering cell along costal margin to base of outer antiapical cell, forth diagonal band across base of apical cells. Legs and ventral area of abdomen yellow to yellowish orange. Dorsal area of

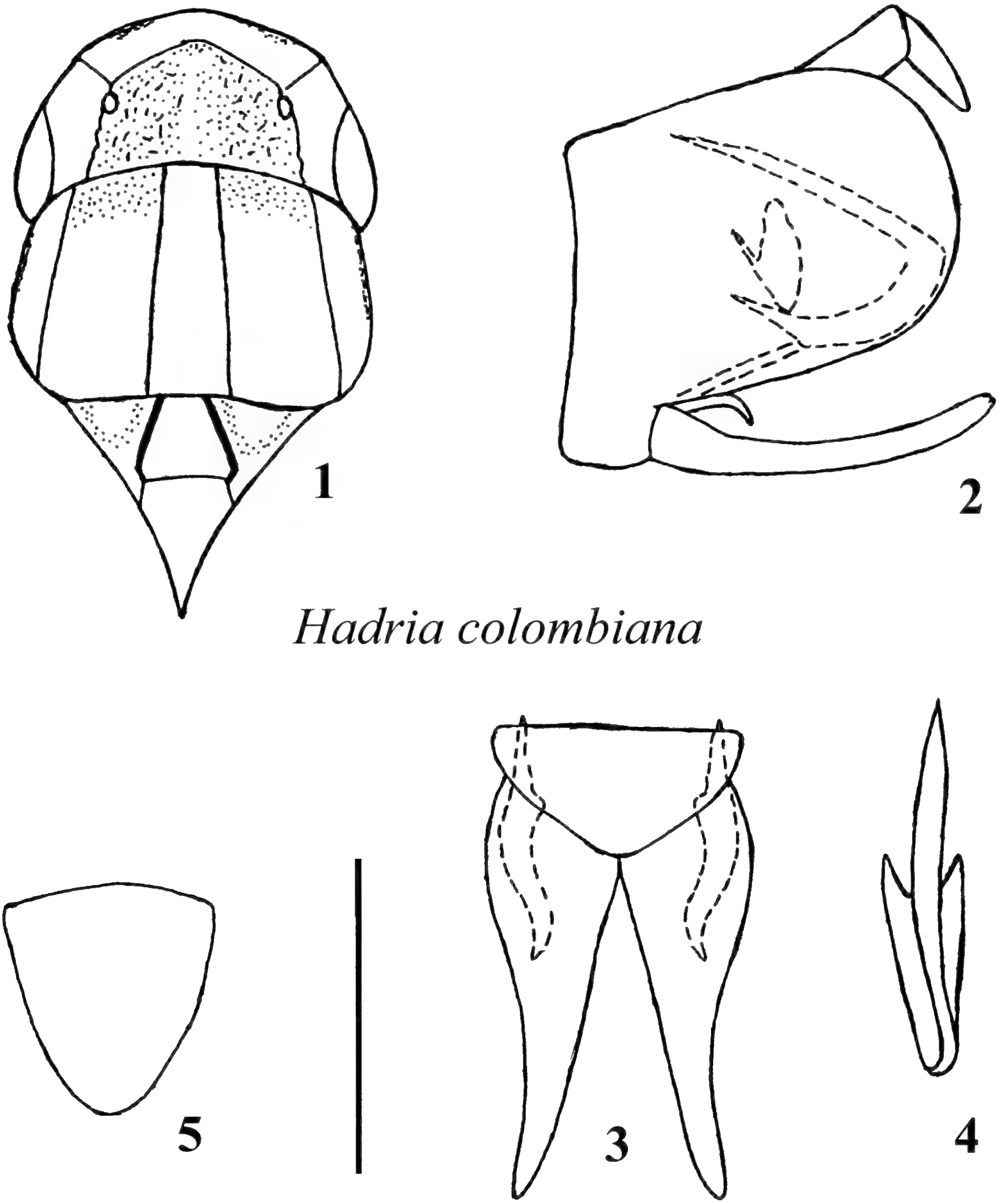
---

[1] Received on May 2, 2007. Accepted on May 20, 2007.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 50546-0091 U.S.A. E-mail: freytag2104@windstream.net

Mailed on May 14, 2008

abdomen red. Male genitalia: Pygofer (Fig. 2) without processes, boldly rounded at apex. Genital plate (Figs. 2-3) nearly as long as pygofer, triangular in ventral view but narrowing on outer margin to nearly pointed apex. Paraphysis (Figs. 2, 4) single, long, somewhat asymmetrical, pointed at apex. Connective t-shaped, with long stem. Style (Figs. 2-3) shorter then connective, hooked, pointed at apex. Aedeagus (Fig. 2) short, narrowed to apex, without processes. Female genitalia: Seventh sternum (Fig. 5) prolonged, narrowed, rounded at apex.



Figures 1-5. *Hadria colombiana* n. sp. Fig. 1, head, pronotum and scutellum, dorsal view. Fig. 2, male genital capsule, lateral view. Fig. 3, valve, genital plates, and styles, ventral view. Fig. 4, paraphysis, dorsal view. Fig. 5, female seventh sternum, ventral view. All drawn to the same scale, which equals one mm.

Type Data: Holotype male: Colombia: Valle del Cauca, PNN farallones de Cali, 3°26' N 76°48' W, 650 m., Malaise, XII-19-2000-I-2-2001, S. Sarria, M 1543 (IHVL). Paratypes: One male, same as holotype, except 730 m., VIII-1-X-10-2000, M 1104 (IHVL); one male, same as holotype, except 650 m., III-13-27-2001, M 1527 (IHVL); one male, same as holotype, except 650 m., I-2-16-2001, M 1544 (IHVL); one male, same data as holotype, except 730 m., V-8-VI-19-2001, M 1893 (UKYL); one male, same data as holotype, except 730 m., II-27-III-27-2001, M 1538 (UKYL); one female, same data as holotype, except 730 m., I-30-II-13-2001, M 1538 (IHVL); and one female, same data as holotype, except 650 m., Anchicaya, IX-11-X-16-2001, M 2866 (UKYL).

Additional Specimens: One male, Colombia: Cauca, PNN Gorgona, El Saman, 2°58' N 78°W, 5 m., Malaise, I-30-II-14-2002, R. Dugue, M 3086 (IHVL); one female, same data, except III-6-22-2001, H. Torres, M 1476 (IHVL).

Notes: This is the only species of this genus known from South America. Another species is now known from Costa Rica and will be described later. All species previous to this were all known from the two islands of Cuba and Hispaniola.

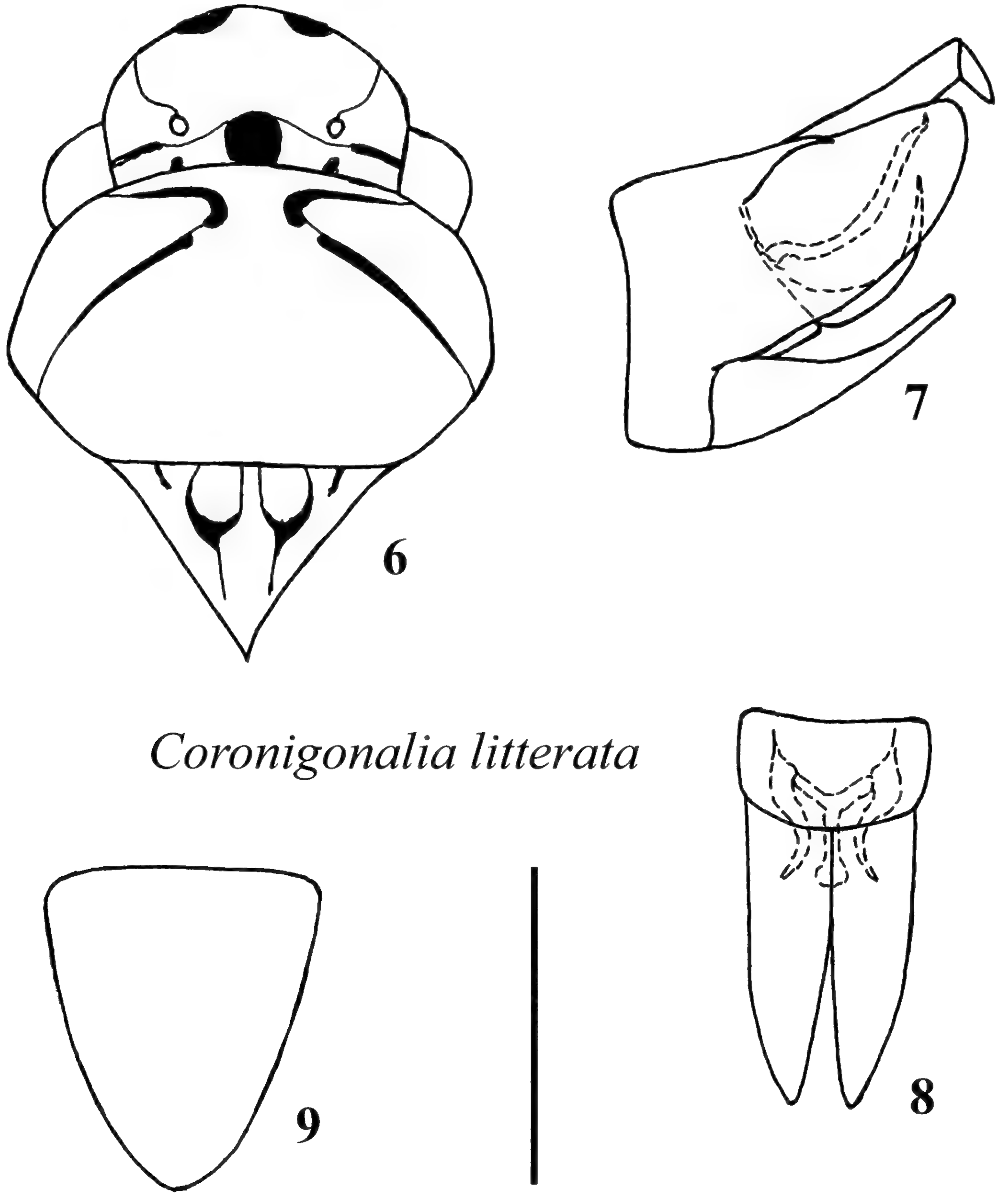
Coronigonalia litterata Freytag, new species
(Figures 6-9)

Description: Length of males 6.1-6.2 mm., females 6.1-6.4 mm. Similar to *spectanda*, except slightly different color pattern, and different male genitalia. Femoral setal formula 2-1-1. Forewing with three antiapical cells. Hind tibia with black setae as in spectanda. Head (Fig. 6) similar to *spectanda* except black pattern indicated only by spots and thinner lines; face with small, nearly square, black spot on dorsal median part of clypeus, extending over margin to appear as a black median spot in dorsal view. Male genitalia: Pygofer (Fig. 7) narrowing to rounded apex, with a dorsal, basal process extending less then half length of pygofer. Genital plate (Figs. 7-8) shorter than pygofer, triangular in lateral view, nearly same width two-thirds length, then narrowing to apex, in ventral view. Connective (Fig. 8) t-shaped, stem longer then basal arms, enlarged near apex of stem. Style (Fig. 8) nearly same length as connective, narrow, curved to pointed apex. Paraphysis (Fig. 7) broad at base, bifurcate, narrowing, curving dorsad to pointed apex, in lateral view. Aedeagus (Fig. 7) long, narrow, curving at base, curving at apex to sharp point. Female genitalia: Seventh sternum (Fig. 9) narrowing to rounded apex.

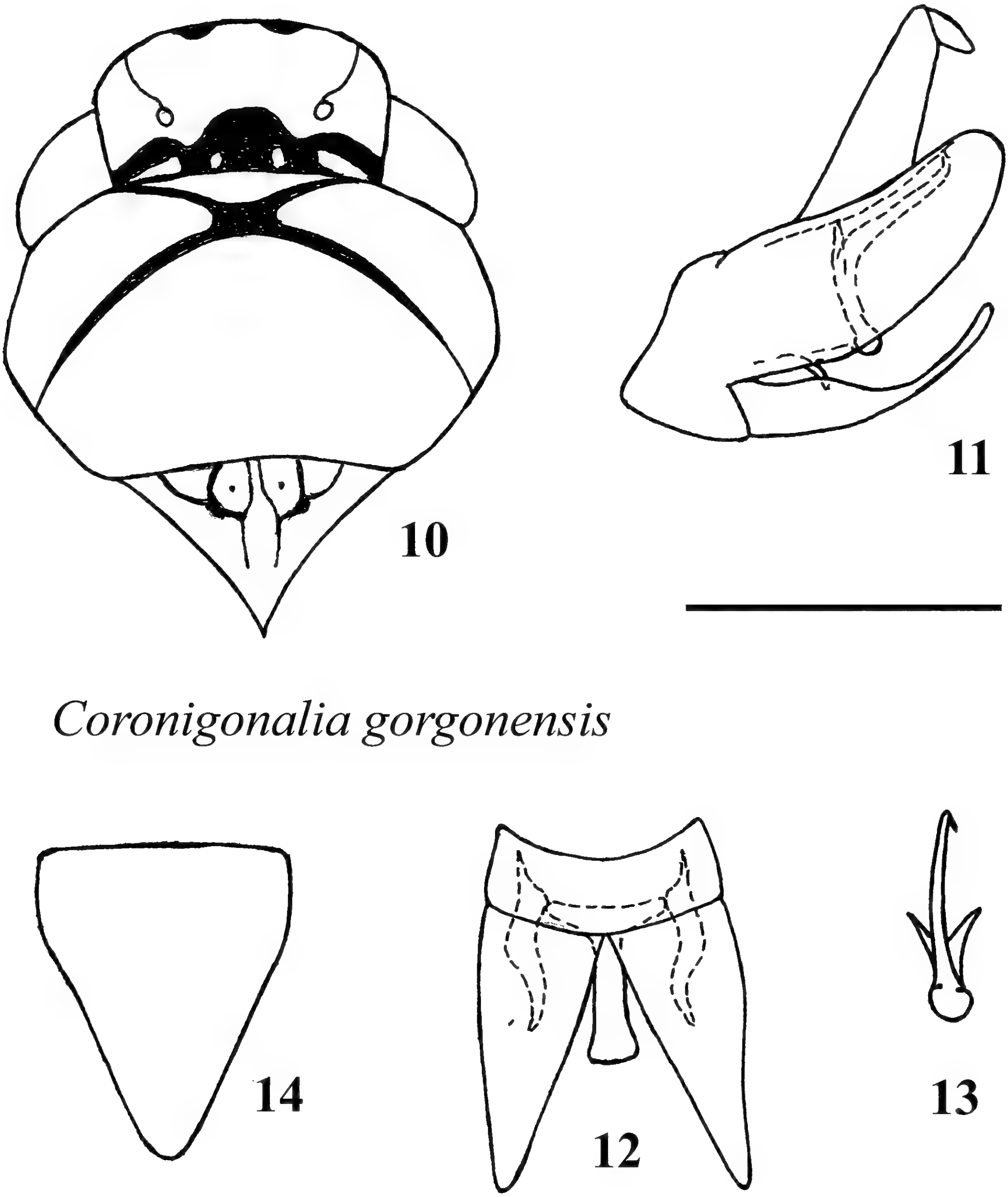
Type Data: Holotype male: Colombia: Valle del Cauca, PNN Farallanes de Cali, 3°26' N 76°48' W, 650 m., Malaise, VII-18-VIII-1-2000, S. Sarria, M 1102 (IHVL). Paratypes: One female, same data as holotype, except 730 m., VIII-1-X-10-2000, M 1104 (IHVL); one female, same data as holotype, except 730 m., X-10-25-2000, M 1107 (IHVL); one female, same data as holotype, except 730 m., II-13-27-2001, M 1530 (IHVL); one female, same data as holotype, except II-27-III-27-2001, M 1536 (IHVL); one female, same data as holotype, except

730 mm., II-27-III-27-2001, M 1538 (UKYL); one female, same data as holotype, except 730 mm., IV-24-V-8-2001, M 1898 (UKYL): one male, same data as holotype, except Anchicaya, 900 m., VII-17-31-2001, M 2836 (UKYL); one female, same data as last, except 650 m., VIII-28-IX-11-2001, M 2863 (UKYL); and one female, same data, except 730 m., IX-11-X-16-2001, M 2867 (UKYL).

Notes: This species is named for the coastal area that this species comes from. It differs from the known species by the short process on the male pygofer, and the long narrow aedeagus.



Figures 6-9. *Coronigonalia litterata* n. sp. Fig. 6, head, pronotum and scutellum, dorsal view. Fig. 7, male genital capsule, lateral view. Fig. 8, valve, genital plates, connective and styles, ventral view. Fig. 9, female seventh sternum, ventral view. All drawn to the same scale, which equals one mm.



Figures 10-14. *Coronigonalia gorgonensis* n. sp. Fig. 10, head, pronotum and scutellum, dorsal view. Fig. 11, male genital capsule, lateral view. Fig. 12, valve, genital plates, connective and styles, ventral view. Fig. 13, aedeagus, caudal view. Fig. 14, female seventh sternum, ventral view. All drawn to the same scale, which equals one mm.

Coronigonalia gorgonensis Freytag, new species

(Figures 10-14)

Description: Length of males 6-6.2 mm., females 6-6.2 mm. Similar to *litterata*, but with different male genitalia. Femoral setal formula 2-1-1. Forewing with three antiapical cells. Hind tibia not having black setae as in *spectanda*, but with dark brown setae. Head (Fig. 10) orange fading to yellow on clypeus and beak; crown behind ocelli mostly black with four smaller spots of yellow, face with median, large, black spot extending over anterior margin as two rounded areas. Pronotum with large median, posterior area, and transverse band along anterior margin, grayish green, outlined in black; anterior lateral areas, orange. Forewing mostly greenish to brown, with costal area, orange. Abdomen reddish orange dorsally, orange ventrally. Legs and thoracic plural areas mostly yellow. Male genitalia: Pygofer (Fig. 11) long, narrowing at rounded apex, with dorsal process coming from base, long, narrow, sharply pointed, extending to near apex of pygofer. Genital plate (Figs. 11-12) triangular, in ventral view, narrowing near middle then extending to small apex, in lateral view. Connective (Fig. 12) t-shaped, robust. Style (Fig. 12) nearly length of connective, sinuate, acute at apex. Paraphysis vestigial. Aedeagus (Fig. 11 and 13) long, bending caudad near middle, thin, with dorsally pointed hook at apex. Female genitalia: Seventh sternum (Fig. 14) narrowing from base to narrow, rounded apex.

Type Data: Holotype male: Colombia: Cauca, Isla Gorgona, III-1-5-2000, Malaise trap, B. Brown, G. Kung, and M. Sharkey (IHVL). Paratypes: Two males and twelve females, same data as holotype (IHVL and UKYL).

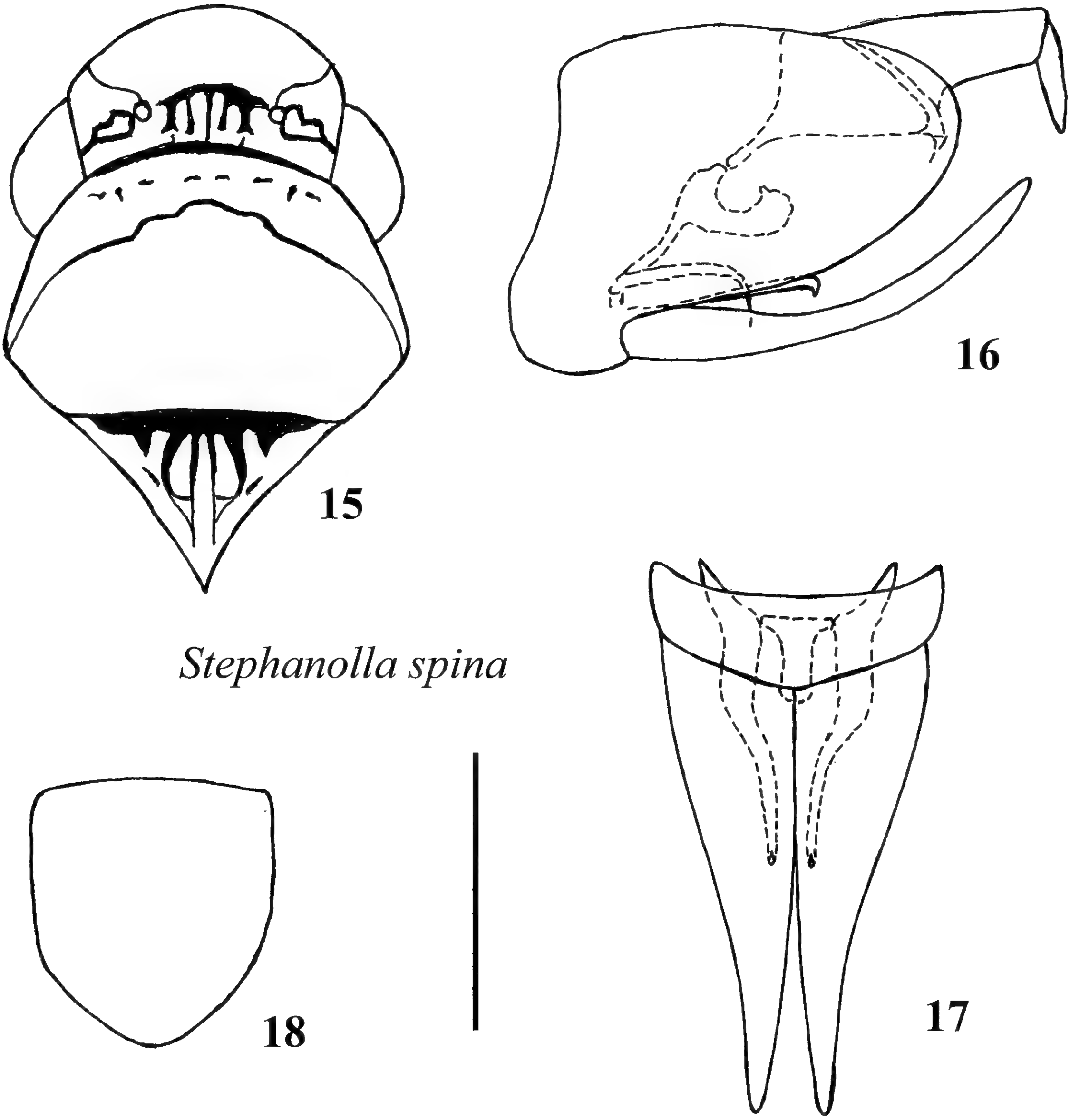
Additional Specimens: Some 595 specimens from Gorgona Island, from the time the types were collected to 2002, from nearly all times of the year (IHVL and UKYL).

Notes: This is a very common species on Gorgona Island, but has not been collected on the mainland. It differs from all other species in the genus by not having a male paraphysis.

Stephanolla spina Freytag, new species

(Figures 15-18)

Description: Length of males 6.3-6.6 mm., females 6.5-6.6 mm. Similar to *rufoapicata* and *remota*, but with different male genitalia. Head (Fig. 15) with crown orange anterior to ocelli, with black median spot on anterior margin, posterior to ocelli, black, with yellow spots and lines; face yellow, with a black, median line or spot below black spot on margin. Pronotum green, with black markings along anterior margin, lateral margins banded with orange, plural area yellow with median black spot. Scutellum yellow patterned with black. Forewings green, with costal margin orange. Abdomen with ventral surface, whitish yellow, dorsal surface red. Legs whitish yellow. Male genitalia: Pygofer (Fig. 16) broad, rounded at apex. Anal tube (Fig. 16) with a median sclaratized brase which extends as a median pointed spine on ventral margin. Genital plate (Figs. 16-17) longer than pygofer, narrowing to nearly pointed apex. Connective (Fig. 17) short, with very short basal arms. Paraphysis (Fig. 16) long, spine-like, bending ventrad near apex. Aedeagus (Fig. 16) short, stocky, with small dorsal process. Female genitalia: Seventh sternum (Fig. 18) nearly same width as length, with rounded apex.



Figures 15-18. *Stephanolla spina* n. sp. Fig. 15, head, pronotum and scutellum, dorsal view. Fig. 16, male genital capsule, lateral view. Fig. 17, valve, genital plates, connective and styles, ventral view. Fig. 18, female seventh sternum, ventral view. Scale equals one mm. for Figs. 15 and 18, and equals one half mm. for Figs. 16-17.

Type Data: Holotype male: Colombia: Valle del Cauca, PNN Farallores de Cali, 3°26' N 76°48' W., 730 m., Malaise, X-10-25-2000, S. Sarria, M 1107 (IHVL). Paratypes: One female, same data as holotype, except VII-18-VIII-1-2000, M 1101 (IHVL); two females, same data as holotype, except 650 m., VII-18-VIII-1-2000, M 1102 (IHVL and UKYL); one female, same data as holotype, except 650 m., VIII-1-X-10-2000, M 1103 (IHVL); one female, same data as holotype, except VIII-1-X10-2000, M 1104 (IHVL); one female, same data as holotype, except 650 m., X-10-25-2000, M 1106 (IHVL); one female, same data as holotype, except 900 m., X-10-25-2000, M 1108 (IHVL); two males, same data as holotype, except 650 m., X-25-XI-8-2000, M 1109 (IHVL and UKYL); and one male, same data as holotype, except X-25-XI-8-2000, M 1110 (IHVL).

Additional Specimens: Four males and six females, same data as holotype, except collected after the type series (IHVL and UKYL).

Notes: This species is named for the spine-like male paraphysis. It looks much like the other species of this genus, but has very distinct male genitalia.

ACKNOWLEDGMENTS

I thank Michael J. Sharkey, Department of Entomology, University of Kentucky, for making the specimens available to me through his National Science Foundation Grant No. 0205982.

LITERATURE CITED

Young, D. A. 1977. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 2. New World Cicadellini and the genus *Cicadella*. North Carolina Agricultural Experiment Station Bulletin 239, 1135 pp.

DESCRIPTIONS OF A NEW SPECIES OF *OXYCERA* MEIGEN AND THE MALE OF *O. LII* YANG AND NAGATOMI FROM SOUTHWESTERN CHINA (DIPTERA: STRATIOMYIDAE)[1]

Zaihua Yang,[2] Maofa Yang,[3] and Lianmeng Wei[4]

ABSTRACT: *Oxycera guizhouensis* sp. nov. from Guizhou Province and the male of *O. lii* Yang and Nagatomi from Sichuan and Yunnan Provinces are described. All essential diagnostic characters are figured and possible relationships of both taxa are briefly discussed.

KEY WORDS: Diptera, Stratiomyidae, *Oxycera*, new species, *Oxycera lii*, China

A review of the Chinese *Oxycera* species, including 13 species, was published by Yang and Nagatomi (1993). The number of the ascertained species corresponds with the recent world catalogue of the family (Woodley 2001), but this is likely to increase, e.g. at least the occurrence of some species from Japan (cf. Nagatomi et al., 2001), eastern Russia (Pleske 1925, Szilády 1941) and even from the Oriental Region (Brunetti 1920, 1923, Kertész 1923, Séguy 1934) may be expected in China. During recent study, we discovered a new species which is described here as *O. guizhouensis* sp. nov. Also, we discovered the male of *O. lii* Yang and Nagatomi (1993). The number of Chinese *Oxycera* species is now 14.

SYSTEMIC ENTOMOLOGY

Oxycera lii Yang and Nagatomi, 1993

Description of the adult male

(Figs. 1-8)

Description: Male: body length 3.5 mm, wing length 3.0 mm.

Head hemispherical, wholly shining black, about 1.1 times higher than long in profile and 1.4 times higher than broad in frontal view. Hairs on head pale, ocellar tubercle and a longitudinal line between eyes without hairs. Eyes almost bare, brown, slightly darker in lower part. In frontal view, width of one eye as long as half distance from antenna to median ocellus and equal to width of frons just above antenna or 2/3 of face width at lowest point. Ocellar tubercle 1.5 times longer than width, upper frontal triangle in front of medial ocellus half as broad as ocellar tubercle. Distance from antenna to medial ocellus twice as long as dis-

---

[1] Received on April 11, 2007. Accepted on May 20, 2007.

[2] Key Laboratory for Plant Pest Management of Mountainous Region, Guizhou Province. Institute of Entomology, Guizhou University, Guiyang 550025, P.R. China. Email: yangzaihua008@126.com.

[3] Key Laboratory for Plant Pest Management of Mountainous Region, Guizhou Province. Institute of Entomology, Guizhou University, Guiyang 550025, P.R. China. Email: yangmaofa68@hotmail.com Corresponding author.

[4] Guizhou Anshun Center for Disease Control and Prevention, Anshun 561000 P. R. China. Email: wlmcdc@126.com.

Mailed on May 14, 2008

tance between antenna and proboscis. Antennae (Fig. 2) yellowish brown, scape and pedicel cup-shaped, with sparse yellow hairs, flagellum black with pale pubescence, round sensory pits well visible, arista subapical. Relative length of two basal antennal segments and flagellum (without arista) as 1:1.2:3 and their relative width as 1:2:2. Arista about as long as rest of flagellum. Face black, with dense pale lateral hairs on upper part, middle hairs sparse. Underside of head with long hairs. Clypeus 1.7 times as long as width, about as wide as lowest face. Proboscis yellow, with sparse yellow pile.

Thorax (Fig. 4): mostly black, with shining and pale hairs; postpronotal calli yellow; scutum with two pairs of small yellow median spots, lateral spot in front of each wing and one pair of yellow spots on postalar calli, anepisternum mostly yellow. Scutellum (Fig. 3) yellow, with yellow hairs, spines slightly divergent, yellowish brown and black on tip, about 1.5 times longer than scutellum. Wing slightly yellowish brown, without vein R_4, veins wanting at posterior margin. Leg yellowish brown, only hind tibia, mid and hind 3, 4 tarsomeres dark brown. Haltere stem yellowish brown to brown, knob yellow.

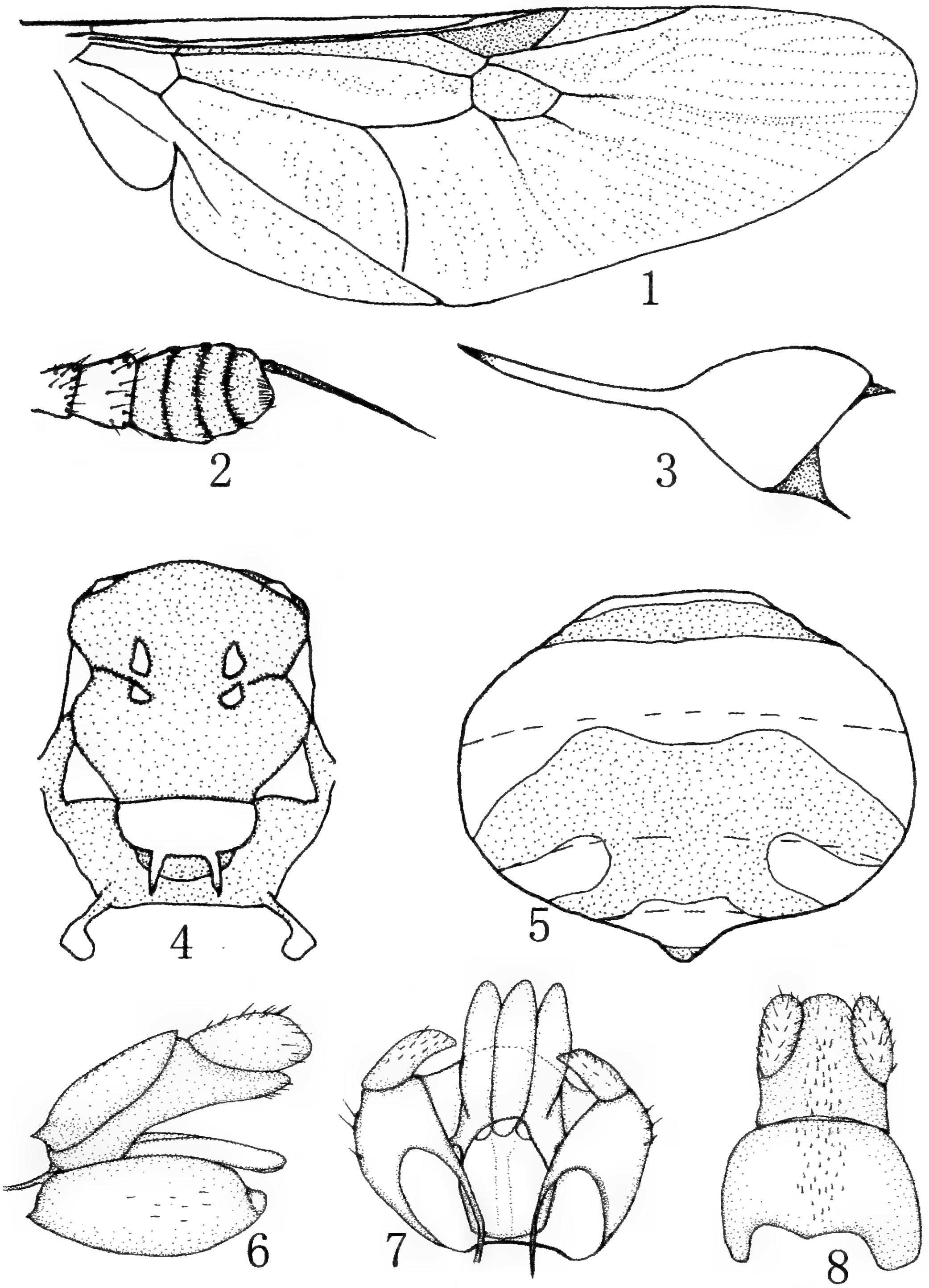
Abdomen. Dorsum dark with yellow pattern, pale haired; tergite 1 black with a narrowly yellow anterior margin, tergites 3-4 with a larger X-shaped black spot, remains of dorsum yellow but black apically (Fig. 5); venter wholly black. Male genitalia species-specific (Figs. 6-8): posterior margin of genital capsule convex, not bilobed, cerci relively short and broad in lateral view, gonocoxal apodemes overreaching proximal margin of genital capsule. Aedeagal complex relatively larger, trifid, all three tubes almost parallel-sided.

Female described in detail by *O. lii* Yang and Nagatomi, 1993.

Material examined (2♂♂): 1♂, Kangding (2700m), Sichuan Province, 10.VIII. 2005; 1♂, Nanping (2500m), Yunnan Province, 14.VIII. 2006; Tang Yi leg.

Distribution: Yunnan, Guizhou, Sichuan.

Remarks. The female holotype was collected at Huaxi, Guizhou Province and the species is thus known to occur in the three Chinese Provinces – Guizhou, Sichuan, and Yunnan. Both sexes are characterized by the unique feature among the Chinese *Oxycera* species, i.e. the absence of the vein R_4 on the wing (Fig. 1). Also the shape of the antenna and the pattern of the thorax are very similar, with yellow postpronotal calli, four symmetrical yellow median spots near the transverse suture, lateral spots just in front of suture and yellow spots on postalar calli (Fig. 4). The scutellum is apparently yellow in the male and darkened in the basal half of the female, the yellow poster-upper part of the female anepisternum is distinctly extended in the male. The legs are predominantly yellow though rather yellowish brown in the male, but the broad median part of the female hind tibia is somewhat darker. In the female the yellow abdominal pattern consists of the central spot on tergite 2, two pairs of oblique lateral markings on tergites 3 and 4, and an apical spot. All these spots are well separated in the female but the central spot and the lateral spots on tergite 3 are fused into a broad transverse band occupying all tergite 2 and large area of tergite 3 in the male (Fig. 5). The male genitalia differs from all the other known males in the target area by the shape of the posterior margin of the genital capsule, which is simply convex, without any medial incision (Fig. 7).



Figures 1-8: *Oxycera lii,* male: 1. wing; 2. antenna, inner view; 3. spine of scutellum, lateral view; 4. thorax, dorsal view; 5. abdomen, dorsal view; 6. genitalia, lateral view; 7. genital capsule and aedeagal complex, dorsal view; 8. cerci, proctiger and epandrium, dorsal view.

Oxycera guizhouensis sp. nov.
(Figs. 9-16)

Description: Male: body length 6.5 mm, wing length 5.0 mm.

Head elliptical in frontal view, shining black, with pale hairs, but ocellar tubercle and a longitudinal line between eyes without hairs. Eyes brown, with sparse but distinct hairs. Head 1.3 times higher than long in profile and twice wider than high in frontal view; width of one eye at mid line 1.4 times as long as distance from antenna to median ocellus in frontal view, or twice as long as width of frons just above antenna, or 1.2 times as long as face at lowest point in frontal view. Ocellar triangle 1.3 times longer than width; upper frontal triangle distinct, half as broad as ocellar triangle; distance from antenna to median ocellus 1.6 times longer than distance from antenna to proboscis. Frontal triangle and upper face with dense pale tomentum laterally. Antenna: yellowish brown to dark brown, scape and pedicel cup-shaped, with sparse brown hairs, flagellum tinged with yellowish brown. Relative length of two basal antennal segments and flagellum (except arista) as 1:1:2 and their relative width as 1:1.8:1.8; arista twice as long as rest of flagellum. Palpus black, distinctly one-segmented; proboscis yellow, with sparse long yellow hairs. Clypeus 1.7 times as long as wide, about width of the lowest face.

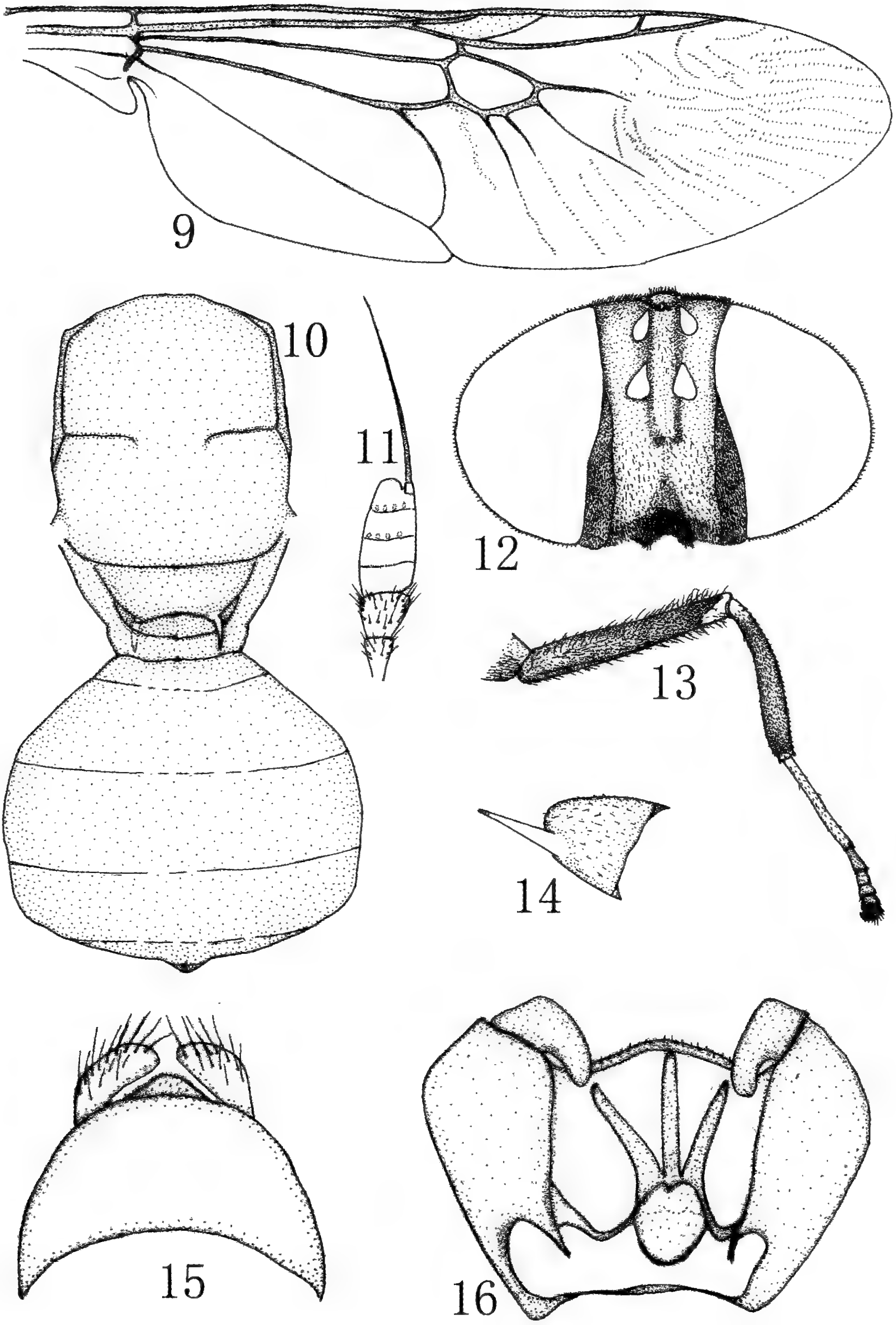
Thorax (Fig. 10): wholly black, with pale hairs. Scutellum (Fig. 14) black, spines on scutellum yellowish brown but black on tip; spines as long as 2/3 of scutellum. Wing hyaline, veins brown; distance from R_{2+3} to R_4 is 1.3 times of distance from R_4 to R_5. Legs haired and black but apices of femora yellowish brown, both ends of tibiae yellowish brown and mid and hind 1-2 tarsomeres white with darkened apex. Haltere stem yellow brown, knob creamy green.

Abdomen (Fig. 10): wholly black, with pale hairs, Male genitalia species-specific (Figs. 15-16): Aedeagal complex divided, relatively short and thin.

Female: body length 6.4 mm, wing length 5.4 mm. Similar to male except as follows: Head pale haired; eyes widely separated, with broader postocular rim which is wholly black. Frons with two pairs of yellow spots, the upper spots close to ocellar tubercle (Fig. 12). Width of one eye at mid line 0.8-0.9 as long as distance from antenna to median ocellus in frontal view, or 1.1 as long as frons just above antenna, or 0.7 as long as width of face at lowest point in frontal view. Ocellar triangle as long as width; width of frons above antenna from frontal view is 2.2 times longer than width of ocellar tubercle; clypeus 1.3 times longer than width, about as wide as lowest face. Thorax: Postpronotal calli with a pair of small yellow spots; spines on scutellum vestigial, only with a pair of dark brown spots.

Type Data: Holotype ♂, paratype 1♀, Maolan (600-650m), Guizhou Province, 14. VI. 2006, Yang Zaihua leg, deposited in Institute of Entomology, Guizhou University.

Etymology: The name refers to the type locality.



Figs. 9-16: *Oxycera guizhouensis* sp. nov.; 9. wing; 10. thorax and abdomen, dorsal view; 11. antenna, inner view,♂; 12. head, frontal view,♀; 13. hind leg, inner view; 14. spine of scutellum, lateral view♂; 15.♂ cerci, proctiger and epandrium, dorsal view; 16. ♂ genitalia, dorsal view.

Remarks: *O. guizhouensis* sp. nov. resembles by its predominantly black body colour and hyaline wing membrane especially *O. chikuni* Yang and Nagatomi, 1993, and *O. guangxiensis* Yang and Nagatomi, 1993, known from China and *O. kusigematii* Nagatomi, 1977, described from Japan. The male of *O. chikuni* is not known and the female differs by the elongate yellow spot at the upper part of the postocular rim and the colour of the femora being predominantly yellow with a median darkened ring whereas the postocular rim of the new species is completely black and the femora are predominantly dark. The essential difference of *O. guizhouensis* sp. nov. from both rest species may be demonstrated by the species-specific characters of the male genitalia (Figs. 15-16): the posterior margin of the genital capsule is slightly convex, the gonostyli are relatively slender and the gonocoxal apodemes very short. The tubes of the trifid aedeagal complex are unusually slender and markedly divergent.

ACKNOWLEDGEMENTS

We are very grateful to Prof. Rudolf Rozkosny, Masaryk University (Czech Republic) and Prof. Ding Yang, China Agriculture University, for their help in many ways.

LITERATURE CITED

Brunetti, E. 1920. Diptera Brachycera. Volume I. *In,* A. E. Shipley (Editor). The fauna of British India, including Ceylon and Burma. Taylor and Francis. London, England, United Kingdom. i-x, 1-401.

Brunetti, E. 1923. Second revision of the Oriental Stratiomyidae. Records of the Indian Museum 25(1): 45-180.

Kertesz, K. 1923. Vorarbeiten zu einer Monographie der Notacanthen. XLV-L. Annales Historico-Naturales Musei Nationalis Hungarici 20: 85-129.

Nagatomi, A., M. Sutou, and N. Tamaki. 2001. Synopsis of Japanese *Oxycera* (Diptera, Stratiomyidae). Entmological Science 4(4): 523-531.

Pleske, T. 1925. Etudes sur les Stratiomyidae de la region palearctique. III. –Revue des especes palearctiques des sous-famille des Clitellariinae. Encyclopedie Entomologique, Serie B (II), Diptera 1(3-4): 105-119.

Séguy, E. 1934. Dipteres de Chine de la collection de M. J. Hervé-Bazin. Encyclopedie Entomologique, Série B(II), Diptera 7: 1-28.

Szilády, Z. 1941. Paläarktische Stratiomyiden. Annales Historico-Naturales Musei Nationalis Hungarici 34 (Pars Zoologica): 88-101.

Woodley, N. M. 2001. A world catalog of the Stratiomyidae (Insecta: Diptera). Myia 11: 1-475.

Yang, D. and A. Nagatomi. 1993. The Chinese Oxycera (Diptera: Stratiomyidae). South Pacific Study 13(2): 131-160.

THE GENUS *MATRATINEA* IS NEW TO CHINA, WITH DESCRIPTIONS OF TWO NEW SPECIES (LEPIDOPTERA: TINEIDAE)[1]

Yunli Xiao[2, 3] and Houhun Li[2]

ABSTRACT: The genus *Matratinea* Sziráki, 1990 is recorded for the first time from China. Two new species are described based on the specimens collected from Hubei, Fujian and Gansu provinces of China. The photographs of the adults and the male genitalia as well as the drawings of the venations are provided. A key to the species of the genus is given.

KEY WORDS: Lepidoptera, Tineidae, *Matratinea*, new species, China

György Sziráki (1990) established the genus *Matratinea* on a basis of the specimens collected by G. Szöcs from Hungary. The genus is superficially similar to *Infurcitinea* Spuler, 1910, *Eudarcia* Clemens, 1860 (partim-as *Meessia* Hoffmann, 1898) and *Agnathosia* Amsel, 1954, but possesses a unique genital structure — the process originated from the costa of the valva bearing a row of tubular pecten at apex. In this study, we report the genus for the first time from China and add two new species to *Matratinea* based on the examination of the specimens collected from China. The generic diagnosis is emended according to the descriptions of the male.

The type specimens are deposited in the Insect Collection, College of Life Sciences, Nankai University, Tianjin, China.

SYSTEMATIC ENTOMOLOGY

Matratinea Sziráki, 1990

Matratinea Sziráki, 1990: 193.

Type species: *Matratinea rufulicaput* Sziráki and Szöcs, 1990

Head covered with erect piliform scales. Labial palpi slender, projecting; second segment carrying sparse lateral bristles. Maxillary palpi five-segmented, folded. Antennae about 0.7-0.9 times length of forewings; scape with pecten; each flagellar segment covered with one annulus of narrow scales; cilia with length about equal to diameter of flagellomere.

Wings: Forewings with width about 0.25 times of length; apex pointed or obtusely pointed; Sc reaching 3/7 of costal margin, R_5 terminated in costal margin, 2A inconspicuous; white or ocherous-white with dark brown spots and streaks, or dark brown with yellow spots and streaks. Hindwings with width about 0.26-0.29 times of length; apex pointed; $Sc+R_1$ reaching 3/5 of costal margin, Rs terminated in costal margin. Fore tibia with epiphysis; hind tibia with medial spurs located at basal 1/3.

Abdomen: First segment with tergum lacking any sclerotized structure in sclerotized frame, narrowly fused with second segmental tergum in middle. Second segment with sternum somewhat rectangular, sometimes concave on posterior margin;

---

[1] Received on April 6, 2007. Accepted on June 19, 2007.

[2] College of Life Sciences, Nankai University, Tianjin 300071 China. E-mail: lihouhun@nankai.edu.cn. To whom correspondence and reprint requests should be addressed.

[3] College of Life Science and Engineering. Huanggang Normal University, Huanggang 438000 China. E-mail: xiaoyunli0817@126.com.

Mailed on May 14, 2008

tergum somewhat trapezoidal. Eighth segment with anterior margin heavily sclerotized, lateral side possessing one small haired brush.

Male Genitalia: Uncus fused with tegumen, gradually narrowed or subrectangular. Gnathos absent. Valva with one developed process at base or at middle of costa, which carries a pecten of hollow and strongly melanized spines at apex or near apex. Transtilla present; apodemes touching each other at ends. Vinculum broad. Saccus gradually narrowed or slender. Aedeagus curved or straight, with numerous small spiny cornuti.

Female: Unknown.

Distribution: China (Hubei, Fujian, Gansu); Hungary.

Remarks: *Matratinea* is similar to *Agnathosia* Amsel, 1954, superficially, but can be distinguished by the process of the valva possessing a row of tubular pecten; the transtilla bifurcate with apodeme of valva; and the aedeagus with cornuti composed of numerous tiny spines. In *Agnathosia*, the valva lacks the tubular pecten; the transtilla is absent and the aedeagus carries one slender, elongate cornutus.

This genus also resembles *Eudarcia* Clemens, 1860 in male genitalia, but it distinctly differs from the latter in the following aspects: antennae covered by one annulus of narrow scales in each flagellar segment; foretibial epiphysis present; abdomen without glands; process of valva bearing a row of tubular pecten at apex; aedeagus with numerous small spiny cornuti. In *Eudarcia*, each flagellar segment is covered by two anulli of scales; the foretibial epiphysis is absent; in males of many species two conspicuous wrinkled glands open into the pleural membrane close to the sternum of the third abdominal segment; the process of the valva lacks the tubular pecten; the aedeagus bears at least one digitate or spine-like cornutus (Robinson and Nielsen, 1993).

Key to the species of *Matratinea* Sziráki

1. Aedeagus long, without annulus of hairs in distal portion 2
   Aedeagus short, with one annulus of hairs at about distal 1/4 ....
   ....*M. rufulicaput* Sziráki and Szöcs
2. Valva broadly rounded in distal portion, costa with a rectangular process near base
   ....*M. latirotunda* sp. n.
   Valva somewhat triangular in distal 2/5, costa with a digitate process at about 3/5
   ....*M. trilineata* sp. n.

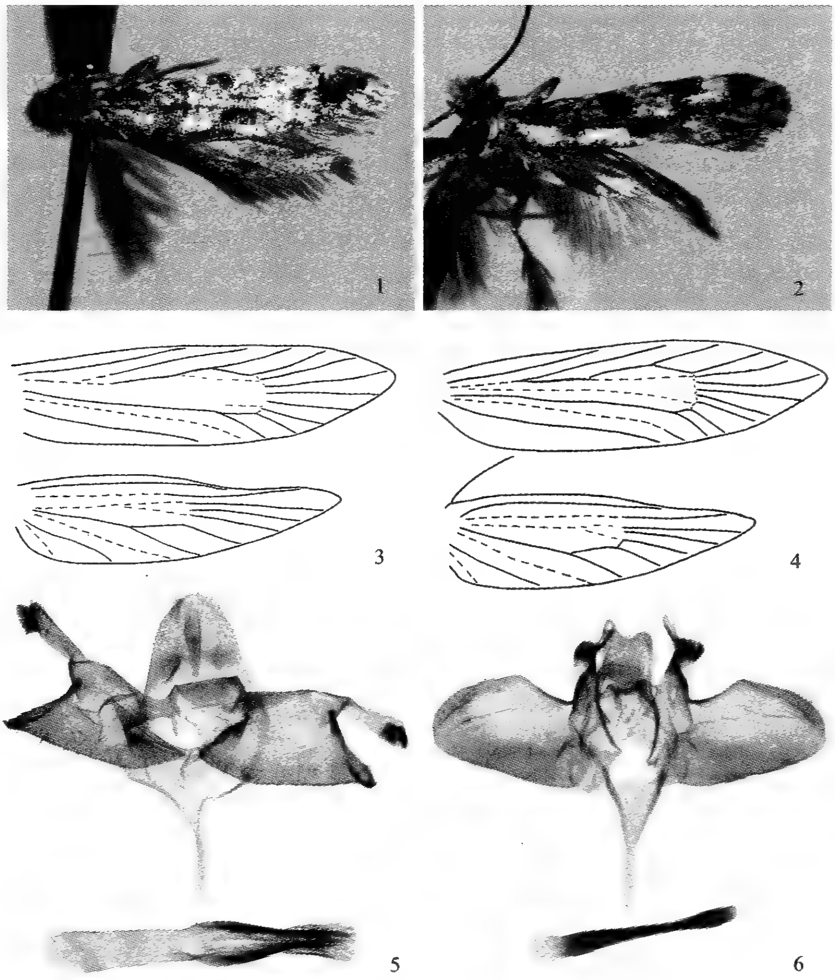
Matratinea trilineata sp. n.

(Figs. 1, 3, 5)

Type Material. Holotype ♂, China: Bifenggou, Wen County (32°58'N, 104° 41'E), Gansu Province, alt. 860 m, 11. Jul. 2005, leg. YU Haili, genitalia slide no. XYL05025. Paratype: 1 ♂, Bajiaomiao, Shennongjia Nature Reserve (31°45'N, 110°40'E), Hubei Province, alt. 1100 m, 19. Jul. 2003, leg. HAO Shulian.

Description (Figs. 1, 3). Wingspan 10.5 mm. Head with piliform scales ocherous yellow except dark brown at apex. Labial palpi ocherous white but ocherous brown at base of third segment. Antennae dark brown; scape ocherous white. Thorax dark brown mixed with ocherous white. Tegulae with anterior half dark brown, posterior half ocherous white. Forewings with basal distance between R_2 and R_3 5.7 x that between R_3 and R_4; ocherous white, with scattered dark brown scales; three inconspicuous dark brown streaks extending from costal 1/3, 2/3, and 3/4 to dorsal margin respectively; large dark brown spot situated at base and between above streaks; cilia ocherous white. Hindwings and cilia grayish white, cilia with length almost equal to width of hindwing.

Male genitalia (Fig. 5): Uncus broad, quadrate or shield-shaped; inflexed in triangle laterally; densely covered with long hairs on inner side, with microtrichia laterally and caudally. Subscaphium inconspicuous or weakly sclerotized, narrowly elongate. Valva with basal 3/5 broad, subrectangular, distal 2/5 subtriangular; apex with a small, pointed, tooth-like process; ventral margin slightly curved; costa curved at 3/5, forming an obtuse angle; costal process originating from about 3/5, elongately digitate, bearing a pecten of 12-15 hollow and strongly melanized spines near apex on ventral margin. Transtilla small; apodemes joined by a broad, weakly sclerotized plate. Vinculum narrow, cestiform. Saccus nearly as long as tegumen, basal 1/3 gradually narrowed, distal 2/3 slender, elongate, pointed at apex. Aedeagus stout and straight, with length about 1.5 x valva, slightly sinuate laterally; cornuti composed of many small spines.



Figs. 1-6. *Matratinea* spp. 1, 3, 5. *Matratinea trilineata* sp. nov.: 1. adult; 3. wing venation; 5. male genitalia (holotype, gen. slide no. XYL05025). 2, 4, 6. *Matratinea latirotunda* sp. nov.: 2. adult; 4. wing venation; 6. male genitalia (holotype, gen. slide no. XYL05080).

Female: Unknown.

Distribution. China (Gansu, Hubei).

Diagnosis. This species is similar to *Matratinea rufulicaput* Sziráki and Szöcs. It can be distinguished by the forewings ocherous white, with three inconspicuous streaks extending from costal margin to dorsal margin; the aedeagus stout and slightly curved laterally, lacking annulus of hairs distally. In the latter species, the forewings are grayish brown, with one conspicuous yellow streak extending from costal margin to dorsum; the aedeagus is long and curved, with one annulus of hairs at about distal 1/4.

Etymology. The specific name is derived from the Latin *trilineatus* (= trilinear), in reference to the forewings with three dark brown, inconspicuous streaks extending from costal margin to dorsum.

Matratinea latirotunda sp. n.

(Figs. 2, 4, 6)

Type Material. Holotype ♂, China: Mt. Wuyi (26°54'N, 116°42'E), Fujian Province, alt. 600 m, 27. May 2004, leg. YU Haili, genitalia slide no. XYL05080. Paratype: 1 ♂, same data as holotype.

Description (Figs. 2, 4). Wingspan 8.5-9.5 mm. Head white, with two small tufts and dark brown piliform scales on vertex and occiput. Labial palpi white on inner side, dark brown on outer side except white apex. Antennae dark brown; scape white. Thorax and tegulae dark brown mixed with white scales, tegulae white on posterior margin. Forewings with distance between R_2 and R_3 at base about 7.5 x that between R_3 and R_4; white; dark brown spot located at base, 2/5, 3/5 and near apex of costal margin respectively, extending to about lower margin of cell, the last two spots joined by a transverse dark brown bridge at distal end; small dark brown spot situated at 1/3 and 3/4 of anal fold and near end of dorsal margin respectively, the last one joined with the above bridge; a discontinuous dark spot placed at apex; cilia dark brown mixed with white. Hindwings gray; cilia grayish white, length almost equal to width of hindwing.

Male genitalia (Fig. 6): Uncus subquadrate, with numerous microtrichia near caudal margin; caudal margin concave in broad V form. Subscaphium weakly sclerotized, somewhat rounded. Valva large and broad, rounded apically; ventral margin nearly straight; costa convex at about middle, costal process near base, rectangular, strongly sclerotized and V-shaped medially, carrying a pecten of about ten hollow and strongly melanized spines and four long, curved spiny hairs at inner end of apex, distally incurved with long hairs. Transtilla slender and elongate, broadly triangular basally; apodemes triangular, joined by a narrow, sclerotized band. Saccus subtriangular in basal half, narrowed in distal half, pointed at apex. Aedeagus straight, slightly longer than length of valva, narrowed medially.

Female: Unknown.

Distribution. China (Fujian).

Diagnosis. This species is similar to *Matratinea trilineata* sp. n. and *M. rufulicaput* Sziráki and Szöcs, 1990. It can be easily recognized by the uncus concave in V-shape on caudal margin; the valva broad and rounded in distal part, and the costa with a rectangular process near base. In the latter two species, the uncus is arched or broadly rounded on caudal margin; the valva is triangular in distal 2/5, and the costa has an elongate, digitate process at about 3/5. In addition, the forewings of the latter two species bear distinctly different patterns of spots or streaks.

Etymology. The specific name is derived from the Latin prefix *lati-* (= broad), and the Latin *rotundus* (= rounded), in reference to the valva with apex broad and rounded.

ACKNOWLEDGEMENTS

We wish to express our thanks to WANG Hongjian, Baishuijiang State Nature Reserve, Wen County, Gansu Province, and WANG Jiashe, Wuyishan Nature Reserve, Fujian Province, for the assistance given in the field. This research was supported by the National Natural Science Foundation of China (No. 30670251 and No. J0630963).

LITERATURE CITED

Robinson, G. S. and G. S. Nielsen. 1993. Tineid genera of Australia (Lepidoptera). Monographs on Australian Lepidoptera 2: i-xvi, 1-344.

Sziráki, G. 1990. Beschreibung einer neuen Tineiden - Gattung und - Art von Ungarn (Lepidoptera). Entomologische Zeitschrift 100 (1): 193-199.

MADELINE BIETZ RECEIVES THE AMERICAN ENTOMOLOGICAL SOCIETY'S CALVERT AWARD

In 1987, the American Entomological Society initiated the Calvert Award to be presented to a young person who has demonstrated outstanding accomplishments in insect-related studies. The Award is named in honor of Dr. Philip P. Calvert, who joined the Society as a teenager, later became its President, and was a member for 74 years. As Professor of Biology at the University of Pennsylvania, Associate of the Academy of Natural Sciences of Philadelphia, and long time Editor of *Entomological News*, Dr. Calvert played an important role in stimulating an interest in insects among young people.

This year, the 22nd Calvert Award was presented to Madeline Bietz, from Philadelphia, Pennsylvania, an eleventh grade student at Springside School. Her project was entitled, "The Effects of Turbulence on Butterfly Flight." Her project was selected from among about 20 insect-related science projects presented at the annual Delaware Valley Science Fairs held on April 2 at the Valley Forge Convention Center. Madeline said she was inspired by spending hours watching butterflies at the Academy of Natural Sciences Living Butterfly Exhibit. The judges for the award were impressed by Madeline's inventiveness and enthusiasm.

Two other students received recognition for their insect-related science projects. These included Matthew Nicewater, an eleventh grade student from Morton, Pennsylvania, whose project, "The More the Merrier?", dealt with the number of termites necessary to sustain a colony for almost six months. He was the first runner-up for the Calvert Award. Second runner-up went to sixth-grader Shyanne Marquette of West Chester, Pennsylvania, for her project, "Mosquito Attraction."

All students were honored at the Calvert Award ceremonies held on April 23 at the Academy of Natural Sciences in Philadelphia. Dr. Susan King, President of the American Entomological Society, presented them with certificates of accomplishment and memberships in the American Entomological Society.

Harold B. White
Department of Chemistry and Biochemistry
University of Delaware, Newark, Delaware 19716 U.S.A.
E-mail: halwhite@udel.edu

SCIENTIFIC NOTE

FIRST RECORD OF THE ASIAN HORNTAIL, *ERIOTREMEX FORMOSANUS* (HYMENOPTERA: SIRICIDAE), IN ARKANSAS, U.S.A.[1]

Michael D. Warriner[2]

A total of 15 species of siricid woodwasps (Hymenoptera: Siricidae) have been recorded from the eastern United States (Smith, 1979, Smith and Schiff, 2002, Hoebeke et al., 2005, Schiff et al., 2006). Three of these species have been accidentally introduced from countries outside of North America. Woodwasps are often inadvertently transported within the wood of crates and pallets. The larvae of most woodwasp species bore within the wood of weakened and dying trees (Smith, 1979). Host preferences of larvae are broadly differentiated along subfamily lines, with Tremicinae associated with angiosperms and Siricinae with gymnosperms (Smith and Schiff, 2002, Schiff et al., 2006). Upon oviposition into woody plant tissues, female woodwasps inject basidiomycetous fungi. Developing larvae feed on the fungi and digested woody tissue (Schiff et al., 2006).

Native to Japan, Laos, Taiwan, and Vietnam (Togashi and Hirashima, 1982, Smith, 1996), *Eriotremex formosanus* (Matsumura), the Asian horntail, was first reported in the United States by Smith (1975) from specimens collected in 1975 from southern Alabama. Later, Smith (1996) reported earlier records for 1974 from Florida and Georgia. *Eriotremex formosanus* has also been recorded from Louisiana, Mississippi, North Carolina, South Carolina, Virginia, and Texas (Smith, 1996). Most occurrences have been from locations along the Atlantic and Gulf Coasts, with a smaller number of records further inland. Given that some of the earliest records for *E. formosanus* in the United States are near military bases, Smith (1996) speculated that heavy traffic between southeastern Asia and the United States during and after World War II may have provided the avenue for this species introduction.

On 6 October 2006, I collected a single female *E. formosanus* from a bottomland hardwood forest within Benson Creek Natural Area, Monroe County, Arkansas. The specimen was found dead on a dying sweetgum (*Liquidambar styraciflua* Linnaeus), its ovipositor firmly sunk into the tree's bark. The specimen was removed and deposited into the University of Arkansas Arthropod Museum. The tree on which this individual was found, had been girdled by chainsaw in August 2006 and was exhibiting signs of stress and insect attack. This record extends the range of *E. formosanus* 370 km (230 miles) inland to the northeast from the nearest published locality in Desoto Parish, Louisiana (Smith, 1996).

---

[1] Received on September 20, 2007. Accepted on October 18, 2007.

[2] Arkansas Natural Heritage Commission, 1500 Tower Building, 323 Center Street, Little Rock, Arkansas 72201 U.S.A. E-mail: michaelw@arkansasheritage.org

Mailed on May 14, 2008

Larval hosts of *E. formosanus* in its native range are currently not known. Its subfamilial inclusion in the Tremicinae suggests it is likely associated with angiosperms. In this country, *E. formosanus* has been recorded primarily from hardwoods with smaller numbers of records from conifer species (Smith, 1996). Like most native woodwasps, this species seems to be associated with dying and dead trees and therefore, probably does not represent a significant economic threat to the wood products industry.

LITERATURE CITED

Hoebeke, E. R., D. A. Haugen, and R. A. Haack. 2005. *Sirex noctilio:* discovery of a Palearctic siricid woodwasp in New York. Newsletter of the Michigan Entomological Society. 50(1–2): 24-25.

Schiff, N. M., S. A. Valley, J. R. LaBonte, and D. R. Smith. 2006. Guide to the siricid woodwasps of North America. USDA Forest Service, Forest Health Technology Enterprise Team. FHTET-2006-15. 102 pp.

Smith, D. R. 1975. *Eriotremex formosanus* (Matsumura), an Asian horntail in North America (Hymenoptera: Siricidae). U.S. Department of Agriculture, Cooperative Economic Insect Report 25(44): 851-854.

Smith, D. R. 1979. Symphyta, pp 3-132. *In,* K. V. Krombein, P.D. Hurd Jr., D. R. Smith, and B. D. Burks, (Editors): Catalog of Hymenoptera in America north of Mexico, Volume 1. Washington, DC: Smithsonian Institution Press. xvi + 1198 pp.

Smith, D. R. 1996. Discovery and spread of the Asian horntail, *Eriotremex formosanus* (Matsumura) (Hymenoptera: Siricidae), in the United States. Journal of Entomological Science. 31(2): 116- 117.

Smith, D. R. and N. M. Schiff. 2002. A review of the siricid woodwasps and their ibaliid parasitoids (Hymenoptera: Siricidae, Ibaliidae) in the Eastern United States, with emphasis on the Mid-Atlantic region. Proceedings of the Entomological Society of Washington. 104: 174-194.

Togashi, I. and Y. Hirashima. 1982. Wood-wasps or horn-tails of the Amami-Oshima Island, with description of a new species (Hymenoptera: Siricoidea). Esakia 19:185-189.

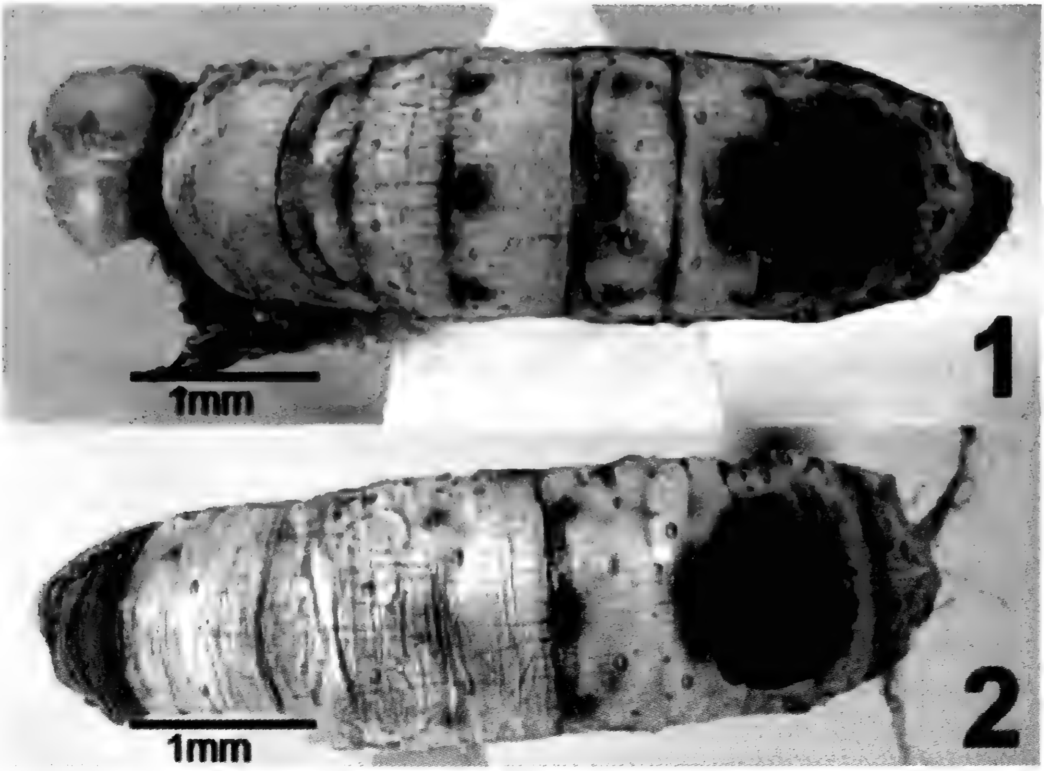
The inside front and back covers of *Entomological News* 119(1) were not printed. The Editor and Dover Litho Printing Company regret this oversight.

SCIENTIFIC NOTE

THE FIRST HOST ASSOCIATION FOR *ALEIODES SHAWI* (HYMENOPTERA: BRACONIDAE: ROGADINAE)[1]

Joseph C. Fortier[2]

Aleiodes Wesmael is a large group of parasitoid wasps, comprising about 220 described species worldwide, and found on every continent except Antarctica. As with other members of the braconid tribe Rogadini, they are koinobiont endoparasitoids of Lepidoptera that mummify the host larva when it dies, and pupate inside the mummy. The mummy is composed of the larval host's skin, which hardens and darkens into a characteristically shaped structure (Figs. 1, 2), often lined inside with a silken cocoon (Shaw and Huddleston 1991). Before it pupates, the larva usually cuts through the ventral thoracic region of the host mummy and glues the mummy to a substrate (usually leaf or twig). The adult *Aleiodes'* exit hole is round and positioned in the dorso-posterior area of the mummy (Shaw 1997) (Figs. 1, 2).



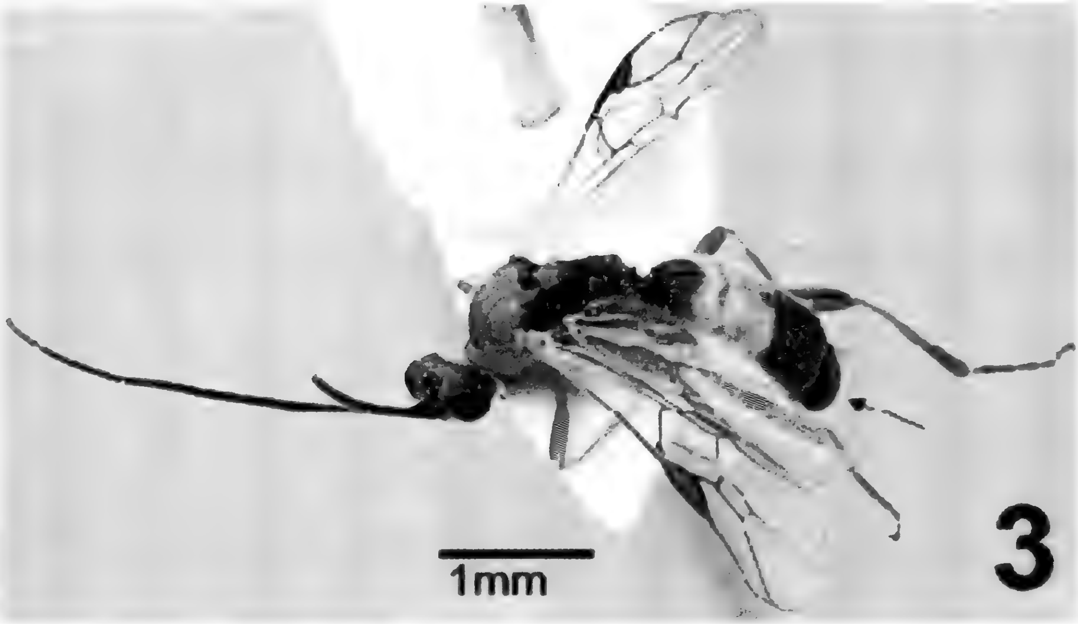
Figures 1-2. Mummied host remains of *Aleiodes shawi*. 1. host remains of holotype; 2. host remains of geometrid *Semiothisa aemulataria* (Common Angle), collected from boxelder (*Acer negundo*), from which an *A. shawi* individual emerged.

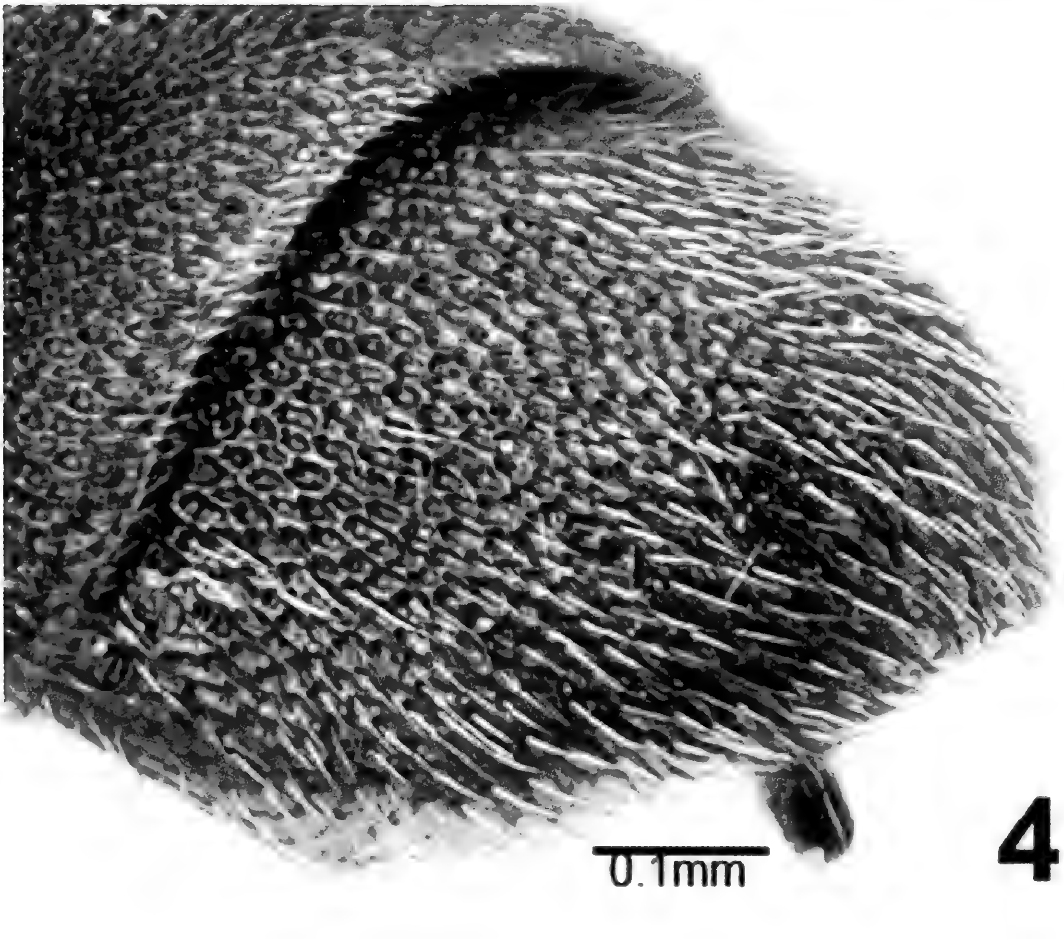
---

[1] Received on May 7, 2007. Accepted on May 30, 2007.

[2] Department of Biology, Saint Louis University, 3507 Laclede Avenue, Saint Louis, Missouri 63013 U.S.A. E-mail: Fortier@slu.edu.

Mailed on May 14, 2008





Figures 3-4. 3. *Aleiodes shawi* individual that emerged from the mummy illustrated in Fig. 2. Metasomal tergite IV is indicated by arrow. 4. *Aleiodes shawi* metasomal tergite IV.

The *Aleiodes pilosus* (Cresson) species-group, to which *Aleiodes shawi* Fortier (2007) belongs, is a monophyletic group supported by one autapomorphy, the carapace-like fourth metasomal tergite, which entirely covers all apical tergites (Figs. 3, 4). Presently there are 27 described species (Fortier 2006a, b; Fortier 2007a, b) in the group and many more undescribed species. The species-group occurs exclusively in the Nearctic as far as known. All specimens in the species group that have been examined and that have host associations attack only inchworm caterpillars (Geometridae) (Fortier 2006a, b; Fortier 2007a, b; Fortier, unpublished data). Prior to this study, the holotype of *Aleiodes shawi* was reported as associated with a mummified geometrid host remains (Fig. 1) (Fortier 2007a). The mummy was collected from redbud (Fabaceae: *Cercis* sp.) in northern Arkansas. Recently, a reared specimen of *A. shawi*, collected from Prince Georges County, Maryland, has been discovered. The specimen (Fig. 3) was reared from the geometrid *Semiothisa aemulataria* (Walker) (common name: Common Angle) that was collected from Boxelder (*Acer negundo* L., Aceraceae).

Material Examined: Holotype female: USA: ARKANSAS, Washington Co., Mt. Sequoyah, 600 m, VIII/1-10/1994, ex: mummy on *Cercis* sp., J. B. Whitfield, col.; female: USA: MARYLAND, Prince Georges Co., Calvert Road, VI-12-1996. A.S.C., col. Host plant: *Acer negundo*. Host: geometrid *Semiothisa aemulataria* (Common Angle). Emerged VI-29-1996.

ACKNOWLEDGMENTS

I am grateful to Scott Shaw for loaning me the above material. This research was funded by NSF grant award #0516515.

LITERATURE CITED

Fortier, J. C. 2006a. The first host association for *Aleiodes pilosus* (=*Tetrasphaeropyx* Ashmead) (Hymenoptera: Braconidae: Rogadinae). Entomological News 117(4): 457-459.

Fortier, J. C. 2006b. Twelve new species and a new combination of the *Aleiodes pilosus* species-group (=*Tetrasphaeropyx* Ashmead) in North America: Part 1. Entomological News 117(5): 465-484.

Fortier, J. C. 2007a. Eight new species and a key to species of the *Aleiodes pilosus* species group (=*Tetrasphaeropyx* Ashmead) (Hymenoptera: Braconidae: Rogadinae) in North America: part 2. Entomological News 118(1): 11-30.

Fortier, J. C. 2007b. The Aleiodes pilosus-group species (=Tetrasphaeropyx Ashmead) of Canada, including seven new species and a key (Hymenoptera: Braconidae: Rogadinae). Submitted to Transactions of the American Entomological Society. 133(1+2) (in press).

Shaw, M. R. and T. Huddleston. 1991. Classification and biology of braconid wasps. Handbooks for the identification of British insects. Volume 7, Part II 7: 1-126.

Shaw, S. R. 1997. Pp. 403-408. *In,* Wharton, R. A., P. M. Marsh, and M. J. Sharkey (Editors). Manual of the New World Genera of the Family Braconidae (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. Washington, D.C., U.S.A. 439 pp.

Agreement. By submitting a paper for publication, authors tacitly agree to not submit in parallel the same manuscript to another journal. For published papers, authors agree to accept responsibility for all page, illustration, and requested reprint or .pdf charges. Rejected manuscripts will be discarded.

Scientific Notes and Book Reviews. These are much shorter contributions, typically not exceeding one (Book Review) or two (Scientific Notes) printed pages. The main difference between these types of contributions and longer papers is that scientific notes and book reviews lack an abstract and most of the main headings, except for the acknowledgments and the literature cited sections.

Reviewers. When submitting papers, all authors are requested to provide the names of two qualified individuals who have critically reviewed the manuscript before it is submitted to *Entomological News*. All papers, except book reviews and American Entomological Society business, are forwarded to experts for final review before acceptance. In order to expedite the review process when submitting papers, the authors are also asked to suggest the name, address, and e-mail of at least five published experts in the subject matter of the submitted paper who may be able to review this paper and who has not seen this contribution before. In order to attempt avoiding the appearance of conflict of interests, the suggested reviewers must not share work affiliations with any of the authors. Ideally, the review process should be completed within 30 days. If additional reviews are necessary, authors will be requested to suggest the name, address, and e-mail of other colleagues to whom the article may be sent. The Editor reserves his prerogative of sending the manuscript to other reviewers. Authors are also welcomed to list the names of colleagues to whom the article should not be sent, with a brief explanation. Upon return of reviews, authors will be asked to modify their papers to accommodate suggestions of the reviewers and the Editor as well as to conform to requirements of *Entomological News*. If authors do not modify their papers, they should specifically address, on a point by point basis, why they are not doing that.

Page Proofs. The printer will send page proofs to the Editor and then the proofs will be sent to the corresponding authors as .pdf files. The computer that authors use must be able to receive files of at least 5MB. Within three days, authors must e-mail the proofs to the Editor, with corrections indicated precisely to the page, paragraph, and line. Authors who anticipate being absent are urged to provide forwarding addresses or to provide a temporary address with dates. Proofs not received on time from authors may be published at a later date. The Editor will collect the page proofs and send them to the printer.

Page and Reprint Charges. Contact the Editor for current page and reprint charges. Authors will be mailed invoices for their total page(s) and reprints, including shipping charges. After receiving invoice, please remit payment, or address questions, to the known Office of Publication. Articles longer than 20 printed pages of *Entomological News* may be published in two or more installments, unless the author is willing to pay the entire cost of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

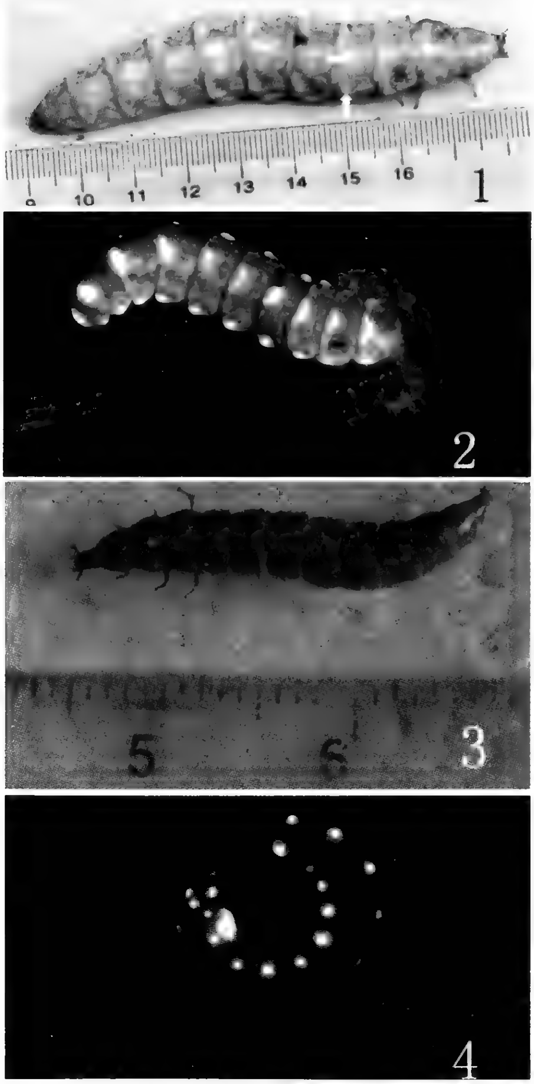
Entomological News is widely indexed. *Entomological News* is listed in the Science Citation Index Expanded (updated on February 26, 2005). In addition, the Ulrich's Periodical Index for 2005 lists *Entomological News* as being indexed by dozens of sources, including Agricola (Agricola (CRIS), Agricultural Engineering Abstracts (AEA), Agroforestry Abstracts (AgrForAb), Aquatic Sciences & Fisheries Abstracts (ASFA), BIOBASE, BiolAb), Biology Digest (BiolDig), BIOSIS Previews (BIOSIS Prev), Chemical Abstracts (ChemAb), Current Awareness in Biological Sciences (BIABS), Current Contents (CurrCont), Field Crop Abstracts (FCA), Faba Bean Abstracts (FaBeAb), Fisheries Review (SFA), Forestry Abstracts (ForAb), Grasslands and Forage Abstracts (HerbAb), Horticultural Science Abstracts (HortAb), Index Veterinarius (indVet), MEDLINE, Nematological Abstracts (NemAb), Nutrition Abstracts and Reviews (NutrAb), Personal Alert (ASCA), Plant Breeding Abstracts (PBA), Post Harvest News and Information (PHN&I), Poultry Abstracts (PoultAb), Protozoological Abstracts (ProtozoAb), Review of Aromatic and Medicinal Plants (RA&MP, Referativnyi Zhurnal (RefZh), Review of Applied Entomology (RevApplEntom), Review of Medical and Veterinary Mycology (RM&VM), Rice Abstracts (RiceAb), Seed Abstracts (SeedAb), Soils & Fertilizers (S&F), Soybean Abstracts (SoyAb), Tropical Diseases Bulletin (TDB), Vitis - Viticulture and Oenology Abstracts (VITIS), Weed Abstracts (WeedAb), Wheat Barley and Triticale Abstracts (TritiAb), Wildlife Review Abstracts (WildRev), Zoological Record (ZoolRec), among others.

Entomological News is printed by Dover Litho Printing Company, 1211 North DuPont Highway, Dover, Delaware 19901 U.S.A. Telephone (302) 678-1211; fax: (302) 678-8091; web page: www.doverlitho.com. Dover Litho has been recognized by DENREC and DELRAP Green Industries as "The Most Environmentally Conscious Printer in the State of Delaware." *Entomological News* is printed on "acid free and archival quality" ... "elemental chlorine free (ECF) or totally chlorine free (TCF)" recycled paper that meets EPA and FTC guidelines for recycled coated papers" (www.storaenso.com/na).

Mailed on May 14, 2008

continued from front cover

AMERICAN ENTOMOLOGICAL SOCETY BUSINESS



Figs. 1-4. 1. Habitus of *Diplocladon* sp (The arrows indicate the luminous organs). Photo by Mr. X.-F. Ma. 2. Luminous *Diplocladon* sp. Photo by Mr. X.-F. Ma. 3. Habitus of *Rhagophthalmus* sp. Larviform female from Northwest of Yunnan. Photo by Dr X.-Y. Li. 4. Luminous *Rhagophthalmus* sp. Larviform female from Northwest of Yunnan. Photo by Mr. Q.-P. Hou.
(See Li and Liang, page 109.)

THE AMERICAN ENTOMOLOGICAL SOCIETY

www.acnatsci.org/hosted/aes

ne 119 Number 3

and June 2008

Entomological News

SCIENTIFIC NOTES

continued on back cover

USISSN 0013-872X

Mailed June 23, 2008

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS
ISSN 0013-872X

Entomological News is a fully refereed scientific international journal published by The American Entomological Society (AES). Manuscripts on systematics, ecology, evolution, morphology, physiology, behavior, biodiversity, conservation, paleobiology, and other aspects of insect and terrestrial arthropod life as well as nomenclature, biographies and history of entomology, among others, are appropriate topics for papers submitted to *Entomological News*. Papers on applied, economic, and regulatory entomology or on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields. In accordance with the spirit and letter of international codes of biological nomenclature, the Editor of *Entomological News* recommends that name-bearing types and representative (voucher) specimens be deposited in collections where such specimens are well curated and available to qualified researchers.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February, and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pennsylvania (U.S.A.), while the October and March meetings are held at the Department of Entomology of the University of Delaware in Newark, Delaware (U.S.A.). Society members who reside in southeastern Pennsylvania, southern New Jersey, and Delaware are urged to attend the meetings whenever possible. Members outside this area as well as guests are cordially invited and welcomed. Information on the Calvert Award for insect-related study by a young person in the Delaware River Valley region sponsored by The American Entomological Society can be found at: http://www.udel.edu/chem/white/Odonata/CalvertAwd.html.

Membership (http://www.ansp.org/hosted/aes/Acrobat/Membership_Form.pdf): Membership to the AES is open to anyone. Annual dues are US$20.00 (regular members) and US$12.00 (student members).

United Stated Postal Service (USPS) Identification Statement: *Entomological News* (ISSN 0013-872X) is published bimonthly, except July-August, by The American Entomological Society. The subscription is not included with the annual dues. The subscription price is US$15.00 per year, prepaid, for members, US$30.00 per year, prepaid for institutional library subscribers located in the U.S.A. and US$34.00 per year, prepaid for institutional library subscribers located out of the U.S.A. Periodicals Postage Paid at Philadelphia, Pennsylvania 19103 U.S.A. and additional mailing offices. The known **Office of Publication** is: Office Manager, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 United States of America. **POSTMASTER:** Send address changes to the Office of Publication.

Subscriptions to current issues, back issues, and microforms of *Entomological News*. Please send inquiries or send completed membership form to the Office of Publication, e-mail: aes@acnatsci.org, or call (215) 561-3978. *Entomological News* is available in microform from ProQuest Information and Learning. Call toll-free (800) 521-3042, (800) 521-0600, (734) 761-4700. Mail inquiry to: ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106-9866 U.S.A. The webpage of ProQuest is: www.proquest.com.

Any author may submit papers. Manuscripts will be accepted from any author, although, papers from members of the American Entomological Society are given priority. Authors are urged to read the guidelines to the authors carefully (http://www.geocities.com/entomologicalnews/intructions.htm) and contact the Editor for any changes that may not have been uploaded. It is suggested that all prospective authors join the AES.

Send manuscripts, books for review, and all editorial correspondence to the Editor. All manuscripts, including scientific notes and book reviews, submitted for publication in *Entomological News* as well as all associated editorial communications must be sent electronically to the Editor, Jorge A. Santiago-Blay at: blayjorge@gmail.com. E-mail is the preferred way to contact the Editor and the fastest way to get a reply. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible.

Previous Editors of *Entomological News*: 1(1) January 1890 and 1(2) February 1890, Eugene Murray Aaron (1852-1940); 1(3) March 1890 to 21(10) December 1910, Henry Skinner (1861-1926); 22(1) January 1911 to 54(9) November 1943, Phillip P. Calvert (1871-1961); 54(10) December 1943 to 57(10) December 1946, Editorial Staff with A. Glenn Richards (1909-1993) and R. G. Schmieder (1898-1967) as co-Editors; 58(1) January 1947 to 79(7) July 1968, R. G. Schmieder; 79(8) October 1968 to 83(10) to December 1972, Ross H. Arnett, Jr. (1919-1999); 84(1) January 1973 to 85(4) April 1974, R. W. Lake; 85(5-6) May & June 1974 to 113(3) May & June 2002, Howard P. Boyd; 113(4) September & October 2002 to 113(5) November & December 2002, F. Christian Thompson and Michael Pogue.

Cover Design by Jane Spencer

Mailed on June 23, 2008

INTRODUCED SPIDERS (ARACHNIDA: ARANEAE) IN AN ARTIFICIAL ECOSYSTEM IN EASTERN CANADA[1]

P. Paquin,[2] N. Dupérré,[3] and S. Labelle[4]

ABSTRACT: Four spider species were found in the artificial tropical ecosystem of the Biodôme de Montréal (Québec, Canada): *Steatoda triangulosa* (Theridiidae), previously reported from Québec and Ontario, *Coleosoma floridanum* (Theridiidae), *Theridion melanostictum* (Theridiidae), and *Scytodes fusca* (Scytodidae), which have never been recorded in Québec. These species were likely to have been imported from Florida along with plants used in the reconstruction of this tropical ecosystem. The occurrences of these species demonstrate an inefficiency in quarantine procedures. Each species is diagnosed and illustrated in order to facilitate their monitoring and possible invasion of natural habitats from this source of introduction.

KEYWORDS: introduction, exotic species, viable populations, quarantine, eastern Canada, spiders, Araneae, artificial ecosystem

The spider fauna of Canada consists of approximately 1300 described species, including 60 introduced species (Paquin, unpublished). Several spiders are inadvertently imported each year, but most of these are not successfully established and fail to maintain a continuous presence in the territory. For instance, *Heteropoda venatoria* (Linnaeus, 1767) (Sparassidae) is occasionally intercepted in imported goods in Canada but has never succeeded in establishing itself. However, successful introduced populations of *H. venatoria* are known from warmer climates such as California and the eastern Gulf States (Lew, 2005). A second example is the Black Widow, *Latrodectus mactans* (Fabricius, 1775) (Theridiidae), which has been found in imported fruit packages, but has never been established in northern latitudes (C. D. Dondale, pers. comm.). Nonetheless, species have recently colonized Canada. The synanthropic European species *Tegenaria atrica* C. L. Koch, 1843, has been collected from houses in Québec and Nova Scotia since 1999 (Paquin and Dupérré, 2003), and is now known from four provinces in Canada. The finding of numerous viable populations and a growing number of localities suggests that *T. atrica* is now established.

Introduced species that maintain viable populations in Canada are part of the Canadian fauna. Synanthropic species, although sometimes restricted to human houses, are also considered as such. In a few cases, however, human constructions are specifically designed to mimic exotic ecosystems. Greenhouses, for

---

[1] Received on September 20, 2007. Accepted on November 7, 2007.

[2] Cave and Endangered Invertebrate Research Laboratory, SWCA Environmental Consultants, 4407 Monterey Oaks Boulevard, Building 1, Suite 110, Austin, Texas 78749 U.S.A. Email: pdx02141@pdx.edu.

[3] 12 Chemin Saxby Sud, Shefford, Québec, Canada, J2M 1S2. Email: dupere.nadine@videotron.ca.

[4] 4777 Boulevard Pierre de Coubertin, Montréal, Québec, Canada, H1V 1B3. Email: stlabelle@ville.montreal.qc.ca.

ENTOMOLOGICAL NEWS 119 (3): 217, May and June 2008
Mailed on June 23, 2008

instance, maintain artificial conditions that are similar to the natural climate of more southern latitudes and favor plant growth. Such systems allow the development and survival of species that otherwise would not be present in Canada. A spectacular example of such an artificial ecosystem is the Biodôme de Montréal, a natural history museum that features different ecosystems as displays. The tropical ecosystem of this museum harbors spider species that have never been recorded in northern latitudes. The precise time of arrival of these spiders is unknown, but their presence has been noticed at least four years, and they reproduce and maintain viable populations within this artificial ecosystem. The large number of visitors that the museum receives each year (850,000 on average) presents a risk of introduction of exotic species. While the chances of survival of these species at this latitude remain unknown, the changes induced by global warming may be important enough in the future to modify natural species ranges (Dukes and Mooney, 1999) and allow the survival of these species in the wild.

The goal of this paper is twofold: 1) to document the spider diversity in this artificial ecosystem, and 2) to provide accurate taxonomic diagnoses for the identification of these species. This will facilitate the monitoring of possible invasions of natural habitats from this source of introduction.

METHODS

The tropical forest of the Biodôme de Montréal [45°31'N, 73°39'W] is an interior landscape that mimics a low altitude, Neotropical American rainforest and is used for both recreational and educational purposes. Within this system, a large collection of plants (over 300 genera), mammals, reptiles and birds are maintained. The spatial arrangement of the plants is complex and consists of large canopy trees, lianas, epiphytes and understory plants. The exhibit has a total area of 3,500 square meters and is enclosed within a glass structure. Sodium and metal halide lamps complement the natural sunlight, which shines through numerous skylights in the main building roof. The climate, somewhat like many greenhouses of northern countries, is maintained by computer-controlled systems providing heating, cooling and humidity. The tropical forest of the Biodôme was first open to the public in 1992. Before being transferred to Montréal, all plants were stored in Florida, USA, for six months.

Spiders specimens were collected in the Biodôme de Montréal during regular operations for pest monitoring; available machinery made collection possible from the ground level up to 15 meters in the tree canopy. All the specimens collected are reported, and these do not represent a subset of the diversity found in this artificial ecosystem. Spiders were identified using the following taxonomic references: Brignoli (1976), Levi (1967, 1980, 2005), and Paquin and Dupérré (2003).

Specimens were examined in 70% ethanol under an SMZ-U Nikon dissection microscope. A Nikon Coolpix 950 digital camera attached to the microscope was used to photograph all structures to be illustrated. The digital photo was then used to trace proportions, and the illustration was detailed and shaded by referring back to the structure under the microscope. Female genitalia were excised using a sharp entomological needle and transferred to lactic acid to clear non-chitinous tissues. A temporary lactic acid mount was used to examine the genitalia under an AmScope XSG Series T-500 compound microscope. All measurements are in millimeters and were made using an ocular micrometer. General morphological terminology follows Ubick et al. (2005). Voucher specimens were deposited in the first authors personal collection (CPAD, Collection Paquin-Dupérré, Shefford, Québec, Canada).

RESULTS

The tropical ecosystem of the Biodôme de Montréal harbors four spider species: *Steatoda triangulosa* (Walckenaer, 1802), already known in Canada from Québec and Ontario, and *Scytodes fusca* Walckenaer, 1837, *Coleosoma floridanum* Banks, 1900, and *Theridion melanostictum* O. Pickard-Cambridge, 1876, which have never been recorded in Québec.

Within the artificial tropical ecosystem. *Scytodes fusca* was mainly found within the foliage of palm trees, while *C. floridanum* was restricted to the understory. *Theridion melanostictum* was widespread, but *S. triangulosa* was restricted to a large terrarium in an artificial bat cave.

Species are illustrated and diagnosed below to facilitate their identification and the monitoring of possible introductions in natural habitats.

Family Scytodidae Blackwall, 1864

Scytodes fusca Walckenaer, 1837

Fig. 1

Material Examined. Canada: *Québec*: Biodôme de Montréal, 2006, tropical ecosystem on *Astrocaryum* sp., 1♂ 2♀, S. Labelle; 31.x.2006, tropical ecosystem, 3♀, S. Labelle.

Diagnosis. Males of *Scytodes fusca* are diagnosed by the combination of the following characters: male cephalothorax light brown with characteristic darker markings (Fig. 1B), abdomen light gray with several transverse darker bands (Fig. 1B). Male palp with a large bulb, and short, distally bent embolus (E) (Fig. 1C). Females are diagnosed by their dark orange-brown cephalothorax with few markings, abdomen dark gray without clear pattern (Fig. 1A). Female genitalia with two large, somewhat triangular sclerotized depressions (Figs. 1D–E); spermathecae (S) small, widely separated (Fig. 1E).

Distribution. Pantropical (Brignoli, 1976; Platnick, 2007), Florida (Kaston, 1972).

Remarks. In North America, the family is represented by a single genus *Scytodes* that contains 7+ species (Ubick, 2005). Species level identification of *Scytodes* is problematic in North America, and the genus is in need of revision.

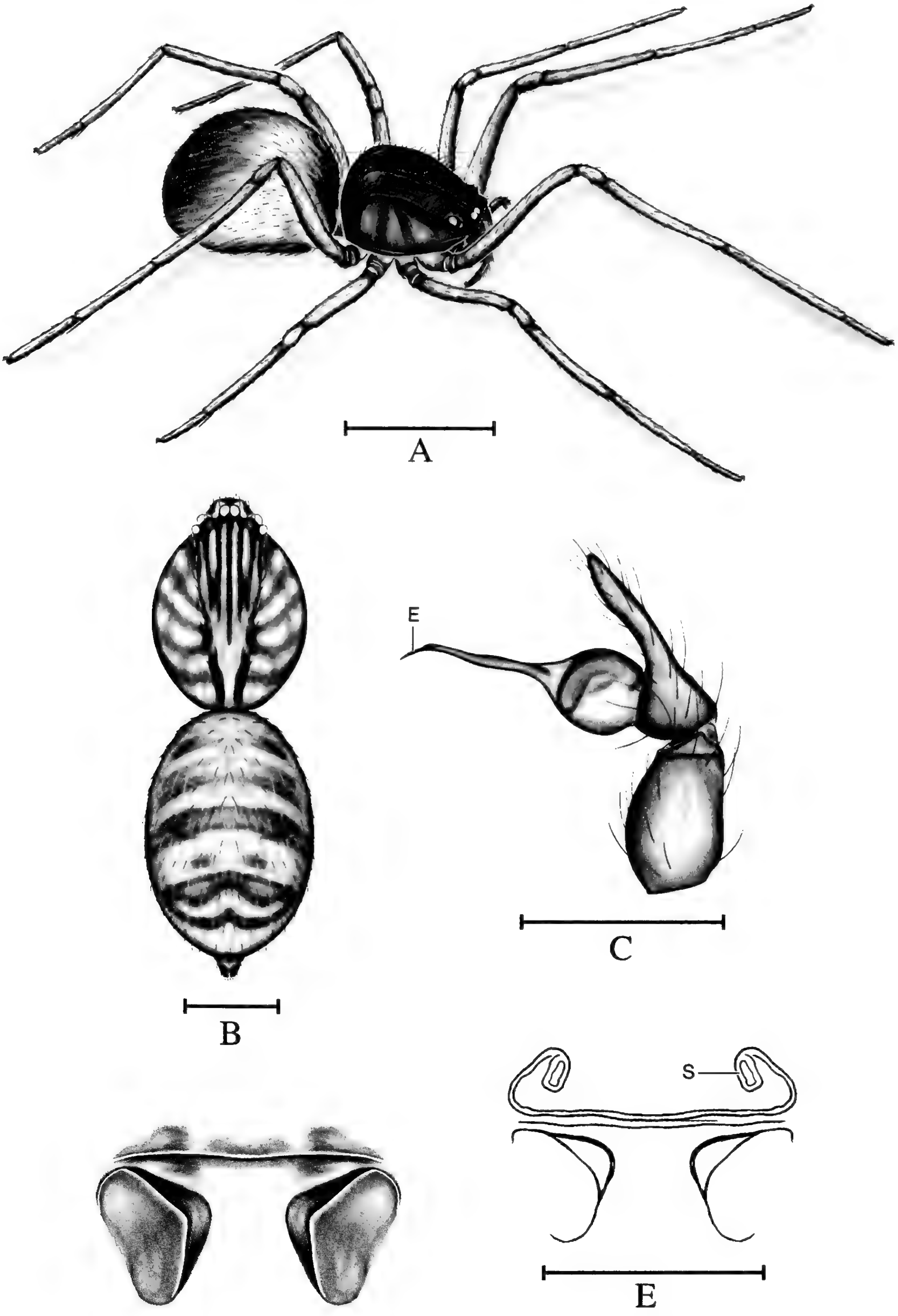


Figure 1. *Scytodes fusca*. A, female habitus, fronto-lateral view; B, male, dorsal view; C, male palp, retrolateral view; D, epigynum, ventral view; E, cleared epigynum, ventral view. Scale bar: A–B = 2.5 mm, C–E = 0.5 mm. Abbreviations used: E, embolus, and S, spermatheca.

Family Theridiidae O. Pickard-Cambridge, 1871
Coleosoma floridanum Banks, 1900

Fig. 2

Material Examined. Canada: *Québec*: Biodôme de Montréal, 03.x.2006, botanical garden greenhouses, 2♂ 3♀, S. Labelle; 29.ix.2006, tropical ecosystem 1♂ 1♀, S. Labelle; 2007, tropical ecosystem on *Bactris* sp., 1♂ 2♀, S. Labelle; 2007, tropical ecosystem, 1♂ 1♀, S. Labelle.

Diagnosis. Males of *C. floridanum* are diagnosed by the combination of the following characters: ant-mimic form, abdomen with characteristic color pattern with black markings (Fig. 2A), bearing two horns anteriorly (Figs. 2A–B) and a sclerotized ring (Fig. 2B). Male palp with long embolus (E) curving clockwise (left palp, Fig. 2D). Females are characterized by their oval, light-colored abdomen with black markings (Fig. 2C); epigynum with large and somewhat oval atrium (A) (Fig. 2E); copulatory openings (CO) located at anterior part of atrium (Fig. 2F); copulatory ducts (CD) short with one loose loop (Fig. 2F) and oval spermathecae (S) (Fig. 2G).

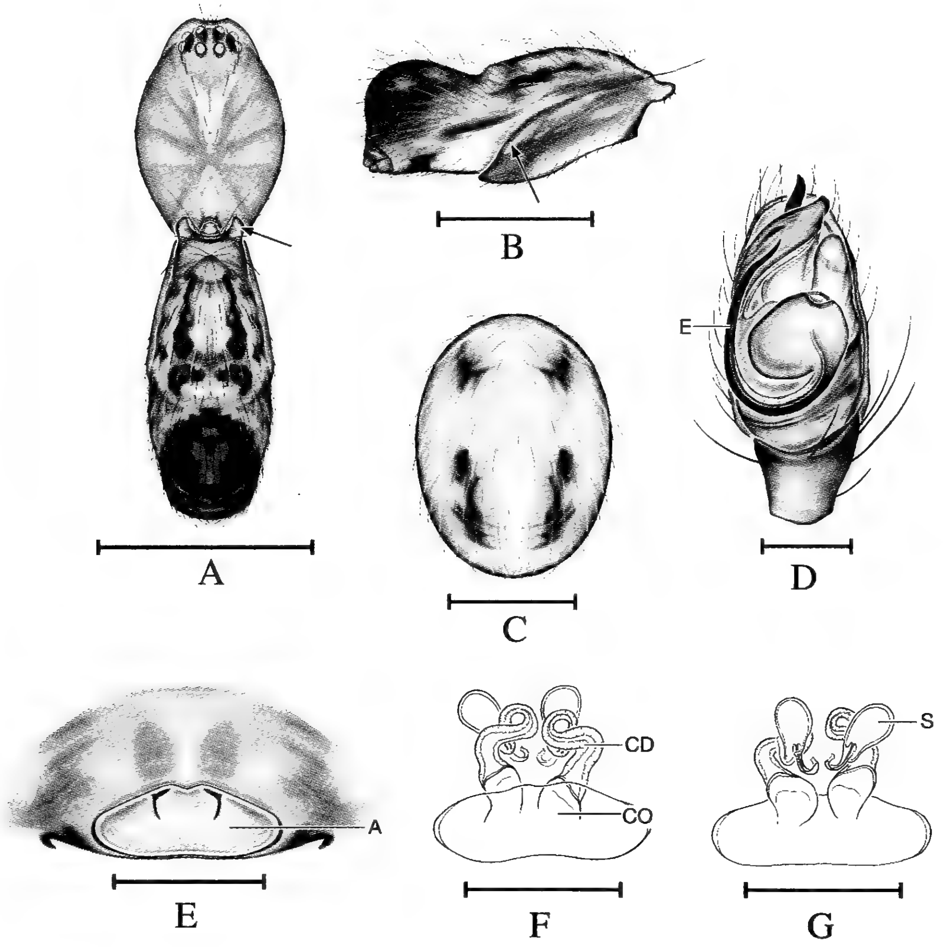


Figure 2. *Coleosoma floridanum*. A, male habitus, dorsal view, arrow points to anterior horns; B, male abdomen, lateral view, arrow points to the sclerotized ring; C, female abdomen dorsal view; D, male palp, ventral view; E, epigynum, ventral view; F, cleared epigynum, ventral view; G, cleared epigynum, dorsal view. Arrow points to the sclerotized ring. Scale bar: A–C = 0.5 mm, D–G = 0.1 mm. Abbreviations used: A, atrium; CO, copulatory openings; CD, copulatory ducts; E, embolus; and S, spermatheca.

Distribution. Pantropical, greenhouses in Europe (Levi, 1959, 1967; Platnick, 2007), greenhouse in Minnesota (Cutler, 1972).

Remarks. The genus *Coleosoma* is represented by three species in North America (Levi, 2005). The only other Canadian record is from a greenhouse in Ontario (unpublished record, voucher specimen at the Canadian National Collection, Ottawa).

Steatoda triangulosa (Walckenaer, 1802)

Fig. 3

Material Examined. Canada: *Québec*: Biodôme de Montréal, no date, tropical ecosystem, artificial bat cave, 4♂ 2♀, S. Labelle.

Diagnosis. *Steatoda triangulosa* is distinguished from all other species of the genus occurring in Québec by the dorsal abdominal patterns of males and females (Figs. 3A–B). Male resembles *Steatoda castanea* (Clerck, 1757), but differs by the shape of the theridiid tegular apophysis (TTA) and embolus (E) (Fig. 3C); females are characterized by their triangular epigynum, U-shaped atrium (Fig. 3D), copulatory ducts (CD) short and stout (Figs. 3E–F), spermathecae (S) rounded and well separated (Figs. 3E–F).

Distribution. Cosmopolitan, probably introduced into North America from Eurasia (Levi, 1967).

Remark. The female genitalia illustrated by Paquin and Dupérré (2003) is covered by a plate.

Theridion melanostictum O. Pickard-Cambridge, 1876

Fig. 4

Material Examined. Canada: *Québec*: Biodôme de Montréal 2006, tropical ecosystem on *Bactris* sp., 1♂ 2♀, S. Labelle; 2006, tropical ecosystem, 2♀, S. Labelle; 02.x.2006, tropical ecosystem, 1♂ 2♀, S. Labelle; 04.x.2006, tropical ecosystem, 2♀, S. Labelle; 08.x.2006, tropical ecosystem, 1♀, S. Labelle; 2006, reared in laboratory, 6♂ 5♀, S. Labelle.

Diagnosis. Males of *Theridion melanostictum* resemble *Theridion murarium* Emerton 1882, but can be differentiated by their pale abdomen with dark markings (Fig. 4A), palp with a long and threadlike embolus (E) (Fig. 4C); and the thorn-shaped radix (R) (Fig. 4C). Females are characterized by their color pattern (Fig. 4B); epigynum with U-shaped atrium (Fig. 4D), sometimes covered by a plate (Fig. 4E); copulatory openings (CO) situated each side of atrium (Fig. 4F); copulatory ducts (CD) long and coiled (Figs. 4F–G); spermathecae (S) somewhat elongated (Fig. 4G).

Distribution. Mediterranean, Aldabra, Seychelles, China, Japan, Hispaniola (Platnick, 2007), recorded in United States from Florida (Levi, 1980).

Remark. The genus *Theridion* includes 65 species in North America (Levi, 2005).

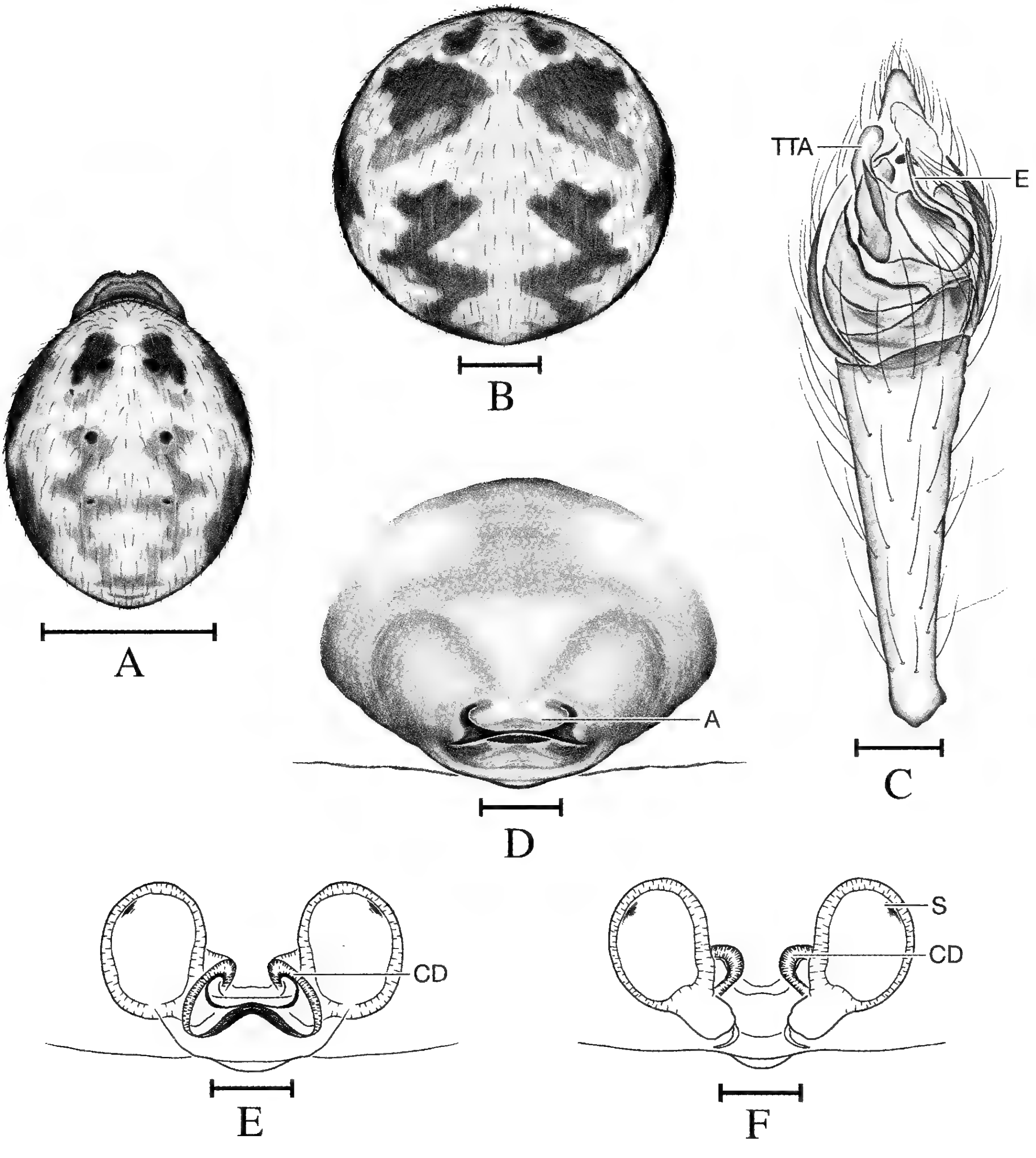


Figure 3. *Steatoda triangulosa*. A, male abdomen, dorsal view; B, female abdomen, dorsal view; C, male palp, ventral view; D, epigynum, ventral view; E, cleared epigynum, ventral view; F, cleared epigynum, dorsal view. Scale bar: A–B = 1.0 mm, C–F = 0.5 mm. Abbreviations used: A, atrium; CD, copulatory ducts; E, embolus; S, spermatheca; and TTA, therdiid tegular apophysis.

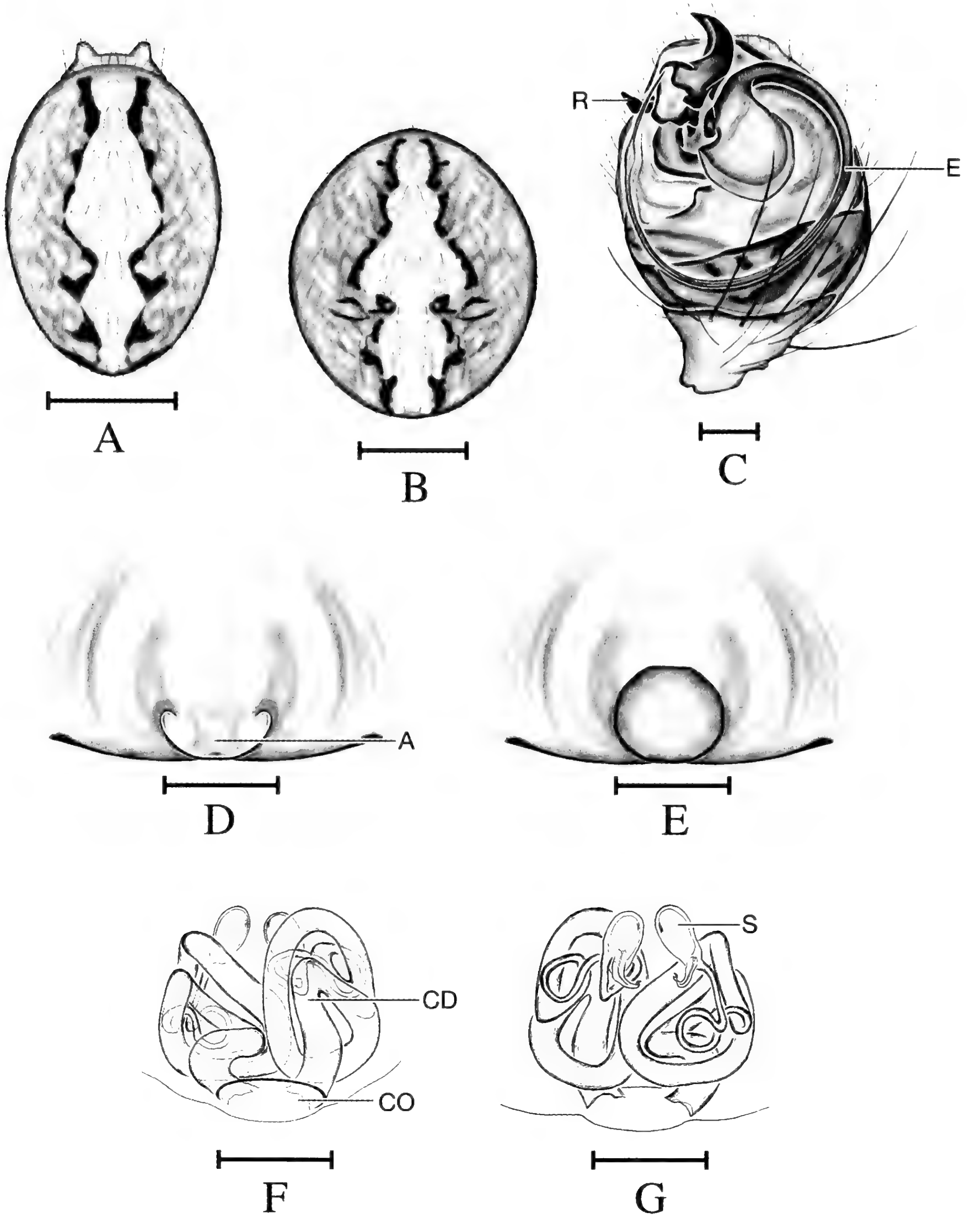


Figure 4. *Theridion melanostictum.* A, male abdomen, dorsal view; B, female abdomen, dorsal view; C, male palp, ventral view; D, epigynum, ventral view; E, epigynum with plate, ventral view; F, cleared epigynum, ventral view; G, cleared epigynum, dorsal view. Scale bar: A–B = 0.5 mm, C–G = 0.1 mm. Abbreviations used: A, atrium; CO, copulatory openings; CD, copulatory ducts; E, embolus; R, radix; and S, spermatheca.

DISCUSSION

The species reported above were the only spiders found in this artificial ecosystem. Further collecting may reveal additional species, but the data clearly shows the dominance of exotic taxa. The information provided here allows easy identification of these species that otherwise would only be possible through scattered references. Other species mentioned in the diagnoses can be identified with Paquin and Dupérré (2003).

The precise mechanism behind the introduction of the spiders in this artificial ecosystem remains uncertain. *Theridion melanostictum* and *S. fusca* are tropical species and likely came along with plants imported from Florida. *Steatoda triangulosa* and *C. floridanum* however, are also known from higher latitudes. It is not possible to know precisely how these two latter species were introduced to the Biodôme, but it is quite possible that all four species were introduced simultaneously as they all are common in the wild in Florida. The presence of these exotic species in Canada implies that the quarantine procedures were insufficient to preclude their introduction.

Species distributions are the result of a slow but dynamic process largely under the influence of climatic conditions. At a given time, the distribution of a species is the result of interactions of multiple variables: latitude and temperature, distribution of food sources, geological history and interaction with other species, among others. A major concern related to global warming and climate change is that it may rapidly alter natural ranges of species distribution (Dukes and Mooney, 1999; Parmesan and Yohe, 2003). The present paper documents occurrences of spiders in an artificial ecosystem and reports that these species are not a part of the Canadian fauna, yet. However, exotic species populations in an artificial habitat where no particular measures are taken to avoid dispersal represents a possible source of introduction. The effect of global warming and species expansions on local faunas is difficult to predict because it not only modifies ranges, but also leads to interactions between species that have not been in contact before (Davis et al. 1998). Newly introduced spiders may compete with indigenous species, progressively invade additional territory, and cause ecological displacement (see Nyffeler et al., 1986; Lapointe and Hutchinson, 1992; Prentice, 2001; Jennings et al., 2002). The potential impacts of new introductions and invasive species are complex and pose multilevel challenges to researchers (Cox, 1999). The data presented here will help to bring attention to these spider species, facilitate their monitoring, and help to recognize potential interactions with native species.

ACKNOWLEDGMENTS

We thank the Biodôme de Montréal for the financial support, Anriet Dimitrova for specimen collection and laboratory work, and Joel Ledford (California Academy of Sciences, San Francisco, California) for his review and grammatical improvements.

LITERATURE CITED

Brignoli, P. M. 1976. Beiträge zur kenntnis der Scytodidae (Araneae). Revue suisse de Zoologie 83(1):125–191.

Cox, G. W. 1999. Alien species in North America and Hawaii: Impacts on Natural Ecosystems. Washington, District of Columbia, Island Press. xii + 387 pp.

Cutler, B. 1972. Notes on the behavior of *Coleosoma floridanum* Banks. Journal of the Kansas Entomological Society 45: 275–281.

Davis, A. J., L. S. Jenkinson, J. H. Lawton, B. Shorrocks, and S. Wood. 1998. Making mistakes when predicting shifts in species range in response to global warming. Nature 391:783–786.

Dukes, J. S. and H. A. Mooney. 1999. Does global change increase the success of biological invaders? Trends in Ecology and Evolution 14(4):135–139.

Jennings, D. T., K. M. Catley, and F. Graham, Jr. 2002. *Linyphia triangularis*, a Palearctic spider (Araneae: Linyphiidae) new to North America. Journal of Arachnology 30:455–460.

Kaston, B. J. 1972. How to know the spiders, second ed. Dubuque, 289 pp.

Lapointe, A. and R. Hutchinson. 1992. Premières mentions de *Neriene montana* (Clerck) (Araneae: Linyphiidae) pour l'Amérique du Nord. Pirata 1(1):120–123.

Levi, H. W. 1959. The spider genus *Coleosoma* (Araneae, Theridiidae). Brevoria 110:1–11.

Levi, H. W. 1967. Cosmopolitan and pantropical species of theridiid spiders (Araneae: Theridiidae). Pacific Insects 9(2):175–186.

Levi, H. W. 1980. Two new spiders of the genera *Theridion* and *Achaearanea* from North America (Araneae: Theridiidae). Transactions of American Microscopical Society 99(3):334–337.

Levi, H. W. 2005. Theridiidae. pp. 235–243. *In*, D. Ubick, P. Paquin, P. Cushing, and V. Roth (Editors). Spiders of North America. An Identification Manual. American Arachnological Society, 377 pp.

Lew, S. 2005. Sparassidae. pp. 224–225. *In*, D. Ubick, P. Paquin, P. Cushing and V. Roth (Editors). Spiders of North America. An Identification Manual. American Arachnological Society, 377 pp.

Nyffeler, M., C. D. Dondale, and J. H. Redner. 1986. Evidence for displacement of a new North American spider, *Steatoda borealis* (Hentz), by the European species *S. bipunctata* (Linnaeus) (Araneae: Theridiidae). Canadian Journal of Zoology 64(4):867–874.

Paquin, P. and N. Dupérré. 2003. Guide d'identification des Araignées (Araneae) du Québec. Fabreries, Supplément 11:1–251.

Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37–42.

Platnick, N. I. 2007. The World Spider Catalog, American Museum of Natural History. Version 7.5. http://research.amnh.org/entomology/spiders/catalog/index.html [accessed 10 June 2007].

Prentice, T. R. 2001. Distinguishing the females of *Trochosa terricola* and *Trochosa ruricola* (Araneae, Lycosidae) from populations in Illinois, USA. Journal of Arachnology 29:427–430.

Ubick, D. 2005. Scytodidae. pp. 217–218. *In*, D. Ubick, P. Paquin, P. Cushing and V. Roth (Editors). Spiders of North America. An Identification Manual. American Arachnological Society, 377 pp.

Ubick, D., P. Paquin, P. Cushing, and V. Roth. 2005 (Editors). Spiders of North America. An Identification Manual. American Arachnological Society, 377 pp.

THE IDENTITY OF *CICADA TIBICEN* LINNÉ [=*TIBICEN CHLOROMERUS* (WALKER, 1850)] (HEMIPTERA: CICADOIDEA: CICADIDAE)[1]

Allen F. Sanborn[2]

ABSTRACT: A lectotype is designated for *Cicada tibicen* Linné, 1758. The Linnaean specimen located in the Zoological Museum of Uppsala University can be traced to Linné and the original species description. The species is determined to be the same as what is currently recognized as *Tibicen chloromerus* (Walker, 1850), making *T. chloromerus* and *Cicada sayi* Smith and Grossbeck, 1907, junior synonyms of *Tibicen tibicen* (L.).

KEYWORDS: Hemiptera, Cicadoidea, Cicadidae, *Cicada tibicen*, *Tibicen chloromerus*

The name *Cicada tibicen* Linné, 1758, has been used for several different species from North and South America (see references in Metcalf 1963; Duffels and van der Laan 1985) since its original description in the 10th edition of *Systema Naturae* (Linné, 1758). The application of the name to several species on two continents can be traced back to both the brevity of Linné's description, and his reference to the historical drawing on plate 49 of Maria Sybille Merian's book (1705) on the insects of Surinam.

The original description of *Cicada tibicen* reads: "C. scutelli apice emarginato" (Linné 1758: 436). However, a notch in the cruciform elevation apex is an insufficient character to separate an individual species, as several cicada genera possess this character.

Linné identified the habitat as 'America.' The citation of Merian's (1705) plate has led authors to consider *Cicada tibicen* a South American species (Davis 1925; Metcalf 1963; China 1964; Duffels and van der Laan 1985) rather than a North American species. Uhler (1892) stated that the figure in Merian was more typical of *Fidicina mannifera* (Fabricius, 1803) and "represent [a] species very different from the true *C. tibicen*" based on comparisons made by Stål to material in the Fabricius collection and presumably to specimens in the Swedish Museum of Natural History, Stockholm. The Fabricius collection in Copenhagen contains a specimen identified as *Cicada tibicen* L. that belongs to *Tibicen lyricen* (De Geer, 1773). The Swedish Museum of Natural History contains specimens labeled *Cicada tibicen* that are currently recognized as *Tibicen chloromerus* (Walker). This all leads to the conclusion that North American taxonomists were using *C. tibicen* for a South American species while historical European taxonomists were consistently applying the name to North American species. In 1764, Linné significantly expanded his description of *Cicada tibicen* and included a statement that the species inhabits Carolina as well as Surinam. Thus Linné attributed the species specifically to North America as well as

---

[1] Received on August 31, 2007. Accepted on October 9, 2007.

[2] Barry University, School of Natural and Health Sciences, 11300 NE Second Avenue, Miami Shores, Florida 33161-6695 U.S.A. E-mail: asanborn@mail.barry.edu

Mailed on June 23, 2008

Surinam. One can consider, as a result, that the "America" Linné (1758) was addressing was North America as well as South America. In addition, Wallin (1992) states that the 1764 manuscript was already written in 1758 (see below).

The expanded species description of *Cicada tibicen* in Linné (1764) describes the color of various morphological features, including the infuscations of the fore wing. Many of these characters can be attributed to several of the *Tibicen* Latreille species inhabiting eastern North America. However, the description of the opercula separates *C. tibicen* from other related North American species: "Opercula sub abdomine ovato-oblonga, concava versus ventrem, viridia, tegentia and excipientia subtus maximam abdominis partem" (Linné 1764).

Linné describes here the opercula as ovate-oblong, concave in ventral direction, becoming green, concealing and taking up most of the under part of the abdomen (Fig. 1). No other North American species that has been attributed to *C. tibicen* has opercula shaped in this manner except *T. chloromerus*. Furthermore, this character cannot be applied to any known species of *Fidicina* Amyot

Fig. 1. A. *Cicada tibicen* specimen in the Linnaean collection of the Uppsala University Zoological Museum. The label is in Thunberg's handwriting and links the specimen to Linné. B. Ventral view of *Cicada tibicen* from the Linnean collection illustrating large opercula described in Linné (1764).

and Serville or related genera from South America (Davis 1925; Metcalf 1963; China 1964; Duffels and van der Laan 1985).

The question remained whether Linné used either one or more cicada specimens or the figure in Merian (1705) to describe *C. tibicen*. It is clear now from Linne's 1764 description that he used the specimen in the Linnaean collection at Uppsala University as the basis for his 1764 description and not the figure in Merian (1705), since this figure does not match the coloration in Linné's 1764 description. The description provided by Merian does not mention the opercula or coloration (figure reprinted and text translated in Davis 1925), but the tegmina of the specimen in the plate show infuscation along and between all the wing crossveins (a character found in many *Fidicina* and *Fidicinoides* Boulard and Martinelli species) rather than the "spots" mentioned in Linné's 1764 description. There is also significant evidence that the 1758 description can be connected to the specimen in the Uppsala collection through the 1764 description.

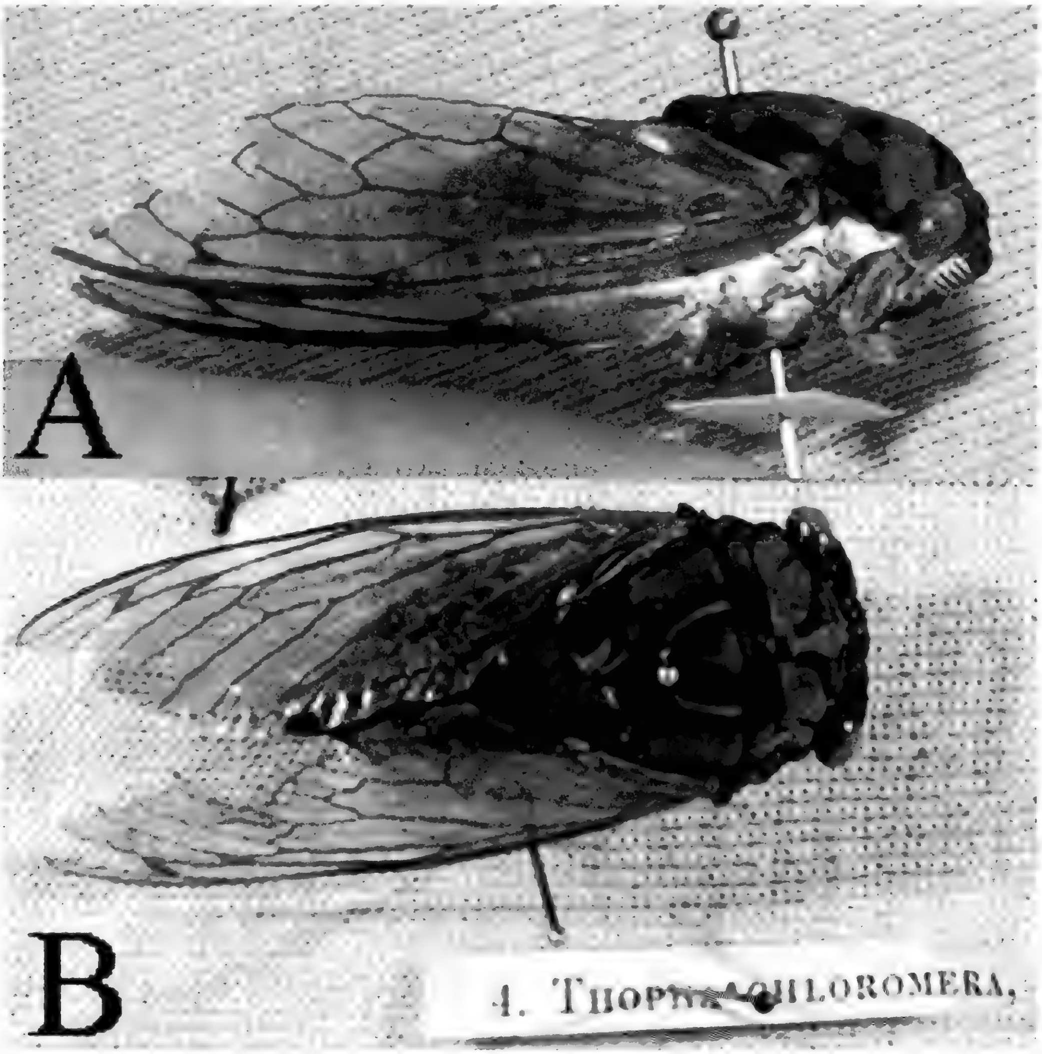


Fig. 2. A. Lateral view of *Cicada tibicen* from the Linnaean collection. The humpbacked shape of the prothorax and head is characteristic of the species. B. Holotype specimen of *Tibicen chloromerus* (Walker) from the Natural History Museum, London. The specimen is identical to the specimen of *Cicada tibicen* in the Linnaean collection.

Wallin (1992) describes how specimens from the 1764 catalogue can be tied to Linné and to descriptions in the 10th edition of *Systema Naturae* (Linné 1758). The label attached to the Uppsala specimen (Fig. 1) was written by Thunberg (a pupil of Linné) identifying it as *Cicada tibicen,* and the source of the specimen as a donation by the Museum Gustavo-Adolphianum (Gustav IV Adolf) as determined by Linné's inventories. The donation by King Gustav IV Adolf included the insects of his grandmother's (Queen Lovisa Ulrika) collection, which had been examined and curated by Linné. Thus, the specimen in the Linnaean collection at Uppsala University can be tied to Linné. Linné's publication of 1764 is a catalog of the specimens in the Queen's collection, but the manuscript was published many years after it was finished, and Linné referred to the manuscript in the 10th edition of *Systema Naturae* (Wallin 1992). The fact that the manuscript containing the 1764 description was already complete when the 10th edition of *Systema Naturae* was published, and the fact that the 1764 description matches specifically to the specimen currently in the collection in Uppsala and not to the drawing also cited in 1758 is compelling evidence that the specimen in the Linnaean collection is the specimen used by Linné to describe *Cicada tibicen* in 1758.

Although some Linnaean cicadas are housed in the collection of the Linnean Society in London (Fitton and Harman 2007; Webb 1979), no specimen matching Linné's description of *Cicada tibicen* could be found there. However, a review of the Linnaean specimens in the Zoological Museum of Uppsala University revealed a specimen that is most probably used by Linné for the description of *Cicada tibicen.* This specimen, bearing the labels: 'Uppsala Univ. Zool. Mus. / Linnesamlingen nr. 1838 / *Cicada tibicen,*' and a label 'Tibicen typus' (of unknown origin but not in the handwriting of Linné or Thunberg) is hereby designated the lectotype. As a consequence of this lectotype designation, *Tibicen tibicen* (Linnaeus, 1758) and the species currently recognized as *Tibicen chloromerus* (Walker, 1850) become synonyms. Figure 2 depicts the holotype of *Thopha chloromera* Walker, 1850 (= *Tibicen chloromerus* (Walker, 1850)), that is now a junior synonym of *Tibicen tibicen* (Linné, 1758). *Cicada sayi* Smith and Grossbeck, 1907, which is regarded as a junior synonym of *Tibicen chloromerus* is now also considered a junior synonym of *Tibicen tibicen* (L.).

Garman (1903) considered *C. tibicen* to be a valid taxon and figured a specimen that would be named *Cicada sayi* by Smith and Grossbeck (1907). Smith and Grossbeck (1907), Davis (1925) and China (1964) use *tibicen* as a valid taxon, as do the bibliographies of Metcalf (1963) and Duffels and van der Laan (1985), making Article 23.9.1.1 inapplicable. The author has been unable to identify 25 papers published by at least 10 authors in the past 50 years using *T. chloromerus* making Article 23.9.1.2 inapplicable as well. As a result, prevailing usage cannot be maintained as per Article 23.9.1, and a *nomen oblitum* and *nomen protectum* cannot be assigned to the taxa as per Article 23.9.2 (ICZN 1999). As a result, *Tibicen tibicen* (Linne, 1758) is the valid taxon based on the Principle of Priority (ICZN 1999).

ACKNOWLEDGEMENTS

Hans Mejlon assisted with access to the collection and reference material at the Zoological Museum, Uppsala University and read a draft of the manuscript, Mick Webb assisted with access to specimens in the Natural History Museum, London, and made suggestions that significantly improved the manuscript, Niels Kristensen assisted with access to the Fabricius material at the Natural History Museum of Denmark, Copenhagen, Bert Gustafsson and Gunvi Lindberg assisted with access to the specimens in the Swedish Museum of Natural History, Stockholm, and Mike Fitton, Natural History Museum, London, and honorary curator of the Linnean Society insect collection for checking the collection for specific specimens. Hans Duffels and Maxine Heath made suggestions that improved the manuscript. Partial financial support was provided by a Barry University Research Mini-Grant.

LITERATURE CITED

China, W. E. 1964. Tibicenidae Van Duzee, 1916 (Insecta, Cicadoidea): proposed suppression under the plenary powers in favour of Platypleuridae Schmidt, 1918. Z.N. (S.) 1626. Bulletin of Zoological Nomenclature 21:154-160.

Davis, W. T. 1925. *Cicada tibicen*, a South American species, with records and descriptions of North American cicadas. Journal of the New York Entomological Society 33:35-51.

Duffels, J. P. and P. A. van der Laan. 1985. Catalogue of the Cicadoidea (Homoptera, Auchenorhyncha) 1956-1980. Series Entomologica 34. Dr. W. Junk Publishers. Dordrect. The Netherlands. 414 pp.

Fitton, M. and K. Harman. 2007. The 'Linnaean' insect collection. The Linnean Special Issue No. 7:47-58.

Garman, H. 1903. Seventeen-year Locusts in Kentucky. Kentucky Agriculture Experiment Station, Bulletin 107:83-100.

International Commission of Zoological Nomenclature. 1999. International code of zoological nomenclature. Fourth edition. International Trust for Zoological Nomenclature. London, United Kingdom. 306 pp.

Linné, C. 1758. Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Tomus I. Edito duodecima, reformata. Laurentius Salvius. Holmiae, Sweden. 824 pp.

Linné, C. 1764. Museum S:ae R:ae M:tis Ludovicae Ulricae reginae Svecorum, Gothorum, Vandalorumque &c. &c. &c. In quo animalia rariora, exotica, imprimis insecta & conchilia describuntur & determinantur, prodromi instar editum. Laurentius Salvius. Holmiae, Sweden. 720 pp.

Merian, M. S. 1705. Metamorphosis insectorum surinamensium. Ofte verandering der Surinaamsche insecten. Waar in de Surinaamsche rupsen en wormen met alle des zelfs veranderingen na het leven afgebeeld en beschreeven worden, zynde elk geplaast op die gewassen, bloemen en vruchten, daar sy op gevonden zyn; waar in ook de generatie der kikvorschen, wonderbaare padden, hagedissen, slangen, spinnen en mieren werden vertoond en beschreeven, alles in America ne het leven en levensgroote geschildert en beschreeven. G. Valck, Amsterdam, The Netherlands.

Metcalf, Z. P. 1963. General catalogue of the Homoptera, Fascicle VIII. Cicadoidea. Part 1. Cicadidae. Section I. Tibiceninae. North Carolina State College Contribution 1502:i-vii, 1-585.

Smith, J. B. and J. A. Grossbeck. 1907. Studies in certain cicada species. Entomological News 18:116-129.

Uhler, P. R. 1892. Preliminary survey of the Cicadoea of the United States, Antilles and Mexico. Transactions of the Maryland Academy of Sciences 1:147-175.

Walker, F. 1850. List of the Specimens of Homopterous insects in the collection of the British Museum. Part 1. British Museum Trustees. London, United Kingdom. 260 pp.

Wallin, L. 1992. Linnaean specimens in the Zoological Museum of Uppsala University. Archives of Natural History 19:219-230.

Webb, M. D. 1979. Revision of Rambur's Homoptera species from the types in the British Museum. Nouvelle Series of the Annals de la Societie Entomologique de France 15:227-240.

-*MESOTRICHOSIPHUM* CALILUNG (HEMIPTERA: APHIDIDAE: GREENIDEINAE), A NEWLY RECORDED GENUS FROM CHINA, WITH THE DESCRIPTION OF A NEW SPECIES[1]

Dong Zhang[2] and Gexia Qiao[3]

ABSTRACT: The genus *Mesotrichosiphum* Calilung, an endemic southeastern Asian group, is reviewed to include *Mesotrichosiphum pentaiarticulatum* Zhang and Qiao, sp. nov. from China (Hainan). The generic diagnosis is supplemented in here, and a key is given to all species worldwide. Some hitherto unknown morphs of *Mesotrichosiphum* are described. New data on distributions and host plants are reported for the genus. The type specimens are deposited in Zoology Museum, Institute of Zoology, Chinese Academy of Sciences.

KEY WORDS: Aphididae, Greenideinae, *Mesotrichosiphum*, China

The aphid genus *Mesotrichosiphum* Calilung, 1967 is a small group in the tribe Greenideini, subfamily Greenideinae, family Aphididae, with only two species (Remaudière and Remaudière, 1997). It is restrictedly distributed in southeastern Asia.

The genus *Mesotrichosiphum* and its type species, *M. uichancoi*, was originally described by Calilung (1967a) based on apterous and alate viviparous females from the Philippines. She noted this genus differs from its affiliated genus *Eutrichosiphum* Essig and Kuwana in having 4-segmented antennae in the apterae and sparse, mostly short body hairs. Blackman and Eastop (1994) included just the type species in the genus *Mesotrichosiphum* on the world's trees. Noordam (1994) described the second species, *M. brevisetosum*, which is from Java, only known as one apterous viviparous female, and also illustrated its important characters.

During a survey by the first author in the Diaoluoshan Nature Reserve Regions, Hainan Province, China, a *Mesotrichosiphum*-like species was collected in the tropical rain forest. After having checked extensively, including re-examining the type species of *Mesotrichosiphum*, we think that *Mesotrichosiphum* is firstly recorded in China and one new species is found. Thereby, the paper will review the genus *Mesotrichosiphum*, redefine its diagnosis, describe one new species, and provide a key to the known species. New data on localities are reported. Some hitherto unknown morphs, such as first stage larvae and embryo, of the genus were described in detail.

METHODS

The corresponding author checked type specimens of type species, *Mesotrichosiphum uichancoi* Calilung, in the Natural History Museum, London, UK. All specimens studied are deposited in the Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, Beijing (ZMCAS), and in the Natural History Museum, London (BMNH).

Aphid terminology follows Noordam (1994) and Qiao (2000). Measurements are in millimeters (mm). The taxonomic system of Remaudière and Remaudière (1997) was followed here.

---

[1] Received on April 23, 2007. Accepted on September 14, 2007.

[2] Institute of Zoology, Chinese Academy of Sciences, Datun Road, Chaoyang, Beijing 100101, P.R. China; Graduate University of Chinese Academy of Sciences, Beijing 100049. E-mail: ernest8445@ 163.com.

[3] Institute of Zoology, Chinese Academy of Sciences, Datun Road, Chaoyang, Beijing 100101, P.R. China. Corresponding Author. E-mail: qiaogx@ioz.ac.cn.

Mailed on June 23, 2008

In Table 1, the following abbreviations have been used: Ant.I, Ant.II, Ant.III, Ant.IV, Ant.V, Ant.Vb, for antennal segments I, II, III, IV, V and the base of antennal segment V, respectively; Ant.IIIWD, widest diameter of antennal segment III; PT, processus terminalis; URS, ultimate rostral segment; BW URS, basal width of ultimate rostral segment; MW hind tibia, mid-width of hind tibia; 2HT, hind second tarsal segment; SIPH, siphunculus; BW SIPH, DW SIPH, basal width and distal width of siphunculi; STDEV, standard deviation; BW Cauda, basal width of cauda; Tergum I and Tergum VIII, abdominal tergites I and VIII.

Mesotrichosiphum Calilung, 1967 NEW RECORD FOR CHINA

Mesotrichosiphum Calilung, 1967a: 89; type specie: *Mesotrichosiphum uichancoi* Calilung, 1967, by original designation.

Mesotrichosiphum Calilung: Calilung, 1967b: 117; Noordam, 1994: 120; Blackman and Eastop, 1994: 744; Remaudière and Remaudière, 1997: 176.

Diagnosis. Body pear-shaped. Eyes with multi-facets and ocular tubercle. Median front slightly convex. Antennae 4- or 5-segmented (occasionally 6-segmented), with sparse and mostly short hairs, which are blunt and acute; processus terminalis bare over its length, about 0.53-0.87 times as long as base of the antennal terminal segment. Dorsal hairs on thorax sparse and tiny, about 0.006-0.020 long. Legs short, with short and sturdy hairs, tibial hairs about 0.007-0.06 long. Hind tibia 0.73-1.23 times as long as the width of the head across eyes. First tarsal chaetotaxy: 5, 5, 5. Dorsal hairs of abdomen same as in thorax. Siphunculi with a convex inner side and a slightly convex outer side, enlarged in median part, covered with over 20 stout and long hairs, spinulose or formed a reticulation at apex. In alatae, median vein of the forewing twice branched, hind wing with one oblique vein.

Host Plants. Fagaceae and Verbenaceae.

Distribution. China, Philippines, and Indonesia.

KEY TO SPECIES OF GENUS *MESOTRICHOSIPHUM* (BASED ON APTEROUS VIVIPAROUS FEMALE)

1. Antennae 5-segmented (occasionally 6-segmented), processus terminalis 0.71-0.87 times as long as base of the segment V; hind tibia 1.10-1.23 times as long as the width of head across eyes. On *Castanopsis hainanensis* .... *M. pentaiarticulatum* Zhang and Qiao, NEW SPECIES
- Antennae 4-segmented, processus terminalis about 1/2 of base of the segment IV; hind tibia at most 0.80 times as long as the width of head across eyes 2
2. Siphunculi reticulated at apex. On *Premna odorata* ....*M. uichancoi* Calilung
- Siphunculi not reticulated at apex, entirely spinulose. On *Lithocarpus bennettii*............ ....*M. brevisetosum* Noordam

Mesotrichosiphum uichancoi Calilung, 1967

Mesotrichosiphum Calilung, 1967a: 89.

Mesotrichosiphum Calilung: Calilung, 1967b: 117; Blackman and Eastop, 1994: 744; Remaudière and Remaudière, 1997: 176.

Specimens Examined. Paratypes: 2 apterous viviparous females, THE PHILIPPINES, Banus, Laguna, alt. 50m, 5 Sep. 1949, leg. L. B. Uichanco, on Premna odorata (BMNH).

Distribution. Philippines.

Mesotrichosiphum brevisetosum Noordam, 1994

Mesotrichosiphum Noordam, 1994: 121.

Mesotrichosiphum Noordam: Remaudière and Remaudière, 1997: 176.

Specimens Examined. None.

Remarks. All the information about this species is from Noordam (1994).

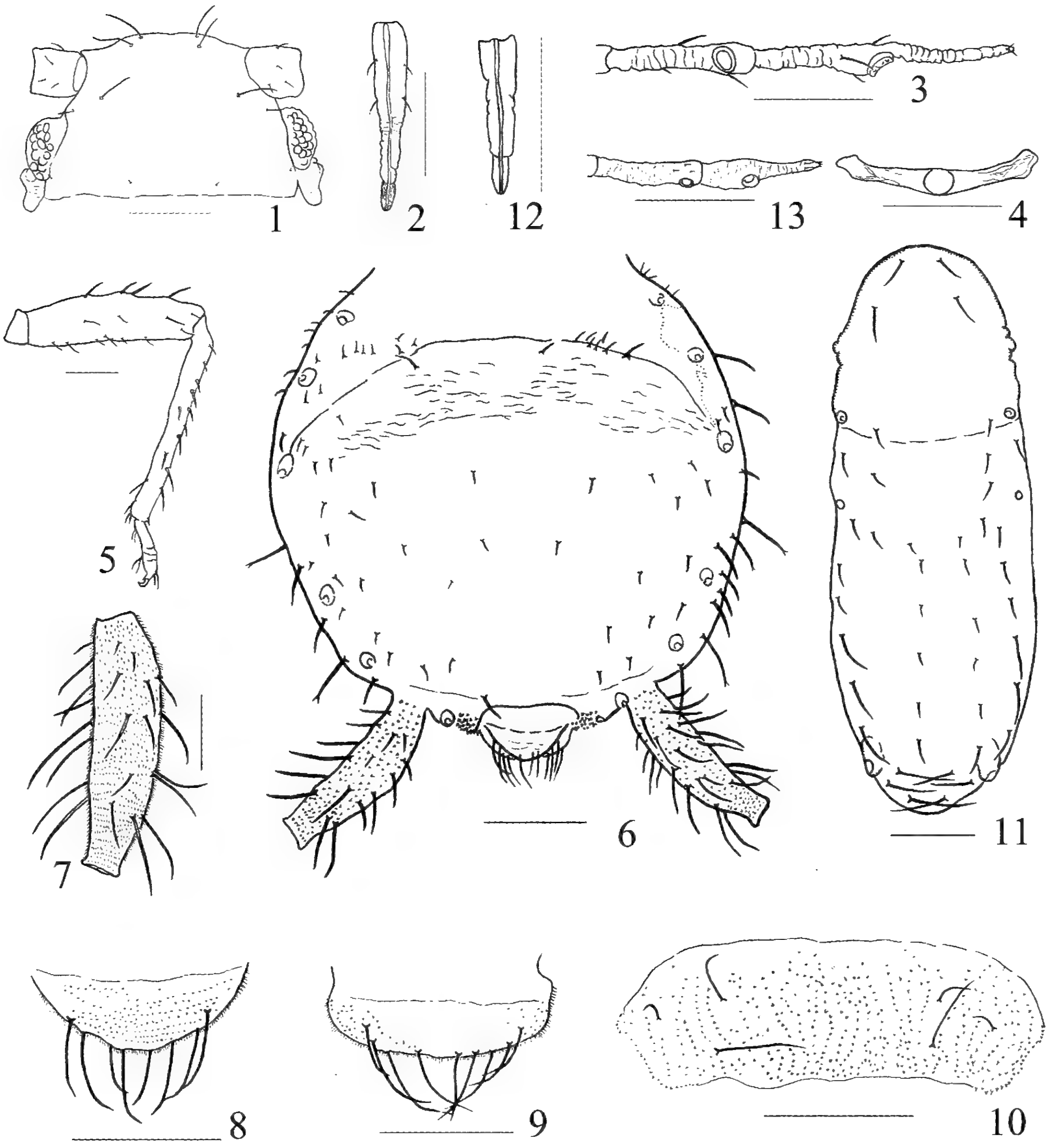
Distribution. Indonesia (Java).

Mesotrichosiphum pentaiarticulatum Zhang and Qiao, NEW SPECIES
(Figures 1-13)

Etymology. The new species is named after its 5-segmented antenna.

Description. Apterous viviparous female. Head and thorax black or blackish green, abdomen brown, siphunculi black in life. General measurements see Table 1. Mounted specimens: Body pear-shaped. Head: Antennal segment IV, base of segment V and ocular tubercles dark brown, other parts brownish. Head fused with prothorax. Only distal half of antennal segments III to V with transverse imbrications, other parts smooth. Median front slightly convex, antennal tubercles indistinct (Fig. 1). Dorsal hairs sparse and elongate, with acuminate apex; ventral hairs fine, long and pointed. Head with 1 pair of frontal hairs, 1 pair of dorsal hairs between antennae, and 3-5 pairs of dorsal hairs between eyes, among which 1 pair of distinct long. Eyes multi-faceted, with ocular tubercles. Antennae 5-segmented or occasionally 6-segmented (Fig. 3); length in proportion of antennal segments I-V: 23: 16: 100: 39: 45+35, respectively. Antennal hairs sparse and most short, pointed at apex, segments I-V each with 4 or 5, 3-5, 11-16, 3 or 4, 2-4+0 hairs, respectively, apex of processus terminalis with 3 hairs. Rostrum reaching the posterior margin of abdominal segment II; ultimate rostral segment long wedge-shaped (Fig. 2), with 3 pairs of primary hairs and 2 pairs of secondary hairs. Thorax: Dorsum of thorax brownish. The lateral and ventral surfaces with transverse wrinkles. Dorsal hairs of thorax sparse and tiny. Pronotum with 4 hairs; mesonotum with 12-16 hairs; metanotum with 8 hairs. Mesosternal furca blackish brown, sclerotized distinctly, with a short stem (Fig. 4), length of single arm 0.09-0.11, 2.50-3.67 times as long as widest diameter of antennal segment III. Legs with sturdy hairs (Fig. 5). Trochanter separated from femur. Coxae, trochanters and femora brown, tibiae and tarsi brownish. Base of each coxae coarsely spinulose. First tarsal chaetotaxy: 5, 5, 5. Abdomen: Brown, except the lateral parts of tergites I-III pale brown. Abdominal tergites I-III each with 1 pair of brown marginal patches, each of which bears 1 or 2 stout and ramifying dorsal hairs. Dorsal patches on the median part of tergites II to VII fused to each other, forming a large round sclerotized patch, which has transverse wrinkles dorsally. Tergite VIII brown, heavily sclerotized, and coarsely spinulose. Most dorsal hairs of abdomen sparse and tiny, only marginal hairs thick, long and ramifying; ventral hairs fine and pointed; dorsal hairs 2.00-3.00 times as long as ventral hairs. Abdominal tergites I-VI each with 10-24 hairs, respectively, somewhat irregularly arranged in 1-3 transverse rows; tergites VII and VIII each with 1 pair of spinal hairs (Fig. 6). Length of marginal hairs on abdominal tergite I 1.00-1.50 times as long as widest diameter of antennal segment III. Spiracles on prothorax and abdominal segments I-VII large, round and open. Siphunculi evenly brown, darker than the body, with a convex inner side and a slightly convex outer side (Fig. 7), enlarged in median part, gradually tapering to the apex, flange distinct, without a net work, entirely covered with spinulose imbrications and separate spinulae; 3.50-4.30 times as long as its widest part, 5.29-6.14 times as long as its distal width; with 32-46 long and thick hairs. Cauda and anal plate spinulose. Cauda semi-round (Fig. 8), 0.29-0.38 times as long as its basal width, with 8 thick long hairs and ventral network, without median processus. Anal plate transversely sub-elliptical (Fig. 9), with 10-14 thick long hairs. Genital plate transverse sub-oval (Fig. 10), with 6-8 hairs. Gonapophyses three, each with 3-5 short and pointed hairs.

First-instar viviparous nymph. General measurements see Table 1. Body long oval. Head pale brown, with 1 pair of frontal hairs, 1 pair of dorsal hairs between antennae, and



Figures 1-13. *Mesotrichosiphum pentaiarticulata* Zhang and Qiao, sp. nov. Figures 1-10, apterous viviparous female. 1. dorsal view of head; 2. ultimate rostral segment; 3. antennal segments IV-V; 4. mesosternal furca; 5. right hind tibia; 6. dorsal view of abdomen; 7. siphunculus; 8. cauda; 9. anal plate; 10. genital plate. Figures 11-13, embryo. 11. dorsal view of body; 12. ultimate rostral segment; 13. antennal segments III-IV. Scale bars in figs 1-5 and 7-13: 0.10 mm; in fig 6: 0.20 mm.

1 pair of dorsal hairs between eyes. Eyes brown, with 3 facets. Antennae 4-segmented; length in proportion of antennal segments I-IV: 45: 33: 100: 58+48, respectively; antennal segments I-IV each with 3, 3, 2, 2+0 hairs, respectively, apex of processus terminalis with 3 or 4 hairs. Rostrum reaching the posterior margin of abdominal segment VI. Thoracic hairs sparse and tiny, pronotum with 1 pair of spinal and 1 pair of marginal hairs; mesonotum and metanotum each with 1 pair of spinal, 1 pair of pleural and 1 pair of marginal hairs. Legs entirely brown. First tarsal chaetotaxy: 2, 2, 2. Abdominal tergites I-VI each with 1 pair of spinal, 2 or 3 pairs of pleural and 1 pair of marginal sclerotized patches, the spinal ones occasionally fused with each other. Tergites I-VI each with 1 pair of thick and

ramifying marginal hairs and 4 dorsal hairs, each on a brown sclerite; tergite VII with 1 pair of marginal tubercles, protruding backwards, nipple-shaped, 0.05 mm long, 0.02-0.03 mm wide, each provided at apex with 1 long and thick hair, 0.09-0.10 mm, 1 pair of spinal hairs, 0.06-0.07 mm, on the posterior margin of the smooth sclerite; tergite VIII brown and heavily sclerotized, with spinulose imbrications and 1 pair of nipple-shaped tubercles which occupy the most part of the tergite and protrude backwards, each with 1 hair at apex. Siphunculi brown on abdominal segment VI, bare, cone-shaped with rounded apex. Cauda with 2 thick long hairs. Anal plate with 4 thick long hairs.

Embryo (in apterous viviparous female). Body long oval and entirely colorless (Fig. 11). Measurements: Body 0.75 mm long, 0.28 mm wide. Antenna 0.27 mm long, segments I-IV: 0.052, 0.039, 0.082, 0.052+0.045 mm long, respectively. Ultimate rostral segment 0.12 mm long (Fig. 12). Second hind tarsal segment 0.072 mm long. Head fused with prothorax. Eyes with 3 facets. Antennae 4-segmented, 0.36 times as long as body; segments III and IV with transverse imbrications (Fig. 13); length in proportion of segments I-IV: 63: 48: 100: 63+55, respectively; processus terminalis 0.87 times as long as base of the segment IV; segments I-IV each with 0, 2, 3, 0+0 stout and long hairs, respectively, apex of processus terminalis with 2 hairs; hairs on segment III tiny and fine. Rostrum reaching abdominal segment IV; ultimate rostral segment wedge-shaped, 3.83 times as long as basal width. Dorsal hairs tiny and sparse, only marginal hairs thick and long, pointed or ramifying. Head with 1 pair of frontal hairs and 1 pair of dorsal hairs between eyes. Pronotum with 1 pair of short pleural hairs; mesonotum with 1 pair of pleural and 1 pair of marginal hairs; metanotum with1 pair of pleural hairs. Abdominal tergite I with 1 pair of spinal, 1 pair of pleural and 1 pair of marginal hairs; tergites II-VI each with 1 pair of spinal and 1 pair of marginal hairs; tergite VII with 1 pair of spinal and 1 pair of pleural hairs; tergites VIII with 1 pair of spinal hairs. First tarsal chaetotaxy: 2, 2, 2. Siphunculi present.

Type Data. Holotype, apterous viviparous female, CHINA, Hainan, Diaoluoshan Reserve Region (N18°40', E109°54'), alt. 265 m, 27 Mar. 2006, on Fagaceae, leg. D. Zhang (ZMCAS, No. 18489). Paratypes, 5 apterous viviparous females, 3 first-instar viviparous nymphs, 1 embryo, from the same collection of holotype; 3 apterous viviparous females, alt. 300 m, 30 Mar. 2006, on *Castanopsis hainanensis*, other data same as holotype (ZMCAS, No. 18519).

Biology. This species infests on the young leaves of *Castanopsis hainanensis* (Fagaceae).

Remarks. Based on dense and long hairs on siphunculi and absence of any finger-like processi, this species is placed in the tribe Greenideini, subfamily Greenideinae. This species can be easily differed from the species of *Greenidea* Schouteden and *Mollitrichosiphum* Suenaga in having cauda without a median processus and hind tibiae without transverse ridge. In addition, the species in *Allotrichosiphum* Takahashi and *Tritrichosiphum* Robinson have seven or three hairs on the tarsal segment I, while this species has five. A similar arrangement of the tarsal chaetotaxy can also be observed in the genera *Eutrichosiphum* Essig and Kuwana and *Greenideoida* van der Goot, but in this species body hairs sparse and tiny; processus terminalis distinctly shorter than base of antennal terminal segment. Based on the above materials, and the keys of Ghosh (1993) and Noordam (1994), the new species should be placed in the genus *Mesotrichosiphum* Calilung. This species can be easily separated from other congeneric species in apterous viviparous females by antennae 5-segmented (occasionally 6-segmented), processus terminalis 0.71-0.87 times as long as base of the segment V; hind tibia 1.10-1.23 times as long as the width of head across eyes; siphunculi entirely covered with spinulose imbrications and separate spinulae.

Table 1. Biometric data (mean, range and standard deviation) of *Mesotrichosiphum pentaiarticulata* Zhang and Qiao, sp. nov. (apterous vivipara female and first-instar apterous nymph).

	Body part (see Methods for abbreviations)	Apterous vivipara females $n = 9$			First-instar apterous nymphs $n = 3$		
		Mean	Range	Stdev	Mean	Range	Stdev
Length (mm)	Body length	1.530	1.40-1.68	0.103	0.841	0.82-0.87	0.021
	Body width	0.925	0.88-1.05	0.057	0.326	0.30-0.34	0.024
	Head width	0.380	0.35-0.44	0.029	0.264	0.25-0.28	0.016
	Antenna	0.856	0.77-1.02	0.077	0.323	0.29-0.35	0.031
	Ant.I	0.074	0.07-0.08	0.005	0.052	0.05	0
	Ant.II	0.052	0.05	0	0.038	0.03-0.04	0.006
	Ant.III	0.312	0.29-0.35	0.026	0.113	0.10-0.12	0.010
	Ant.IV (Ant.IVb in first-instar nymph)	0.122	0.11-0.13	0.009	0.065	0.06-0.07	0.006
	Ant.Vb (PT in first-instar nymph)	0.144	0.13-0.15	0.007	0.055	0.04-0.06	0.012
	PT	0.122	0.10-0.13	0.012	—	—	—
	Length of hairs on Ant.III	0.026	0.02-0.04	0.007	0.014	0.01-0.02	0.003
	Ant.IIIWD	0.032	0.03-0.04	0.003	0.022	0.020-0.023	0.001
	URS	0.199	0.19-0.22	0.015	0.141	0.13-0.14	0.006
	BW URS	0.031	0.03	0	0.031	0.03	0
	Hind femur	0.371	0.34-0.43	0.030	0.155	0.15	0
	Hind tibia	0.443	0.39-0.48	0.047	0.192	0.18-0.21	0.012
	MW hind tibia	0.046	0.04--0.05	0.004	0.039	0.036-0.041	0.003
	2HT	0.108	0.10-0.11	0.005	0.079	0.07-0.08	0.006
	Length of hairs on hind tibia	0.051	0.04-0.06	0.005	0.043	0.041-0.046	0.003
	SIPH	0.386	0.34-0.44	0.035	0.096	0.07-0.11	0.021
	BW SIPH	0.067	0.06-0.07	0.006	0.048	0.04-0.05	0.006
	DW SIPH	0.068	0.06-0.07	0.005	?	?	?
	Cauda	0.054	0.05-0.06	0.005	0.029	0.026-0.031	0.003
	BW cauda	0.165	0.15-0.18	0.007	0.079	0.07-0.09	0.012
	Length of cephalic hairs	0.053	0.04-0.06	0.006	0.041	0.04	0
	Length of marginal hairs on tergum I	0.037	0.03-0.05	0.006	0.021	0.02	0
	Dorsal hairs on tergum VIII	0.048	0.04-0.06	0.008	0.081	0.077-0.082	0.003

Ratios	Antenna/Body	0.560	0.50-0.61	0.037	0.384	0.33-0.42	0.045
	Hind femur/Ant.III	1.200	1.03-1.54	0.169	1.371	1.25-1.50	0.125
	Hind tibia/Body	0.290	0.25-0.33	0.029	0.229	0.21-0.25	0.017
	PT/Ant.Vb (PT/Ant.IVb In first-instar nymph)	0.802	0.71-0.87	0.052	0.841	0.67-0.86	0.167
	URS/BW URS	6.444	5.67-7.00	0.471	4.556	4.33-4.67	0.192
	URS/2HT	1.852	1.70-2.00	0.109	1.792	1.63-2.00	0.191
	SIPH/Body	0.251	0.23-0.27	0.020	0.114	0.09-0.14	0.020
	SIPH/Cauda	7.208	6.17-8.60	1.04	3.268	2.81-3.67	0.434
	SIPH/BW SIPH	5.786	4.71-6.33	0.500	1.983	1.75-2.20	0.225
	Cauda/BW Cauda	0.327	0.29-0.38	0.031	0.373	0.33-0.43	0.050
	Length of hairs on Ant.III/Ant.IIIWD	0.826	0.67-1.33	0.236	0.618	0.50-0.68	0.102
	Cephalic hairs/ Ant. IIIWD	1.657	1.25-2.00	0.252	1.882	1.82-2.00	0.102
	Marginal hairs on Tergum I/ Ant.IIIWD	1.166	1.00-1.50	0.204	0.941	0.91-1.00	0.051
	Dorsal hairs on Tergum VIII/ Ant. IIIWD	1.500	1.00-2.00	0309	3.681	3.65-3.75	0.061
	Hairs on hind tibia/ MW hind tibia	1.102	1.00-1.34	0.121	1.089	1.00-1.14	0.078
	Head width/SIPH	0.979	0.90-1.09	0.059	2.856	2.40-3.71	0.744
	Head width/Cauda	7.119	5.67-8.60	0.898	9.140	8.00-10.42	1.216
	PT/SIPH	0.297	0.26-0.31	0.015	0.601	0.40-0.86	0.234

ACKNOWLEDGEMENTS

Thanks are due to Drs. R. L. Blackman and V. F. Eastop for having invited the corresponding author to BMNH on a study visit. Mr. M. Webb is thanked for providing assistance to the corresponding author during his visit to the BMNH. Ms. Caiping Liu prepared the slides. This work was sponsored by the National Natural Sciences Foundation of China (Grant No. 30570214, No. 30670240), CAS innovation program (No. KSCX2-YW-Z-011), the Ministry of Science and Technology of the People's Republic of China (MOST grant no. 2006FY110500), the National Science Fund for Fostering Talents in Basic Research (Special subjects in animal taxonomy, NSFC-J0630964/J0109), and Key Project of Science-technology Basic Condition Platform from The Ministry of Science and Technology of the People's Republic of China (No. 2005DK A21402).

LITERATURE CITED

Blackman, R. L. and V. F. Eastop. 1994. Aphids on the world's trees. An Identification and Information Guide. CAB International in association with The Natural History Museum. Wallingford, UK. 904 pp.+16 plates.

Calilung, V. J. 1967a. A new genus and species of Aphididae (Homoptera) on *Premna odorada* Blanco. The Philippine Agriculturist 51: 89-92.

Calilung, V. J. 1967b. A faunistic study of Philippine aphids (Aphididae, Homoptera). The Philippine Agriculturist 51: 93-170.

Noordam, D. 1994. Greenideinae from Java (Homoptera, Aphididae). Zoologische Verhandelingen 296: 1-284.

Qiao, G. X. 2000. *Allotrichosiphum* (Homoptera: Greenideidae), a newly recorded genus from China, and description of a new species. Entomological News 111: 307-311.

Remaudière, G. and M. Remaudière. 1997. Catalogue of the World's Aphididae, Homoptera Aphidoidea. Institut National de la Recherche Agronomique. Paris, France. 473 pp.

EFFECT OF MULTIPLE IMMERSIONS ON EGGS AND DEVELOPMENT OF IMMATURE FORMS OF *HAEMAGOGUS JANTHINOMYS* FROM SOUTH-EASTERN BRAZIL (DIPTERA: CULICIDAE)[1]

Jeronimo Alencar,[2] Hosana Moura de Almeida,[2] Carlos Brisola Marcondes,[3] and Anthony Érico Guimarães[2]

ABSTRACT: The effect of multiple immersions on *Haemagogus janthinomys* Dyar, 1921 eggs and the development of its immature forms were studied. Eggs of *Hg. janthinomys* from Linhares (state of Espírito Santo) were submitted to multiple immersions, counting the number of hatched eggs and observing the periods for development until adult. The egg-hatching proportion attained 42-88% (mean=68.2%), after 16 immersions, in three trials. After 8-9 immersions, the effect of additional immersions was negligible. The periods for development of immature forms were 3.67±0.89, 1.2±0.66, 1.12±0.63, 4.86±1.77, 2.25±0.67 and 12.40±0.82 days, respectively for 1st-4th instar larvae, pupae and the total. The postponement of the egg-hatching can be important for the production of mosquitoes, from one egg batch, during several months. The total period of larval development is very similar to previous indirect field calculations in the Brazilian state of Para and to mosquitoes from Panama studied in the laboratory.

KEY WORDS: Egg-hatching; immersion, development, diapause; drought; *Haemagogus janthinomys*; yellow fever

Haemagogus janthinomys Dyar, 1921 has been shown to be the most important vector of yellow fever in Brazil (Antunes and Whitman, 1937; Vasconcelos, 2003) and other countries (Trapido and Galindo, 1957), and has also been found infected by Mayaro (Hoch et al., 1981) and Ilhéus virus (De Rodaniche and Johnson, 1961). *Haemagogus janthinomys* feeds mostly in primates (Vasconcelos, 2003), but also on several other animals (Alencar et al., 2004).

This species lives mostly in primary forests, as is usual in other species of *Haemagogus*, and its immature forms develop in tree holes and in bamboo oviposition traps (Arnell, 1973). *Haemagogus* mosquitoes have a preference for ovipositing in bamboo traps with large horizontal holes, instead of those with small lateral holes, preferred by *Sabethes* mosquitoes (Galindo et al., 1951, 1955). The effect of immersions on the eggs of some species of *Haemagogus* from Panama was studied, but the resistance of eggs of *Hg. janthinomys* and the effect of immersions is poorly known (Galindo et al., 1955). Mattingly (1973, 1974) and Linley and Chadee (1991) described the morphology of the egg of this species; its dorsal surface adheres to surfaces by a glue, probably indicating a tendency to be fixed to surfaces, more accessible in cut bamboos than in holed ones.

---

[1] Received on May 8, 2007. Accepted on July 13, 2007.

[2] Department of Entomology, Oswaldo Cruz Institute - FIOCRUZ, 20945-900 Rio de Janeiro, Brazil. E-mails: jalencar@ioc.fiocruz.br, hosana@ioc.fiocruz.br, anthony@ioc.fiocruz.br, respectively.

[3] Department of Microbiology and Parasitology, Federal University of Santa Catarina, 88040-900 Florianópolis, Brazil. E-mail: cbrisola@mbox1.ufsc.br

Mailed on June 23, 2008

A study on the effect of multiple immersions of eggs of *Hg. janthinomys* on their hatching was developed. The development of larvae was observed until the emergence of adults.

METHODS

Egg collection in the field and processing

Haemagogus janthinomys eggs were obtained from ovitraps baited with leaves, utilized in a primary forest at Linhares Municipality (19°18'S 40°04'W, 25m a.s.l.), in the Brazilian south-eastern State of Espírito Santo; the locality was described by Borgonovi (1983). Ovitraps and their utilization were previously described (Alencar et al., 2005); briefly, 1-litre black flowerpots, containing four wood plates (2.5 x 14 cm), were exposed at 2.5-6 m above ground. Plates were exposed for 3-4 days, examined for the presence of eggs, and their number was recorded. The positive plates were transported dry to the laboratory in plastic bags, in polystirene boxes. The plates were then dipped in white trays, with tap water, at 29±1°C. The plates were maintained three days in the water, and were then removed, counting the hatched larvae. The egg-hatching was observed in three trials, respectively for 206, 156, and 495 eggs. The dipping was repeated 16 times, with intervals of three days.

Development of immature forms

Twenty-one first instar larvae were observed until the emergence of adults. The larvae received fish food (Tropi-Fish), and the excess of food and sediment was cleaned daily. The temperature was maintained at 28±1°C, and the photoperiod was 10:14 (L:D). The difference between the total periods for development for females and males was analysed by ANOVA. The genera were abbreviated as proposed by Reinert (2001).

RESULTS

Egg-hatching proportion varied, after 16 immersions, from 42 to 88%; the evolution of the proportion of hatching after the immersions can be seen in Fig. 1. After 8-9 immersions, the effect of additional immersions was usually negligible. As previously observed (Alencar et al., 2004), all eggs on the plates belonged to *Hg. janthinomys*. Williams' mean, a modified logarithmic mean (Bidlingmayer, 1969) was utilized.

One larva died in the second instar, three in the third and one in the fourth. The other 16 immature mosquitoes evolved to adults. The periods for the development of immature forms, with the ranges between brackets, were 3.67±0.89 (0-4), 1.2±0.66 (1-3), 1.12±0.63 (1-2), 4.86±1.77 (4-11), 2.25±0.67 (2-3) and 12.40±0.82 (11-13) days, respectively for 1st-4th instar larvae, pupae and the total. The mean duration for the cycle was 13.42±0.13 (13-14) and 12.75±2.75 (9-13), respectively for females and males; the difference was not significant.

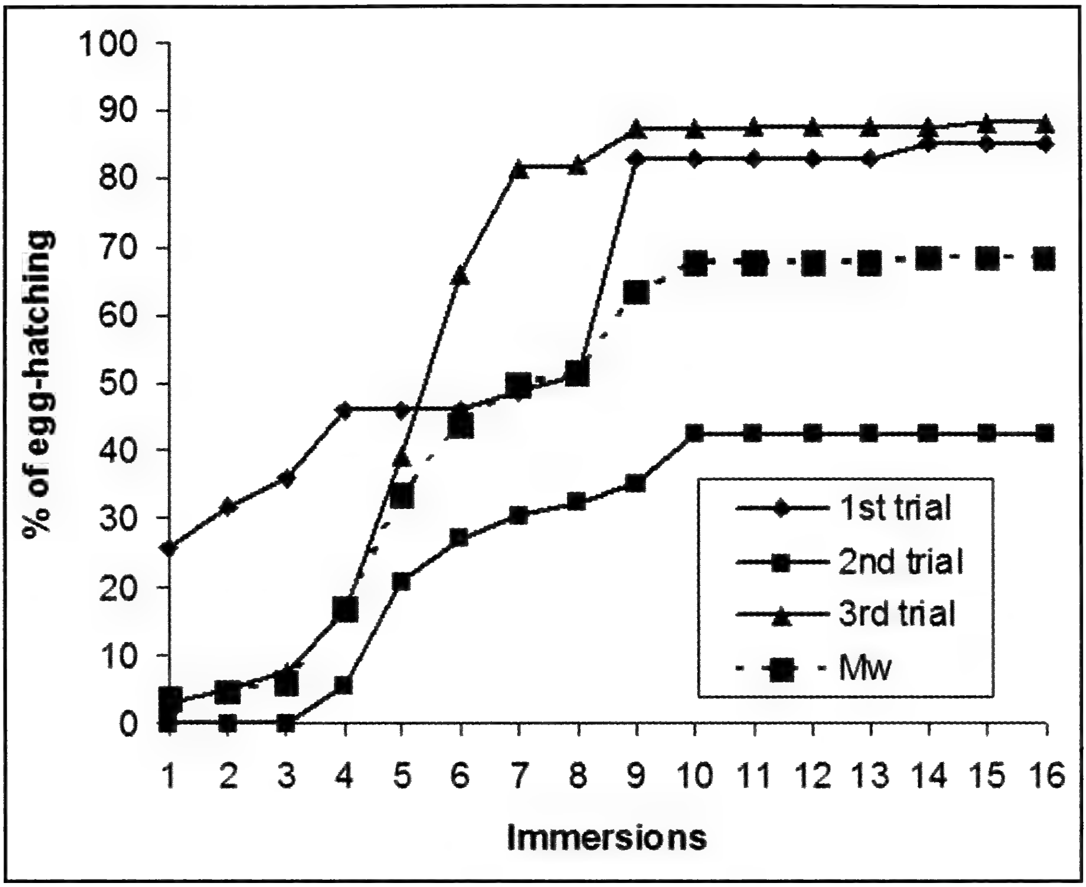


Figure 1. Effect of multiple immersions on the egg-hatching in *Hg. janthinomys*. M_W – Williams' Mean.

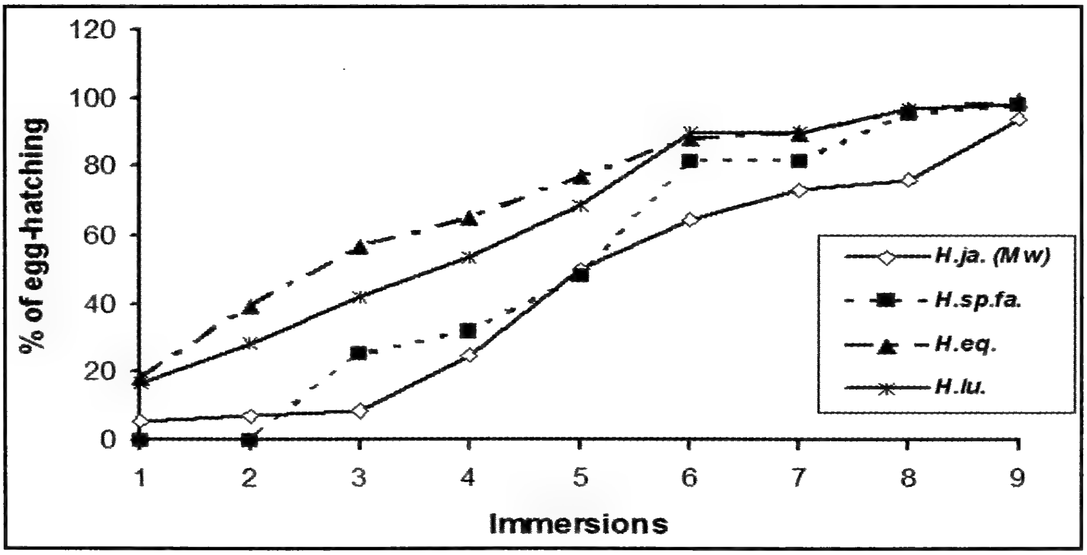


Figure 2. Effect of multiple immersions on the egg-hatching in *Hg. janthinomys* and three species of *Haemagogus* studied by Galindo et al. (1955 - Tables III and IV). H.ja. (M_W) – *Hg. janthinomys*; H.sp.fa. – *Hg. spegazzinii falco* (= *Hg. janthinomys*); H.eq. – *Hg. equinus*; H.lu. – *Hg. lucifer*.

DISCUSSION

Our results show variable effects of immersions; they are most evident when one compares the first to the third trial (Fig. 1). There was a cumulative effect of the immersions, until the 8th-10th immersions. Hovanitz (1946) observed hatching of eggs of *Hg. janthinomys* (as *Hg. spegazzinii falco*, see Arnell, *loc. cit.*) after one immersion. Galindo et al. (1955) submitted eggs from bamboo traps to 6 to 11 immersions, in two experiments, and respectively 8 and 44 eggs hatched, mostly after the 3rd and 4th immersions.

The observed proportions attained 85-90% after 9-11 immersions, in two trials, and the mean was almost 70% (Fig. 1). Although the effect of multiple immersions in the egg-hatching of *Hg. janthinomys* had been reported (Galindo et al., 1955), no complete information on the proportion of the eggs hatching was available for comparisons. The need of several immersions for the hatching of most eggs seems to occur in several populations of the species, even so distant as those from Panama and south-eastern Brazil.

If the egg-hatching index continues to rise after so many immersions, as observed for *Hg. janthinomys*, eggs deposited by the females, possibly in the same batch, can quickly produce adults after each rain strong enough to submerge the eggs. This high number of immersions and desiccations would probably be equivalent to several months, indicating that the production of adults can occur throughout the year, unless meteorological conditions are unfavourable for the egg-hatching. The observed period for the larval and pupal development of *Hg. janthinomys* (12.40±0.82 days) is very similar to that supposed for mosquitoes in the nature in Para State (13 days) (Dégallier et al., 2006).

This postponing of hatching in *Hg. janthinomys* was probably correlated to the late appearance of adults, compared to *Haemagogus equinus* Theobald, 1903 and *Haemagogus lucifer* (Howard, Dyar and Knab, 1912) in Panama (late June or July vs. May and early June) (Galindo et al., 1951). Supposing the sums of proportions of the hatched eggs in the tables of Galindo et al. (1955 - Tables III and IV) as 68.2% of the totals, as in the present study, all these species would have similar curves, with some postponing for *Hg. janthinomys* (Fig. 2). So, this small postponing of the egg-hatching could explain the differences among the three species. Since oviposition of females of *Hg. janthinomys* is significantly greater in wet season, compared to dry season, in Trinidad (Chadee et al., 1992), the gradual hatching of eggs may be a way to survive through the dry season. A study of seasonal variation of *Hg. janthinomys* in Rio de Janeiro is being developed (Alencar et al. – unpublished results).

Tap water was used in the present study. Maybe the presence of bacteria and nutrients (Gjulin et al., 1941; Barbosa and Peters, 1969) of a falling oxygen concentration (Judson, 1960) could influence the results. Since the hatching of *Ochlerotatus sierrensis* (Ludlow, 1905) (=*Aedes sierrensis*) (Reinert, 2000) occurred only when the oxygen concentration was very low (0.25 ppm or less) (Judson et al., 1966), the concentration for the hatching of eggs of *Hg. janthinomys* should be determined.

The effect of immersions can also be very important for survival, competition and seasonal fluctuation of some African mosquitoes in tree holes (Lounibos, 1981).

The influence of genetic programming and of physiological factors on the reaction of eggs of *Hg. janthinomys* to multiple immersions should be investigated. The eggs of these mosquitoes from Panama did not hatch before they were submitted to a period of at least two weeks under moist conditions (Galindo *et al.*, 1951). In the present study, this period was only the 3-4 days enough for the transportation of the eggs for the laboratory. This difference can also be related to biological differences due to the origin (south-eastern Brazil).

The dormancy of Aedine eggs usually ends in the first immersion, as in *Aedes aegypti* (Linnaeus, 1762), but some eggs can need more than one immersion for the hatching (Clements, 1963). This is known as *instalment hatching* (Gillett, 1955a), and is probably a strategy for the survival of mosquitoes in temporary pools submitted to several inundations (Andreadis, 1990). The regulation of this occurrence, variable between populations of the same species and eggs of the same female (Gillett, 1955b), is still not understood, and has not been studied for *Haemagogus* mosquitoes. The effect of multiple immersions on *Oc. albifasciatus* (Macquart, 1838) eggs is related to day-length and temperature (Campos and Sy, 2006).

ACKNOWLEDGEMENTS

To CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico, Proc. - 690143-0), for the financial help for part of this work (CBM). To Dr. Renato Moraes de Jesus, General Manager of Reserva Florestal de Linhares, for the collaboration to the development of this study.

LITERATURE CITED

Alencar, J. A., H. R. Gil-Santana, C. M. Lopes, J. S. Santos, and A. E. Guimarães. 2004. Utilização de armadilha "ovitrampa" para monitoramento de *Haemagogus janthinomys* (Diptera: Culicidae) em área de Mata Atlântica. Entomología y Vectores 11:369-374.

Alencar, J., E. S. Lorosa, N. Dégallier, N. M. Serra-Freire, J. B. Pacheco, and A. E. Guimarães. 2005. Feeding patterns of *Haemagogus janthinomys* (Diptera: Culicidae) in different regions of Brazil. Journal of Medical Entomology 42:981-985.

Andreadis, T. G. 1990. Observations on the installment egg hatching in the Brown Salt Marsh mosquito, *Aedes cantator*. Journal of the American Mosquito Control Association 6:727-729.

Antunes, P. C. A. and L. Whitman. 1937. Studies on the capacity of mosquitoes of the genus *Haemagogus* to transmit yellow fever. American Journal of Tropical Medicine 17:825-831.

Arnell, J. J. 1973. Mosquito studies (Diptera, Culicidae). XXXII. A revision of the genus *Haemagogus*. Contributions of the American Entomology Institute 10:1-174.

Barbosa, P. and T. M. Peters. 1969. Comparative study of egg hatching techniques for *Aedes aegypti* (L). Mosquito News 29:548-551.

Bidlingmayer, W. L. 1969. The use of logarithms in analyzing trap collections. Mosquito News 29:635-640.

Borgonovi, M. N. 1983. A Reserva Florestal de Linhares: Estado do Espírito Santo. Boletim da Fundação Brasileira de Conservação da Natureza 18:32-43.

Campos, R. E. and V. E. Sy. 2006. Variation in the hatching response of *Ochlerotatus albifasciatus* egg batches (Diptera: Culicidae) in temperate Argentina. Memórias do Instituto Oswaldo Cruz 101:47-53.

Chadee, D. D., E. S. Tikasingh, and R. Ganesh. 1992. Seasonality, biting cycle and parity of the yellow fever vector mosquito *Haemagogus janthinomys* in Trinidad. Medical and Veterinary Entomology 6:143-148.

Clements, A. N. 1963. The physiology of mosquitoes. International Series of Monographs on Pure and Applied Biology. Zoology Division. Volume 17. Pergamon Press. Oxford, England, United Kingdom. 393 pp.

De Rodaniche, E. and C. M. Johnson. 1961. St. Louis encephalitis in Panama. II. Survey of human blood for antibodies against St. Louis and two related group B viruses, Ilhéus and yellow fever. American Journal of Tropical Medicine and Hygiene 10:387-389.

Dégallier, N., H. A. O. Monteiro, F. O. Castro, O. V. Silva, G. C. Sá Filho, and E. Elguero. 2006. An indirect estimation of the developmental time of *Haemagogus janthinomys* (Diptera: Culicidae), the main vector of yellow fever in South America. Studies of Neotropical Fauna Environment 41:117-122.

Galindo P, S. J. Carpenter, and H. Trapido. 1951. Ecological observations on forest mosquitoes of an endemic yellow-fever area in Panama. American Journal of Tropical Medicine and Hygiene 31:98-137.

Galindo, P., S. J. Carpenter, and H. Trapido. 1955. A contribution to the ecology and biology of tree hole breeding mosquitoes of Panama. Annals of the Entomological Society of America 48:158-164.

Gillett, J. D. 1955a. Variation in the hatching response of *Aedes* eggs (Diptera: Culicidae). Bulletin of Entomological Research 46:241-254.

Gillett. J. D. 1955b. The inherited basis of variation in the hatching of *Aedes* eggs (Diptera: Culicidae). Bulletin of Entomological Research 46:255-265.

Gjullin, G. M., C. P. Hegarty, and W. B. Bollen. 1941. The necessity of a low oxygen concentration for the hatching of *Aedes* eggs (Diptera: Culicidae). Journal of Cellular Comparative Physiology 17:193-202.

Hoch, A. L., N. E. Peterson, J. W. Leduc, and F. P. Pinheiro. 1981. An outbreak of Mayaro virus disease in Belterra, Brazil. III. Entomological and ecological studies. American Journal of Tropical Medicine and Hygiene 30:689-698.

Hovanitz, W. 1946. Comparisons of mating behavior, growth rate, and factors influencing egg-hatching in South American *Haemagogus* mosquitoes. Physiological Zoology 19:35-53.

Judson, C. L. 1960. The physiology of hatching of aedine mosquito eggs: hatching stimulus. Annals of the Entomological Society of America 53:688-691.

Judson, C. L., Y. Hokama, and J. W. Kliewer. 1966. Embryogeny and hatching of *Aedes sierrensis* eggs (Diptera: Culicidae). Annals of the Entomological Society of America 59:1181-1184.

Linley, J. R. and D. D. Chadee. 1991. Fine structure of the eggs of *Haemagogus equinus* and *Hg. janthinomys* (Diptera: Culicidae). Journal of Medical Entomology 28:434-445.

Lounibos, L. P. 1981. Habitat segregation among African tree hole mosquitoes. Ecological Entomology 6:129-54.

Mattingly, P. F. 1973. Mosquito eggs XXII. Eggs of two species of *Haemagogus* Williston. Mosquito Systematics 5:24-26.

Mattingly, P. F. 1974. Mosquito eggs XXV. Eggs of some subgenera of *Aedes* with a further note on *Haemagogus*. Mosquito Systematics 6:41-45.

Reinert, J. F. 2001. Revised list of abbreviations for genera and subgenera of Culicidae (Diptera) and notes on generic and subgeneric changes. Journal of the American Mosquito Control Association 17:51-55.

Reinert, J. F. 2000. New classification for the composite genus *Aedes* (Diptera: Culicidae: Aedini), elevation of subgenus *Ochlerotatus* to generic rank, reclassification of the other subgenera, and notes on certain subgenera and species. Journal of the American Mosquito Control Association 16:175-188.

Trapido, H. and P. Galindo. 1957. Mosquitoes associated with sylvan yellow fever near Almirante, Panama. American Journal of Tropical Medicine and Hygiene 6:114-144.

Vasconcelos, P. F. 2003. Febre amarela. Revista da Sociedade Brasileira de Medicina Tropical 36:275-293.

DESCRIPTION OF THE LARVA OF *SEFRANIA BLEUSEI* PIC AND ASSIGNMENT OF *SEFRANIA SABULORUM* (BEAL) TO THE NEW GENUS *ARAPHONOTOS* BEAL AND KADEJ (COLEOPTERA: DERMESTIDAE)[1]

R. S. Beal, Jr.[2] and Marcin Kadej[3]

ABSTRACT: We describe the mature larva of *Sefrania bleusei* Pic and establish the new genus *Araphonotos* Beal and Kadej for the reception of *S. sabulorum* (Beal). We argue the latter species is erroneously assigned to the genus *Sefrania*. Tables comparing *S. bleusei* and *A. sabulorum* indicate a generic distinction between the two. Also provided are important differences between *Araphonotos* and the type species of *Novelsis* (*Attagenus horni* Jayne), the genus to which *S. sabulorum* was initially assigned.

KEY WORDS: *Sefrania bleusei, Sefrania sabulorum, Araphonotos sabulorum, Novelsis sabulorum,* Dermestidae, Attagenini, new genus, new combination

Sefrania Pic (1899) included only *S. bleusei* until Háva (2004) transferred *Novelsis sabulorum* Beal (1984) to *Sefrania*. Háva provided no justification for the transfer other than his remark, "All general morphological differences of the both species are identical."

The genus *Novelsis* was described by T. L. Casey in 1900. Beal (1954) designated *Attagenus horni* Jayne, 1882, as the type of the genus. Nearctic Attagenini were revised by Beal in 1970. In it, he considered the genus *Novelsis* a polymorphic assemblage. In 1984, Beal described the adult male and larva of *N. sabulorum*, a sand dune inhabiting species. He assigned the species to *Novelsis* with some misgivings, stating, "The systematic position of this species needs further investigation."

Sefrania bleusei was originally described from Algeria. Its African distribution is now known to include Tunisia and Morocco (Háva, 2003). It has recently been introduced into Poland (Ruta et al., 2004). In 1997, it was observed for the first time in the facilities of the Department of Systematic Zoology, Adam M. Mickiewicz University, Poznań. Larvae and adults of *S. bleusei* were collected in Poznań, Collegium Maius, by Konwerski and Bunalski (3-II to 26-V-2000) in dry bones of fish and amphibians stored in boxes. Adult males were taken on window sills. The species was reported by Ruta et al. (2004) in cultivars of insects and in dried entomological collections. No studies have been made on the biology of the species.

---

[1] Received on April 26, 2007. Accepted on July 13, 2007.

[2] C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado, USA. Author's mailing address: 1094 Pine Country Court, Prescott, Arizona 86303, USA. E-mail: rsbeal@northlink.com

[3] Department of Biodiversity and Evolutionary Taxonomy, Institute of Zoology, University of Wroclaw, ul. Przybyszewskiego 63/77, 51/148 Wroclaw, Poland. E-mail: entomol@biol.uni.wroc.pl. Authors listed alphabetically; each author equally responsible for the study.

Mailed on June 23, 2008

METHODS

All larval structures were observed using exuviae, of which we had about 30 specimens. Most morphological structures were observed in glycerin under phase contrast with a Nikon Eclipse E 600 microscope and figured using a drawing attachment. Drawing of the spiracle and the spiracular sclerite was made from a balsam-mounted slide of a larval cast using 975x magnification of a compound binocular microscope equipped with an ocular grid.

Eight adult specimens of *S. bleusei* were available for our study. Voucher specimens of adults and larval exuviae are deposited in the C. P. Gillette Museum of Arthropod Diversity at Colorado State University, Fort Collins, Colorado, U.S.A., in the University of Wroclaw (coll. of Department of Biodiversity and Evolutionary Taxonomy), and in the Academy of Agriculture in Poznań (coll. Department of Entomology), Wroclaw, Poland.

Special terms used

Antecostal suture. A thread-like suture near the anterior margin of nota 2 and 3 and the abdominal terga.

Acrotergite. That part of a tergum anterior to the antecostal suture.

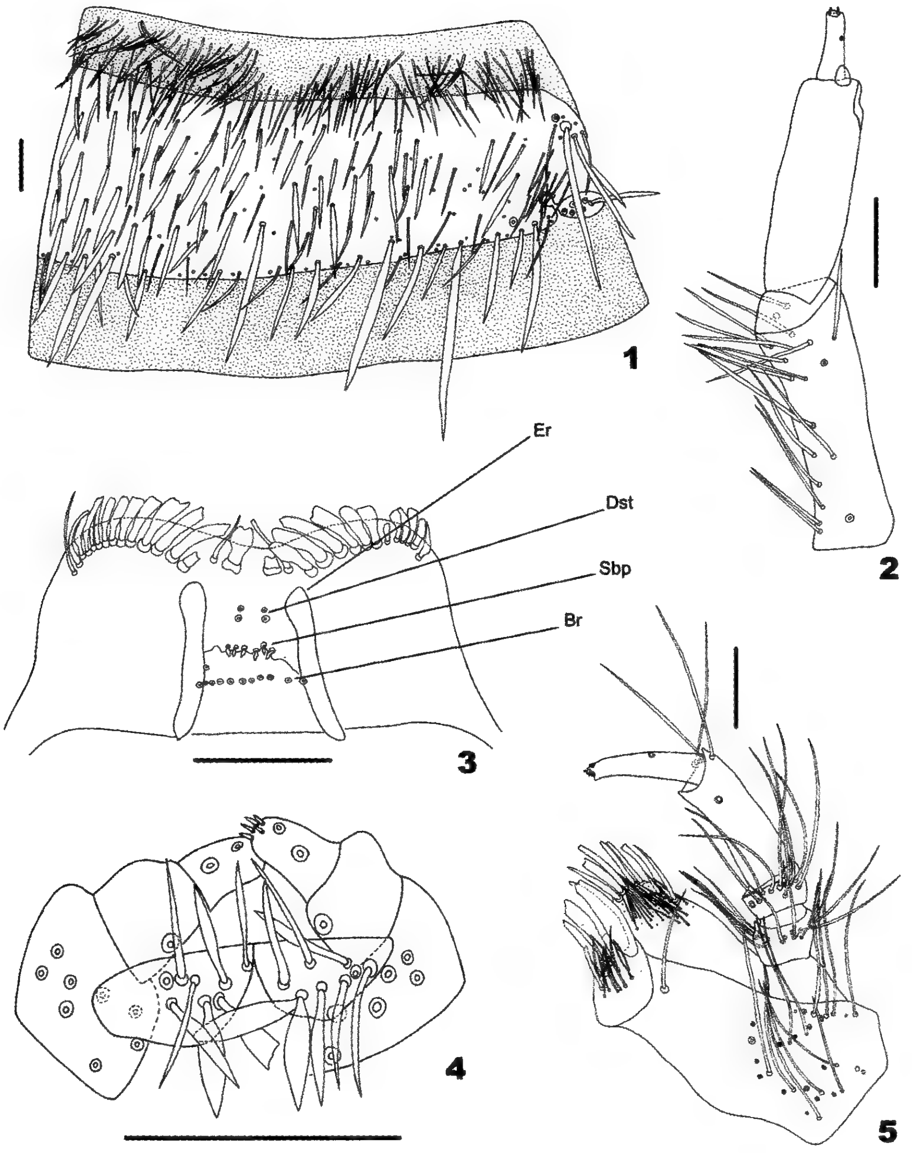
Prostheca. A small, hyaline projection from the base of the medial side of the larval mandible of some Dermestidae including some Attagenini (Rees, 1943).

Tergite. That part of a tergum posterior to the antecostal suture.

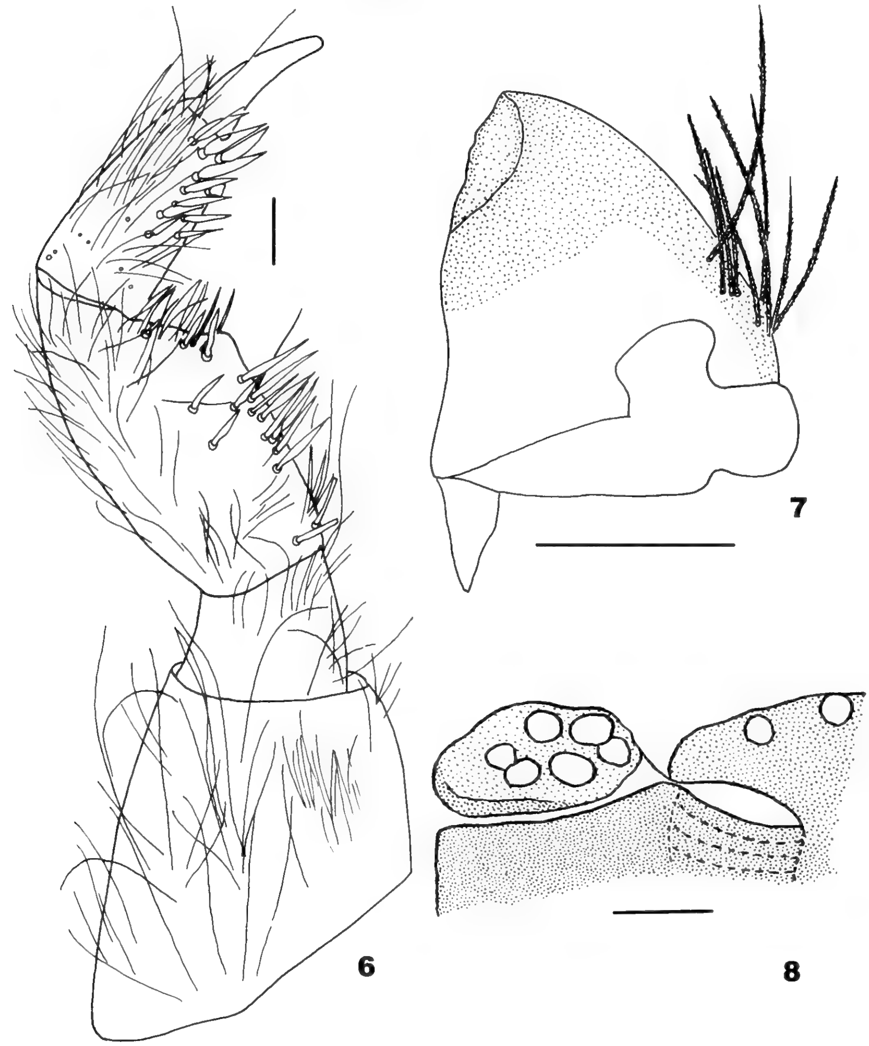
SYSTEMATIC ENTOMOLOGY

Sefrania bleusei Pic, 1899:29
Attagenus (Sefrania) bleusei Kocher, 1956:25
(Figs. 1-8)

Description: Mature larva. Dorsal and ventral surfaces of body covered with golden-brown setae. Longest setae of posterior margin of pronotum 1.3 times length of pronotum at midline; longest setae of lateral margin of pronotum 1.6 times length of pronotum at midline. Margins of setae smooth; larger setae with 4 ribs between margins; smaller setae with 2 or no discernable ribs between margins. Head with surface of frons and epicranial plates covered with narrowly ensiform setae about 1/3 length of frons and few very fine setae about as long as frons. Antenna as shown in Fig. 2; basal segment with numerous but variable number of setae; second segment with small apical sensorium on dorso-lateral side; sensorium appressed to base of segment 3. Epipharynx and labro-epipharyngeal margin (Fig. 3) with 11-14 sensory cups (Br) in proximal series; 6 sensory papillae (Sbp) in medial transverse series; 2 sensory cups (Dst) in distal transverse series; epipharyngeal rods (Er) as illustrated. Lateral margin of mandible with minute denticles over surface; prostheca not present (Fig. 7). Maxilla (Fig. 5) with first and second maxillary palp segments short bearing numerous setae; apices of galea and lacinia with strongly curved setae dorsally and numerous fine setae ventrally. Labium as in Fig. 4. Abdominal terga (tergum 1 shown in Fig. 1) with acrotergite bearing numerous fine setae, longest about 1/3 length of tergite. Disc of tergite with numerous setae; few setae fine but most wider and narrowly lanceolate; longest setae of disc of tergite about 1/3 length of tergum; disc without row of erect setae. Numerous long and short setae along posterior margin of tergite; longest about 1-1/3 times length of tergite. Spiracular sclerite of terga (Fig. 8) not projecting beyond lateral margin of tergum; 4 to 8 lanceolate setae inserted in sclerite. Spiracle slit-like with lateral side close to spiracular sclerite. Sterna entirely covered with setae with stoutest and longest on posterior margins. Legs covered with numerous long, fine setae; some setae as long as 3/4 length of metathoracic tibia. Prothoracic leg (Fig. 6).



Figs. 1-5. Larval structures of *Sefrania bleusei.* 1. Right half of abdominal tergum 1. 2. Antenna. 3. Epipharyng and labro-epipharyngeal margin. 4. Labium. 5. Maxilla. (Er, epipharyngeal rod; Dst, distal epharyngeal sensilla; Sbp, subproximal epipharyngeal sensilla; Br, basal row of epipharyngeal sensilla. Lines = 0.1 mm.)



Figs. 6-8. Larval structures of *S. bleusei*. 6. Prothoracic leg; 7. Mandible; 8. Spiracle and spiracular sclerite of 2d abdominal tergum. Empty circles are sockets for insertion of setae. (Lines = 0.1 mm.)

Araphonotos sabulorum **(Beal), new combination**

Novelsis sabulorum Beal, 1984
Sefrania sabulorum: (Háva), 2004

Description: The adult male and the mature larva were described by Beal (1984). Females remain unknown. As a monotypic genus, the original description suffices for the description of the new genus *Araphonotos*.

Etymology: *Araphonotos* is a combination of 2 Greek words; *araphos,* seamless, and *notos,* back, referring to the lack of antecostal sutures on the notal and tergal segments of the larva.

DISCUSSION AND COMPARISONS

Based on what is known of larvae and adults within the Attagenini, the differences listed in the following 2 tables are of generic significance and warrant removing *S. sabulorum* from the genus *Sefrania* and moving it to the new genus *Araphonotos*. There is a superficial dorsal similarity between adults of *A. sabulorum* and *S. bleusei*, yet when both adult and larval characters are considered, there is little doubt but that *A. sabulorum* does not belong to *Sefrania*. Probably the most convincing character arguing for separation of *S. bleusei* and *A. sabulorum* is the absence of antecostal sutures on the larval nota and terga of *A. sabulorum* and their presence on all other known Attagenini, including *Sefrania*.

Adult characters that we consider to be generically significant in view of characters found in other species of the Attagenini are the following:

(1) Profemora of *A. sabulorum* are stout, presumably adapted for a fossorial habitat. Profemora of *S. bleusei* are slender.
(2) The ratio of antennal segment 9 to segment 10 and segment 11 in *A. sabulorum* is 1:1.3:2.1. The ratio of length of segments 9 to segment 10 and segment 11 of the male antennal club in *S. bleusei* are 1:0.7:2.4.
(3) Segment 2 of protarsus of *A. sabulorum* is less than 2 times as long as segment 1 and only 2/13 as long as tibia. Segment 2 of protarsus of *S. bleusei* is 4 times as long as segment 1 and 2/5 as long as tibia;
(4) Protibia of *A. sabulorum* has long outer and somewhat shorter apical spines; the outer apical spine of the protibia extends to apex of tarsal segment 2. Tibiae of *S. bleusei* have apical spines subequal and extending very slightly beyond apex of tarsal segment 1.

The following are observed significant larval differences between *A. sabulorum* and *S. bleusei*.

(1) Nota 2 and 3 and all abdominal terga of *A. sabulorum* lack antecostal sutures. Nota 2 and 3 and all abdominal terga of *S. bleusei* have distinct antecostal sutures.
(2) *A. sabulorum* has numerous setae inserted on antennal segment 2. No setae are inserted on antennal segment 2 of *S. bleusei*.
(3) The spiracular sclerite of *A. sabulorum* is located almost entirely laterad of the lateral margin of the tergum. The spiracular sclerite of *S. bleusei* does not project beyond the lateral margin of the tergum (Fig. 8).
(4) 10 to 16 setae are inserted on the spiracular sclerite of *A. sabulorum*. At most, 8 setae are inserted on the spiracular sclerite of *S. bleusei*.
(5) Two pairs of longer stout setae on the ventral apex of the prothoracic tibia of *A. sabulorum* are 2/3 as long as pretarsal claw. Stout setae at the apex of tibia in *S. bleusei* are less than 1/2 as long as pretarsal claw. (In all significant respects, the meso- and metathoracic legs in *S. bleusei* are identical to the prothoracic leg.)

Although a general similarity of the adult body and antennae of *A. sabulorum* and *N. horni* suggests they are congeneric, larval differences shown in the table below clearly separate the two. Beal (1970) distinguished 6 groups of Nearctic Attagenini, each of which he considered generically distinct. Group I included the type species of *Attagenus*. Other than for Group I, he did not assign generic names to the groups, not having access to larvae of the type species of some named and described Palearctic genera (*Telopes* and *Lanorus*). He placed *N. horni* and related species in his Group VI.

(1) *A. sabulorum* lacks antecostal sutures on all nota and terga. Antecostal sutures are clearly present on the nota and terga of *N. horni*.

(2) *A. sabulorum* has 2 distal sensory cups on the epipharynx. *N. horni* lacks distal sensory cups on the epipharynx. Within the species assigned to Group VI of *Novelsis*, as far as is known, only *N. horni* and other members lack distal sensory cups.

(3) 12 to 17 setae are inserted on antennal segment 2 of *A. sabulorum*. No setae are inserted on antennal segment 2 of *N. horni*.

ACKNOWLEDGMENTS

For the generous loan of specimens used in this study we thank M. Bunalski of the Department of Entomology, Academy of Agriculture in Poznań, S. Konwerski of the Academy of Agriculture in Szczecin, and R. Ruta of the Zoological Institute, Wroclaw University. For helpful criticisms of the manuscript we thank A. Warchalowski, L. Borowiec, A. Kilian, J. Swietojańska, and R. Stelmaszczyk, each of the Zoological Institute, Wroclaw University, T. Kiselyova of Monroe, Georgia, and anonymous reviewers.

LITERATURE CITED

Beal, R. S. 1954. A revision of the species included in the genus *Novelsis* (Coleoptera: Dermestidae). Transactions of the American Entomological Society 80:73-90.

Beal, R. S. 1970. A Taxonomic and Biological Study of Species of Attagenini (Coleoptera: Dermestidae) in the United States and Canada. Entomologica Americana 45(3):141-235.

Beal, R. S. 1984. A New Sand-dune-inhabiting *Novelsis* (Coleoptera: Dermestidae) from California and Nevada. Proceedings of the Entomological Society of Washington 86(3):630-634.

Casey, T. L. 1900. Review of the American Corylophidae, Cryptophagidae, Tritomidae, and Dermestidae, with other studies. Journal of the New York Entomological Society 8:51-173.

Háva, J. 2003. World Catalogue of the Dermestidae (Coleoptera). Studie a zprávy Oblastního Musea Praha-vychod v Brandyse nad Labem a Staré Boleslaví, Supplementum 1. 196 pp.

Háva, J. 2004. World keys to the genera and subgenera of Dermestidae (Coleoptera), with descriptions, nomenclature and distributional records. Acta Musei Nationalis Pragae, Series B, Natural History 60(3-4):149-164.

Jayne, H. F. 1882. Revision of the Dermestidae of the United States. Proceedings of the American Philosophical Society 20:343-377, pls. 1-4.

Kocher, L. 1956. Catalogue commenté des Coléopteres du Maroc. Fasc. IV - Clavicornes et groupes voisins. Travaux de l'Institut Scientifique Chérifien 11:1-36.

Pic, M. 1899. Description d'un genre nouveau de Coléoptères d'Algerie. Bulletin de la Société Entomologique de France 1899:28-29.

Rees, B. E. 1943. Classification of the Dermestidae (Larder, Hide, and Carpet Beetles) based on larval characters, with a key to the North American genera. United States Department of Agriculture Miscellaneous Publication No. 511. 18 pp.

Ruta, R., Sz. Konwerski, M. Kadej, A. Herrmann, and A. Lasoń. 2004. Three dermestid beetles species (Coleoptera: Dermestidae) new to the Polish fauna and remarks on dermestids introduced to Poland. Polskie Pismo Entomologiczne 73:307-314.

ECTOLACHESILLA: A NEW GENUS OF LACHESILLIDAE (INSECTA: PSOCOPTERA) FROM AMAZONAS, BRAZIL

Alfonso Neri Garcia Aldrete

ABSTRACT: *Ectolachesilla ariasi* n.g., n. sp., is described from a single female collected in the state of Amazonas, Brazil. It belongs in subfamily Lachesillinae, and presents a combination of characters that makes it quite distinct from the other genera in the subfamily. Wing venation is caeciliusid, gonapophyses have a sclerotized band anteriorly, and the subgenital plate has two short, setose, postero-lateral lobes. A key to the genera of Lachesillinae is provided. The female holotype will be deposited in the INPA Collection, Manaus, Amazonas, Brazil.

KEY WORDS: Psocoptera, Amazonas, Brazil, *Ectolachesilla,* new genus

Among the specimens of Psocoptera in the Collection of Invertebrates of the Instituto Nacional de Pesquisas da Amâzonia (INPA, Manaus, Amazonas, Brazil), made available for study thanks to the kindness of Dr. José Albertino Rafael, researcher of that institution, I found a female specimen of a lachesillid (subfamily Lachesillinae, as diagnosed by García Aldrete (2006)) whose characters do not allow inclusion in any of the genera in the subfamily (*Hemicaecilius, Lachesilla* and *Nadleria*); this specimen presents wing venation and gonapophyses typical of Lachesilla, and a unique subgenital plate, unlike the subgenital plates in the genera of the subfamily, strongly reminiscent of the subgenital plate in species of *Ectopsocus*, in the neighboring family Ectopsocidae (Yoshizawa 2002); it hence constitutes an undescribed genus, and the purpose of this paper is to describe it and to provide a key to the genera in the subfamily.

The specimen was dissected in 80% ethyl alcohol, and the head, wings, legs and genitals were mounted on a slide in Canada Balsam; unfortunately, the epiproct and paraprocts were almost lost in preparation due to the poor condition of the specimen, as it had dried out and did not reconstitute well in acetic acid and soap solutions. Measurements (in µm) of parts on the slide were taken with a filar micrometer whose measuring unit is 1.36 µm for wings and 0.53 µm for other parts. Abbreviations of parts measured are as follows: FW: length of right forewing, HW: length of right hindwing, F, T, t1, t2: lengths of femur, tibia and tarsomeres 1 and 2 of hind leg, ctt1: number of ctenidobothria on t1, Mx4: length of fourth segment of right maxillary palp, IO: minimum distance between compound eyes, D: antero-posterior diameter of right compound eye, d: transverse diameter of right compound eye, PO: d/D. The female holotype will be deposited in the Collection of Invertebrates, INPA, Manaus, Amazonas, Brazil.

---

[1] Received on August 7, 2007. Accepted on September 25, 2007.

[2] Instituto de Biología, Universidad Nacional Autónoma de México, Departamento de Zoología, Apartado Postal 70-153, 04510 México, D. F. Mexico. E-mail: anga@ibiologia.unam.mx

Mailed on June 23, 2008

SYSTEMATIC ENTOMOLOGY

Group Homilopsocidea
Lachesillidae, Lachesillinae
Ectolachesilla NEW GENUS (FEMALE)

Diagnosis. Description. With five distal inner labral sensilla, a central placoid, flanked on each side by a trichoid and outer placoid. Vertex of head not impressed. Wing venation caeciliusid (forewing Rs two-branched, M three-branched, areola postica free), veins Rs and M of forewing fused for a distance; hindwing Rs two-branched, M single, Rs and M fused basally for a distance (Fig. 1). Lacinial tip bifid, outer cusp larger than the inner one (Fig. 2). Pretarsal claw with a preapical denticle, pulvillus slender, acuminate (Fig. 3). Subgenital plate with two postero-lateral short lobes, each bearing distally a field of three setae; a row of setae along border of the gap between the lobes (Fig. 6). Gonapophyses: only v3 present, slender, setose, with a strongly sclerotized band anteriorly on outer edge (Fig. 4).

Differential diagnosis. See key plus the following. Differing from *Hemicaecilius* in having a setal field on each lobe of subgenital plate and in having a row of setae along border of gap between lobes. Differing from *Nadleria* in having vertex of head not impressed, and in lacking setae on the forewing membrane.

Generotype: ***Ectolachesilla ariasi* new species**

Ectolachesilla ariasi NEW SPECIES (FEMALE)

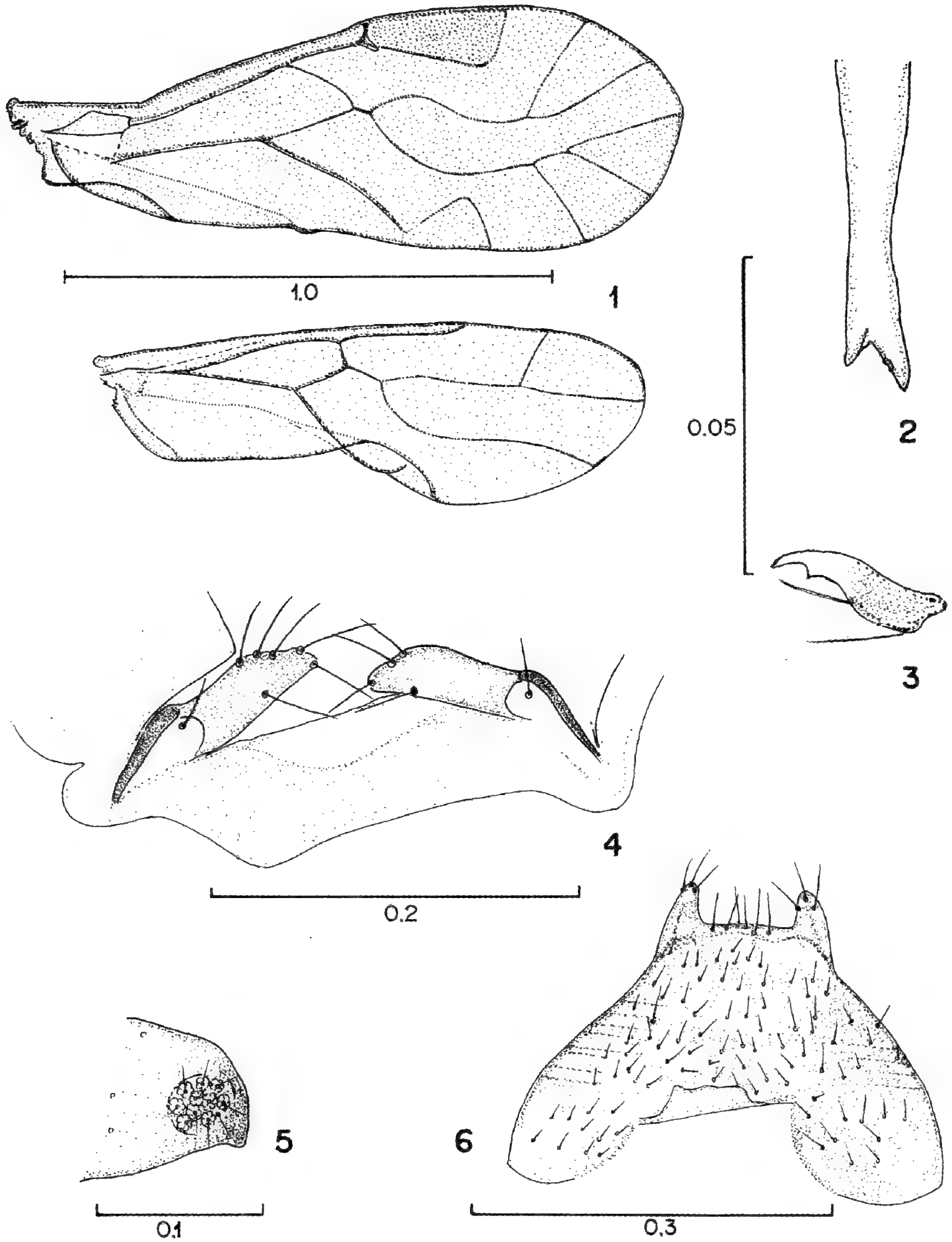
Color (in 80% alcohol). Body pale yellowish brown. Compound eyes black, ocelli hyaline, without pigmented centripetal crescents. Maxillary palps brown, antennae and legs pale brown, wings almost hyaline, with a pale orange hue, veins pale brown. Abdomen pale brown, with brown, transverse subcuticular rings, more pigmented dorsally.

Morphology. As described for the genus plus the following. Forewing pterostigma almost rectangular, wider distally, veins Rs and M fused for a distance, areola postica small, almost triangular (Fig. 1). Hindwing veins Rs and M fused basally for a distance (Fig. 1). Paraprocts with almost circular sensory field, bearing ten trichobothria issuing from basal rosettes and one marginal trichobothrium without basal rosette (Fig. 5).

Measurements. FW: 1413, HW: 1147, F: 303, T: 558, t1: 200, t2: 80, cttl: 15, Mx4: 73, IO: 240, D: 154, d: 86, IO/D: 1.55, PO: 0.55

Type Locality. Brazil. Amazonas. Río Purus. 13-17.VIII.1983, CDC trap (Center for Disease Control, cf. McNelly 1989), 1m. Jorge Arias. Holotype ♀.

Etymology. The generic name is a composite word formed with the root 'ecto,' from *Ectopsocus,* and *Lachesilla*, in reference to the combination of characters of both genera presented by the new taxon. The specific name honors Dr. Jorge Arias, its collector.



Figures 1-6. *Ectolachesilla ariasi* n. sp. ♀. 1. Fore- and hind-wings. 2. Lacinial apex. 3. Pretarsal claw. 4. Gonapophyses. 5. Proximal half of right paraproct. 6. Subgenital plate. Scales in mm.

KEY TO THE GENERA IN SUBFAMILY LACHESILLINAE

1. Veins Rs and M in forewing meeting in a point or fused for a distance 2
-. Veins Rs and M in forewing joined by a crossvein 3

2. Female subgenital plate simple, without posterior projections; gonapophyses with or without a sclerotized band anteriorly on outer edge ....*Lachesilla* Westwood
-. Female subgenital plate with a pair of rounded, setose lobes, projected posteriorly; gonapophyses with a strongly sclerotized band anteriorly on outer edge ....*Ectolachesilla* García Aldrete

3. Subgenital plate simple; vertex of head impressed; forewings with a large field of setae anteriorly on wing membrane.. ....*Nadleria* Badonnel and García Aldrete
-. Subgenital plate with two slender, glabrous posterior projections; vertex of head impressed; forewings without a field of setae on wing membrane ....*Hemicaecilius* Enderlein

DISCUSSION

To erect a new taxon of generic level on basis of a single female specimen presents risks, and I will try to justify such a decision in what follows. The specimen here dealt with presents a combination of characters that makes it different from the genera in the subfamily Lachesillinae; it has wing venation and gonapophyses typical of *Lachesilla,* but the subgenital plate, with postero-lateral, setose lobes are not seen in species of any of the 14 species groups recognized in the genus. The fact that *Lachesilla ariasi* García Aldrete (2004), was described from a male collected in the same CDC trap, the same date in the same locality as *Ectolachesilla ariasi,* opened the possibility of both taxons being conspecific; although there are some differences in forewing venation, definitive proof of distinctness was provided by a male-female association of *Lachesilla ariasi,* collected near Villa Tunari, Cochabamba, Bolivia, in April, 2005: the female has subgenital plate and gonapophyses typical of species in group Forcepeta of *Lachesilla.* A preliminary cladistic analysis of the genera of Lachesillinae, including also an undescribed genus from southern Mexico, and utilizing *Ectopsocus* as outgroup, indicates that *Ectolachesilla* is close to *Lachesilla,* and that *Nadleria* and *Hemicaecilius* are sister groups. *Ectolachesilla* shares with *Lachesilla* the wing venation, and the gonapophyses having a sclerotized anterior band; the genus is defined by a distinct autapomorphy: the *Ectopsocus*-like subgenital plate. The closeness of *Nadleria* and *Hemicaecilius* is supported by the following characters, shared by both genera: vertex impressed, forewing Rs-M joined by a crossvein, paraprocts with mesal prongs, epiproct with posterior projections—one in the latter, one or two in the former,—and similar structural plan of the male claspers: slender, short distal ends in *Nadleria*, and slender, very long distal ends in *Hemicaecilius* (the information for the latter comes from the only known male of this genus, an undescribed species in my collection, from Cuzco, Peru). In addition, species of *Nadleria* have a field of setae on the forewing membrane, and the subgenital plate of *Hemicaecilius venezolanus* García Aldrete and Mockford (1997), has two slender, smooth postero-lateral projections, and the area between the projections is glabrous, unlike *E. ariasi* (compare Fig. 6 in this paper with Fig. 5 in García Aldrete and Mockford 1997). The above justifies the erection of *Ectolachesilla* as a new genus, close to *Lachesilla*. This genus, presently including more than 300 species in 14 species groups will probably have to be fragmented in the future, to create several genera, on the basis of some of the present species groups.

ACKNOWLEDGMENTS

I thank Dr. José Albertino Rafael (INPA, Manaus, Amazonas, Brazil), for making available for study the Psocoptera in the INPA collection. Felipe Villegas (Instituto de Biología, UNAM) provided technical support during the preparation of this paper. I thank Instituto de Biología, Universidad Nacional Autónoma de México, for supporting my research on the Psocoptera throughout the years. Dr. Edward L. Mockford (Illinois State University, Normal, Illinois, U.S.A.), Dr. Charles Lienhard (Muséum d'histoire naturelle, Genève, Switzerland), and three anonymous reviewers read a former version of this manuscript and provided important and useful comments that improved it; my gratitude for all of them.

LITERATURE CITED

García Aldrete, A. N. 2004. New species of Psocoptera (Insecta) from Brazil. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 75(2): 303-311.

García Aldrete, A. N. 2006. New genera of Psocoptera (Insecta), from Mexico, Belize and Ecuador (Psoquillidae, Ptiloneuridae, Lachesillidae). Zootaxa 1319: 1-14.

García Aldrete, A. N. and E. L. Mockford. 1997. The position of *Hemicaecilius* (Psocoptera: Lachesillidae) and description of a new species from Venezuela. Entomological News 108(2): 102-106.

Mc Nelly, J. R. 1989. The CDC trap as a special monitoring tool. Proceedings of the 76th Annual Meeting of the New Jersey Mosquito Control Association, Inc. pp. 26-33.

Yoshizawa, K. 2002. Phylogeny and higher classification of suborder Psocomorpha (Insecta: Psocodea: 'Psocoptera'). Zoological Journal of the Linnean Society 136: 371-400.

A NEW SPECIES OF THE LEAFHOPPER GENUS *BALEJA* MELICHAR, 1926 FROM COLOMBIA (HEMIPTERA: CICADELLIDAE: CICADELLINAE)[1]

Gabriel Mejdalani[2] and Luiz G. N. Rodrigues[2]

ABSTRACT: A new species of *Baleja* Melichar, 1926, is described and illustrated based on specimens from Colombia (Nariño and Valle del Cauca departments). *Baleja bella* sp. nov. can be distinguished from other species of the genus mainly by the color pattern and male genital structures. The new species presents on the head a pair of peculiar lenticular sclerites, delimited by the loral sutures and adjacent to the frons, which are for the first time reported for *Baleja*. Taxonomic notes on the genus are included.

KEY WORDS: Hemiptera, Auchenorrhyncha, Membracoidea, Cicadellini, *Baleja*, sharpshooter, morphology, Colombia

The genus *Baleja* Melichar, 1926, currently comprises five species and is recorded from Nicaragua, Costa Rica, Panama, Colombia (including Gorgona Island), French Guiana, Ecuador, Bolivia, and Brazil (Young, 1977). The known species are: *B. discordans* Young, 1977, *B. flavoguttata* (Latreille, 1811), *B. marginula* (Osborn, 1926), *B. rufofasciata* (Distant, 1879), and *B. serratula* (Breddin, 1902). According to Young (1977), *Baleja* belongs to the *Paromenia* complex of genera. It shares with two other genera of this complex, *Jozima* Young, 1977, and *Parathona* Melichar, 1926, a peculiar feature: the apical margin of the clypeus is concave and has a pair of lateral lobes (Fig. 2). Specimens of *Baleja* are also superficially similar to those of *Diedrocephala* Spinola, 1850, and *Lebaja* Young, 1977.

Baleja can be distinguished from the aforementioned genera, as well as from other Cicadellini genera, by the following combination of characters (Young, 1977): (1) head (Fig. 1) well produced with anterior margin narrowly rounded to acutely subangular in dorsal view, (2) ocelli (Fig. 1) located slightly behind a line between anterior eye angles (well behind in *Parathona*), (3) crown without a median fovea (with a fovea in *Lebaja*), (4) clypeus (Fig. 2) with apical margin concave and with a pair of lateral lobes (convex in *Diedrocephala*), (5) forewings (Fig. 3) with apex convex (concave in *Diedrocephala*), (6) paraphyses absent or vestigial, (7) aedeagus (Fig. 8) with shaft directed dorsally or posteriorly (decurved ventrally in an acute process in *Jozima*).

In this paper, a new Colombian species of *Baleja* is described and illustrated based on a male and female from Tumaco, Department of Nariño, and an additional female from Obando, Department of Valle del Cauca. Taxonomic notes comparing the new species with the other known species of the genus are added.

---

[1] Received on July 4, 2007. Accepted on August 14, 2007.

[2] Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro 20940–040 RJ, Brazil. Email: mejdalan@acd.ufrj.br, luiz.gabriel.nog@hotmail.com, respectively.

Mailed on June 23, 2008

The presence in the new species of a pair of peculiar lenticular sclerites on the face is briefly discussed.

METHODS

Techniques for preparation of male and female genital structures follow those of Oman (1949) and Mejdalani (1998), respectively. The dissected parts are stored in microvials with glycerin and attached below the specimens, as suggested by Young and Beirne (1958). The morphological terminology follows mainly Young (1977), except that of the head, which follows Hamilton (1981), as suggested by Mejdalani (1998). The specimens herein described are deposited in the following institutions: Instituto de Ciencias Naturales, Universidad Nacional de Colombia (UNCB; Bogotá); Facultad de Ciencias Agrícolas, Universidad de Nariño (FAUN; Pasto); and Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ; Rio de Janeiro).

SYSTEMATIC ENTOMOLOGY

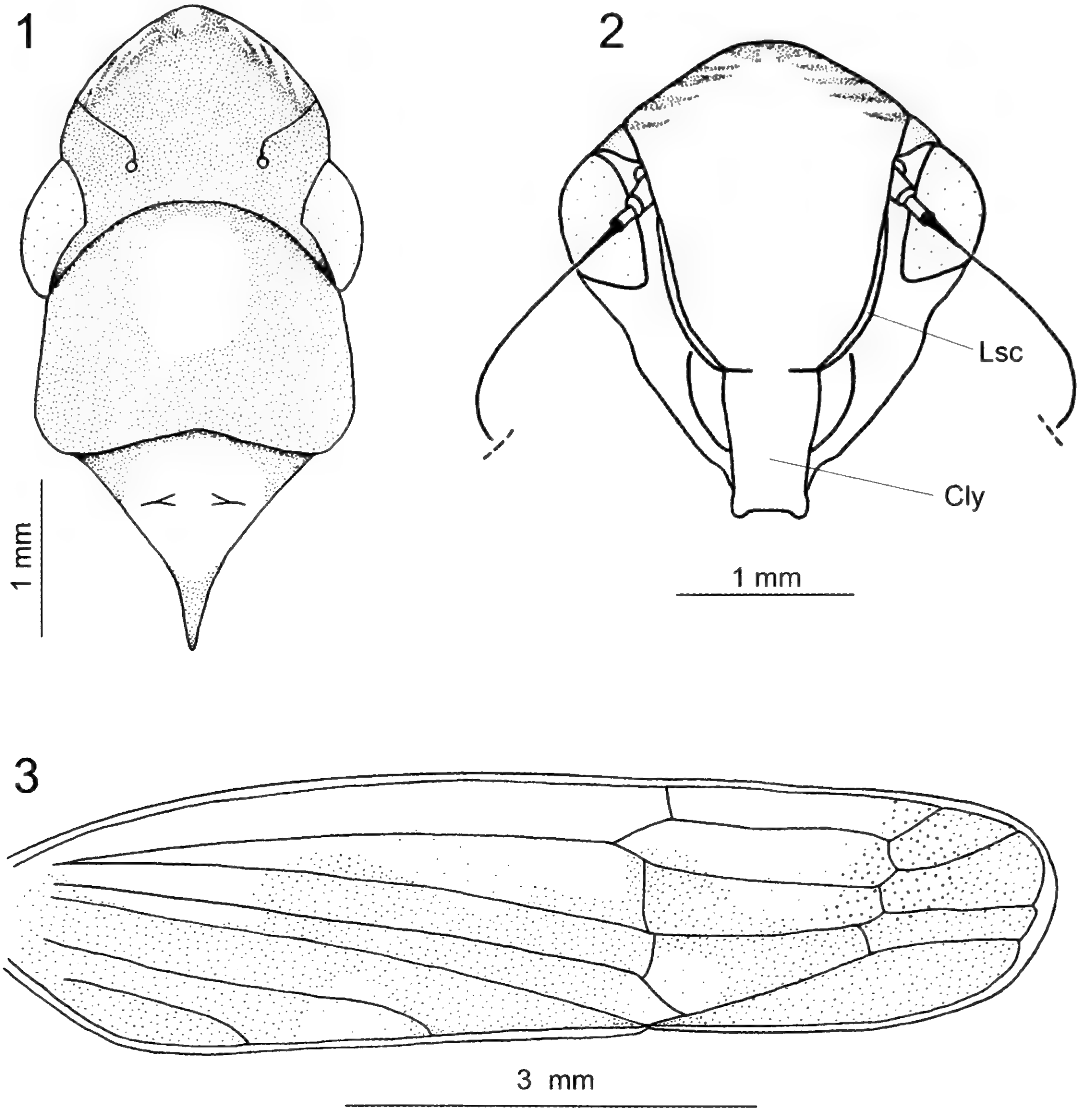
Baleja bella NEW SPECIES

(Figures 1-14)

Description of the Holotype. Length 10.6 mm. Head (Fig. 1) well produced anteriorly, deltoid; anterior margin rounded in dorsal view; without carina at transition from crown to frons. Ocelli (Fig. 1) located slightly behind imaginary line between anterior eye angles; each approximately equidistant from adjacent eye angle and median line of crown. Disk of crown (Fig. 1) flat; without median fovea, sculpturing or conspicuous setae. Frontogenal sutures (Fig. 1) clearly extending onto crown. Antennal ledges (Fig. 1) not protuberant in dorsal view; anterior margin convex and oblique in lateral view. Frons convex; muscle impressions distinct but not conspicuous. Epistomal suture (Fig. 2) incomplete medially. Clypeus (Fig. 2, Cly) with apical margin shallowly emarginate between apicolateral lobes. Loral sutures forming pair of lenticular sclerites (Fig. 2, Lsc) adjacent to frons.

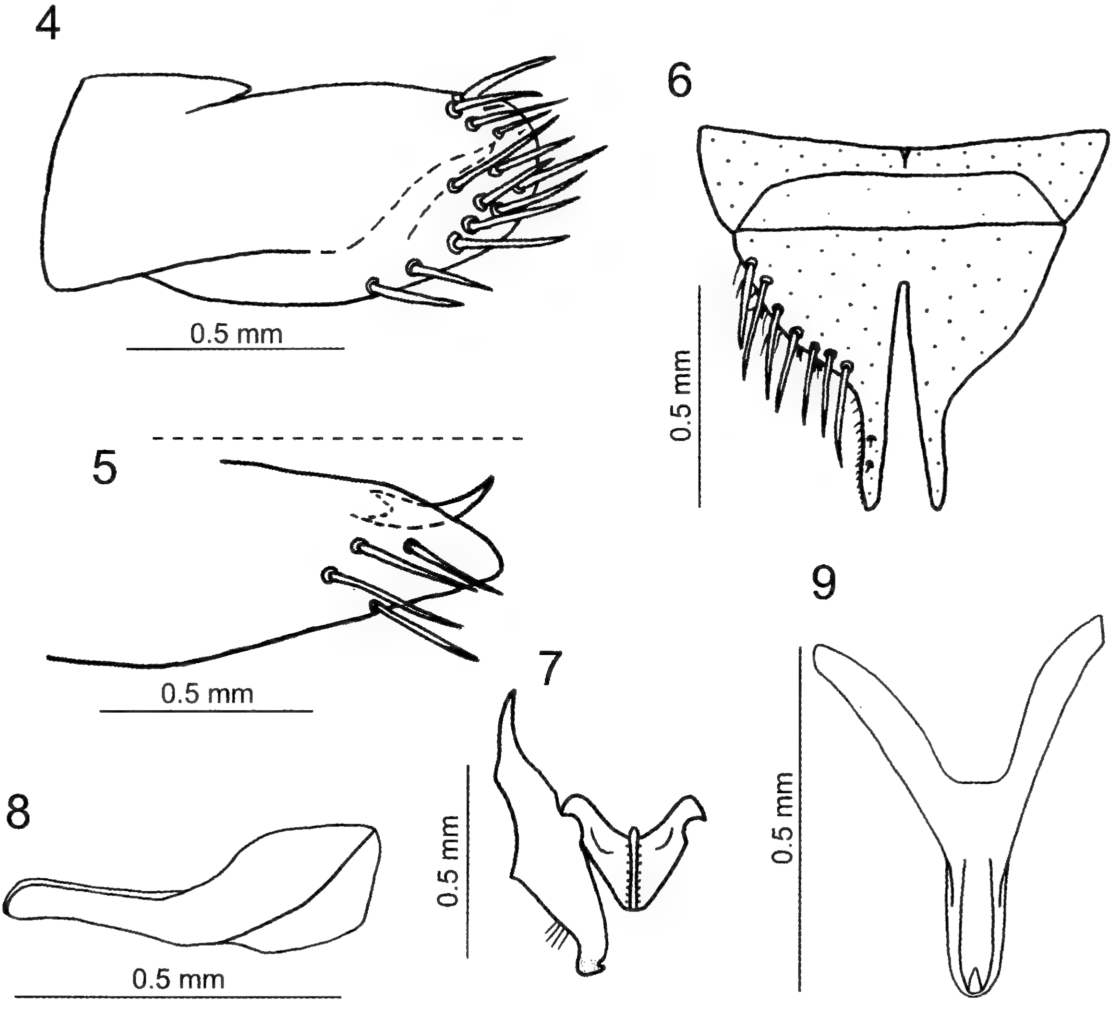
Thorax (Fig. 1) with pronotal width less than transocular width of head; lateral margins convergent anteriorly; dorsopleural carinae complete; posterior margin concave. Mesonotum (Fig. 1) not striate behind transverse sulcus. Forewings (Fig. 3) with four apical cells; veins not very distinct or elevated; texture coriaceous and without sculpturing. Hindlegs with femoral setal formula 2:1:1; length of first tarsomere greater than combined length of two more distal tarsomeres and with two parallel rows of small setae on plantar surface.

Male genitalia: Pygofer (Fig. 4) moderately produced with apical margin convex in lateral view; with large macrosetae along posterior margin and extending anteroventrally for short distance; inner surface with large spiniform process (Figs. 4 and 5) located on posteroventral portion and extending posterodorsally. Valve (Fig. 6) with posterior margin strongly broadly concave, separated from subgenital plates by trapezoidal membranous area. Subgenital plates (Fig. 6) triangular in ventral view; fused basally; short, not extending posteriorly as far as pygofer apex; with uniseriate macrosetae and with some microsetae along lateral margins. Styles (Fig. 7) extending posteriorly beyond apex of connective in dorsal view; with small median outer projection; without preapical lobe; with small number of setae on outer preapical margin; apex with very small, sharp projection directed inwards. Connective (Fig. 7) Y-shaped in dorsal view; anterior arms short; stalk with median dorsal keel. Aedeagus (Figs. 8 and 9) symmetrical, small and slender; without processes; truncate posteriorly in lateral view (Fig. 8); basal apodemes well developed, strongly divergent in ventral view (Fig. 9); gonopore (Fig. 9) located on apex.

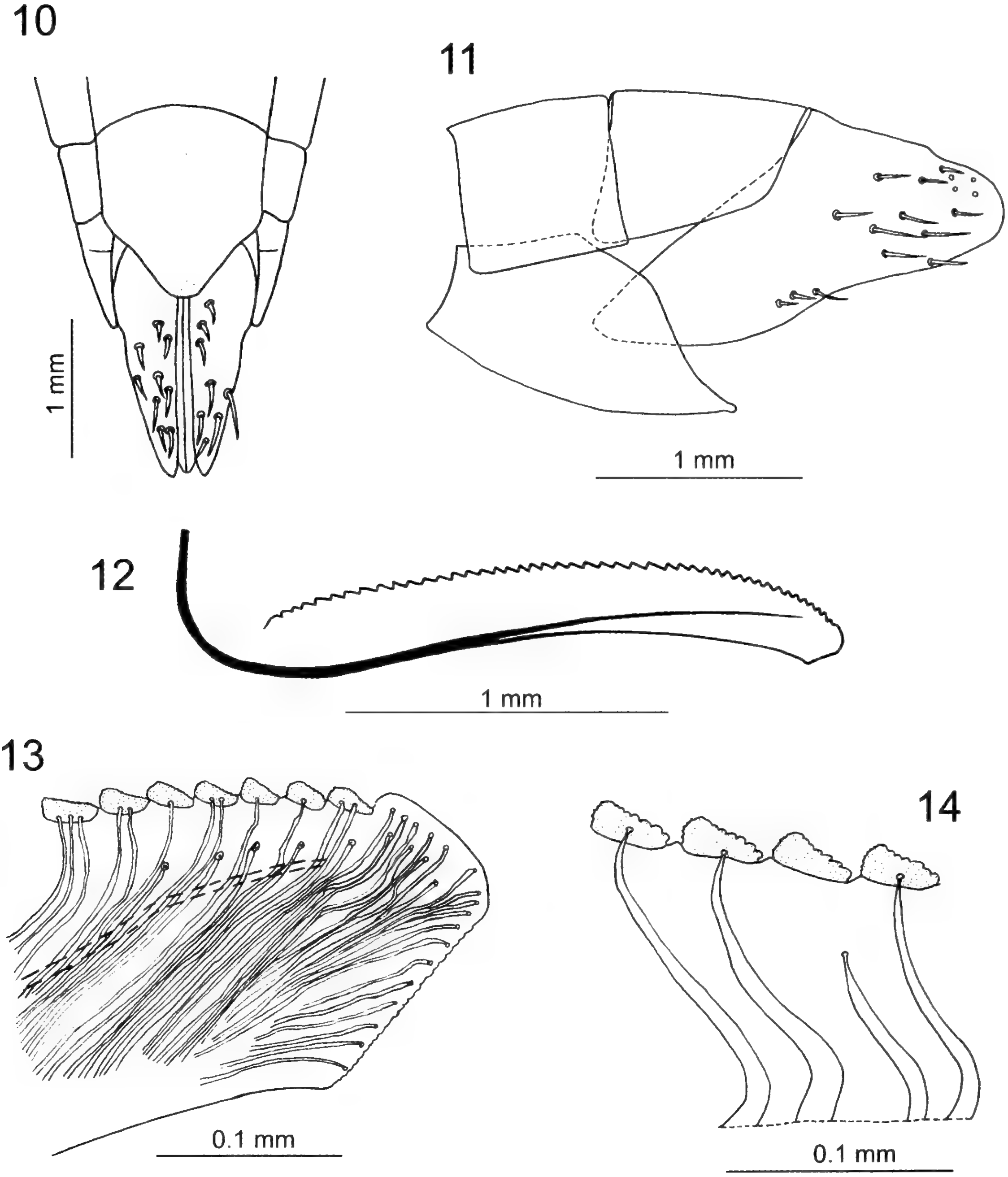


Figures 1-3. *Baleja bella* sp. nov. Fig. 1, crown, pronotum, and mesonotum, dorsal view. Fig. 2, head, frontal view. Fig. 3, forewing. Cly: clypeus. Lsc: lenticular sclerite.

Color: Anterior dorsum (Fig. 1) dark brown to black; anterior margin of crown with small median spot and small lateral stripes (extended from face), brownish-yellow; pronotum (Fig. 1) with large median yellow spot on anterior half; mesonotum (Fig. 1) with large median yellow spot covering most of its surface. Forewings (Fig. 3) brown; costal margin dull brownish-yellow (partially translucent) forming three conspicuous subtriangular projections on corium; with yellow elongate macula above median (second) projection; with red oblique macula on posterior portion of distal (third) projection; one yellow transcommissural spot on median portion of clavus; one yellow spot on corium adjacent to claval apex. Face (Fig. 2) and lateral and ventral portions of thorax mostly yellow to brownish-yellow. Abdomen mostly yellow in ventral view.



Figures 4-9. *Baleja bella* sp. nov., male genitalia. Fig. 4, pygofer, lateral view. Fig. 5, pygofer, ventral view. Fig. 6, valve and subgenital plates, ventral view (setae not shown on left plate). Fig. 7, style and connective, dorsal view. Fig. 8, aedeagus, lateral view. Fig. 9, aedeagus, ventral view.



Figures 10-14. *Baleja bella* sp. nov., female genitalia. Fig. 10, apical portion of abdomen, ventral view. Fig. 11, apical portion of abdomen, lateral view. Fig. 12, second valvula of ovipositor, general lateral view. Fig. 13, apical portion of second valvula, lateral view. Fig. 14, teeth on median third of second valvula, lateral view.

Female Paratypes (n = 2, one with spread forewings). Length 10.6 mm (n = 1, with wings in rest position). Forewings in rest position exceeding apex of ovipositor. Genitalia: Abdominal sternite VII (Fig. 10) with lateral margins slightly convergent posteriorly on basal half and strongly convergent posteriorly on apical half, the latter forming triangular projection; apex narrowly rounded. Pygofer (Figs. 10 and 11) moderately produced posteriorly in lateral view; posterior margin convex; with macrosetae on apical half and extending anteriorly along ventral margin. Second valvulae of ovipositor (Figs. 12-14) with preapical prominence distinct in lateral view; dorsal margin of shaft convex, with subtriangular teeth from basal portion to apex; each tooth (Fig. 14) bearing denticles; apical portion of shaft with larger denticles on ventral margin and minute ones on dorsal margin; apex of shaft (Fig. 13) narrowly rounded.

Type Data: Colombia. Holotype male with label "III-30-88 \ [San Andrés de] Tumaco (N [Nariño Department]) \ Rastrojo \ H. Castillo" (UNCB). One female paratype, same data as holotype (FAUN). One female paratype, "III/94 \ Motitui \ Obando [Valle del Cauca Department]" (MNRJ).

DISCUSSION

Baleja bella sp. nov. differs from other species of the genus by the following combination of features: crown with (1) an apical yellow spot and (2) small lateral stripes (extended from face) on anterior margin (Fig. 1); pronotum with (3) a median yellow spot on anterior half and with (4) lateral margins convergent anteriorly (Fig. 1); forewings with (5) costal margin brownish-yellow forming three conspicuous subtriangular projections on corium, with (6) yellow elongate macula above median projection, with (7) red oblique macula on posterior portion of distal projection, (8) one yellow transcommissural spot on median portion of clavus, (9) one yellow spot on corium adjacent to claval apex (Fig. 3); male pygofer with (10) its apical portion rounded, with (11) macrosetae along posterior margin and extending anteroventrally for short distance, and with (12) a spiniform process arising from its inner ventral portion and extending posterodorsally (Figs. 4 and 5); male valve (13) with posterior margin strongly broadly concave, separated from subgenital plates by a trapezoidal membranous area (Fig. 6); connective (14) Y-shaped (Fig. 7); (15) aedeagus small, simple, without processes (Figs. 8 and 9); female abdominal sternite VII with (16) lateral margins strongly convergent posteriorly on apical half, forming triangular projection, and with (17) apex rounded (Fig. 10).

The color pattern of *B. bella* is similar to those of *B. flavoguttata* (type-species), *B. serratula*, and *B. discordans* (Fowler, 1900; Breddin, 1902; Young, 1977). The above-mentioned features of the male genitalia will readily distinguish *B. bella* from these three species. The pygofer in *B. flavoguttata* has a concave posterior margin and the aedeagal shaft is curved dorsally and bears a pair of filamentous processes (Young, 1977). The latter processes are also present in *B. serratula* (Young, 1977). The pygofer in *B. discordans* has a dentiform projection on posterior margin and the aedeagus has one median, unpaired ventral process that is flattened and with lateral margins dentate (Young, 1977). None of these features are observed in the new species, in which the pygofer has a simple, convex posterior margin and bears a spiniform process arising from its inner ventral portion (Fig. 4), and the aedeagal shaft is small and has no processes (Fig.

8). Due to the absence of aedeagal processes, *B. bella* keys to *B. rufofasciata* in Young's (1977) key to the species of the genus (couplet 1). The latter species, which has at least four color varieties, has no pygofer processes (Young, 1977).

Two peculiarities are observed in the head of *B. bella*. One, the concave apex of clypeus with a pair of lateral lobes (Fig. 2, Cly), has already been reported by Young (1977) for the other species of *Baleja*. The other, the presence on face of a pair of elongate lenticular sclerites positioned between the gena and the frons (Fig. 2, Lsc), has not been reported for this genus. These sclerites are separated from the gena by the loral suture and from the frons, by the frontogenal suture (see Hamilton, 1981 and Mejdalani, 1998). Morphologically, they appear to be homologous with the upper portion of the lorum as recognized by Hamilton (1981) in *Melampsalta* Amyot, 1847 (Cicadidae) and *Evacanthus* Le Peletier and Audinet-Serville, 1825 (Cicadellidae). Similar sclerites were reported by Young (1977) in several genera of Cicadellini, mostly from Central America (e.g., *Apogonalia* Evans, 1947, *Camaija* Young, 1977, *Hadria* Metcalf and Bruner, 1936, and *Graphogonalia* Young, 1977). Such lenticular sclerites are apparently an uncommon feature. Considering that many Cicadellini genera are very similar externally, we believe that these sclerites should be searched for in other South American members of the tribe because their presence in a given species significantly reduces the possibilities of generic placement.

ACKNOWLEDGMENTS

Dr. Tito Bacca (Facultad de Ciencias Agrícolas, Universidad de Nariño) has kindly allowed us to study a small collection of Colombian sharpshooters under his care. The manuscript benefited from the useful comments of Alcimar Carvalho and Rachel Carvalho (Museu Nacional, Universidade Federal do Rio de Janeiro) and three anonymous reviewers. This research was supported in part by Fundação Universitária José Bonifácio (FUJB). A PIBIC fellowship from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) to LGNR is acknowledged.

LITERATURE CITED

Breddin, G. 1902. Neue neotropische Wanzen und Zirpen. Societas Entomologica 17:2-3.

Fowler, W. W. 1900. Order Rhynchota. Suborder Hemiptera-Homoptera. Biologia Centrali-Americana 2:257-264.

Hamilton, K. G. A. 1981. Morphology and evolution of the rhynchotan head (Insecta: Hemiptera, Homoptera). Canadian Entomologist 113:953-974.

Mejdalani, G. 1998. Morfologia externa dos Cicadellinae (Homoptera, Cicadellidae): comparação entre *Versigonalia ruficauda* (Walker) (Cicadellini) e *Tretogonia cribrata* Melichar (Proconiini), com notas sobre outras espécies e análise da terminologia. Revista Brasileira de Zoologia 15:451-544.

Oman, P. W. 1949. The Nearctic leafhoppers (Homoptera: Cicadellidae). A generic classification and check list. Memoirs of the Entomological Society of Washington 3:1-253.

Young, D. A. 1977. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 2. New World Cicadellini and the genus *Cicadella*. Technical Bulletin of the North Carolina Agricultural Experiment Station 239:1135pp.

Young, D. A. and B. P. Beirne. 1958. A taxonomic revision of the leafhopper genus *Flexamia* and a new related genus (Homoptera, Cicadellidae). Technical Bulletin of the United States Department of Agriculture 1173:1-53.

TWO NEW SPECIES OF THE GENUS *RHINOPPIA* BALOGH, 1983 (ACARI: ORIBATIDA) FROM TURKEY[1]

Ayşe Toluk[2] and Nusret Ayyıldız[2]

ABSTRACT: Two new species belonging to the genus *Rhinoppia* of the family Oppiidae were described and illustrated based on adult specimens collected from Artvin province, Turkey. One of these species, *Rhinoppia artvinensis* n. sp., was found in litter and soil under plum trees *(Prunus domestica)*, and the second species, *Rhinoppia tasdemiri* n. sp., was found in moss pads on the ground in a mixed forest (mostly *Pinus sylvestris*) and in the same place as for the previous new species.

KEY WORDS: Acari, Oribatida, *Rhinoppia*, Systematics, new species, Artvin, Turkey

The genus *Rhinoppia* was established by Balogh (1983) within the subfamily Oppiellinae Seniczak, 1975. And then, Subias and Balogh (1989) considered that this genus had to be excluded from the Oppiellinae, and placed it within the Medioppiinae. On the basis of the presence of four pairs of genital setae, Subias (2004) stated that there is only one species in the genus *Rhinoppia*. Later, Weigmann (2006) stated that there are six pairs of genital setae instead of four pairs of genital setae mentioned for the type species. He also synonymized the genera *Medioppia*, *Kunoppia*, *Lauroppia*, *Ctenoppiella* with *Rhinoppia*. So far, 26 species of the genus *Rhinoppia* are known (Subias 2007). Of these, two species viz. *Rhinoppia obsoleta* (Paoli, 1908) and *Rhinoppia subpectinata* (Oudemans, 1900) have been recorded before from Turkey (Özkan et al., 1994; Erman et al., 2007).

This paper describes two new species, *Rhinoppia artvinensis* n.sp. and *Rhinoppia tasdemiri* n.sp. on the basis of the materials collected from Artvin Province, Turkey.

METHODS

The specimens were collected in moss, soil, and litter samples from Artvin province and extracted using a Berlese funnel apparatus. They were fixed and stored in 70% ethanol. The specimens were sorted from the samples under a stereo microscope and mounted on slides in modified Hoyer's medium. Measurements and illustrations were made using a standard light microscope equipped with a drawing attachment.

The terminology used in this paper follows Grandjean (see Trave and Vachon, 1975), Balogh (1983) and Subias and Balogh (1989). All measurements are given in micrometers (μm).

---

[1] Received on August 2, 2007. Accepted on November 19, 2007.

[2] Department of Biology, Faculty of Arts and Sciences, Erciyes University, 38039 Kayseri, Turkey. E-mails: atoluk@erciyes.edu.tr; nayildiz@erciyes.edu.tr

Mailed on June 23, 2008

SYSTEMATIC ACAROLOGY

Acari: Oribatida: Oppioidea: Oppiidae: Medioppiinae
Rhinoppia Balogh, 1983

Rhinoppia artvinensis, NEW SPECIES

(Figs. 1-7)

Type Locality. TR. Artvin Prov. - Yusufeli, Bahçeli village, 850 m a.s.l., 20 September 1992.

Description. Holotype:

Measurements: Body length: 312-348 (holotype: 344), body width: 168-180 (holotype: 172). Ten specimens were measured.

Prodorsum (Figs. 1, 3): Rostrum elongate, nasiform, projecting medially, not incised. The rostral setae (*ro*) smooth, 22 in length. Lamellar setae (*le*) thin, smooth, 10 in length. Interlamellar setae (*in*) thick, 8 in length. Lamellar setae nearer to interlamellar setae than to rostral setae. A pair of tubercles behind the interlamellar setae present. The *le-le* distance is shorter than the *in-in*. Exobothridial setae (*exa*) smooth, directed towards centre of prodorsum. Two bothridial costulae, oriented in an anterior direction, and slightly convergent. Bothridia round, with small opening. Sensilli fusiform, medium long, its head expanded, short ciliated unilaterally.

Notogaster (Fig. 1): Oval shaped, anterior border convex. Crista absent. Ten pairs of smooth notogastral setae present, all different in length.

Ventral side (Fig. 2): Labiogenal articulation arched. Infracapitulum 72 in length, 48 in width. Setae *h* 2 in length. Distance *h-h* 16 in length. Prodorsum widest at *pdI* level. Epimeral borders distinctly visible and strongly sclerotized. Epimeral setal formula 3-1-3-3. Genital plates 36 in length, 40 in width, with six pairs of setae. Anal plates 46 in length, 48 in width, with two pairs of setae. One pair of aggenital and three pairs of adanal setae. Distance between genital and anal plates 82. Fissurae *iad* situated in para-anal position. Adanal setae ad_1 in postanal, ad_2 in para-anal and ad_3 in preanal positions.

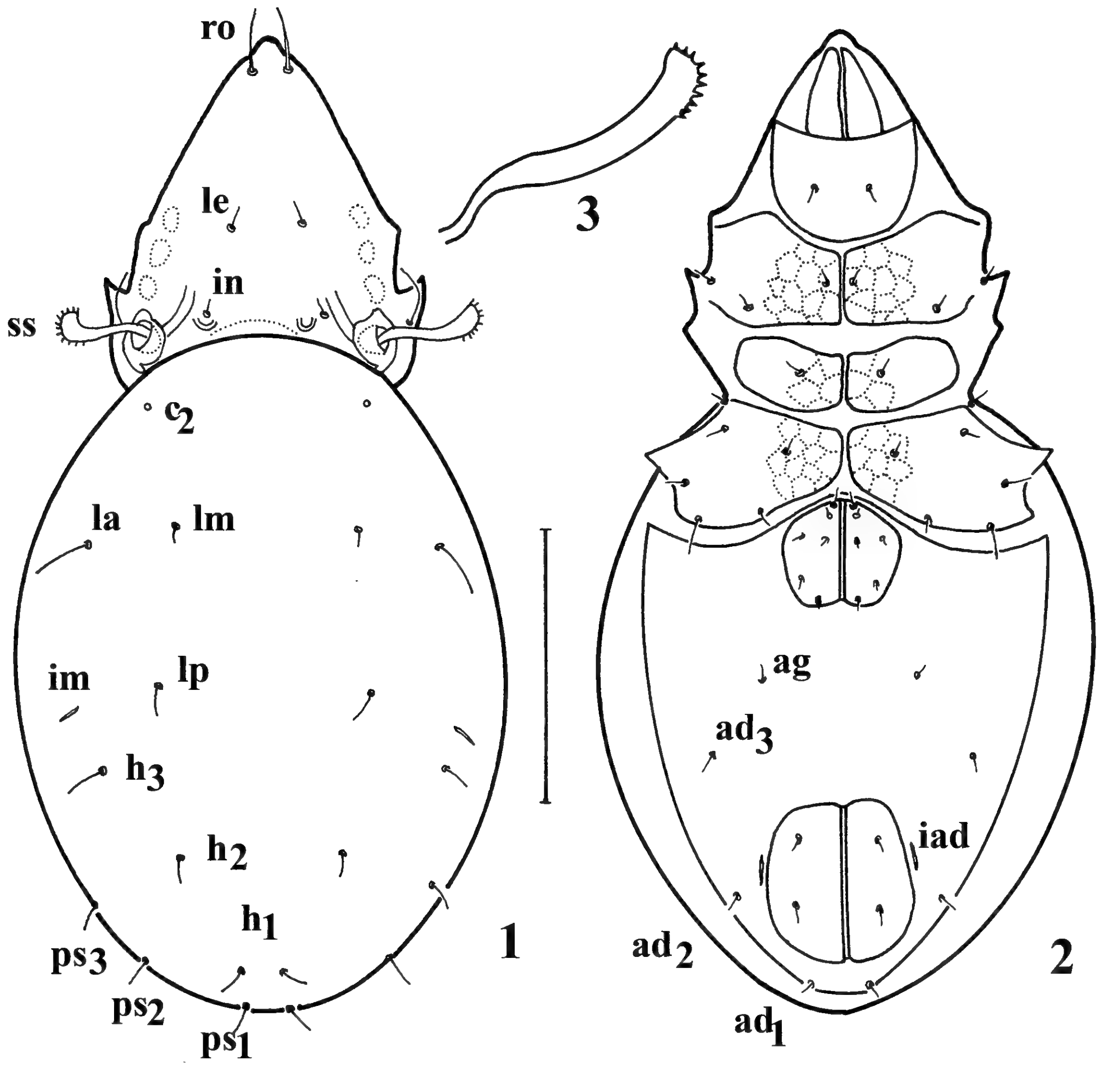
Legs: Formula of leg setation (trochanter to tarsus): I (1-5-2+1-4+2-21+2); II (1-5-2+1-4+1-13+2); III (2-3-1+1-3+1-12); IV(1-2-2-3+1-10). Structure and setation of legs I-IV as shown in Figures 4-7.

Material Examined: The type material is deposited in the Acarological Collection of the Zoological Museum, Erciyes University, Kayseri, Turkey (ZMEU). Holotype (ZMEU: 1) and 28 paratypes (ZMEU: 2-29) collected from litter and soil under plum trees *(Prunus domestica)*, Bahçeli village, Yusufeli, Artvin, Turkey; 850 m a.s.l.; 20 September 1992.

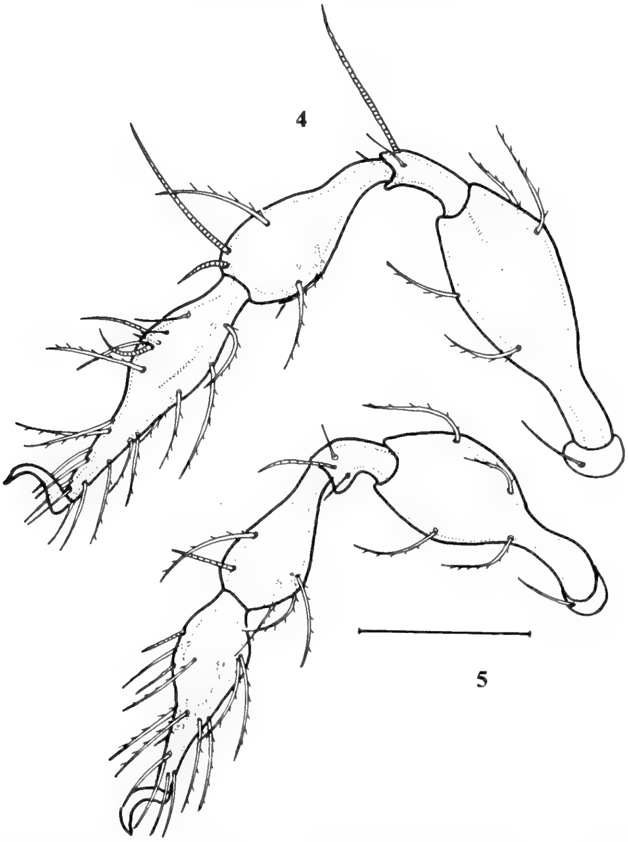
Discussion: This new species resembles *Rhinoppia hygrophila* (Mahunka, 1987) by having a pair of bothridial costulae. However; it can be distinguished from *R. hygrophila* by the following features: 1) ratio of prodorsal setae: *in* < le < *ro* = *ex* in the new species (ratio of prodorsal setae: *le* < *ro* < *ex* < *in* in *R. hygrophila*); 2) sensilli fusiform, medium long, their head expanded, short ciliated unilaterally in the new species (sensilli very long, their head dilated, with 2-3 cilia in *R. hygrophila*); 3) all notogastral setae different in length in the new species (all notogastral setae nearly equal in length in *R. hygrophila*).

This new species also resembles *Rhinoppia obsoleta* (Paoli, 1908) by the shape of sensilli (Paoli, 1908; Woas, 1986; Arillo and Subias, 1996; Subias and Arillo, 2001). However; it can be distinguished from *R. obsoleta* by the following features: 1) bothridial costulae present in the new species (absent in *R. obsoleta*); 2) the anterior notogastral margin convex in the new species (the anterior notogastral margin truncate in *R. obsoleta*).

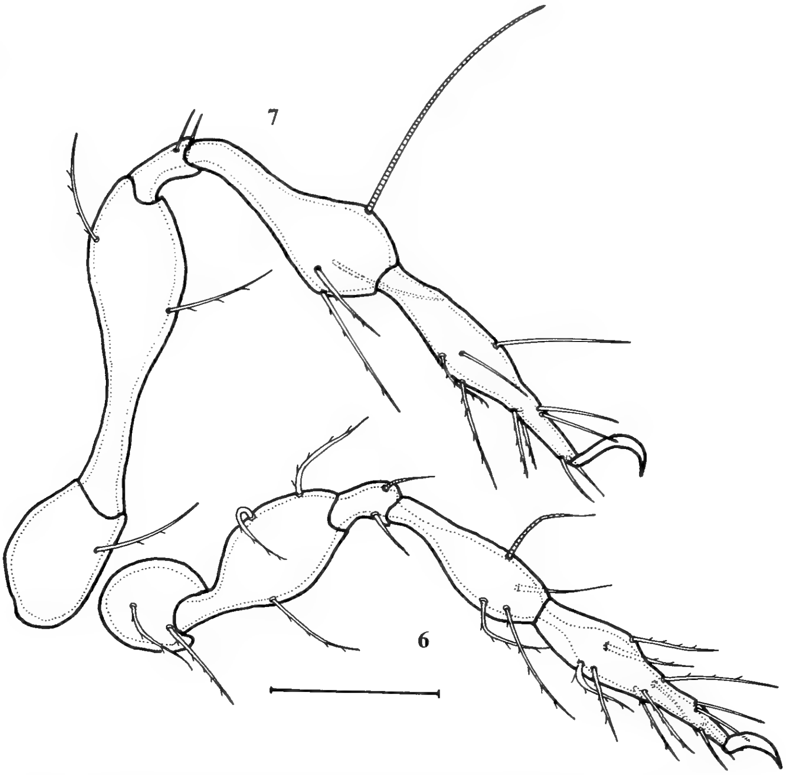
Etymology: The species is named after its locality which is Artvin province, Turkey.



Figs. 1-3. *Rhinoppia artvinensis* n.sp. – 1. Dorsal view; 2. Ventral view; 3. Sensillus (scale bar for all drawings = 100 µm).



Figs. 4, 5. *Rhinoppia artvinensis* n.sp. – Trochanter to tarsus: 4. Leg I, 5. Leg II (scale bar for all drawings = 40 μm).



Figs. 6, 7. *Rhinoppia artvinensis* n.sp. – Trochanter to tarsus: 6. Leg III, 7. Leg IV (scale bar for all drawings = 40 μm).

Rhinoppia tasdemiri, NEW SPECIES

(Figs. 8-13)

Type Locality. TR. Artvin Prov.- Yusufeli, Bahçeli village, 1350 m a.s.l., 20 September 1992 for Holotype and 30 paratypes; same locality as above, 850 m a.s.l., 20 September 1992 for 12 paratypes.

Description. Holotype:

Measurements: Body length: 356-388 (holotype: 356), body width: 172-212 (holotype: 176). Ten specimens were measured.

Prodorsum (Fig. 8): Rostrum elongate, nasiform, projecting medially, not incised. The rostral setae smooth, 22 in length. Lamellar setae thin, smooth, 2 in length. Interlamellar setae thick. Lamellar setae nearer to interlamellar setae than to rostral setae. The *le-le* distance are shorter than the *in-in.* Exobothridial setae smooth. Lamellar costulae absent. Bothridia round, with small opening. Sensilli long and their head being dilated, short ciliated bilaterally.

Notogaster (Fig. 8): Oval shaped. Crista absent, but there is a pair of short, diverging ridges extending across the sejugal groove. Ten pairs of smooth notogastral setae present.

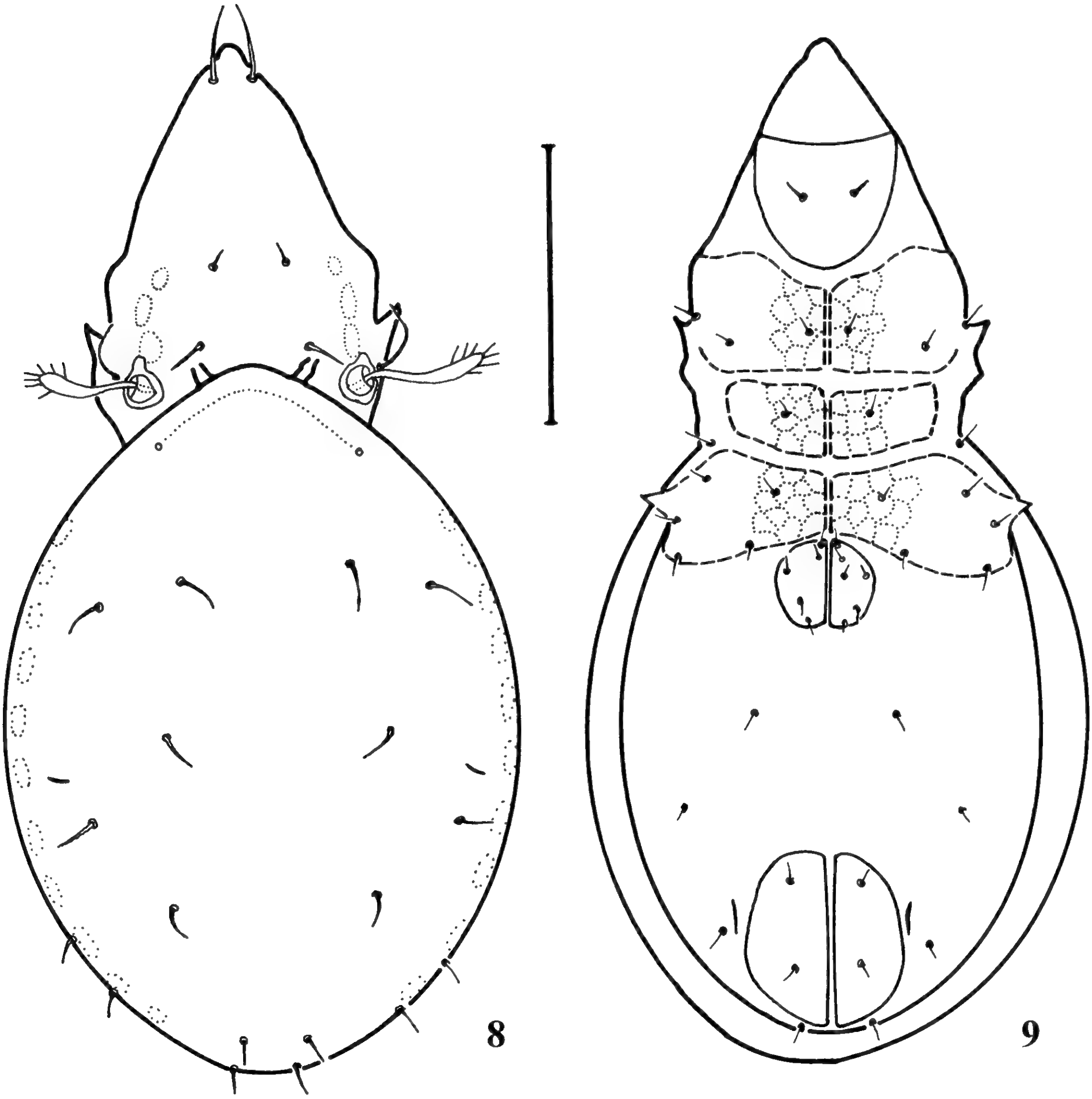
Ventral side (Fig. 9): Labiogenal articulation arched. Infracapitulum 78 in length, 50 in width. Setae *h* 6 in length. Distance *h-h* 14 in length. Prodorsum widest at *pdI* level. Epimeral borders distinctly visible and strongly sclerotized. Epimeral setal formula 3-1-3-3. Genital plates 30 in length, 36 in width, with six pairs of setae. Anal plates 64 in length, 58 in width, with two pairs of setae. One pair of aggenital and three pairs of adanal setae. Distance between genital and anal plates 76. Fissurae *iad* situated in para-anal position. Adanal setae ad_1 in postanal, ad_2 in para-anal and ad_3 in preanal positions.

Legs: Formula of leg setation (trochanter to tarsus): I (1-5-2+1-4+2-21+2); II (1-5-2+1-4+1-13+2); III (2-3-1+1-3+1-12); IV (1-2-2-3+1-10). Structure and setation of legs I-IV as shown in Figures 10-13.

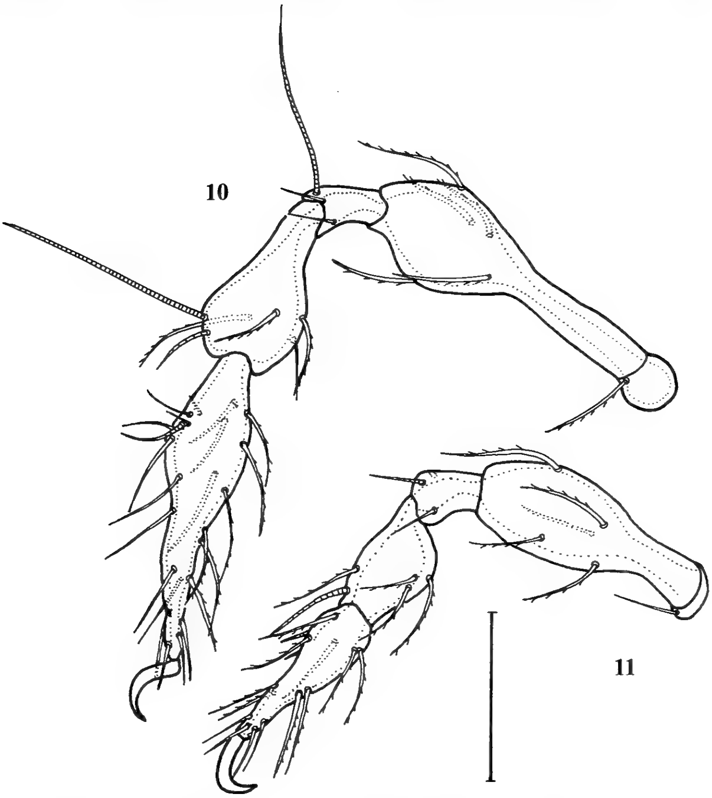
Material Examined: The type material is deposited in the Acarological Collection of the Zoological Museum, Erciyes University, Kayseri, Turkey (ZMEU). Holotype (ZMEU: 30) and 30 paratypes (ZMEU: 31-61) collected from moss pads on the ground in a mixed forest (mostly *Pinus sylvestris*), Bahçeli village, Yusufeli, Artvin, Turkey, 1350 m a.s.l., 20 September 1992; 12 paratypes (ZMEU: 62-74) collected from litter and soil under plum trees *(Prunus domestica)*, Bahçeli village, Yusufeli, Artvin, Turkey; 850 m a.s.l., 20 September 1992.

Discussion: This new species resembles *Rhinoppia plumata* (Gordeeva and Karppinen, 1988) by the shape of sensilli. However, it can be distinguished from *R. plumata* by the following features: 1) rostral apex elongate, nasiform in the new species (rostral apex elongate, not nasiform in *R. plumata*); 2) interlamellar setae not extended to the setae c_2 in the new species (interlamellar setae extend to the setae c_2 in *R. plumata*); 3) sensilli as long as 30% of the length of prodorsum (about 111) in the new species (sensilli as long as 70% of the length of prodorsum (about 115) in *R. plumata*); 4) longitudinal ridges absent between setae *le* and *in* in the new species (longitudinal ridges present between setae *le* and *in* in *R. plumata*); 5) body measurement in Holotype: 356/176 (body measurement in Holotype: 325 /180 in *R. plumata*).

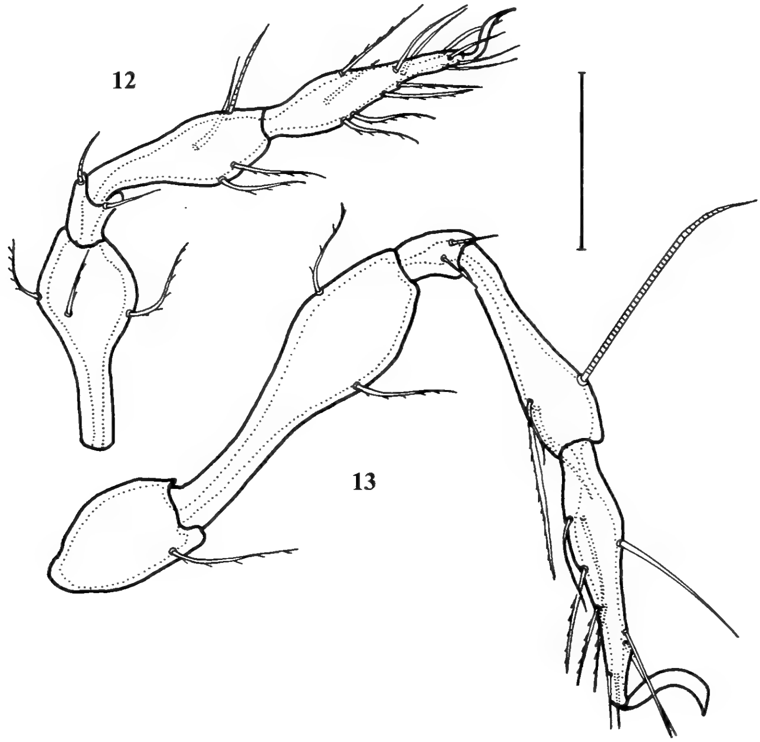
Etymology: This species is named after Abdulkadir Taşdemir (Erciyes University) our colleague.



Figs. 8, 9. *Rhinoppia tasdemiri* n.sp. – 8. Dorsal view; 9. Ventral view (scale bar for all drawings = 100 µm).



Figs. 10, 11. *Rhinoppia tasdemiri* n.sp. – Trochanter to tarsus: 10. Leg I, 11. Leg II (scale bar for all drawings = 40 µm).



Figs. 12, 13. *Rhinoppia tasdemiri* n.sp. – Trochanter to tarsus: 12. Leg III, trochanter removed, 13. Leg IV (scale bar for all drawings = 40 µm).

ACKNOWLEDGEMENTS

The authors want to thank Prof. Dr. M. Ozkan (Uludag University, Turkey) and Assist. Prof. S. Baran (Atatürk University, Turkey) for their assistance and suggestions at the improvement of our manuscript.

LITERATURE CITED

Arillo, A. and L. S. Subías. 1996. La subfamilia Medioppiinae en el sur de España. Descripción de *Medioppia pinsapi* sp. nov. (Oppiidae). Estudios del Museo de Ciencias Naturales de Álava 10-11: 211-221.

Balogh, J. 1983. A partial revision of the Oppiidae Grandjean, 1954 (Acari: Oribatei). Acta Zoologica Academiae Scientiarum Hungaricae 29 (1-3): 1-79.

Erman, O., M. Özkan, N. Ayyıldız, and S. Doğan. 2007. Checklist of the mites (Arachnida: Acari) of Turkey. Second supplement. Zootaxa 1532: 1-21.

Gordeeva, E. W. and E. Karppinen. 1988. New oribatid mites of the family Oppiidae Grandjean, 1954 (Acarina, Oribatei) from Crimea and Caucasus. Annales Entomologici Fennici 54: 59-64.

Mahunka, S. 1987. A survey of the oribatids of the Kiskunság National Park (Acari: Oribatida). *In,* Mahunka, S. (Editor): The Fauna of the Kiskunság National Park, II. Akadémia Kiadó. Budapest, Hungary. pp. 346-397.

Özkan, M., N. Ayyıldız, and O. Erman. 1994. Check list of the Acari of Turkey. First supplement. EURAAC News Letter 7(1): 4-12.

Paoli, G. 1908. Monografia del genere *Dameosoma* Berl. e generi affini. Redia 5: 31-91.

Subías, L. S. 2004. Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del Mundo (Excepto fósiles). Graellsia 60: 3-305.

Subías, L. S. 2007. Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del Mundo (Excepto fosiles). Graellsia 60: 3-305. (Actualizado en junio de 2006 y en abril de 2007). http://www.ucm.es/info/zoo/Artropodos/Catalogo.pdf.

Subías, L. S. and A. Arillo. 2001. Acari, Oribatei, Gymnonota II. *In,* Fauna Ibérica. Volume 15. Ramos, M.A., J. A. Tercedor, X. B. Ros, J. G. Noguera, A. G. Sierra, E. M. Mayol, F. M. Piera, J. S. Marino, and J. T. González (Editors). Museo Nacional de Ciencias Naturales. CSIC. Madrid, España. 289 pp.

Subías, L. S. and P. Balogh. 1989. Identification keys to genera of Oppiidae Grandjean, 1954 (Acari: Oribatei). Acta Zoologica Academia Scientiarum Hungaricae 35: 355-412.

Travé, J. and M. Vachon. 1975. François Grandjean 1882-1975 (notice biographique). Acarologia 17: 1-19.

Weigmann, G. 2006. Hornmilben (Oribatida). Die Tierwelt Deutschlands, Begründet 1925 von Friedrich Dahl, 76. Teil. Goecke & Evers. Keltern, Germany. 520 pp.

Woas, S. 1986. Beitrag zur Revision der Oppioidea sensu Balogh, 1972 (Acari, Oribatei). Andrias 5: 21-224.

ERRATUM

Entomological News 119(2), p. 211, incorrectly reported the name of the first runner-up for the Calvert Award as Mr. Matthew Nicewater. The correct name is Mr. Matthew Nicewinter.

FIRST RECORD OF THE GENUS *ORFELIA* FROM CHINA, WITH DESCRIPTIONS OF THREE NEW SPECIES (DIPTERA: KEROPLATIDAE)[1]

Jian Cao,[2,3] Huachao Xu,[4] Zuji Zhou,[2] Hong Wu,[4] and Yunjie Gu[5]

ABSTRACT: Three new species of the genus *Orfelia* Costa are described from China: *O. baishanzuensis* Cao et Xu, n. sp.; *O. helvola* Cao et Xu, n. sp.; *O. maculata* Cao et Xu, n. sp.. These new species belong to the *O. nemoralis* Meigen group. A key to Chinese species of *Orfelia* is given to aid in their identification.

KEY WORDS: Keroplatidae, *Orfelia*, taxonomy, new species, China

Orfelia Costa, 1857 is a rather large genus in the tribe Orfeliini of the Keroplatinae, according to the recent world catalogue of Keroplatidae (Evenhuis, 2006), this genus includes 43 described species. Of these, half of the species are known from the Palaearctic Region and seven species are known from the Oriental Region.

This is the first report of the genus *Orfelia* from China. Three new species were found among the specimens deposited in the entomological collection of Zhejiang Forestry College, Lin'an, Zhejiang, China (ZJFC). Undoubtedly, this is a significant addition to the knowledge of the genus *Orfelia* in Southeast Asia. However, China includes areas belonging to both the Palaearctic and Oriental Regions, so there are more species awaiting discovery.

The genus is distinguished from other related genera by the following characters: branches of medial and cubital veins bare dorsally; tibia with about 6 rows of setae much more closely set than others, appearing as conspicuous black lines; mesonotum uniformly setose, mediotergite with many short hairs.

METHODS

The material was collected by sweeping and Malaise traps and preserved in 80% ethanol. The specimens were determined mainly by genital characters, which were treated in the standard way (heating in a solution of 10% KOH followed by neutralization in acetic acid and washing in distilled water). The genitalia were placed into glycerin for detailed study and later preserved as glycerin

---

[1] Received on September 17, 2007. Accepted on October 18, 2007.

[2] Provincial Key Laboratory of Forest Protection, Sichuan Agricultural University, Ya'an, Sichuan 625014, P.R. China. E-mails: (JC) caojian0818@yahoo.com.cn, (ZJZ) zujizhou@yahoo.com.cn.

[3] Changdu Secondary Vocational and Technical School, Changdu, Tibet 854000, P. R. China.

[4] School of Foresrty and Biotechnology, Zhejiang Forestry College, Lin'an, Zhejiang 311300, P.R. China. E-mails: (HCX) xhcinsect@zjfc.edu.cn (corresponding author), (HW) wh931908@sohu.com.

[5] Sichuan Academy of Forestry, Chengdu, Sichuan 610081, P.R. China. E-mail: guyunjie7901@ 163.com.

Mailed on June 23, 2008

preparations. All material in this study is deposited in ZJFC. Morphological terminology follows that of Søli et al. (2000).

Key to the species of *Orfelia* known from China

1. Crossvein r-m fusion longer than petiole M (Fig. 2).. ....*O. maculata* Cao et Xu, n. sp.
-. Crossvein r-m fusion shorter than petiole M (Figs. 1, 3)..............................2
2. Tergite IX subequal in length to gonocoxites (Fig. 11).................................. ....*O. helvola* Cao et Xu, n. sp.
-. Tergite IX tapered from base to apex, about 1.5 times as long as gonocoxites (Fig. 5)..*O. baishanzuensis* Cao et Xu, n. sp.

SYSTEMATIC ENTOMOLOGY

Orfelia baishanzuensis Cao et Xu, n. sp.

(Figs. 1, 4-6)

Diagnosis. This species is similar to *O. nemoralis* (Meigen, 1818) (Hutson et al., 1980). However, it is easily distinguished by palpal segments long (short and rounded in *O. nemoralis*), very faint brown shade apically from costa to middle of cell r5 (whole wing tip more or less evenly darkened in *O. nemoralis*) and the upper posterior lobe of gonostyli narrow, sclerotized and toothlike (broad and not sclerotized in *O. nemoralis*). The shape of gonostyli is also a good character to distinguish it from the other two Chinese species of the genus.

Description. Male. Lengths: Body: 5.5 mm; wing: 4.4 mm. **Head.** Yellowish brown. Antennae: scape and pedicel cup-shaped, obscurely yellow. Flagellum: first flagellomere yellowish brown, obscurely yellow basally; remaining flagellomeres yellowish brown; terminal flagellomere with a small papilla. Palpi yellow to obscurely yellow, terminal palpomere long.

Thorax. Mesonotum yellowish brown; patch of thick black setae above wing root. Scutellum obscurely yellow with a row of long dark setae on posterior margin. Prothorax yellow with some long setae. Anepisternum and katepisternum yellow, bare; laterotergite obscurely yellow, bare; mediotergite yellowish brown, with a few black setae apically. Halter yellow.

Legs. Yellow. Fore tibia without setae and comb, mid tibia with setae and posterior comb, hind tibia with setae and anterior comb and posterior comb. Tibial spurs dark brown. Fore, mid and hind basitarsi 0.7x lengths of respective tibiae. Claws minute.

Wing (Fig. 1). Hyaline with very faint brown shade apically from costa to middle of cell r5. Veins dark brown. Costa slightly beyond the tip of R_5; Sc ends in C at level of 0.7-0.8 of distance between h and base of Rs; Sc-R situated at level of 0.3-0.4 of distance between h and tip of Sc. Distance between tips of R_1

and R_4 1.8-2.0 times as long as R_4. Ratio of r-m fusion / petiole of M: 0.8-0.9. Petiole of M one-fifth as long as length of M_1. vein A not reaching wing margin.

Abdomen. Tergites I-IV yellowish brown with yellow band on posterior half; tergites V-VII yellowish brown. Sternum yellow.

Hypopygium (Figs. 4-6). Tergite IX yellow, about 1.5 times as long as gonocoxites, with a bare stripe on medial area. Cercus concealed in dorsal view. Gonocoxites broad and bilobed, with black stiff setae on medial area and remaining area with uniform short setae; Gonostyli yellow, strongly swollen with three lobes apically, distal lobe dark brown, sclerotized and toothlike; medial lobe a smaller slightly sclerotized tooth; proximal lobe not sclerotized, with some black stiff ventral setae. Aedeagus with a pair of distinct apical projections, yellowish brown, almost reaching the level of the top of gonostyli and slightly bending inward apically in ventral view.

Female. Unknown.

Type Data: Holotype ♂ (ZJFC 940325) and paratypes ♂♂ from: China: Zhejiang province: Baishanzu National Natural Reserve, 20 Apr 1994, Hong Wu, Malaise traps.

Etymology. The species name refers to the type locality: Baishanzu National Natural Reserve.

Orfelia maculata Cao et Xu, n. sp.

(Figs. 2, 7-9)

Diagnosis. This species is similar to *O. baishanzuensis* n. sp. but distinguished from it by ratio of r-m fusion / petiole of M: 1.3-1.5 (0.8-0.9 in *O. baishanzuensis*), mesonotum usually with three dark brown stripes (absent in *O. baishanzuensis*) and gonostyli with two lobes at apex (with three lobes in *O. baishanzuensis*).

Description. Male. Lengths: Body: 5.7 mm; wing: 4.5 mm. **Head.** Yellowish brown. Antennae: scape and pedicel cup-shaped, obscurely yellow. Flagellum: first flagellomere yellowish brown, obscurely yellow basally; remaining flagellomeres yellowish brown to pale brown; terminal flagellomere with a small papilla. Palpi yellow to obscurely yellow, terminal palpomere long.

Thorax. Mesonotum yellow, usually with three dark brown stripes on disc, medial stripe not reaching pronotum; patch of thick black setae above wing root. Scutellum obscurely yellow with a row of long dark setae on posterior margin. Prothorax yellow with some long setae. Anepisternum yellow, with or without a little patch of short setae above; katepisternum and laterotergite yellow, bare; mediotergite yellowish brown to dark brown, with a few black setae apically. Halter yellow, knob pale brown.

Legs. Yellow. Fore tibia without setae and comb, mid tibia with setae and posterior comb, hind tibia with setae and anterior comb and posterior comb. Tibial spurs dark brown. Fore, mid, and hind basitarsi 0.8x lengths of respective tibiae. Claws minute.

Wing (Fig. 2). Hyaline with very faint brown shade apically from R_5 to mid of cell r5. Veins dark brown. Costa almost reaching one-third distance from vein R_5 to vein M_1; Sc ends in C at level of 0.6-0.7 of distance between h and base of Rs; Sc-R situated at level of 1/2 distance between h and tip of Sc. Distance between tips of R_1 and R_4 1.4-1.6 times as long as R_4. Ratio of r-m fusion / petiole of M: 1.4-1.5. Petiole of M one-seventh as long as length of M_1. vein A not reaching wing margin.

Abdomen. Tergite I dark brown; tergites II–III dark brown with yellow band on posterior third; tergites IV-V yellow with dark brown band on anterior third; tergites VI–VII obscurely yellow. Sternum yellow.

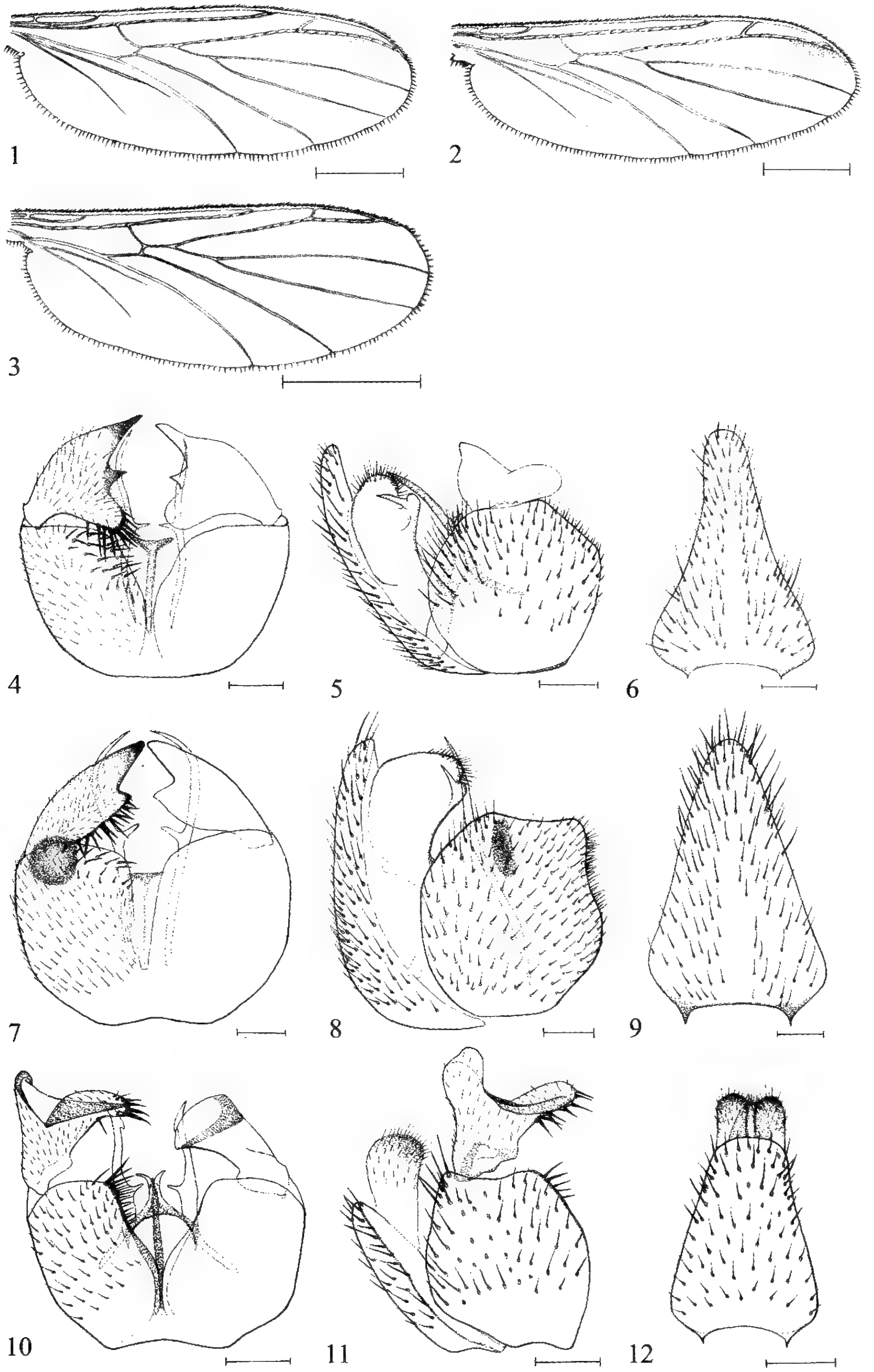
Hypopygium (Figs. 7-9). Tergite IX yellow, tapered from base to apex and 1.5 times as long as gonocoxites; with a bare stripe on medial area. Cercus concealed in dorsal view. Gonocoxites broad and bilobed, with black stiff setae on apical margin and remaining area with uniform short setae; two large round black spots (yellow medially) apically. Gonostyli yellow with two lobes apically, distal lobe black, sclerotized like tooth; proximal lobe not sclerotized, with some black stiff ventral setae. Aedeagus with a pair of distinct apical projections, brownish yellow, reaching the level of the top of gonostyli and curved inward apically in ventral view.

Female. Unknown.

Type Data.

Holotype ♂ (ZJFC 060021) and paratypes ♂♂ from: China: Zhejiang province: Wuyanling National Natural Reserve, 5 May 2006, Xiaoling Niu; Other paratypes: 2♂♂, Zhejiang province: Gutian Mountains, 14 Apr 1993, Hong Wu; 1♂, Zhejiang province: Tianmu Mountains, 10 Jun 1999, Mingshui Zhao, Malaise traps; 2 ♂♂, Zhejiang province: Baishanzu National Natural Reserve, 21 Apr 1994, Hong Wu; 2♂♂, Zhejiang province: Tianmu Mountains, 24 May 2006, Jian Cao, Malaise traps.

Etymology. The species name refers to gonocoxites with two large round black spots apically.



Figures 1-3. *Orfelia* wings. 1. *Orfelia baishanzuensis*, n. sp. 2. *Orfelia maculata*, n. sp. 3. *Orfelia helvola*, n. sp. Scale bar = 1.0 mm. Figures 4-6. *Orfelia baishanzuensis*, n. sp. 4. male terminalia, ventral view. 5. male terminalia, lateral view. 6. tergite IX, dorsal view. Scale bar = 0.1 mm. Figures 7-9. *Orfelia maculata*, n. sp. 7. male terminalia, ventral view. 8. male terminalia (gonostylus removed), lateral view. 9. tergite IX, dorsal view. Scale bar = 0.1 mm. Figures 10-12. *Orfelia helvola*, n. sp. 10. male terminalia, ventral view. 11. male terminalia, lateral view. 12. tergite IX, dorsal view. Scale bar = 0.1 mm.

Orfelia helvola Cao et Xu, n. sp.

(Figs. 3, 10-12)

Diagnosis. This species is similar to *O. angulata* (Sasakawa, 1994), but it is easily distinguished by the fore basitarsus shorter than the fore tibia (subequal in *O. angulata*), gonostyli folded outward apically (not folded apically in *O. angulata*) and aedeagus with a pair of distinct apical projections, slightly bending outward apically in ventral view (bending inward in *O. angulata*).

Description. Male. Lengths: Body: 3.8 mm; wing: 3.0 mm. **Head.** Yellowish brown. Antennae: scape and pedicel cup-shaped, yellow. Flagellum: first flagellomere obscurely yellow, yellow basally; remaining flagellomeres obscurely yellow; terminal flagellomere with a small papilla. Palpi yellow.

Thorax. Mesonotum yellow with three brownish yellow stripes on disc, medial stripe extending anteriorly to pronotum; patch of thick black setae above wing root. Scutellum yellow with a row of long dark setae on posterior margin. Prothorax obscurely yellow with some long setae. Anepisternum, katepisternum and laterotergite obscurely yellow, bare; mediotergite obscurely yellow, with a few black setae apically. Halter yellow.

Legs. Yellow. Fore tibia without setae and comb, mid tibia with setae and posterior comb, hind tibia with setae and anterior comb and posterior comb. Tibial spurs brown. Fore, mid and hind basitarsi 0.7x lengths of respective tibiae. Claws minute.

Wing (Fig. 3). Hyaline with very pale brown shade apically. Veins brown. Costa extends slightly beyond the tip of R_5; Sc ends in C at level of 0.4-0.5 of distance between h and base of Rs; Sc-R absent. R_4 very short, distance between tips of R_1 and R_4 7.4-7.8 times as long as R_4. Ratio of r-m fusion / petiole of M: 0.7-0.8. Petiole of M one-fifth as long as length of M_1. Vein A not reaching wing margin.

Abdomen. Tergites I-III yellow; tergites IV-VII brownish yellow. Sternites I-IV yellow, sternites V-VII brownish yellow.

Hypopygium (Figs. 10-12). Tergite IX yellow, subequal in length to gonocoxites. Cercus visible in dorsal view, rounded apically. Gonocoxites yellow, broad and bilobed, with stiff black setae on medial margin and remaining area with uniform short setae; Gonostyli yellow, folded outward apically and with some stiff setae on the apex. Aedeagus with a pair of distinct apical projections, yellow, almost reaching the level of the top of gonostyli and slightly curved outward apically in ventral view.

Female. Unknown.

Type Data: Holotype ♂ (ZJFC 880591) and paratypes ♂♂ from: China: Yunnan province: Kunming city, Huahongdong, 20 Mar 1981, Chikun Yang.

Etymology: The species name refers to mesonotum with three brownish yellow stripes.

DISCUSSION

We have found most known species of *Orfelia* have narrowly curved and lanceolate gonostyli and very few species have large, rounded and lobed gonostyli as in these Chinese species. The unusal shape of the gonostyli in these species is a good character to distinguish them from the other species of the genus, while in the Palearctic, *O. nemoralis* (Meigen) comes closest to the shape of the specimens herein described. In our studies, we also have found some defective specimens with narrowly curved and lanceolate gonostyli, and we suspect that there are more species awaiting discovery in China.

ACKNOWLEDGEMENTS

We thank Dr. Neal Evenhuis and Mr. Peter Chandler for providing some data. We gratefully acknowledge Dr. Neal Evenhuis and two anonymous reviewers for their critical review of the manuscript.

LITERATURE CITED

Evenhuis, N. L. 2006. Catalog of the Keroplatidae of the World. Bishop Museum Bulletins in Entomology 13: 1-178.

Hutson, A. M., D. M. Ackland, and L. N. Kidd. 1980. Mycetophilidae (Bolitophilinae, Ditomyiinae, Diadocidiinae, Keroplatinae, Sciophilinae and Manotinae) (Dipt. Mycetophilidae). Handbooks for the Identification of British Insects 9(3): 30-39. (Royal Entomological Society London.)

Sasakawa, M. 1994. Fungus gnats associated with flowers of the genus Arisaema (Aracaeae). Part 2. Keroplatidae and Mycetophilidae (Diptera). Transactions of the Shikoku Entomological Society 20(3-4): 293-306.

Søli, G. E., J. R. Vockeroth, and L. Matile. 2000. A.4. Families of Sciaroidea. pp. 49-92. *In*, L. Papp and B. Darvas (Editors). Contributions to a Manual of Palaearctic Diptera (with Special Reference to Flies of Economic Importance). Appendix. Science Herald, Budapest, Rumania. 978 pp.

A REVIEW OF THE NEOTROPICAL BEE GENUS *CTENIOSCHELUS* ROMAND (HYMENOPTERA: APIDAE: ERICROCIDINI)[1]

Rainer Thiele[2]

ABSTRACT: The female of *Ctenioschelus chalcodes* Thiele is described from northwestern Costa Rica. Lacking the characteristic antennae of the male, the females are not easily distinguished from those of *C. goryi* (Romand). The lack of strongly violet iridescent scales on the head and mesosomal dorsum of *C. chalcodes* and the largely concave dorsum of the mesoscutellar tubercles distinguish females of this species from those of *C. goryi*. Most external characters of the additional male specimens of *C. chalcodes* agree with those mentioned in the original description. The geographic distribution of *C. chalcodes* in Costa Rica seems to be restricted to dry forest in the northwest, whereas *C. goryi* occurs in wet forests throughout the rest of the country, indicating a parapatric distribution pattern for the two species. Nectar host plants and associated species are provided, but no bee hosts for these cleptoparasitic species could be determined so far. A key to the species is provided.

KEY WORDS: Hymenoptera, Apidae, Ericrocidini, Apinae, bees, Neotropical, cleptoparasite, *Centris*, *Ctenioschelus*, Guanacaste

The New World tribe Ericrocidini consists of anthophoriform to euceriform bees, which, according to Snelling and Brooks (1985), are largely centered in the Amazonian Basin where seven of the nine currently recognized genera occur (Michener, 2007). Four genera are known to occur in Costa Rica: *Aglaomelissa*, *Ctenioschelus*, *Mesocheira*, and *Mesoplia* (Snelling and Brooks, 1985; Thiele, unpubl. data). Adults and first larval instars of Ericrocidini show anatomical features associated with a cleptoparasitic lifestyle (Rozen, 1991), and adult females do not possess pollen-carrying structures. However, although cleptoparasitic behavior has been documented in several genera (Snelling and Brooks 1985; Rozen, 1991), for many species and some genera like *Ctenioschelus,* host bee records are still not available.

In 1840, M. de Romand (1840b) described the genus *Ctenioschelus* based on a male specimen of a species he had described earlier in the same year as *Acanthopus Goryi* Romand (1840a). No other valid species was described until 2005, when *C. chalcodes* Thiele was described from a single male collected by the author in the dry forest of the Guanacaste province in northwestern Costa Rica (Thiele, 2005). During a subsequent field trip, two females and three males of *C. chalcodes* were collected at the type locality. One month later, one male and two female specimens were discovered in the collection of the Instituto Nacional de Biodiversidad (INBIO) in Costa Rica and identified as *C. chalcodes* Thiele.

Between 1996 and 2000, a large number of *C. goryi* specimens were collected at flowering rainforest canopy trees of up to 25 to 40 m height in the Atlantic lowlands of northeastern Costa Rica. Together with additional specimens from

---

[1] Received on September 13, 2007. Accepted in October 9, 2007.

[2] Staatliches Museum für Naturkunde, Abteilung für Entomologie, Erbprinzenstr. 13, 76133 Karlsruhe, Germany. E-mail: centris_vidua@yahoo.com.

Mailed on June 23, 2008

the INBIO collection, a sufficient number of specimens is now available for a review of the genus.

In the current study, the hitherto undescribed female of *C. chalcodes* is described and its diagnostic characters compared with those of the female of *C. goryi*. The availability of two additional males allows the revision of diagnostic characters of the previously described male. Unpublished data on host plants, associated bees and a key to the species are provided.

METHODS

Morphological terms generally follow Engel (2001) and Michener (2007) and terms for surface sculpturing and pilosity follow Snelling (1984). The abbreviations T and S are for metasomal terga and sterna; thus T3 indicates the third metasomal tergum, IS is for iridescent scales.

The specimen used for the following female description has the author's reference #8504, and is listed with complete data in the material examined section. Bees collected by the author were caught using standard insect nets on extendable aluminium poles with lengths of up to 5.5 meters. At wet forest sites flowering trees were sampled throughout the year between September 1996 and September 2000. Sampling at Guanacaste only took place during the dry season, i.e. between January and April of 2003–2005.

Material utilized in this study is from the following institutional and private collections: Museo de Zoología, Universidad de Costa Rica (MZCR), Instituto Nacional de Biodiversidad, Costa Rica (INBIO) and Rainer Thiele, personal collection (RTHC).

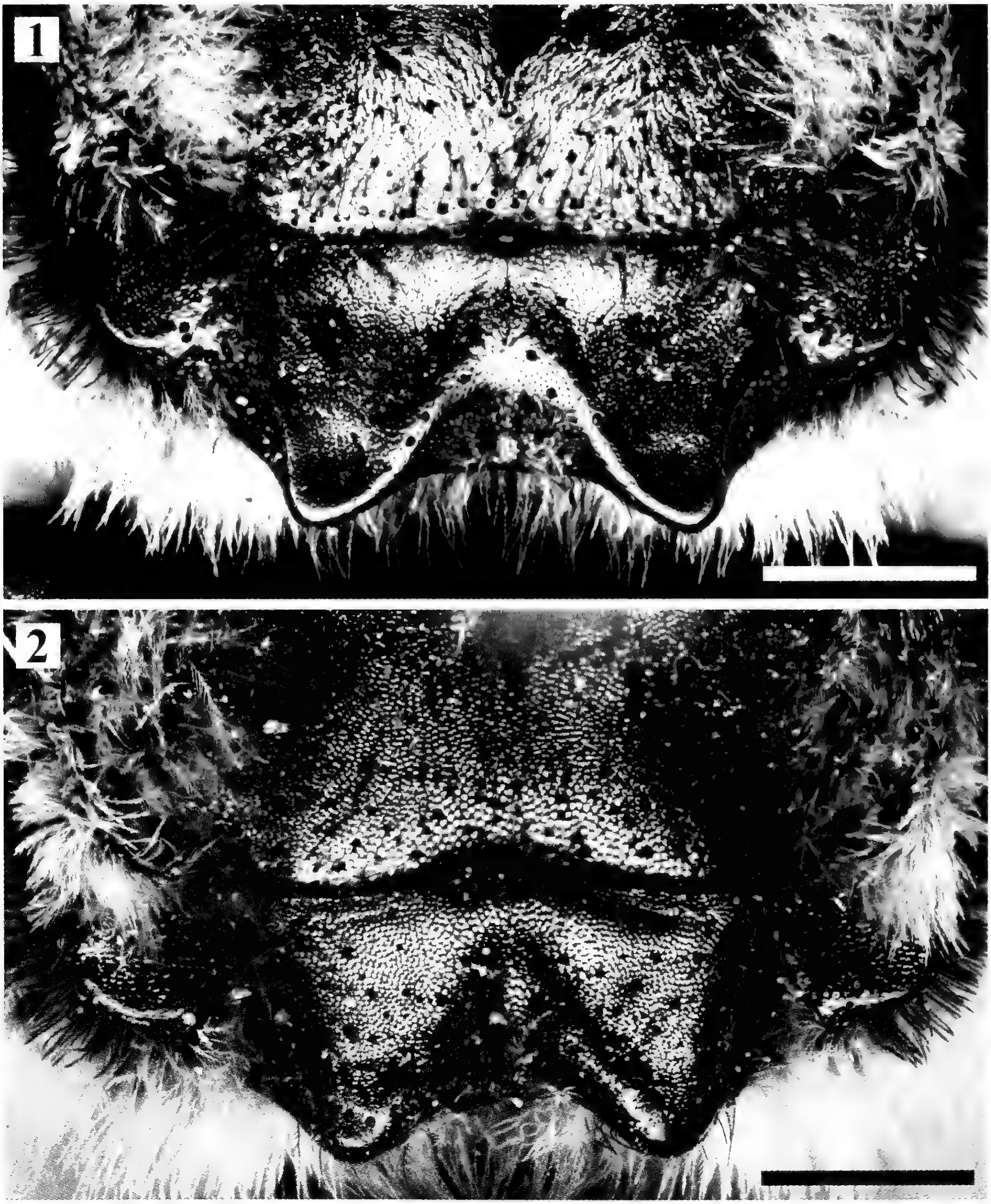
SYSTEMATIC ENTOMOLOGY

Ctenioschelus chalcodes Thiele, 2005

Ctenioschelus chalcodes Thiele, 2005: 272. Holotype male, Costa Rica, Guanacaste (MZCR)

Diagnosis: *Female:* Differing from females of *C. goryi* by green and bronze iridescence of frons, process of dorsolateral angle of pronotum and posterior half of scutum, lacking clearly violet iridescent scales. The scutellar lobes clearly concave across posterior half of dorsal surface, not appearing protuberant (Fig. 1); in *C. goryi* females, scutellar lobes showing at most only small, point-like depressions, covering much less than half of dorsal surface, overall appearance of scutellar lobes mostly protuberant (Fig. 2).

Description: *Measurements (mm):* Total length 14.13, forewing length 12.64, intertegular distance 4.10, head width 4.20, head length 2.80. Head: 1.50 times broader than long; upper frontal width 0.80 times that of lower; inner compound eye margin subparallel, convergent above; interocellar distance 2.00 times diameter anterior ocellus, ocellocular distance 0.59 times diameter anterior ocellus, transocellar distance 1.22 mm; scape 2.54 times longer than wide and 3.23 times longer than first flagellomere, first flagellomere 0.49 times length of second; clypeus only slightly convex, basally not raised above level of lower frontal carina; mandible simple; antenna not reaching beyond apex of scutellar lobe; flagellomeres subparallel.



Figs. 1-2. Dorsal view of female mesoscutellum. 1. *Ctenioschelus chalcodes*. 2. *C. goryi*. Scale bars equal 1 mm in both images.

Mesosoma: Dorsolateral angle of pronotum prominent laterally, pronotal lobe somewhat raised; scutellum bilobed, scutellar tubercle projecting over declivious portion of scutellum, metanotum and propodeum; posterior half of mesoscutellar tubercle dorsally concave (Fig. 1).

Metasoma: Apical margin of S1 medially with small, shallow emargination, apical margin of S2 almost straight, S4 with very evenly rounded, deep and broadly emarginate apical margin, extreme lateral portion with very narrow, transparent area.

Pilosity: Frons, genal, and paraocular areas covered with abundant whitish, plumose setae except for patch of black plumose setae between antennal toruli and sparse simple black setae scattered across frons. Most of mesosoma covered with whitish plumose setae, less on metanotum, propodeum and ventral surfaces of mesosomal segments; black plumose setae present along medial line of mesoscutum, omaulus, and margin of pronotal lobe, abundant black plumose setae along inner margin of tegula and entire lateral surface of axilla. Legs with whitish plumose setae on outer edge of protibia, very few or none on protibia, conspicuous tuft on posterior dorso-lateral surface of metacoxa; protrochanter with roughly equal number of black and white plumose setae; anterior apical margin of mesotibia with tuft of buff-colored to black simple setae. Metasoma with conspicuous tufts of white plumose setae on apicolateral portions of S3 and S4, on S5 tuft extended along apical margin, almost reaching middle of segment.

Color: Integument of head, mesosoma, and metasoma blackish to dark brown, narrow marginal zone of S4 to S5 and most of lateral to dorsolateral surface of S6 appearing pale brown; iridescence of scales varying from red to golden/bronze or green to bluish/violet depending on light conditions and type of iridescent scales (IS); abundant IS present on clypeus, frons, tegulae, mesoscutellum and metasomal terga 1-5; IS on T1-T5 mainly appearing green with bronze or bluish hue; metasomal sterna with inconspicuous greenish-bronze IS or scale-like iridescent hairs on lateral areas of S2 and centrad tufts of white plumose hairs on S3 and S4; meso- and metabasitarsus with some green-bronze IS, pro- and mesotibia with abundant bronze to greenish IS on outer surface, metatibia mainly with shiny green IS and few green-blue and green-bronze IS on outer surface, patch of bronze IS or scale-like iridescent hairs on ventral surface of mesotrochanter, metacoxa with small patch of bronze IS ventrad whitish plumose setae.

Specimens Examined: Holotype male, Costa Rica, Provincia Guanacaste, Parque Nacional Santa Rosa, Sector Santa Rosa, 10°50'N, 85°36'W, 250m elevation, 8.Mar.2003, R. Thiele #7371 (MZCR). Costa Rica: Provincia Guanacaste: 1 female, Parque Nacional Santa Rosa, Sector Santa Rosa, 10°50'N, 85° 36'W, 250m elevation, 6.Apr.2005, R. Thiele #8504 (MZCR); 1 female, same data, 7.Apr.2005, R. Thiele #8736 (RTHC); 1 male same data, 7.Apr.2005, R. Thiele #8711 (UKAN); 2 males, same data, 6.Apr.2005, R. Thiele #8503, #8681 (RTHC); 1 male, same data, 300m, Feb 1992, G. Pereira (INBIO); 1 female, Parque Nacional Guanacaste, Los Almendros, 28.Mar.-24.Apr.1992, M. Reyes (INBIO), 1 female, Casa Oeste, Cerro El Hacha, 12 km SE La Cruz, 300m, Jan.1988, M. Espinoza (INBIO).

In addition to the specimens mentioned above I have seen a digital photograph of a *C. chalcodes* male collected at Jalisco, México, with the following label data: Estación de Biología Chamela, 20/VIII/1985, R. Ayala, No. RA78, on *Cae-*

salpinia sclerocarpa Standl. (Fabaceae), "*volando en el dosel*" (flying in the canopy). I was able to identify this specimen based on the external diagnostic characters, which were clearly visible due to the high quality of the color digital image. According to R. Ayala, another male of the same species was collected together with the specimen mentioned above. Both specimens are deposited in the Colección de Insectos, Estación de Biología Chamela, Instituto de Biología, Universidad Nacional Autónoma de México.

Biological Remarks: The holotype was collected at flowers of *Securidaca* sp. (Polygalaceae). All five specimens subsequently collected by the author were collected at only two flowering trees of *Dalbergia retusa* (Fabaceae) with heights of about 6 and 12 m. Both trees were located 3.8 km apart on the upper plateau of the Santa Rosa National Park. The smaller tree stood more or less isolated in savannah-type vegetation, the other was found at the edge of a larger patch of deciduous forest (see Janzen, 1983 for a more extensive site description). Bees associated with *C. chalcodes* in both trees were: *Centris* (*Hemisiella*) *nitida* Smith (48), *Melipona* (*Melikerria*) *beechii* Bennett (48), *Gaesischia* (*Gaesischiana*) *exul* Michener et al. (29), *Apis* (*Apis*) *mellifera* Linnaeus (28), *C.* (*Centris*) *inermis* Friese (26), *C.* (*Centris*) *aethyctera* Snelling (10), *C.* (*Heterocentris*) *analis* Fabricius (5), *C.* (*Centris*) *flavifrons* (Friese) (4), *C.* (*Hemisiella*) *vittata* Lepeletier (3). (Only large bee species with a head width of at least 3.4 mm and at least three individuals collected are listed by rank; number collected in parenthesis; data for both trees pooled.)

***Ctenioschelus goryi* (Romand, 1840)**

Acanthopus goryi Romand, 1840a: 248
Ctenioschelus goryi Romand, 1840b: 335
Melissoda latreillii Lepeletier, 1841: 508
Ctenioschelus latreillii (Lepeletier); Smith, 1854: 284

Specimens Examined: Costa Rica: Provincia Limón: 1 female, R. B. Hitoy Cerere, Valle La Estrella, 100-200m, 5.Dez.1993-7.Jan.1994, G. Carballo, #2576 (INBIO); 1 female, same data, 28.Feb.-8.Mar.1994, G. Carballo, #2688 (INBIO); Provincia Puntarenas: 1 female, P. N. Corcovado, Sendero a Rio Claro, Jan.-Mar.1992, Tp Malaise, L-S-508200, 270500 (INBIO); 1 female, San Vito, Coto Brus, Jardín Botánico Las Cruces, 1200-1300m, 18.Jun.2001, Charlotte Skov (INBIO). Costa Rica: Provincia Heredia: La Selva Biological Station, Puerto Viejo de Sarapiquí, 10'26N, 84'00W, 50m elevation, leg. R. Thiele, accession numbers (#) refer to the authors collection (RTHC) where deposited unless otherwise indicated: 1 female, 26.Mar.1997, #590, ex. *Vochysia guatemalensis*; 1 female, 27.Mar.1997, #636, ex. *Vochysia guatemalensis*; 1 male, same data, #637; 1 male, 31.Mar.1997, #946, ex. *Vochysia guatemalensis*; 1 female, 5.Apr. 1997, #1033, ex. *Vochysia guatemalensis*; 1 female, 16.Jun.1997, #1594, ex. *Hymenolobium mesoamericanum*; 1 male, 26.Aug.1998, #4058, ex. *Dussia macroprophyllata*; 3 males, 3.Sep.1998, #4153-4155, ex. *Dussia macroprophyllata*; 2 males, 11.Sep.1998, #4287-4288, ex. *Dussia macroprophyllata*; 5 males, 16.Aug.1999, #5566-5570, ex *Dipteryx panamensis*; 1 female, 18.Aug.1999, #5589, ex *Dipteryx panamensis*; 1 male, 18.Aug.1999, #5590, ex *Dipteryx panamensis*, 1 female, 22.Aug.1999, #5626, ex *Dipteryx panamensis* (MZCR); 6 males, same data, #5627-5632, 2 females, 26.Aug.1999, #5653-5654, ex *Dipteryx panamensis*; 5 males, 26.Aug.1999, #5655-5659, ex *Dipteryx panamensis*; 1 female, 28.Aug.1999, #5670, ex *Dipteryx panamensis*; 2 females, 29.Aug. 1999, #5696-5697, ex *Dipteryx panamensis*; 4 males, 29.Aug.1999, #5698-5701, ex *Dipteryx panamensis*; 6 males, 2.Sep.1999, #5761-5766, ex *Dipteryx panamensis*; 2 females, 2.Sep.1999, #5767-5768, ex *Dipteryx panamensis*; 1 female, 6.Sep.1999, #5817, ex *Dipteryx panamensis*; 1 male, 12.Oct. 1999, #5827, ex. *Dussia macroprophyllata* (MZCR); 1 female, 16.Oct.1999, #5873, ex. *Dussia macroprophyllata*. The genera *Dipteryx*, *Dussia*, and *Hymenolobium* are members of the Fabaceae, whereas *Vochysia* is a genus in the Vochysiaceae.

Biological Remarks: All nectar host plants of *C. goryi* at La Selva Biological Station were tall canopy trees with a height of 25 to 40 m. Of the 49 males and females collected at flowering plants, 37 had been collected at only two trees of *Dipteryx panamensis* (Fabaceae) between 18. August and 2. September 1999. Both trees were 1.1 km apart, growing in the "old growth forest" away from the forest edge of "Old La Selva," in a terrain characterized by hills or ridges up to 100 m a.s.l. often divided by steep slopes (see McDade et al., 1994 for a more extensive site description). Bees associated with *C. goryi* in both trees were: *Thygater* (*Thygater*) sp. 1 (34), *Megachile* (*Austromegachile*) sp. 5 (17), *Centris* (*Heterocentris*) *labrosa* (Friese) (10), *C.* (*Melacentris*) *agiloides* Snelling (7), *Epicharis* (*Epicharoides*) *maculata* Smith (6), *C.* (*Aphemisia*) *plumipes* Smith (5), *C.* (*Heterocentris*) *analis* Fabricius (4), *C.* (*Trachina*) *longimana* Fabricius (3). (Only large bee species with a head width of at least 3.4 mm and at least three individuals collected are listed by rank; number collected in parenthesis; data for both trees pooled.)

KEY TO THE SPECIES OF *CTENIOSCHELUS* ROMAND

1. Male, antennae 13-segmented, very long, extending well beyond apex of metasoma 2
- Female, antennae 12-segmented, normal, not extending beyond posterior margin of mesoscutellum..3
2. Flagellomeres 7 to 10 conspicuously clavate; frons, mesoscutum and often first three metasomal terga with strong violet iridescence; dorsal surface of mesoscutellar tubercles flat to convex, sometimes with very small depression but never clearly concave ....*goryi* (Romand)
- Flagellomeres 7 to 10 parallel sided; frons, mesoscutum and often first three metasomal terga without strong violet iridescence, rather bronze-like; dorsal surface of mesoscutellar tubercles clearly concave ....*chalcodes* Thiele
3. Frons with strong to moderate violet iridescence, mesoscutum with strong violet iridescence; dorsal surface of mesoscutellar tubercles convex, sometimes with small depression but never clearly concave (Fig. 2)......................
....*goryi* (Romand)

- Frons and mesoscutum without strong violet iridescence, at least frons with rather plain greenish to bronze iridescence; dorsal surface of mesoscutellar tubercles clearly concave (Fig. 1)..*chalcodes* Thiele

DISCUSSION

The diagnostic characters of the male of *C. chalcodes* include "few scattered plumose hairs" on the disc and extreme lateral surface of the first metasomal tergum (Thiele, 2005). One of the four males from Santa Rosa does not exhibit this character, and of the 36 *C. goryi* males from La Selva, one male had very few plumose setae on one side of the disk. I therefore have decided not to include this character in the key to the species. In the discussion of the above-mentioned publication, I had given some character states to look for in prospective females of *C. chalcodes*. The aforementioned plumose setae were included, but they are not present in the females examined; also the black stripe along the medial line of the mesoscutum is not clearly less developed than in *C. goryi* females and hence not a useful character.

Compared to the males, females of *C. chalcodes* have a much less pronounced bronze-like iridescence of the metasomal terga, and therefore the overall appearance is rather greenish and very similar to greenish females of *C. goryi*. However, the mesosoma of all *C. chalcodes* females examined had bronze-like iridescent scales, most easily seen on the mesoscutellar lobes and the posterior half of the mesoscutum. In *C. goryi* females, the frons, the protuberant process of the dorsolateral angle of the pronotum, and the anterior quarter of the mesoscutum are covered with strongly violet iridescent scales, whereas the *C. chalcodes* females examined by me had no violet iridescent scales on the frons, very few on the pronotal lobe and, if at all, very few on the anterior mesoscutum. The best single character to distinguish the two species appears to be the color of the iridescent scales on the frons (females of *C. chalcodes* lack strongly violet iridescent scales on the frons). However, care must be taken not to interpret some sort of bluish reflection on the surface of iridescent scales (of any color) in strong counter light as the "strong violet iridescence" mentioned throughout this study.

The *Ctenioschelus* specimens from Jalisco, Mexico (Ayala, 1990), originally identified as *C. goryi*, could now be identified as specimens of *C. chalcodes*. Therefore, the currently known geographical range of *C. chalcodes* reaches from northern Costa Rica to central western Mexico, although no published records are yet available for the intervening countries. The geographical range of *C. gory* is now documented from northern Argentina (unpublished record provided by J. S. Ascher of AMNH: http://www.discoverlife.org/mp/20l?id=AMNH_BEE00013685), across several Brazilian states (Silveira et al., 2002) to northern Costa Rica. However, since continuous rainforest once covered the entire area of northeastern Costa Rica and southeastern Nicaragua, it seems most likely that *C. goryi* also will be found in Nicaragua. The geographical distribution of *Ctenioschelus chalcodes* and of *C. goryi* in Costa Rica is illustrated in Fig. 3.

Although Tropical Dry Forest (Murphy and Lugo, 1986; Bullock et al., 1995) once covered at least 60 percent of the forested tropics (Janzen, 2004), in most parts

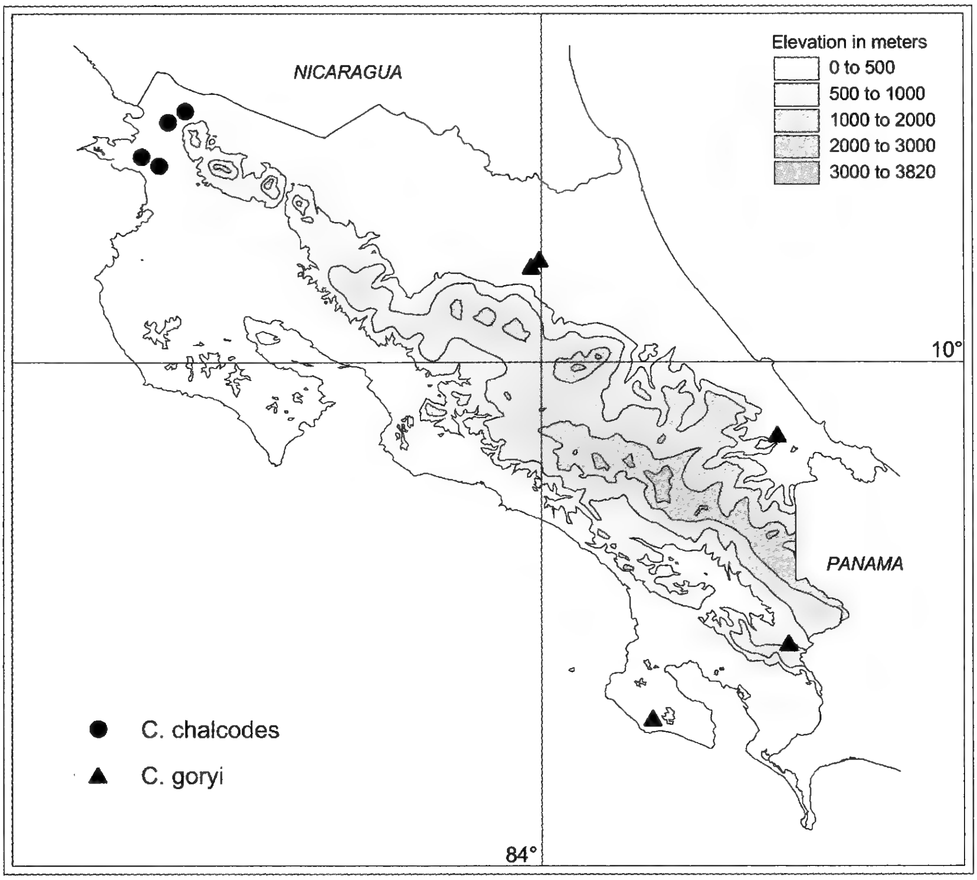


Figure 3. Distribution of *Ctenioschelus chalcodes* and *C. goryi* in Costa Rica.

of Central America it is now reduced to small patches of secondary forest, very rarely primary forests. All new records of *C. chalcodes* came from dry forest reserves with at least some primary forest or larger areas of closed stands of dry forest. Hence, the role of larger dry forest reserves like the Parque Nacional Santa Rosa for the conservation of rarely collected species like *C. chalcodes* cannot be emphasized enough.

As far as known, all hosts of ericrocidine bees are within the related tribe Centridini (Snelling and Brooks, 1985); hence, hosts of both *Ctenioschelus* species might be found among the larger centridine species of the accompanying bees listed herein. Likely hosts for *C. chalcodes* might be *Centris* (*Centris*) *inermis* or *C.* (*Centris*) *aethyctera,* whereas for *C. goryi*, species like *C.* (*Melacentris*) *agiloides*, *C.* (*Aphemisia*) *plumipes* and *C.* (*Trachina*) *longimana* could serve as hosts.

The different heights at which the two species were collected in flowering trees should not be used to infer possible differences in stratum preference; rather they reflect the general difference in canopy height between dry and rain forest, or trees in closed stands versus trees in open Savannah type vegetation. However, based on a large number of bees collected in treetops of both, tropical Dry and Wet Forests (Thiele, unpubl. data), bees of the genera *Ctenioschelus*, *Centris* and *Epicharis* seem to prefer foraging at canopy level and are rarely found at intermediate or shrub level food plants in closed forests.

ACKNOWLEDGMENTS

I am grateful to Ricardo Ayala for kindly providing a digital image and label data of the Mexican *C. chalcodes* specimens. For help with the digital photography I am indebted to Alexander Riedel, Karlsruhe. I thank Charles D. Michener for providing me with two Romand papers. Manuel Zumbado and Ronald Zuñiga of INBIO kindly helped with loans and gave permission to use the map template. Michael S. Engel, Charles D. Michener, and an anonymous reviewer provided valuable comments on the manuscript. Many people at OTS, the La Selva Biological Station, and the Centro de Investigación of the Parque Nacional Santa Rosa helped to make this work possible. I further owe thanks to Javier Guevara of MINAE for his help with the permits.

LITERATURE CITED

Ayala, R. 1990. Abejas silvestres (Hymenoptera: Apoidea) de Chamela, Jalisco, México. Folia Entomológica Mexicana 77 (1988): 395-493.

Bullock, S. H., H. A. Mooney, and E. Medina (Editors). 1995. Seasonally dry tropical forests. Cambridge University Press, Cambridge, England, Great Britain. 450 pp.

Engel, M. S. 2001. A monograph of the Baltic amber bees and evolution of the Apoidea (Hymenoptera). Bulletin of the American Museum of Natural History 259: 1-192.

Janzen, D. H. (Editor). 1983. Costa Rican Natural History. The University of Chicago Press. Chicago, Illinois, U.S.A. 816 pp.

Janzen, D. H. 2004. Ecology of dry-forest wildland insects in the Area de Conservation Guanacaste. pp. 80-96. *In,* G. W. Frankie, A. Mata, and S. B. Vinson (Editors). Biodiversity Conservation in Costa Rica: learning the lessons in a seasonal dry forest. University of California Press. Berkeley, California, U.S.A. 352 pp.

Lepeletier de Saint Fargeau, A. 1841. Histoire Naturelle des Insectes, Hymenoptères. Vol. 2. Paris, France. 680 pp.

McDade, L. A., K. S. Bawa, H. A. Hespenheide, and G. S. Hartshorn. 1994. La Selva: Ecology and Natural History of a Neotropical Rain Forest. The University of Chicago Press. Chicago, Illinois, U.S.A. 486 pp.

Michener, C. D. 2007. The Bees of the World. Johns Hopkins University Press. Baltimore, Maryland, U.S.A. 953 pp.

Murphy, P. G. and A. Lugo. 1986. Ecology of tropical dry forest. Annual Review of Ecology and Systematics 17: 67-88.

Romand, M., de 1840a. Description d'un insecte Hyménoptère de la famille des Mellifères (*Acanthopus Goryi*), par M. De Romand. Revue Zoologique par la Société Cuvierienne (1840): 248.

Romand, M., de 1840b. Sur l'Hyménoptère nommé *Acanthopus Goryi* (voy. cette Revue, 1840, p. 248). - Extrait d'une lettre de M. de Romand, en date du 1er octobre 1840. Revue Zoologique par la Société Cuvierienne (1840): 335-336.

Romand, M., de 1841. Notice sur divers insectes Hyménoptères de la famille des Mellifères. Magasin de Zoologie (2) 3: 1-8.

Rozen, J. G. 1991. Evolution of cleptoparasitism in anthophorid bees as revealed by their mode of parasitism and first instars (Hymenoptera: Apoidea). American Museum Novitates 3029: 1-36.

Silveira F. A., G. A. R. Melo, and E. A. B. Almeida. 2002. Abelhas Brasileiras: Sistemática e Identificação. Idmar. Belo Horizonte, Brazil. 253 pp.

Smith, F. 1854. Catalogue of hymenopterous insects in the collection of the British Museum. Part II: pp.199-465. Apidae. British Museum (Natural History). London, Great Britain.

Snelling, R. R. and R. W. Brooks. 1985. A review of the genera of cleptoparasitic bees of the tribe Ericrocini (Hymenoptera: Anthophoridae). Contributions in Science, Natural History Museum of Los Angeles County 369: 1-34.

Snelling, R. R. 1984. Studies on the taxonomy and distribution of American centridine bees. Contributions in Science, Natural History Museum of Los Angeles County 347: 1-69.

Thiele, R. 2005. A new species of *Ctenioschelus* Romand from Costa Rican dry forest (Hymenoptera: Apidae: Ericrocidini). Journal of the Kansas Entomological Society 78: 272-276.

XYSTICUS ANATOLICUS N. SP. (ARANEAE: THOMISIDAE), A NEW SPECIES FROM TURKEY[1]

Hakan Demir,[2] Metin Aktaş,[2] and Aydın Topçu[3]

ABSTRACT: *Xysticus anatolicus* n.sp. (Araneae: Thomisidae) is described in the male sex from Kayseri Province, Turkey.

KEY WORDS: *Xysticus*, new species, Thomisidae, Turkey

The genus *Xysticus* C. L. Koch, 1835, is represented with many taxa (156 species and 24 subspecies) in the Palearctic Region (Platnick, 2007). As the fauna of Turkey is concerned, Thomisidae must be regarded as an insufficiently known family. Early studies of this genus were carried out by Karol (1966a–c; 1968), who described four new *Xysticus* species from Turkey. However, *X. sislii* Karol, 1966, *X. turcicus* Karol, 1966, and *X. pelini* Karol, 1968, turned out to be synonyms of *X. thessalicus* Simon, 1916 (Wunderlich, 1995), and *X. jezequeli* Karol, 1966, is a synonym of *X. gymnocephalus* Strand, 1915 (Assi 1986). Afterwards, there are various authors, both Turkish and foreign researchers, who made important contributions to the Turkish *Xysticus* fauna which currently comprises 36 species and 1 subspecies (Topçu et al., 2005; Logunov & Demir, 2006; Logunov, 2006, Demir et al., 2006). However, the previous works were mainly made in the Central Anatolian Region, Black Sea Region, and Mediterranean Region (Central parts) of Turkey respectively. Nevertheless, it is impossible to say that the fauna of Turkey has been completely investigated. Turkey is, in terms of climatical features and field structures, a very diverse country, and the number of studies are not sufficient for a survey of the complete fauna. In the present paper, a new species from Turkey is described.

METHODS

Specimen was collected under a stone from marshy area. All illustrations were made with a Nikon SMZ-U stereomicroscope with drawing tube. All measurements are in millimeters. Abbreviations used in the text and in the figures are as follows: ALE, anterior lateral eyes; AME, anterior median eyes; ap, apical; d, dorsal; MOA, median ocular area; MOA-L, length of MOA; MOA-WA, anterior width of MOA; MOA-WP, posterior width of MOA; Mt, metatarsus; PLE, posterior lateral eyes; PME, posterior median eyes; p, prolateral; r, retrolateral; v, ventral; NUAM, Arachnology Museum of the Niğde University, Niğde, Turkey. Terminology of genitalia and system of leg spination follow Ono (1988).

---

[1] Received on June 21, 2007. Accepted on July 13, 2007.

[2] Department of Biology, Faculty of Science and Arts, Gazi University, TR-06500 Ankara, Turkey. E-mails: hakandemir@gazi.edu.tr, maktas@gazi.edu.tr, respectively.

[3] Department of Biology, Faculty of Science and Arts, Niğde University, TR-51200 Niğde, Turkey. E-mail: atopcu3@msn.com

Mailed on June 23, 2008

SYSTEMATIC ARANEOLOGY

Xysticus anatolicus n.sp.

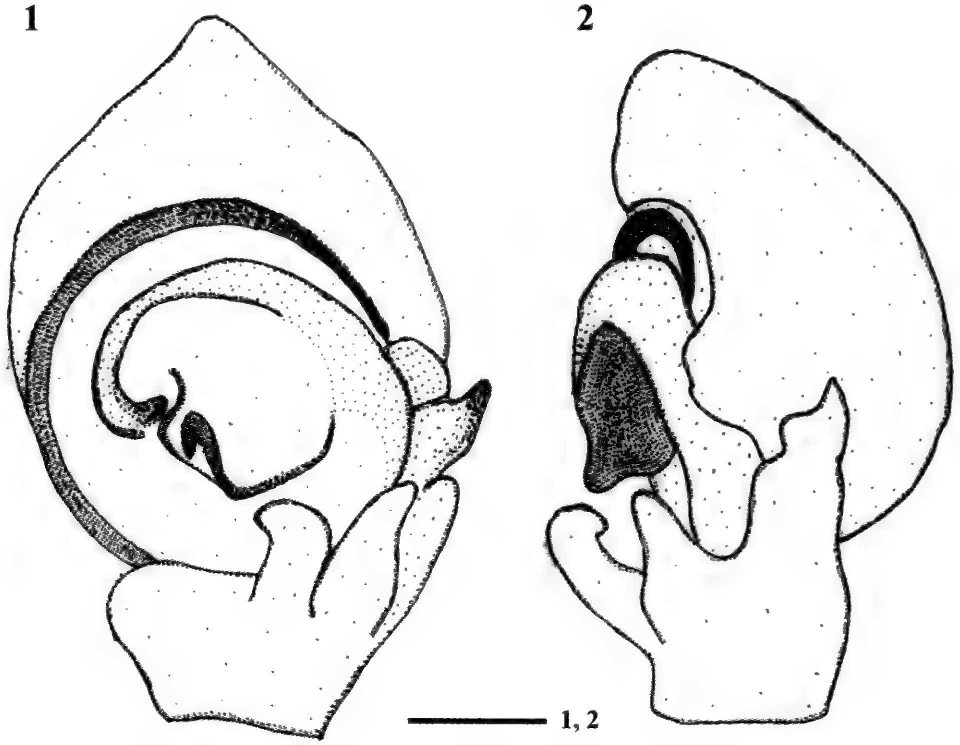
Figs 1-4

Material. Holotype ♂ (NUAM), Turkey: Kayseri Province, Sultan Sazlığı, Çayağzı Village (1066m.) (38°14'N, 35°11'E) 03.VII.2003, leg. Hakan Demir.

Etymology. Named after the region of Anatolia.

Diagnosis. *Xysticus anatolicus* n.sp. is closely related to *X. tenebrosus* Silhavy, 1944 (*cf.* Silhavy, 1944: fig. 2; Wunderlich 1995: fig. 43), *X. ovadan* Marusik & Logunov, 1995 (*cf.* Marusik & Logunov, 1995: figs. 24-25), *X. ovtsharenkoi* Marusik & Logunov, 1990 (*cf.* Marusik & Logunov, 1990: figs 14-15), *X. turlan* Marusik & Logunov, 1990 (*cf.* Marusik & Logunov, 1990: figs. 18-19) and *X. caperatus* Simon, 1875 (*cf.* Levy, 1976: figs. 18-19). The new species can be distinguished from the latter species, especially in the shape of tegular apophysis and the long, slightly pointed conelike intermediate apophysis.

Description. Measurements (holotype ♂). Carapace: 2.68 long, 2.60 wide. Abdomen: 2.80 long, 2.64 wide. Clypeus 0.28 long, chelicera 0.84 long. Eye sizes and inter distances: AME 0.12, ALE 0.16, PME 0.12, PLE 0.20; MOA–WA 0.56, MOA–WP 0.60, MOA–L 0.45, AME–AME 0.28, AME–ALE 0.16, PME–PME 0.40, PME–PLE 0.36. Lengths of legs [total length (femur+patella+tibia+metatarsus+tarsus)]: I 8.48mm (2.40+1.20+2.00+1.80+1.08), II 8.08 (2.40+1.12+1.92+1.60+1.04), III 5.80 (1.76+0.80+1.20+1.04+1.00), IV 5.60 (1.60+0.80+1.20+1.00+1.00).



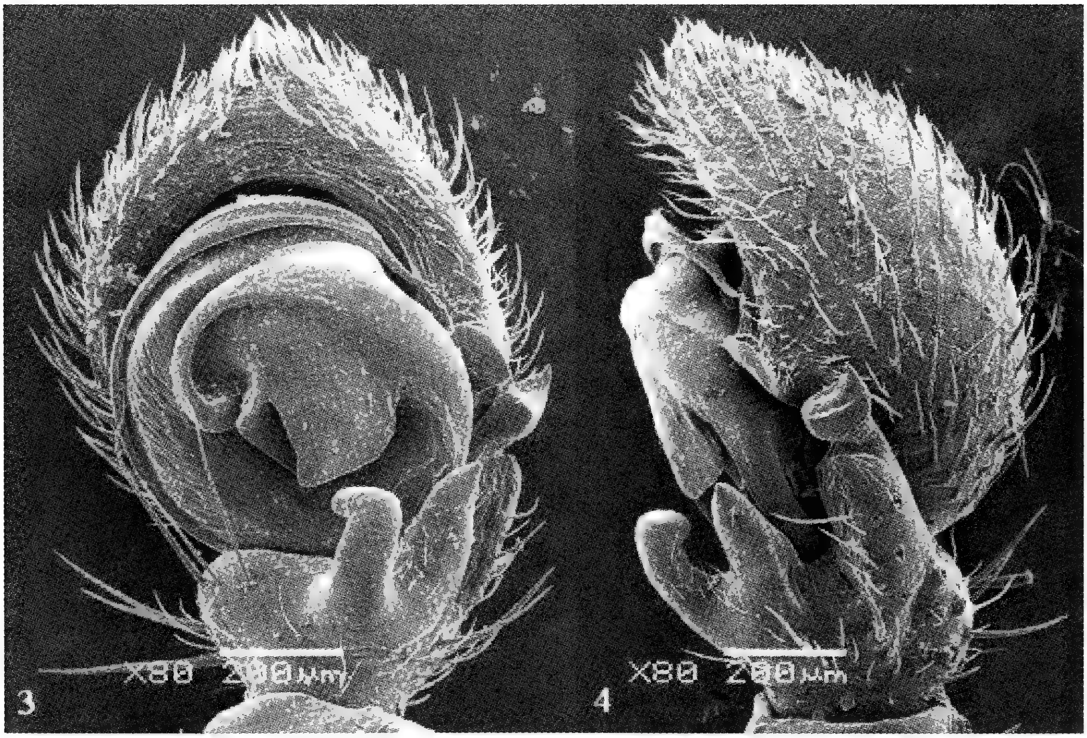
Figures 1-2. *Xysticus anatolicus* n.sp., 1-2. left male palp; 1. ventral view; 2. retrolateral view. Scale bars = 0.2 mm.

Carapace reddish-brown with dark brown spots and yellow V-shaped mark. Eye tubercles creamy-coloured, margins of carapace brown. Chelicerae light brown with dark brown spots. Sternum, labium and maxillae brown with black spots. Legs; femora and patellae I and II reddish with black spots, tibia I and II yellow with brown spots, distally lighter than proximally, metatarsi and tarsi yellow, femora, patellae and tibia III and IV yellow with brown spots, metatarsi and tarsi creamy-coloured. Dorsum of abdomen white with black and brown spots and stripes, venter of abdomen with black and brown spots. Spinnerets yellow brown, branchial opercula light brown. Leg I spination: femur d. 1–1–1–1, p. 1–2–2–2, tibia p. 1–1–1, r. 1–1–1–1, v. 2–2–2–2–2ap., metatarsus p. 1–1–1–1ap., r. 1–1–1, v. 2–2–2–2ap.

Palpus. Tibia with ventral, intermediate and retrolateral apophyses. Ventral apophysis fingerlike, inclined slightly inwards and with a round swelling apically on medial side. Intermediate apophysis conelike and upwards slightly pointed. Retrolateral apophysis thick with a deeply steplike protuberance on the apcial side. Tutaculum cuplike. Tegulum encircled by broad, black sclerotic embolar duct and a large leaflike tegular apophysis projecting obliquely downwards. Palpal structure as in Figs. 1-2, 3-4.

Female. Unknown.

Distribution. Turkey (known only from the type locality).



Figures 3-4. *Xysticus anatolicus* n.sp., 3-4. left male palp; 3. ventral view; 4. retrolateral view.

ACKNOWLEDGEMENTS

We are very grateful to Dr. Dmitri V. Logunov (Russia), Dr. Yuri M. Marusik (Russia) and Dr. Vlastimil Ruzicka (Czech Republic) for their advice and valuable comments.

LITERATURE CITED

Assi, F. 1986. Note faunistique sur les Thomisidae et les Philodromidae du Liban (Araneae). Revue Arachnologique 7: 41-46.

Demir, H., A. Topçu, and T. Türkeş. 2006. A new species of the genus *Xysticus* C. L. Koch from Turkey (Araneae: Thomisidae). Zootaxa 1364: 45-49.

Karol, S. 1966a. Description d'une araignée nouvelle en Turquie (Araneae, Thomisidae). Communications de la Faculté des Sciences de l'Université d'Ankara 11(C): 1-5.

Karol, S. 1966b. Sur une nouvelle espéce du genre *Xysticus* (Araneae, Thomisidae) en Turquie. Communications de la Faculté des Sciences de l'Université d'Ankara 11(C): 7-9.

Karol, S. 1966c. Spiders of Ankara and environs with a description of a new species *Xysticus turcicus* (Araneae, Thomisidae). Communications de la Faculté des Sciences de l'Université d'Ankara 11(C), 15-32.

Karol, S. 1968. Description de deux espéces nouvelles de Thomisidae (Araneae) de Turquie. Bulletin du Museum National d'Historie Naturelle, Paris 39: 908-911.

Levy, G. 1976. The spider genus *Xysticus* (Araneae: Thomisidae) in Israel. Israel Journal of Zoology 25: 1-37.

Logunov, D. V. and H. Demir. 2006. Further faunistic notes on *Cozyptila* and *Xysticus* from Turkey (Araneae, Thomisidae). Arachnologische Mitteilungen 31: 38-43.

Logunov, D. V. 2006. Notes on *Xysticus kempeleni* Thorell, 1872 and two closely related spider species (Araneae, Thomisidae). Acta Arachnologica 55 (1): 59-66.

Marusik, Y. M. and D. V. Logunov. 1990. The crab spiders of middle Asia, USSR (Aranei, Thomisidae). 1. Descriptions and notes on distribution of some species. Korean Arachnology 6: 31-62.

Marusik, Y. M. and D. V. Logunov. 1995. The crab spiders of middle Asia (Aranei, Thomisidae), 2. Beiträge zur Araneologie 4: 133-175.

Ono, H. 1988. A revisional study of the spider family Thomisidae (Arachnida, Aranei) of Japan. National Science Museum. Tokyo, Japan. 252 pp.

Platnick N. I. 2007. The world spider catalog, version 7.0. American Museum of Natural History. Available from: http://research.amnh.org/entomology/spiders/catalog/THOMISIDAE.html.

Silhavy, V. 1944. De Araneis familiae Thomisidae in Balcano occidentali viventibus. Sbornik Klubu prirodovedeckeho v Brne za rok 1942 a 1943, roc. 25: 90-95.

Topçu, A., H. Demir, and O. Seyyar. 2005. A Checklist of the spiders of Turkey. Serket 9, 109-140.

Wunderlich, J. 1995. Zur Kenntnis west-paläarktischer Arten der Gattungen *Psammitis* Menge 1875, *Xysticus* C. L. Koch 1835 und *Ozyptila* Simon 1864 (Arachnida: Araneae: Thomisidae). Beiträge zur Araneologie 4: 749-774.

A NEW SPECIES OF *CYMODUSA* (*CYMODUSA*) HOLMGREN, [1859] (HYMENOPTERA: ICHNEUMONIDAE: CAMPOPLEGINAE) FROM TURKEY[1]

Janko Kolarov[2] and Saliha Çoruh[3]

ABSTRACT: A new species of the genus *Cymodusa* (*Cymodusa*) Holmgren, [1859] from Turkey is described and figured. It is distinguished from the similar *C.* (*Cymodusa*) *oculator* Dbar, 1985 by elongated basal area and area superomedia of propodeum, moderately narrowed behind head, developed clypeal fovea, no intercepted nervellus and coloration of the body.

KEY WORDS: *Cymodusa* (*Cymodusa*), Campopleginae, Ichneumonidae, Hymenoptera, new species, Turkey

The genus *Cymodusa* (*Cymodusa*) Holmgren, [1859] is a moderately large genus with about 38 species in Holarctic, Oriental and Neotropic regions (Yu and Horstmann, 1997). Usually the species occur among grasses and parasitize caterpillars (Lepidoptera). A key of Campopleginae genera is given by Townes (1970). Palaearctic species was reviewed and keyed by Dbar (1984 and 1985). In Western Palaearctic region there are 18 species (Yu et al., 2005).

Until now only two species was known from Turkey (Kolarov and Beyarslan, 1995). After examining *Cymodusa* (*Cymodusa*) materials collected from North Eastern Turkey, a new species was found and it is described below.

SYSTEMATIC ENTOMOLOGY

Cymodusa (*Cymodusa*) *yildirimi* sp. nov.

Female. Front wing 3.3 mm, body 4.5 mm, ovipositor sheath 1.3 mm long. Head narrowed behind eye (Fig. 1). Frons densely punctured mat. Occipital carina connected oral carina far from base of mandible. Diameter of hind ocellus 0.83 as long as the distance between ocellus and eye. Flagellum with 30 segments, postannellus 3.2 as long as wide, subapical segments square. Eyes densely hairy, swollen, both front and hind margins concave. Front margins of eyes strongly convergent down (Fig. 2). Maximal distance between them 2.4 as long as minimal distance. Clypeus separated from face, with regularly curved front margin. Clypeal foveae touching eyes. Malar space 0.14 as long as basal width of mandible. Oral carina high, lamelliform.

---

[1] Received on July 18, 2007. Accepted on August 14, 2007.

[2] University of Plovdiv, Faculty of Pedagogie, 24 Tsar Assen Str., 4000 Plovdiv, Bulgaria. E-mail: jkolarov@uni-plovdiv.bg .

[3] Atatürk University, Faculty of Agriculture, Department of Plant Protection, 25240 Erzurum, Turkey. E-mail: spekel@atauni.edu.tr.

Mailed on June 23, 2008

Mesonotum moderately dense punctured on coriaceous background, notaulus weak. Meso- and metapleurum coriaceous, not punctured. Prepectal carina strong connected front margin of mesopleurum on its middle. Mesosternum excavated longitudinally along mesosternal suture, more deeply from behind. Legs moderately slender, hind femur 5.0 as long as wide. Correlation between hind tarsal segments as 35:17:11:6:7. Tarsal claws pectinated basally. Front wing with petiolate areolet (Fig. 3). Second radius 1.53 as long as first one. Second recurrent vein (2mCu) connected with areolet in front of its middle. Nervulus interstitial, nervellus vertical, not intercepted, discoidella absent (Fig. 4). Propodeum well areolated, with area basalis elongated separated from areola (Fig. 5). Area superomedia hexagonal, open from behind, costula present. Combined area basalis and area superomedia 1.57 as long as petiolar area.

First metasomal tergite without dorsolateral carinae, glymma absent. Second metasomal tergite 1.6 as long as wide apically, sculptured. Sixth and seventh metasomal tergites deeply excavated apically (Fig. 6). Ovipositor sheath as long as hind tibia.

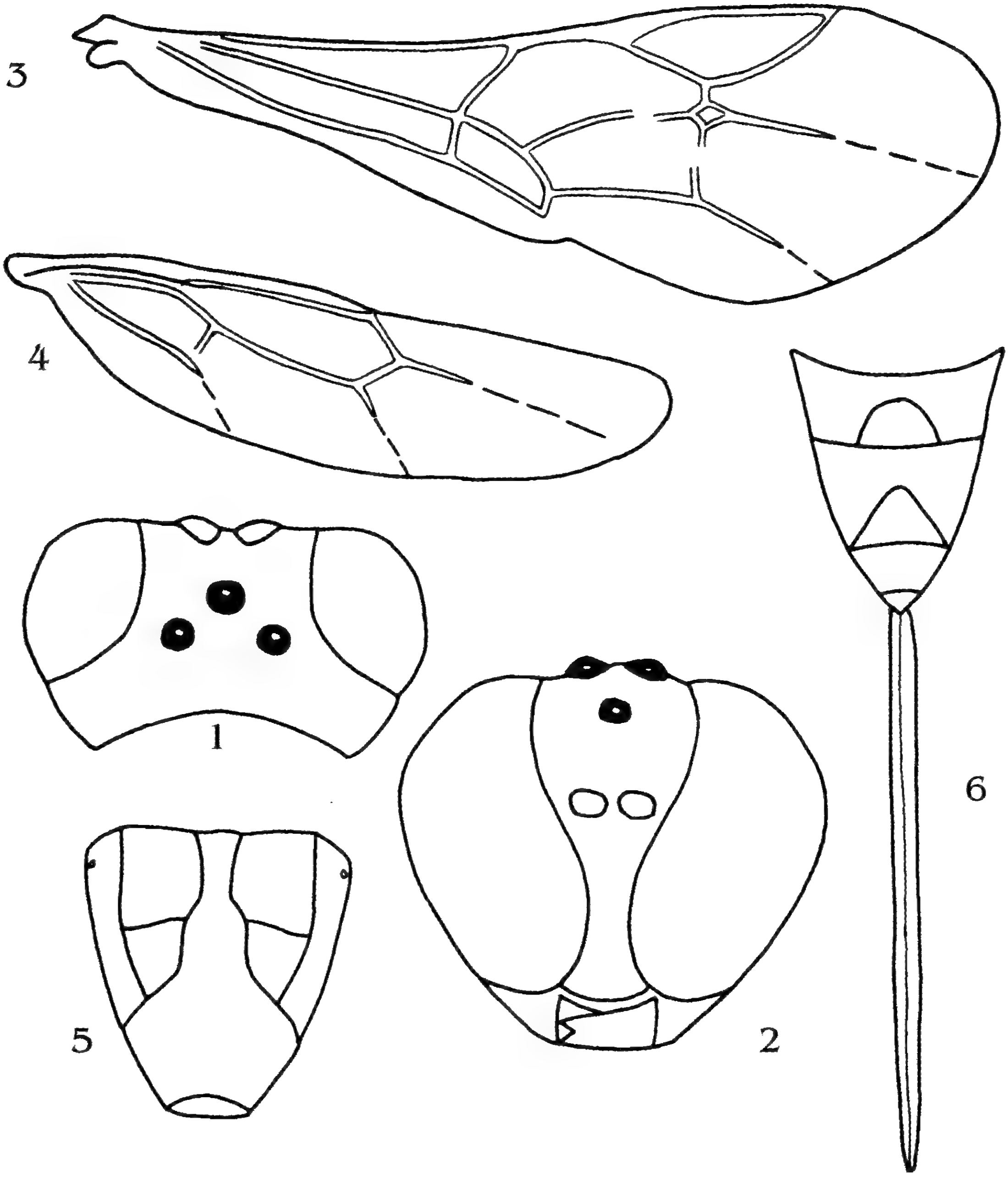
Black; palpi, mandible except teeth and tegula yellow; legs except hind coxa and first hind trochanter reddish; middle coxa, base of hind femur, hind tibia apically and subbasally brownish; second and third metasomal sternites yellowish; first – third metasomal tergites with reddish apical band.

Male unknown.

The newly described species belongs to the *australis* species group by the short malar space, strongly convergent down eyes orbitae, long ovipositor and strongly excavated apically sixth and seventh metasomal tergites. It is distinguished from the similar *Cymodusa* (*Cymodusa*) *oculator* Dbar, 1985 by elongated basal area and area superomedia of propodeum, moderately narrowed behind head, developed clypeal fovea, not intercepted nervellus and coloration of the body.

Material Examined: Holotype female, Turkey, Erzurum, 1850 m, 30.07. 1998, leg E. Yildirim, preserved in the collection of Plovdiv University; Paratype female, Turkey, Erzurum, Palandoken, 2300 m, 7.07.1996, leg. S. Tosun, preserved in the collection of Atatürk University, Erzurum.

Etymology: The species is dedicated to Dr. E. Yildirim, who collected one of the type specimens and for his investigations on Hymenoptera.



Figures 1-6. *Cymodusa* (*Cymodusa*) *yildirimi* sp. nov. 1. head from above; 2. face; 3. front wing; 4. hind wing; 5. propodeum; 6. last metasomal tergites, dorsal view (x 40).

ACKNOWLEDGEMENTS

We are grateful to four anonymous reviewers for their help for improving the article.

LITERATURE CITED

Dbar, R. S. 1984. Revision of the Palaearctic species of the genus *Cymodusa* Holmgren (Hymenoptera, Ichneumonidae). Entomologicheskoye Obozreniye 63(4):802-812. [Entomological Review 63(4):127-138]

Dbar, R. S. 1985. Revision of the Palaearctic species of *Cymodusa* Holmgren (Hymenoptera, Ichneumonidae). II. Entomologicheskoye Obozreniye 64(3):588-600. [Entomological Review 65(1):5-17]

Kolarov, J. and A. Beyarslan. 1995. New and little known Turkish Campopleginae (Hymenoptera, Ichneumonidae). *In*, Third National Scientific Conference of Entomology, 18-20 September 1995. Sofia, Bulgaria. pp. 18-21.

Holmgren, A. E. 1859. Conspectus generum Ophionidum Sueciae. Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar.15(1858):321-330.

Townes, H. 1970. The Genera of Ichneumonidae. Part 3. Memoirs of the American Entomological Institute 13. 307 pp.

Yu, D. S. and K. Horstmann. 1997. A Catalogue of World Ichneumonidae (Hymenoptera). Memoirs of the American Entomological Institute No. 58 (1/2) 1558 pp.

Yu, D. S., **C. van Achterberg (Braconidae), and K. Horstmann (Ichneumonidae).** 2005. World Ichneumonoidea 2004 - Taxonomy, Biology, Morphology and Distribution. — DVD/CD. Taxapad. Vancouver, Canada. www.taxapad.com.

SCIENTIFIC NOTE

SIGNIFICANT WESTWARD RANGE EXTENSION FOR THE LIMNEPHILID CADDISFLY *PHANOCELIA CANADENSIS* (TRICHOPTERA): FIRST RECORD FROM ALASKA, U.S.A.[1]

Daniel J. Rinella[2] and Daniel L. Bogan[2]

Phanocelia canadensis Banks, the sole species of this northern North American trichopteran genus, has previously been reported from scattered locations in the northeastern United States, most Canadian provinces from Alberta eastward, and the Northwest Territories (see Colburn and Garretson Clapp, 2006, for a recent review). Holocene fossil remains have been reported from the northern Yukon Territory (>9000 y.b.p.; Matthews and Telka, 1997). However, no living or fossilized *P. canadensis* have been reported from west of the Continental Divide.

We collected two *P. canadensis* larvae in a small, unnamed tributary to the Zitziana River in the northern foothills of the Kuskokwim Mountains, interior Alaska (64.511° N, 151.435° W) on July 25, 2004. The site, approximately 65 km southwest of the settlement of Manly Hot Springs, was one of 45 randomly selected sites sampled throughout the Tanana River basin as a stream monitoring effort. We used a 500-µm D-frame net to collect a composite macroinvertebrate sample from 11 transects systematically arranged over a 150-m stream reach from which we identified a 500-organism fixed count in the laboratory.

The unnamed tributary drains boreal forest that typifies areas of interior Alaska underlain by discontinuous permafrost: mixed stands of black spruce (*Picea mariana* [P. Mill.] B.S.P., Pinaceae) and paper birch (*Betula papyrifera* Marsh., Betulaceae) with an ericaceous shrub understory and a thick bryophyte layer. Our sampling reach was immediately downstream of a small *Carex*-dominated cyperacean wetland. Riparian vegetation consisted of an open overstory of black spruce and paper birch with an understory of willow (*Salix* spp., Salicaceae) and graminoid vegetation (*Carex* spp. and grasses) that densely shaded most of the stream channel. The channel width averaged 1.5 m, the slope averaged 2.6%, and the streamflow measured 0.6 L/s. The streambed consisted primarily of organic detritus (mainly grass and wood fragments) with some silt. Temperature was 9.9°C, specific conductance was 102 µs/cm, and pH was 7.33. *Phanocelia canadensis* was the sole Trichoptera taxon collected at this site. Other insect taxa collected at this site included Coleoptera (*Agabinus* sp. [Dytiscidae]); Diptera (Chironomidae spp., *Dixella* sp. [Dixidae], *Simulium* sp.

---

[1] Received on September 13, 2007. Accepted on October 18, 2007.

[2] Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 U.S.A. E-mails: (DJR) rinella@uaa.alaska.edu, (DLB) bogan@uaa.alaska.edu.

Mailed on June 23, 2008

[Simuliidae], *Dicranota* sp. [Tipulidae]); Ephemeroptera (*Baetis* sp. [Baetidae]); and Plecoptera (*Nemoura* sp. [Nemouridae]). Aside from the presence of *P. canadensis*, the insect assemblage at this site was roughly similar to those collected at other small, non-glacial streams in our survey of the Tanana River basin.

Larvae of *P. canadensis* have previously been reported only from acidic ponds (Fairchild and Wiggins 1989, Colburn and Garretson Clapp 2006), making this the first reported collection from a circum-neutral and lotic habitat. However, this collection does not necessarily represent a departure from the previously documented habitat preferences of *P. canadensis*. It is conceivable that the wetland upstream of our sample reach is the primary habitat of this *P. canadensis* population and that our specimens had been displaced downstream. Previous reports indicate these larvae to be strongly associated with submerged *Sphagnum* and shrubs (Fairchild and Wiggins 1989, Colburn and Garretson Clapp 2006); while such taxa were absent from the stream reach where we collected the *P. canadensis* larvae, we do not know if they occurred in the upstream wetland. Further effort would be required in order to determine the preferred habitat of this population.

Prior to this collection, the westernmost record of *P. canadensis* was from the Northwest Territories (Schmid 1968), making this a significant westward range extension of over 1500 km. This record, together with previous publications, appears to indicate that *P. canadensis*' current range extends the breadth of northern North America. Despite this broad distribution, *P. canadensis* is rarely collected. Populations appear to be highly localized and specific in their habitat requirements. Further, much of *P. canadensis*' range consists of boreal forest with sparse human habitation and very little collecting effort. It is noteworthy to mention this region of interior Alaska was unglaciated during the Pliocene and Quaternary and served as a major refugium for boreal and arctic species (see Abbott and Brochmann 2003, Cook et al., 2005 and references cited therein); interior Alaska was also isolated from the rest of North America by ice sheets throughout much of the last two million years. The Alaskan population of *P. canadensis* has therefore persisted in isolation for many thousands of years or has been established by more recent dispersal. Molecular and morphological-anatomical systematic studies, as well as further ecological investigations, are warranted to determine the taxonomic status, history, and ecology of this widely disjunct population.

ACKNOWLEDGMENTS

We thank Mike Booz for help with field data collection and David Ruiter for specimen verification. Also, we thank Matt Carlson, Alaska Natural Heritage Program, and David Ruiter for helpful insights on the manuscript. This work was funded by the U.S. Environmental Protection Agency's Ecological Monitoring and Assessment Program Western Pilot Study and the Alaska Department of Environmental Conservation's Alaska Monitoring and Assessment Program.

LITERATURE CITED

Abbott, R. J. and C. Brochmann. 2003. History and evolution of the arctic flora: in the footsteps of Eric Hultén. Molecular Ecology 12:299–313.

Colburn, E. A. and F. M. Garretson Clapp. 2006. Habitat and life history of a northern caddisfly, *Phanocelia canadensis* (Trichoptera: Limnephilidae), at the southern extreme of its range. Northeastern Naturalist 13:537–550.

Cook, J. A., E. P. Holberg, A. Koehler, H. Henttonen, L. Wickström, V. Haukisalmi, K. Galbreath, F. Chernyavski, N. Dokuchaev, A. Lahzuhtkin, S. O. MacDonald, A. Hope, E. Waltari, A. Runck, A. Veitch, R. Popko, E. Jenkins, S. Kutz, and R. Eckerlin. 2005. Beringia: Intercontinental exchange and diversification of high latitude mammals and their parasites during the Pliocene and Holocene. Mammal Study 30:S33–S40.

Fairchild, W. L. and G. B. Wiggins. 1989. Immature stages and biology of the North American caddisfly genus *Phanocelia* Banks (Trichoptera: Limnephilidae). Canadian Entomologist 121: 515–519.

Matthews, J. V., Jr. and A. Telka. 1997. Insect fossils from the Yukon. Pp. 911–962. *In,* H. V. Danks and J. A. Downes (editors) Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods). Ottawa, Ontario, Canada, 1034 pp.

Schmid, F. 1968. Quelques Trichoptères nearctiques nouveaux ou peu connus. Le Naturaliste Canadien 95:673–698.

Entomology in the News and Message from the Editor

This issue introduces two new, occasional sections in *Entomological News*: Entomology in the News and Message from the Editor. Entomology in the News hopes to summarize short stories about insects and other arthropods that make it into the popular culture, including newspapers, magazines, and other popular media. Readers are encouraged to forward any story they deem of interest to the Editor. In Message from the Editor, I hope to call to the attention of readers, anything I consider of importance to *Entomological News.*

ENTOMOLOGY IN THE NEWS — Last year, New York Yankees pitcher, Joba Chamberlain, was interrupted by flies late in a major league baseball playoff game against the Cleveland Indians (http://sportsillustrated.cnn.com/2007/baseball/mlb/specials/playoffs/2007/10/05/yankees.indians.bugs.ap/index.html). Sometimes, entomology is important in unexpected situations.

Last month, large sized scarabaeids were intercepted in a shipment from Taiwan to the United States (http://readingeagle.com/article.aspx?id=91868). This emphasizes the importance of regulatory entomology.

MESSAGE FROM THE EDITOR — Authors are encouraged to send book reviews to *Entomological News.* In rendering all citations, authors are urged to use the utmost care. Recently, this Editor has found some bibliographic conundrums (or conundra) that emphasize the importance of correct and full bibliographic data.

Jorge A. Santiago-Blay, Washington,
District of Columbia U.S.A.
E-mail: blayjorge@gmail.com

SCIENTIFIC NOTE

NEW STATE RECORD AND NORTHERN RANGE EXTENSION OF *STICTHIPPUS CALIFORNICUS* (SCUDDER) (ORTHOPTERA: ACRIDIDAE) FROM OREGON, U.S.A.[1]

JoVonn G. Hill[2]

Sticthippus californicus (Scudder) was described by Scudder (1892) from Gilroy, Santa Clara County, California, and it is widespread in that state (Strohecker et al., 1968; Otte, 1984). *Sticthippus californicus* was only known from California until it was reported from western Nevada in 2004 (Stidham, 2004). On 4 August 2006, in the Cascade mountain range of east-central Oregon, R. L. Brown collected a single male specimen of *S. californicus* in the Willamette National Forest (Lane County, 44°14'14"N 122°05'08"W). Subsequently, another single male specimen of *S. californicus* from Oregon was found in an undetermined section of the United States National Museum. This specimen was collected in Ritter, Grant County on the 3rd of August 1962 by J. F. G. Clarke at 1280.16 m in elevation. The collections are only the second record of this species outside of California, and represents a northern range extension for this species and a new state record for Oregon. Other species collected with this specimen included *Trimerotropis verruculata suffusa* Scudder and two undetermined species of *Melanoplus*. The *S. californicus* specimens are typical of the species and have morphological characters that agree with those given in Otte (1984), including a bilobed epiphalus, red tibia, and hind wings with a yellow basal area. The specimen is deposited in the Mississippi Entomological Museum.

ACKNOWLEDGEMENTS

I thank Richard L. Brown for collecting grasshopper specimens for me on his trip to Oregon. This is journal article A-11202 of the Mississippi Agricultural and Forestry Experiment Station. I thank David Nickle for allowing me access to the National Museum of Natural History (Washington, DC) collection and for the loan of the *S. californicus* specimen.

LITERATURE CITED

Otte, D. 1984. The North American Grasshoppers. Volume II, Acrididae Oedipodinae. Harvard University Press, Cambridge. 366 pp.

Scudder, S. H. 1892. The orthopteran genus *Hippiscus*-IV Pysche 6: 317-320.

Stidham, T. A. 2004. First record of *Sticthippus californicus* (Orthoptera: Acrididae) outside California, U.S.A. Entomological News 115: 54.

Strohecker, H. F., W. W. Middlekauff, and D. C. Rentz. 1968. The grasshoppers of California (Orthoptera: Acrididae). Bulletin of the California Insect Survey 10: 1-177.

---

[1] Submitted on October 12, 2007. Accepted on November 7, 2007.

[2] Mississippi Entomological Museum, Box 9775 Mississippi State University, Mississippi 39762 U.S.A. E-mail: jgh4@entomology.msstate.edu.

Mailed on June 23, 2008

SCIENTIFIC NOTE

FIRST DATA ON CADDISFLIES (TRICHOPTERA) IN STREAMS OF NORTHERN MIDDLE SIBERIA, RUSSIA[1]

Mikhail A. Beketov[2]

The large territory of Siberia covers approximately one-tenth of the Earth's landmass, and almost entire northern Asia except the Russian Far East. However, Siberian caddisflies, as well as many other insect groups, remain poorly studied because most of the large Siberian territory is difficult to access. Previous faunistic investigations of caddisflies have been mainly conducted in southern regions of Siberia (Beketov and Ivanov, 2004; Beketov and Kryukov, 2004; Beketov, 2006; Ivanov and Melnitsky, 2007). To my knowledge, in Asia caddisflies of polar or near-polar territories have been previously investigated only in the giant Siberian rivers Ob', Enisey, and Lena (Martynov, 1910; 1914; Pirozhnikov 1929; Lepneva, 1948; 1949; Greze, 1957; Ivanov et al., 1996), and also in streams located in the Russian Far East (Levanidova, 1982). Besides, a new species description based on imagoes collected in northern middle Siberia was recently published by Mey (2003). Nevertheless, almost nothing is known about Trichoptera of small or medium-size watercourses in the northern Siberian territories.

In the present paper, I report eleven Trichoptera species collected in several small to medium-sized streams in the Nizhnyaya Tunguska River basin (65°37' – 65° 49' N, 90°0' – 91°26' E, Fig. 1). The region studied is located near the polar circle in the Enisey River basin, northern middle Siberia. Mean January and July temperatures are –27°C and +16°C, respectively. Predominant vegetation type is taiga. The material (larvae only) was collected at six sites on the rivers Oneko, Nekongdokon, Erachimo, and Nizhnyaya Tunguska using D-frame net (500 μm mesh). Sampling dates, names of the streams, and main environmental characteristics of the sample sites are given in Table 1. The high water temperature in the Oneko, Nekongdokon, and Erachimo rivers is due to the lake feeding type. Surface current velocity was assessed by timing a bobber over 10 m of stream at 2-3 m from the shoreline.

Taxonomic identification was mainly based on the recent key by Ivanov et al. (2001) and additionally on the keys by Lepneva (1964; 1966). The identified specimens were thoroughly compared with the reference collection of the author and deposited in the Institute of Systematic and Ecology of Animals, Siberian Division of Russian Academy of Science (Novosibirsk, Russia).

---

[1] Received on December 19, 2007. Accepted on January 15, 2008.

[2] UFZ – Helmholtz Centre for Environmental Research, Permoserstrasse 15, D - 04318 Leipzig, Germany. E-mail: mikhail.beketov@ufz.de

Mailed on June 23, 2008

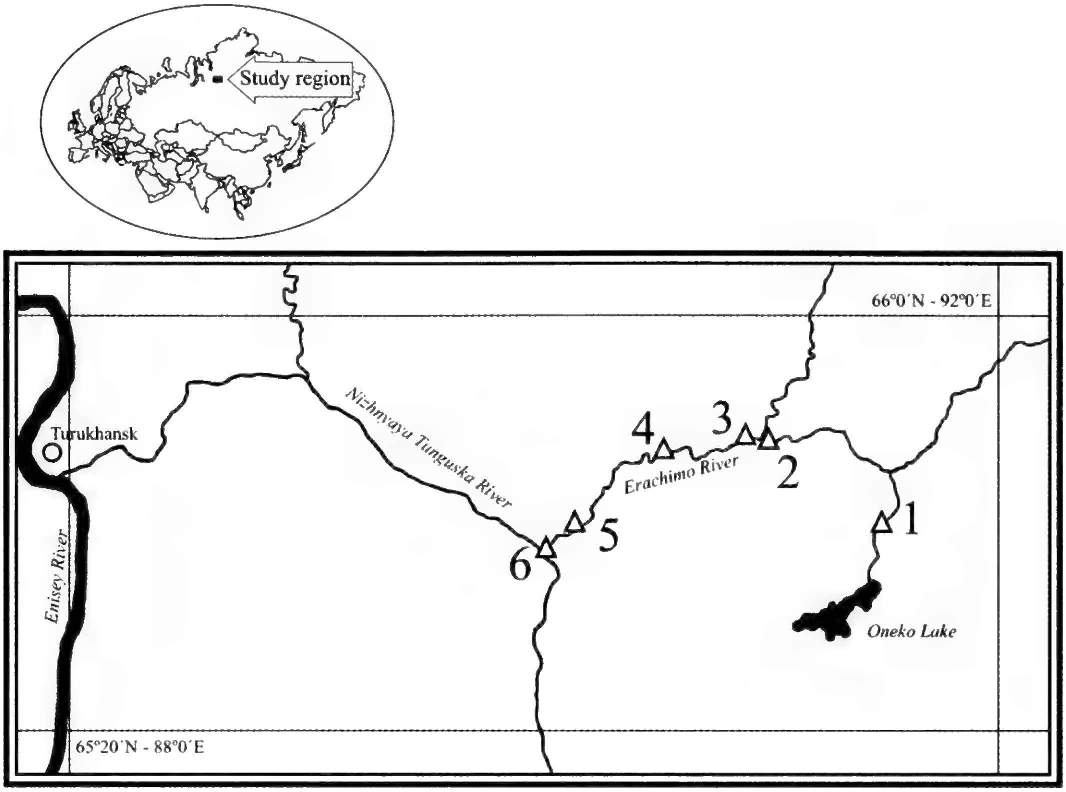


Figure 1. Study area. The sampling sites are marked as triangles.

Table 1. Sampling dates, names of the streams, and main environmental characteristics of the sample sites (for geographical location see Figure 1).

Parameter	Sampling Sites					
	1	2	3	4	5	6
River name	Oneko	Nekong-dokon	Erachimo	Erachimo	Erachimo	Nizhnyaya Tunguska
Sampling date	25-VII-2005	27-VII-2005	31-VII-2005	4-VIII-2005	8-VIII-2005	10-VIII-2005
Elevation, m a.s.l.	520	480	420	380	214	380
Stream width, m	15	70	80	85	90	180
Water temperature, °C	21	21	19	18	16	14
Current, m/sec	0.8	0.6	0.2	0.9	1.7	0.9
Substrate composition (% of size classes):						
boulders (>40 cm)	40	8	15	5	5	5
cobbles (20-40 cm)	40	10	10	20	30	50
gravel (6-20 cm)	7	80	70	70	60	40
fine gravel (0.2-2 cm)	3	2	5	5	5	5

Eleven species referable to eight families were encountered (Table 2). Two of the species, *Stenopsyche marmorata* Navás, 1920, and *Dicosmoecus palatus* Mac Lachlan, 1872, are recorded for the first time from northern Siberia. Previous records of *S. marmorata* are from the south of Siberia and the Russian Far East (Levanidova 1982; Beketov, 2005; 2006; Ivanov and Melnitsky, 2007) and its known range is thus extended northwards. In contrast, *D. palatus* has been previously recorded from the northern parts of the Russian Far East and Europe (Levanidova, 1982; Ivanov et al., 2001).

The remaining nine species have formerly been recorded from the Enisey River in the neighboring territory to the south of the Nizhnyaya Tunguska River mouth (Fig. 1) (Lepneva, 1948; 1949; Greze, 1957). These species are common in the relatively well-studied southern regions of Siberia (Beketov and Ivanov, 2004; Beketov, 2005; 2006; Ivanov and Melnitsky, 2007), but not in the northern parts of the Russian Far East (Levanidova, 1982). In conclusion, the present records suggest that the caddisfly fauna of northern Siberian streams includes typical Siberian species known from southern Siberia.

Table 2. Caddisflies (number of specimens) collected in the Nizhnyaya Tunguska River basin. Species recorded in northern middle Siberia for the first time are asterisked (*). Geographical distribution defined as Palaearctic (P), east-Palaearctic (EP), and Holarctic (H).

Taxa	Geographical Distribution	Sample Sites					
		1	2	3	4	5	6
Rhyacophilidae							
Rhyacophila sp. (*Hyporhyacophila* gr. Doehler, 1950)	EP unclear	1				1	
Arctopsychidae							
Arctopsyche ladogensis (Kolenati, 1859)	P	8					
Stenopsychidae							
Stenopsyche marmorata Navás, 1920 *	EP			1			
Hydropsychidae							
Macrostemum radiatum (MacLachlan, 1872)	EP						1
Hydropsyche kozhantshikovi Martynov, 1924	EP		2				
Hydropsyche newae (Kolenati, 1858)	P		2	3	3		
Potamya czekanowskii (Martynov, 1910)	EP						2
Brachycentridae							
Brachycentrus subnubilus Curtis, 1834	P						1
Limnephilidae							
Dicosmoecus palatus MacLachlan, 1872 *	P					1	
Molannidae							
Molanna albicans (Zetterstedt, 1840)	P			1			
Leptoceridae							
Ceraclea excisa (Morton, 1904)	H			3			

ACKNOWLEDGEMENTS

I am indebted to S. V. Luchnin for collecting the material, to Yu. A. Noskov and Yu. A. Yurchenko for help with literature, and to V. D. Ivanov, V. Yu. Kryukov, and anonymous reviewers for valuable comments on the manuscript.

LITERATURE CITED

Beketov, M. A. 2005. Mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera) of water streams of Sema river basin, Altai Mountains. pp. 47-50. *In*, V. Yu. Kryukov and M. A. Beketov (Editors). Proceedings of the conference "Autumn Zoological Sessions 2005." Novosibirsk, Russia. [In Russian with English abstract]

Beketov, M. A. 2006. Caddisflies (Trichoptera) of south-western Siberia: new zoogeographical records, aquatic habitat preferences and flight periods. Braueria 33: 13-16.

Beketov, M. A. and V. D. Ivanov. 2004. New data on the caddisflies (Trichoptera) of south-western Siberia. Braueria 31: 26-28.

Beketov, M. A. and V. Yu. Kryukov. 2004. Caddisflies (Trichoptera) of Southern Trans-Ural region. Euroasian Entomological Journal 3: 213-215. [In Russian, with English abstract]

Greze, V. N. 1957. Food resources of fish of the Enisey River and their usage. Izvestiya Vsesoyuznogo nauchno-issledovatelskogo instituta ozernogo i rybnogo khozyaistva 41: 1-234. [In Russian]

Ivanov, V. D., V. N. Grigorenko, and T. I. Arefina. 2001. Order caddisflies – Trichoptera. pp. 7-72. *In*, S. J. Tsalolikhin (Editor). Key to the freshwater invertebrates of Russia and the adjacent lands. Volume 5: Higher insects. Zoological Institute of Russian Academy Science, St- Petersburg, Russia. [In Russian]

Ivanov, V. D. and S. I. Melnitsky. 2007. New data of the Trichoptera of Siberia. Braueria 34: 31-35.

Ivanov, V. D., A. I. Tsibulsky, and A. Yu. Gukov. 1996. To the fauna of caddisflies of lower Lena. Problemy zapovednogo dela 8: 110-121. [In Russian]

Lepneva, S. G. 1948. Caddisfly larvae of the Enisey River basin. Izvestiya Biologo-geograpficheskogo nauchno-issledovatelskogo instituta pri Irkutskom Gosudarstvennom Universitete 10: 60-99. [In Russian]

Lepneva, S. G. 1949. To the question on ecological classification of caddisflies of flowing waters. Entomologicheskoe Obozrenie 30: 253-265. [In Russian]

Lepneva, S. G. 1964. Caddisflies. Larvae and pupae of suborder Annulipalpia. Fauna of USSR. Volume 2, Part 1. Nauka, Moscow, Leningrad. 565 pp. [In Russian]

Lepneva, S. G. 1966. Caddisflies. Larvae and pupae of suborder Integripalpia. Fauna of USSR. Volume 2, Part 2. Nauka, Moscow, Leningrad. USSR. 563 pp. [In Russian]

Levanidova, I. M. 1982. Amphibiotic insects of mountain regions of USSR Far East. Nauka, Leningrad, USSR. 215 pp. [In Russian]

Martynov, A. V. 1910. Trichoptera of Siberia and adjacent lands. Part 2. Ezhegodnik Zoologicheskogo muzeya AN USSR 15: 351-429. [In Russian]

Martynov, A. V. 1914. Trichoptera of Siberia and adjacent lands. Part 4. Ezhegodnik Zoologicheskogo muzeya AN USSR 19: 173-285. [In Russian]

Mey, W. 2003. *Agraylea taymyrensis* n. sp. – a new arctic caddisfly from Siberia (Trichoptera, Hydroptilidae). Entomologische Nachrichten und Berichte 47: 39-40. [In German, with English abstract]

Pirozhnikov, P. L. 1929. Towards investigation of benthos of the Enisey River. Russkii Gidrobiologicheskii Zhurnal 8: 68-73. [In Russian]

SCIENTIFIC NOTE

A NEW STATE RECORD OF *ALLOCAPNIA SIMMONSI* KONDRATIEFF AND VOSHELL (PLECOPTERA: CAPNIIDAE) FROM WEST VIRGINIA, U.S.A., WITH ADDITIONAL RECORDS FROM PENNSYLVANIA AND VIRGINIA[1]

Robert W. Hood,[2] Ralph F. Kirchner,[3] and Jane I. Earle[4]

The eastern Nearctic snowfly genus *Allocapnia* (Plecoptera: Capniidae) is presently recognized by 44 species (Stark and Baumann, 2005; Grubbs, 2006). A recent checklist of the stoneflies of West Virginia (Tarter and Nelson, 2006) reported 135 species. During a recent winter collecting trip, the rare snowfly *Allocapnia simmonsi* Kondratieff and Voshell was collected for the first time from the eastern panhandle of West Virginia. Previous records of *A. simmonsi* have been reported from Pennsylvania (Earle, 1994) and Virginia (Kondratieff and Voshell, 1981; Kondratieff and Kirchner, 1987).

The eastern panhandle of West Virginia is located in the Ridge and Valley Physiographic Province. All collection localities were in the Cacapon River drainage, a tributary of the Potomac River. The majority of the landscape in the Cacapon River drainage is deciduous forest with some agriculture. Agriculture is mostly confined to the valleys of this area with the majority of the hillsides being forested. This is a rural area of West Virginia with the region's agricultural economy lead by the poultry and beef industry. The poultry industry has grown rapidly since the early 1990s which has triggered concerns with water quality in this area (Constantz et al., 1995).

Stonefly collections from the eastern panhandle of West Virginia appear to be under represented and future collecting may add new state records. Stonefly species collected in association with *A. simmonsi* from West Virginia included *A. curiosa* Frison, *A. granulata* (Claassen), *A. nivicola* (Fitch), *A. pygmaea* (Burmeister), *A. rickeri* Frison, *Paracapnia angulata* Hanson, *Prostoia completa* (Walker), *Strophopteryx fasciata* (Burmeister), *Taeniopteryx burksi* Ricker and Ross, and *T. maura* (Pictet). Our efforts and previous collecting have not yielded large collections of this species. *Allocapnia simmonsi*, which is extremely rare in Penn-

---

[1] Received on August 30, 2007. Accepted on September 18, 2007.

[2] United States Geological Survey, National Water Quality Laboratory, P.O. Box 25046, Denver Federal Center, MS 407, Denver, Colorado 80225-0046 U.S.A. E-mail: rwhood@usgs.gov

[3] Department of the Army, Huntington District Corps of Engineers, Water Quality Section, P.O. Box 9, Apple Grove, West Virginia 25502 U.S.A. E-mail: Ralph.F.Kirchner@lrh01.usace.army.mil. The views of this author do not purport to reflect the position of the Department of the Army or the Department of Defense of the U.S.A.

[4] 20 Red Fox Lane, Mechanicsburg, PA 17050 U.S.A. E-mail: JaneEarle7@msn.com

Mailed on June 23, 2008

sylvania, has been collected along with *A. pygmaea*, *A. granulata*, and *A. rickeri*, but in much lower numbers than these other species. In Pennsylvania, *A. simmonsi* has been collected in medium to large warm water or limestone-influenced streams, however, the Pine Creek site (listed below) is a smaller, 2nd-order stream, which is relatively warm due to open farmland in half of its watershed. The Virginia Natural Heritage Program (Roble, 2006) ranks *A. simmonsi* as S1S2, which is extremely rare to very rare. It also has a global rank of G2, which is critically imperiled to imperiled (Roble, 2006). Future collecting in neighboring Maryland may also reveal additional populations of *A. simmonsi.*

Of the 11 known collection sites for *A. simmonsi* (5 in Pennsylvania, 3 in Virginia, 3 in West Virginia), 10 are from the Ridge and Valley Physiographic Province, and 1 from the Piedmont Physiographic Province (Fig. 1). The additional Pennsylvania and Virginia collection sites are listed below. All specimens were deposited in the personal collections of the authors.

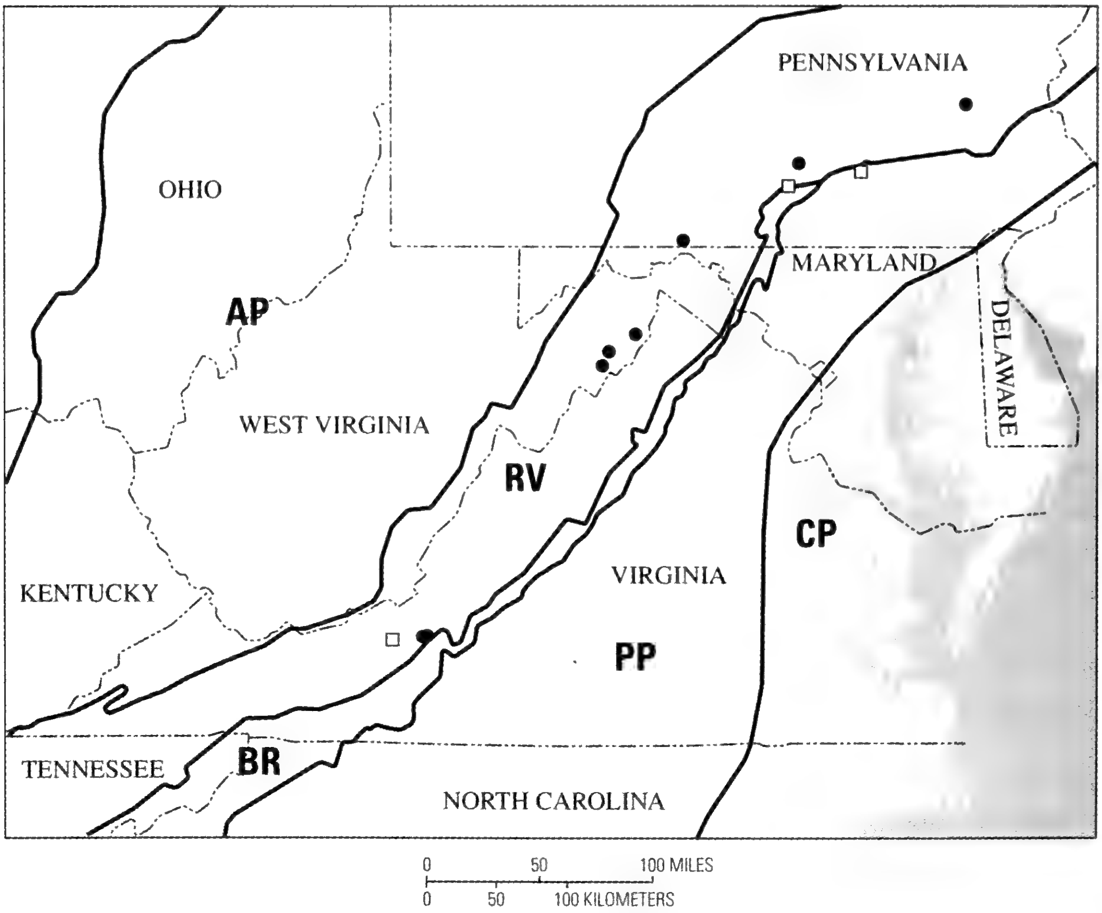


Fig. 1. Map of the geographic distribution of *Allocapnia simmonsi*. Previously known collection locations (□), new collection locations (●), with major Physiographic Provinces: AP = Appalachian Plateau; BR = Blue Ridge; CP = Coastal Plain; PP = Piedmont Plateau; RV = Ridge and Valley.

Material Examined: PENNSYLVANIA - Yellow Breeches Creek, Huntsdale, 8-III-1993, N 40°10'56" W 77°30'28", J. I. Earle, 1 ♂ 1 ♀; Dauphin County, Swatara Creek, Middletown, 24-III-1993, N 40°19'19" W 76°72'47", J. I. Earle, 3 ♂ 2 ♀; New Records: Berks County, Pine Creek 0.7 mile upstream from PA Rte. 143, N 40°61'25" W 75°88'13", 8-III-2000, J. I. Earle, 1 ♂ 3 ♀; Fulton County, Tonoloway Creek, PA Rte. 2004 at Johnsons Mill, N 39°75'12" W 78°14'82", 6-II-2005, J. I. Earle, 1 ♂; Little Tonoloway Creek, PA Rte. 2004 at Johnsons Mill, N 39°74'97" W 78°14'83", 28-III-2003, J. I. Earle, 2 ♂. **VIRGINIA** – Montgomery County, CR-655 bridge, near junction of CR-781, Toms Creek, N 37°13'38" W 80°03'53", 31-III-1980, B. C. Kondratieff and P.L. Firth, 1 ♂ 1 ♀ (paratypes); same location but 1-IV-1981, B. C. Kondratieff, 2 ♂; New Records: Montgomery County, Interstate-81 north rest area, 1.5 miles N of Elliston, North Fork Roanoke River, N 37°14'16" W 80°13'32", 8-III-1991, R. F. Kirchner and R. W. Baumann, 2 ♂; CR-603 bridge, 2 miles NE of Ironto, North Fork Roanoke River, N 37°13'56" W 80°15'15", 25-II-2001, R. F. Kirchner, B. C. Kondratieff, and R. E. Zuellig, 5 ♂. **WEST VIRGINIA** – New State Records: Hampshire County, CR-16 bridge at Capon Lake, off WV-259, Cacapon River, N 39°09'30" W 78°32'07", 22-II-2005, R. W. Hood and R. F. Kirchner, 2 ♂; Hardy County, WV-259 bridge at Baker, Baker Run of Lost River, N 39°02'29" W 78°44'50", 22-II-2005, R. W. Hood and R. F. Kirchner, 6 ♂; WV-259 bridge 0.5 miles north of Lost River, Lost River, N 38°57'44" W 78°48'15", 22-II-2005, R. W. Hood and R. F. Kirchner, 3 ♂.

ACKNOWLEDGMENTS

We thank Boris Kondratieff (Colorado State University, Ft. Collins, Colorado) and Robert Zuellig (U.S. Geological Survey, Denver, Colorado) for reviewing the paper. We also thank two anonymous reviewers for improving the manuscript.

LITERATURE CITED

Constantz, G., N. Ailes, and D. Malakoff. 1995. Portrait of a river: The ecological baseline of the Cacapon River. Pine Cabin Run Ecological Laboratory. High View, West Virginia, U.S.A. 30 pp.

Earle, J. 1994. New records of stoneflies (Plecoptera) from Pennsylvania. Entomological News 105 (2): 80-84.

Grubbs, S. A. 2006. *Allocapnia sano*, a new species of snowfly (Plecoptera: Capniidae) from Alabama, U.S.A., plus six new state records. Zootaxa 1197: 39-43.

Kondratieff, B. C. and J. R. Voshell, Jr. 1981. *Allocapnia simmonsi*, a new species of winter stonefly (Plecoptera: Capniidae). Annals of the Entomological Society of America 74: 58-59.

Kondratieff, B. C. and R. F. Kirchner. 1987. Additions, taxonomic corrections, and faunal affinities of the stoneflies (Plecoptera) of Virginia, USA. Proceedings of the Entomological Society of Washington 89 (1): 24-30.

Roble, S. M. 2006. Natural Heritage Resources of Virginia: Rare animal species. Natural Heritage Technical Report 06-10. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, Virginia, U.S.A. 44 pp.

Stark, B. P. and R. W. Baumann. 2005. North American stonefly (Plecoptera) complete list. http://mlbean.byu.edu/plecoptera/list.asp

Tarter, D. C. and C. H. Nelson. 2006. A revised checklist of the stoneflies (Plecoptera) of West Virginia (USA). Proceedings of the Entomological Society of Washington 108(2): 429-442.

SOCIETY MEETING OF NOVEMBER 16, 2005

North American Geometrine Moths (Lepidoptera: Geometridae); Noteworthy polyphenisms in adult moths and larvae

John Gruber, Chairman, Upper School Science Department
Friends' Central School, Wynnewood, Pennsylvania 19096 U.S.A.

Geometrine moths are a distinctive subfamily of the Geometridae or inchworm moths. They are widely represented in the tropics, and comprise some 1,400 species, with approximately 200 genera worldwide.

As a group, many Geometrine moths are distinctive in their bright green pigmentation and are commonly called 'Emeralds.' Such green pigmentation results from the presence of an apparently unique lepidopteran pigment provisionally named geoverdin. The molecular structure of geoverdin is unknown. Geoverdin is unstable and often, when exposed to light and heat, it degrades. Consequently, adults in life are often faded when collected. Killing agents such as cyanide and ethyl acetate do not seem to affect this green pigment, but relaxing the moths for mounting can turn the wings brown.

In the mid-Atlantic region, Geometrine moths are found in the genera *Nemoria, Dichorda, Synchlora, Chlorochlamys, Hethemia,* and *Chloropteryx.* Wing patterns, abdominal markings, as well as characteristics of the legs and the antennal region can aid in the identification of individual species.

Geometrine moths exhibit several interesting polyphenisms in both larvae and adults. Caterpillars of several species of *Nemoria* have been shown to exhibit varying coloration and morphology that, in at least some cases, is induced by dietary cues present in host plant material. For example, two larval forms of *N. outina* often occur at the same time on their host plant. On mature foliage, the caterpillar is a twig mimic, and on fresh foliage, a leaf mimic. This plasticity in larval form is hypothesized to be adaptive in aiding in the camouflage of the larvae on the host plant.

Several species of *Nemoria* also have seasonal color forms in wing pigmentation that include brown instead of green wings (e.g. *N. bistriaria* or *N. bifilata*) or darkened melanic forms that overshade green pigment with a suffusion of black marking (e.g. *N. lixaria*). Growth chamber experiments have demonstrated the ability of *N. lixaria* to produce dark forms by having the adult moths eclose from pupae at cool temperatures.

Questions from the audience revealed that in the family Geometridae, there is a carnivorous caterpillar, unusual for a Lepidopteran. Hawaiian *Eupithecia* larvae are wait and strike predators feeding on other insects. Our speaker has collected the first Pennsylvania record for the geometrine moth *Nemoria tuscarora* in Fayette County. The larvae feed on St. John's wort, *Hypericum densiflorum* (Clusiaceae).

Notes of entomological interest – A change is underway in the local mosquito fauna as the introduced Asian Tiger mosquito, *Aedes albopictus,* becomes established in the Philadelphia vicinity. Dale Schweitzer pointed out that a Japanese noctuid, *Niphonyx segregata,* is becoming common at bait in early July to August in Cumberland County, New Jersey. Jon Gelhaus noted that the mirid, *Halticotoma valida,* from South America is common now on the variegated yuccas (Agavaceae) in his Voorhees, New Jersey yard. Present at the meeting was Ms. Oyunchuluun Yadamsuren (Oyunaa), a Tipuloidea researcher from Mongolia. There were 23 attendees at the meeting.

Greg Cowper, Corresponding Secretary
The American Entomological Society
gwcowper@popflymag.com

Mailed on June 23, 2008

SCIENTIFIC NOTE

A TERATOLOGICAL SPECIMEN OF *CALOSOMA SYCOPHANTA* (L.) (COLEOPTERA, CARABIDAE) FROM CONNECTICUT, U.S.A.[1]

Raul N. Ferreira[2]

Teratological specimens of Coleoptera are rarely observed. The anomalous morphology of such specimens presumably reduces their chances of survival, making them uncommon in the environment. A classification and suggested terminology for describing teratological specimens of Coleoptera were published by Balazuc (1948). Publications by Dallas in Argentina (1927) and Cappe de Baillon in Europe (1927) are also noteworthy. Prior to this publication, Ferreira (1966, 1967) reported on several anomalies when he was affiliated with the Zoological Museum, University of Coimbra (Portugal).

The carabid reported here was identified as *Calosoma sycophanta* (L.) (Fig. 1). The right hind leg has a reduced tibia ending in a 45 degree angle with a thicker tibial spine, and a tarsus with only three reduced tarsomeres (Fig. 2). The tip of the last deformed tarsomere is rounded and without tarsal claws. The left hind leg is normal (Fig. 3). The teratological specimen was collected in Pawcatuck (New London County), Connecticut, in a lot close to the Elm Ridge golf course. Other individuals of *Calosoma sycophanta* (L.) were seen running in the area and climbing small trees.

Balazuc (1948) describes anomalies such as the one reported here as *meiomelies*, involving either the loss (*ectromelie*) or reduction (*atrophy*) of an appendage or part of an appendage. The specimen reported here has both a loss of part of an appendage as well as a reduction in the existing parts of the appendage (tarsus). Such an anomaly is usually considered the result of a purely physical problem, which may be related to physiological or environmental influences during development (Balazuc, 1948). However the anomaly may also have a genetic basis as in similar anomalies reported by Arendsen Hein (1920, 1924). The report of an identical anomaly in the front leg of a *Carabus intricatus* L. by Mocquerys (1880) adds weight to the latter possibility.

---

[1] Received on January 10, 2002. Accepted on June 18, 2002.

[2] 6 Fairview Drive, Pawcatuck, Connecticut 06379-1223 U.S.A. E-mails: insectcatcher@aol.com; raul.ferreira @ametek.com.

Mailed on June 23, 2008

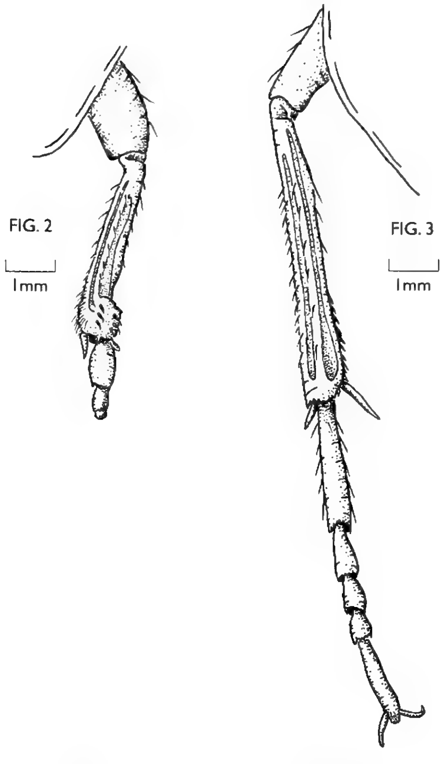


FIG. 2

FIG. 3

Figures 1-3. 1. *Calosoma sycophanta* (L.). 2. Right hind leg. 3. Left normal hind leg.

ACKNOWLEDGMENTS

Special thanks to Dr William Krinsky and Dr. Jane O'Donnell for reviewing the early draft of the manuscript and for providing suggestions to improve it.

LITERATURE CITED

Arendson Hein, S. A. 1920. Studies on variations in the meal-worm *Tenebrio molitor* L. 1- Biological and genetical notes on *Tenebrio molitor*. Journal of Genetics 10(3): 227-264, 16 figs.

Arendson Hein, S. A. 1924. Studies on variation in the meal-worm *Tenebrio molitor* L. 2-Variation in tarsi and antennae. Journal of Genetics 14(1): 1-38, 19 figs.

Balazuc, J. 1948 (printed in December 1947). La Teratologie des Coleopteres et experiences de transplantation sur *Tenebrio molitor* L. Memoires du Museum National d'Histoire Naturelle, Paris (nouvelle serie) XXV: 1-193.

Cappe de Baillon, P. 1927. Recherches sur la teratologie des insects. Encyclopedie Entomologique 8. P. Lechevalier (Editor), Paris, France. 291 pp., 85 figs., 9 pls.

Dallas, E. D. 1927. Sobre los diversos tipos de anomalías observados en coleópteros. Revista de la Sociedad Entomologica Argentina 1(3): 67-70, pl. 5.

Ferreira, R. N. 1966. Casos Teratologicos - Atrofia do tarso posterior de um *Oryctes nasicornis* L. (Col). Graellsia. Revista de Entomologos Ibéricos XXII: 25-27.

Ferreira, R. N. 1967 III - Casos Teratologicos – Hemibraquelitria em *Pterostichus (Poecilus) cupreus* L. Instituto Don Ernesto Sena de Oliveira, Movimento de Estudantes. Coimbra, Portugal, 1967, pp. 34-35.

Mocquerys, S. 1880 - Recueil de Coleopteres anormaux par feu M. S. Mocquerys avec introduction par M. J. Bourgeois, Roen, France, in Teratologie Entomologiques, Imprimerie Leon Deshays. xvi+3-142.

SOCIETY MEETING OF FEBRUARY 22, 2006

Cicada Killers: Their Unusual Biology and Ranges in the New World

Chuck Holliday, Department of Biology
Lafayette College, Easton, Pennsylvania 18042 U.S.A.

There are five New World species of the commonly termed Cicada Killer (Hymenoptera: Sphecidae.) Cicada Killers are placed in the genus *Sphecius*. *Sphecius speciosus* is familiar to those living in the eastern United States; *S. convallis* is the Pacific Cicada Killer; *S. grandis* occurs in the western United States; *S. hogardii* is a Caribbean species that occurs in southern Florida, and *S. spectabilis* is reported from the northern half of South America. It is not unusual for ranges of three of the species, *S. speciosus, S. convallis,* and *S. grandis*, to overlap. Video footage was presented of these three species feeding together on the sap of a Tamarix (Tamaricaceae) tree in Big Bend National Park in southwestern Texas, U.S.A.

In Easton, Pennsylvania, Periodical Cicadas and *S. speciosus* males emerge together in mid July. The cicadas are in "high song," that is singing profusely, when the female Cicada Killers follow in approximately a week. Males stay where they emerge and form a lek competing to mate with females. Females release a pheromone that elicits mating in the males, a controlled chaos ensues, females mate once, and save the sperm for later egg laying. Copulation can last up to an hour, the male guarding the female once mating ends.

Dr. Holliday observed and emphasized precopulatory behavior not mentioned in the literature since the beginning of the twentieth century. Before mating, the male mounts the female and shakes her head with his forelegs and taps the female's antennae with his own. Ichneumonid (Hymenoptera) males have tyloid glands in their antennae, and the secretions make the female more receptive to mating. This may well be true for *S. speciosus* also.

The life span of a typical cicada killer female is 30+ days. Up to two weeks, morning to night, may be spent looking for an appropriate nest site. Well-drained southerly facing berms are preferred. Once a location is chosen, the female digs a burrow, memorizes landmark details, directionally orients to it, and then flies away to hunt, returning to provision the nest cell with a cicada, deposit an egg and close the chamber.

Females dig by using their mandibles to 'bite' chunks of substrate and then 'kick' the materials out of the burrow. A spine on the hind leg assists in excavation. Digging is a stereotypical behavior. Provisioning the nest is interesting. One cicada is used to provision the nest for a male egg, while two cicadas are the meal for a female. One explanation of this may be that the females 'intend' or actively determine the sex of their offspring. The size of the cicada prey determines the size of the *Sphecius* adult and thus females would be larger than males. Because haplodiploidy is the rule for Hymenoptera, an unfertilized egg becomes a haploid male and fertilized eggs become diploid females.

Notes of entomological interest. Dr. Sigitas Podenas and his wife Virginija, visiting from Lithuania, were introduced. They have spent three summers in Mongolia working on Tipuloidea. Sigitas is also an expert on Baltic amber and studies insect inclusions. Dr. Ken Frank and his wife were in Cape Cod for Christmas 2005. During the visit, an evening of 40° temperatures prompted an outbreak of a new arrival from Europe, the introduced Geometrid moth, *Operophtera brumata,* or 'winter moth.' "The density of these moths was like snow," Ken remarked. The recently published *Evolution of the Insects* by David Grimaldi and Michael S. Engel (2005, Cambridge University Press) was discussed. This beautiful, well written and researched tome will become the standard for this subject, it was agreed. There were 26 present for the meeting.

Greg Cowper, Corresponding Secretary
The American Entomological Society
E-mail: gwcowper@popflymag.com

Mailed on June 23, 2008

TWO NEW RECORDS OF ICHNEUMONIDAE SPECIES FROM TURKEY (HYMENOPTERA: ICHNEUMONIDAE)[1]

Saliha Çoruh[2]

ABSTRACT: The present study is based upon the material collected from Kars provinces in recent years. Two species, *Therion brevicorne* Gravenhorst and *Syzeuctus irrisorius* Rossi have been recorded in the subfamilies Anomaloninae and Banchinae respectively as new for the Turkish fauna. Short descriptions of the species are given with drawing.

KEY WORDS: New records, Ichneumonidae, Hymenoptera, fauna, Turkey

Ichneumonidae is the largest family of the Hymenoptera with at least 60,000 species in 35 subfamilies worldwide (Wahl, 1993). Currently, there are 731 recognized species in 262 genera in Turkey (Coruh et al., 2005). In the present paper, an additional two species are recorded as new for the Turkish fauna.

The present study deals with the subfamilies Anomaloninae and Banchinae. Anomaloninae is a moderately small cosmopolitan group with 38 genera worldwide. The anomalonines are koinobiont endoparasitoids, mostly Lepidoptera and some Coleoptera; oviposition is into larvae, with emergence always from the pupa (Gauld and Bolton, 1988; Wahl, 1993). Twenty-eight species of Anomaloninae have been recorded from Turkey so far (Kolarov et al., 1994; Kolarov, 1995; Coruh et al., 2004).

Banchinae also is a large group, represented in the world by 53 genera. The banchines are koinobiont endoparasitoids of Lepidoptera larvae; the tribes Glyptini and Atrophini parasitize caterpillars in leaf rolls, tunnels, buds (Wahl, 1993). Seventy-one species of Banchinae have been recorded from Turkey so far (Kolarov et al., 1994; Kolarov, 1995; Ozdemir, 1996; Kolarov et al., 1997 a; Kolarov et al., 1997 b; Pekel, 1999; Pekel et al., 2000). With this contribution, the number of species of Anomaloninae known from Turkey is increased to 29 and that of Banchinae to 72.

METHODS

The material for this study was collected from eastern and north eastern Turkey during 2004. One of them was collected by sweeping flowering plants with an insect net; the other was collected by Malasia trap. Specimens were transferred into a handmade aspirator and were killed with ethyl acetate. Known standard methods were used for preparation of the samples. The body parts of species were drawn under microscope. The distribution of the species were taken from Yu and Horstmann (1997). All the material were deposited in the Entomology Museum, Erzurum, Turkey (EMET).

---

[1] Received on February 22, 2007. Accepted on May 20, 2007.

[2] Atatürk University, Faculty of Agriculture, Department of Plant Protection, 25240 Erzurum, Turkey. Email: scoruh@atauni.edu.tr.

Mailed on June 23, 2008

SYSTEMATIC ENTOMOLOGY

Anomaloninae

Therion brevicorne Gravenhorst, 1829

Material: Kars province, city boundary, 1470 m, 14.VI.2004, ♂.

Distribution: Palearctic.

Diagnosis: Length 1.7 cm., body weakly polished, punctures small and weakly. Clypeus large, convex; face, clypeus, labial and maxillary palpus yellow, eyes and ocelli brown, clypeal pits black, temporal orbit with feather; scape and pedicel yellow, first flagellar segment with black-yellow, other segments light brown, antenna length half times as long as body length. Thorax completely black and with distinct feather; epomia long; notaulus short and not sharp. Wings strongly tinted, fore wing 0.9 cm; without areolet; pterostigma light brown, second recurrent vein with bulla, nervulus not opposite basal vein, weakly reaching to brachius, postnervulus not intercepted (Figure 1.a); nervellus not reaching to vein (Figure 1.b). Fore and middle legs brownish-yellow, tarsal claws black, metacoxae completely black, trochanters yellow, metafemur, metatibia and first tarsal segment with yellow-black marking, other tarsal segments and tarsal claws black (Figure 1.c). Abdominal tergits I-IV light brown, postpetiole and others black.

Hosts: Thompson (1957), listed *Acronicta euphorbiae* Schiff, *Cucullia verbasci* L. and *Polia persicariae* (Lepidoptera, Phalaenidae) as host of *T. brevicorne.*

Banchinae

Syzeuctus irrisorius Rossi, 1794

Material: Kars province, Sarıkamış, Karakurt, TCK Çeşmesi, 1500 m, 30.VI.2004, ♀.

Distribution: Palaearctic.

Diagnosis: Length 0.85 cm, head and thorax polished with punctures big and strong; punctures on abdomen small and weak; clypeus narrow, very strongly convex; temporal orbit, ocellar triangle, clypeal space and band between antennal sockets clypeus black, ocelli, labial and maxillary palpus brown; eyes brownish-black, groove distinct, antenna with scape and pedicel black, first flagellar segment 2 times as long as flagellar segment and dark brown, antenna length almost body length. Thorax with yellow black spot; epomia long and strong not reaching margin of propodeum; mesopleurum, mesepimeron, scutellum, postscutellum and pronotum yellow, mesoscutum (Figure 1.d) and propodeum with yellow and black markings. Areolet present and rectangular, pterostigma yellow with dark anterior margin, second intercubitus vein reclivous, second recurrent vein inclivous and with bulla, nervulus not opposite basal vein, weakly reaching to brachius, postnervulus not intercepted (Figure 1.e), nervellus not intercepted (Figure 1.f). Procoxa black, other segments yellow, mesocoxa with dark yellow marking; first trochanter brown, second trochanter yellow, femur and tibia yellow, others black; metacoxa with dark and yellow marking; first trochanter black, second trochanter yellow, femur and tibia brown, other segments black; abdominal tergites with yellow black stripe. Abdominal tergit third with basolateral angular ledges; ovipositor sheath about 1.5 as long as hind leg; lower valve longer than upper valve.

Host: Thompson (1957), listed *Eublemma noctualis* Hb. (Lepidoptera, Phalaenidae) as host of *S. irrisorius*.

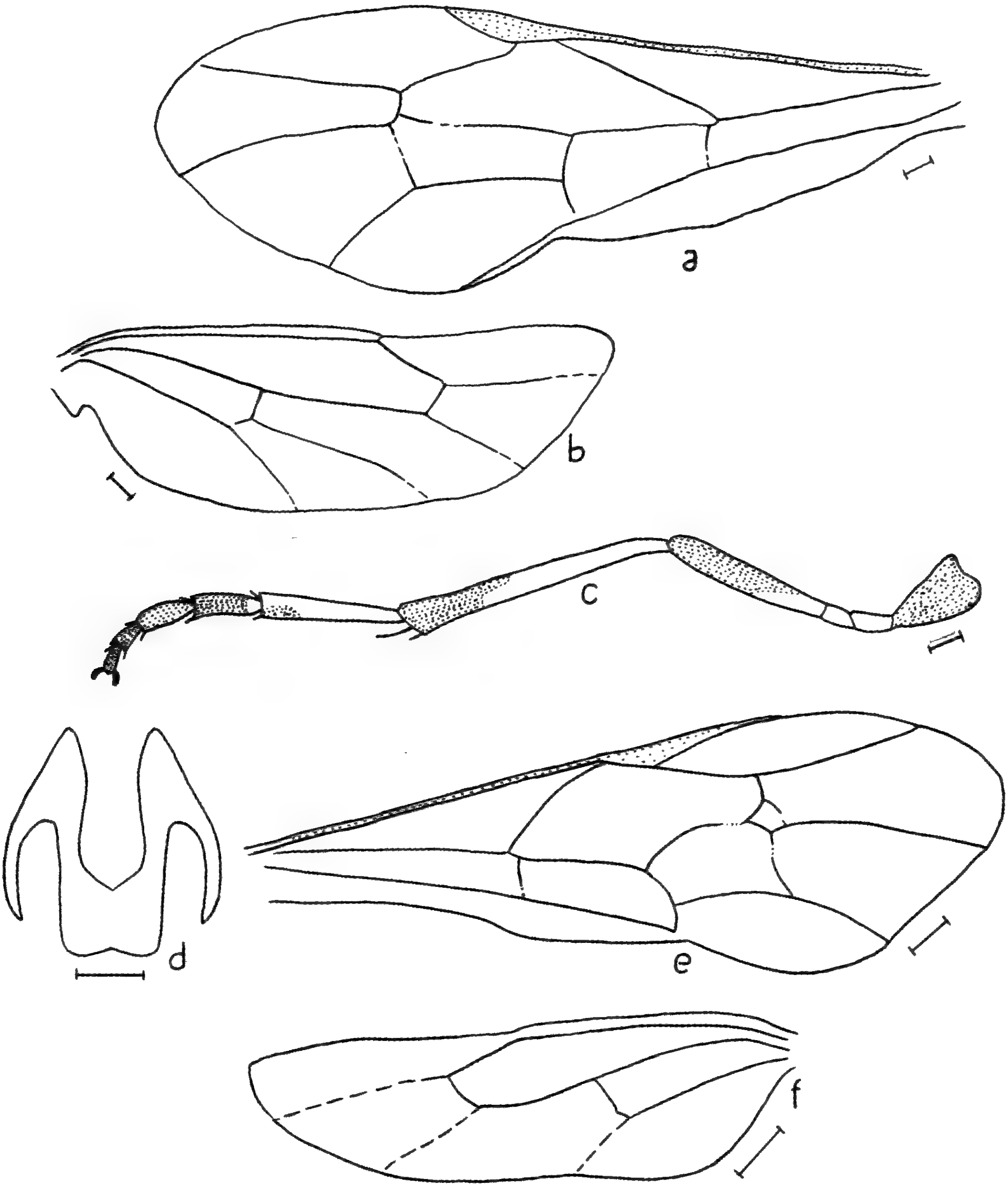


Figure 1. *Therion brevicorne* (a,b,c): a-front wing, b-hind wing, c-hind leg; *Syzeuctus irrisorius* (d,e,f): d-mesoscutum, e-front wing, e-hind wing.

ACKNOWLEDGMENTS

I wish to express my cordial thanks to Prof. Dr. Janko Kolarov (Plovdiv, Bulgaria) for identification of the species and for his advice and valuable comments to Prof. Dr. Hikmet Özbek (Erzurum, Turkey).

LITERATURE CIDED

Coruh, S., J. Kolarov, and H. Ozbek. 2004. New and little known Anomaloninae (Hymenoptera-Ichneumonidae) from Turkey. Linzer Biologische Beitrage. 36 (2): 1199-1204.

Gauld, I. D. and B. Bolton (Editors). 1988. The Hymenoptera. Oxford University Press/British Museum (Natural History). Oxford, England, U.K. 332 pp.

Kolarov J., A. Beyarslan, and M. Yurtcan. 1994. New and little known Turkish Anomaloninae (Hymenoptera-Ichneumonidae). XII. Biology Congress. July 6-8, Edirne, Turkey. 248-251.

Kolarov, J. 1995. A catalogue of the Turkish Ichneumonidae (Hymenoptera). Entomofauna. 16 (7): 137-188.

Kolarov, J., M. Yurtcan, and A. Beyarslan. 1997a. New and rare Ichneumonidae (Hymenoptera) from Turkey. I. Pimplinae, Tryphoninae, Phygadeuontinae, Banchinae and Ctenopelmatinae. Acta Entomologica Bulgarica. 3 (4): 9-12.

Kolarov, J., A. Beyarslan, and M. Yurtcan. 1997b. Ichneumonidae (Hymenoptera) from the Gökçeada and Bozcaada Island, Turkey. Acta Entomologica Bulgarica. 3 (4): 13-16.

Ozdemir, Y. 1996. Ichneumonides Banchinae et Ichneumoninae d'Anatolie Centrale. Bitki Koruma Bülteni. 36 (3-4): 91-104

Pekel, S. 1999. New and little known Turkish Banchinae (Hymenoptera, Ichneumonidae). Acta Entomologica Bulgarica. 1: 37-41.

Pekel, S., J. Kolarov, and H. Özbek. 2000. New records of the subfamily Banchinae (Hymenoptera, Ichneumonidae) from Turkey. Journal of Entomological Reseach Society. 2 (3): 1-4.

Thompson, W. R. 1957. A catalogue of the parasites and predators of insect pests. Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control. 562 pp.

Wahl, D. B. 1993. Family Ichneumonidae. *In:* H. Goulet and J. T. Huber (Editors). Hymenoptera of the World: an identification guide to families. Research Branch. Monograph no. 1894c. Agriculture Canada Publication. Ottawa, Ontario, Canada. 668 pp.

Yu, D. S. and K. Horstmann. 1997. A catalogue of World Ichneumonidae (Hymenoptera) Part 1: Subfamilies Acaenitinae to Ophioninae. The American Entomological Institute. 58 (1): 763 pp.

REPLACEMENT NAMES FOR TWO PREOCCUPIED BEETLE GENERA (COLEOPTERA: SCARABAEIDAE: MELOLONTHINAE)[1]

Hüseyin Özdikmen[2] and Hakan Demir[2]

ABSTRACT: Two junior homonyms were detected amongst the genera of Melolonthinae and the following replacement names are proposed: *Brittonius* nom. nov. for *Bryantella* Britton, 1957 and *Bezdekia* nom. nov. for *Metagonia* Kolbe, 1899. Accordingly, new combinations are herein proposed for the species currently included in these genera.

KEY WORDS: Nomenclatural changes, homonymy, replacement names, Coleoptera, Scarabaeidae

The purpose of the present paper is to bring the taxonomy of Melolonthinae scarabs into accordance with the requirements of the International Code of Zoological Nomenclature (1999). In an effort to reduce the number of homonyms in Melolonthinae, we recently found two genus group names which had been previously published for spider taxa, making them junior homonyms. In accordance with Article 60 of the International Code of Zoological Nomenclature, we propose substitute names.

Order Coleoptera, Family Scarabaeidae, Subfamily Melolonthinae Tribe Automoliini

Genus *Brittonius* nom. nov.

Bryantella Britton, 1957. A revision of the Australian chafers (Coleoptera: Scarabaeidae: Melolonthinae). British Museum (Natural History) London 1: 102. (Insecta: Coleoptera: Polyphaga: Scarabaeoidea: Scarabaeidae: Melolonthinae: Automoliini). Preoccupied by *Bryantella* Chickering, 1946. Bull. Mus. comp. Zool. Harv. 97: 389 (Arachnida: Araneae: Salticidae).

Nomenclatural Remarks: The *Bryantella* Britton, 1957 was established for an Australian genus (type species, *Bryantella castanea* Britton, 1957) of the Coleoptera. It is still used as a valid genus name in the family Scarabaeidae (e.g. Houston and Weir, 2002). Currently, the genus includes only one named species, *Bryantella castanea* Britton, 1957 [Australian Region: W Australia (NW coastal, SW coastal)]. Nevertheless, the name *Bryantella* is preoccupied. Chickering (1946) established a spider genus *Bryantella,* with the type species *Bryantella speciosa* Chickering, 1946 in the Araneae. Also, it is still used as a valid genus name in the family Salticidae (e.g. Prószyñski, 2003, 2006a,b; Platnick, 2007). Currently, the genus includes three named species: *Bryantella smaragdus* (Crane, 1945) [Argentina, British Guyana, Panama], *Bryantella speciosa* Chickering, 1946 [Brasil, Panama] and *Bryantella tropica* (Peckham and Peckham, 1901) [Brasil, North Argentina]. Thus, the beetle genus *Bryantella* Britton, 1957 is a junior homonym of the genus *Bryantella* Chickering, 1946.

---

[1] Submitted on October 24, 2007. Accepted on November 12, 2007.

[2] Gazi Üniversitesi, Fen-Edebiyat Fakültesi, Biyoloji Bölümü, 06500 Ankara, Turkey. E-mails: (HO) ozdikmen@gazi.edu.tr and (HD) ozyptila@gmail.com.

Mailed on June 23, 2008

In accordance with Article 60 of the International Code of Zoological Nomenclature, Fourth Edition (1999), we suggest here that the name *Brittonius* should be erected as a replacement name for *Bryantella* Britton, 1957, not *Bryantella* Chickering, 1946.

Etymology: from E. B. Britton, author of the preexisting genus name *Bryantella.* It is masculine in gender.

Summary of nomenclatural changes: *Brittonius* **nom. nov.** = *Bryantella* Britton, 1957 (non Chickering, 1946). *Brittonius castaneus* (Britton, 1957) **comb. nov.** = *Bryantella castanea* Britton, 1957

Tribe Diplotaxini

Genus *Bezdekia* nom. nov.

Metagonia Kolbe, 1899. Ent. Nachr., 25, 42, 57. (Insecta: Coleoptera: Polyphaga: Scarabaeoidea: Scarabaeidae: Melolonthinae: Diplotaxini). Preoccupied by *Metagonia* Simon, 1893. Ann. Soc. ent. France, 62, 318 (Arachnida: Araneae: Pholcidae).

Nomenclatural Remarks: Kolbe (1899) described three new subgenera within the beetle genus *Apogonia* Kirby, 1819: *Catagonia, Ceratogonia*, and *Metagonia.* In his catalogue, Bezdìk (2004a) accepted the provisional generic treatment as proposed by Moser (1918) and Burgeon (1945) concerning the former subgenera of the genus *Apogonia* Kirby, 1819. This means that *Ceratogonia* Kolbe, 1899; *Metagonia* Kolbe, 1899; *Rhynchogonia* Arrow, 1902; and *Dichecephala* Brenske, 1895 (=*Catagonia* Kolbe, 1899) are assumed to be valid genera. In his catalogue, Bezdìk (2004) also designated the species *Metagonia mediocris* (Kolbe, 1891) as the type species of *Metagonia* Kolbe, 1899. Bezdìk (2004b) stated that the tribe Diplotaxini Burmeister, 1855 is one of the least studied Melolonthine groups in Old World. Bezdek (2004b) listed 422 valid species and subspecies distributed in the Palaearctic, Oriental, and Ethiopian Regions. Over 300 species are placed in the genus *Apogonia* Kirby, 1819, which will most probably be subdivided into several independent genera during revisionary works. In his paper, Bezdìk also mentioned that the subgenus *Catagonia* Kolbe, 1899, was subsequently synonymized with the genus *Dichecephala* Brenske, 1895, by Arrow in Scott (1940). Moreover, Arrow (1902) created an additional subgenus *Rhynchogonia.* In his revision of Diplotaxini from Belgian Congo (currently Democratic Republic of the Congo), Burgeon (1945) elevated the taxa *Ceratogonia*, *Dichecephala*, *Metagonia,* and *Rhynchogonia* to the generic level. Unfortunately, the generic name, *Metagonia*, was already preoccupied by Simon (1893), who had described the genus *Metagonia* with the type species *Metagonia bifida* Simon, 1893 in the spider family Pholcidae (Araneae). It is still used as a valid genus name in the family Pholcidae (e.g. Gertsch, 1971, 1977, 1986; Gertsch and Peck, 1992; Huber 1997; Huber 2000; Platnick, 2007). The genus *Metagonia* Simon, 1893 is very rich. For the present, the genus includes 81 species. Thus, the genus *Metagonia* Kolbe, 1899 is a junior homonym of the genus *Metagonia* Simon, 1893 (Araneae). We propose a new replacement name *Bezdekia* **nom. nov.** for *Metagonia* Kolbe, 1899.

Etymology: The name "Bezdekia" dedicated to well-known coleopterist Ales Bezdìk (Czech Republic).

Summary of nomenclatural changes: *Bezdekia* **nom. nov.** = *Metagonia* Kolbe, 1899 (non Simon, 1893). *Bezdekia brunoi* (Frey, 1976) **comb. nov.** = *Metagonia brunoi* (Frey, 1976). *Bezdekia kaszabi* (Frey, 1974) **comb. nov.** = *Metagonia kaszabi* (Frey, 1974). *Bezdekia mediocris* (Kolbe, 1891) **comb. nov.** = *Metagonia mediocris* (Kolbe, 1891). *Bezdekia platypus* (Kolbe, 1899) **comb. nov.** = *Metagonia platypus* (Kolbe, 1899). *Bezdekia platypyge* (Kolbe, 1899) **comb. nov.** = *Metagonia platypyge* (Kolbe, 1899).

LITERATURE CITED

Bezdìk, A. 2004a. Catalogue of the tribe Diplotaxini (Coleoptera: Scarabaeidae: Melolonthinae) of the Old World. Zootaxa 463:1-90.

Bezdìk, A. 2004b. Revision of the genus *Ceratogonia* Kolbe, 1899 (Scarabaeidae: Melolonthinae: Diplotaxini). Annales Zoologici (Warszawa) 54:797-801.

Britton, E. B. 1957. A revision of the Australian Chafers (Coleoptera: Scarabaeidae: Melolonthinae). The British Museum (Natural History). London, England. United Kingdom. Volume 1, 185 pp.

Chickering, A. M. 1946. The Salticidae of Panama. Bulletin of the Museum of Comparative Zoology (Harvard University) 97:1-474.

Gertsch, W. J. 1971. A report on some Mexican cave spiders. Association for Mexican Cave Studies Bulletin 4:47-111.

Gertsch, W. J. 1977. Report on cavernicole and epigean spiders from the Yucatan peninsula. Association for Mexican Cave Studies Bulletin 6:103-131.

Gertsch, W. J. 1986. The spider genus *Metagonia* (Araneae: Pholcidae) in North America, Central America, and the West Indies. Texas Memorial Museum, Speleological Monographs 1:39-62.

Gertsch, W. J and S. B. Peck. 1992. The pholcid spiders of the Galápagos Islands, Ecuador (Araneae: Pholcidae). Canadian Journal of Zoology 70:1185-1199.

Houston, W. W. K and T. A. Weir. 2002. Australian Biological Resources Study; updated by Calder, A. A. CSIRO Entomology, Canberra, Australia. Updated: 01 Dec 2002. Available from: http://www.environment.gov.au/cgibin/abrs/fauna/details.pl?pstrVol=SCARABAEOIDEA;pstrTaxa=354;pstrChecklist Mode=2.

Huber, B. A. 1997. On American *Micromerys* and *Metagonia* (Araneae, Pholcidae), with notes on natural history and genital mechanics. Zoologica Scripta 25:341-363.

Huber, B. A. 2000. New World pholcid spiders (Araneae: Pholcidae): a revision at generic level. Bulletin of the American Museum of Natural History 254:1-348.

International Comission of Zoological Nomenclature. 1999. International Code of Zoological Nomenclature. Fourth Edition. The International Trust for Zoological Nomenclature, London.

Kolbe, H. J. 1899. Ueber neue oder wenig bekannte Arten der Melolonthiden-Gattung *Apogonia* aus Africa. Entomologische Nachrichten 25:39-60.

Prószyñski, J. 2006a. Salticidae (Araneae) of the World, Part II: Catalogue of Salticidae (Araneae), synthesis of quotations in the world literature since 1940, with basic taxonomic data since 1758. Museum and Institute of Zoology, Polish Academy of Sciences, Ul. Wilcza 64, 0-679 Warsaw, Poland.

Prószyñski, J. 2006b. Catalogue of Salticidae (Araneae), synthesis of quotations in, the world literature since 1757. Version June, 2006. Available from: http://salticidae.org/salticid/catalog/Bryantel.htm.

Platnick, N. I. 2007. The world spider catalog, version 6.0. American Museum of Natural History. Last updated June 26, 2007. Available from: http://research.amnh.org/entomology/spiders/catalog/index.html.

Simon, E. 1893. Etudes arachnologiques. 25e Memoire. XL. Descriptions d'especes et de genres nouveaux de l'ordre des Araneae. Annales de la Société Entomologique de France 62:299-330.

NOTHRIS VERBASCELLA (DENIS-SCHIFFERMULLER, 1775) (LEPIDOPTERA: GELECHIIDAE) FROM TURKEY AND ITS TWO NEW ICHNEUMONID PARASITOIDS[1]

Murat Yurtcan[2] and Zuhal Okyar[2]

ABSTRACT: The parasitoids of *Nothris verbascella* larvae (Lepidoptera: Gelechiidae) found on *Verbascum densiflorum* and *V. sinuatum* (Scrophulariaceae) in Edirne, Turkey were studied between May 2005 and May 2007. Three species of Ichneumonidae (Hymenoptera) were recorded as parasitoids of *N. verbascella* (*Temelucha interruptor, T. decorata*, and *Tricholabus femoralis*). Parasitoidism by *T. decorata* on *N. verbascella* larvae is a new record for Turkey. In addition, we first report new host-parasitoid relationships: *N. verbascella* with *T. interruptor* and *Tricholabus femoralis. Tricholabus femoralis* is also a new record for the Turkish fauna. The presence of *N. verbascella* on *V. densiflorum* and *V. sinuatum* is a new record. This study also reports the first host record of *Tricholabus femoralis.*

KEY WORDS: *Nothris verbascella*, Lepidoptera, Gelechiidae, *Verbascum*, Scrophulariaceae, *Temelucha interruptor, Temelucha decorata, Tricholabus femoralis,* Ichneumonidae, biocontrol pressure, biological control, ethnobotany

Nothris verbascella (Denis-Schiffermüller, 1775) is a bivoltine, monophagous species feeding and living inside the galleries of the fresh rosette leaves of *Verbascum* (Scrophulariaceae), such as *V. pulverulentum* in the British Isles and *V. thapsus* in Italy (http://internt.nhm.ac.uk/jdsml/research-curation/projects/hostplants). Many insects are attracted to species of *Verbascum* because of their rich food contents, particularly by fleshy leaves of *V. densiflorum* Bertol. Furthermore, their mullein content makes species of *Verbascum* useful in medical sciences and pharmacology as an antiasthmatic, a diaphoretic (or inducer of sudden sweating or sudofiric), a mucolytic (or agent that helps break up mucus in the respiratory system), a diuretic (urination stimulant), and a bacteriostatic (or agent that slows down or inhibits bacterial growth) (http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Verbascum+densiflorum).

Verbascum densiflorum is a common species throughout Europe. However, in Turkey it is restricted to the Thrace region (Edirne and Kırklarelı provinces) (Davis, 1978). Conversely, *V. sinuatum* L. is distributed in the circum Mediterranean region, Iran, and Transcaucasia (Armenia, most of Georgia, and Azerbaijan), and it is known widely in Turkey, from both Anatolia, or Asian portion of Turkey, and the Turkish Thrace (Davis, 1978).

Ichneumonids develop mostly on phytophagous insects from many insect orders, such as Lepidoptera, Coleoptera, Hymenoptera, Diptera, Trichoptera, but also in some species of Araneae (Kasparyan 1981; Fitton et al., 1987, 1988; Gauld and Bolton, 1988; Wahl, 1993; Shaw, 1998; Georgiev and Kolarov, 1999; Finch, 2005). Ichneumonids can play an important role in the ecosystem by par-

---

[1] Received on July 30, 2007. Accepted on December 14, 2007.

[2] Trakya University, Faculty of Arts and Sciences, Department of Biology, 22030-Edirne, Turkey. E-mails: (MY) muratyurtcan@yahoo.com and (ZO) zuhalo@trakya.edu.tr, respectively.

Mailed on June 23, 2008

asitizing various pestiferous insects (Fernandez-Arhex and Corley, 2003; Caitlin and Whitehouse, 2004).

Previously, a total of six species of Ichneumonoidea (= Braconidae and Ichneumonidae) parasitizing *N. verbascella* have been recorded, none from Turkey. This study identifies the parasitoids of *N. verbascella* feeding on *V. densiflorum* and *V. siniatum* and evaluates the effects of these parasitoids on viability of their hosts.

METHODS

Nothris verbascella larvae feeding inside the fresh rosette leaves of *V. densiflorum* (n = about 300) and *V. sinuatum* (n = 30) were collected during two years, from May 2005 to May 2007. All plants were visited once every 10 days during the entire study period. A total of 123 *N. verbascella* larvae were collected and kept in the laboratory at 60-65% relative humidity and 25-30°C, inside boxes covered with nets. They were fed fresh host leaves and their development was monitored. Identifications of *N. verbascella* were made by the second author; the parasitoids were identified by the first author and by J. Kolarov (Plovdiv University, Pedagogic Faculty, Plovdiv, Bulgaria) using the relevant literature (Kasparyan, 1981; Medvedev, 1990). All specimens are deposited in the collection of the Zoological Museum (Department of Biology, Trakya University, Turkey).

Study Area. About 4500 m^2 was selected as the study area in Gullapoglu Campus of Trakya University (41° 38' 08" N, 26° 36' 36" E, h: 40 m.). This is almost a pasture area surrounded with almond trees (*Amygdalus communis* L., Rosaceae).

RESULTS

Temelucha interruptor (Gravenhorst, 1829), *T. decorata* (Gravenhorst, 1829), and *Tricholabus femoralis* (Thomson, 1894) obtained in the laboratory from *N. verbascella* larvae were identified as ichneumonid parasitoids of *Nothris verbascella*. All these three parasitoids emerged as solitary individuals from host larvae.

Nothris verbascella constitutes the first host record for *Tricholabus femoralis*. This is the first time that *Temelucha interruptor* and *Tricholabus femoralis* are reported parasitizing *N. verbascella* larvae.

The percentage of plants infected by *N. verbascella* was evaluated for both host plant species for each year of the study period. During the first year, 81% (170 out of 210 specimens) of *V. densiflorum* parasitized; the second year, 65% (130 out of 200 specimens). The parasitization rates of *V. sinuatum* were smaller with 30% (9 out of 30 specimens) and 35% (7 out of 20 specimens) for the first and the second year, respectively.

A total of 16 *Temelucha decorata*, 6 *Temelucha interruptor* and 1 *Tricholabus femoralis* emerged from 123 *N. verbascella* larvae collected from infected rosette leaves of *V. densiflorum* and *V. sinuatum*. Parasitism rates of the *N. verbascella* by these three ichneumonid species were 13%, 5%, and 1%, respectively.

Six species of Ichneumonoidea (Braconidae and Ichneumonidae) [*Agathis anglica* Marshall, 1885; *Apanteles dorsalis* (Spinola, 1808), *Diadegma contractum* (Brischke, 1880); *Diadegma erucator* (Zetterstedt, 1838); *Hypsicera curvator* (Fabricius, 1793); *Temelucha decorata* (Gravenhorst, 1829)] are known to live in *N. verbascella* larvae (Yu et al., 2005). This study raised this number of ichneumonoids on *N. verbascella* to eight.

The presence of *Temelucha decorata* in *N. verbascella* larvae as a parasitoid is a new record for Turkey, whereas host-parasitoid relationships of *N. verbascella* with *T. interruptor* and *Tricholabus femoralis* is new knowledge for these species. The host insect *N. verbascella* is a new record for the Turkish Thrace. *Tricholabus femoralis* is also a new record for Turkey and *Temelucha interruptor* is a new record for the Turkish Thrace. Furthermore, *N. verbascella* was reported for the first time on *V. densiflorum* and *V. sinuatum*.

DISCUSSION

Temelucha decorata parasitizes a total of 21 species belonging to the lepidopteran families Depressariidae, Gelechiidae, Lymantriidae, Noctuidae, Plutellidae, Pyralidae, and Tortricidae (Yu et al., 2005). This species, with its 13% parasitization rate, is the one parasitoid investigated with the highest biocontrol pressure and it is the most promising agent against *N. verbascella*

Temelucha interruptor parasitizes a total of seven species belonging to the lepidopteran families Gelechiidae, Psychidae, and Tortricidae (Yu et al., 2005). Its biocontrol pressure is only 5% and we do not believe it is a good candidate for biological control of *N. verbascella*.

An adult ♀ *Tricholabus femoralis* emerged on 09.01.2007 from an *N. verbascella* larva collected on 07.12.2006. We do not know in which instar *Tricholabus femoralis* parasitized its host, but we can conclude that the parasitoid emerged from the larvae as an adult after, at least, 30-45 days of egg-laying. *Tricholabus femoralis* cannot be considered as an effective biocontrol agent as its parasitizing rate was as low as 1%.

ACKNOWLEDGMENTS

We wish to express our thanks to Prof. Dr. Feruzan Dane (Trakya University-Turkey) for identification of the *Verbascum* and to Dr. Janko Kolarov (Plovdiv University, Bulgaria) for identification of some species of Ichneumonidae.

LITERATURE CITED

Caitlin, V. J. and M. E. A. Whitehouse. 2004. Mass rearing of two larval parasitoids of *Helicoverpa* spp. (Lepidoptera: Noctuidae): *Netelia producta* (Brullé) and *Heteropelma scaposum* (Morley) (Hymenoptera: Ichneumonidae) for field release. Australian Journal of Entomology 43:83-87.

Davis, P. H. 1978. Flora of Turkey and the East Aegean Islands. Edinburg at the University Press. England, U.K. 6:1-825.

Fernandez-Arhex, V. and J. C. Corley. 2003. The Functional Response of Parasitoids and its Implications for Biological Control. Biocontrol Science and Technology 13(4):403-413.

Finch, O. D. 2005. The parasitoid complex and parasitoid-induced mortality of spiders (Araneae) in a Central European woodland. Journal of Natural History 39 (25):2339-2354.

Fitton M. G., M. R. Shaw, and A. D. Austin. 1987. The Hymenoptera Associated With Spiders in Europe. Zoological Journal of the Linnean Society 90:63-93.

Fitton M. G., M. R. Shaw, and I. D. Gauld. 1988. Pimpline Ichneumon-Flies, Hymenoptera, Ichneumonidae (Pimplinae). Handbooks for the Identification of British Insects. Royal Entomological Society of London 7 (1):1-110.

Gauld, I. D. and B. Bolton (Editors). 1988. The Hymenoptera. Oxford University Press/British Museum (Natural History). Oxford, England, U.K. 332 pp.

Georgiev, G. and J. Kolarov. 1999. New Ichneumonidae (Hymenoptera) Parasitoids of forest insect pests in Bulgaria. Anzeiger Fur Schadlingskunde. Journal of Pest Science 72 (3):57-61

http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Verbascum+densiflorum: Accessed on 01.VI. 2007.

http://internt.nhm.ac.uk/jdsml/research-curation/projects/hostplants: Accessed on 01.VI.2007.

Kasparyan, D. R. 1981. Opredelitel Nasekomich Europeiskoy Casti U.S.S.R. Part III. Prepontchatokrilie 3:1-688 (In Russian).

Medvedev, G. S. 1990. Keys to the Insects of The European Part of the U.S.S.R. IV. Part Two, Brill Publishing Company. Leiden, Netherlands. 1092 pp.

Shaw, M. R. 1998. Hymenopteres Europeens en particulier les Polysphinctini don't les larves se nourrissent d'araignees, pp. 14-40. *In*, Valerie Chansigaud (Editor). Les Insectes parasites des cocoons d'Araignees, Connaissance des Invertabres serie Arachnides No: 3, 56 pp.

Wahl, B. D. 1993. Family Ichneumonidae. pp. 395-509. *In*, Henri Goulet and John T. Huber (Editors). Hymenoptera of the World: an identification guide to families. Research Branch Agriculture Canada Publication 1894/E. Ottawa, Canada. 668 pp.

Yu, D. S., C. Achterberg, and K. Horstmann. 2005. Interactive Catalogue of World Ichneumonoidea Taxonomy, biology, morphology and distribution. Compact Disc (Master version). Taxapad. Vancouver, Canada.

NEW REPLACEMENT NAMES FOR TWO NEOTROPICAL LEAFHOPPER GENERA (HEMIPTERA: CICADELLIDAE)[1]

Hüseyin Özdikmen[2] and Emine Demir[2]

ABSTRACT: Two junior homonyms were detected among leafhopper genera and the following replacement names are proposed: *Nallia* nom. nov. for *Nollia* Hamilton, 1983, and *Neosuarezia* nom. nov. for *Suarezia* Linnavuori and DeLong, 1978. Accordingly, new combinations are herein proposed for the species currently included in these genera: *Nallia pallida* (Linnavuori and DeLong, 1977) comb. nov.; *Nallia rustica* (Hamilton, 1983) comb. nov.; *Neosuarezia reflexus* (Osborn, 1923) comb. nov.

KEY WORDS: homonymy, replacement names, Cicadellidae, Homoptera

The purpose of the present paper is to bring the taxonomy of leafhoppers into accordance with the requirements of the International Code of Zoological Nomenclature (1999). In an effort to reduce the number of homonyms in the Cicadellidae, we found two Neotropical leafhopper genera whose names had been previously published for other taxa, making them junior homonyms. In accordance with Article 60 of the Code, we propose substitute names for these genus group names.

Family Cicadellidae

Subfamily Macropsinae

Genus *Nallia* nom. nov.

Nollia Hamilton, 1983. Memoirs ent. Soc. Can. No. 123: 19. (Insecta: Hemiptera: Auchenorrhyncha: Cicadellidae: Macropsinae: Neopsini). Preoccupied by *Nollia* Eisenack, 1979. Senckenbergiana leth. 60 (1-3): 52. (Protozoa: Acritarcha).

Remarks on nomenclatural change: The Neotropical *Nollia* Hamilton, 1983, was established for a leafhopper genus with the type species *Neopsis pallidus* Linnavuori and DeLong, 1977, from Chiloe Is. (Chile). It is still used as a valid genus name in Cicadellidae (e.g. Oman et al., 1990).

Nevertheless the name *Nollia* is already occupied. Eisenack (1979) established a microfossil genus *Nollia* with the type species *Nollia eifelensis* Eisenack, 1979, in Acritarcha (Protozoa). It is still used as a valid genus name in Acritarcha (e.g. Mullins, 2007). It is a monotypic genus. The genus name *Nollia* Eisenack, 1979 (Protozoa) is recorded by Edwards et al. (1996) in volume 9, page 442 of Nomenclator Zoologicus. In fact, that in accordance with Article 1.1.1 and 2.2 of the Code, we regard *Nollia* Eisenack, 1979, as an animal name.

Thus the leafhopper genus *Nollia* Hamilton, 1983, is a junior homonym of *Nollia* Eisenack, 1979. In accordance with Article 60 of the ICZN, Fourth

---

[1] Received on August 20, 2007. Accepted on August 28, 2007.

[2] Gazi Üniversitesi, Fen-Edebiyat Fakültesi, Biyoloji Bölümü, 06500 Ankara. Turkey. E-mails: ozdikmen@gazi.edu.tr and eminedemird@yahoo.com.

Mailed on June 23, 2008

Edition (1999), we suggest here *Nallia* as a replacement name for *Nollia* Hamilton, 1983.

Etymology: From the preexisting name *Nollia.*

Summary of nomenclatural changes

Nallia **new replacement name**
  = *Nollia* Hamilton, 1983 (nec Eisenack, 1979).
Nallia pallida (Linnavuori and DeLong, 1977) **comb. nov.**
  = *Neopsis pallidus* Linnavuori and DeLong, 1977
  = *Nollia pallida* (Linnavuori and DeLong, 1977)
Nallia rustica (Hamilton, 1983) **comb. nov.**
  = *Nollia rustica* Hamilton, 1983

Subfamily Deltocephalinae

Genus *Neosuarezia* nom. nov.

Suarezia Linnavuori and DeLong, 1978. Brenesia 14-15: 121. (Insecta: Hemiptera: Auchenorrhyncha: Cicadellidae: Deltocephalinae: Athysanini). Preoccupied by *Suarezia* Budde-Lund, 1904. Revis. Crust. Is. terr., fasc. 2-3, 41 (Crustacea: Malacostraca: Eumalacostraca: Peracarida: Isopoda: Oniscidea: Scleropactidae).

Remarks on nomenclatural changes: Linnavuori and DeLong (1978) proposed the Neotropical leafhopper genus *Suarezia* with the type species *Eutettix reflexus* Osborn, 1923, from Puerto Suarez (Bolivia) in Cicadellidae. It is still used as a valid genus name (e.g. Oman et al., 1990; Freytag and Sharkey, 2002). Unfortunately, the generic name was already preoccupied by Budde-Lund (1904), who described *Suarezia* with the type species *Mesarmadillo heterodoxa* Dollfus, 1895, in the crustacean family Scleropactidae. *Suarezia* Budde-Lund, 1904, is still used as a valid genus name in Isopoda (e. g. Schotte et al., 1995). It includes two species from Madagascar, *Suarezia heterodoxa* (Dollfus, 1895) and *Suarezia differens* Barnard, 1959.

Thus, the generic name *Suarezia* Linnavuori and DeLong, 1978, is a junior homonym of *Suarezia* Budde-Lund, 1904 (Isopoda). We propose a new replacement name *Neosuarezia* **nom. nov.** for *Suarezia* Linnavuori and DeLong, 1978.

Etymology: From the preexisting name *Suarezia.* The prefix "Neo-" from the Greek "*neos*" meaning new.

Summary of nomenclatural changes:

Neosuarezia **new replacement name**
  = *Suarezia* Linnavuori and DeLong, 1978 (nec Budde-Lund, 1904).
Neosuarezia reflexus (Osborn, 1923) **comb. nov.**
  = *Eutettix reflexus* Osborn, 1923
  = *Suarezia reflexus* (Osborn, 1923)

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to Dr. K. G. Andrew Hamilton (Canada) for his permission to publish this paper.

LITERATURE CITED

Budde-Lund, G. 1904. A Revision of 'Crustacea Isopoda terrestria' with additions and illustrations. Parts 2 and 3. H. Hagerup. Copenhagen, Denmark. pp. 32-144.

Edwards, M. A., P. Manly, and M. A. Tobias. 1996. Nomenclator Zoologicus. The Zoological Society of London 9 (1978-1994): 442.

Eisenack, A. 1979. *Nollia eifelensis* (Acritarcha), ein Pyrocystis-ähnliches Mikrofossil aus dem Unter-Devon der Eifel. Senckenbergiana Lethaea 60 (1-3): 51-53.

Freytag, P. H. and M. J. Sharkey. 2002. A preliminary list of the leafhoppers (Homoptera: Cicadellidae) of Colombia. Biota Colombiana 3 (2): 235-283.

Hamilton, K. G. A. 1983. Revision of the Macropsini and Neopsini of the new-world (Rhynchota: Homoptera: Cicadellidae), with notes on intersex morphology. Memoirs of the Entomological Society of Canada 123. 223 pp.

ICZN. 1999. International Code of Zoological Nomenclature. Fourth Edition. The International Trust for Zoological Nomenclature. London, Great Britain, UK. XXIX + 306 pp.

Linnavuori, R. and D. M. Delong. 1978. Neotropical leafhoppers of the *Bahita* group (Homoptera, Cicadellidae, Deltocephalinae). Brenesia (San José, Costa Rica). 14-15: 109-169.

Mullins, G. L. 2007. The phytoPal Taxonomic Database (taxon list). Collated and edited by G. L. Mullins, with contributions from R. J. Aldridge, K. J. Dorning, A. Le Herisse, Li Jun, M. Moczydlowska-Vidal, S. G. Molyneux, T. Servais, and R. Wicander. Updated February 2, 2007. Pages 1-1132. Available from: http://www.le.ac.uk/geology/glm2/phytopal/taxa.pdf.

Oman, P. W., W. J. Knight, and M. W. Nielson. 1990. Leafhoppers (Cicadellidae): A bibliography, generic check-list and index to the world literature 1956-1985. CAB International Institute of Entomology. Wallingford, UK. 368 pp.

Schotte, M., B. F. Kensley, and S. Shilling. 1995. World list of Marine, Freshwater and Terrestrial Crustacea Isopoda National Museum of Natural History Smithsonian Institution: Washington, D.C., U.S.A. Available from: http://www.nmnh.si.edu/iz/isopod/.

Agreement. By submitting a paper for publication, authors tacitly agree to not submit in parallel the same manuscript to another journal. For published papers, authors agree to accept responsibility for all page, illustration, and requested reprint or .pdf charges. Rejected manuscripts will be discarded.

Scientific Notes and Book Reviews. These are much shorter contributions, typically not exceeding one (Book Review) or two (Scientific Notes) printed pages. The main difference between these types of contributions and longer papers is that scientific notes and book reviews lack an abstract and most of the main headings, except for the acknowledgments and the literature cited sections.

Reviewers. When submitting papers, all authors are requested to provide the names of two qualified individuals who have critically reviewed the manuscript before it is submitted to *Entomological News*. All papers, except book reviews and American Entomological Society business, are forwarded to experts for final review before acceptance. In order to expedite the review process when submitting papers, the authors are also asked to suggest the name, address, and e-mail of at least five published experts in the subject matter of the submitted paper who may be able to review this paper and who has not seen this contribution before. In order to attempt avoiding the appearance of conflict of interests, the suggested reviewers must not share work affiliations with any of the authors. Ideally, the review process should be completed within 30 days. If additional reviews are necessary, authors will be requested to suggest the name, address, and e-mail of other colleagues to whom the article may be sent. The Editor reserves his prerogative of sending the manuscript to other reviewers. Authors are also welcomed to list the names of colleagues to whom the article should not be sent, with a brief explanation. Upon return of reviews, authors will be asked to modify their papers to accommodate suggestions of the reviewers and the Editor as well as to conform to requirements of *Entomological News*. If authors do not modify their papers, they should specifically address, on a point by point basis, why they are not doing that.

Page Proofs. The printer will send page proofs to the Editor and then the proofs will be sent to the corresponding authors as .pdf files. The computer that authors use must be able to receive files of at least 5MB. Within three days, authors must e-mail the proofs to the Editor, with corrections indicated precisely to the page, paragraph, and line. Authors who anticipate being absent are urged to provide forwarding addresses or to provide a temporary address with dates. Proofs not received on time from authors may be published at a later date. The Editor will collect the page proofs and send them to the printer.

Page and Reprint Charges. Contact the Editor for current page and reprint charges. Authors will be mailed invoices for their total page(s) and reprints, including shipping charges. After receiving invoice, please remit payment, or address questions, to the known Office of Publication. Articles longer than 20 printed pages of *Entomological News* may be published in two or more installments, unless the author is willing to pay the entire cost of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Entomological News is widely indexed. *Entomological News* is listed in the Science Citation Index Expanded (updated on February 26, 2005). In addition, the Ulrich's Periodical Index for 2005 lists *Entomological News* as being indexed by dozens of sources, including Agricola (Agricola (CRIS), Agricultural Engineering Abstracts (AEA), Agroforestry Abstracts (AgrForAb), Aquatic Sciences & Fisheries Abstracts (ASFA), BIOBASE, BiolAb), Biology Digest (BiolDig), BIOSIS Previews (BIOSIS Prev), Chemical Abstracts (ChemAb), Current Awareness in Biological Sciences (BIABS), Current Contents (CurrCont), Field Crop Abstracts (FCA), Faba Bean Abstracts (FaBeAb), Fisheries Review (SFA), Forestry Abstracts (ForAb), Grasslands and Forage Abstracts (HerbAb), Horticultural Science Abstracts (HortAb), Index Veterinarius (indVet), MEDLINE, Nematological Abstracts (NemAb), Nutrition Abstracts and Reviews (NutrAb), Personal Alert (ASCA), Plant Breeding Abstracts (PBA), Post Harvest News and Information (PHN&I), Poultry Abstracts (PoultAb), Protozoological Abstracts (ProtozoAb), Review of Aromatic and Medicinal Plants (RA&MP, Referativnyi Zhurnal (RefZh), Review of Applied Entomology (RevApplEntom), Review of Medical and Veterinary Mycology (RM&VM), Rice Abstracts (RiceAb), Seed Abstracts (SeedAb), Soils & Fertilizers (S&F), Soybean Abstracts (SoyAb), Tropical Diseases Bulletin (TDB), Vitis - Viticulture and Oenology Abstracts (VITIS), Weed Abstracts (WeedAb), Wheat Barley and Triticale Abstracts (TritiAb), Wildlife Review Abstracts (WildRev), Zoological Record (ZoolRec), among others.

Entomological News is printed by Dover Litho Printing Company, 1211 North DuPont Highway, Dover, Delaware 19901 U.S.A. Telephone (302) 678-1211; fax: (302) 678-8091; web page: www.doverlitho.com. Dover Litho has been recognized by DENREC and DELRAP Green Industries as "The Most Environmentally Conscious Printer in the State of Delaware." *Entomological News* is printed on "acid free and archival quality" ... "elemental chlorine free (ECF) or totally chlorine free (TCF)" recycled paper that meets EPA and FTC guidelines for recycled coated papers" (www.storaenso.com/na).

Mailed on June 23, 2008

continued from front cover

AMERICAN ENTOMOLOGICAL SOCIETY BUSINESS

THE AMERICAN ENTOMOLOGICAL SOCIETY

www.acnatsci.org/hosted/aes

ne 119 Number 4

ember and October 2008

Entomological News

continued on back cover

USISSN 0013-872X

Mailed November 12, 2008

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS
ISSN 0013-872X

Entomological News is a fully refereed scientific international journal published by The American Entomological Society (AES). Manuscripts on systematics, ecology, evolution, morphology, physiology, behavior, biodiversity, conservation, paleobiology, and other aspects of insect and terrestrial arthropod life as well as nomenclature, biographies and history of entomology, among others, are appropriate topics for papers submitted to *Entomological News*. Papers on applied, economic, and regulatory entomology or on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields. In accordance with the spirit and letter of international codes of biological nomenclature, the Editor of *Entomological News* recommends that name-bearing types and representative (voucher) specimens be deposited in collections where such specimens are well curated and available to qualified researchers.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February, and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pennsylvania (U.S.A.), while the October and March meetings are held at the Department of Entomology of the University of Delaware in Newark, Delaware (U.S.A.). Society members who reside in southeastern Pennsylvania, southern New Jersey, and Delaware are urged to attend the meetings whenever possible. Members outside this area as well as guests are cordially invited and welcomed. Information on the Calvert Award for insect-related study by a young person in the Delaware River Valley region sponsored by The American Entomological Society can be found at: http://www.udel.edu/chem/white/Odonata/CalvertAwd.html.

Membership (http://www.ansp.org/hosted/aes/Acrobat/Membership_Form.pdf): Membership to the AES is open to anyone. Annual dues are US$20.00 (regular members) and US$12.00 (student members).

United Stated Postal Service (USPS) Identification Statement: *Entomological News* (ISSN 0013-872X) is published bimonthly, except July-August, by The American Entomological Society. The subscription is not included with the annual dues. The subscription price is US$15.00 per year, prepaid, for members, US$30.00 per year, prepaid for institutional library subscribers located in the U.S.A. and US$34.00 per year, prepaid for institutional library subscribers located out of the U.S.A. Periodicals Postage Paid at Philadelphia, Pennsylvania 19103 U.S.A. and additional mailing offices. The known **Office of Publication** is: Office Manager, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 United States of America. **POSTMASTER:** Send address changes to the Office of Publication.

Subscriptions to current issues, back issues, and microforms of *Entomological News*. Please send inquiries or send completed membership form to the Office of Publication, e-mail: aes@acnatsci.org, or call (215) 561-3978. *Entomological News* is available in microform from ProQuest Information and Learning. Call toll-free (800) 521-3042, (800) 521-0600, (734) 761-4700. Mail inquiry to: ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106-9866 U.S.A. The webpage of ProQuest is: www.proquest.com.

Any author may submit papers. Manuscripts will be accepted from any author, although, papers from members of the American Entomological Society are given priority. Authors are urged to read the guidelines to the authors carefully (http://www.geocities.com/entomologicalnews/instructions.html) and contact the Editor for any changes that may not have been uploaded. It is suggested that all prospective authors join the AES.

Send manuscripts, books for review, and all editorial correspondence to the Editor. All manuscripts, including scientific notes and book reviews, submitted for publication in *Entomological News* as well as all associated editorial communications must be sent electronically to the Editor, Jorge A. Santiago-Blay at: blayjorge@gmail.com. E-mail is the preferred way to contact the Editor and the fastest way to get a reply. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible.

Previous Editors of *Entomological News*: 1(1) January 1890 and 1(2) February 1890, Eugene Murray Aaron (1852-1940); 1(3) March 1890 to 21(10) December 1910, Henry Skinner (1861-1926); 22(1) January 1911 to 54(9) November 1943, Phillip P. Calvert (1871-1961); 54(10) December 1943 to 57(10) December 1946, Editorial Staff with A. Glenn Richards (1909-1993) and R. G. Schmieder (1898-1967) as co-Editors; 58(1) January 1947 to 79(7) July 1968, R. G. Schmieder; 79(8) October 1968 to 83(10) to December 1972, Ross H. Arnett, Jr. (1919-1999); 84(1) January 1973 to 85(4) April 1974, R. W. Lake; 85(5-6) May & June 1974 to 113(3) May & June 2002, Howard P. Boyd; 113(4) September & October 2002 to 113(5) November & December 2002, F. Christian Thompson and Michael Pogue.

Cover Design by Jane Spencer

Mailed on November 12, 2008

ODOUR AND COLOUR SIMILARITY IN TWO SPECIES OF GREGARIOUS CARABID BEETLES (COLEOPTERA) FROM THE CRATI VALLEY, SOUTHERN ITALY: A CASE OF MÜLLERIAN MIMICRY?[1]

Teresa Bonacci,[2] Pietro Brandmayr,[2] Renato Dalpozzo,[3] Antonio De Nino,[3] Alessandro Massolo,[4] Antonio Tagarelli,[3] and Tullia Zetto Brandmayr[2]

ABSTRACT: Bombardier beetles of the genus *Brachinus* (Carabidae) are disagreeable prey because they discharge irritating quinones. *Brachinus* beetles live in aggregations and display warning colours. Like *Brachinus* beetles, *Anchomenus dorsalis* beetles produce methylsalicylate, and present a similar colour pattern. *Anchomenus dorsalis* beetles are usually found within *Brachinus* aggregations. Our aim was to investigate the similarity of cuticular chemical profiles of these two species to test the hypothesis of interspecific chemical mimicry. We investigated the cuticular composition of *A. dorsalis*, *B. sclopeta*, and *Poecilus cupreus*. *Poecilus cupreus*, a non-aposematic carabid commonly found in *Brachinus* spp and *Anchonemus dorsalis* aggregations, was used as a control. The cuticular profiles of the three species include 48 different hydrocarbons. The cuticular hydrocarbon profiles of the three species of carabids were different, but individuals of *Brachinus* were chemically more similar to those of *Anchomenus* than to those of *Poecilus*; in turn, individuals of *Poecilus* were more similar to *Anchomenus* than to *Brachinus*. We suggest that *A. dorsalis* is possibly mimicking the cuticular profile of *B. sclopeta* as an effective antipredator strategy. *Brachinus sclopeta* may benefit from a reduction of individual predation risk due to an increased number of aggregated preys (dilution effect), while *A. dorsalis* may increase the benefit both from the dilution effect and from the greater chemical defense of *B. sclopeta*.

KEY WORDS: gregariousness, aposematism, cuticular profile, Müllerian mimicry, *Brachinus*, *Anchomenus, Poecilus,* Coleoptera, Carabidae, Crati Valley, Italy

Müllerian mimicry, when at least two species share a warning pattern (Skelhorn and Rowe 2005), frequently involves different defense chemicals. In this form of mimicry, the mimics that possess different defense chemicals are better protected than those that share a single defense chemical (Skelhorn and Rowe 2005) because they enhance predator learning and memory. In Müllerian mimicry, the species involved are sympatric and share the same or similar warning colour pattern (Wickler, 1968).

Many animals use warning colours (or aposematism) to signal their dangerousness to potential predators (Cott, 1940; Guilford, 1990). Aposematic coloration decreases the probability of attack by naïve predators, as an effect of the novelty, a reaction to aversive colours (Coppinger, 1969, 1970; Roper and Cook, 1989; Gamberale and Tullberg, 1996 a, b), or both (Sillén-Tullberg, 1985). Experienced predators tend to avoid repeated contact with aposematic prey items (Gittleman and Harvey 1980; Roper 1994).

---

[1] Received on October 29, 2007. Accepted on February 24, 2008.

[2] Dipartimento di Ecologia, Università della Calabria 87036 Arcavacata di Rende (Cosenza) Italy. E-mails: (TB) t.bonacci@unical.it, (PB) brandmay@unical.it, and (TZB) tuzetto@unical.it, respectively.

[3] Dipartimento di Chimica, Università della Calabria 87036 Arcavacata di Rende (Cosenza) Italy. E-mails: (RD) dalpozzo@unical.it, (ADN) denino@unical.it, and (AT) a.tagarelli@unical.it, respectively.

[4] Dipartimento di Biologia Animale e Genetica, Università di Firenge, via Roma 17, I-50125, Firenze, Italy. E-mail: massolo@unifi.it.

ENTOMOLOGICAL NEWS 119 (4): 325 September and October 2008
Mailed on November 12, 2008

In insects, aposematism often occurs together with gregariousness (Edmunds 1974). Some authors suggested that the gregariousness increases the effect of the aposematic signal (Poulton, 1890; Cott, 1940; Riipi et al., 2001). This increased signal efficiency could influence both the initial unconditioned aversion of naïve predators as well as the speed and memorability of avoidance learning (Gamberale and Tullberg, 1998; Roper and Marples, 1997; Skelhorn and Rowe, 2005). Indeed, predator's avoidance learning can be faster and more durable when the prey item is gregarious, as the would-be predator can see warningly coloured prey items simultaneously or immediately after perceiving the noxious stimulus (Gagliardo and Guilford, 1993; Speed and Turner, 1999). As a result, gregariousness is more common in aposematic distasteful prey items than in palatable and cryptic species (Sillén-Tullberg and Bryant, 1983). Moreover, studies on the effect of prey aggregation on phobic reactions in *Gallus gallus domesticus* have good evidence that aggregations of live aposematic prey items generate higher levels of avoidance neophobias than solitary prey items (Gamberale and Tullberg, 1996a; 1998). Gregariousness enhances the effectiveness of chemical defense (Cott, 1940; Treisman, 1975; Aldrich and Blum, 1978).

Some carabid beetles, such as bombardier beetles of the genus *Brachinus* (Weber 1801), are well protected against predators because they release irritating quinones produced by the oxidation of hydroquinones in a double-chambered apparatus (Schildknecht, 1961; Schildknecht et al., 1968). The heat and the explosion associated with the reaction reinforce the defensive effect. The genus *Brachinus* includes some species with parasitoid habits in the larval stage (Erwin, 1967; Juliano, 1984). Additionally, some species of *Brachinus* (*B. explodens* and *B. crepitans*) develop on pupae of *Amara* ground beetles (Saska and Honìk, 2004). Predation on *Brachinus* beetles appears to be rare (Juliano, 1985). In Europe, *Anchomenus dorsalis* (Pontoppidan,1763), which produces toxic methylsalicylate from its pygidial gland (Schildknecht, 1970), is often found in association with species of *Brachinus* (Juliano, 1985; Zaballos, 1985; Lindroth, 1986; Bonacci et al., 2004b; Mazzei et al., 2005; Zetto Brandmayr et al., 2006) and, like *Brachinus*, it has a bright bicoloured (green-blue and red-brown) coat body that contrasts with the background (Fig. 1).

Recently, we demonstrated that individuals of *Ocypus olens* (Staphylinidae) and *Crocidura leucodon* (Insectivora, Soricidae) reject *Brachinus* as a prey (Bonacci et al., 2004a; 2006). Many species of the genus *Brachinus* have gregarious behaviour (Wautier, 1971; Bonacci et al., 2004b; Zetto Brandmayr et al., 2006); when disturbed, they use their explosive secretion against predators, enhancing the aggregation's positive effect. Unlike most carabid beetles, which are homogeneously brown or brownish-black, some species of *Brachinus* are bright orange-red with blue or green elytra; likely an aposematic signal.

The most common predators of carabid beetles are hedgehogs, shrews, moles, birds, owls, frogs, toads, ants, flies, spiders, and carnivorous ground beetles (Burda and Bauerová, 1985; Thiele, 1977). Only some birds, frogs, and toads locate prey items by visual cues; the others are olfactory and/or tactile-cued predators (Thiele, 1977) for which warning colours as a repellence signal are inadequate.

Several species of carabids are frequently found in multispecies *Brachinus* aggregations in cropland habitats of the Crati Valley, Province of Cosenza, Southern Italy (Bonacci et al., 2004; Mazzei et al., 2005; Zetto Brandmayr et al., 2006). The most common of these carabids is certainly *Anchomenus dorsalis*, which shares the same shelters under stones, especially in spring. The aggregations are composed of: *Brachinus sclopeta* (Fabricius, 1792), *A. dorsalis*, *B. crepitans* (Linné, 1758), *B. psophia* (Audinet-Serville, 1821), *B. ganglbaueri* (Apfelbeck, 1904), *B. immaculicornis* Dejean, 1826, *Chlaenius chrysocephalus* (P. Rossi, 1790) (all aposematically and chemically defended species). In the same groups, also *Poecilus cupreus* (Linné, 1758) and *Steropus* (*Pterostichus*) *melas italicus* (Dejean, 1828) specimens are found (Fig. 1). These two species are not aposematic and are chemically less protected by repugnatory glands.

Figure 1. Typical interspecific aggregation of *Brachinus sclopeta* (a) and *Anchomenus dorsalis* (b). In the group, we frequently found individuals of *Poecilus cupreus* (c). Scale: 2 mm.

Mimetic associations has already been recorded in some carabid beetles of the genus *Lebistina* that have similar colour pattern to syntopically living poisonous *Diamphidia* sp and *Polyclada* sp, leaf beetle of the subfamily Alticinae (Chrysomelidae) (Balsbaugh, 1967; Lindroth, 1971 in Cassola et al., 1988). The coloration of some tiger beetles (Cicindelidae) is interpreted as mimetic. The tiger beetle genera *Collyris* and *Tricondyla* are presumably distasteful and are mimicked by successive instars of the grasshopper *Condylodera tricondyloides* as well as cerambycid beetles, and a sciomyzid fly (Shelford 1902 in Acorn 1988). About other mimetic strategies in carabid beetles, Will et al. (2000) hypothesized chemical mimicry between ants and ground beetles as a potential factor in the evolution and maintenance of formic acid in the Harpalinae (Carabidae). Also, this mimicry form is evidence for strong association of ants and ground beetles.

The aim of the present paper is to compare the cuticular hydrocarbon profile composition of two gregarious aposematic and protected species *Brachinus sclopeta* (Fabricius, 1792) and *Anchomenus dorsalis* as well as a nonprotected and non-aposematic species, *Poecilus cupreus* (Linné, 1758) to test the hypothesis of interspecific chemical mimicry.

METHODS

Study Species

Samples of *Anchomenus dorsalis* (N = 15), *Brachinus sclopeta* (N = 15), and *Poecilus cupreus* (N = 15), were collected by hand from different field aggregations found in the Calabrian cultivated landscape [Crati Valley, province of Cosenza, southern Italy (latitude: 39°35'56"N; longitude: 16°15'48"E and elevation: 60 m a.s.l.)]. Immediately after collection, monospecific groups were placed in separate plastic cages (30 x 22 x 20 cm) with 4 cm of clay soil, kept in a climatic chamber at 22°C and L/D: 18/6 photoperiod. The individuals were fed on veal meat and earthworms *Lumbricus terrestris* (L.).

Chemical Investigations

We investigated the cuticular hydrocarbon profile of *B. sclopeta* (N = 4), *A. dorsalis* (N = 5), and *Poecilus cupreus* (N = 5). The individuals were tested 15 days after isolation. The GC/MS analyses were performed by solid phase-microextraction (SPME) technique. The syringe needle was equipped with a 100 µm polydimethylsiloxane fiber (Supelco, Bellefonte, Pennsylvania, U.S.A.) that was introduced into a vial containing an animal; the fiber was lowered and gently rubbed against the body of the carabid for about 15 seconds and then withdrawn into the needle. The adsorbed compounds were thermally desorbed by introducing the needle into the injector port and lowering the fiber for 10 min. Sample analyses were performed using a Varian (Walnut Creek, California, U.S.A.) Saturn 2000 GC–MS ion-trap system in electron impact, and positive chemical ionization modes, with acetonitrile as reagent gas, coupled to a Varian 3400 gas chromatograph (GC) in splitless mode. The column was a 30 m Chrompack CP-Sil 8 CB low bleed/MS (0.25 mm i.d., 0.25 µm film thick). The GC oven temperature was initially held at 100°C for 3 min, then ramped at 16°C/min to 280°C and held for 20 min. The carrier gas was helium at 1 ml/min.

The chromatograms obtained have been integrated considering all peaks that have a threshold value of signal/noise ratio (S/N) > 5. For each GLC sample, peak areas were obtained by integration, excluding the peaks related to the chromatographic column bleed. The identification of chemicals was carried out by Saturn library and by the method of Moneti et al. (1997) recommended for sampling insect cuticle hydrocarbons of live animals (Zanetti et al., 2001).

Statistical Analyses

Chemical distances between individuals of the three species of carabids were estimated by calculating the Pattern Difference that is a dissimilarity measure for binary data (presence-absence of each single chemical compound) that ranges from 0 to 1. It is computed from a fourfold table as $bc/(n^2)$, where b and c represent the diagonal cells corresponding to cases (chemical compounds) present on one item (insect) but absent on the other and n is the total number of observations (peaks; $n = 24$). The distance within the same species was not computed as all the individual profiles were carrying the same compounds. Differences in the computed chemical distances between the three species were first tested with the Kruskal-Wallis test for k in the independent samples, and then by means of Mann-Whitney U test for pairwise comparisons (Siegel and Castellan, 1988). The probability level was computed using a complete randomisation method (permutation or exact test; P_{exact}) or by a Monte Carlo (Mehta and Patel, 1996; Good, 2000) simulation based on a 10,000 sampled tables ($P_{Monte\ Carlo}$) when computation was not possible. These methods provide a better estimate of probability levels as they compare the observed distributions against the one that is actually obtained from all the possible combinations (permutation) of the actual collected values in the experimental groups, or from a random sample (Monte Carlo) of them. All the statistical analyses were performed by Statistical Package for Social Sciences ver. 15.01 (SPSS®).

RESULTS

Cuticular Profiles

The qualitative composition of the cuticular extract of the investigated species of carabid beetles is similar to that reported for many other insects (Table 1).

Brachinus sclopeta, *Anchomenus dorsalis*, and *Poecilus cupreus* individuals examined have a total of 48 hydrocarbons with molecular skeletons ranging from 11 to 29 carbons. The cuticular hydrocarbons identified in *B. sclopeta* are pentadecane, eicosane, 7-heneicosene, heneicosane, 8-docosene, docosane, n-tricosene, tricosane, 8-tetracosene, tetracosane, n-pentacosene, pentacosane, 9-heptacosene, heptacosane, squalene and nonacosane. Some of the compounds identified only in *B. sclopeta* are p-benzoquinone and 2-methyl-p-benzoquinone, typical of bombardier beetles' defensive secretions, as well as two phenols, 2-cloro-4-1(1,1-dimethyl)-phenol and 1-(2-hydroxy-5-methoxyphenyl)-ethanone (Table 1). However, in *B. sclopeta* and *A. dorsalis* cuticular hydrocarbons consisted of exactly the same compounds (Figs. 2 and 3); except for the undecane and the 2-tridecanone molecules found only in *A. dorsalis*. The cuticular hydrocarbons of *Poecilus cupreus* consisted mainly of unknown n-disopropylnafthalene isomer, n-heneicosene, n-docosene, n-tricosene, n-tetracosene, n-pentacosene, and finally n-heptacosene.

The statistical comparison of the three cuticular profile demonstrates that *B. sclopeta*, *A. dorsalis*, and *P. cupreus* were chemically different (Kruskal_Wallis, $x^2 = 46.656$, 2 d.f., $P_{Monte\ Carlo} < 0.001$; Fig. 2), but individuals of *Brachinus* were chemically closer to those of *Anchomenus* than to those of *Poecilus* ($U = 0.0$, $W =$

210.0, $P_{Monte\ Carlo} < 0.001$). *Poecilus* chemical profiles were less different to those of *Anchomenus* than of *Brachinus* ($U = 125.0$, $W = 350$, $P_{Monte\ Carlo} < 0.01$).

GC-MS analysis of the total cuticular surface showed that *B. sclopeta* and *A. dorsalis* have similar cuticular profiles (Table 1 and Fig. 3); some differences occur amongst the first peaks, with a low retention time, but the hydrocarbons with more than 20 atoms of *A. dorsalis* were all found on *B. sclopeta* cuticle. The chemical compounds identified in emerged *A. dorsalis* individuals (N=2) are similar to those of mature individuals examined.

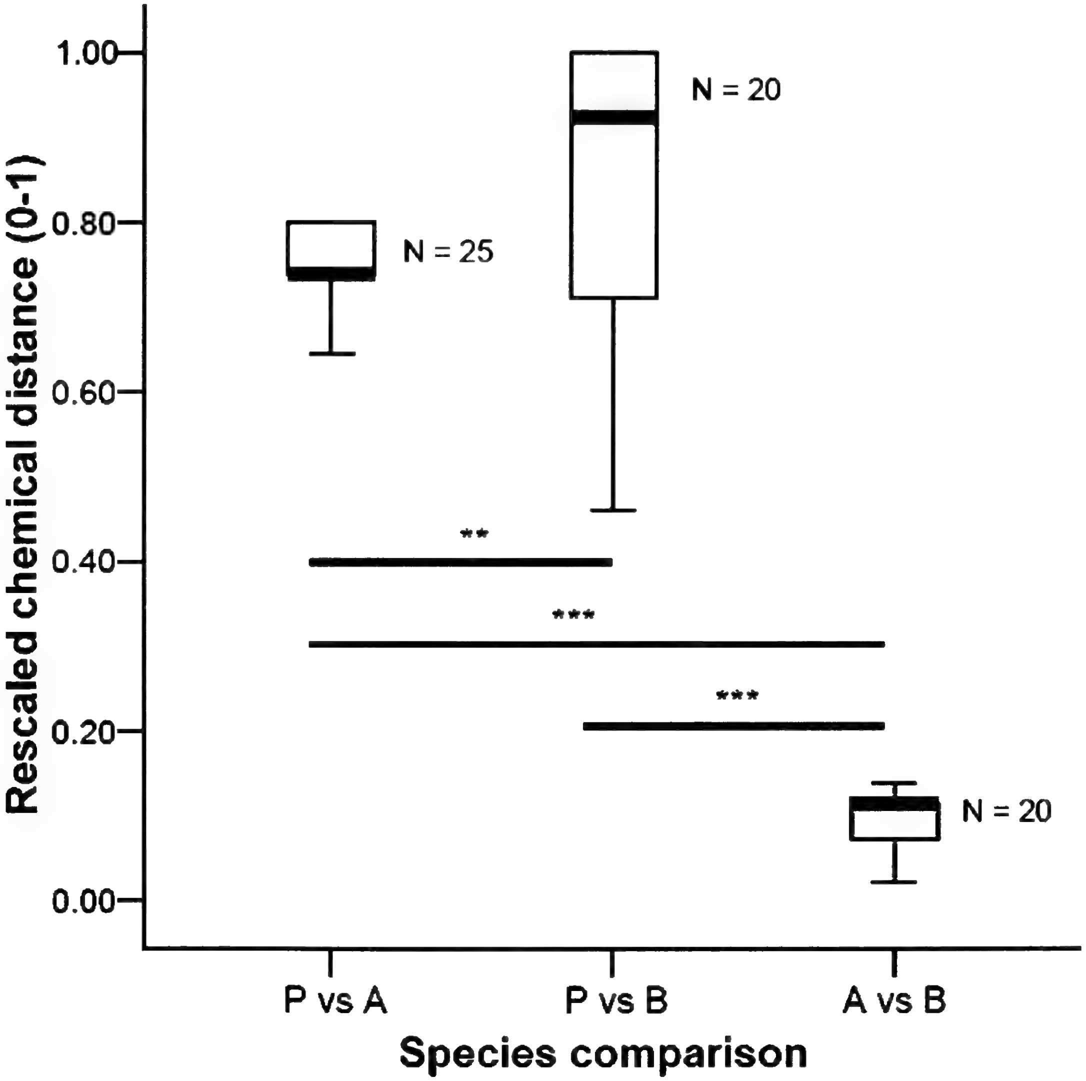


Figure 2. Differences in the chemical profiles between adult individuals of *Poecilus cupreus* (P, n = 5), *Brachinus sclopeta* (B, n = 4), and *Anchomenus dorsalis* (A, n = 5). Fgure 2 shows the medians (thick line), the 2nd and 3rd quartiles (inferior and superior box ends, respectively), along with the extreme values (bars) and the sample size of the rescaled (from 0 to 1) chemical distances computed for each possible dyad.

Table 1. Chemical compounds present in adults of *Brachinus sclopeta*, *Anchomenus dorsalis*, and *Poecilus cupreus*.

Peak No.	Compound	*Brachinus sclopeta*	*Anchomenus dorsalis*	*Poecilus cupreus*
1	p-benzoquinone	x		
2	2-methyl-p-benzoquinone	x		
3	undecane		x	
4	tridecane	x		
5	2.cloro-4-1(1,1-dimethyl)-phenol	x		
6	1-(2-hydroxy-5-methoxyphenyl)-ethanone	x		
7	pentadecane	x		
8	4-methy-1H- indole			x
9	2-tridecanone		x	
10	Unknown compound isomer			x
11	Disoprophylnaftalene isomer			x
12	Disoprophylnaftalene isomer			x
13	Disoprophylnaftalene isomer			x
14	Disoprophylnaftalene isomer			x
15	Disoprophylnaftalene isomer			x
16	Unknown compound isomer			x
17	Eicosene C_{20}			x
18	Eicosane C_{20}	x	x	x
19	7-heneicosene C_{21}	x	x	
20	7-heneicosadiene C_{21}			x
21	Heneicosene C_{21}			x
22	Heneicosane C_{21}	x	x	x
23	8-docosene	x	x	
24	9-docosene C_{22}			x
25	7-docosene C_{22}			x
26	Docosane C_{22}	x	x	x
27	9-tricosene C_{23}	x	x	x
28	7-tricosene C_{23}	x	x	x
29	Tricosane C_{23}	x	x	x
30	Tetracosene C_{24} isomer			x
31	Tetracosene C_{24} isomer			x
32	Tetracosene C_{24} isomer			x
33	8-tetracosene	x	x	
34	Tetracosane C_{24}	x	x	x
35	9-pentacosene	x	x	
36	7-pentacosene	x	x	
37	Pentacosene C_{25} isomer			x
38	Pentacosene C_{25} isomer			x
39	Pentacosene C_{25} isomer			x
40	Pentacosene C_{25} isomer			x
41	Pentacosene C_{25} isomer			x
42	pentacosane	x	x	
43	9-heptacosene	x	x	
44	11-heptacosene C_{27}			x
45	Heptacosane C_{27}	x	x	x
46	Squalene	x	x	
47	11-nonacosene			x
48	Nonacosane C_{29}	x	x	x

DISCUSSION

Müllerian mimicry occurs when several noxious species evolve to resemble each other, and hence all benefit by a reduction in predation (Müller, 1879; Fogden and Fogden, 1974; Turner, 1987). Frequently the mimics are sympatric, aposematic species that share the same or similar warning patterns (Wickler, 1968). The key points in mimicry are the existence of a similarity of colours and odours and the reinforcement of the defense mechanisms. Similarity is critical, and it can be expressed through different modality (shape, colour, odour), as its success depends on the sensorial channels (sight, taste, olfaction) of predators (Rettenmeyer, 1970; Speed and Turner, 1999). In Müllerian mimicry, similarity does not necessarily need to be complete (Huheey, 1988; Ihalainen, et al., 2007), as in the case of *Anchomenus dorsalis* and *Brachinus sclopeta* (Fig. 3) that are similar in body size and colour pattern and live in conspicuous aggregations. This incomplete similarity can act nonetheless as an effective anti-predatory strategy, as potential predators, finding an aggregation of dozens of individuals of the two species under stones or in other diurnal shelters, may have consistent difficulties in discerning one species from the other, owing to the rapid movements of the individuals in the aggregation: the outcome is a blinking mixing up of aposematic colours. The conspicuousness of the aggregations increases the effectiveness of the deceit, decreasing the attack probability, and the fact that both species may exert a chemical defense possibly reinforce the anti-predatory effect.

Gamberale and Tullberg (1998) found an unconditioned response gradient along a stimulus dimension consisting in the number of aposematic prey. Since *Brachinus* aggregations signal their unpalatability to optical predators by means of warning colour patterns, we infer that they have also evolved warning olfactory elaborate cues (e.g. coccinellid beetles) to avoid olfactory/tactile predators (Pasteels et al., 1973; Rothschild and Moore, 1987). Warning cues (colours and odours) would constitute a template, which natural predators would acquire through learning and use to identify the prey as noxious without the risk of triggering a chemical reaction, expensive for the prey and disagreeable to the predator.

Our observations on the cuticular profiles reveal that *B. sclopeta* and *A. dorsalis* have a close similarity in their cuticle molecular composition along with similar aposematic colours, particularly if compared to non-aposematic carabid beetles, such as *Poecilus cupreus*. The qualitative chemical profiles in emerged individuals of *A. dorsalis* were similar to those of mature individuals collected in the field, supporting the hypothesis that similarity is more likely to be innate than gained in the *Brachinus-Anchomenus* aggregations.

Most of the peaks represent hydrocarbons with more than 20 atoms, which in many insects are thought to constitute the basic odorous profile (Lockey, 1988; De Renobales et al., 1991). Hydrocarbon profiles tend to be species specific (Howard, 1998), behaving in some species of insects as "surface pheromones" which are perceived by other insects through direct contact or over a short distance (Shorey, 1973). Regarding true olfactory predators, we believe that learning and prey recognition play an important role in their predatory behaviour. Bioassays carried out in our laboratory, using *B. sclopeta* and *A. dorsalis* as "model prey" (Bonacci et al., 2004; 2006), seem to support this hypothesis. Despite the incomplete chemical similarity, we believe that a mechanism similar to that involved in colour similarity may be effective in reducing the predation risk.

We hypothesize that *A. dorsalis* uses chemical camouflage by mimicking the cuticular profile of *B. sclopeta* (bombardier beetle). The adaptive value of this behaviour may be related to the strengthening of an effective antipredator strategy, as beetles belonging to the genus *Brachinus* are chemically protected, they are easily recognized as unpalatable prey by predators. *Brachinus sclopeta* may use rapid and chaotic movement of individuals inside the aggregation, while *A. dorsalis* may increase the benefit both from the dilution effect and from the greater chemical defense exerted by *B. sclopeta* (Zetto Brandmayr et al., 2006). In this sense, the similarity of the cuticular profile of *A. dorsalis* with that of *B. sclopeta*, and perhaps of other *Brachinus* species may be interpreted as a defensive mimicry. In a recent paper Zetto Brandmayr et al. (2006) discussed a behaviour displayed by *A. dorsalis* versus *B. sclopeta*. In this interaction *A. dorsalis* actively rubs its back against *B. sclopeta*'s body, and the authors called these actions "rubbing behaviour," and hypothesized for it a role in maintaining a high degree of odour similarity in the aggregation.

Skelhorn and Rowe (2005) showed that the presence of two defense chemicals in a Müllerian mimicry system enhances predator learning and memory. Preliminary chemicals data (work in progress) suggest that *A. dorsalis* and *B. sclopeta* are able to synthesize different alkaloids (aposematic odours) against predators. A similar process has been described in other insects, such as *Adalia bipunctata*, *Coccinella septempunctata* (Gilsan-King and Meinwald, 1996; Marples et al., 1994), and other lady birds (Pasteels et al., 1973). Besides, *A. dorsalis* and *B. sclopeta*, which in natural habitats live gregariously, use aposematic colours and warning odours. We supposed that the combination of these signals, common in many insect groups (especially aposematic coloured insects, Rothschild and Moore, 1987; Moore et al., 1990), can produce a multimodal warning display that, acting along many sensory channels (Rowe and Guilford, 1999), increases the antipredatory strategies.

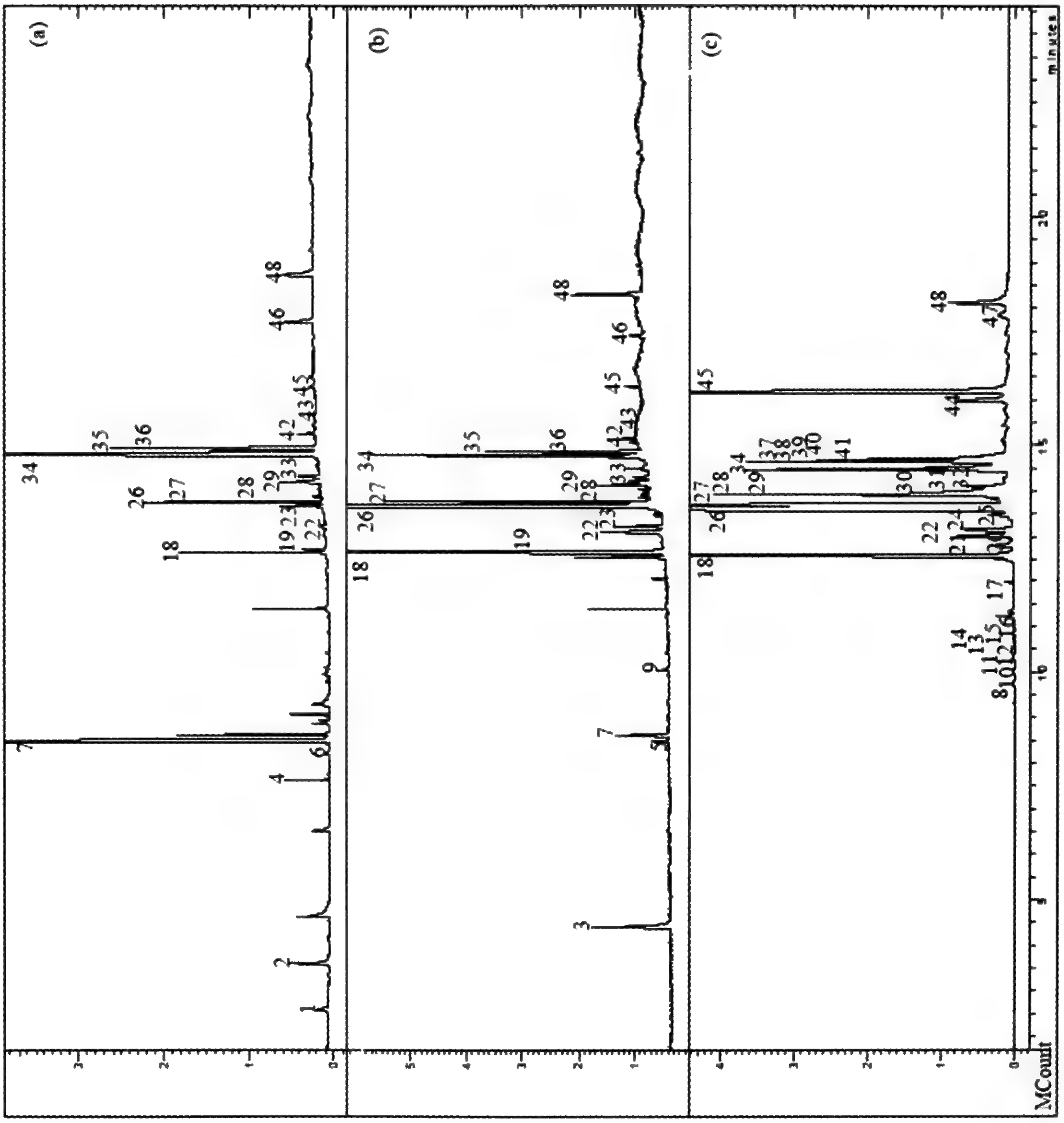


Figure 3. Chemical profiles of *Brachinus sclopeta* (a), *Anchomenus dorsalis* (b), and *Poecilus cupreus* (c).

LITERATURE CITED

Acorn, J. H. 1988. Mimetic tiger beetles and the puzzle of cicindelid coloration (Coleoptera: Cicindelidae). The Coleopterists Bulletin 42(1): 28-33.

Alatalo, R. V. and J. Mappes. 1996. Tracking the evolution of warning signals. Nature 382:708-710.

Aldrich, J. R. and M. S. Blum. 1978. Aposematic aggregation of a bug: the defensive display and formation of aggregations. Biotropica 10: 58-61.

Balsbaugh, E. U. 1967. Possible mimicry between certain Carabidae and Chrysomelidae. The Coleopterists Bulletin 21: 139-140.

Bonacci, T., G. Aloise, P. Brandmayr, and T. Zetto Brandmayr. 2004a. Risposte comportamentali di *Crocidura leucodon* (Hermann, 1780) (Insectivora, Soricidae) ai meccanismi antipredatori di alcuni Artropodi. Hystrix, Italian Journal of Mammalogy (Nova Series, Pavia, Italy) 15(1): 73-76.

Bonacci, T., A. Mazzei, T. Zetto Brandmayr, and P. Brandmayr. 2004b. Aposematic aggregation of carabid beetles (Coleoptera Carabidae): preliminary data. Redia 87: 243-245.

Bonacci, T., A. Massolo, P. Brandmayr, and T. Zetto Brandmayr. 2006. Predatory behaviour on ground beetles (Coleoptera: Carabidae) by *Ocypus olens* (Müller) (Coleoptera: Staphylinidae) under laboratory conditions. Entomological News 117 (5): 545-551.

Burda, H. and Z. Bauerová. 1985. Hearing adaptations and feeding ecology in *Sorex araneus* and *Crocidura suaveolens* (Soricidae). Acta Zoologica Fennica 173: 253-254.

Cassola, F. and A. Vigna Taglianti. 1988. Mimicry in Cicindelini e Graphipterini africani (Coleoptera, Caraboidea). Biogeographia 14: 229-233.

Coppinger, R. P. 1969. The effect of experience and novelty on avian feeding behaviour with reference to the evolution of warning coloration in butterflies. I. Reaction of wild-caught adult blue jays to novel insects. Behaviour 35: 4-60.

Coppinger, R. P. 1970. The effect of experience and novelty on avian feeding behaviour with reference to the evolution of warning coloration in butterflies. II. Reactions of naive bords to novel insects. American Naturalist 104: 323-335.

Cott, H. B. 1940. Adaptive coloration in animals. Oxford University Press. New York, NY, U.S.A. 508 pp.

De Renobales, M. M., Leimare, and G. J. Blomquist. 1991. Cuticular lipids. pp. 240-251. *In*, K. Binnington, and A. Retnakaran (Editors). Physiology of the insect epidermis. CSIRO Publishing Melbourne, Australia. 344 pp.

Edmunds, M. 1974. Defence in animals: a survey of anti-predator defences. Longman Press. Harlow, UK. 357 pp.

Erwin, T. L. 1967. Bombardier beetles (Coleoptera, Carabidae) of North America: Part II. Biology and behaviour of *Brachinus pallidus* Erwin in California. The Coleopterist's Bulletin 21: 41-55.

Fazekas, J. P., F. Kádár, M. Sárospataki, and G. L. Lövei. 1999. Seasonal activity and reproduction in the spring breeding ground beetle species *Agonum dorsale* and *Brachinus explodens* in Hungary (Coleoptera, Carabidae). Entomologia Generalis 23: 259-269.

Fogden, M. and D. Fogden. 1974. Animals and their colors. Crown Publishers, Inc. New York, NY, U.S.A. 172 pp.

Gagliardo, A. and T. Guilford. 1993. Why do warning-colored prey live gregariously? Proceedings of the Royal Society of London B 286(B): 149-150.

Gamberale, G. and B. S. Tullberg. 1998. Aposematic and gregariousness: the combined effect of group size and coloration on signal repellence. Proceedings of the Royal Society of London 265(B): 889-894.

Gamberale, G. and B. S. Tullberg. 1996a. Evidence for a more effective signal in aggregated aposematic prey. Animal Behaviour 52: 597-601.

Gamberale, G. and B. S. Tullberg. 1996b. Evidence for a peak-shift in predator generalization among aposematic prey. Proceedings of the Royal Society of London B 263: 1329-1334.

Gilsan-King, A. and J. Meinwald. 1996. Review of the defence chemistry of Coccinellids. Chemical Reviews 96: 1105-1122.

Gittleman, J. L. and P. H. Harvey. 1980. Why are distasteful prey not cryptic? Nature 286: 149-150.

Good, P. 2000. Permutation tests: a practical guide to resampling methods for testing hypotheses, II. 2nd Edition. Springer Verlag Press. New York, NY, U.S.A. 114 pp.

Guilford, T. 1990. The evolution of aposematism. pp. 23-61 *In*, D. L. Evans and J. O. Schmidt (Editors). Insect Defences. Adaptive Mechanisms and Strategies of Prey and Predators. State University of New York Press. Albany, New York, U.S.A. 350 pp.

Huheey, J. E. 1988. Mathematical models of mimicry. The American Naturalist 131: 22-41.

Ihalainen, E., L. Lindström, and J. Mappes. 2007. Investigating Müllerian mimicry: predator learning and variation in prey defences. Journal of Evolutionary Biology 20 (2): 780-791.

Juliano, S. A. 1984. Multiple feeding and aggression among larvae of *Brachinus lateralis* Dejean (Coleoptera: Carabidae). Coleopterists Bulletin 38: 358-360.

Juliano, S. A. 1985. Habitat associations, resources, and predators of an assemblage of *Brachinus* (Coleoptera: Carabidae) from southeastern Arizona. Canadian Journal of Zoology 63: 1683-1691.

Joron, M. and J. L. B. Mallet. 1998. Diversity in mimicry: paradox or paradigm? Trends in Ecology and Evolution 13(11 SU): 461-466.

Lindroth, C. H. 1971. Disappearance as a protective factor: a supposed case of Batesian mimicry among beetles (Coleoptera: Carabidae and Chrysomelidae). Entomologica Scandinavica 2: 41-48.

Lindroth, C. H. 1986. The Carabidae (Coleoptera) of Fennoscandia and Denmark Fauna. Entomologica Scandinavica, 15, part 2. Scandinavian Science Press Ltd., Copenhagen. 225 pp.

Lockey, K. H. 1988. Lipids of the insects cuticle: origin, composition and function. Comparative Biochemistry and Physiology 89(B): 595-645.

Marples, N. M., W. van Veelen, and P. M. Brakefield. 1994. The relative importance of colour, taste and smell in the protection of an aposematic insect *Coccinella septempunctata*. Animal Behaviour 48(4): 967-974.

Mazzei, A., T. Bonacci, T. Zetto Brandmayr, and P. Brandmayr. 2005. Capacità di aggregazione di Coleotteri geoadefagi, in ambiente ipolitico di suoli argillosi del bioclima mediterraneo arido. Proceedings of XV Congress of the Italian Society of Ecology. Torino, Italy.12-14 September 2005. pp. 1-4.

Mehta, C. R. and N. R. Patel. 1996. SPSS Exact Tests 7.0 for Windows®. Chicago, U.S.A: SPSS Inc. 220 pp.

Moneti, G. , G. Pieraccini, F. Dani, S. Turillazzi, D. Favretto, and P. Traldi. 1997. Ion-molecule reaction of ionic species from acetonitrile with unsaturated hydrocarbons for the identification of the double-bond position using an ion trap. Journal of Mass Spectrometry 32 (12): 1371-1373.

Moore, B. P., W. Vance Brown, and M. Rothschild. 1990. Methylalkylpyrazines in aposematic insects, their hostplants and mimics. Chemoecology 1: 43-51.

Müller, F. 1879. *Ithuna* and *Thyridia*: a remarkable case of mimicry in butterflies. Transaction of the Royal Entomological Society of London. pp. 20-29.

Pasteels, J. M., C. Deroe, B. Tursch, J. C. Braekman, D. Daloze, and C. Hootele. 1973. Distribution et activité des alcaloïdes des coccinelles. Journal of Insect Physiology 19: 1771-1784.

Poulton, E. B. 1890. The colours of animals. their meaning and use. especially considered in the case of insects. Kegal Paul, Trench, Trübner. London, England, UK 688 pp.

Rettenmeyer, C. W. 1970. Insect mimicry. Annual Review of Entomology 15: 43-74.

Riipi, M., R. V. Alatalo, L. Lindström, and J. Mappes. 2001. Multiple benefits of gregariousness cover detectability costs in aposematic aggregations. Nature 413: 512-514.

Roper, T. J. 1994. Conspicuousness of prey retards reversal of learned avoidance. Oikos 69: 115-118.

Roper, T. J. and S. E. Cook. 1989. Responses of chicks to brightly colored insect prey. Behaviour 110: 276-293

Roper, T. J. and N. M. Marples. 1997. Odour and colour as cues for taste-avoidance learning in domestic chicks. Animal Behaviour 53: 1241-1250.

Rothschild, M. and B. Moore. 1987. Pyrazines as alerting signals in toxic plants and insects. pp. 97-107. *In*, V. Laberie, G. Fabres, and D. Lachaise (Editors). Insects-Plants. Dordrecht: W. Junk Holland. 381 pp.

Rowe, C. and T. Guilford. 1999. The evolution of multimodal warning displays. Evolutionary Ecology 13: 655-671.

Saska, P. and A. Honek. 2004. Development of the beetle parasitoids, *Brachinus explodens* and *B. crepitans* (Coleoptera: Carabidae). Journal of Zoology London. 262: 29-36

Schildknecht, H. U. 1961. Die Bombardierkäfer und ihre Explosionschemie. Angewandte Chemie 73(1): 1-7.

Schildknecht, H. U. 1970. Die Wehrchemie von land-und Wasserkäfern. Angewandte Chemie 82(1): 16-25.

Schildknecht, H., U. Maschwitz, and H. Winkler. 1968. Zur Evolution der Carabiden-Wehrdrüsensekrete Über Arthropoden-Abwehrstoffe XXXII. Naturwissenshaften 55: 112-115.

Shorey, H. H. 1973. Behavioral responses to insect pheromones. Annual Review of Entomology 18: 349-380.

Siegel S. and N. J. J. Castellan. 1988. Nonparametric statistics for the behavioral sciences. McGraw-Hill. New York, NY, USA. 399 pp.

Sillén-Tullberg, B. 1985. Higher survival of an aposematic than of a cryptic form of distasteful bug. Oecologia 67: 411-415.

Sillén-Tullberg, B. and E. H. Bryant. 1983. The evolution of aposemtaic coloration in distasteful prey: and individual selection model. Evolution 37: 993-1000.

Skelhorn, J. and C. Rowe. 2005. Tasting the difference: do multiple defence chemicals interact in Müllerian mimicry? Proceedings of the Royal Society of London. 272: 339-345.

Speed, M. and J. R. G. Turner. 1999. Learning and memory in mimicry: II. Do we understand the mimicry spectrum? Biological Journal of the Linnean Society 67: 281-312.

Thiele, H. U. 1977. Carabid beetles in their environments. A study on habitat selection by adaptations in physiology and behaviour. Springer Verlag Press. Berlin, Germany. 369 pp.

Treisman, M. 1975. Predation and the evolution of gregariousness. I. Models for concealment and evasion. Animal Behaviour 23: 779-800.

Turner, J. R. 1987. The evolutionary dynamics of Batesian and Mullerian mimicry: similarities and differences. Ecological Entomology 12: 81-95.

Wautier, V. 1971. Un phénomène social chez les Coléoptères: le grégarisme de *Brachinus* (Caraboidea, Brachinidae). Insectes Sociaux 18: 1-84.

Wickler, W. 1968. Mimicry in plants and animals. Weidenfeld and Nicolson Press. London, England, U.K. 403 pp.

Will, K. W., A. B. Attygalle, and K. Herath. 2000. New defensive chemical data for ground beetles (Coleoptera: Carabidae): interpretations in a phylogenetic framework. Biological Journal of the Linnean Society 71: 459-481.

Zaballos, P. 1985. Paralelismo fenológico en *Brachinus variventris* Schaufuss, 1862 y *Anchomenus dorsalis* (Pontoppidan, 1963). (Coleoptera Carabidae). Actas do II Congresso Ibérico de Entomologia, Lisboa, Ispagna 85-92.

Zanetti, P., F. Dani, S. Destri, D. Fanelli, A. Massolo, G. Moneti, G. Pieraccini, and S. Turillazzi. 2001. Nestmate recognition in *Parischnogaster striatula* (Hymenoptera, Stenogastrinae), visual and olfactory recognition cues. Journal of Insect Physiology 47: 1013-1020.

Zetto Brandmayr, T., F. Bonacci, A. Massolo, and P. Brandmayr. 2006. What is going on between aposematic carabid beetles? The case of *Anchomenus dorsalis* (Pontoppidan 1763) and *Brachinus sclopeta* (Fabricius 1792) (Coleoptera Carabidae). Ethology Ecology and Evolution 18: 335-348.

NEW PECULIAR EASTERN PALAEARCTIC *RHAMPHOMYIA* (DIPTERA: EMPIDIDAE)[1]

Miroslav Barták[2] and Stepán Kubík[2]

ABSTRACT: *Rhamphomyia* (*Pararhamphomyia*) *minutiforceps* sp. n. (Russia, Primorskiy Territory) and *R.* (*P.*) *minutiforcipella* sp. n. (Russia, Amur Province) are described and illustrated.

KEY WORDS: Empididae, *Rhamphomyia*, *Pararhamphomyia*, new species, Russia, East Palaearctic

Rhamphomyia Meigen is a large genus of the family Empididae comprising about 350 described species in the Palaearctic Region (Barták et al., 2007), however, many new species are still awaiting description, especially in South and East parts of this region. All species of the genus are predators, at least in larval stage, and the adults of several species are important pollinators in high mountains and in boreal environments. Studying materials deposited in the Zoological Museum of Moscow State University, we found two peculiar species of *Pararhamphomyia* with very small epandrium and relatively large U-shaped cercus resembling the Neotropical genus *Macrostomus* Wiedemann (redescribed by Rafael and Cumming, 2004). However, both species described below differ in other morphological characters (e.g. wing with well developed axillary lobe, acrostichals present and biserial, etc.).

METHODS

The material studied is deposited in the following collections: CULSP (Czech University of Life Sciences, Prague – former Czech University of Agriculture) and ZMMU (Zoological Museum of Moscow State University).

The genitalia were macerated in 10% KOH (24 hours, room temperature) and stored together with specimens in plastic microvials with glycerine. The morphological terms used here follow those of Merz and Haenni (2000) and Sinclair (2000). Abbreviations: T1l, T2l, T3l = length of fore, mid, hind tibia; B1l, B2l, B3l = length of fore, mid, hind basal tarsomere; B1w, B2w, B3w = width of fore, mid, hind basal tarsomere; M2/D = length of vein M2: greatest length of discal medial cell; M3/Db = length of apical: preapical sections of vein CuA_1; lw: ww = greatest length of wing: greatest width of wing. Ratio of antennal segments = length of first: 2nd: 3rd: style (in 0.01 mm scale). Characters marked with a question mark "?" are unclear (e.g. width of face or frons may be difficult to measure when shrunken, or length of setae when broken, etc.).

---

[1] Received on December 4, 2007. Accepted on December 12, 2007.

[2] Czech University of Life Sciences, Faculty of Agrobiology, Food and Natural Resources, Department of Zoology and Fisheries, 165 21 Praha 6, Suchdol, Czech Republic. E-mail: bartak@af.czu.cz, kubik@af.czu.cz

Mailed on November 12, 2008

SYSTEMATIC ENTOMOLOGY

Rhamphomyia (*Pararhamphomyia*) *minutiforceps* NEW SPECIES

Figures 1-2

Male: Eyes holoptic, facets in ventral half of eye smaller than those in dorsal half. Frons brownish-black, grey microtrichose, setulae absent. Ocellar setae black and fine, half as long as frons, ocellar triangle with 2 pairs of additional rather long setae. Face brownish-black, grey microtrichose, about 0.15 mm broad ventrally and 0.27 mm long, bare. Occiput brownish-black, grey microtrichose, covered with rather long and fine black setae, postocular row distant from eye margin on middle third and absent on ventral third. Both basal antennal segments brown, remaining parts brownish-black, ratio of antennal segments = 8: 9: 29: 9, both basal antennomeres rather short setose (the longest setae about 0.08 mm long). Labrum brown, lustrous, 2/3 as long as head is high. Palpus brown, short, bearing several setae. Gena narrow and microtrichose, clypeus microtrichose. Thorax brownish-black, mesoscutum rather dark brown microtrichose, without stripes, pleura more grey microtrichose. All setae black. Chaetotaxy: 6-8 setae on proepisternum; prosternum bare; proepisternal depression with 1-2 setae; about 30 biserial, fine acrostichals; more than 30 irregularly 3-4 serial dorsocentrals ending in 2-3 scarcely differentiated prescutellars (both acrostichals and dorsocentrals about 0.20 mm long in middle of rows); entire presutural part of mesoscutum covered with dense setae from which neither intrahumerals nor posthumerals are differentiated; postpronotum with 1 long and about 15 slightly shorter setae; 3 notopleurals (many long setae on anterior part of notopleuron); 1 supra-alar, 5-7 setae on prealar area, and several additional setae between supra-alar and prealars; 1 long and 1 small postalars; two pairs of scutellars (1 additional internal pair of small setae present in holotype); laterotergite with black setae. Legs including coxae blackish-brown, microtrichose, black setose. One long and strong seta present in comb at tip of hind tibia. Fore femur with short anteroventral setae, posteroventral setae short on basal part of femur but on apical third nearly as long as femur is deep, dorsal setation short. Fore tibia with uniform posterodorsal setation nearly as long as tibia is deep, dense ventral setae short. Mid femur with anteroventral setae about half as long as femur is deep (only on basal part with several longer setae), posteroventrals short on basal half but on apical half with 1-2 setae slightly longer than femur is deep, dorsal setation short. Mid tibia with 2-3 anterodorsal and 1-2 posterodorsal setae on basal half slightly longer than tibia is deep (and with similar preapical pair), ventrally with anteroventral row of spine-like setae and posteroventral row of setae, those on posteroventral position slightly longer than anteroventrals and slightly longer than tibia is deep. Hind femur with anteroventral setae shorter than femur is deep and with dense posteroventral setation and anterodorsal setae — all of them slightly shorter than femur is deep. Hind tibia rather stout, dorsally with 3-4 setae slightly longer than tibia is deep, ventral setae short except several spinose setae slightly longer than tibia is deep. Basal tarsomeres of all legs thin and short setose, T1l: B1l = 2.3, B1l: B1w = 6.1, T2l: B2l = 2.6, B2l: B2w = 6.0, T3l: B3l

= 2.1, B3l: B3w = 5.8. Wing (Fig. 2) light brownish, stigma brown, veins yellowish-brown, anal vein (A1) absent in apical part. Costal seta present, axillary angle right to slightly acute. M2/D = 1.3, M3/Db = 1.5-1.6, lw: ww = 2.7-2.8. Halter brownish-yellow with brown stem, calypter dark brown with dark fringes. Abdomen brown, microtrichose, with all setae dark. Hind marginal setae on sides of tergites as long as or slightly longer than corresponding segments, discal setae shorter. Dorsum of tergites relatively long setose. Terminalia as in Fig. 1: hypandrium well developed, forming tube-like sheet around basal part of phallus; epandrium triangular, higher than long, firmly attached to cercus; cercus deeply U-shaped, posterior part developed in a form of S-shaped finger-like process; phallus long, slightly swollen basally, narrowly S-shaped medially and with small hook apically. Length of body 4.4 mm (without genitalia), wing 4.8 mm.

Female: Similar to male but with the following exceptions. Eyes broadly dichoptic, dorsalmost facets slightly smaller than ventral ones. Frons 0.17 mm broad and 0.21 mm long, with several rather long setae on each side. Face equally long and broad as frons. Ratio of antennal segments = 12: 7: 26: 9. Ocellar setae strong, longer than frons. Occiput short and sparsely setose, bare in middle part except complete postocular row. Labrum slightly shorter than head is high. Thorax similarly colored and setose as in male, only setae shorter (both acrostichals and dorsocentrals about 0.12 mm long) and less numerous (more strikingly on presutural area laterad of dorsocentrals), 2 pairs of scutellars (no additional pair). Legs including coxae similarly colored as in male, however, differently setose. Fore femur as in male. Fore tibia short setose, with several short but distinct anterodorsal setae. Mid femur with broad pennation dorsally and posteroventrally and with row of short anteroventral setae. Mid tibia with dense but short pennation dorsally, ventrally with row of spine-like setae on basal third of tibia somewhat longer than tibia is deep but shorter apically. Hind femur broadly pennate on both sides, otherwise almost bare. Hind tibia broadly pennate on both sides and with row of posterodorsal setae as long as anterodorsal pennation. Basal tarsomeres of all legs thin and short setose, T1l: B1l = 2.1-2.2, B1l: B1w = 6.7, T2l: B2l = 2.1-2.2, B2l: B2w = 6.2-6.3, T3l: B3l = 2.2, B3l: B3w = 5.3. Wing brown, darker brown on basal part and along costal margin, stigma equally dark, M2/D = 1.2-1.3, M3/Db = 1.4, lw: ww = 2.8. Halter brown, anal vein (A1) almost complete. Abdomen brown, microtrichose, hind marginal setae on sides of tergites 2-4 half as long as their corresponding segments, on tergite 5 1/3 as long as segment, on remaining tergites shorter, discal setae shorter than marginals. Length of body (without genitalia) 4.9 mm, wing 4.6 mm.

Differential Diagnosis: *Rhamphomyia* (*P.*) *minutiforceps* sp. n. belongs to a species-rich group of *Pararhamphomyia* with multiserial dorsocentral setae, dark legs and entirely black setose body. The most allied species is undoubtedly *R. minutiforcipella* sp. n. Both species can be readily distinguished from remaining species of this group by characteristic genitalia (see Remarks, page 341). Female may be distinguished from other species of the above-mentioned group due to dark brown mesoscutum, entirely microtrichose abdomen, brown halter and pennation pattern on legs. *Rhamphomyia minutiforcipella* sp. n. is distinctly smaller than *R. minutiforceps* sp. n. (wing length 3.4-3.7 mm) with yellow halteres, slightly different male genitalia (see figures and discussion under *R. minutiforcipella* sp. n.) and different pennation pattern on the female legs (notably, mid tibia is not pennate in the former species).

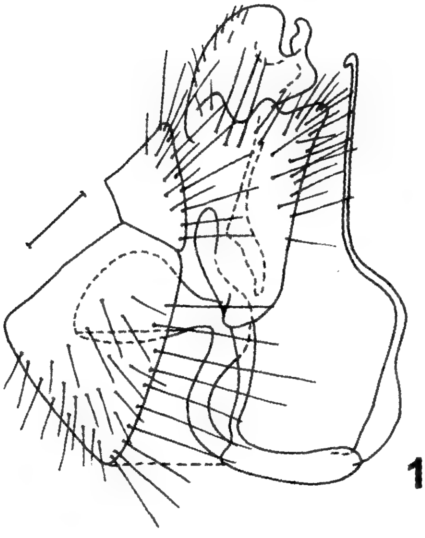
Remarks: The general shape of the epandrium (triangle-shaped and higher than long) and the cercus (bilobate with internal process) is strikingly similar to the Neotropical genus *Macrostomus* (as redescribed and delimited by Rafael and Cumming, 2004). Also the hypandrium is similar (with a dorsal sulcus in which the phallus fits), only shorter. However, both species described here differ from *Macrostomus* in several other morphological characters (e.g. the wing has a well developed axillary lobe, the phallus is long and free, acrostichals are present and biserial, reaching prescutellar depression posteriorly, etc.).

Type Data. Holotype male: Juzhnoje Primorie, Kamenuschka, 15.vi.1984, A. Shatalkin leg. (ZMMU). **Paratypes**: same locality as holotype, 1 female, 13.vi.1984 (CULSP).

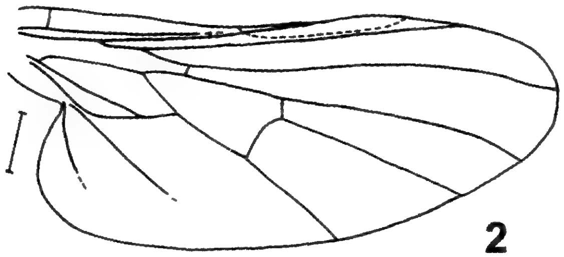
Distribution: Russia (Primorskiy Territory).

Dates of Occurrence: June.

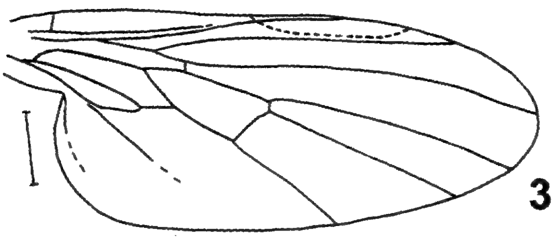
Derivatio Nominis: The species is named after the unusually short epandrium.



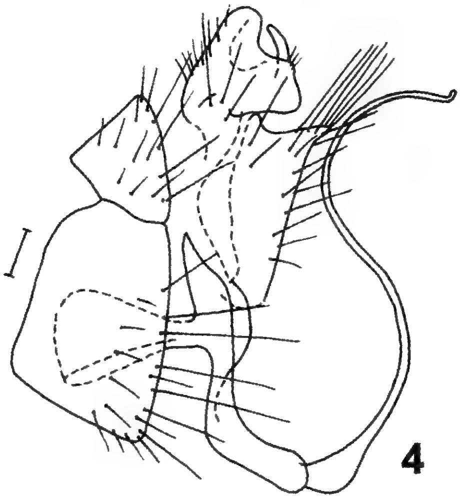
1



2



3



4

Figures 1-2. *Rhamphomyia* (*Pararhamphomyia*) *minutiforceps* sp. n. 1. Male (holotype) terminalia (macerated), lateral view, scale 0.2 mm, 2. Male (holotype) wing. Scale 0.5 mm. Figures 3-4. *R.* (*P.*) *minutiforcipella* sp. n. 3. Male (holotype) wing. Scale 0.5 mm, 4. Male (holotype) terminalia (macerated), lateral view, scale 0.1 mm.

***Rhamphomyia* (*Pararhamphomyia*) *minutiforcipella* NEW SPECIES**

Figures 3-4

Male: Eyes holoptic, facets in ventral half of eye smaller than those in dorsal half. Frons brownish-black, grey microtrichose, lacking setulae. Ocellar setae black and fine, scarcely half as long as frons, ocellar triangle with 2 additional setae. Face brownish-black, grey microtrichose, about 0.13 mm broad ventrally and 0.20 mm long, bare. Occiput brownish-black in ground-colour, brownish-grey microtrichose, covered with rather long and fine black setae, postocular row complete but distant from eye margin on middle third. Both basal antennal segments brown, remaining parts brownish-black, ratio of antennal segments = 6: 7: 20: 8, both basal antennomeres rather short setose (longest setae about 0.06 mm long). Labrum brown, lustrous, 4/5 as long as head is high. Palpus brown, short, with several setae. Gena narrow and microtrichose, clypeus microtrichose. Thorax blackish-brown, mesoscutum brown microtrichose, without stripes, pleura grey microtrichose. All setae black. Chaetotaxy: 4-6 setae on proepisternum; prosternum and proepisternal depression bare; about 18 biserial, fine acrostichals; about 19 irregularly 2-3 serial dorsocentrals ending in 2-3 prescutellars (both acrostichals and dorsocentrals about 0.15 mm long in middle of rows); about 6 setae on presutural part of mesoscutum laterad of dorsocentrals including scarcely differentiated intrahumeral and better differentiated posthumeral; postpronotum with one long and about 8 slightly shorter setae; 3 notopleurals (fore one in unusually forward position and 3-4 rather long setae on anterior part of notopleuron); 1 supra-alar and 3-4 setae on prealar area; 1 long and 1 small postalars; two pairs of scutellars; laterotergite with black setae. Legs including coxae blackish-brown, microtrichose, black setose. One long and strong seta in comb at tip of hind tibia. Fore femur almost lacking anteroventrals, posteroventrals very short on basal part of femur, on apical third slightly shorter than femur is deep, dorsal setation short. Fore tibia with fine setae dorsally nearly as long as tibia is deep, ventral setae short. Mid femur with anteroventral and posteroventral rows of setae shorter than femur is deep (posteroventrals slightly more numerous and stronger than anteroventrals), dorsal setation short. Mid tibia with 2-4 irregularly arranged setae dorsally nearly twice as long as tibia is deep, ventrally with 2 rows of subequally long spine-like setae. Hind femur with row of anteroventral setae short on basal part and somewhat longer on apical part of femur and similar setae arranged in almost regular posterior row longest on basal third of femur and short apically, dorsal setation short. Hind tibia rather stout, with 1-2 anterodorsals and 6-7 posterodorsals slightly longer than tibia is deep, and with anteroventral row of spinose setae on middle part slightly longer than tibia is deep, posteroventrals short and fine. Basal tarsomeres of all legs thin and short setose, those on mid and hind legs with short ventral spines, T1l: B1l = 1.9, B1l: B1w = 8.8, T2l: B2l = 2.8, B2l: B2w = 7.0, T3l: B3l = 2.3, B3l: B3w = 5.5. Wing (Fig. 3) clear, stigma yellowish, veins brownish-yellow, anal vein (A1) incomplete, absent in apical part. Costal seta present, axillary angle right. M2/D =

1.5, M3/Db = 1.9, lw: ww = 2.6-2.7. Halter yellow including stem, calypter brown with dark fringes. Abdomen, including terminalia, brown, microtrichose, only cercus lustrous, all setae dark. Hind marginal setae on sides of tergites 2-4 as long as or longer than corresponding segments, on segment 5 slightly shorter and on segment 6 short, discal setae shorter than marginals. Dorsum of tergites relatively long setose. Terminalia as in Fig. 4: hypandrium as in preceding species; epandrium triangular, higher than long, firmly attached to cercus; cercus U-shaped, posterior part with a nearly straight finger-like process; phallus broadly S-shaped. Length of body 3.1 mm (without genitalia), wing 3.7 mm.

Female: Similar to male but with the following exceptions. Eyes broadly dichoptic, dorsalmost facets slightly smaller than ventral ones. Frons 0.13 mm broad and 0.22 mm long, with several setae on each side. Face subequally long and broad as frons. Ratio of antennal segments = 8: 5: 21: 8. Ocellar setae strong and subequally long as frons. Occiput as in male, without bare median area. Labrum as long as head is high. Thorax similarly colored and setose as in male, thoracic setae almost as long as in male. Legs including coxae similarly colored as in male, however, differently setose. Fore femur and tibia short setose. Mid femur with short anteroventral setae and posteroventral pennation on apical half of femur, dorsal setae short. Mid tibia with 0-1 anterodorsal and posterodorsal setae an middle subequally long as tibia is deep, otherwise short setose. Hind femur with anteroventral setae almost as long as femur is deep and with subequally long posteroventral pennation, dorsally with somewhat shorter pennation arranged in two rows. Hind tibia with short pennation on both sides. Basal tarsomeres as in male, T1l: B1l = 1.9, B1l: B1w = 6.9, T2l: B2l = 2.1-2.2, B2l: B2w = 4.7, T3l: B3l = 2.3-2.4, B3l: B3w = 5.3. Wing brown, stigma equally dark, M2/D = 1.4, M3/Db = 2.3, lw: ww = 2.4. Abdomen brown, microtrichose, hind marginal setae on sides of tergites 2-5 half as long as their corresponding segments, on remaining tergites slightly shorter, discal setae shorter than marginals. Length of body 3.4 mm, wing 3.4-3.7 mm.

Differential Diagnosis: *Rhamphomyia* (*P.*) *minutiforcipella* sp. n. belongs to the same group as the previous species. The most allied species is undoubtedly *R. minutiforceps* sp. n. Both species can be readily distinguished from other species of this group by characteristic genitalia (see note under *R. minutiforceps* sp. n.). The female specimens may be recognized from other species of above-mentioned group due to the leg pennation pattern (the mid femur is pennate only ventrally, the mid tibia is not pennate, both hind femur and tibia pennate on both sides), blackish-brown mesoscutum lacking stripes and microtrichose abdomen. *Rhamphomyia minutiforceps* sp. n. is distinctly larger than *R. minutiforcipella* sp. n. (wing length 4.6-4.8 mm), with darker halteres and different pennation pattern on female legs (especially the mid tibia is shortly pennate dorsally in the former species). There are also slight differences in the terminalia between *R. minutiforceps* sp. n. and *R. minutiforcipella* sp. n.: the 8th sternum in the former species is more densely setose (about 30 discal setae on each side, but only about 15 setae in the latter species), the shape of the phallus is different including the ejaculatory apodeme (compare figures 1 and 4), and an internal finger-like tooth of the cercus is distinctly S-shaped in the former species but nearly straight in the latter species.

Type Data. Holotype male: Russia, Amur region, Zeja, 9.vii.1978, leg. A. Shatalkin (ZMMU). **Paratypes:** same locality as the Holotype, 6.vi.1984, 1 female, leg. A. Shatalkin; same locality, 30.vi.1981, 1 female, leg. A. Shatalkin; same locality, 6.vii.1982, 1 female, leg. A. Ozerov (ZMMU and CULSP).

Distribution: Russia (Amur Province).

Dates of Occurrence: June-July.

Derivatio Nominis: The name of this species stresses its similarity with *R. minutiforceps* sp. n.

ACKNOWLEDGEMENTS

This paper was supported by IRP MSM 6046070901 and NAZV project QH72151 (MZe). The authors thank A. Shatalkin and A. Ozerov (Moscow) for providing valuable specimens for study and Mrs. Drahomíra Bartáková for drawing the illustrations.

LITERATURE CITED

Barták, M., M. C. Çiftçi, and A. Hasbenli. 2007. A new species of *Rhamphomyia* (s. str.) Meigen (Diptera, Empididae) from southern Anatolia, Turkey. Entomological News 118 (2): 143-147.

Merz, B. and J.-P. Haenni. 2000. Morphology and terminology of adult Diptera (pp. 21-51). *In*, L. Papp and B. Darva (Editors). Contributions to a Manual of Palaearctic Diptera. Volume 1. Science Herald, Budapest, Romania. 978 pp.

Rafael, J. A. and J. M. Cumming. 2004. The Neotropical genera *Macrostomus* Wiedemann and *Porphyrochroa* Melander (Diptera, Empididae, Empidinae). Revista Brasileira de Zoologia 21 (3): 439-448.

Sinclair, B. 2000. Morphology and terminology of Diptera male terminalia (pp. 53-74). *In*, L. Papp and B. Darva (Editors). Contributions to a Manual of Palaearctic Diptera. Volume 1. Science Herald, Budapest. 978 pp.

ERRATUM

The actual mailing date for *Entomological News* Vol. 119 Number 3 (May-June 2008) was June 24, 2008 not June 23, 2008 as it was printed on the publication. The Editor deeply regrets this delay.

THREE NEW SPECIES OF *PSEUDACHORUTES* (COLLEMBOLA: NEANURIDAE: PSEUDACHORUTINI) FROM CHINA[1]

Yan Gao,[2] Wen-Ying Yin,[2] and José G. Palacios-Vargas[3]

ABSTRACT: The genus *Pseudachorutes* is recorded for the first time from China, with three new species: *P. lishanensis*, *P. jianxiucheni* and *P. wandae*, all of them are from LiShan Mountain, Shaan Xi Province, Northwest China. *Pseudachorutes lishanensis* n. sp. is easy to distinguish, having two kinds of setae (macrosetae and microsetae) and mandible with three teeth. *Pseudachorutes jianxiucheni* n. sp. has 11-15 vesicles in the postantennal organ, mandible with 4-5 teeth, a relatively small body size, and tenent hair on tibiotarsi. *Pseudachorutes wandae* n. sp. has minute body setae and long sensorial setae; postantennal organ composed of 16-18 simple vesicles, and very small size. The new taxa are described and illustrated.

KEY WORDS: Collembola, Neanuridae, Pseudachorutini, taxonomy, China

Pseudachorutes is a large genus with 94 species described all over the world (Christiansen and Bellinger, 1998; Fjellberg, 1998), but none have been recorded from China before (Zhao et al., 1997). During our ongoing study on the biodiversity of North-West China, we collected three new species from LiShan Mountain, Shaan Xi province which are described in this paper.

All specimens studied for this contribution are deposited at the Insect Specimen Gallery, Institute of Plant Physiology and Ecology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences. Abbreviations used in this paper are: Ant. = antennal segment; Abd. = abdominal segment; PAO = postantennal organ; sgd = dorsal guard sensillum; sgv = ventral guard sensillum; Th. = thoracic segment.

SYSTEMATIC ENTOMOLOGY

Pseudachorutes lishanensis NEW SPECIES

Figs. 1-10

Material Examined: Holotype: male mounted specimen, Northwest China, Shaanxi Province, LiShan Mountain, 100 m altitude, litter-rich soil in forest, 7 /VI / 2006, Yun-Xia Luan, Yun Bo, Yan Gao leg. Paratypes: 2 pre-adult females, 1 male and 4 juvenile mounted specimens, same data as Holotype.

Description: Body length (n=8): 845 µm (range: 780-1000µm). Body color dark gray. Granulations big and homogenous. Body setae simple and smooth, but with two kinds of setae, long macrosetae (42 – 62 µm) and short microsetae (12 – 25 µm), the sensorial setae relatively short (25 – 30 µm, Fig. 1).

---

[1] Received on October 24, 2007. Accepted on December 14, 2007.

[2] Institute of Plant Physiology and Ecology, Shanghai Institutes for Biological Sciences. Shanghai Fenglin Road 300, Shanghai, 200032 China. E-mail: yangao@sibs.ac.cn, wyyin@sibs.ac.cn

[3] Laboratorio de Ecología y Sistemática de Microartrópodos, Departamento de Ecología y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México 04510 México, Distrito Federal. E-mail: jgpv@hp.fciencias.unam.mx

Mailed on November 12, 2008

Antennae 0.75 as long as head. Antennal segment I with 7 setae, antennal segment II with 12 setae. Antennal segments III and IV fused dorsally. Antennal segments ratio I: II: III+IV as 1: 1: 2. Antennal III-organ with two small straight internal sensilla covered by a cuticular fold, two guard sensilla (the sgv is about 1.5 times as long as sgd) and one microsensillum close to ventral guard sensillum. Ant. IV with trilobed apical bulb, six cylindrical sensilla, seta "i", subapical organite (Fig. 2-3), ventral file poorly developed (Fig. 3).

Postantennal organ elliptical composed of 8-12 simple vesicles, 1.1 times larger than nearest ocelli (Figs. 7). Eye patch with 8+8 small ocelli (Fig. 7), F, G 0.9 times smaller than others.

Buccal cone elongated. Mandible with three slender teeth (Fig. 6). Maxilla styliform, with two blades, one of which has an apical tooth (Fig. 5). Labium with normal chaetotaxy of the genus with setae A-G and three lateral setae, 1+1 setae L on a small tubercle (Fig. 4).

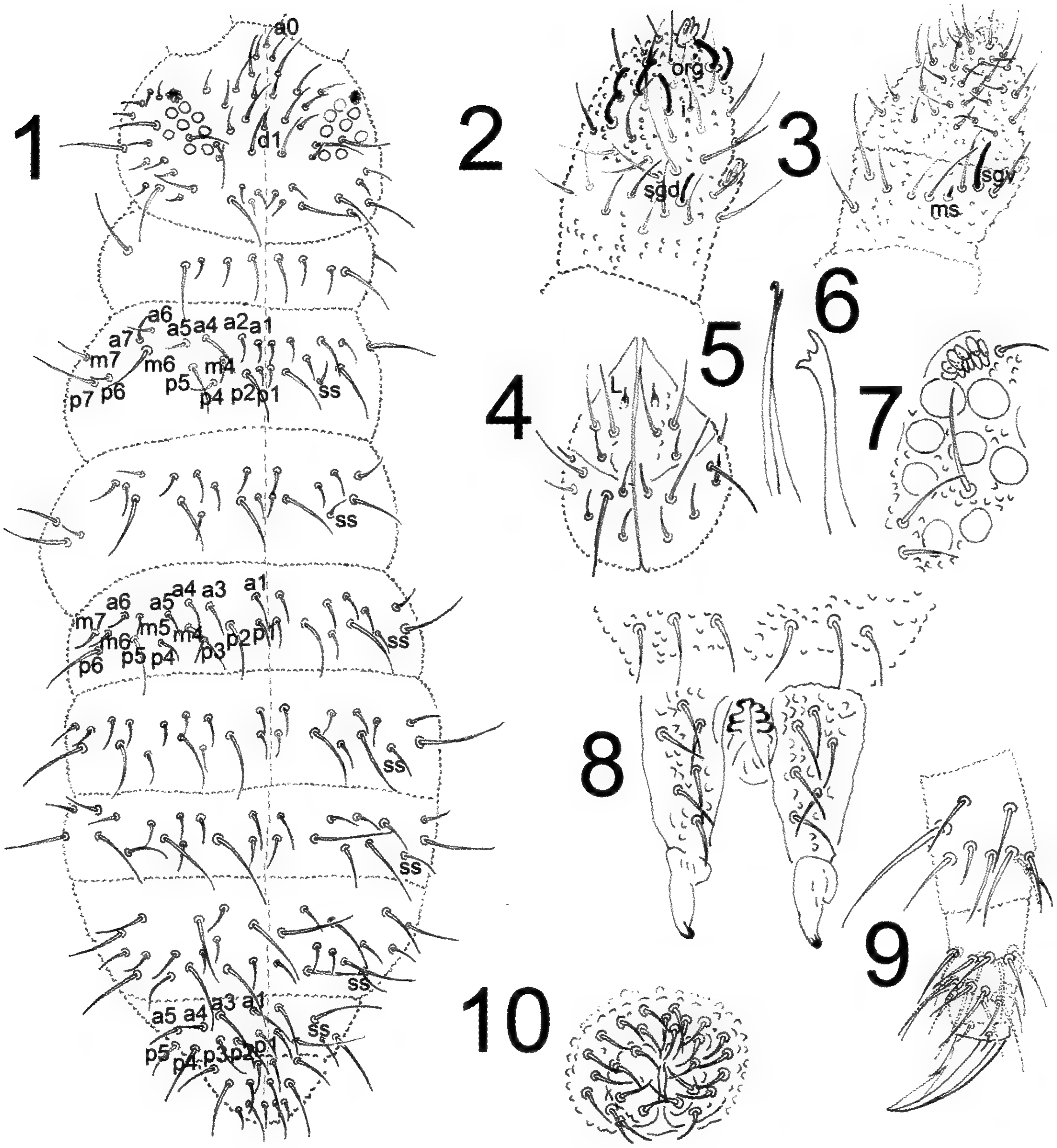
Dorsal chaetotaxy as in Fig. 1. Seta a0 on the head present, unpaired seta d1 present. Th. I with 4+4 dorsal setae and one on each subcoxa 1. Setae a2 present on Th. II, but absent from Th. III to Abd. V. Setae m4 and a6 present. Sensory setae s on the body in position of p4 and m7 on Th. II and Th. III, p4 from Abd. I to IV and p3 on Abd. V. Sensorial formula of the body 022/11111. Sensory setae s subequal to ordinary short setae, but more slender. Ratio of largest Abd. V setae to inner unguis length is 2.0. Thoracic sterna without setae. Ventral tube with 4+4 setae on the body. Male genital plate with 3+3 pregenital setae, 18-21 circumgenital setae and 4+4 eugenital setae (Fig. 10).

Tibiotarsi I, II, III with 19, 19, 18 setae respectively, without tenent hairs. Unguis wide with one inner tooth near basal 1/3, and a weak lateral tooth. Ratio of tibiotarsus III to unguis about 1.1. Unguiculus absent (Fig. 9). Femur I, II, III with 11, 11, 10 setae respectively. Trochanters with five setae each. Coxae I, II, III with 3, 7, 7 setae respectively. Subcoxae 2. I, II, III with 0, 3, 3 setae respectively. Subcoxae 1. I, II, III with 1, 3, 3 setae respectively.

Furcula well developed. Dens dorsally with six setae and strong granulation. Mucro as half as dens length, boat-shaped, with a large badal bladder-like swelling visible and a hook-like tip (Fig. 8). Tenaculum with 3+3 teeth (Fig. 8).

Remarks: This new species resembles *P. conicus* Lee and Kim, 1994, by its heterochaetosis, mandible with three teeth, dens with six setae and tenaculum with 3+3 teeth. *P. chazeaui* Najt and Weiner, 1991 and *P. longisetis* Yosii, 1961 also have such characters as mandible with three teeth, dens with six setae and tenaculum with 3+3 teeth. Main differences between them can be seen in Table 1. In addition, *P. conicus* has a very long and thin unguis, but in *P. lishanensis* n. sp. it is short and thick.

Etymology: The name of the new species is after the type locality: LiShan Mountain from China.



Figs. 1-10. *Pseudachorutes lishanensis* n. sp.: 1. Dorsal chaetotaxy. 2. Antennal segments III-IV of right antenna, dorsal view. 3. Antennal segments III-IV of right antenna, ventral view. 4. Labium. 5. Maxilla. 6. Mandible. 7. Ocular area and postantennal organ, right. 8. Furcula and tenaculum. 9. Femur and Tibotarsus III. 10. Male genital plate.

Table 1. Main differences between *P. lishanensis* n. sp. and similar species

Characters	*P. conicus*	*P. lishanensis* n. sp.	*P. chazeaui*	*P. longisetis*
Labium setae L	-	+	+	?
Ant. IV sensilla	7	6	7	6
PAO vesicles number	13-15	8-12	13-17	10
Ventral tube setae	3+3	4+4	4+4	?
Maxilla lamellae	3	2	2	1
Lateral unguis tooth	-	1	3	-

Pseudachorutes jianxiucheni NEW SPECIES

Figs. 11-20

Material Examined: Holotype: female mounted specimen, from Northwest China, Shaanxi Province, LiShan Mountain, 100 m altitude, litter-rich soil in forest, 7 /VI / 2006, Yun-Xia Luan, Yun Bo, Yan Gao Leg. Paratypes: 2 females, 2 males and 8 juveniles mounted specimens, same data as Holotype.

Description: Body length (n=13): 820 µm (range: 650-1050 µm). Body color dark gray. Granulation homogenous. Body setae short and smooth (12 – 17 µm), longer on Abd. VI (25 µm). Sensorial setae about 25 µm.

Antennae 0.8 times head length. Ant. I with seven setae, Ant. II with 12 setae. Ant. III and IV dorsally fused. Antennal segments ratio I: II: III+IV as 1: 1: 2. Ant. III-organ with two curved microsensilla covered by a cuticular fold, two large guard sensilla (the sgv is about 1.3 times as long as sgd), and 1 microsensillum close to the ventral guard sensillum (Figs.12-13). Ant. IV with trilobed apical bulb, 6 cylindrical sensilla, seta “i”, dorsoexternal microsensillum and one subapical organite. Ventral “file” with 10-15 straight short setae (Fig. 12-13).

Postantennal organ elliptical composed of 11-15 simple vesicles, 1.3 times larger than nearest ocelli. Eye patch with 8+8 small ocelli, F, G are 0.9 times smaller than others.

Buccal cone elongated. Mandible with four teeth (Fig. 14). Maxilla styliform, with two blades, one of which carries two apical teeth (Fig. 15). Labium with typical genus chaetotaxy of the genus with setae A-G and three lateral setae, Setae L1+1, straight, short and without tubercle (Fig. 16).

Dorsal chaetotaxy as in Fig. 11. Seta a0 on the head present, unpaired seta d1 present. Th. I with 5+5 dorsal setae and one seta on each subcoxa 1. Setae a2 present on the Th. II, but absent from Th. III to Abd. V. Sensory setae on the body in position of p4 and m6 on the Th. II and III, and p4 from Abd. I to IV and p2 on Abd. V. Sensorial formula of the body 022/11111. Sensorial setae 1.5-2.5 times longer than short ordinary setae. Ratio of the largest Abd. V seta to inner unguis length is 0.5. Thoracic sterna without setae. Ventral tube with 4+4 setae on the body. Male genital plate with 3+3 pregenital setae, eight circumgenital setae and 4+4 eugenital setae (Fig. 19). Female genital plate with 3+3 pregenital, 10 circumgenital and 1+1 eugenital setae (Fig. 20).

Tibiotarsi I, II, III with 19, 19, 18 setae respectively, with one acuminate dorsal tenent hair. Unguis with one inner tooth at 1/3 from the basal part. Unguiculus absent (Fig. 18). Femur I, II, III with 11, 11, 10 setae respectively. Trochanters with five setae each. Coxae I, II, III with 3, 7, 7 setae respectively. Subcoxae 2. I, II, III with 0, 2, 2 setae respectively. Subcoxae 1. I, II, III with 1, 3, 3 setae respectively.

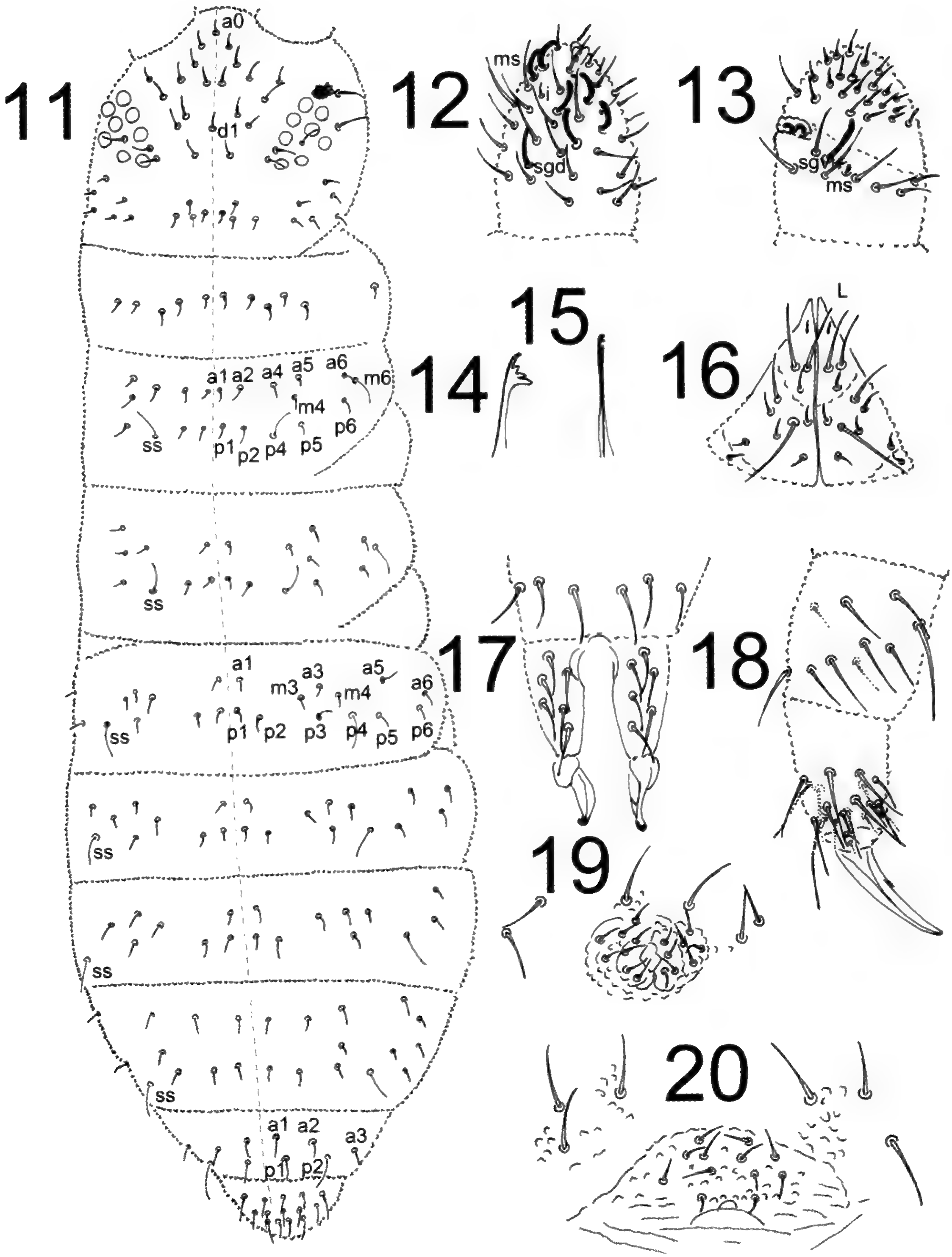
Furcula well developed. Dens with six dorsal setae. Mucro half of the dens, boat-shaped, with two long basal bladder-like swellings and a hook-like tip (Fig. 17). Tenaculum with 3+3 teeth.

Remarks: *Pseudachorutes jianxiucheni* n. sp. resembles *P. isawaensis* Tamura, 2001, *P. simplex* Maynard. 1951 and *P. subcrassoides* Mills, 1934 (Stach, 1949), all of them with 11-15 vesicles in the PAO and mandible with 4-5 teeth. However, we can see the differences among them in Table 2.

Etymology: The new species is dedicated to Dr. Jian-Xiu Chen, Nanjing University, China for his contribution to Chinese Collembola.

Table 2. Characters distinguishing *P. jianxiucheni* n. sp. and similar species

Characters	*P. isawaensis*	*P. simplex*	*P. jianxiucheni* n. sp.	*P. subcrassoides*
Maximum size	1.6	2.2	1.05	1.8
Distal labium setae	3+1 L seta	?	3+1 L seta	4
Ratio dens - mucro	1.7	1.5	2	2
Setae of ventral file on Ant. IV	-	20-30	10-15	-
Maxilla lamellae	1	1	2	?
Ant. IV sensilla	5	6	6	5
Tenent hair	-	-	+	-
Mucro form	Bladder-like basal swelling	Bladder-like basal swelling	Bladder-like basal swelling	Broadly lamellate



Figs. 11-20. *Pseudachorutes jianxiucheni* n. sp.: 11. Dorsal chaetotaxy. 12. Left antennal segments III-IV, dorsal view. 13. Left antennal segments III-IV, ventral view. 14. Mandible. 15. Maxilla. 16. Labium, 17. Furcula, 18. Femur and Tibotarsus III. 19. Male genital plate. 20. Female genital plate.

Pseudachorutes wandae NEW SPECIES

Figs. 21-29

Material Examined: Holotype: female on slide, Northwest China, Shaanxi Province, LiShan Mountain, 100 m altitude, litter-rich soil in forest, 7 /VI / 2006, Yun-Xia Luan, Yun Bo, Yan Gao leg. Paratypes: 1 female mounted specimen, same data as holotype.

Description: Body length (n=2): 950-1400 μm. Color of the body dark blue. Granulation homogenous. Body setae simple, very small (about 10 μm) and smooth, sensorial setae (55 – 75 μm) 5.5-7.5 times as long as the ordinary setae (Fig. 21). On Abd. VI setae are longer (17 – 25 μm). Postlabial setae (30 μm) and all ventral setae (50 μm) longer than dorsal setae.

Antennae 0.7 times headlength. Ant. I with seven setae, Ant. II with 12 setae. Antennal segments III and IV dorsally fused. Antennal segments ratio I: II: III+IV as 1.5: 2: 3. Antennal III organ with two internal curved microsensilla in a cuticular fold, two larger straight guard sensilla (the sgv is about 1.2 times as long as sgd), and one microsensillum close to ventral guard sensilla (Fig. 22-23). Antennal segment IV with trilobed apical bulb, six cylindrical sensilla seta “i”, microsensillum, one small sensorial pit (Fig. 23), without ventral file (Fig. 22). Postantennal organ with 16-18 simple vesicles arranged in an ellipse, 2.5 times larger than nearest ocelli. Eye patch with 8+8 small ocelli (Fig. 21), F, G slightly smaller than others.

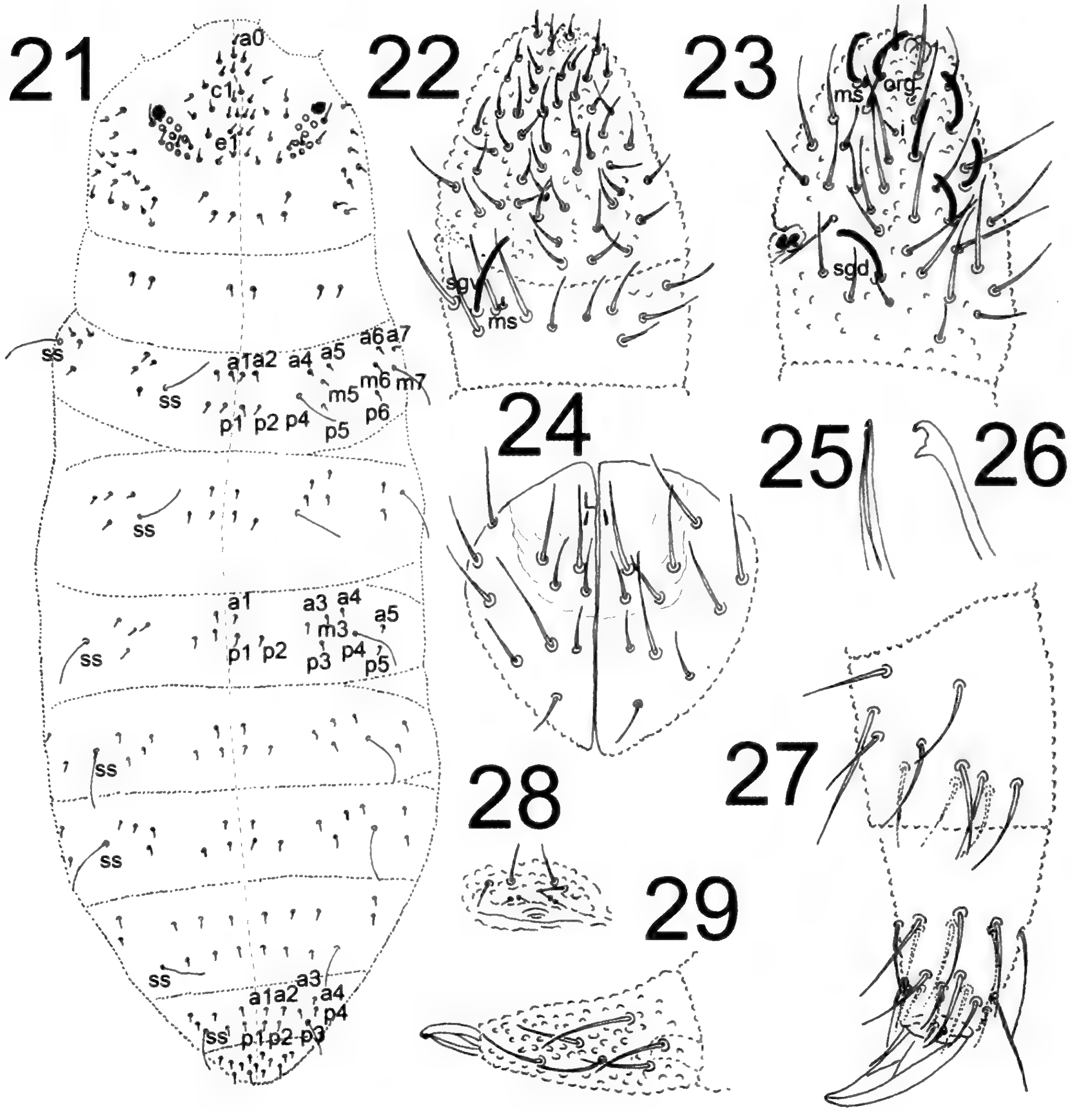
Buccal cone short. Maxilla styliform, with two blades, one with an apical tooth (Fig. 25), Mandible with two large teeth (Fig. 26). Labium with 4+4 distal and 7+7 proximal setae, Setae L small, spine-like (Fig. 24).

Dorsal chaetotaxy as in Fig. 21. Seta a0 on the head present, unpaired seta a1, b1, c1, e1 present. Th. I with 3+3 setae and one on subcoxa 1. Setae a2 present on the Th. II, but absent from Th. III to Abd. III. Sensory setae on the body in position of p4 and m7 on Th. II and III, p4 from Abd. I to IV and p3 on Abd. V. Sensorial formula of the body 022/11111. Sensorial setae 5.5-7.5 times as long as ordinary setae. Ratio of the largest Abd. V setae to inner unguis length is 0.3-0.4. Thoracic sterna without setae, ventral tube with 4+4 setae. Female genital plate with 2+2 circumgenital setae and 1+1 eugenital setae (Fig. 28).

Tibiotarsi I, II, III with 19, 19, 18 setae respectively, without special tenent hair. Claws with one inner tooth on the middle of the claw. Unguiculus absent (Fig. 27). Femur I, II, III with 11, 11, 10 setae respectively. Trochanters with five setae each. Coxae I, II, III with 3, 7, 8 setae respectively. Subcoxae 2. I, II, III with 0, 2, 2 setae respectively. Subcoxae 1. I, II, III with 1, 2, 2 setae respectively.

Furcula well developed. Dens with strong granulation and six dorsal setae, one of them outstanding. Mucro 1/4 the length of the dens, straight, without bladderliker swelling (Fig. 29). Tenaculum with 3+3 teeth.

Etymology: This species is dedicated to Dr. Wanda Weiner, from the Institute of Systematics and Evolution of Animals Polish Academy of Sciences, Krakow, Poland, for her contribution to poduromorph Collembola.



Figs. 21-29. *Pseudachorutes wandae* n. sp.: 21. Dorsal chaetotaxy. 22. Left antennal segments III-IV, ventral view. 23. Left antennal segments III-IV, dorsal view. 24. Labium. 25. Maxilla. 26. Mandible. 27. Tibiotarsus and Femur II. 28. Female genital plate. 29. Furcula.

Remarks: *P. wandae* n. sp. is similar to *P. andrei* Weiner and Najt, 1985 in having very small tergal microsetae. They also share the similar number of PAO vesicles, the PAO/eye ratio and the number of Ant. IV sensillae. The new species is smaller (1.25 to 1.4 mm) than *P. andrei* (1.75 – 1.85 mm). Even though both species have very short body setae, in *P. andrei* the sensorial setae are 3.5 – 4.0 times as long as ordinary setae, whereas in *P. wandae* n. sp. they are from 5.5. to 7.5 times longer. The labium in the new species has 1+1 small spine-like setae L which *P. andrei* lacks. Th. I has 3+3 setae in the new species and 4+4 in *P. andrei*.

ACKNOWLEDGMENTS

Professors Byung-Hoon Lee and Jian-Xiu Chen provided many helpful suggestions and original literature. Drs. Yun-Xia LUAN and Yun BU gave their help in our research. This study is supported by the National Natural Sciences Foundation of China (No. 30630010 and 30570210). Dr. Kenneth Christiansen (Grinnell College, Grinnell, Iowa, USA) reviewed the manuscript and gave criticism, Dr. Wanda Maria Weiner (Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Krakow, Poland) also reviewed the manuscript and checked the type material of *P. andrei* to compare with the new species. This contribution was done thanks to the international exchange between Universidad Nacional Autónoma de México and the Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences.

LITERATURE CITED

Christiansen, K. A. and P. Bellinger. 1998. The Collembola of North America North of the Rio Grande, a taxonomic analysis. Grinnell College, Iowa, U.S.A. 1520 pp.

Fjellberg, A. 1998. The Collembola of Fennoscandia and Denmark, Part I: Poduromorpha, Fauna Entomologica Scandinavica. 35: 1-184.

Lee, B. H. and J. T. Kim. 1984. Eight New Species of Korean Pseudachorutinae (Neanuridae, Collembola). The Korean Journal of Entomology 14 (1): 13-23.

Maynard, E. A. 1951. A monograph of the Collembola or springtail insects of New York State. Comstock Publishing Company Inc., Ithaca, New York, U.S.A. 339 pp.

Najt, J. and W. M. Weiner. 1991. Collembola Poduromorpha épiédaphiques de la Réserve de la Rivière Bleue, Nouvelle-Calédonie., Bulletin du Museum National d'Histoire Naturelle, Paris, France. 4 (13): Section A, n° 1-2, pp. 97-112.

Stach, J. 1949. The Apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Families: Anuridae and Pseudachorutidae. Kraków, Poland. pp. 1-122.

Tamura, H. 2001. Collembola of the central region of the Ou Mountains, northeast Japan. I. Two new species of the genus *Pseudachorutes* from Mt. Yakeishi (Collembola: Hypogastruridae). Natural History Bulletin of Ibaraki University, Ibaraki Prefecture, Japan. 5: 23-26.

Weiner, W. M. and J. Najt. 1985. Collemboles de Corée du Nord. IV. Brachystomellinae, Frieseinae et Pseudachorutinae ad partem, Acta Zoologica Cracoviensia. 28 (6): 245-276.

Zhao, L. J., H. Tamura, and X. Ke. 1997. Tentative checklist of Collembolan species from China (Insecta). Publication of Itako Hydrobiological Station Ibaraki University, Ibaraki Prefecture, Japan. 9: 15-40.

DESCRIPTION OF THE IMMATURE STAGES OF *EURYTOMA SIVINSKII* GATES AND GRISSELL (HYMENOPTERA: EURYTOMIDAE), AN ECTOPARASITOID OF *ANASTREPHA* (DIPTERA: TEPHRITIDAE) PUPAE IN MEXICO[1]

M. Gates[2] **J. Mena Correa,**[3] **J. Sivinski,**[4] **R. Ramírez-Romero,**[3]
G. Córdova-García,[3] **and M. Aluja**[3]

ABSTRACT: We describe and illustrate for the first time the egg, larva, and pupa of *Eurytoma sivinskii* Gates and Grissell (Hymenoptera: Eurytomidae), a parasitoid that attacks *Anastrepha obliqua* (Macquart) pupae in Veracruz, Mexico. We obtained the immature stages of *E. sivinskii* using lab-reared *A. ludens* (Loew) pupae as hosts.

KEYWORDS: *Eurytoma*, Eurytomidae, ectoparasitoid, *Anastrepha*, Tephritidae

Eurytoma Illiger is remarkably diverse, both in number of species and the wide range of hosts utilized (Noyes 2003). Of approximately 700 nominal species worldwide, 204 are known from the New World, with 84 known from the Neotropical Region (Noyes 2003). Only 28 Neotropical species have documented hosts and only 3 of those species are known to attack Tephritidae (Gates and Grissell 2004). In North America, *Eurytoma gigantea* Walsh attacks *Eurosta solidaginis* (Fitch), a gall former in stems of *Solidago* spp. (Asteraceae), and at least seven other *Eurytoma* species are known from Tephritidae (Bugbee 1967, Noyes 2003). Most of these species that attack Tephritidae parasitize larvae in above-ground situations, often in flower heads or galls of Asteraceae (Bugbee 1967, 1975; Claridge 1961; Goeden 2001a,b; Peck 1963).

Eurytoma sivinskii Gates and Grissell (Hymenoptera: Eurytomidae) is a recently described parasitoid (Gates and Grissell 2004) discovered in *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae) puparia whose larvae developed in tropical plum fruit, *Spondias mombin* L. (Anacardiaceae), in Tejería, Veracruz, Mexico.

METHODS

Specimens used in this study originated from a colony maintained at Unidad de Entomología Aplicada of the Instituto de Ecología A. C., Xalapa, Veracruz, Mexico. Environmental conditions were maintained at 27 ± 2°C, 75 ± 5 % RH, and 12:12 h

---

[1] Received on December 30, 2007. Accepted on February 25, 2008.

[2] Systematic Entomology Laboratory, PSI, ARS, USDA, c/o Smithsonian Institution, MRC-168, P.O. Box 37012, Washington, District of Columbia 20013-7012 U.S.A; E-mail: michael.gates@ars.usda.gov.

[3] Instituto de Ecología, A. C., Apartado Postal 63, 91000 Xalapa, Veracruz, México. E-mails: (JMC) jackiemec@yahoo.com.mx, (RRR) rramireze@cucba.udg.mx, (GCG) azolla29@yahoo.com, (MA) martin.aluja@inecol.edu.mx, respectively.

[4] Center for Medical, Agricultural and Veterinary Entomology, USDA-ARS, P.O. Box 14565, Gainesville, Florida 32604 U.S.A. E-mail: john.sivinski@ars.usda.gov.

Mailed on November 12, 2008.

photoperiod. The colony was established with specimens originally reared from *Anastrepha obliqua* (Macquart) pupae collected as larvae from tropical plum (*Spondias mombin*) in November 1997 at Tejería, Veracruz, Mexico.

To rear the parasitoids, we exposed 300 ml of two-day-old, laboratory-reared *A. ludens* pupae to three *E. sivinskii* cohorts kept in 30" x 30" x 30" Plexiglas cages (200 females and 100 males per cage; fed *ad libitum* with honey and water) for 6-8 days. Twenty-four hours after exposure to parasitoids, pupae were removed and placed in plastic vials (500 ml) with humidified vermiculite and covered with a lid. We made a randomized selection of pupae and dissected them one by one until obtaining a total of 26 eggs, 169 larvae (all stages represented), 40 prepupae, and 127 pupae. The specimens were placed in recently prepared Carnoy's fixing solution (60 ml of absolute alcohol, 30 ml of chloroform and 10 ml of acetic acid) for 24 hr. Subsequently, the specimens were washed and preserved in hermetic glass in 70% EtOH until needed. Another set of fly pupae was dissected systematically at 24-hr intervals for 23 days (start of *E. sivinskii* adult emergence) and preserved as above. Dissections were made in a physiological solution to minimize tissue contraction.

We used two different microscopy techniques to study corporal structures: a scanning electron microscope (SEM) and a stereomicroscope with attached Nikon Eclipse 50i camera. The stereomicroscope (1.6X main objective) set up along with Image Pro-plus® software was used to obtain images of specimens fixed with Carnoy's and preserved in 70% EtOH. Specimens were imaged and measured in 70% EtOH. Some specimens preserved in 70% EtOH were dyed with chlorazol black, using lactofenol as a support medium to enhance visualization of some structures. Specimens neither fixed nor dyed but preserved in ethanol were dehydrated through 100% ethanol and HMDS (Heraty and Hawks 1998) before point, SEM stub or card mounting. A Nikon SMZ1500 stereomicroscope with 10X (Nikon C-W10X/22) and Chiu Technical Corp. Lumina 1 FO-150 fiber optic light source were used for card- and point-mounted specimen observation. Mylar film was placed over the ends of the light source to reduce glare from the specimen. Scanning electron microscope (SEM) images were taken with an Amray 1810 (LaB_6 source). Specimens were cleaned of external debris with bleach and distilled water after Bolte (1996), dehydrated with HMDS, and affixed to 12.7 X 3.2 mm Leica/Cambridge aluminum SEM stubs with carbon adhesive tabs (Electron Microscopy Sciences, #77825-12). Stub-mounted specimens were sputter coated using a Cressington Scientific 108 Auto with a gold-palladium mixture from at least three different angles to ensure complete coverage (~20-30nm coating).

Measurements recorded for each include body length and width plus cephalic width. Descriptions for 1st-4th instars report basic measurements and qualitative observations while that of the 5th instar also includes chaetotaxy. This is done in accordance with previously published larval descriptions that focus primarily on the morphology of final instars, especially when comparing to conspecific taxa or differentiating genera (Phillips 1927, Plaut 1972, Roskam 1982, Henneicke et al., 1992, Dawah and Rohfritz 1996, Tormos et al., 2004). Larval chaetotaxy follows Roskam (1982) and Henneicke et al. (1992). The mandible is referred to as "Type

2" (Henneicke et al., 1992), overall elongate and slender, with a main apical tooth subtended by a smaller tooth approximately one-third the size of the former. The following abbreviations are used in the descriptions: A1-9 = abdominal segments; an = antennae; AS = anal segment; CI = clypeal seta; Di = inferior dorsal setae; Ds = superior dorsal setae; DT = dorsal terminal seta; Fi = inferior frontal setae; Fs = superior frontal setae; Ge = genal setae; Hy = hypostomal setae; L = lateral seta; La = labral setae; P = pleural setae; prls = lateral prelabial setae; prms = middle prelabial setae; TH1-3 = thoracic segments; ulc = under lip complex; V = ventral setae; VT = ventral terminal setae.

SYSTEMATIC ENTOMOLOGY

DESCRIPTION OF THE IMMATURE STAGES

Egg (n = 26). White, oval (0.402 ± 0.08 mm long; range: 0.371-0.416 mm), with two pedicels, one at each pole, one pedicel longer (0.180 ± 0.03 mm; range: 0.163-0.204 mm) than other (0.042 ± 0.02 mm; range: 0.028-0.056 mm). Chorion spinose (Fig. 7), the spines darkening over time.

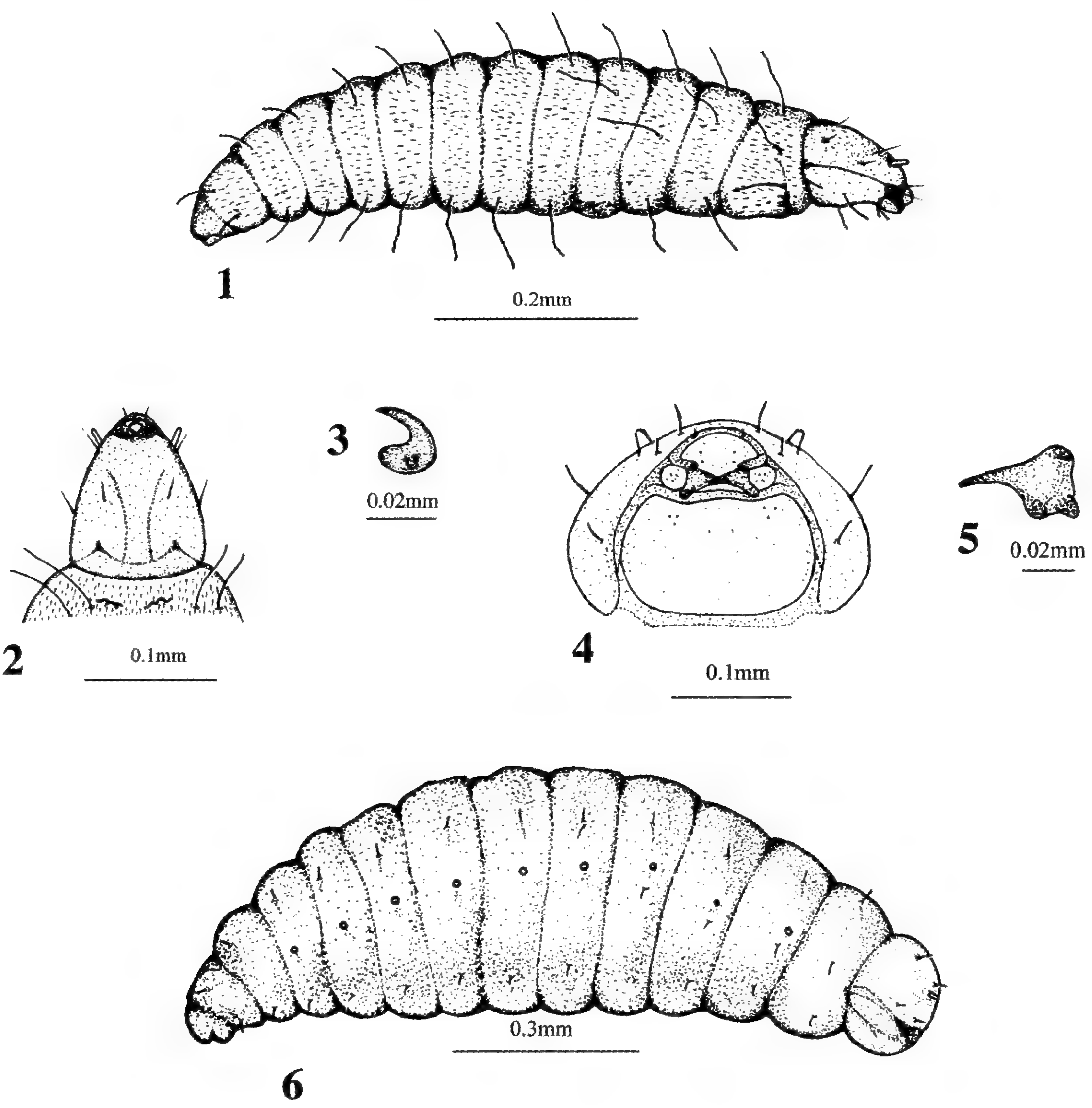
First instar (n = 29). White, 13-segmented plus the head (0.669 ± 0.10 mm long; range: 0.532-0.725 mm; 0.175 ± 0.04 mm wide; range: 0.137-0.201 mm). Head hypognathous, triangular in dorsal view (0.100 ± 0.02 mm wide; range: 0.094-0.104 mm) (Fig. 2); mandible falcate (Fig. 3).

Second instar (n = 33). White, 13-segmented plus the head, slightly dorsoventrally flattened (Fig. 1) (1.289 ± 0.42 mm long; range: 0.871-1.825; 0.430 ± 0.17 mm wide; range: 0.289-0.681) (Fig. 6). Head ovate to pentagonal (0.218 ± 0.07 mm wide; range: 0.139-0.299), mandible triangular (Figs. 4-5).

Third instar (n = 27). White, 13-segmented plus the head (1.768 ± 0.43 mm long; range: 1.186-2.102 mm), (0.605 ± 0.15 mm wide; range: 0.374-0.706 mm). Head broad, ovate (0.296 ± 0.06 mm wide; range: 0.186-0.315); mandible triangular.

Fourth instar (n = 25). Beige, 13-segmented plus the head (2.673 ± 0.48 mm long; range: 1.796-3.654 mm; 0.865 ± 0.14 mm wide; range: 0.641-1.087). The head is circular (0.384 ± 0.06 mm wide; range: 0.271-0.444 mm); mandible triangular, elongated.

Fifth instar (n = 55). Beige with white granules, 13-segmented plus the head (3.248 ± 0.44 mm long; range: 2.419-3.612 mm; 1.062 ± 0.13 mm wide; range: 0.847-1.202 mm) (Figs. 11-12). Body barrel shaped, broadest medially, tapering anteriorly and posteriorly (Figs. 11-12). Head with usual complement of setae (Henneicke et al., 1992): one pair of Fs, one pair of Fi, one pair of Ge, one pair of La, and one pair of Hy (Figs. 9-10); ulc typically collapsing but ms, prms, and prls present. Antenna ~2.0x as long as broad (Figs. 9-10, an). Mandibles of type 2, moderately sclerotized. Setae moderately sclerotized, papilla borne, long, conspicuous (Figs. 9-12). TH1-2 with four dorsal setae (2 Ds and 2 Di), one pair of pleural setae (P), one pair of lateral setae (L), and one pair of ventral setae (V); TH3 with two dorsal setae (2 Ds), one pair of P, one pair of L, and one pair of V; A1-8 each with less conspicuous pair Ds setae, a single pair P, and a single pair V setae, A1 lacks V setae. AS with two pair inconspicuous DT, one pair of VT present.



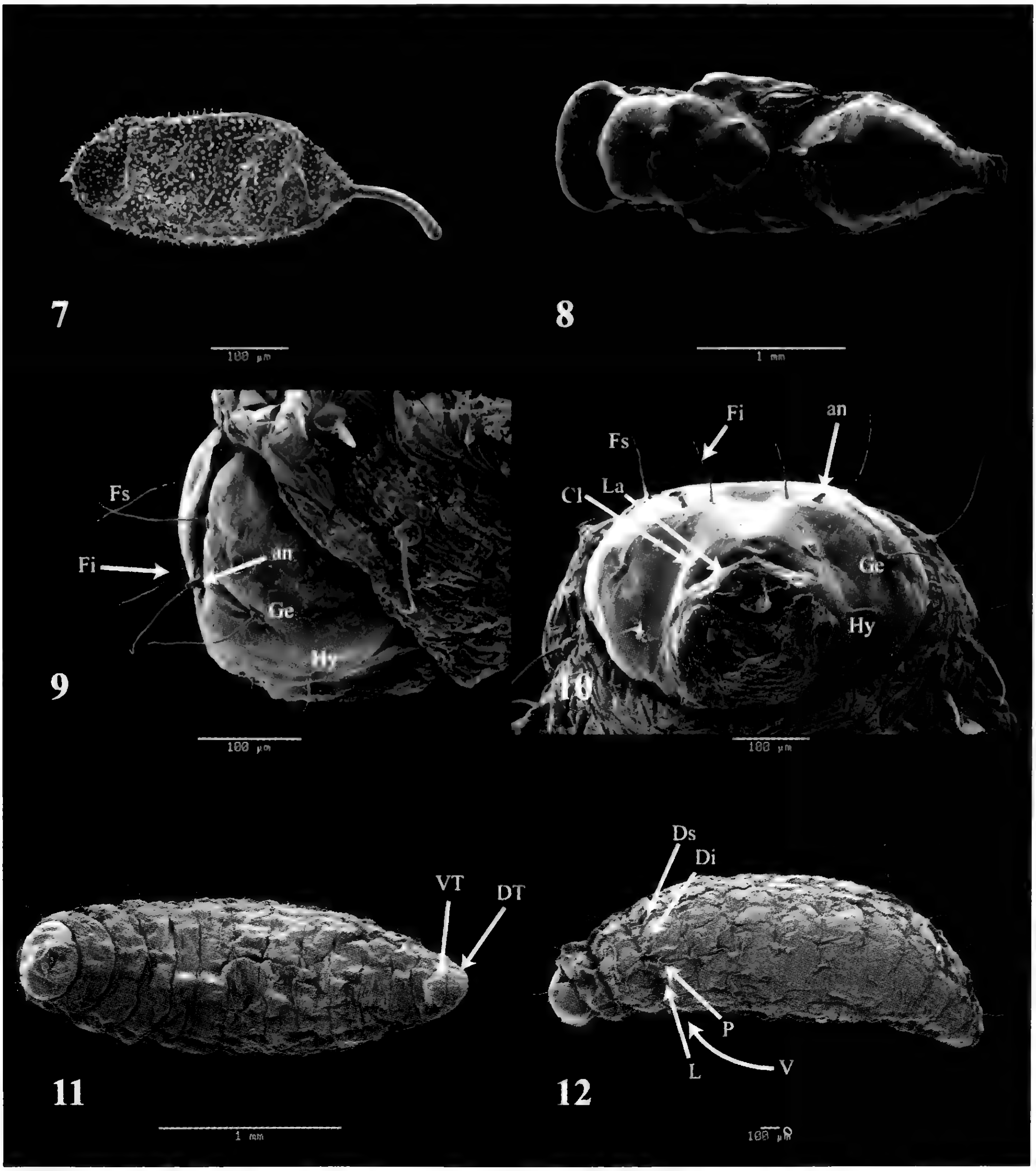
Figures 1-6. *Eurytoma sivinskii*: 1, first instar, lateral habitus. 2, first instar, dorsal head capsule. 3, first instar, falcate mandible. 4, second instar, ventral head capsule. 5, second instar, triangular mandible. 6, second instar, lateral habitus.

Prepupa (n = 40). White to beige without well-defined segmentation (0.3080 ± 0.37 mm long; range: 2.442-3.200 mm; 0.984 ± 0.13 mm wide; range: 0.777-1.074 mm). Spiracles covered on surface by an operculum and a reservoir sac. Cephalic width 0.429 ± 0.11 mm; range: 0.170-0.555 mm.

Pupa (n = 30). White to beige dorsally (2.826 ± 0.38 mm long; range: 1.672-3.124 mm; 0.859 ± 0.10 mm wide; range: 0.487-1.053) (Fig. 8). Cephalic width 0.714 ± 0.08 mm; range: 0.510-0.971 mm. Darkens significantly during course of development with adult characteristics increasingly visible.

DISCUSSION

The immature stages of *E. sivinskii* are similar to those described for other *Eurytoma* species such as *E. pini* Bugbee (Arthur 1961) and *E. amygdali* Enderlein (Plaut 1972). However, our results indicated that body length is a good indicator to distinguish immature stages of *E. sivinskii*. The structural description of the egg of *E. sivinskii* is similar to that of *E. parva* (Girault) (Phillips 1927), *E. pini* Bugbee (Arthur 1961) and *E. amygdali* (Plaut 1972) with oval shape, a spinose and bipedicellate chorion. Five instars are identified in *E. sivinskii* which is the same number reported for *E. pini* by Arthur (1961).



Figures 7-12. *Eurytoma sivinskii*: 7, egg. 8, pupa, dorsal. 9, final instar, lateral head capsule. 10, final instar, ventral head capsule. 11, final instar, ventral habitus. 12, final instar, lateral habitus. See Materials and Methods for explanation of abbreviations.

Significant differences were evident between lengths (F=252.502; 4 df; P<0.001), widths (F=251.378; 4 df; P<0.001) and cephalic widths (F=186.353; 4 df; P<0.001) of each instar.

ACKNOWLEDGMENTS

We gratefully acknowledge the help of Armando Torres Anaya, Cecilia Martínez Arcos, Jovita Martínez Tlapa, and Sandy Méndez Trejo (all Instituto de Ecología, A. C., Xalapa, Veracruz, Mexico [INECOL]), who helped rear the parasitoids used during this study. Larissa Guillén, Andrea Birke, and Martín Pale (also INECOL) helped organize experiments, supplied needed materials and provided critical advice along the way. Financial support for this study was furnished principally by the Mexican Campaña Nacional contra las Moscas de la Fruta (Secretaría de Agricultura, Ganadería, Desarrollo Rural y Pesca - Instituto Interamericano de Cooperación para la Agricultura (SAGARPA-IICA). Additional funds were provided by the United States Department of Agriculture – Agricultural Research Service (USDA-ARS) and INECOL. Given that *E. sivinskii* was discovered while conducting studies funded by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO; Project Number FB325/H296/96) and the Consejo Nacional de Ciencia y Tecnología (CONACyT) / Fondo del Sistema de Investigación del Golfo de México (SIGOLFO, Project Number SIG96001/ 96-01-003-V), we also gratefully acknowledge their support. Information reported here forms part of the undergraduate thesis of JCM (Universidad Nacional Autónoma de México [UNAM]), directed by MA. We also thank Thomas Henry and John Brown (Systematic Entomology Laboratory [SEL], PSI, ARS, USDA) and David Smith (SEL, retired) for their critical review of this paper, Jeffrey Chiu (SEL) for his efforts with imaging, and Scott Whittaker (SEM Lab Manager of the Scanning Electron Microscopy Lab, SI, NMNH) for stub preparation and SEM access.

LITERATURE CITED

Arthur, A. 1961. The cleptoparasitic habits and the immature stages of *Eurytoma pini* Bugbee (Hymenoptera: Chalcidae), a parasite of the European pine shoot moth, *Rhyacionia buoliana* (Schiff.) (Lepidoptera: Olethreutidae). Canadian Entomologist 93: 655-660.

Bolte, K. 1996. Techniques for obtaining scanning electron micrographs of minute arthropods. Proceedings Entomological Society Ontario 127: 67-87.

Bugbee, R. E. 1967. Revision of chalcid wasps of the genus *Eurytoma* in America north of Mexico. Proceedings United States National Museum 118: 433-552.

Bugbee, R. E. 1975. New species of the genus *Eurytoma* (Hymenoptera: Eurytomidae) from galls on *Rubus* and *Chrysothamnus*. Journal Kansas Entomological Society 48(4): 582-584.

Claridge, M. F. 1961. Biological observations on some eurytomid (Hymenoptera: Chalcidodea) parasites associated with Compositae, and some taxonomic implications. Proceedings Royal Entomological Society London (A) 36: 153-158.

Dawah H. A. and H. Rothfritz. 1996. Generic-level identification of final instar larvae of Eurytomidae and their parasitoids associated with grasses (Poaceae) in N.W. Europe (Hymenoptera: Braconidae, Eulophidae, Eupelmidae, Eurytomidae, Ichneumonidae, Pteromalidae). Journal Natural History 30: 1517-1526.

Gates, M. W. and E. E. Grissell. 2004. A new species of *Eurytoma* (Hymenoptera: Eurytomidae) attacking the mango fruit fly, *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae). pp. 147-159. *In*, K. Rajmohana, K. Sudheer, P. Girish-Kumar, and S. Santhosh (Editors) Perspectives on Biosystematics and Biodiversity. Harvest Media Services, Calicut, India. 666 pp.

Goeden, R. D. 2001a. Life history and description of immature stages of *Neaspilota achilleae* Johnson (Diptera: Tephritidae) on *Stephanomeria* spp. (Asteraceae) in southern California. Proceedings Entomological Society Washington 103: 60-73.

Goeden, R. D. 2001b. Life history and description of immature stages of *Tephritis joanae* Goeden (Diptera: Tephritidae) on *Ericameria pinifolia* (A. Gray) H. M. Hall (Asteraceae) in southern California. Proceedings Entomological Society Washington 103: 586-600.

Henneicke K., H. A. Dawah, and M. A. Jervis. 1992. Taxonomy and biology of final-instar larvae of some Eurytomidae (Hymenoptera: Chalcidoidea) associated with grasses in the UK. Journal Natural History 26: 1047-1087.

Heraty, J. and D. Hawks. 1998. Hexamethyldisilazane – a chemical alternative for drying insects. Entomological News 109: 369-374.

Noyes, J. S. 2003. Universal Chalcidoidea Database. World Wide Web electronic publication. www.nhm.ac.uk/entomology/chalcidoids/index.html [Accessed 11-Nov-2006].

Peck, O. 1963. A catalogue of the Nearctic Chalcidoidea (Insecta; Hymenoptera). Canadian Entomologist (Supplement) 30: 798.

Phillips, W. J. 1927. *Eurytoma parva* (Girault) Phillips and its biology as a parasite of the wheat jointworm, *Harmolita tritici* (Fitch). Journal Agricultural Research 34: 743-758.

Plaut, H. N. 1972. On the biology of the immature stages of the almond wasp, *Eurytoma amygdali* End. (Hym. Eurytomidae) in Israel. Bulletin of Entomological Research 61: 681-687.

Roskam, J. 1982. Larval characters of some eurytomid species (Hymenoptera, Chalcidoidea). Proceedings Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam (C), 85: 293-305.

Tormos, J., J. Asís, S. Gayubo, and M. Martín. 2004. Descriptions of the final instar of *Eurytoma nodularis* and *E. heriadi* (Hymenoptera: Eurytomidae). Florida Entomologist 87: 278-282.

NONTOXIC ANTIFREEZE FOR INSECT TRAPS[1]

Donald B. Thomas[2]

ABSTRACT: Propylene glycol in water is a safe and effective alternative to ethylene glycol as a capture liquid in insect traps (pitfalls, flight intercepts, pan traps). Propylene glycol formulations are readily available because it is the primary (95%) ingredient in certain automotive antifreeze formulations. However, an even safer and less expensive alternative is the USP food grade RV antifreeze used for winterizing drinking water systems. The automotive formulations contain additives (about 5%) that contribute to the cost and involve safety, environmental, and waste disposal issues. Using bacterial inhibition as an indicator, the preservational attributes of the automotive and RV antifreeze were found to be comparable in laboratory tests. Entomologists are urged to use nontoxic antifreeze in their trapping programs.

KEY WORDS propylene glycol, ethylene glycol, pitfall traps, RV antifreeze

Several insect trap configurations use liquids to capture insects by immersion, including pitfall traps, pan traps, flight-intercept traps and suspended bottle traps. Greenslade and Greenslade (1971) reported that ethanol added to water not only improved preservation of the catch but increased the numbers of beetles captured in pitfall traps compared to formalin, brine, or water alone. They suspected that the alcohol may be attractive to some beetles. In spite of a publication by Hall (1991) warning of its dangers, some authors have recently reported favorably on the use of ethylene glycol-based automotive antifreeze as the capture liquid in pitfall traps because of its ready availability and for its preservative and low evaporational attributes (Koivula et al., 2003, Schmidt et al., 2006). However, these formulations may not be appropriate in many circumstances due to the environmental risks, and moreover unnecessary, inasmuch as there are safer and equally efficacious glycol formulations available.

Ethylene glycol is highly toxic to mammals with a lethal dose of 1.5-6.6 mg/kg, the equivalent of two spoonfuls for the average sized dog (Beasley 1985). The American Academy of Clinical Toxicology cites an average of 40-60 human deaths per year in the United States alone and estimates thousands of deaths per year to pets due to ethylene glycol poisoning, most of it from ingestion of spilled automotive antifreeze (Barceloux et al., 1999). Ethylene glycol is sweet to the taste, inducing animals to ingest the material. On entering the bloodstream, ethylene glycol is metabolized to oxalic acid which precipitates in the kidneys as calcium oxalate crystals, resulting in death due to renal failure, usually within 24 hours of ingestion. Hence, ethylene glycol should never be used in open traps in situations where they could be accessed by mammals, wild or domestic.

Because of the annual toll on pets, some manufacturers offer an alternative form of antifreeze based on propylene glycol. Propylene glycol is considered by

---

[1] Received on January 9, 2008. Accepted on February 19, 2008.

[2] USDA-ARS Subtropical Agriculture Research Center, 2413 East Highway 83, Weslaco, Texas 78596 U.S.A. E-mail: Donald.Thomas@ars.usda.gov.

Mailed on November 12, 2008

the EPA and the FDA as a GRAS (generally regarded as safe) material. It is a common food additive and an ingredient in cosmetics and medicines. Propylene glycol metabolizes to lactic acid, which is a natural waste product in all eukaryotes.

Weeks and McIntyre (1997) compared captures of arthropods in pitfall traps using propylene glycol-based antifreeze against the ethylene glycol-based product and found no significant difference. However, although less toxic, propylene glycol-based automotive antifreeze should still be avoided for environmental considerations because it includes an array of additives making up about 5% of the formulation. Because these additives are proprietary, they are not all listed on the material safety data sheets (MSDS) for these products, but based on industry standards the list includes lubricants, buffers, corrosion inhibitors and anti-foaming agents, many of which are harmful if ingested. Tolytriazole is listed on the MSDS for Low Tox antifreeze (Prestone, Danbury, CT) because it is a known carcinogen. Depending on the circumstances, federal and state laws may apply, and these regulations generally prohibit disposal of automotive antifreeze by discharge into the ground, storm drains, or waste water treatment systems (US-EPA 2006). Thus trapping programs using automotive antifreeze have a waste-disposal issue.

Alternatively, USP (food grade) propylene glycol is readily available in commercial formulations as swimming pool or recreational vehicle (RV) antifreeze. The RV formulation is used to winterize drinking water systems in recreational vehicles, boats, and mobile homes. These nontoxic aqueous formulations contain 25-40% propylene glycol depending on the brand, with a small amount (<0.1-0.2%) of dipotasium phosphate (an ingredient in laundry detergent and dairy products) as a water softener, and a pink dye (rhodamine) for identification.

Tests with diluted Low Tox antifreeze indicated that 10% propylene glycol concentration gave adequate preservation for traps serviced weekly (Thomas et al., 2001). But preservation over longer service intervals was not tested. In some cases, especially with pitfall traps, the service interval may be a month or longer. Therefore, tests were conducted in the laboratory to compare preservation and evaporation among the alternative glycol formulations.

METHODS

Three glycol formulations were tested. These were Prestone Extended Life Antifreeze, which is a 95% ethylene glycol formulation, yellow in color; Prestone Low Tox Antifreeze, which is a 95% propylene glycol formulation, green in color; and Splash RV/Marine Antifreeze (Fox Packaging Co., St. Paul, Minnesota, U.S.A.) which is a 27.5% food grade propylene glycol formulation, pink in color. For testing, each formulation was diluted with water to have approximately equivalent glycol concentration which was 7:1, 7:1, and 1:1 respectively, giving concentrations of approx. 13.5%. At the initiation of the test it was discovered that insects placed in the RV formulation tended to float on the surface. Therefore, one drop of a surfactant (Triton X-100, Dow Chemical, Indianapolis, Indiana, U.S.A.) was added to each replicate of all capture liquids tested to ensure that the insect specimens immersed in the liquid rather than floated on the surface.

Five replicates of each capture liquid, each in the amount of 100 ml, was poured into open, 7 cm diam plastic cups. As controls, five cups containing 100 ml of water plus Triton were used. Into each cup of liquid, five chilled specimens of Mexican fruit flies, *Anastrepha ludens* (Loew), from the Weslaco USDA Lab colony, were introduced. The cups containing the liquid with immersed insects then were maintained together on the same shelf of an environmental chamber maintained at 28 ± 2°C and 50 ± 5% rh for a period of six weeks.

At the end of the experiment, specimens from the different glycol formulations were tested for bacterial growth. One specimen from each replicate (n=15) was rinsed in RO (reverse osmosis) water to remove the glycol and then placed in an autoclaved test tube with 3 ml sterilized RO water for 24 h. As controls, live flies (n= 5) were also tested. After 24 h a sample of 0.5 ml of the water from each test tube was injected into autoclaved borate glass test tubes (Bausch & Lomb, Rochester, NY) containing 5 ml standard nutrient L-broth (Sigma-Aldrich, St. Louis, MO) and incubated for 24 h at 30°C with shaking. Each individual test tube of broth was then tested for opacity as an indication of bacterial growth by measuring percent light transmittance with a Bausch & Lomb Spectronic 20 spectrophotometer set to wavelength 475 nm. A pair-wise t-test was used to compare means.

RESULTS AND DISCUSSION

In water alone the insect specimens began to disintegrate with separation of the wings within two weeks. Over the six-week study period there was a notable reduction in the volume of the glycol formulations, presumably due to evaporation of the diluent resulting in a proportionate increased concentration of the glycol. By three weeks the cups containing water alone were completely dry and the flies were in a state of decomposition that rendered them as unsuitable as museum specimens or for most scientific purposes. In contrast, all specimens in the glycol formulations were well preserved, although somewhat darker and stiffer than living specimens, presumably due to the alcohol induced denaturation of proteins in the cuticle. Subjectively, under visual and manual inspection, there was no overt difference in the specimens from the different glycol formulations. Therefore, an objective test based on bacterial inhibition was performed with the results shown in Table 1.

The control specimens produced strong bacterial growth in the nutrient broth within 24 hrs such that the broth turned visibly murky. In contrast, the broth with specimens stored in the glycols remained translucent, at least to the unaided eye. The specimens immersed in ethylene glycol and RV propylene glycol were not completely disinfected however, and some bacterial growth was detectable as a reduction in transmittance of the broth, although the difference between them (79.2% vs 78.4%) was not statistically significant ($t = 0.08$, $p = 0.47$). On the other hand, material immersed in Low Tox were essentially sterile as indicated by virtually no reduction in the transmittance of the nutrient broth; the small amount (1-2%) detected photometrically was within measurement error. Thus, the additives in Low Tox may contribute to preservation.

Table 1. Opacity (percent transmittance) by treatment at 24 h incubation in L-broth. Means followed by the same letter are not significantly different.

Treatment Specimen	Control (non-treated)	E-Glycol (Prestone)	P-Glycol (Lo-Tox)	P-Glycol (Splash-RV)
A	20	97	98	88
B	15	76	99	81
C	3	75	97	45
D	14	45	98	91
E	20	98	99	92
Mean	14.4^a	78.2^b	98.2^c	79.4^b
SD	6.9	21.6	0.8	19.7

It is concluded that while not as strongly antibiotic as the Low Tox formulation, RV antifreeze provides the preservational and evaporational attributes necessary for an effective capture liquid in insect traps even when diluted. Its performance, as measured by bacterial inhibition, was comparable to that of the ethylene glycol formulation. However, unlike the automotive formulations, the RV antifreeze does not have surfactants. In this respect propylene glycol, with a surface tension of 38 dynes/cm^2, has an advantage over ethylene glycol, with a surface tension of 48 dynes/cm^2 (pure water is 73 dynes/cm^2) (Ash and Ash 2004). In either case, however, these surface tensions are too high for effective capture liquids and thus, adding a drop of surfactant to each trap is necessary to ensure that the insects become immersed rather than float on the surface. The amount of surfactant necessary will depend on the trap configuration inasmuch as the surface area rather than the volume of the liquid is the determining factor. For these experiments an industrial strength surfactant was used, but in ad hoc tests one drop of household dishwashing detergent gave satisfactory results.

Although RV antifreeze is less expensive than the automotive product on a gallon per gallon basis, when the concentration of glycol is factored in, cost of deployment is about the same. In any case, for safety and environmental considerations, entomologists are urged to consider using nontoxic antifreeze, rather than automotive coolant formulations, in their trapping programs.

ACKNOWLEDGEMENTS

The author thanks Rolf Aalbu and Allan Showler for providing comments on a draft of the manuscript and A. J. Martinez (USDA-APHIS) for providing advice on microbiology test protocols. Reyes Garcia provided technical assistance. Mention of trade names or commercial products in this article is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

LITERATURE CITED

Ash, M. and I. Ash. 2004. Handbook of Preservatives. Synapse Information Resources. Endicott, New York, U.S.A. 850 pp.

Beasley, V. R. 1985. Diagnosis and management of ethylene glycol (antifreeze) poisoning. Feline Practice 15: 41-46.

Barceloux, D. G., E. P. Krenzalik, K. Olson, and W. Watson. 1999. Guidelines on the treatment of ethylene glycol poisoning. Clinical Toxicology 37: 537-560.

Greenslade, P. and P. J. Greenslade. 1971. The use of baits and preservatives in pitfall traps. Journal of the Australian Entomological Society 10: 253-260.

Hall, D. 1991. The environmental hazard of ethylene glycol in insect pitfall traps. Coleopterists Bulletin 45: 193-194.

Koivula, M., D. J. Kotze, L. Hiisivuori, and H. Rita. 2003. Pitfall trap efficacy: do trap size, collecting fluid and vegetation structure matter? Entomologica Fennica 14: 1-14.

Schmidt, M. H., Y. Clough, W. Schulz, A. Westphalen, and T. Tscharntke. 2006. Capture efficiency and preservation attributes of different fluids in pitfall traps. Journal of Arachnology 34: 159-162.

Thomas, D. B., T. C. Holler, R. R. Heath, E. J. Salinas, and A. L. Moses. 2001. Trap-lure combinations for surveillance of *Anastrepha* fruit flies (Diptera: Tephritidae). Florida Entomologist 84: 344-351.

United States - Environmental Protection Agency (US-EPA). 2006. http://www.epa.gov/epaoswer/non-hw/muncpl/antifree.htm

Weeks, R. D. and N. E. McIntyre. 1997. A comparison of live versus kill pitfall trapping: techniques using various killing agents. Entomologia Experimentalis et Applicata 82: 267-273.

A NEW SPECIES OF *MYSTROTHRIPS* PRIESNER (THYSANOPTERA: PHLAEOTHRIPIDAE) FROM CHINA[1]

Jun Wang,[2] Xiao-li Tong,[2] and Wei-qiu Zhang[2]

ABSTRACT: *Mystrothrips longantennus* sp. nov., of the Subfamily Phlaeothripinae is described and illustrated from China. The new species can be distinguished from *M. nipponicus* Okajima from Japan by postocular long, antennae more than 2.1 times as long as head length, B_2 on abdominal tergites IX about as long as tube length. New distributional information of *M. flavidus* Okajima in China is also provided.

KEY WORDS: leaf litter thrips, Phlaeothripinae, *Mystrothrips*, new species, China

The genus *Mystrothrips* was established by Priesner from Java in 1949 with the type species *Sagenothrips dammermani*. Since then, five other species have been added including *M. clavatoris* from Brazil (Hood, 1954), *M. dilatus* from the Solomon Islands (Mound, 1970), *M. reteanum* from Korea (Shin and Woo, 1999), and the Japanese species *flavidus* and *nipponicus* (Okajima, 2006). These species belong to Glyptothripini and differ from other species of the tribe by having the pronotal anteroangular setae well developed (Mound and Marullo, 1996; Okajima, 2006). The genus *Mystrothrips* Priesner is divided into two completely different groups based on the morphological characters (Mound, 2007). One group has major body setae elongate, not fan-shaped; cheeks not constricted behind eyes; two sense-cones on antennal segment III, and it comprises *M. flavidus* and *M. reteanum*. The other four species have major body setae not elongate, fan-shaped; cheeks constricted behind eyes; three sense-cones on antennal segment III form the second group.

Diagnosis of the genus includes the following features: (1) body strongly reticulate including antennae and leg; (2) eyes distinctly separated from cheeks by a deep constriction; (3) head longer than broad, distinctly produced in front of eyes, longer than prothorax; (4) Major body setae well developed, stout, spoon-shaped; (5) one pair of stout and short postoculars present; (6) antennae segment VIII constricted at base, sharply separated from VII, three sense-cones on antennae segment III and IV, long and slender; antennae terminal setae longer than segment VIII; (7) pelta broad, reticulate, withdrawn into concave anterior margin of tergite II; Tergites II-VII with two pairs of sigmoid wing-retaining setae; (8) sternites with a row of about 6 pairs of setae.

Only one species, *M. flavidus* Okajima, has been recorded from China. In this paper, a new species of the genus is described.

METHODS

All thrips specimens were extracted by using Tullgren funnels from leaf litter, and then sorted and preserved in 75% alcohol. Type specimens were mounted with Canada balsam. Illustrations were made with the help of a camera Lucida. Measurements are given in micrometers. All specimens were deposited at the Insect Collection, Department of Entomology, South China Agricultural University (SCAU).

---

[1] Received on December 30, 2007. Accepted on February 5, 2008.

[2] Department of Entomology, South China Agricultural University, Guangzhou 510642 China. E-mails: tubulifera@gmail.com, xtong@scau.edu.cn (corresponding author), wqzhang@scau.edu.cn, respectively.

Mailed on November 12, 2008

SYSTEMATIC ENTOMOLOGY

Mystrothrips flavidus Okajima

Mystrothrips flavidus Okajima, 2006: 485. (Type locality: Ogasawara Islands, Japan)

Diagnosis: Body strongly reticulate including antennae and leg; pronotum with five pairs of major developed setae; head short, as long as broad; cheeks not constricted behind eyes; antennal segments short, segment III about 1.4 times as long as broad; antennal segment III with two sense-cones; major body setae elongate, not fan-shaped.

Examined Specimens: P. R. China, Guangdong Province: 1 male (microptera), Fengkai, Mt. Heishiding (23°24'38"N, 111°54'45"E), 20. Jul. 1987, leg. Xiao-Li Tong from litter of chestnut forest; 1 female (macroptera), Shixing, Chebaling National Natural Reserve (24°42'29"N, 114°13'12"E), 14. Jul. 1989, leg. Xiao-Li Tong; 5 females (microptera), 2 males (microptera), Guangzhou, Longdong (23°13'57"N, 113° 23'48"E), 20. May. 2005, leg. Jun Wang from leaf-litter of *Acacia mangium* plantation and *Cunninghamia* forest; 2 females (microptera), 1 male (microptera), Guangzhou, Longdong, 20. Nov. 2005, leg. Jun Wang from bamboo litter; 8 females (microptera), 3 males (microptera), Guangzhou, Longdong, 1. Dec. 2006, leg. Jun Wang; 14 females (1 macroptera and 13 microptera), 11 males (microptera), Guangzhou, Botanical Garden of South China Agricultural University (23°09'28"N, 113°21' 15"E), 4-28. Sep. 2005, leg. Jun Wang; 4 females (1 macroptera and 3 microptera), 2 males (microptera), Longmen, Mt. Nankunshan (23°38'38"N, 113°53'02"E), 10.Sep.1987, leg. Yi Wang from dry grass; 1 female (microptera), 1 male (microptera), Conghua, Mt. Wuzhishan (23°43'43"N, 113°48'15"E), 9. May. 2005, Leg. Jun Wang; 7 females (microptera), 1 male (microptera), Conghua, Shanyatang (23°44' 07"N, 113°47'48"E), 28. Oct. 2004, leg. Jun Wang; 1 female (microptera), 2 males (microptera), Haifeng, Gongping (23°05'41"N, 115°19'31"E), 13. Mar. 2005, Leg. Jun Wang from litter of *Eucalyptus* plantation.

Distribution: China (Guangdong Province: Fengkai, Shixing, Guangzhou, Longmen and Conghua); Japan.

Mystrothrips longantennus, NEW SPECIES

(Fig. 1 A–I)

Diagnosis: Body strongly reticulate including antennae and leg; pronotum with five pairs of major developed setae; cheeks constricted just behind eyes; head as long as broad or a little longer; antennae more than 2.1 times as long as head length; antennal segment III with three sense-cones; major body setae not elongate, fan-shaped.

Mystrothrips longantennus sp. nov. is somewhat similar to *M. nipponicus* Okajima from Japan but can be distinguished from the latter by the following features: postocular long, antennae more than 2.1 times as long as head length, B_2 on abdominal tergites IX about as long as tube length; whereas the latter species postocular setae very short, antennae 1.85 times as long as head length, B_2 on abdominal tergites IX shorter than tube length.

Macropterous Female: Body yellow with brown shades at sides of head, metathorax, abdominal tergite II and apex of tube. Antennal segments I and II brown, III yellow, IV-VIII yellowish brown. Wings gray brown, but paler at base and middle.

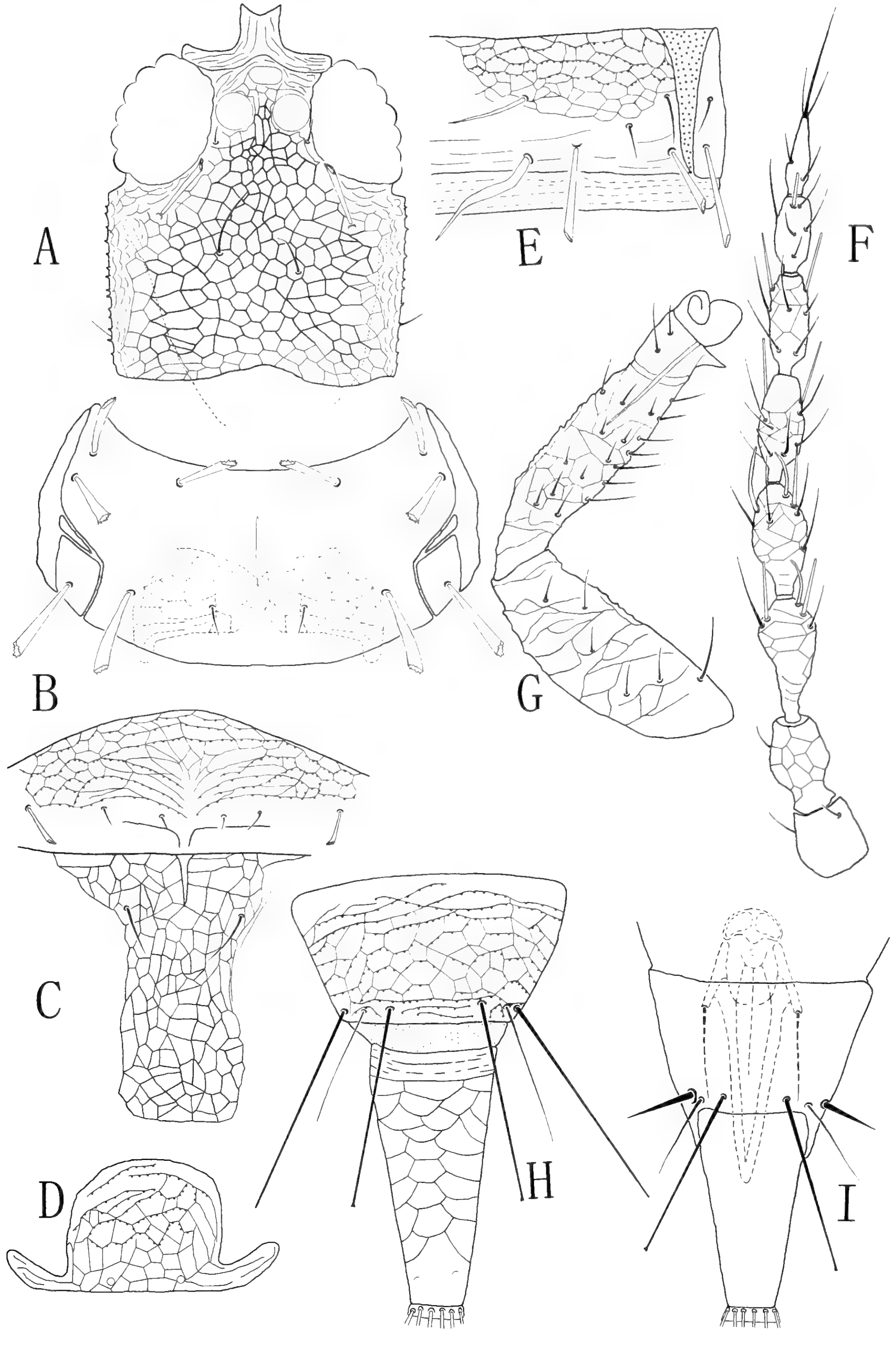


Fig. 1. *Mystrothrips longantennus*, new species. Female (macroptera): A. head. B. prothorax. C. mesonotum and metanotum. D. pelta. E. abdominal tergite V (right half). F. antenna. G. fore-leg. H. abdominal tergite IX and tube. Male (microptera): I. abdominal tergite IX, tube and male genitalia.

Head: Head (Fig. 1. A) about 1.1 times as long as broad (including preocular part) and projecting in front of eyes; cheeks almost parallel and strongly constricted just behind eyes, dorsum of head entirely reticulated; eyes about 0.3 times as long as head; postocular setae about 2/3 as long as eyes, strongly expanded at apex, fan-shaped; ocelli well developed, postocellar setae pointed at apex and a little longer than posterior ocellus; antennae (Fig. 1. F) more than 2.1 times as long as head, segment III and IV each with three sense-cones, segment III longest, terminal setae as long as segment III, length/width of segments: I 1.07, II 1.36, III 2.23, IV 1.92, V 2.50, VI 2.40, VII 2.13, VIII 3.40; maxillary stylets not reaching postocular setae, U-shaped.

Thorax: Pronotum (Fig. 1. B) at middle 0.59 times as long as head length and entirely reticulate; five pairs of major setae developed, strongly expanded at apex, fan-shaped; epimeral sutures complete; praepectus very weak and almost not visible; fore tarsal tooth present (Fig. 1. G); metanotum polygonally reticulated (Fig. 1. C); forewing about 1/3 of total body length, three pairs of basal setae expanded at apex and B_3 setae distinctly longer than the others.

Abdomen: Pelta (Fig. 1. D) hat-shaped and distinctly reticulated; tergites II-VII (Fig. 1. E) each with two pairs of sigmoid wing-retaining setae, with B_1 and B_2 pan-shaped and the latter distinctly shorter; B_1 and B_2 on tergite IX (Fig. 1. H) blunt at apex, B_1 distinctly shorter than tube length and B_2 about as long as tube length; tube (Fig. 1. H) 0.68 times as long as head length.

Measurements: Total body length 2000; head L/W (205/180); eyes length 63, diameter of ocelli 20; pronotum median length 120; tube length 140, tube maximum width 75. Antennal total length 435, segments I–VIII length (width) as follows: 40(38); 48(35); 73(33); 63(33); 63(25); 60(25); 43(20); 43(13). Postocular setae 38; antennal terminal setae 75; pronotum anteroangular setae 30, anteromarginal setae 32, midlateral setae 32, posteroangular setae 45, epimeral setae 45; forewing subbasal setae B_1 25, B_2 27, B_3 33; tergum IX B_1 setae 118, B_2 setae 138, pointed setae between B_1 and B_2 88; annals 88.

Micropterous Female: Color and structure similar to macropterous female. However, ocelli smaller and postocellar setae variable in length and shape, pointed or expanded at apex; tube 0.65 times as long as head length.

Measurements: Total body length 1960; head L/W (200/170); eyes length 58; pronotum median length 115; tube length 130, tube maximum width 73. Antenna 445, segments I–VIII length (width) as follows: 35(38); 48(35); 75(35); 68(35); 68(28); 60(25); 40(23); 40(13). Postocular setae 38; antennal terminal setae 75; pronotum anteroangular setae 38, anteromarginal setae 40, midlateral setae 45, posteroangular setae 43, epimeral setae 43; forewing basal setae B_1 25, B_2 25, B_3 30; tergum IX B_1 setae 113, B_2 setae 125, pointed setae between B_1 and B_2 75.

Micropterous Male: Body color and appearance similar to micropterous female. However, B_2 seta on abdominal tergite IX (Fig. 1. I) pointed at apex, shorter and strong.

Measurements: Total body length 1540; head L/W 158/150; eye length 50; pronotum median length 113; tube length 115, tube maximum width 65. Antennal total length 188, segments I–VIII length (width) as follows: 40(35); 43(33); 63(33); 58(30); 55(28); 50(25); 40(20); 38(13). Postocular setae 35; antennal terminal setae

65; pronotum anteroangular setae 35, anteromarginal setae 38, midlateral setae 38, posteroangular setae 43, epimeral setae 45; tergum IX B_1 setae 103, B_2 setae 50, pointed setae between B_1 and B_2 70.

Type Data: *Holotype*: female (macroptera), P. R. China: Yunnan, Xishuangbanna (21°31'N, 101°24'E), 9. Sep. 1993, leg. unknown. *Paratypes*: P. R. China, Yunnan Province: 8 females (microptera), the same data as holotype; 1 female (microptera), Mengla, Tropical Botanic Garden (21°27'59"N, 101°34'59"E), 9. Apr. 1992, leg. unknown; 3 females (macroptera), Mengla, 10. Apr. 1992, leg. unknown. P. R. China, Guangdong Province: 2 females (1 macroptera and 1 microptera), 1 male (microptera), Guangzhou, Botanical Garden of South China Agricultural University (23°09'28"N, 113°21'15"E), 21. May. 2005, leg. Jun Wang; 1 female (microptera), Zhaoqing, Mt. Dinghushan (23°10'26"N, 112°32'28"E), 3. Oct. 1986, leg. Xiao-Li Tong; 1 female (microptera) and 1 male (microptera), Conghua, Shimen National Forest Park (23°38'46"N, 113°45'17"E), 19. Sep. 2004, leg. Jun Wang; 4 females (microptera), Foshan, Gaoming, Heshui (22°29'53"N, 111°30'58"E), 27. Mar. 2005, leg. Jun Wang.

Etymology: The specific epithet is a combination of Latin word *long* and *antenn*, referring to long antennae.

Distribution: China (Yunnan: Jinghong and Mengla; Guangdong: Guangzhou, Conghua, Zhaoqing and Foshan).

ACKNOWLEDGEMENTS

Thanks are due to Dr. Laurence Mound (CSIRO Entomology, Australia) and Prof. S. Okajima (Tokyo University of Agriculture, Japan) for kindly providing important references. Thanks also to three anonymous reviewers for providing helpful comments on the manuscript. This study was partly supported by KFBG (Kadoorie Farm & Botanic Garden) Biodiversity Studentship of Hong Kong.

LITERATURE CITED

Hood, J. D. 1954. Brasilian Thysanoptera IV. Proceedings of the Biological Society of Washington 67: 17–54.

Shin, H. K. and K. S. Woo. 1999. Taxonomic notes of Phlaeothripinae (Thysanoptera, Phlaeothripidae) from Korea (I). Insecta Koreana 16(2): 103–118.

Mound, L. A. 1970. Thysanoptera from the Solomon Islands. Bulletin of the British Museum (Natural History) Entomology 24: 83–126.

Mound, L. A. 1977. Species diversity and the systematics of some New World leaf litter Thysanoptera (Phlaeothripinae; Glyptothripini). Systematic Entomology 2: 225–244.

Mound, L. A. and R. Marullo. 1996. The thrips of Central and South America: An Introduction. Memoirs on Entomology, International 6: 1– 488.

Mound, L. A. 2007. Thysanoptera (Thrips) of the World – a checklist. http://www.ento.csiro.au/thysanoptera/worldthrips.html.

Okajima, S. (Editor) 2006. The Insects of Japan. Volume 2. The suborder Tubulifera (Thysanoptera). Touka Shobo Co. Ltd. Fukuoka, Japan. 720 pp.

Priesner, H. 1949. Genera Thysanopterorum. Keys for the identification of the genera of the order Thysanoptera. Bulletin de la Societe Fouad Ier d'Entomologie 33: 31–157.

OSMOREGULATORY ORGANS OF IMMATURE *CULICOIDES SONORENSIS* (DIPTERA: CERATOPOGONIDAE) IN NORTH AMERICA[1]

Will K. Reeves[2]

ABSTRACT: Aquatic insects must regulate the ion concentrations of their haemolymph, and freshwater insects tend to loose ions to their aquatic environment. The osmoregulatory organs of larvae and pupae of *C. sonorensis* have not been previously reported. Silver nitrate was used to detect tissues in immature stages of *C. sonorensis* with active chloride exchange. Larvae of *C. sonorensis* actively exchanged ions with their anal papillae, cutaneous chloride cells, and to a lesser extent the hindgut. Only the cutaneous chloride cells were stained in their pupae.

KEY WORDS: Diptera, Ceratopogonidae, biting midge, *Culicoides sonorensis*, osmoregulation, larva, pupa, chloride cells

Aquatic insects survive in habitats with fluctuating osmotic conditions and must regulate the ion concentrations of their haemolymph. Freshwater insects tend to loose ions to the environment. The water-saturated soils and wet feces in and around livestock feedlots support a variety of aquatic and semiaquatic Diptera, including *Musca* spp. and *Culicoides* spp. (Blanton and Wirth, 1979; Skoda et al., 1993). Larvae of *Musca autumnalis* and *M. domestica* can develop in semi-aquatic habitats containing wet dung, and probably use their anal organs to regulate the ion concentrations in their haemolymph (Stoffolano, 1970). The toxicity of chemicals that inhibit the osmoregulation of larval flies has been previously studied (e.g. Broce et al., 1988) and might represent a potential category of pesticides.

Larvae of *Culicoides* spp. presumably use their anal papillae for osmoregulation but some species lack these organs (Murphree and Mullen, 1991). Lawson (1951) described the larvae of *C. nubeculosus* and used silver nitrate to stain the anal papillae, which he suggested they used for osmoregulation. The osmoregulatory organs of larvae and pupae of *C. sonorensis* have not been previously reported, but these organs are probably similar to those of *C. nubeculosus*. Understanding the osmoregulatory organs of *C. sonorensis* is important because they could possibly be targeted with pesticides. *Culicoides sonorensis* is a member of the *C. variipennis* complex that was recently revised by Holbrook et al. (2000). The *C. variipennis* complex contains three species: *C. variipennis, Culicoides sonorensis,* and *Culicoides occidentalis. Culicoides sonorensis* is economically important in North America, where it vectors two major viral diseases, bluetongue and epizootic hemorrhagic disease of deer, to domestic ruminants and wildlife (Mellor et al., 2000).

METHODS

The osmoregulatory organs of *C. sonorensis* were detected using the techniques described by Koch (1938). Briefly, 15 live 4th instar larvae, 4 dead larvae, and 7

---

[1] Received on January 22, 2008. Accepted on February 25, 2008.

[2] Arthropod-Borne Animal Diseases Research Laboratory, USDA, 1000 E. University Avenue, Department 3354, Laramie, Wyoming 82071 U.S.A. E-mail: will.reeves@ars.usda.gov.

Mailed on November 12, 2008

pupae were removed from the VanRyan colony of *C. sonorensis* and allowed to soak in 150 ml of distilled water for 20 minutes. The colony has been maintained continuously at the USDA Arthropod-Borne Animal Diseases Research Laboratory, as described Hunt (1994). Ten live larvae, 3 dead larvae, and 5 pupae were placed in a Petri dish with 50 ml of 1% aqueous silver nitrate and held in the dark for 30 min. The larvae and pupae were then uncovered and held in bright light on a dissecting microscope for 20 min. Larvae and pupae in distilled water were compared to those in the silver nitrate and photographed (Figs. 1 and 2). Tissues that transport chloride ions were stained black when insoluble silver salts precipitated and blackened under bright light. The experimental larvae were immobilized because, 1% silver nitrate will paralyze and eventually kill immatures of *Culicoides* (Lawson, 1951). Unstained insects were immobilized with ice. Voucher specimens were deposited in the University of Wyoming Insect Collection.

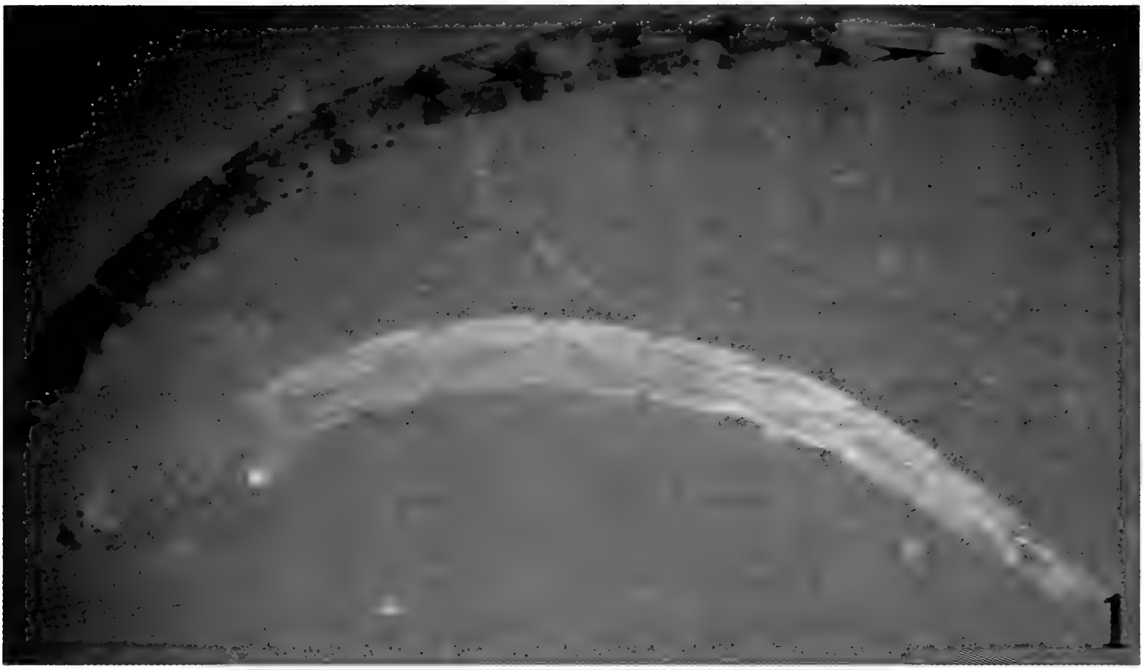
RESULTS

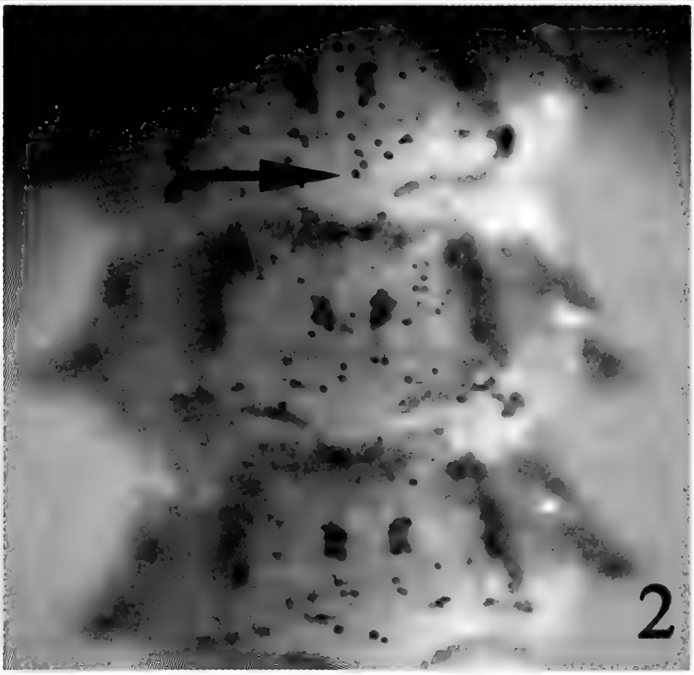
Three different organs were stained by silver nitrate in live larvae of *C. sonorensis*, the anal papillae and cutaneous chloride cells (Fig. 1). The hindgut also turned light brown in some larvae, but there were no darkened tissues in the dead larvae. After staining with silver nitrate, cutaneous chloride cells were visible on the pupae (Fig. 2).

DISCUSSION

Tissues in dead larvae of *C. sonorensis* were not stained, which indicates that a physiological process caused the staining. Lawson (1951) noted that the anal papillae of *C. nubeculosus* were only lightly stained by silver nitrate, and he inferred that they actively reduced the silver nitrate. The anal papillae of *C. sonorensis* stained dark black (Fig. 1), which indicates that the reaction was a simple reduction of silver chloride. Single chloride cells were scattered over the body of the larvae of *C. sonorensis* (Fig. 1). Chloride cells were more numerous on the dorsum and near the ends of each segment. They were distributed on all body segments except the head capsule and were bilaterally asymmetrical. Komnick (1977) reviewed the structures of these cells in aquatic insects and noted their presence on larvae of other Nematocera. In addition to these external organs, a portion of the hindgut was lightly stained in some larvae. This indicates that the hindgut actively reduced silver nitrate but at a lower rate than the anal papillae or chloride cells. All of these organs are most likely involved with osmoregulation and the uptake of ions from the environment.

Pupae of *C. sonorensis* float to the surface of their developmental habitat and are slightly hydrophobic. Chloride cells were visible on the pupae and were present on the all surfaces, but were most numerous on the ventral surface of the abdomen (Fig. 2). The chloride cells were generally smaller than those on the larvae; however, these organs must continue to exchange chloride ions with the environment. Previous descriptions of pupae of *Culicoides* (e.g. Lawson, 1951) did not mention chloride cells.





Figures 1-2. 1. Silver nitrate stained (top) and unstained (bottom) larvae of *Culicoides sonorensis*. The black stained anal papillae and chloride cells, indicating the osmoregulatory organs, are marked with arrows. 2. Chloride cells on the abdomen of a pupa of *Culicoides sonorensis* are stained black with silver nitrate.

ACKNOWLEDGEMENTS

I thank Dr. W. Grogan, Jr. for his helpful review of the manuscript, Dr. A. Broce for his suggestions and help with the silver staining procedure and to L. DeBrey and J. Kempert for maintaining the laboratory colonies of *C. sonorensis*.

LITERATURE CITED

Blanton, F. S. and W. W. Wirth. 1979. The sand flies (*Culicoides*) of Florida (Diptera: Ceratopogonidae). Arthropods of Florida and Neighboring Land Areas 10: 1-204.

Broce, A. B., M. J. Gordowitz, and J. G. Riley. 1988. Effect of the ionophore lasalocid on face fly (Diptera: Muscidae) larval survival and physical and chemical parameters of cattle feces. Journal of the Kansas Entomological Society 61: 471-476.

Holbrook, F. R., W. J. Tabachnick, E. T. Schmidtmann, C. N. McKinnon, R. J. Bobian, and W. L. Grogan. 2000. Sympatry in the *Culicoides variipennis* complex: a taxonomic reassessment. Journal of Medical Entomology 37: 65-76.

Hunt, G. J. 1994. A procedural manual for the large-scale rearing of the biting midge, *Culicoides variipennis* (Diptera: Ceratopogonidae). U.S. Department of Agriculture, Agricultural Research Service, ARS-121. National Technical Information Service. Springfield, Virginia, U.S.A. pp. 1-68.

Koch, H. J. 1938. The osmo-regulatory function of anal papillae in Culicidae. Journal of Experimental Biology 15: 152-160.

Komnick, H. 1977. Chloride cells and chloride epithelia of aquatic insects. International Review of Cytology 49: 285-329.

Lawson, J. W. H. 1951. The anatomy and morphology of the early stages of *Culicoides nubeculosus* Meigen (Diptera: Ceratopogonidae = Heleidae). Transactions of the Royal Entomological Society of London 102: 511-574.

Mellor P. S., J. Boorman, and M. Baylis. 2000. *Culicoides* biting midges: their role as arbovirus vectors. Annual Review of Entomology 45: 307-340.

Murphree, C. S. and G. R. Mullen. 1991. Comparative larval morphology of the genus *Culicoides* Latreille (Diptera: Ceratopogonidae) in North America with a key to species. Bulletin of the Society of Vector Ecology 16: 269-399.

Skoda, S. R., G. D. Thomas, and J. B. Campbell. 1993. Abundance of immature stages of the housefly (Diptera; Muscidae) from five areas in beef cattle feedlot pens. Journal of Economic Entomology 86: 455-461.

Stoffolano, J. G., Jr. 1970. The anal organ of larvae of *Musca autumnalis, M. domestica,* and *Orthellia caesarion* (Diptera: Muscidae). Annals of the Entomological Society of America 63: 1647-1654.

REVISION OF THE GENUS *AGASTA* HOPE (COLEOPTERA: CHRYSOMELIDAE: CHRYSOMELINAE)[1]

Siqin Ge,[2] Mauro Daccordi,[3] and Xingke Yang[2]

ABSTRACT: The genus *Agasta* Hope is revised. *Agasta formosa* Hope, 1840, *A. annamica* Kimoto and Gressitt, 1981 are redescribed and illustrated. *Agasta fleutiauxi* Laboissière, 1932 is confirmed as the synonym of *A. formosa* Hope. Detailed illustrations as well as detailed synonymies of *A. formosa* and of *A. annamica* are provided.

KEY WORDS: revision, *Agasta*, *Plagiosterna*, *Plagiodera*, *Linaeidea*, Chrysomelinae, Chrysomelidae

The genus *Agasta* was erected by Hope (1840), with *A. formosa* Hope as type of the genus, and Singapore its typical locality. This Oriental genus includes two species: *Agasta formosa* Hope and *A. annamica* Kimoto and Gressitt, 1981, from Vietnam. Additional publications dealing with *Agasta* include Baly (1867), Chapuis (1874), Maulik (1926), Chen (1934, 1936), Gressitt and Kimoto (1963, 1981), and Wang et al. (1996). The taxon, *Agasta fleutiauxi* Laboissière, 1932, was treated as a synonym of *A. formosa* Hope by Kimoto and Gressitt (1981) without checking type specimens. We confirmed the accuracy of this synonymy by checking the type specimens. Kimoto and Gressitt (1981) also transferred *Plagiodera marginipennis* Jacoby, 1889 to *Agasta,* but Daccordi (1982) retransferred it to *Linaeidea* Motchulsky, 1860, now *Plagiosterna* Motchulsky, 1860 (Biondi and Daccordi 1998). After checking the types of *Plagiosterna marginipennis* Jacoby, we found that another species, *Plagiosterna seximpressa* (Chen, 1931), should be the new synonym of *Plagiosterna marginipennis* Jacoby.

METHODS

Internal and external morphological characters form the basis of this work. Specimens were examined using a Leica stereomicroscope with a drawing tube (8 to 100x). The measurements were made using an ocular micrometer. Internal sclerotized structures were dissected in hot water. Heavily sclerotized parts were soaked in a dilute solution of potassium hydroxide (about 25%), then put in acetic acid, and finally in ethanol. Species have been characterized using pattern of the colour and form of the clypeus, eyes, mouth parts, antennae, pronotum, scutellum, elytra, legs, punctuation of head, and venter. The terms mesoventrite and metaventrite replace the terms mesosternum and metasternum following Lawrence (1999) and Beutel and Haas (2000).

---

[1] Received on October 25, 2007. Accepted on December 14, 2007.

[2] 90Box, Institute of Zoology, Chinese Academy of Sciences, Datun, Chaoyang, Beijing, 100101, China. E-mails: gesq@ioz.ac.cn, yangxk@ioz.ac.cn (corresponding author).

[3] Museo Civico di Storia Naturale, Lungadige Porta Vittoria 9, 37129 Verona, Italy. E-mail: mauro.daccordi@tiscali.it.

Mailed on November 12, 2008

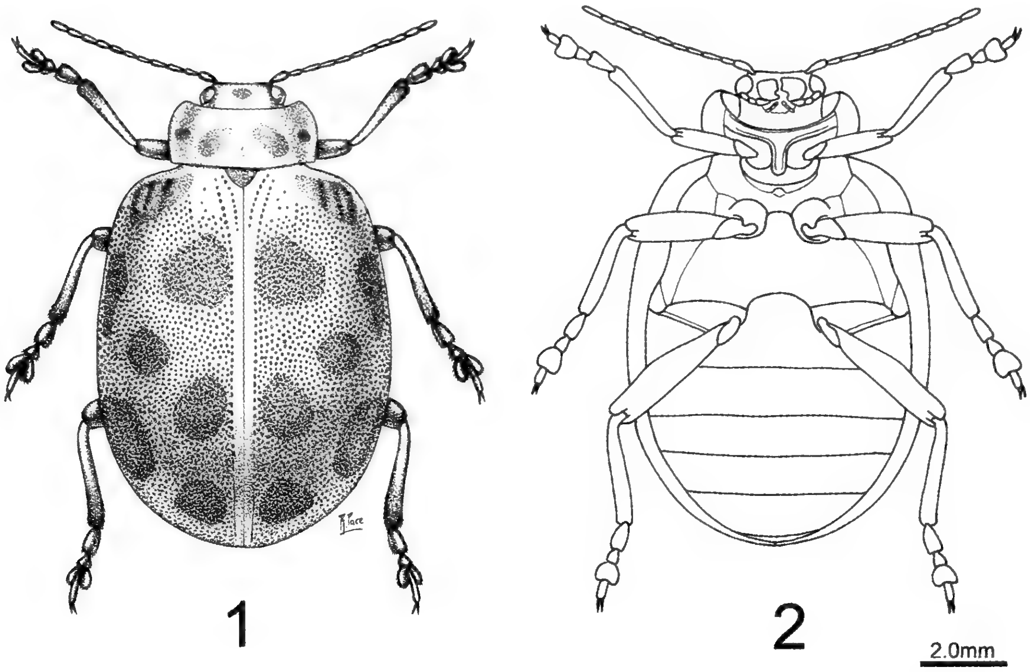
All the materials are coming from the following collections: **BMNH**: Natural History Museum, London, UK; **BPBM**: Bernice P. Bishop Museum, Hawaii, USA; **IZAS**: Institute of Zoology, Chinese Academy of Sciences, Beijing, China; **MDC**: Mauro Daccordi's collection; **NHMW**: Naturhistorisches Museum, Wien, Austria; **NMEG**: Naturkundesmuseum, Erfurt, Germany; **MNHN**: Museum National d'Histoire Naturelle, Paris, France; **UMO**: University Museum of Natural History, Oxford, UK; **USNM**: United States National Museum of Natural History, Washington D.C., US; **ZMUH**: Zoologisches Institut und Zoologisches Museum, Universität von Hamburg, Germany.

SYSTEMATIC ENTOMOLOGY

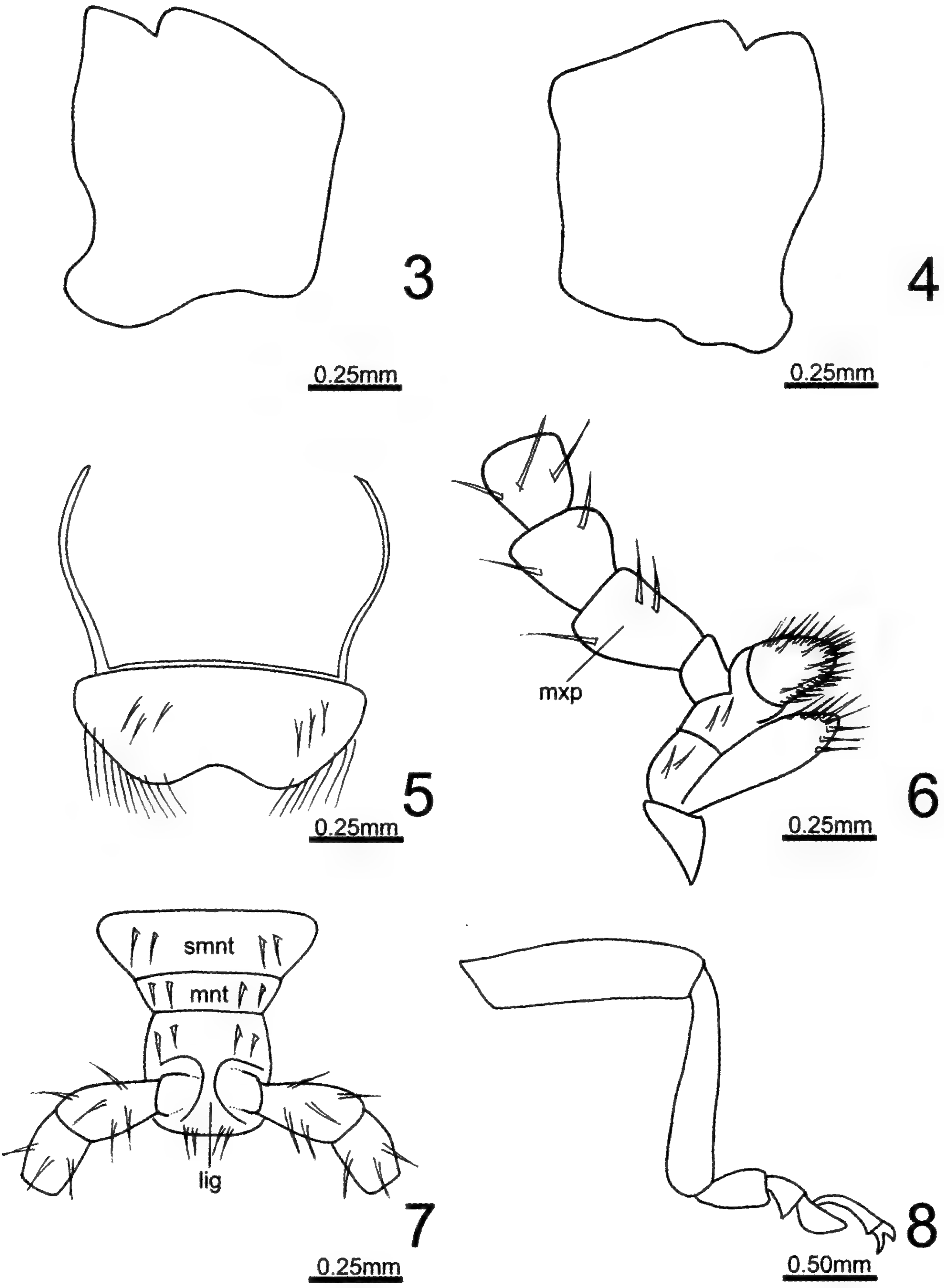
Genus *Agasta* Hope

Agasta Hope, 1840: 177-178 (Type species: *Agasta formosa* Hope, 1840, by monotypy).

Diagnosis. The genus *Agasta* can be distinguished from the genera *Humba* Chen, 1934, *Agrosteomela* Gistel, 1857, *Sphaerolina* Baly, 1871 by basal part of labium palpi closed to each other; epipleuron without cilia-like bristles; third segment of tarsi bilobed. It can also be distinguished from the genus *Plagiodera* by the following characters: fourth segment of maxillary palpi short and truncate apically; anterior angles of pronotum rounded and broadened; width of pronotum much narrower than that of elytra. As for *Plagiodera* Chevrolat, 1837, the characters are as follows: the last segment of maxillary palpi is more slender than the previous and pointed apically; anterior angles of pronotum pointed and narrow; width of pronotum and elytra almost equal to each other.



Figs. 1-2. Habitus of *Agasta formosa* Hope. 1. Dorsal view; 2. ventral view.



Figs. 3-8. *Agasta formosa* Hope. 3. Left mandible; 4. right mandible; 5. labrum; 6. maxilla; 7. labium; 8. hind-leg. Abbreviations: lig: ligula; mnt: mentum; mxp: maxillary palpi; smnt: submentum.

Description. Elongate-oval, convex in lateral view (Fig. 1). Head small, coronal suture and frontal suture present. Anterior margin of clypeus incised; apical segment of maxillary palpi slightly shorter than third (Figs. 6, 12, 13); basal part of labium palpi closed to each other, apical segment slightly shorter than former segment (Figs. 7, 12, 13). Antennae filiform, exceeding to base of pronotum, third segment longer than second and fourth segment, apical five segments slightly broadened (Figs. 16, 19). Pronotum much narrower than base of elytra, lateral side straight (Fig. 1); anterior margin slightly emarginate with protruding anterior angles. Central disc slightly convex, without longitudinal line and depressions; anterior, posterior margin and lateral side bordered. Elytra convex, with punctuations confused, a short stria near scutellum, humeral calli prominent, inner side depressed. Epipleura flat, inner side without pubescence. Venation of hind wing without cv (Fig. 9). Apex of prosternal process rounded (Figs. 2, 12); metanotum simplified, allocrista slightly curved (Fig. 10); metascutum larger than metascutellum (Fig. 10); mesoventrite quadrate; anterior margin of metaventrite bordered by a groove (Fig. 2); anterior coxal cavities open behind; metendosternite with stalk slightly longer than wide (Fig. 11). Third segment of tarsi bilobed; claws simple (Figs. 8, 14). Aedeagus with very long flagellum, base of median lobe incised deeply, hook-shaped apically (Fig. 6). Spermatheca and ductus quite complicated and fused, twisted together, fairly long (Fig. 7).

Type Species. *Agasta formosa* Hope, 1840, by monotypy.

Distribution. South China; Indo-Malaya Region.

KEY TO SPECIES OF *AGASTA* HOPE

1. Pronotum yellowish brown with a pair of large markings on middle, a pair of smaller markings laterally and a smaller marking before scutellum, violaceous blue; elytron normally with 7 large violaceous blue spots and 1 smaller marginal spot; scutellum violaceous blue; head yellowish brown with a bluish marking on vertex; ventral surface yellowish brown with lateral part of mesoventrite, most of metaventrite and median band of each abdominal segment black .... *Agasta formosa* Hope

\- Pronotum pitchy brown with anterior parts of basal margin, basal part of sutural margin, a smaller latero-marginal marking and an irregular apical marking yellowish brown, elytra without 8 isolate markings; ventral surface bluish black .... *Agasta annamica* Kimoto and Gressitt

Agasta formosa Hope

Agasta formosa Hope, 1840: 177, pl. 2, fig. 3 (Type locality: Singapore, deposited in UMO).

Agasta fleutiauxi Laboissière, 1932: 130 (Type locality: Cochinchina, Vietnam, deposited in MNHN and ZMUH). CONFIRMED SYNONYM.

Diagnosis. This species is quite different from *Agasta annamica* Kimoto and Gressitt by the markings of the body, aedeagus, and spermatheca.

Redescription. Body: length: 9.5 - 14.5 mm, width: 4.5 - 7.5 mm, large, elongate ovoid, convex in later view, hairless. Hind-wing present. Dorsal surface yellowish brown, vertex with round violaceous blue markings on central part; pronotum with a pair of large markings on middle, a pair of smaller markings laterally and a smaller marking before scutellum, violaceous blue; elytron with 7 large violaceous blue markings and 1 smaller marginal spot; scutellum violaceous blue; lateral part of mesoventrite, most of metaventrite and median part of each abdominal segment dark; first segment of antennae yellowish brown, apical five segments of antennae dark brown; legs yellowish brown or dark brown (Fig. 17).

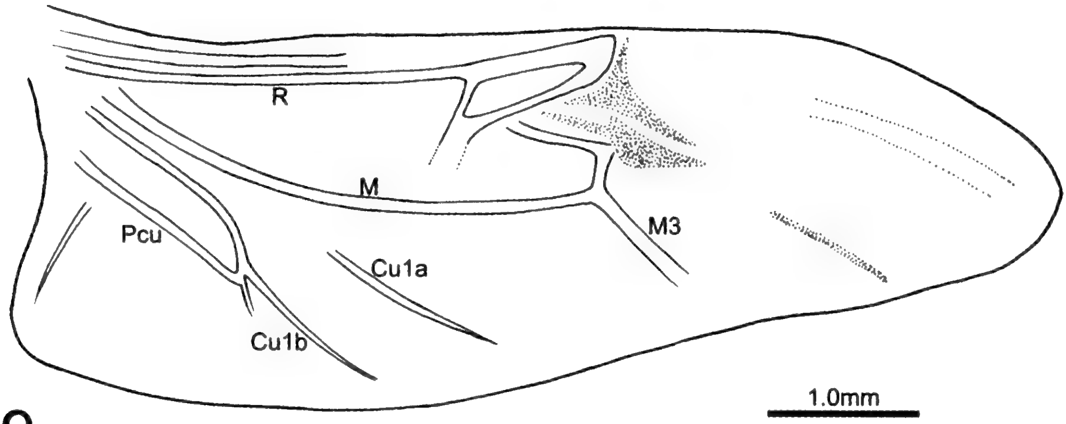
Head (Figs. 3, 4, 5, 6, 7, 12, 13). Subprognathous, convex in lateral view; frons and vertex formed convex line in lateral view; compound eyes elliptic; average dorso-ventral eye length 1.0 - 1.5 mm, average interocular distance 4.0 - 4.8 mm. Frons smooth and depressed, with sparse and small punctuations; coronal and frontal suture present; vertex smooth, with dense and small punctuations; clypeus trapezoid, with sparse, small punctuations, and sparse pubescence; base of clypeus not raised; anterofrontal ridge separated from clypeus; middle part of labrum incised (Fig. 5); mandible with two denticles, outer surface with small, sparse punctuations and sparse pubescence (Figs. 3-4); fourth segment of maxillary palpi shorter than third, apex truncate (Figs. 6, 12-13); basal part of labium palpi closed to each other (Figs. 7, 12-13); antennal callus present, raised and triangular, longer than wide, contiguous. Antennae exceeding to base of elytra, with narrow segments; length of antennae segments: 1.3 : 1.6 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.2 (Fig. 16).

Pronotum (Fig. 1). Length: 4.9 - 6.5 mm, width: 2.2 - 3.1 mm. Cilia of anterior margin of pronotum present; narrowed anteriorly, not strongly dilated anterior to middle; anterior angle pointed and narrow; anterior and posterior margin bordered; with narrow lateral margin; central disc with small and sparse punctuations, as same as that of head; lateral side with large punctuations. Scutellum sub-triangular, smooth and impunctate.

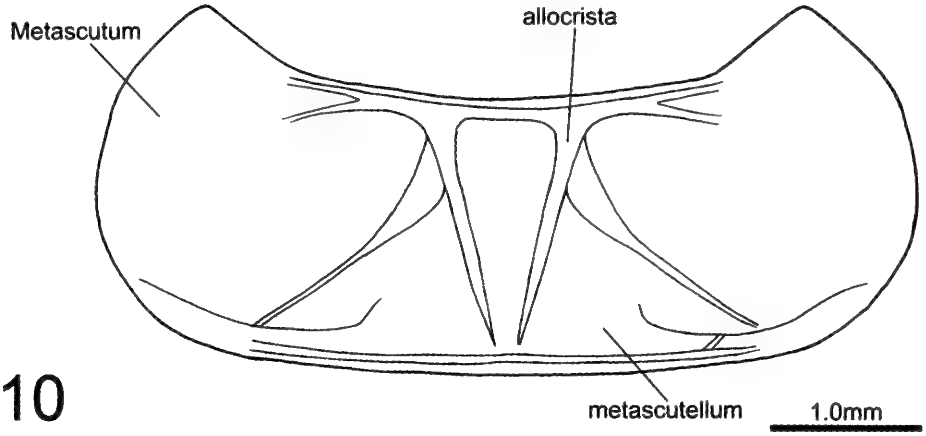
Elytra. Elytral suture length: 7.5 - 11.1 mm, width of elytra: 6.5 - 8.5 mm. Punctuations confused, as strong as that of side of pronotum; humeral calli present; epipleura flat, horizontal, without bristles on inner side.

Underside. Hypomera without punctuations; cilia of anterior and posterior margin of prosternum present; intercoxal prosternal process narrowed basely, then slightly broadened and rounded apically, middle part more than half width of apex, emarginate on apex (Fig. 12); anterior coxal cavities open behind. Mesoventrite well developed, almost as long as prosternum between coxae; intercoxal process of metaventrite margined and truncate anteriorly; metaventrite longer than prosternum; anterior margin of metaventrite bordered by a groove; mesepisternum and metepisternum without punctuations; last abdominal sternite of male rounded.

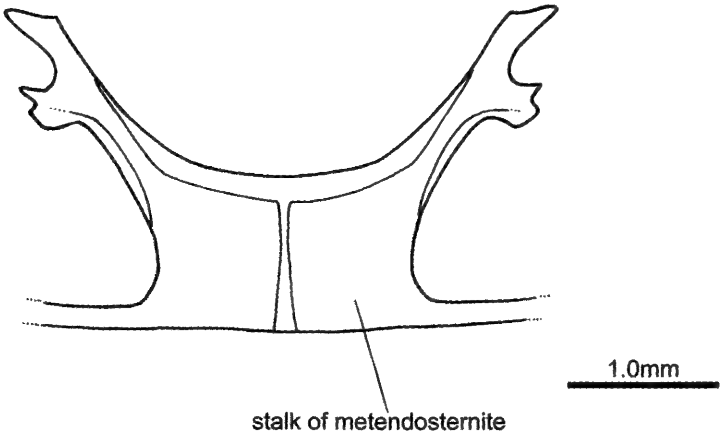
Legs. Hind tarsal segment 3 entirely pubescent beneath; tibial apices rounded, not angularly dilated apically; tarsal segment 3 bilobed and deeply emarginate; tarsal claws simple (Fig. 15).



9

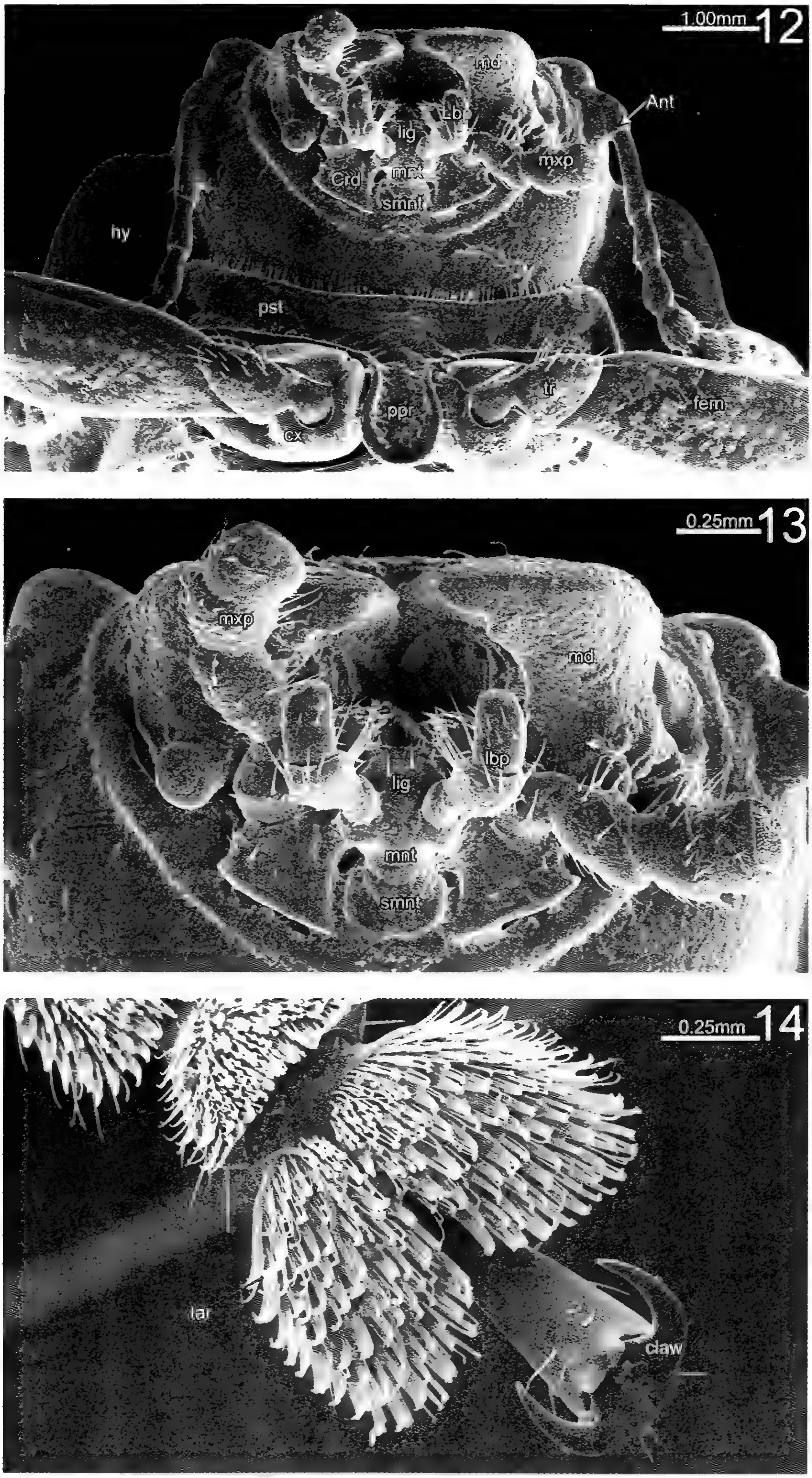


10

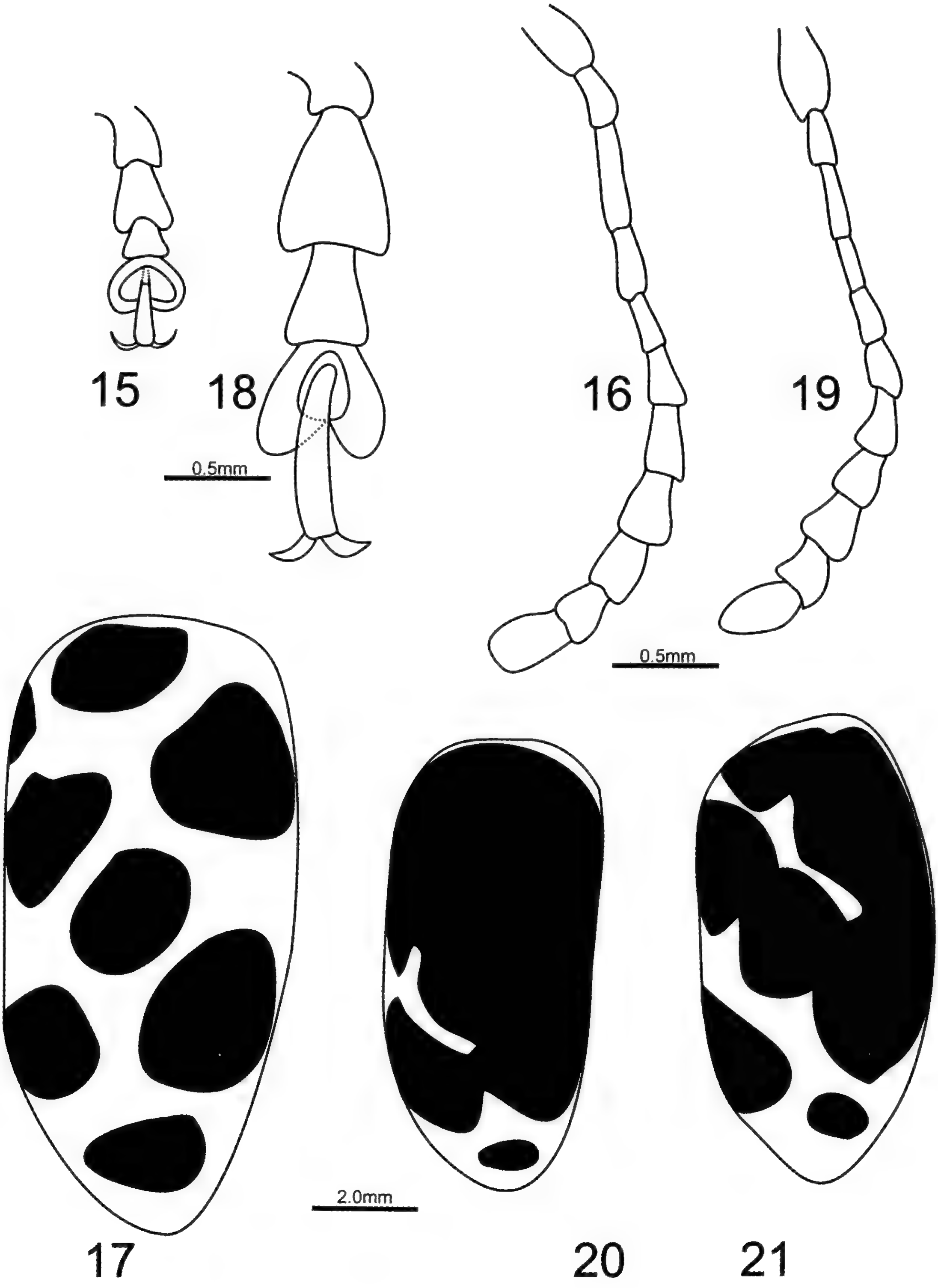


11

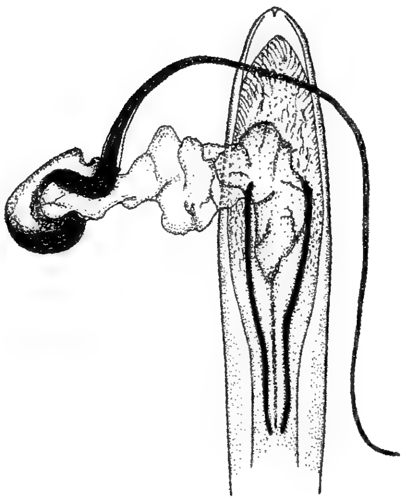
Figs. 9-11. *Agasta formosa* Hope. 9. Hind-wing; 10. metanotum; 11. metendosternite.



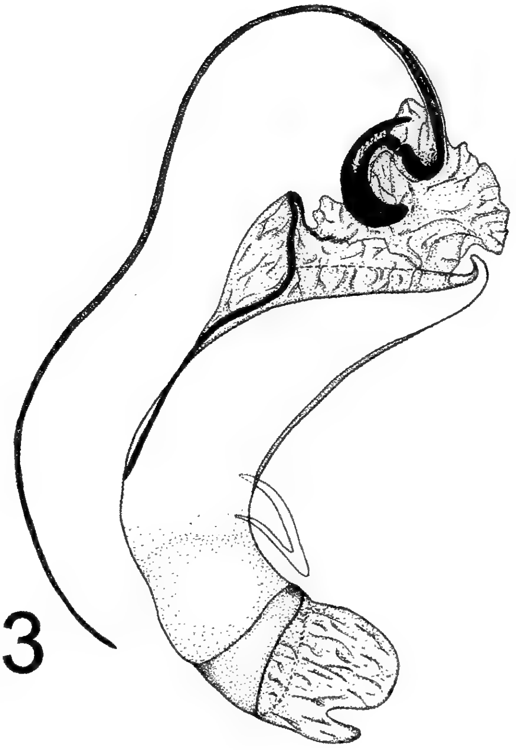
Figs. 12-14. SEM of *Agasta formosa* Hope. 12. Head, ventral view; 13. mouthpart, ventral view; 14. tarsus, ventral view. Abbreviations: Ant: antennae; Crd: Cardo; cx: coxa; fem: femur; hy: hypomeron; lbp: labial palpi; md: mandible; mnt: mentum; smnt: submentum; mxp: maxillary palpi; ppr: prosternal process; tar: tarsi; tr: trochanter.



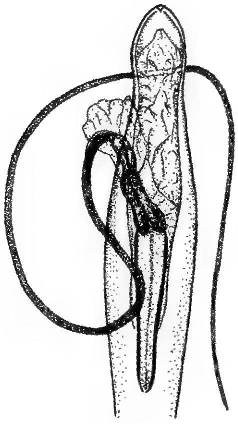
Figs. 15-17. *Agasta formosa* Hope; 15. Tarsus, dorsal view; 16. antenna; 17. elytron. Figs. 18-21. *Agasta annamica* Kimoto and Gressitt. 18. Tarsus, dorsal view; 19. antenna; 20, 21. elytron.



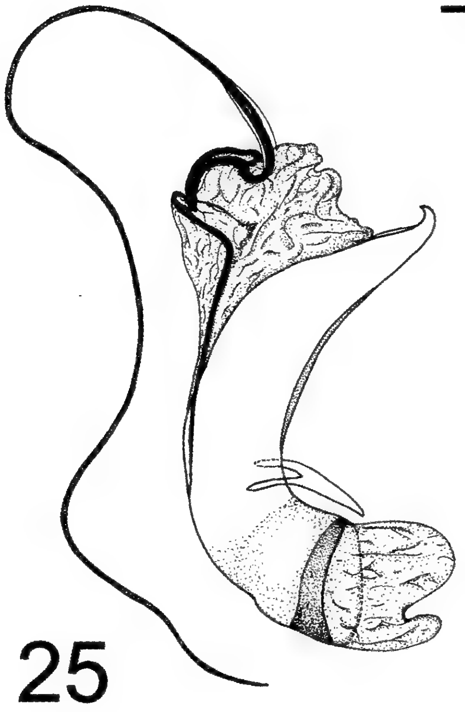
22



23



24



25

Figs. 22-25. Aedeagus. 22. Dorsal view, *Agasta formosa* Hope; 23. lateral view, *Agasta formosa* Hope; 24. dorsal view, *Agasta annamica* Kimoto and Gressitt; 25. lateral view, *Agasta annamica* Kimoto and Gressitt. Notes: Internal sac was moved to lateral side for checking the apex of median lobe.

Aedeagus (Figs. 22-23). Lateral view: median lobe sclerotized except basal part, median part of anterior and posterior walls, basal sclerotized part slightly depressed; base of median lobe deeply incised; basal foramen membranous; apex of median lobe hook-shaped; ligulae long and thin; internal sac very complicated, always half extruding of median lobe; flagellum very long and sclerotized, basal broadened. Dorsal view: basal part almost parallel-sided, then narrowed, slightly rounded apically; ligulae fairly long, reaching basal of median lobe.

Spermatheca (Fig. 26). Complicated and fused, without wide coil U-shaped; ductus also very complicated and fused, chitinous bulb absent. The original position is spermatheca and ductus twisted together, but we adjusted the original position, stretched and divided spermatheca and ductus with each other in order to draw it clearly.

Type Material. Holotype: 1 male, *Agasta formosa* Hope, col: man. pt3. pl.2.f.3 / Type / Named 1900 by M. Jacoby, *Agasta formosa* Hope / Type: col. 2032. *Agasta formosa* Hope. Hope Dept. Oxford.

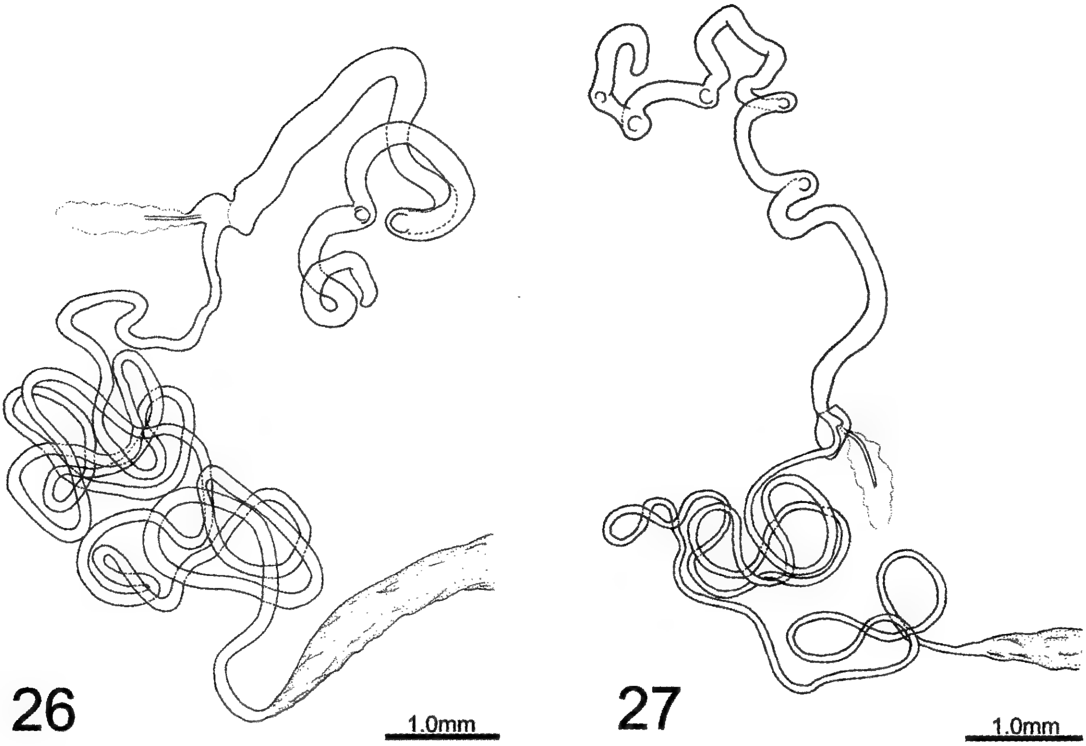
Agasta fleutiauxi Laboissière, 1932, lectotype and paralectotype designated here. Lectotype: 1 male, labeled: Long Xuyen Cochinchine Dorr. / Cotype / Museum Paris, Coll. GÉNÉRALE / *agasta fleutiauxi* Lab., V. Laboissière, -Det. / Lectotype, *Agasta fleutiauxi* Laboissière, 1932, Designated, Daccordi, M. & Ge, S., 2007 / *Agasta formosa* Hope, det. Daccordi, M. & Ge, S., 2007 (MNHM). Paralectotype, 1 male (ZMUH) and 2 females (MNHN), same data as lectotype, only the labels of Paralectotype are different.

Other specimens examined. China: Guangdong: Dinghushan, 200 m, 21 April 1965, 1 female, leg. Youwei Zhang; Guangxi: Longzhou Daqingshan, 360m, 25 April 1963, 1 male, leg. Shuyong Wang. Yunnan: Xishuangbanna: Mengzhe, 870m, 8 July 1985, 1 female, leg. Shuyong Wang; Xiaomengyang, 810m, 30 March 1957, 1 female, leg. Lingchao Zang; Kongmingshan, 2200m, 29 Sep. 1957, 5 males and 5 females, leg. Lingchao Zang; Ganlanba, 650m, 19 March 1957, 1 male, leg. Lingchao Zang; Menga, 1050-1080m, 19 August 1958, 5 males and 5 females, leg. Fuji Pu; Mengla, 620-650m, 9 July 1959, 5 males and 5 females, leg. Fuji Pu; Pingbian Daweishan, 1500m, 17 June 1956, 3 males and 3 females, leg. Keren Huang; Simao, Kunluo Road 591km, 1350m, 11 May 1957, 1 female, leg. Fuji Pu; Cheli, 580-600m, 30 March 1957, 1 female, leg. Lingchao Zang; Ruili Nongsheng, 1450m, 7 June 1956, 2 males and 1 female, leg. Benshou Zhou; Baoshan, Nujiang Honghegu, 1000m, 11 May 1955, 1 female, leg. Buxike; Lancang, 1000m, 1 August 1957, 2 males and 2 females, leg. Shuyong Wang (IZAS). Vietnam: Indochina, August 1932, 3 males, leg. Unknown; NE India : Meghalaya Khasi Hills, Mawsynram, 25°18'N, 91°29'E, 800m, 5-9 June 2006, 1 male, leg. P. Pacholatcho; Arunachal, Dirang vicinity, 1800+/-100m, a.s.l. 27°21'N 92°13'E, 8-22 May 2006, leg. L. Dembicky (BMNH). N Laos: Prov. Lg Nam Tha, ca. 25 Km, SE Muang Sing, 14-15, 20-22 June 6 1996, 900m, 2 females, leg. Schillhammer (27, 34); N. Laos, Myanmar: Shan State Kalaw, above May Palaung Rest. ca. 1300m, 25-30 May 2002, 1 female, leg. Schillhammer & Myint Hlaing (74) (NHMW). India: West Bengalen Dist., Darjeeling Kalimpong, Dumra, Dusty, 1000m, 29 March 1991, 1 male, leg. N. Pangal (NMEG). Sikkim: Harman, 1886, 1 male (MNHN). Indonesia: Java, Borneo, Oudumatra, Boucard, 417-73, 1 male; J. D. Pasteur, 268-94, 1 male; Thailand: Lakhon, Harmand, 1878, 1 female (MNHN).

Distribution. China, Vietnam, Laos, Sikkim, Thailand, Burma, India, Indonesia.

Host Plants. *Casearia* sp. (Flacourticaceae) (Jolivet and Hawkeswood, 1995).

Remarks. After dissecting one female of this species, it was quite unusual that we found over 40 eggs in abdomen. Also for checking the holotype of this species, we cannot find any locality label, so we added the locality "Singapore" in this paper according to the original description by Hope (1840). Kimoto and Gressitt (1981) proposed *Agasta fleutiauxi* Laboissière as the new synonym of *Agasta formosa* Hope, but they did not check the type specimen. We confirmed it as the synonym of *Agasta formosa* Hope after checking the type of *Agasta fleutiauxi* Laboissière.



Figs. 26-27. Spermathecae. 26. *Agasta formosa* Hope; 27. *Agasta annamica* Kimoto and Gressitt.

Agasta annamica Kimoto and Gressitt, 1981

Agasta annamica Kimoto and Gressitt, 1981: 378 (Type locality: Vietnam, Annam. Types deposited in the USNM (Holotype and 1 paratype) and BMBP (2 paratypes), original designated by Kimoto and Gressitt, 1981).

Diagnosis. This species is quite different from *Agasta formosa* (Hope) by the characters of markings, aedeagus and spermatheca.

Redescription. Body: length: 9.6 - 9.8 mm, width: 4.8 - 5.1 mm; elongate-ovoid, large, convex in later view. Hind-wing present.

Head dark brown with labrum and anterior part of clypeus yellowish brown; pronotum dark brown with anterior and lateral parts narrowly brownish; scutellum dark; elytron greenish blue with interior parts of basal margin, basal part of sutural margin, a smaller latero-marginal marking and an irregular apical marking yellowish brown; ventral surfaces bluish black; antenna pitchy black with basal segments brownish; legs bluish black with dorsal surface of tibiae brownish basally (Figs. 20, 21).

Head. Subprognathous, convex in lateral view; frons and vertex formed convex line in lateral view; compound eyes elliptic, average dorso-ventral eye length 1.1 mm. Average interocular distance 3.7 mm; frons depressed and smooth, with sparse and small punctuations; coronal and frontal suture present; vertex smooth, with sparse and small punctuations; clypeus trapezoid, with sparse, small punctuations, and with sparse pubescence; base of clypeus not raised; middle part of labrum incised; mandible with two denticles; outer surface of mandible with sparse, small punctuations, and sparse pubescence; fourth segment of maxillary palpi shorter than third, truncate apically; basal part of labial palpi closed to each other; antennal callus present, raised and triangular, longer than wide, contiguous. Antennae exceeding to base of elytra, with narrow segments; length of antennae segments: 1.3 : 0.8 : 1.2 : 0.7 : 0.7 : 0.7 : 1.0 : 0.8 : 0.8 : 0.6 : 1.1 (Fig. 19).

Pronotum. Length: 4.5 - 5.1 mm; width: 2.1 - 2.4 mm; cilia of anterior margin present; narrowed anteriorly; with narrow lateral margin; not strongly dilated anterior to middle; anterior angles pointed and narrow; anterior margin of pronotum bordered; pronotum punctuations on central part similar to those of head; central part of pronotum with small and sparse punctuations; lateral side with moderate punctuations; base of pronotum margined. Scutellum sub-triangular, smooth and impunctate.

Elytra. Suture length: 0.8 - 0.81 mm; width: 7.0 - 7.5 mm; punctuations as strong as that of side of pronotum; humeral callus present; elytral punctuations confused; epipleura flat and horizontal, without bristles on inner side.

Underside. Hypomera without punctuations; cilia of anterior and posterior margin of prosternum present; intercoxal prosternal process narrowed basely, then slightly broadened and rounded apically, middle part more than half width of apex, emarginate on apex; anterior coxal cavities open behind. Mesoventrite well developed, as long as prosternum between coxae; metaventrite longer than prosternum; anterior margin of metaventrite bordered by a groove; mesepisternum and metepisternum without punctuations; last abdominal sternite of male rounded.

Legs. Tibial apices not armed with a tooth-like process; hind tarsal segment 3 entirely pubescent beneath; tarsal segment 3 bilobed, deeply emarginate; tarsal claws simple (Fig. 18).

Aedeagus (Figs. 24, 25). Lateral view: median lobe sclerotized except basal part, median part of anterior and posterior walls, basal sclerotized part slightly depressed; base of median lobe deeply incised; base of foramen membranous; apex of median lobe hook-shaped; ligula long and thin; internal sac very complicated, always out of median lobe; flagellum extremely long, basal broadened. Dorsal view: slightly widened basally, then narrowed, slightly sharpened apically; ligulae fairly long, reaching basal part of median lobe.

Spermatheca (Fig. 27). Complicated, without wide coil U-shaped; ductus also very complicated and fused, chitinous bulb absent. The original position is spermatheca and ductus twisted together, but we adjusted the original position, stretched and divided spermatheca and ductus with each other in order to draw it clearly.

Variation. There are some colour variations present in this species. Head dark brown with labrum and anterior part of clypeus yellowish brown. Pronotum dark brown with anterior and lateral portions narrowly brownish; scutellum dark; elytron dark brown with interior parts of basal margin, basal part of sutural margin, a long irregular latero-marginal marking and an irregular apical marking yellowish brown; ventral surfaces bluish black; antenna pitchy black with basal segments brownish; legs bluish black with dorsal surface of tibiae brownish basally.

Material Examined. Types: Paratype: 1 male, Annam / Prov, Haut Donai Col De Blao / Alt. 900m, IX-23'32 / M. Poilane Coll. / US / PARATYPE / *Agasta annamica* Kimoto & Gressitt (BPBM); 1 female, Agr. stat. of Biao, Prov. Haut Donai. Alt. 800m. VII 2 33 / Annam, Cochinchina / M P pilane Coll. / US / PARATYPE / *Agasta annamica* Kimoto & Gressitt / 1 spm, same data kept in BPBM, G. A. Samuelson det. 1979 (BPBM).

Other materials examined. Annam, Cochinchina - Agr. stat. of Biao, Prov. Haut Donai. Alt. 800m. VII 2 33. M. Poilane Coll. 1 male and 1 female (USNM); same data: 1 male and 1 female (MDC); same data excepted collecting date, IV 20 33, 1 male and 1 female (USNM); same data excepted collecting date, IV 23 33, 1 male (USNM), same data excepted collecting date, IX 23 32, 1 male and 1 female (IZAS), 1 male (USNM). S. Vietnam: 14 KM SW Bao Loc, 16-29 May 1994, 1 female, leg. Pacholatko & Dembicky (NHMW). Annam: Dajiring, 1 female, H. Perrot (MDC).

Distribution. Vietnam.

ACKNOWLEDGEMENTS

We thank Mrs. Sharon Shute (BMNH), Dr. Nicole Berti (MNHM), Dr. G. Alan Samuelson (BMBP), Dr. David Furth, and Dr. Alexander Konstantinov (USNM) for helping borrow the type specimens. Mr. Roberto Pace (Monteforte D'Alpone, Verona, Italy) for drawing the habitus of *Agasta formosa* Hope. This project was supported by a grant from National Science Foundation of China (Grant No. 30499341).

LITERATURE CITED

Baly, J. S. 1867. Phytophaga Malayana. Transactions of the Entomological Society of London, 3, 4 (2): 1-300, 5 plates.

Beutel, R. G. and F. Haas. 2000. Phylogenetic relationships of the suborders of Coleoptera (Insecta). Cladistics 16: 103-141.

Biondi, M. and M. Daccordi. 1998. A proposed new supra-specific classification of *Chrysomela* Linné and other related genera, and a description of new taxa. 49-71. *In*, M. Biondi, M. Daccordi, and D.G. Furth (Editors). Proceedings of the Fourth International Symposium on the Chrysomelidae. Museo Regionale di Scienze Naturali. Torino, Italy. 327 pp.

Chapuis, F. 1874. *In*, M.T. Lacordaire and M.F. Chapuis (Editors). Histoire Naturelle des Insectes. Genera des Coléoptères ou exposé méthodique et critique de tous les genres proposés jusqu'ici dans cet ordre d'insectes. 10. Famille des Phytophages. Librairie Encyclopédique de Roret. Paris, France. 455 pp.

Chen, S. H. 1931. Description de trois Chrysomelinae nouveaux de l'Asie orientale. Bulletin de la Société Entomologique de France 1931: 127-131.

Chen, S. H. 1934. Recherches sur les Chrysomelinae de la Chine et du Tonkin. Thèses présentées à la Faculté des Sciences de L' Université de Paris 1re thèse. Paris, France. 105 pp.

Chen, S. H. 1936. Catalogue des Chrysomelinae de la Chine, de l'indochine et du Japon. Notes d'Entomologie Chinoise 3(5): 63-102.

Daccordi, M. 1982. Crisomeline orientali nuove o poco note del Museo di Storia Naturale di Basilea (Svizzera) (Col. Chrysomelidae). Entomologica Basiliensia 7: 394-407.

Gressitt, J. L. and S. Kimoto. 1963. The Chrysomelidae (Coleopt.) of China and Korea. Part 2. Pacific Insects Monograph 1B: 301-1026.

Hope, F. W. 1840. The Coleopterist's Manual, part the third, containing various families, genera and species of beetles recorded by Linneus and Fabricius, also descriptions of newly discovered and unpublished insects. J. C. Bridgewater. London, UK. 191 pp.

Jacoby, M. 1889. Descriptions of some new species of phytophagous Coleoptera. Entomological Monthly Magazine 25: 203-206.

Jolivet, P. and T. J. Hawkeswood. 1995. Host-Plants of Chrysomelidae of the world. Backhuys. Leiden, Neitherland. 281 pp.

Kimoto, S. and J. L. Gressitt. 1981. Chrysomelidae, Coleoptera of Thailand, Cambodia, Laos, and Vietnam 2. Clytrinae, Cryptocephalinae, Chlamisinae, Lamprosomatinae and Chrysomelinae. Pacific Insects 23 (3-4): 286-391.

Laboissière, V. 1932. Chrysomelidae nouveaux de l'Indochine et de la presqu'ile de Malacca. Annales de l'Association des Naturalistes de Levallois-Perret 20: 130-135.

Lawrence, J. F. 1999. The Australian Ommatidae (Coleoptera:Archostemata): New species, larva and discussion of relationships. Invertebrate Taxonomy 13 (3): 369-390.

Maulik, S. 1926. The fauna of British India, including Ceylon and Burma, Coleoptera, Chrysomelidae, (Chrysomelinae and Halticinae). London, England, UK. 442 pp.

Wang, S. Y. 1996. Chrysomelinae: *Agasta*. pp. 64-65. *In,* P. Y. Yu, S. Y. Wang, and X. K. Yang (Editors). Economic Fauna of China, Vol. 54, Coleoptera: Chrysomeloidea II. Science Press. Beijing, China. 324 pp.

THREE NEW SPECIES OF *KAPSA* (HEMIPTERA: CICADELLIDAE: TYPHLOCYBINAE) FROM CHINA[1]

Yue-hua Song,[2] Can Li,[2, 3] and Zi-zhong Li[2]

ABSTRACT: In this paper, three new species of the genus *Kapsa* Dworakowska, 1972 from China are described and illustrated: *K. fangxianga* n. sp., *K. biprocessa* n. sp. and *K. arca* n. sp.

KEY WORDS: Hemiptera, Cicadellidae, Typhlocybinae, leafhoppers, *Kapsa*, new species, China

The leafhopper genus *Kapsa* Dworakowska (1972) belongs to the tribe Erythroneurini (Typhlocybinae) with *Typhlocyba farcifrons* Jacobi, 1941 as its type species. Until now, twenty-one species are known in the world (Chiang and Knight, 1990; Dworakowska, 1972, 1979, 1980, 1981a, 1981b, 1994; Dworakowska, Nagaich and Singh, 1978; Dworakowska and Sohi, 1978; Sohi and Mann, 1992). In this paper, three new species are described and illustrated from Guizhou province, China. The type specimens of the new species are deposited in the Institute of Entomology, Guizhou University, Guiyang, Guizhou (IEGU).

SYSTEMATIC ENTOMOLOGY

Kapsa Dworakowska, 1972

Kapsa Dworakowska, 1972. Bull. Acad. Pol. Sci. Cl. II. Ser. Sci. Biol. 20(6): 402.

Type Species: *Typhlocyba farcifrons* Jacobi, 1941 (by original designation).

This genus is very closely related to *Empoascanara* Dworakowska, subgenera *Empoascanara* Distant and *Kanguza* Dworakowska, but with narrower head and face and broader pronotum. Male pygofer, aedeagus, connective and abdominal apodemes similar to those of *Empoascanara*, but subgenital plate with very long macrosetae and microsetae on dorsal margin not grouped. Style with secondary extension.

Distribution: India (Sikkim); Sri Lanka; Indonesia; Nepal; New Guinea; Vietnam; China (Taiwan, Sichuan, Guizhou) (Chiang and Knight, 1990; Dworakowska, 1972, 1979, 1980, 1981a, 1981b, 1994; Dworakowska, Nagaich and Singh, 1978; Dworakowska and Sohi, 1978; Sohi and Mann, 1992).

---

[1] Received on September 24, 2007. Accepted on November 6, 2007.

[2] Institute of Entomology, Guizhou University, Guiyang, Guizhou, 550025, China. E-mail: songyuehua@163.com

[3] Department of Biology & Engineering, Guiyang University, Guizhou, 550005, China. E-mail: lican790108@163.com. Corresponding author. (ZZL) e-mail: lizizhong38@163.com

Mailed on November 12, 2008

Kapsa fangxianga Song and Li, Z. Z., NEW SPECIES

(Figures 1-9, 28)

Type Locality: CHINA, Guizhou, Fangxiang, Mt. Leigong.

Description: Color: Body milky. Vertex (Fig. 1) with pair of milk yellow irregular streaks. Eyes black. Pronotum (Fig. 1) light brown, median area with dark brown arched stripe; scutellum brownish, transverse impression distinct. Dorsal surface of abdomen yellowish, ventral surface dark brown medially; legs light yellow. Forewing and hindwing transparent.

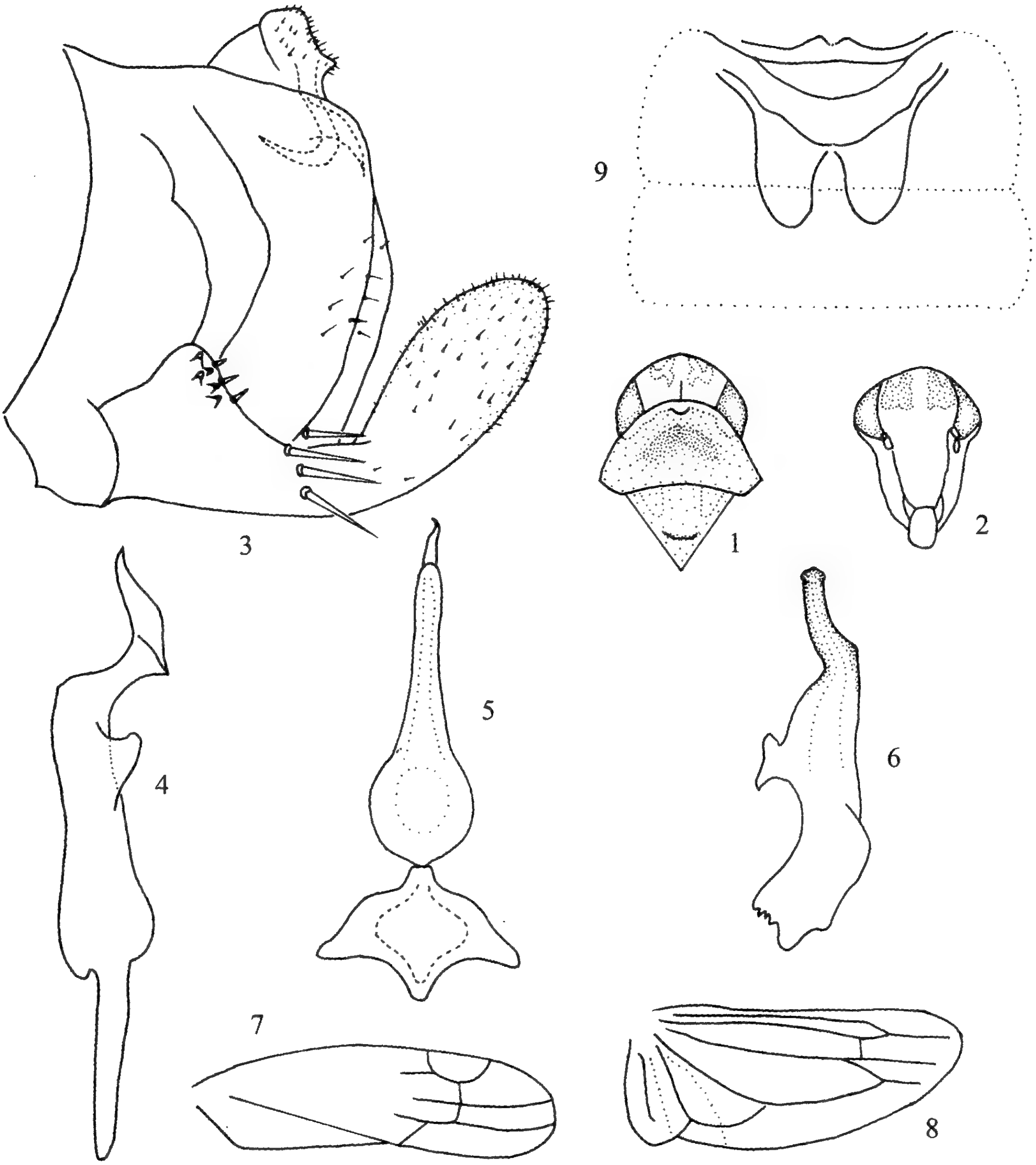
Structure: Body length males 2.7-2.9 mm, females 2.9-3.0 mm. Head (Figs. 1, 2) long, slightly narrower than pronotum, anterior margin bluntly produced. Coronal suture distinct, length about 0.5x median length of vertex. Face (Fig. 2) long and narrow, frontoclypeal area gently swollen, anteclypeus expanded at apex. Pronotum broad, anterior margin rounded and posterior margin shallowly concave; scutellum slim, triangular, little longer than median length of pronotum. Forewing (Fig. 7) with 4 apical cells, 1st largest; 2nd slender; 4th smallest, nearly semicircular.

Male Genitalia: Pygofer side (Fig. 3) broad, with numerous microsetae at apex, dorsal appendage shorter, hook-like. Anal tube appendage (Fig. 3) crescent-like apical, short at base, it bends towards dorsal margin. Subgenital plate (Fig. 3) deeply concave medially, expanded at apex, with four long macrosetae on outer lateral surface; several peg-like setae at base. Style (Fig. 4) apex sinuate; base slender, with clear lamellate process subapically. Aedeagal shaft (Fig. 5) long, with a small process, teeth-like (Fig. 6), preatrium expanded, gonopore apical. Connective about M- or Y-shaped. Abdominal apodemes (Fig. 9) reaching 4th segment, wide and short, finger-like. Female genitalia (Fig. 28): ovipositor extending about a fifth its length beyond pygofer. Seventh sternite (Fig. 28) posterior margin sinuate, and sharp in center.

Material Examined: Holotype, male: Guizhou: Fangxiang, Mt. Leigong, 26°43'N 108°20'E, 900-1100m., 17-IX-2005, coll. Yuehua Song. Paratypes: seven males, ten females, same data as holotype.

Diagnosis: This new species is most similar to *K. simlensis* Dworakowska, Nagaich and Singh, 1978 (see Dworakowska, Nagaich and Singh, 1978), but can be distinguished from the latter by the following characteristics: 1) the new species vertex with pair of irregular spots at anterior margin, each one with three branches, and the spots of *K. simlensis* crescent-like; 2) *K. simlensis* aedeagal shaft with scale-like sculptures at apex, but the new species without that; 3) the new species connective nearly M- or Y-shaped, is not the same as *K. simlensis*.

Etymology: This new species is named after its locality (Fangxiang). It is feminine in gender.



Figures 1-9. *Kapsa fangxianga* n. sp. 1. Head and thorax, dorsal view. 2. Face. 3. Pygofer side and subgenital plate, left lateral view. 4. Style, ventral view. 5. Aedeagus and connective, ventral view. 6. Aedeagus, right lateral view. 7. Right forewing. 8. Hindwing. 9. Abdominal apodemes.

Kapsa biprocessa **Song and Li, Z. Z., NEW SPECIES**

(Figures 10-18, 29)

Type Locality: CHINA, Guizhou, Sandu.

Description: Color: Crown (Fig. 10) brownish-yellow, with some yellowish spots and lateral symmetry. Eyes dark brown. Body light yellow. Forewing brownish-yellow and hindwing transparent.

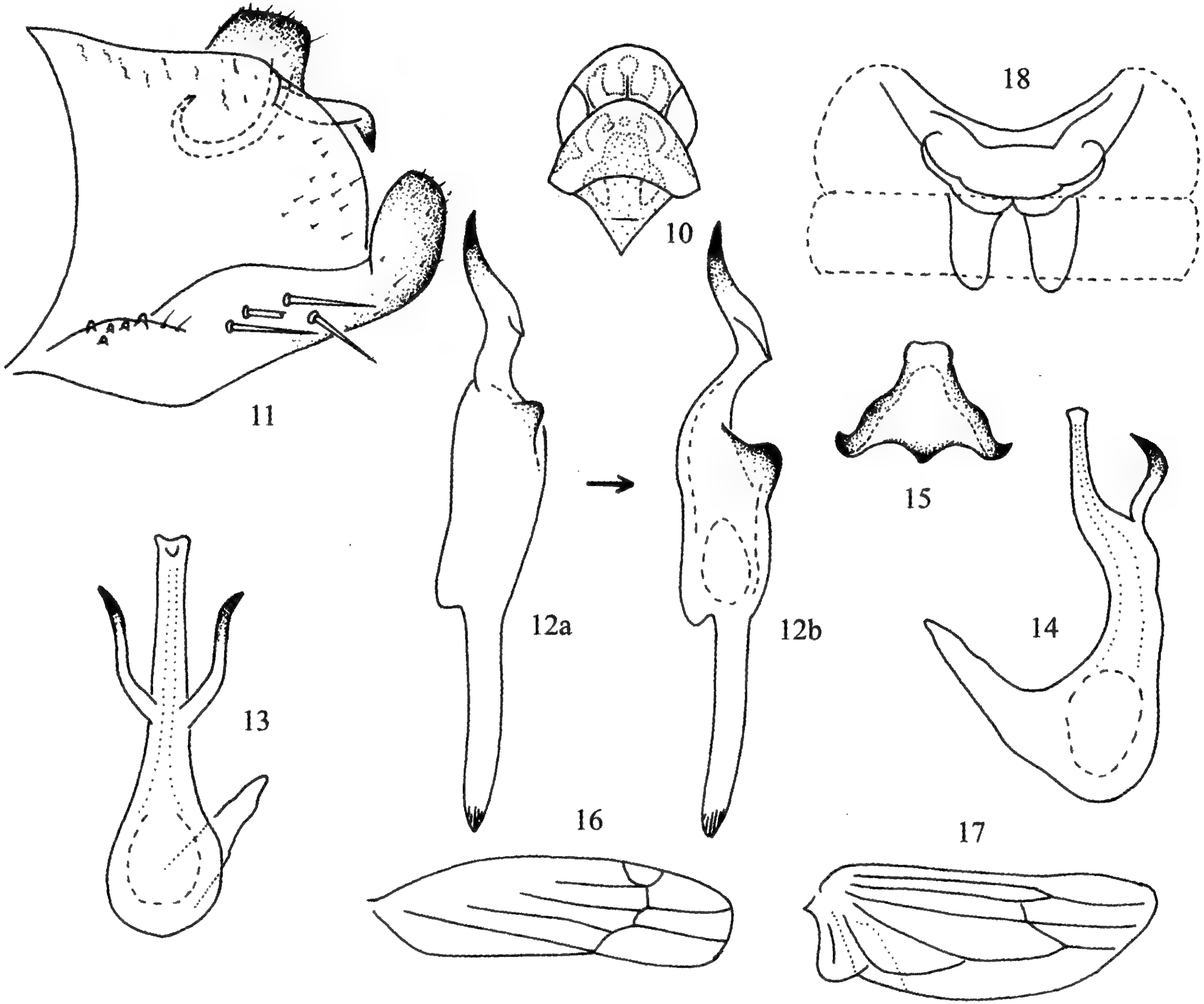
Structure: Body length males 2.5-2.6 mm, females 2.5-2.8 mm. Structural characters as in *K. fangxianga*.

Male Genitalia: Dorsal pygofer appendage (Fig. 11) with a nearly triangular, very sharp apex. Anal tube appendage (Fig. 11), a little longer than that of *K. fangxianga.* Subgenital plate (Fig. 11) slightly swollen at base and concave near median, apex pocket-like, with four (one of them broken) macrosetae on outer lateral surface, several microsetae and some peg-like setae at base. Style (Figs. 12a, 12b) as in *K. fangxianga*. Aedeagal shaft (Figs. 13, 14) with pair of long processes, gonopore near apex. Connective nearly Y-shaped. Female genitalia (Fig. 29): ovipositor shorter than that of *K. fangxianga*. Seventh sternite (Fig. 29) posterior margin sinuate, nearly truncate in center.

Material Examined: Holotype, male: Guizhou: Sandu, 26ºN 107°86'E, 984m., 27-X-1984, coll. Zizhong Li. Paratypes: three males, fourteen females, same data as holotype.

Diagnosis: This new species is related to *K. elscinta* Chiang and Knight, 1990 (see Chiang and Knight, 1990), but differentiated in that *K. elscinta* has: 1) the new species aedeagal shaft with pair of long processes, each one S-shaped (Figs. 13, 14), the processes of *K. elscinta* very short, teeth-like; 2) the new species abdominal apodemes (Fig. 18) much shorter, finger-like, but that of *K. elscinta* longer, extending to 5th sternite; 3) the new species crown with the unique yellowish patches (Fig. 10), but *K. elscinta* without any patches on head.

Etymology: The name of the new species refers to the pair of processes of the aedeagal shaft (Figs. 13, 14), it is derived from the Latin prefix “bi-” (two), plus “process,” and it is feminine in gender.



Figures 10-18. *Kapsa biprocessa* n. sp. 10. Head and thorax, dorsal view. 11. Pygofer side and subgenital plate, left lateral view. 12a. Style, ventrolateral view. 12b. Style, ventral view. 13. Aedeagus and connective, ventral view. 14. Aedeagus, right lateral view. 15. Connective. 16. Right forewing. 17. Hindwing. 18. Abdominal apodemes.

Kapsa arca Song and Li, Z. Z., NEW SPECIES

(Figures 19-27, 30)

Type Locality: CHINA, Guizhou, Luodian.

Description: Color: Body brownish except yellowish abdomen. Crown with pair of small patches near anterior margin, milky yellow. Eyes black. Frontoclypeal area thin, long, brownish. Hindwing transparent.

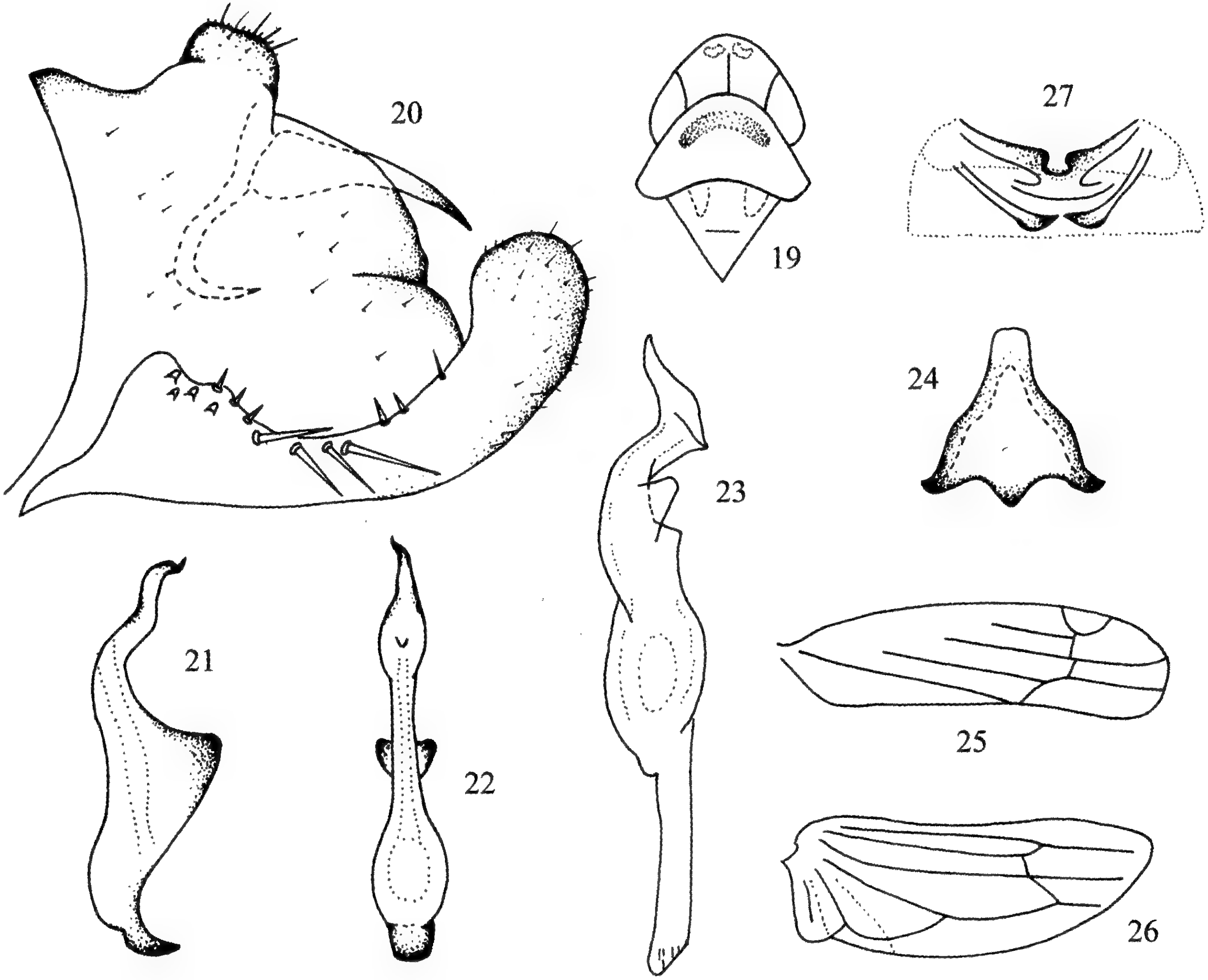
Structure: Body length males 2.7-2.8 mm, females 2.9-3.0 mm. Crown (Fig. 19) width slightly less than greatest width of pronotum. Vertex little produced, coronal suture distinct. Vertex median length about 2/3 times pronotum. Pronotum (Fig. 19) very broad, with arched brown band near anterior margin; anterior margin convex, posterior margin concave. Scutellum median length subequal to that of pronotum.

Male Genitalia: Pygofer side (Fig. 20) broad, with numerous microsetae. Dorsal appendage long (Fig. 20), extending about half its length beyond posterior margin of pygofer. Anal tube appendage long, apex hook-like, bends caudally. Subgenital plate with four medial macrosetae, other structural characters as in *K. fangxianga*. Aedeagal shaft (Figs. 21, 22) long, sinuate at apex, S-shaped. Gonopore (Fig. 22) subapical. Connective (Fig. 24) about Y-shaped, as in that of *K. biprocessa*, but with a longer body. Abdominal apodemes extremely small, just in 3rd sternite. Female genitalia (Fig. 30): ovipositor extending a little of its length beyond pygofer. Seventh sternite (Fig. 30) posterior margin sinuate, arcuate in center.

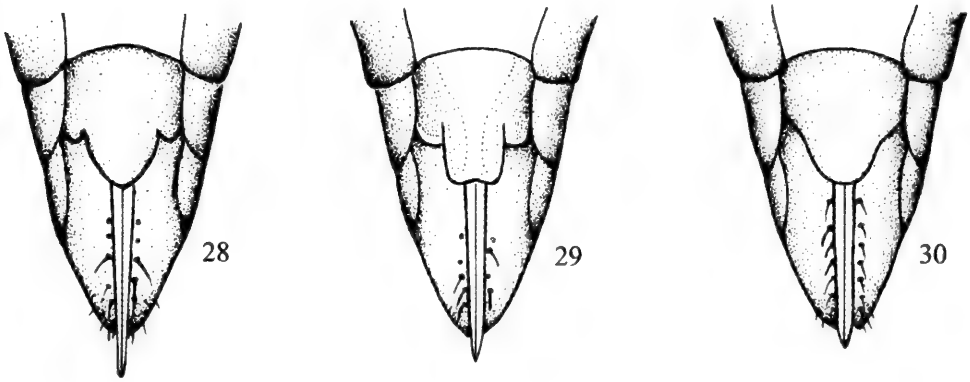
Material Examined: Holotype, male: Guizhou: Luodian, 25°21'N 105°55'E, 800m., 3-VI-1981, coll. Zizhong Li. Paratypes: three males, seven females, same data as holotype; Four males, six females, Guizhou: Weng'an, 27°08'N 107°48'E, 1028m., 18-VI-1981, coll. Zizhong Li.

Diagnosis: This new species resembles *K. dolka* Dworakowska, 1979 (see Dworakowska, 1979), but differs from the latter by the following characteristics: 1) the new species with an arc-like brown band on the pronotum (Fig. 19), *K. dolka* without that, 2) the new species gonopore subapical (Fig. 22), but that of *K. dolka* apical; 3) the new species connective about Y-shaped, with body as long as arms (Fig. 24), and that of *K. dolka* nearly M-shaped.

Etymology: This species is named for the arc-like brown band on the pronotum (Fig. 19), it is derived from the Latin word "arc" (shaped like a bow), and it is feminine in gender.



Figures 19-27. *Kapsa arca* n. sp. 19. Head and thorax, dorsal view. 20. Pygofer side and subgenital plate, left lateral view. 21. Aedeagus, left lateral view. 22. Aedeagus, ventral view. 23. Style, ventral view. 24. Connective. 25. Right forewing. 26. Hindwing. 27. Abdominal apodemes.



Figures 28-30. Female terminal segments, ventral view. 28. *Kapsa fangxianga* n. sp. 29. *K. biprocessa* n. sp. 30. *K. arca* n. sp.

ACKNOWLEDGMENTS

We would like to thank Dr. D. A. Dmitriev, Section for Biodiversity, Illinois Natural History Survey, USA; and Mr. C. C. Chiang and Dr. K. W. Huang, National Museum of National Science, Taiwan, China, who presented valuable literature for this study. Also, thanks to Dr. Hong Yang, Institute of Entomology, Guizhou University, Guiyang, Guizhou 550025, China, for providing warm-hearted assistance during the preparation of this manuscript.

LITERATURE CITED

Chiang, C. C. and W. J. Knight. 1990. Studies on taiwanese Typhlocybinae (Homoptera: Cicadellidae) (IV) tribe Erythroneurini. Bulletin of the National Museum of Natural Science Number 2: 191-255.

Dworakowska, I. 1972. On some oriental Erythroneurini (Auchenorrhyncha, Cicadellidae, Typhlocybinae). Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques 20(6): 395-405.

Dworakowska, I. 1979. On some Erythroneurini from Vietnam (Typhlocybinae, Cicadellidae). Annotationes Zoologicae et Botanicae 131: 1-50.

Dworakowska, I. 1980. On some Typhlocybinae from India (Homoptera, Auchenorrhyncha, Cicadellidae). Entomologische Abhandlungen Staatliches Museum für Tierkunde in Dresden 43(8): 152-202.

Dworakowska, I. 1981a. On some Typhlocybinae from India, Sri Lanka and Nepal (Homoptera, Auchenorrhyncha, Cicadellidae). Entomologische Abhandlungen Staatliches Museum für Tierkunde in Dresden 44(8): 153-202.

Dworakowska, I. 1981b. *Proskura* gen.n. and some Erythroneurini from Southern India (Homoptera, Auchenorrhyncha, Cicadellidae, Typhlocybinae). Reichenbachia Staatliches Museum für Tierkunde Dresden 19(37): 225-246.

Dworakowska, I. 1994. Typhlocybinae (Auchenorrhyncha: Cicadellidae) of Sikkim, a preliminary survey. Folia Entomologica Hungarica Rovartani Közlemények 55: 93-215.

Dworakowska, I., B. B. Nagaich, and S. Singh. 1978. *Kapsa simlensis* sp.n. from India and some other Typhlocybinae (Auchenorrhyncha, Cicadellidae). Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques 26(4): 243-249.

Dworakowska, I. and A. S. Sohi. 1978. *Kadrabia* gen.n. and some other Typhlocybinae (Auchenorrhyncha, Cicadellidae) from India. Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques 26(7): 463-471.

Sohi, A. S. and J. S. Mann. 1992. Fourteen new species and some new records of Asian Erythroneurini (Insecta, Auchenorrhyncha, Cicadellidae, Typhlocybinae). Reichenbachia Staatliches Museum für Tierkunde Dresden 29(22): 123-143.

NITIDULIDAE (COLEOPTERA) FOUND IN FLOWERS OF *CALYCANTHUS FLORIDUS* LINNAEUS (LAURALES: CALYCANTHACEAE) IN NORTHEASTERN OHIO, U.S.A.[1]

Roger N. Williams,[2] Nuris M. Acosta,[2] and Michele B. Price[3]

ABSTRACT: Attractiveness of sweet shrub flowers, *Calycanthus floridus* Linnaeus, to species of Nitidulidae was determined from collections made May to mid-July (1991-2004) at the Ohio Agricultural Research and Development Center (OARDC) of the Ohio State University and surrounding areas. A total of 2064 nitidulids were collected, representing 17 species and 9 genera. The most abundant nitidulids collected at OARDC were *Carpophilus lugubris* Murray (56%), *Colopterus truncatus* (Randall) (20%) and *Carpophilus brachypterus* (Say) (15%). The most common nitidulids collected in the surrounding areas were *C. truncatus* (56%) followed by *C. lugubris* (28%). The remaining nitidulid species in both areas represented less than 7% of the specimens collected. Our data show a diversity of nitidulid species attracted to *C. floridus* flowers, with two species accounting for nearly 80% of the nitidulids associated with *Calycanthus*.

KEY WORDS: *Calycanthus floridus*, Lauraceae, Nitidulidae, inventory, sweet shrub, northeastern Ohio, U.S.A.

Calycanthus floridus Linnaeus is a shrub native to the moist woodlands of the eastern United States. Its range extends from New York, south to Florida, and west to Missouri (USDA 2007). There are many common names for this plant, all alluding to the aromatic properties of its leaves, bark, twigs and roots, with the most common names being: sweet shrub, sweet bush, spice bush, Carolina allspice, strawberry shrub, bubby blossom, sweet bubby, and sweet bettie (Floridata 2004). The flowers have a fragrant smell, which has been described as a combination of strawberry, pineapple, and banana.

The attraction of sap beetles to volatiles of *Calycanthus* was first reported by McCormack (1975). James et al. (1993) also noted the lure of nitidulids to volatiles from fermenting fruit and grains. Several sap beetles are considered as minor pests; however the presence of large numbers on a plant can cause economic damage due to feeding, the main impact being reduced value of the product due to contamination (Bartelt et al., 1992, Dowd, 2000). In Ohio several studies have been conducted on the use of aggregation pheromones for nitidulids as alternative control measures (Williams et al., 1993; Williams et al., 1995) and baits (Blackmer and Phelan, 1995). Therefore, natural substrates that are strongly attractive to nitidulids are worthy of investigation.

We observed the presence of nitidulids on the fruitlike fragrant flowers of *Calycanthus* and conducted a preliminary study. The beetles are generally not seen on the *Calycanthus* flowers, but when the flower is broken off and placed

---

[1] Received on November 15, 2007. Accepted on January 9, 2008.

[2] Department of Entomology, OARDC, The Ohio State University, 1680 Madison Avenue, Wooster, Ohio 44691 U.S.A. E-mails: williams.14@osu.edu, acosta.26@osu.edu, respectively.

[2] Department of Entomology, University of Wisconsin-Madison, 445 Russell Laboratories, Madison, Wisconsin 53706 U.S.A. E-mail: mprice@wisc.edu.

Mailed on November 12, 2008

in a container, the beetles begin to emerge from the flower heads allowing for easy collection. After several collections we had caught a wide variety of sap beetles. Subsequently we decided to make this a long-term study. The objectives of this study were 1) to determine the breadth of attractiveness of *C. floridus* flowers to nitidulids on the Wooster Campus of the Ohio State University (Ohio Agricultural Research and Development Center, OARDC) and, 2) to sample nearby locations to confirm the presence and diversity of the nitidulid species.

METHODS

Most collections were made from *C. floridus* shrubs at the Secrest Arboretum on the OARDC campus at Wooster, Ohio. Additional collections were made in nearby plantings in the following areas: Kingwood Center in Mansfield, a backyard in Wooster, and Dawes Arboretum in Newark. Collections were made at approximately seven-day intervals during the local blooming season of *C. floridus*, (May through mid-July). Ten to 100 blooms were gathered for each collection, depending on availability. Blooms were separated in groups of approximately 10, placed in plastic bags, and taken to the laboratory for processing. In the laboratory, blooms were torn apart and the nitidulids were collected. Collections were made over an eight-year period from 1991-2004; no collections were made during 1992, 1998, and 2000-2003. Nitidulid identifications were conducted by Sean Ellis, Ohio State University and coauthor MBP. Voucher specimens will be placed at the Charles A. Triplehorn Insect Collection at the Ohio State Department of Entomology in Columbus, Ohio.

RESULTS

Fifty-two nitidulid collections were obtained, yielding 2064 specimens (Table 1). Seventy percent of the collections were on the OARDC campus, about 15% in a backyard in Wooster, as well as, Kingwood Center and only 2% in Mansfield and Dawes Arboretum. On average we found approximately 2 nitidulids per bloom. Some blossoms contained 6 or 8, others had none.

Seventeen nitidulid species in nine genera were found in varying frequencies (Table 1). At OARDC, 3 species comprised 90% of the 15 species collected; the most abundant species (> 100 specimens) being the dusky sap beetle, *Carpophilus lugubris* Murray (Fig. 1), with nearly 900 specimens collected and accounting for 56% of the nitidulids collected. *Colopterus truncatus* (Randall) (Fig. 2) (20%) and *Carpophilus brachypterus* (Say) (Fig. 3) (15%) accounted for the second and third most abundant nitidulid speciecs collected at OARDC. At the other sites, only 2 of the 11 species collected were considered abundant, with over 250 specimens of *C. truncatus* (56%) and about 130 specimens of *C. lugubris* (28%). The picnic beetle, *Glischrochilus quadrisignatus* (Say) was of moderate abundance (31-78 specimens). The remaining species, 15 at OARDC and 11 at the other sites, were relatively rare and did not exceed 5%. Besides nitidulids, we also observed other coleopterans in the blooms. We did not attempt to identify these beetles; however, from the collections of 2002 we can estimate that 4% of the beetles collected were other than nitidulids.

Table 1. Nitidulid beetles collected in *Calycanthus floridus* in northeastern Ohio, 1991-2004. OARDC represents the Secrest Arboretum on the Ohio Agricultural Research and Development Center at Wooster, Ohio.

	Site and total number captured			
Species	**OARDC**	**%**	**Surrounding Areas**	**%**
***Carpophilus brachypterus* (Say)**[1]	**246**	**15.4**	13	2.8
Carpophilus corticinus Erichson	4	0.3	8	1.7
Carpophilus freemani Dobson	1	0.1	0	0.0
Carpophilus hemipterus (Linnaeus)	6	0.4	1	0.2
***Carpophilus lugubris* Murray**	**890**	**55.7**	**131**	**28.2**
Carpophilus marginellus Motschulsky	44	2.8	7	1.5
Carpophilus sayi Parsons	0	0.0	3	0.6
Carpophilus sp.	1	0.1	0	0.0
Colopterus semitectus (Say)	2	0.1	7	1.5
***Colopterus truncatus* (Randall)**	**316**	**19.8**	**262**	**56.3**
Cryptarcha strigatula Parsons	0	0.0	1	0.2
Epuraea sp.	2	0.1	1	0.2
Glischrochilus fasciatus (Olivier)	4	0.3	0	0.0
Glischrochilus quadrisignatus (Say)	78	4.9	31	6.7
Meligethes sp.	2	0.1	0	0.0
Omosita colon (Linnaeus)	1	0.1	0	0.0
Stelidota geminata (Say)	2	0.1	0	0.0
Total Specimens	**1599**		**465**	

[1] Most abundant species in bold face.

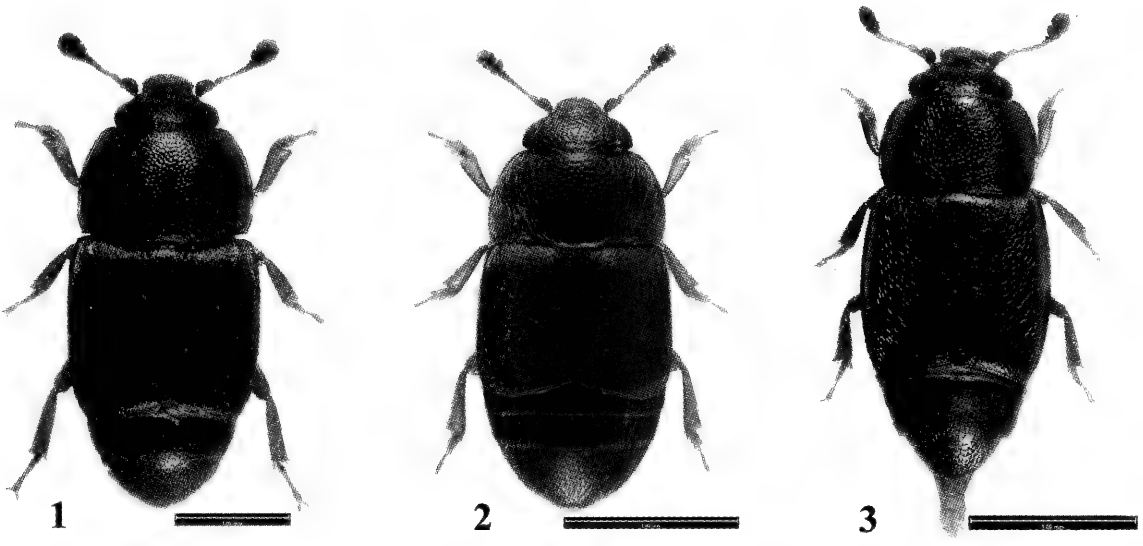
DISCUSSION

The diversity of nitidulid species associated with the fragrant flowers of *Calycanthus floridus* confirmed the attraction sap beetles have to this flower; the most abundant species being *Carpophilus lugubris* (1021 specimens, 49%) and *Colopterus truncatus* (578 specimens, 28%). Grant (1950) observed in California the sap beetle, *C. truncatus,* as the primary pollinator of western sweet shrub, *Calycanthus occidentalis* Hooker and Arnott. Beetles were attracted to the floral odor, entered the flower and became trapped by inwardly pointing bracts and tepals, which are equipped with a series of stiff bristles. The trapped beetles feed on succulent tips of the stamens, staminodia, and upper petals. While feeding, they are covered with sticky pollen and with the separation of the tepals, the beetles are free to move on to a new flower. Rickson (1979) in Oregon demonstrated the food available to the beetles while they are trapped in the flower comes from specialized cells that accumulate rich resources of proteins in vacuoles. The existence of such highly specialized tissues indicates close co-evolution between the plant and its pollinator. Interestingly, McCormack (1975) observed that many species of beetles are initially attracted to *Calycanthus* flowers by a complex array of volatile compounds that may mimic fungal odors, rather than by the food supplies themselves. McCormack found that nitidulids are among the most important pollinators of *Calycanthus*. Due to the diversity of nitidulid species found in *Calycanthus* flowers, no single species or group of species could be designated as the primary pollinator, since the most abundant species changed with the season. In Connecticut, McCormack (1975) recorded 15 nitidulid species in *C. floridus* flowers. We collected 11 of these species plus an additional 6 species in Northeastern Ohio. Due to similarities of many of the species of nitidulids, as can be observed in the figures, consult a specialist when in doubt.

While some nitidulids have been reported to occur in flowers, the majority have been documented to occur in decaying fruits, fermenting plant juices, and in fungi (Habeck 2002). The most abundant nitidulid species collected in our study are commonly considered agricultural pests or nuisance pests. *Carpophilus lugubris* can be a major pest of sweet corn (Connell 1956, Daugherty and Brett 1966, Tamaki et al., 1982). It also infests a wide variety of ripening fruits and vegetables (Harrison 1974). However, *C. lugubris* has also been collected on flowers of *Yucca filamentosa* Linnaeus (Connell 1956) and *Prunus americanus* Marshall (Price and Young 2006). *Colopterus truncatus* has been reported as a vector of the oak wilt pathogen *Ceratocystis fagacearum* (Bretz) Hunt in the north-central United States (Ambourn et al., 2005). Although *Carpophilus brachypterus* has been reported in stored grains (Pellitteri and Boush 1983, Bousquet 1990), it has commonly been documented to feed and mate on a variety of flowering plants (Blatchley 1910, Connell 1956, Price and Young 2006).

Nitidulidae are a diverse group of beetles whose abundance and richness has been reported from Ohio in studies using different baited traps (Williams et al., 1992; Blackmer and Phelan 1995; Williams et al., 1997). Although many previous studies (bait assessment) differ from our current study (flower visitation) in collection methodology, we found a good diversity of nitidulids (17 species) considering the average reported in those studies was 23 species with a maximum of 35 species. In our current study, we found *C. lugubris* to be the most abundant species at OARDC; in previous studies it was abundant, but the most common species were *Stelidota geminata* (Say) and *Glischrochilus quadrisignatus* (Say).

Baits and pheromones have been used to demonstrate that some nitidulid species are attracted to the ripening odors of fruits and vegetables. With the ripening fragrance from flowers of *Calycanthus*, we were able to collect a diversi-



Figures 1-3. 1. *Carpophilus lugubris* Murray. 2. *Colopterus truncatus* (Randall). 3. *Carpophilus brachypterus* (Say).

ty of nitidulid species and confirmed the diversity reported from previous nitidulid surveys in northeastern Ohio. In addition, this study provides the first nitidulid species record on flowers of *C. floridus* in Ohio, hence documenting the variety of beetles that may play a critical role in the pollination of this flowering plant within Ohio.

ACKNOWLEDGEMENTS

We wish to thank Kevin McClure and Dan Fickle for their assistance with this and the other projects with nitidulids that we have conducted.

LITERATURE CITED

Ambourn, A. K., J. Juzwik, and R. D. Moon. 2005. Seasonal dispersal of the oak wilt fungus by *Colopterus truncatus* and *Carpophilus sayi* in Minnesota. Plant Disease 89: 1067-1076.

Bartelt, R. J., P. F. Dowd, R. D. Vetter, H. H. Shorey, and T. C. Baker. 1992. Responses of *Carpophilus hemipterus* (Coleoptera: Nitidulidae) and other sap beetles to the pheromone of *C. hemipterus* and host-related coattractants in California fields tests. Environmental Entomology 21: 1143-1153.

Blackmer, J. L. and P. H. Phelan. 1995. Ecological analyses of Nitidulidae-seasonal occurrence, host choice and habitat preference. Journal of Applied Entomology 119: 321-329.

Blatchley, W. S. 1910. The Coleoptera or beetles of Indiana: An illustrated descriptive catalogue of the Coleoptera known to occur in Indiana. Bulletin of the Indiana Department of Geology and Natural Resources 1: 1-1386.

Bousquet, Y. 1990. Beetles associated with stored products in Canada: An identification guide. Research Branch, Agriculture Canada Publication 1837. Canadian Publishing Centre Supply Services Canada. Ottawa, Canada. 215 pp.

Connell, W. A. 1956. Nitidulidae of Delaware. University of Delaware Agricultural Experiment Station Technical Bulletin 318: 1-67.

Daugherty, D. M. and C. H. Brett. 1966. Nitidulidae associated with sweet corn in North Carolina. North Carolina Agricultural Experimental Station Technical Bulletin 171: 1-40.

Dowd, P. F. 2000. Dusky sap beetles (Coleoptera: Nitidulidae) and other kernel damaging insects in Bt and Non-Bt sweet corn in Illinois. Journal of Economic Entomology 93: 1714-1720.

Floridata. Com LC. 2004. *Calycanthus floridus*. Tallahassee, Florida, U.S.A. 8 August 2007. <http://www.floridata.com/ref/C/caly_flo.cfm>

Grant, V. 1950. The pollination of *Calycanthus occidentalis*. American Journal of Botany 37: 294-297.

Habeck, D. H. 2002. Family 77: Nitidulidae, pp. 311-315. *In*, R. H. Arnett, Jr., M. C. Thomas, P. E. Skelley, and J. H. Frank (Editors). American Beetles. Volume 2. CRS Press. Boca Raton, Florida, U.S.A. 861 pp.

Harrison, F. P. 1974. Chemical control of ear infesting insects of sweet corn. Journal of Economic Entomology 67: 548-550.

James, D. G., R. J. Bartelt, R. J. Faulder, and A. Taylor. 1993. Attraction of Australian *Carpophilus* spp. (Coleoptera: Nitidulidae) to synthetic pheromones and fermenting bread dough. Journal of the Australian Entomological Society 32: 339-345.

McCormack, J. H. 1975. L.: pollinator behavior as a function of volatile oils. Ph.D. Dissertation, University of Connecticut. Storrs, Connecticut, U.S.A. 125 pp.

Pellitteri, P. and G. M. Boush. 1983. Stored-product insect pests in feed mills in southern Wisconsin. Wisconsin Academy of Sciences, Arts and Letters. 71: 103-112.

Price, M. B. and D. K. Young. 2006. An annotated checklist of Wisconsin sap and short-winged flower beetles (Coleoptera: Nitidulidae, Kateretidae). Insecta Mundi 20: 69-84.

Rickson, F. R. 1979. Ultrastructural development of the beetle food tissue of *Calycanthus* flowers. American Journal of Botany 66: 80-86.

Tamaki G., L. Fox, and P. Featherston. 1982. Laboratory biology of the dusky sap beetle and field interaction with the corn earworm in ears of sweet corn. Journal of the Entomological Society of British Columbia 79: 3-8.

USDA, NRCS. 2007. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, Louisiana 70874-4490, U.S.A. 8 August 2007. <http://plants.usda.gov/java/ profile?symbol= CAFL22>

Williams, R. N., J. L. Blackmer, D. S. Richmond, and M. S. Ellis. 1992. Nitidulidae (Coleoptera) diversity in three natural preserves in Portage County, Ohio, U.S.A. Ohio Journal of Science 92: 82-87.

Williams, R. N., D. S. Fickle, R. J. Bartelt, and P. F. Dowd. 1993. Responses by adult Nitidulidae (Coleoptera) to synthetic aggregation pheromones, a coattractant, and effects of trap design and placement. European Journal of Entomology 90: 287-294.

Williams, R. N., M. S. Ellis, and R. J. Bartelt. 1995. Efficacy of *Carpophilus* aggregation pheromones on nine species in northeastern Ohio and identification of the pheromone of *C. brachypterus*. Entomologia Experimentalis et Applicata 77: 141-147.

Williams, R. N., M. S. Ellis, and S. Teraguchi. 1997. Nitidulidae (Coleoptera) survey in Northeast Ohio. Journal of Entomological Science 32: 204-211.

DIOSPILUS BELOKOBYLSKIJI BEYARSLAN SP. NOV., WITH NEW RECORDS OF DIOSPILINI (HYMENOPTERA: BRACONIDAE: HELCONINAE) FROM TURKEY[1]

Ahmet Beyarslan,[2] Özlem Çetin Erdogan,[2] and Mitat Aydogdu[2]

ABSTRACT: *Diospilus belokobylskiji* Beyarslan sp. nov. is described and diagnostic characters are illustrated and compared with the related species *Diospilus inflexus* Reinhard. New distributional records for eight species of Diospilini are reported for Turkey. Seven of these species are new to Turkey.

KEY WORDS: Hymenoptera, Braconinae, Helconinae, Diospilini, *Diospilus belokobylskiji*, new records, Turkey

In Turkey, Helconinae braconids are found in Asia Minor (Euxin, Mediterranean, and Irano-Anatolian phytogeographical provinces); only three species (*Diospilus capito*, *D. productus*, and *Tapheus hiator*) are known from the Turkish Thrace or the European part of Turkey. The tribe Diospilini (Helconinae) contains species of braconids recorded from less deeply concealed phytophagous beetles, such as the Curculionidae and the Nitidulidae (Shaw and Huddleston, 1991). Curculionids are plant feeders, some being serious pests of cultivated crops (http://eny3005.ifas.ufl.edu/lab1/Coleoptera/Curculionid.htm). Some species of nitidulids are considered serious pests of date palms throughout the world. Nitidulids attack ripe fruit, causing it to rot, and damage is reflected in reduced yield and lower fruit quality (Glazer et. al., 2007). Pollen beetles (*Meligethes* spp. [Coleoptera: Nitidulidae]), in particular, are important pests on *Brassica* oilseed crops throughout Europe (Billqvist and Ekbom, 2001).

In recent years, studies on *Diospilus* (Diospilini: Helconinae) braconids, which could be especially useful in the biological control of nitidulid pests, have gained momentum. *Diospilus capito* has been reported to be the most common species found in pollen beetle larvae (Kevväi et al., 2005). Belokobylskij and Lobodenko, 1997 reported a list of Palaearctic species of *Diospilus* with data on their distribution. In the interactive TAXAPAD world catalogue on Ichneumonoidea, the tribe Diospilini Foerster was represented by 14 genera, of which six are present in the European fauna (Yu et al., 2005).

In this study, eight species of Diospilini representing two genera (*Diospilus* and *Tapheus*) are recorded from Turkey for the first time, including a new species belonging to *Diospilus*. The genus *Diospilus* differs from *Tapheus* by having a square or anteriorly broadened second radiomedial cell, by the uniformly rounded bend between the upper part the second metasomal tergite and its basal part, and by its metasoma usually shorter than the mesosoma (Tobias, 1986).

---

[1] Received on October 24, 2007. Accepted on December 4, 2007.

[2] Trakya University, Faculty of Arts and Science, Department of Biology 22030 Edirne, Turkey. E-mails: abeyars@trakya.edu.tr, cetinozlem@hotmail.com, maydogdu75@hotmail.com.

Mailed on November 12, 2008

METHODS

Adult specimens of Diospilini (Hymenoptera: Braconidae: Helconinae) were collected from various habitats in Turkey between the years 1998 and 2006 (Figure 1). Sweep nets were used to obtain samples from field layer grassland plants. The specimens were identified mostly using the keys of Tobias (1986, 2000). Geographical coordinates of the localities are given. For general distributions of examined species, references from the literature on Palaearctic fauna were used (Yu et al., 2005). Specimens are deposited in the Zoological Museum of Department of Biology, Trakya University.

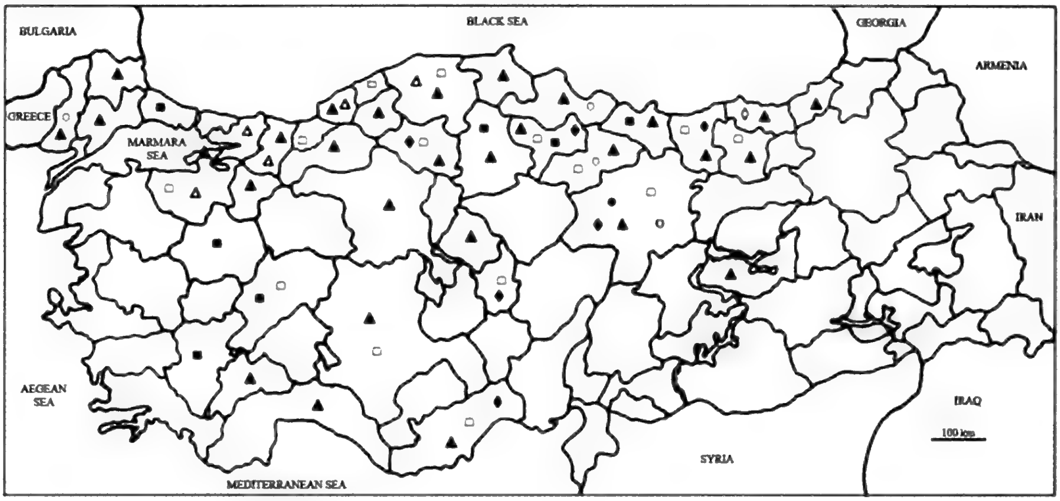


Fig. 1. Distribution of Helconinae species in Turkey. *Diospilus belokobylskiji* sp. nov. (♦), *D. capito* (▲), *Diospilus melanoscelus* (△), *D. morosus* (□), *D. nigricornis* (◇), *D. productus* (■), *Tapheus hiator* (○), *T. rufocephalus* (●).

SYSTEMATIC ENTOMOLOGY

Diospilini Foerster, 1862

Diospilus Haliday, 1833

Diospilus belokobylskiji Beyarslan sp. nov.

Figs. 2-8

Holotype (female): Body color: Black; legs (except coxae and basal halves of femora, which are black) and pterostigma dark brown; wing membrane hyaline; veins yellowish-brown.

Body Length: 2.1 mm. Antenna length 1.8 mm. Forewing length: 2.4 mm. Mesosoma length: 0.9 mm. Metasoma length: 0.8 mm. Ovipositor sheath length: 0.8 mm.

Head: Antennal segments 21, the length of the third flagellar segment as long as the fourth segment, length of third, fourth and penultimate segments 2.3, 2.3 and 1.5 times their widths, respectively (Fig. 2). Last antennal segment sharply pointed. Antenna setiform. Width of head 1.8 times its medial length. Temple roundly narrowed behind the eye and as long as transverse diameter of eye in dorsal view. Vertex smooth, glabrous; ocelli very small, almost positioned in equilateral triangle; POL 2.0 times OD, 3.5 times shorter than OOL (Fig. 3). Eyes scarce hairy, longitudinal diameter of eye 1.4 times its transverse diameter. Length of malar space as long as basal width of mandible and 0.4 times longitudinal diameter of eye (Fig. 4). Anterior tentorial pit deep and large, clypeal suture very deep; width of face 1.6 times height of face and clypeus combinated; face smooth, medially punctate and with long and sparse setae. Clypeus and mandible microsculptured; temple smooth. Occipital carina distinct. Length of maxillary palp 0.5 times height of head; frons smooth and weakly convex.

Mesosoma. Length of mesosoma 1.4 times its height; pronotum smooth, glabrous; side of pronotum smooth, posteriorly with crenulae; mesonotum smooth, glabrous, notauli very deep and weakly punctate; mesopleuron smooth, precoxal sulcus distinct and crenulated (Fig. 5); scutellar sulcus with wide crenulae; scutellum distinctly convex, smooth and glabrous; sides of scutellum roughly sculptured; subalar depression deep and punctate; metapleuron finely punctate, medially smooth and glabrous; metanotum convex laterally; surface of propodeum rugo-rugulose and with long, grey setae laterally.

Wings. Forewing: length of pterostigma 2.0 times its maximum width and 1.5 times anterior margin of radial cell; medial vein on forewing originating together with basal vein directly from parastigma; r very short, almost absent; cu-a interstitial; m-cu antefurcal; vein 1-SR+M almost straight. 3-SR : SR1 = 8 : 34; 2-SR : 3-SR : r-m = 12 : 8 : 12. Hind wing: lr-m 2.5 times 2-SC+R and as long as SC+R1 (Fig. 6).

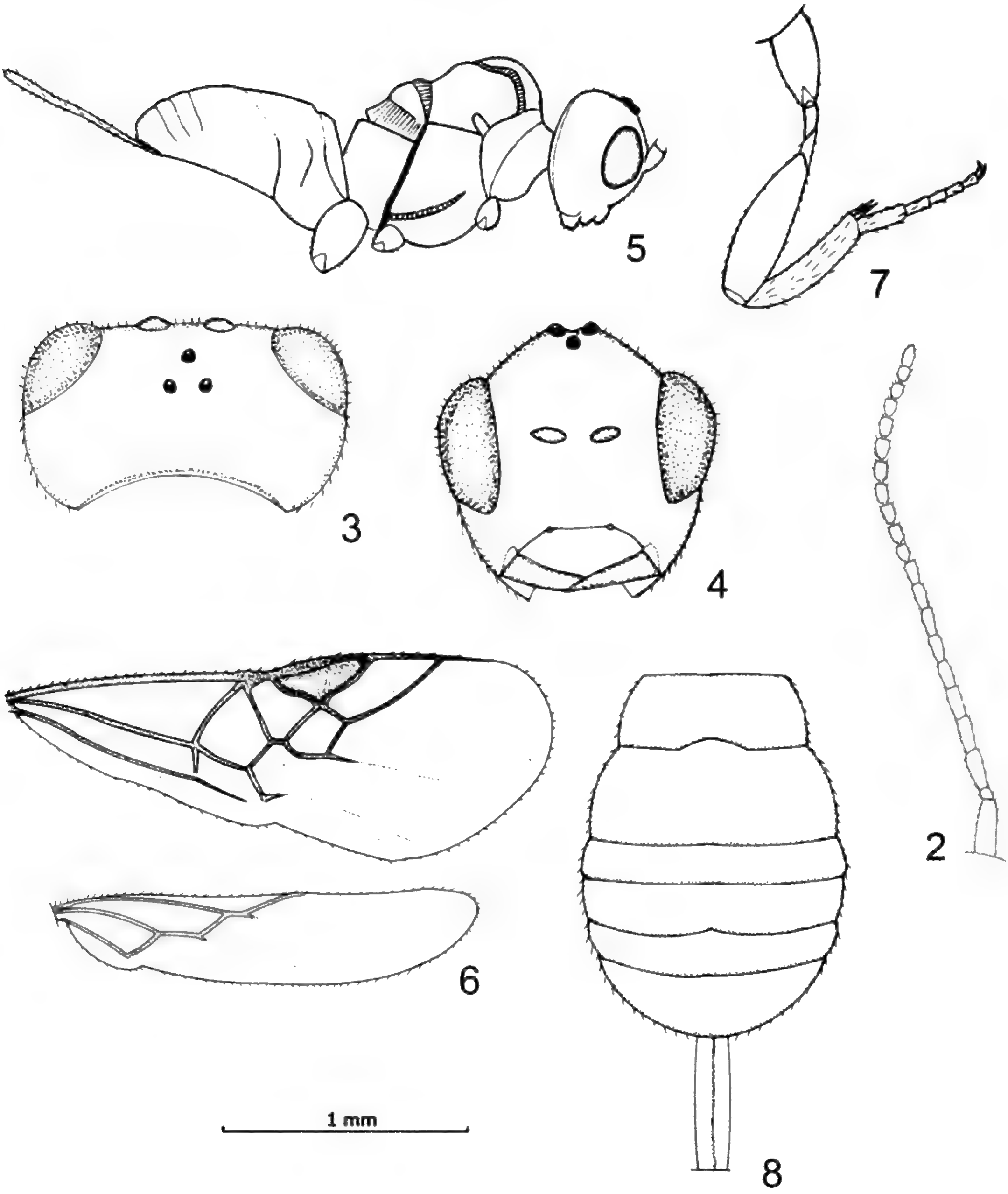
Legs. Latero-medial side of hind coxa with a deep depression; ratio of fe mur : tibia : basitarsus of hind leg = 34 : 41 : 9; length of femur, tibia, and basitarsus of hind leg 3.7, 6.6 and 3.3 times their maximum widths, respectively (Fig. 7); length of hind tibial spurs 0.40 and 0.38 times hind basitarsus, tibia, and tarsus densely and femur sparsely setose.

Metasoma. Length of first tergite 0.5 times its apical width (Fig. 8), its median area smooth, laterally very weakly striato-rugulose; other tergites smooth and glabrous; basal width of second tergite 1.2 times its median length; apical width of second tergite 1.75 times its median length; length of ovipositor sheath 0.9 times of length of metasoma and 0.45 times length of forewing.

Host Information. Unknown.

Type Material. Holotype (female). Sivas, Sarkişla, 6.V.2001, (39° 21' 16N-36° 24' 27E), 1253 m. In Zoological Museum, Trakya University, Edirne. **Paratypes:** Sivas, Divrigi, 10.V.2001, 39° 22' 1N-38° 6' 12E, 1077 m., 1♀. Çankırı, Çerkeş, 4.VII. 2001, 40° 49'35"N 32° 52' 71"E, 1170 m., 1♀. Amasya, Yolyanı, 30.VI.2004, 40° 34' 0N-36° 7' 0E, 800 m., 4♂♂. Giresun, Alucra, Gürbulak, 29.VIII.2004, 40° 16' 32N-38° 49' 44E, 1582 m, 1♂. Nevşehir, 2.VI. 2003, 38° 37' 30N-34° 42' 44E, 1224 m., 1♂. Içel, Güzeloluk, 27.VI.1980, 36° 47' 40N-34° 4' 56E, 1421 m., 1♂.

Distribution and Remarks. Amasya, Çankırı, Içel, Giresun, Nevşehir, and Sivas. The area, where the type specimens is collected mostly over 1000 m. This species seems to prefer rather montane habitats.



Figs. 2-8. *Diospilus belokobylskiji* sp. nov. (female): (2) habitus, lateral aspect; (3) head, dorsal aspect; (4) head, frontal aspect; (5) antenna; (6) wings; (7) hind leg; (8) metasoma, dorsal aspect. Scale 1 mm (Figs. 2, 7), 1.8 mm (Figs. 3, 6), 1.9 mm (Fig. 4), 1.7 mm (Fig. 5), 0.9 mm (Fig. 8).

Differential Diagnosis. *Diospilus belokobylskiji* sp. nov. is related to *Diospilus inflexus*. The two species are distinguishable as follows:

- Anterior margin of marginal cell shorter than pterostigma, 1-M as long as cu-a or 1r-m ....*Diospilus belokobylskiji* sp. nov.
- Anterior margin of marginal cell longer than pterostigma, 1-M longer than 1r-m ....*Diospilus inflexus*

Etymology. Named in honour of Dr. Sergey A. Belokobylskij, Russian specialist of Braconidae (Hymenoptera).

Diospilus capito (Nees, 1834)

Material Examined. Amasya-Gümüş-Hacıköy, 4.VII.2004, 40° 52' 23N-35° 12' 53E, 794 m., ♀; Amasya-Merzifon, 4.VII.2004, 40° 52' 24N-35° 27' 47E, 704 m., 2♂♂, 1♀; Amasya-Merzifon-Esenköy yay., 9.VII.2003, 41°00' 37N-35° 17' 23E, 1538 m., 7♀♀, 3♂♂; Amasya-Merzifon-T.Dagı-Aşagıbük, 27.VIII. 2004, 41° 00' 59N-35° 21' 01E, 1459 m., 3♂♂; Amasya-Merzifon-T.Dagı-Esenköy, 27.VIII.2004, 41° 00' 37N-35° 17' 23E, 1538 m., 3♀♀, 13♂♂; Amasya-Merzifon-T.Dagı-U.agaç, 9.VII.2003, 41° 00' 30N-35° 21' 38E, 1571 m., 2♀♀; 1♂; Amasya-Taşova-Boraboy gölü, 29.VI.2004, 40° 48' 49N-36° 09' 41E, 1066 m., 1♀; Amasya-Yolyanı, 30.VI.2004, 40° 34' 0N-36° 7' 0E, 800 m., 1♀; Ankara-Ayaş, 31.V.2002, 40° 1' 2N-32° 20' 54E, 1045 m., ♂; Antalya-Korkuteli, 16.VII. 1987, 37° 4' 59N-30° 12' 15E, 1023 m., 1♀, 1♂; Bilecik-Demirköy, 10.VII.1993, 40° 0' 0N 30° 1' 0E, 693m,1♀; Bilecik-Küplü, 20.IX.1992, 40° 6' 7N-30° 1' 0E, 534 m., ♂; Bolu-Gölcük, 30.VI.2001, 40° 49' 0N-31° 41' 60E, 1068 m., 1♀; Burdur-Karamanlı, 7.VIII.1980, 37° 22' 12N-29° 49' 17E, 1106 m., 2♀♀; Çankırı-Çerkeş, 4.VII.2001, 40° 28' 34N-33° 34' 50E, 1170 m., 1♀; Çorum-Dodurga-Gücümen, 28.VI.2004, 40° 50' 26N-34° 46' 05E, 793 m., ♀; Çorum-Dodurga-Yeniköy, 28.VI.20004, 40° 49' 27N-34° 42' 34E, 1035 m., 2♀♀; Edirne-Trakya Üni.Güllapoglu Yerl., 25.V.2001, 41° 40' 28N 26° 33' 39E, 26 m. 1♀; Edirne-Uzunköprü-Altınyazı, 30.VII.1992, 41° 4' 13N-26° 34' 32E, 23 m., 1♀; Elazıg-Baskil-Hacımustafa, 8.VIII.1990, 38° 34' 3N-38° 49' 17E, 1201 m., 2♀♀; Giresun-Dereli-Kümbet obasy, 3.VIII.2005, 40° 33' 42N-38° 28' 31E, 1584 m., 1♀; Giresun-Dereli-Kümbet yaylası, 3.VIII.2005, 40° 33' 25N-38° 27' 24E, 1747 m., 1♀; Giresun-Ş.Karahisar-Dereli, 2.VIII.2005, 40° 32' 06N-38° 21' 17E, 1431 m., 2♀♀; Gümüşhane-Kelkit-Yeniköy, 29.VIII.2004, 40° 19' 26N-39° 29' 33E, 1474 m., 1♀; Gümüşhane-Şiran-Arıtaş, 2.VII.2004, 40° 09' 43N-39° 01' 40E, 1300 m., 1♀; Içel-Güzeloluk, 27.VII.1980, 36° 47' 40N-34° 4' 56E, 1421m., 1♂, 1♀; Karabük-Çay, 13.VI.2002, 41° 10' 0N-31° 26' 60E, 93 m., 1♂; Karabük-Safranbolu-Inceçay-Sarıçiçek D., 29.VI.2001, 1♀; 30.VI.2001, 41° 15' 03N-32° 41' 39E, 1000 m., 5♀♀; Kastamonu-Daday-Ballıdag, 1.VII.2001, 41° 32' 60N-32° 32' 60E, 1750 m., 1♀; Kastamonu-Ilgazdagı-Çatören, 3.VII.2001, 41° 7' 60N-33° 47' 60E, 1690 m., 2♀♀; Kastamonu-Küre-Ersizlerdere, 12.VI.2001, 41° 51' 0N-33° 43' 60E, 979 m., 1♀; Kastamonu-Daday-Ballıdag-Sarpun, 1.VII.2001, 41° 34' 0N 33° 23' 60E, 1441 m., 2♀♀; Kastamonu-Ilgazdagı-Çatören, 3.VII. 2001, 41° 7' 60N 33° 47' 60E, 1690 m., 3♀♀; Kastamonu-Taşköprü-Alamaşişli, 2.VII.2001, 41° 30' 50N 34° 12' 53E, 553 m., 1♀; Kırklareli-Dereköy, 6.IX.1985, 41° 55' 58N-27° 22' 0E, 446 m., 2♀♀; Kırşehir, 3.VI.2003, 39° 8' 45N-34° 9' 50E, 1027 m., 1♂; Konya-Cihanbeyli, 29.IV.2002, 38° 39' 29N-32° 55' 41E, 950 m., 1♂; Ordu-Akkuş-Y.Dügencili, 1.IX.2003, 40° 47' 35N-37° 00' 59E, 1340 m., 1♀; Ordu-Akkuş-Y.Dügencili, 5.VII.2003, 1♀; 01.IX.2003 ♀; 40° 46' 0N 37° 1'

0E, 1340 m.; Ordu-Gölköy, 6.VII.2004, 40° 41' 15N-37° 37' 4E, 1054 m., 1♀; Ordu-Korgan-Belalan, 31.VIII.2003, 40° 46' 0N- ♀; 1♂; Ordu-Ünye-Çatalpınar, 5.VII.2003, 41° 7' 0N-37° 15' 0E, 22 m., 2♂♂; Ordu-Ünye-Dizdar, 1.IX.2003, 40° 58' 0N-37° 7' 0E, 608 m., 1♀; Rize-Çamlıhemşin-Aşagışimşirli, 26.VI.2001 1♂; 25.VI.2005, 41° 01' 29N-41° 08' 12E, 490 m., 1♂; Sakarya-Sapanca-Ist.Üni.Tesisi, 16.VIII.1994, 1♂; 40° 41' 26N-30° 16' 13E, 60 m., 2♀♀; Samsun-Havza-Mismiliagaç, 2.VII.2003, 40° 58' 14N-35° 39' 44E, 610 m., 2♂♂; Samsun-Kocadag-TRT Istasyonu, 29.VIII.2003, 41° 34' 4N-35° 54' 25E, 1200 m., 1♂; Samsun-S.Pazarı-A.Tepe mevkii, 3.VII.2003, 41° 10' 10N-36° 10' 20E, 970 m., 1♂; Sinop-Boyabat-Çangal dagı-Kozcagız, 2.VII.2001, 41° 43' 60N-34° 46' 0E, 1023 m., 1♀, Sinop-Boyabat-Salar, 3.VII.2001, 41° 31' 60N-34° 40' 60E, 401 m. 2♀♀; Sivas-Cumh.Uni Kampus, 7.VII.2002, 39° 44' 54N-37° 0' 58E, 1278 m., 1♀; Sivas-Şarkışla, 18.V.2002, 39° 21' 16N-36° 24' 27E, 1253 m., 1♀; Tekirdag-Banarlı, 9.VI.2001, 41° 3' 54N-27° 20' 16E, 120 m., 1♀; Tokat-Kemalpaşa, 30.VI.2004, 41° 29' 35N-41° 31' 51E, 12 m., 2♂♂; Tokat-Niksar-Çamiçi, 5.VII. 2003, 40° 40' 0N-37° 0' 0E, 1288 m., 1♂; Tokat-Reşadiye-Çayırpınar, 1.VII. 2004, 40° 24' 16N-37° 16' 16E, 672 m., 1♂; Tokat-Turhal-D.Çiftligi, 30.VI. 2004, 40° 18' 14N-36° 19' 29E, 554 m., 1♀; Tokat-Turhal-Üçyol, 7.VII.2003, 40° 28' 0N-36° 17' 60E, 1249 m., 1♀; Trabzon-Maçka-Gülindagı, 6.VIII.2005, 40° 49' 59N-39° 34' 13E, 1572 m., 2♂♂; Trabzon-Maçka-Ocaklı, 5.VIII.2005, 40° 59' 26N-38° 34' 01E, 1071 m., 1♂; Yalova-Safran deresi, 27.X.2001, 40° 39' 13N-29° 17' 5E, 40 m., 2♂♂; Zonguldak-Devrek-Davulga, 29.VI.2001, 41° 13' 9N-31° 57' 21E, 227 m., 1♀, 1♂.

Distribution. Eastern Palaearctic, Europe, Western Palaearctic.

Diospilus melanoscelus (Nees, 1834)

Material Examined. Adapazarı-Hendek-Hüseyinşeyh, 27.VI.2001, 40° 49' 0N-30° 46' 60E, 248 m., 1♀; Bursa-Burhaniye, 18.IX.1992, 39° 43' 60N-29° 22' 60E, 703 m., 1♀; Bursa-Keles-Baraklı, 13.VII.1993, 39° 58' 1N-29° 13' 40E, 1066 m., 1♀; Kastamonu-Daday-Ballıdag-Sarpun, 1.VII.2001, 41° 34' 0N-33° 23' 60E, 1441 m., 1♀; Kocaeli-Izmit-Karasu, 8.VII.1993, 41° 4' 13N-30° 47' 1E, 20 m., 1♀; Zonguldak-Devrek-Davulga, 29.VI.2001, 41° 13' 9N-31° 57' 21E, 227 m., 2♀♀.

Distribution. Belarus, Germany, Russia, Slovakia.

Diospilus morosus Reinhard, 1862

Material Examined. Afyon-Bayat-Köroglu, 29.VI.1998, 38° 58' 59N-30° 55' 29E, 1100 m., 1♀; Afyon-Emirdag-Koruca, 29.VI.1998, 39° 1' 11N-31° 8' 60E, 980 m., 1♀; Afyon-Sandıklı-Ekinhisar, 28.VI.1998, 38° 31' 50N-30° 13' 27E, 1035 m., 1♀; Amasya-Merzifon-Esenköy yaylası, 9.VII.2003, 41° 00' 37N-35° 17' 23E, 1538 m., 1♀; Amasya-Yolyanı, 30.VI.2004, 40° 34' 0N-36° 7' 0E, 800 m., 1♂; Bartın-Çamlık 30.VI.2001, 41° 38' 09N-32° 20' 15E, 60 m., 1♂; Bursa-Karacabey-Çingene Çeşmesi, 18.VIII.1994, 40° 12' 50N-28° 21' 22E, 32 m., 1♂; Düzce-Kaynaşlı-Üçköprü, 27.VI.2001, 40° 46' 9N-31° 19' 16E, 500 m., 1♂; Giresun-Dereli-Kümbet, 5.VII.2004, 40° 33' 51N-38° 27' 40E, 1756 m., 1♀, 1♂; Gümüşhane-Kelkit-Gürüzdagı, 2.VII.2004, 40°15'57N-39°28'58E, 1871 m., 1♀; Kastamonu-Taşköprü-Alamaşişli, 6.IX.2001, 41° 30' 50N-34° 12' 53E, 553 m., 1♂; Kocaeli-Karasu, 8.VII.1993, 41° 4' 13N-30° 47' 1E, 20 m., 2♀♀; Konya-Beyşehir-Altınapa, 23.IV.2001, 37° 40' 35N-31° 43' 34E, 1205 m., 1♀; Tokat-Pazar-Ballıca, 7.VII.2003, 40° 13' 60N-36° 19' 0E, 1248 m., 1♂.

Distribution. Eastern Palaearctic, Europe, Western Palaearctic.

Diospilus nigricornis (Wesmael, 1835)

Material Examined. Trabzon-Çaykara-Uzungöl, 4.VII.2004, 40° 37' 21N-40° 17' 14E, 1281 m., 1♀.

Distribution. Austria, Azerbaijan, Czechoslovakia, Finland, France, Germany, Hungary, Italy, Lithuania, Norway, Poland, Slovenia, Switzerland, Yugoslavia.

Diospilus productus Marshall, 1894

Material Examined. Amasya-Merzifon-Esenköy yaylası, 9.VII.2003, 41° 00' 37N-35° 17' 23E, 1538 m., 1♂; Afyon-Emirdag-Koruca, 29.VI.1998, 39° 1' 11N-31° 8' 60E, 980 m., 1♂; Çorum-Dodurga-Gücümen, 28.VI.2004, 40° 50' 26N-34° 46' 05E, 793 m., 1♀; Denizli-Çardak, 28.VI.1998, 37° 49' 37N-29° 40' 6E, 847 m., 2♀♀; Kütahya-Gediz-Murat Dagı-Sobaalanı, 28.VI.2001, 39° 2' 30N-29° 24' 36E, 950 m., 1♀; Istanbul-Çatalca-Oklalı, 14.VII.2002, 41° 13' 29N-28° 28' 42E, 49 m., 1♂; Ordu-Gürgentepe, 6.VII.2004, 40° 47' 18N-37° 36' 6E, 1120 m., 1♀.

Distribution. Armenia, Greece, Hungary, Italy, Switzerland, Ukraine, United Kingdom.

Tapheus hiator (Thunberg, 1824)

Material Examined. Edirne-Uzunköprü-Yeniköy, 22.V.2002, 41° 20' 41N-26° 46' 5E, 69 m., 1♂; Samsun-S.Pazarı-A.Tepe mevkii, 3.VII.2003, 41° 10' 10N-36° 10' 20E, 970 m., 1♀; Sivas-Gürün, 5.VI.2002, 38° 43' 19N-37° 15' 43E, 1332 m., 1♂; Sivas-Şerefiye-Arapçı, 5.V.2001, 40° 7' 60N-37° 46' 60E, 1670 m., 2♂♂; Sivas-Yeniçubuk, 2.VI.2001, 39° 12' 44N-36° 5' 43E, 1145 m., 1♀; Tokat-Niksar, 17.V.2001, 40° 35' 30N-36° 57' 6E, 426 m., 1♀.

Distribution. Holoarctic.

Taphaeus rufocephalus (Thunberg, 1824)

Material Examined. Sivas-Şerefiye-Arapçı, 5.V.2001, 40° 7' 60N-37° 46' 60E, 1670 m., 1♂.

Distribution and Remarks. *Tapheus rufocephalus* is a rare species through the Palaearctic, and it is known only from Far East Russia in the Eastern Palaearctic, from Kazakhistan and Germany, both in the Western Palaearctic. The report from Turkey is the third record of the species for the western Palaearctic.

ACKNOWLEDGMENTS

We are grateful to Dr. Belokobylskij from the Zoological Institute of the Russian Academy of Sciences (St. Petersburg) for the confirmation of the species belonging to *Diospilus* and *Taphaeus*. We are greatly thankful to Dr. Mark Shaw for helpful suggestions, comments, and linguistic corrections on an earlier version of the manuscript. This research was supported by the Scientific and Technical Research Council of Turkey (TUBITAK) (TBAG-1924, 2356). We thank the TUBITAK for their financial support.

LITERATURE CITED

Belokobylskij, S. A. and Yu S. Lobodenko. 1997. Brief review of Palaearctic species of the genus *Diospilus* (Hymenoptera, Braconidae) with description of four new species. Zoologicheskii Zhurnal 6(8): 915-924.

Billqvist, A. and B. Ekbom. 2001. Effects of host plant species on the interaction between the parasitic wasp *Diospilus capito* and pollen beetles (*Meligethes* spp.). Agricultural and Forest Entomology 3(2): 147-152

Glazer, I., M. Eliyau, L. Salame, Y. Nakash, and D. Blumberg. 2007. Evaluation of the efficacy of the entomopathogenic nematodes *Heterorhabditis* sp. against sap beetles (Coleoptera: Nitidulidae). BioControl 52(2): 259-270.

http://eny3005.ifas.ufl.edu/lab1/Coleoptera/Curculionid.htm. ENY 3005 Families of Coleoptera. Accessed on 20.02.2008.

Kevväi, R., E. Veromann, and A. Luik. 2005. Pollen beetles (*Meligethes aeneus* F.) and their hymenopterous parasitoids in the spring oilseed rape. Transactions of EAU 220, 207-210.

Shaw, M. R. and T. Huddleston. 1991. Classification and biology of braconid wasps (Hymenoptera: Braconidae). Handbooks of the Identification of British Insects 7(11): 1-126.

Tobias, V. I. 1986. Keys to the Insects of the European Part of USSR. Volume III: Hymenoptera IV. (Subfam. Braconinae). pp. 95-150. Nauka, Leningrad, USSR (English). 869 pp.

Tobias, V. I. 2000. Subfam. Braconinae. *In*, A. S. Lelej (Editor). Key to insects of the Russian Far East. Neuropteroidea, Mecoptera, Hymenoptera. 4(4): 109-192. Dalnauka, Vladivostok, Russia. 651 pp.

Yu, D. S., C. Achterberg, and K. Horstmann. 2005. Interactive Catalogue of World Ichneumonoidea Taxonomy, biology, morphology and distribution. Compact Disc (Master version). Taxapad.

NEW RECORDS OF CERATOPOGONIDAE (DIPTERA) FROM SOUTH CAROLINA, U.S.A.[1]

Dustin A. Swanson[2] and William L. Grogan, Jr.[3]

ABSTRACT: Three species of biting midges (Diptera: Ceratopogonidae) previously unknown from South Carolina were collected with UV-lighted and lightless miniature CDC light traps baited with CO_2 during 2006 and 2007 in Barnwell County. We provide details of the microhabitats and biology for these species: *Forcipomyia* (*Euprojoannisia*) *unica* Bystrak and Wirth, *Forcipomyia* (*Metaforcipomyia*) *fehrerorum* Grogan and Sigrist, and *Culicoides* (*Haematomyidium*) *torreyae* Wirth and Blanton.

KEYWORDS: Biting midges, Ceratopogonidae, Diptera, new records, South Carolina, U.S.A.

Records of biting midges (Diptera: Ceratopogonidae) from South Carolina are sparse compared with those of other southeastern Atlantic states. None of the 602 species currently known in the United States and Canada have type localities in South Carolina (Borkent and Grogan 2008). In contrast, 62 species have their type localities in Florida, 4 species in Georgia, 52 species in Maryland and the District of Columbia, 1 species in North Carolina, and 21 species in Virginia. *Culicoides* is the largest genus of biting midges in the world, with 152 species in North America, most of which take blood meals from vertebrates and, therefore, are of medical and veterinary importance. Battle and Turner (1971) listed 19 species of *Culicoides* from South Carolina: 17 species were recorded from Beaufort, Charleston, Colleton, and Jasper counties in the southeastern part of the state, whereas only 3 species were reported outside this region. Records for other ceratopogonid genera in South Carolina are scattered and less complete than those for *Culicoides*. We report here the first records of three species of Ceratopogonidae from South Carolina.

Specimens were collected during a survey of the vertical distribution of biting flies in Barnwell County, South Carolina, near the town of Williston (33.3668°N 81.4060°W, 90 m) from 20 August - 7 October 2006 and 10 March - 1 September 2007. The site was in a managed loblolly pine (*Pinus taeda*) forest along a series of stream-fed beaver ponds. Collections were made using miniature CDC light traps, with no light or ultraviolet light and baited with CO_2. Biting midges were slide mounted in phenol-balsam in the manner described by Wirth and Marston (1968), and voucher specimens were deposited in the Clemson University Arthropod Collection and the synoptic collection of ceratopogonids maintained by WLG at Salisbury University, Salisbury, Maryland.

---

[1] Received on November 19, 2007. Accepted on December 14, 2007.

[2] Department of Entomology, Soils, and Plant Sciences, Clemson University, Clemson, South Carolina 29634 U.S.A. E-mail: dswanso@clemson.edu

[3] Department of Biological Sciences, Salisbury University, Salisbury, Maryland 21801 U.S.A. E-mail: wlgrogan@salisbury.edu

Mailed on November 12, 2008

SYSTEMATIC ENTOMOLOGY

Subfamily Forcipomyiinae

Forcipomyia (Euprojoannisia) unica Bystrak and Wirth

Forcipomyia (*Euprojoannisia*) *unica* Bystrak and Wirth, 1978: 44 (female, male; Florida, Bahamas; figs. male, female); Borkent and Wirth, 1997: 32 (in world catalogue).

Previously known only from Florida and the Bahamas, a single female of this species was collected on 9 September 2006 in a lightless CDC miniature light trap 10.0 m above the ground, baited with CO_2. Species of the subgenus *Euprojoannisia* do not feed on vertebrate blood, and the collection of a single female of this species in a CO_2-baited, lightless CDC trap was therefore unexpected. The collection of *F. unica* in South Carolina might represent a recent dispersal event, but more likely, this species was simply overlooked during prior light-trap surveys in this state.

Forcipomyia (Metaforcipomyia) fehrerorum Grogan and Sigrist

Forcipomyia (*Metaforcipomyia*) *fehrerorum* Grogan and Sigrist, 2007: 531 (male, female; Maryland, Florida; figs. male, female).

This species was recently described from specimens collected in Wicomico County, Maryland, and Highlands and Wakulla counties, Florida (Grogan and Sigrist 2007). In South Carolina, one female was collected on 24 May 2007 in a miniature lightless CDC trap situated 10.0 m above the ground baited with CO_2. The reduced, vestigial, toothless mandibles of all females in the subgenus *Metaforcipomyia* indicate that *F. fehrerorum* is not ectoparasitic on other insects.

Forcipomyia fehrerorum is associated with open bog habitats or flooded forests on the Outer Coastal Plain (Delmarva Peninsula) of Maryland (Grogan and Sigrist 2007), and similar microhabitats in Florida. *Forcipomyia fehrerorum* was subsequently collected in large numbers during spring and summer 2007 in Wicomico County, Maryland, by a Malaise trap along a headwater tributary of the Nanticoke River (Chesapeake Bay drainage). The South Carolina site is open, bog-like habitat, while seepage from the beaver ponds partially floods the forest below their dams, thus providing a habitat similar to the type locality.

Subfamily Ceratopogoninae

Tribe Culicoidini

Culicoides (Haematomyidium) torreyae Wirth and Blanton

Culicoides torreyae Wirth and Blanton, 1971: 73 (female, male; Florida; figs. female, male); Blanton and Wirth, 1979: 156 (female, male; Florida; figs. female, male).

Culicoides (*Haematomyidium*) *torreyae*: Wirth et al., 1985: 26 (fig. female wing); Borkent and Wirth, 1997: 84 (in world catalogue).

Wirth and Blanton (1971) originally described this species from specimens collected by light traps in three northern Florida counties: Liberty (Torreya State Park, the type locality), Marion, and Orange. Blanton and Wirth (1979) considered *C. torreyae* a rare species, and to our knowledge, no additional material has been collected since its original description in 1971 (Wilkening et al. 1985).

In South Carolina, one female was collected on 7 October 2006 in a miniature lightless CDC trap situated 1.5 m above the ground baited with CO_2. A second, gravid female was collected on 6 June 2007 in an ultraviolet CDC light trap 5.0 m above the ground, baited with CO_2. Whether these specimens represent a range expansion of *C. torreyae,* or if the presence of this species has merely been overlooked in South Carolina, is unclear. *Culicoides torreyae* can be confused with *C. debilipalpis* Lutz, which also inhabits South Carolina (Blanton and Wirth 1979), and previously might have been misidentified as this close relative. The gravid female collected on 6 June 2007 suggests that *C. torreyae* is capable of overwintering in South Carolina, and probably occurs naturally in the state.

There are a couple of morphological differences between the *C. torreyae* collected in South Carolina and the original description from Florida specimens. Wirth and Blanton (1971) described females of *C. torreyae* as having sensilla coeloconica on flagellomeres 6-8. However, a female paratype, from the type locality in the synoptic collection of WLG, has these sensilla on flagellomeres 4-8, and similarly, our two females from South Carolina have these sensilla on flagellomeres 4-8 and 5-8, respectively. Therefore, as in many other species of *Culicoides*, the number and distribution of sensilla coeloconica on their distal flagellomeres is variable in *C. torreyae*. The illustration of the third palpal segment of *C. torreyae* provided by Wirth and Blanton (1971) in their original description depicts 13 capitate sensilla. However, our examination of the female paratype and thc two South Carolina females at 400X reveals only 5-7 and 7-8 observable capitate sensilla, respectively. The observed number of sensilla might be due to limitations of light microscopy, and the actual number of sensilla might be higher.

ACKNOWLEDGEMENTS

We thank P. H. Adler and M. P. Nelder for reviewing the manuscript and S. G. Turnipseed for the use of his property in Barnwell County, South Carolina. This is Technical Contribution No. 5391 of the Clemson University Experiment Station, and is based on work supported by the CSREES/USDA, under project number SC-1700276.

LITERATURE CITED

Battle, F. V. and E. C. Turner, Jr. 1971. The insects of Virginia: No. 3. A systematic review of the genus *Culicoides* (Diptera: Ceratopogonidae) of Virginia with a geographic catalog of the species occurring in the eastern United States north of Florida. Virginia Polytechnic Institute and State University, Research Division Bulletin 44. 129 pp.

Blanton, F. S. and W. W. Wirth. 1979. The sand flies (*Culicoides*) of Florida (Diptera: Ceratopogonidae). Arthropods of Florida and Neighboring Land Areas. Volume 10. Florida Department of Consumer Services, Gainesville, Florida, U.S.A. 204 pp.

Borkent, A. and W. L. Grogan, Jr. 2008. Checklist of the New World biting midges north of Mexico (Diptera: Ceratopogonidae). Myia 12: In press.

Borkent, A. and W. W. Wirth. 1997. World species of biting midges (Diptera: Ceratopogonidae). Bulletin of the American Museum of Natural History 233. 257 pp.

Bystrak, P. G. and W. W. Wirth. 1978. The North American species of *Forcipomyia*, subgenus *Euprojoannisia* (Diptera: Ceratopogonidae). United States Department of Agriculture Technical Bulletin number 1951. 51 pp.

Grogan, W. L., Jr. and E. A. Sigrist. 2007. A new Nearctic species of biting midge in the subgenus *Metaforcipomyia* Saunders of *Forcipomyia* Meigen (Diptera: Ceratopogonidae). Proceedings of the Entomological Society of Washington 109: 530-540.

Wilkening, A. J., D. L. Kline, and W. W. Wirth. 1985. An annotated checklist of the Ceratopogonidae (Diptera) of Florida with a new synonymy. Florida Entomologist 68: 511-537.

Wirth, W. W. and F. S. Blanton. 1971. New species and synonymy of Florida *Culicoides* (Diptera: Ceratopogonidae). Florida Entomologist 54: 73-78.

Wirth, W. W. and N. Marston. 1968. A method for mounting small insects on microscope slides in Canada balsam. Annals of the Entomological Society of America 61: 783-784.

PHORETIC DEUTONYMPHS OF *SCHWIEBEA* SP. (ACARI: ASTIGMATA: ACARIDAE) TRAVEL IN COMMODIOUS NITID DORSAL PITS OF ADULT *LAGOCHEIRUS ARANEIFORMIS STROHECKERI* DILLON (COLEOPTERA: CERAMBYCIDAE: LAMIINAE) IN FLORIDA, U.S.A[1]

Foster Forbes Purrington[2] and Cathy J. Drake[3]

ABSTRACT: Smooth-floored asetose pits on the pronotum and elytra of adult longicorn beetles, *Lagocheirus araneiformis stroheckeri*, are used for dispersal by *Schwiebea* sp. phoretic mites anchored in them with caudo-ventral suckers. Manifest suitability of the pits for transporting these mites, demonstrated by dimensions, shape, surface structure and a high occupancy rate connotes a beetle/mite mutualism, supported by their congruent life histories.

KEY WORDS: Acaridae, deutonymphs, *Schwiebea*, phoresy, longicorn beetles, mites

Mites in many families of the Astigmata (Acari: Sarcoptiformes) produce a non-feeding pre-adult deutonymph phoretic stage which is typically dorso-ventrally flattened, heavily sclerotized, and that in taxa using arthropod phoronts usually bears a prominent array of caudo-ventral suckers (MacNulty, 1971; Lindquist, 1975; OConnor, 1982; Athias-Binche, 1991; Houck and OConnor, 1991; OConnor, 1994; Walter and Proctor, 1999). We found that adults of the large longicorn beetle, *Lagocheirus araneiformis stroheckeri* Dillon (Coleoptera: Cerambycidae: Lamiinae), recorded only from dead wood of gumbo limbo tree (*Bursera simaruba* (L.) Sargent (Burseraceae) (Linsley and Chemsak, 1995), commonly bear many limuloid deutonymphs (Figures 1A, 1B) of *Schwiebea* sp. (Acari: Astigmata: Acaridae: Rhizoglyphinae).

This beetle subspecies is distributed in southern Florida and Cuba (Linsley and Chemsak, 1995). The mites are attached via paraproctal caudo-ventral suckers (Figure 2; for sucker plate structure nomenclature see Fashing and Chua, 2002) inside deep smooth-bottomed asetose pits on the pronotum and elytra. High mite occupancy rates in these pits and their frequency of occurrence on beetle phoronts, together with structural details of the pits, co-occurrence of beetle larvae and mites in the same microhabitat, and the specificity of decayed gumbo limbo wood as trophic substrate for both imply a co-evolution that has shaped the beetles' dorsal pits.

---

[1] Received on January 18, 2008. Accepted on February 25, 2008.

[2] Department of Entomology, Ohio State University, 400 Aronoff Lab, 318 W. 12th Avenue, Columbus, Ohio 43210 U.S.A. E-mail: purrington.1@osu.edu.

[3] Department of Evolution, Ecology, and Organismal Biology, 300 Aronoff Lab, 318 W. 12th Avenue, Columbus, Ohio 43210 U.S.A. E-mail: drake.2@osu.edu.

Mailed on November 12, 2008

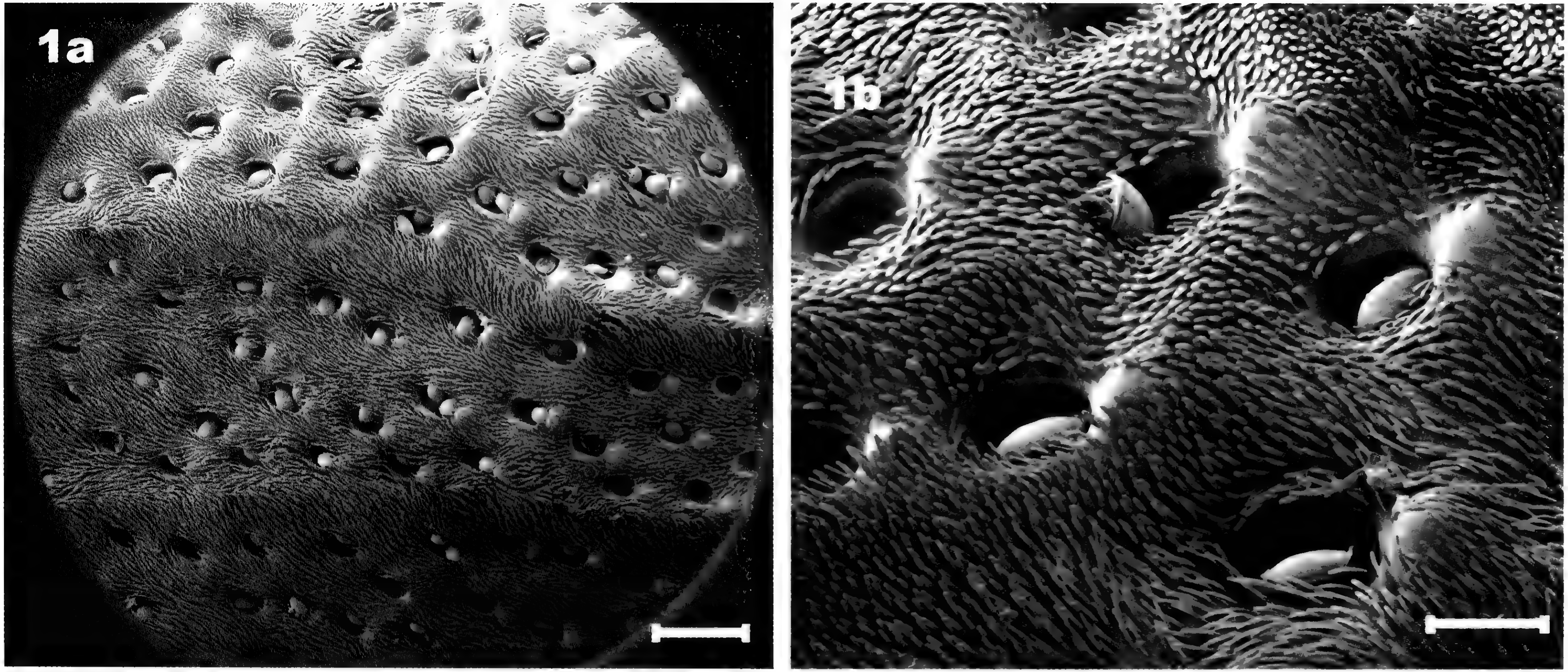
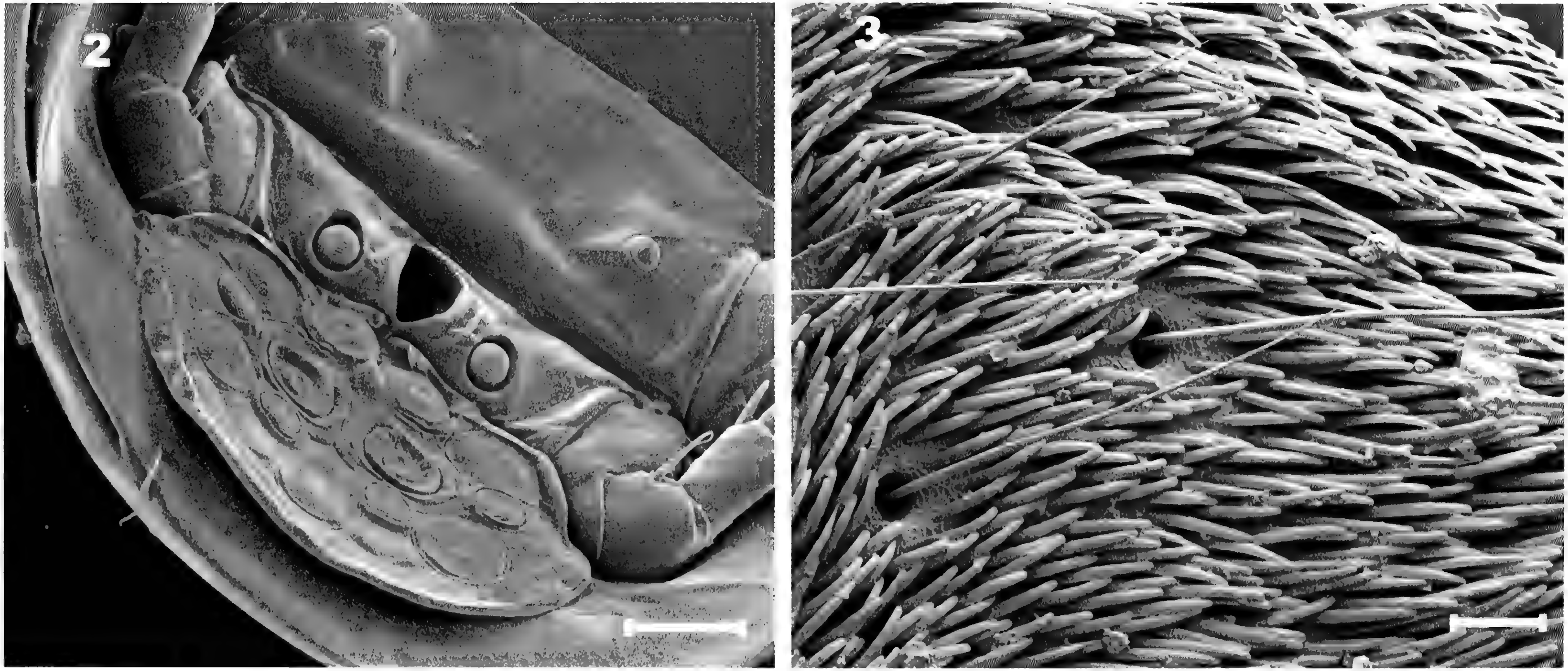


Figure 1. Phoretic deutonymphs of *Schwiebea* sp. in asetose elytral pits of a female *Lagocheirus araneiformis strohеckeri*. A. scale bar: 500 mm; B. scale bar: 100 µm.



Figures 2-3. 2. *Schwiebea* sp. deutonymph, showing caudo-ventral sucker plate; scale bar: 10 mm. 3. Setose pits on female *Lagocheirus araneiformis strohecker*i pronotum; scale bar: 50 µm.

METHODS

We collected a series of *Lagocheirus araneiformis strohеckeri* adults on Big Pine Key (Monroe County, Florida) in 2002 and following years. Others eclosed in our Ohio State University (O.S.U.) laboratory in Columbus from pieces of decayed gumbo limbo wood taken from the same Florida location. Additional specimens were borrowed from the Charles A. Triplehorn Insect Collection in the Museum of Biological Diversity at O.S.U., and from private collections.

We obtained scanning electron micrographs (SEM) at the Campus Microscopy and Imaging Facility (CMIF) at O.S.U. Specimens for SEM imaging were taken from a single female beetle that eclosed in April 2006 at O.S.U. They were sputter-coated in a Cressington 108 with gold-palladium and examined with an FEI NOVA nanoSEM 400 scanning electron microscope.

Mites were determined by Barry M. OConnor, Museum of Zoology, University of Michigan, Ann Arbor.

RESULTS AND DISCUSSION

Dorsal pits of two types exist on *Lagocheirus araneiformis*: large asetose pits and smaller pits each bearing a long erect central seta (Figure 3). The largest pits are arrayed along the dorsal and lateral anterior and posterior pronotal margins and over the basal third of the elytra; asetose elytral pits diminish in size apically and deutonymphs generally are not found in any pits of the posterior half of elytra.

On most beetles examined, *Schwiebea* sp. phoretics occupied only pronotal, and external dorsal and lateral pits of elytra. In a few beetles, a few of these mites also were attached upon and within clusters of Uropodidae (Acari: Mesostigmata: Uropodina) deutonymphs attached laterally on the beetle pronotum with characteristic hyaline para-anal pedicels, on the ventral surfaces of the elytra along with uropodines, or elsewhere on the mesonotum and abdominal tergites underneath the flight wings. Some dorsal pits were occupied by more than one *Schwiebea* sp. phoretic, some by two, rarely three. Some beetles carried *circa* 75 deutonymphs in external pronotal and elytral surface pits.

Other acarids in the Rhizoglyphinae with close beetle associations include the Nearctic *Bolitoglyphus ornatus* (Fain and Ide), which uses as phoront the beetle polypore fungus specialist *Bolitotherus cornutus* (Panzer) (Coleoptera: Tenebrionidae), and the Palearctic mite *Bolitoglyphus bolitophagi* (Turk) on the beetle *Bolitophagus reticulatus* (L.) (Tenebrionidae). Like their beetle transporteurs, adults of both these mite species are polypore mycovores, and their deutonymphs are transported in large asetose dorsal elytral pits (Fain and Ide, 1976; OConnor, 1984). OConnor (1984) points to such cases of mite/beetle structural and feeding site conformity as possible evidence of co-evolution.

We suggest the evident congruence of the longicorn/mite relationship we outline here parallels these other reported cases. Structural accommodations manifested by the deep dorsal pits generated by *Lagocheirus* adults are likely driven by beneficial trophic conditions that these mites satisfy for them. *Schwiebea* sp. feeding stages, elongate cylindrical larvae that tunnel in vascular bundles (Barry M. OConnor, *in littorem*) of dead gumbo limbo tree wood, probably condition the fungal/cellulose substrate on which the tunneling longicorn larvae feed.

ACKNOWLEDGMENTS

We thank Barry OConnor (Museum of Zoology, University of Michigan) for his perspicacious insights and for identifying the *Schwiebea* specimens; Hans Klompen (Museum of Biological Diversity, O.S.U), Norm Fashing (Department of Biology, College of William and Mary), Heather Proctor (Department of Biological Sciences, University of Alberta), and Chuck Triplehorn (Department of Entomology, O.S.U.) provided valuable comments and helped with obscure literature. Creighton Freeman (Museum of Biological Diversity, O.S.U.) kindly arranged a loan of *Lagocheirus* specimens. Brian Kemmenoe (Campus Microscopy and Imaging Facility, O.S.U.) provided the crisp SEM imagery. We appreciate the generous technical support of Barb Shardy and Andrea Prouty (Department of Evolution, Ecology, and Organismal Biology, O.S.U.). We gratefully acknowledge financial support from the Department of Entomology, O.S.U. Monica Farfan and Dave Horn (O.S.U.) reviewed an early draft of the manuscript.

LITERATURE CITED

Athias-Binche, F. 1991. Evolutionary ecology of dispersal in mites, pp. 27-41. *In*, F. Dusbabek and V. Bukva (Editors). Modern Acarology. Volume 1. SPB Academic Publications, The Hague. 651 pp.

Fain, A. and G. S. Ide. 1976. A new genus and species of Acaridae (Acari) phoretic on the beetle *Bolitotherus cornutus* (Panzer, 1794). Entomological News 87: 233-236.

Fashing, N. J. and T. H. Chua. 2002. Systematics and ecology of *Naiadacarus nepenthicola*, a new species of Acaridae (Acari: Astigmata) inhabiting the pitchers of *Nepenthes bicalcarata* Hook. F. in Brunei Darussalam. International Journal of Acarology 28(2): 157-167.

Houck, M. A. and B. M. OConnor. 1991. Ecological and evolutionary significance of phoresy in the Astigmata. Annual Review of Entomology 36: 611-636.

Lindquist, E. E. 1975. Associations between mites and other arthropods in forest floor habitats. Canadian Entomologist 107: 425-437.

Linsley, E. G. and J. A. Chemsak. 1995. The Cerambycidae of North America, Part VII, No. 2: Taxonomy and classification of the subfamily Lamiinae tribes Acanthocinini through Hemilophini. University of California Publications in Entomology Volume 114. University of California Press, Berkeley and Los Angeles. 292 pp.

MacNulty, B. J. 1971. An introduction to the study of Acari-Insecta associations. Proceedings and Transactions of the British Entomological and Natural History Society (4): 46-70.

OConnor, B. M. 1982. Evolutionary ecology of astigmatid mites. Annual Review of Entomology 27: 385-409.

OConnor, B. M. 1984. Acarine-fungal relationships: the evolution of symbiotic associations. pp. 354-381. *In*, Fungus-Insect Relationships. Q. Wheeler and M. Blackwell (Editors). Columbia University Press, New York. 514 pp.

OConnor, B. M. 1994. Life-history modifications in astigmatid mites. pp. 136-159. *In*, M. A. Houck (Editor). Mites: Ecological and Evolutionary Analyses of Life-History Patterns. Chapman and Hall. New York, NY, U.S.A. 357 pp.

Walter, D. E. and H. C. Proctor. 1999. Mites: Ecology, Evolution, and Behaviour. CABI Publishing. New York, NY, U.S.A. 322 pp.

A NEW SPECIES OF *HELOPHORUS* FABRICIUS, 1775 (COLEOPTERA: HELOPHORIDAE) FROM TURKEY, WITH A REMARK TO THE KEY TO SUBGENERA IN ANGUS (1992)[1]

Umit Incekara[2]

ABSTRACT: A new species of hydrophiloid beetles, *Helophorus (Orphelophorus) turca* sp. n., is described from high altitude in northern Anatolia (Asiatic Turkey) and compared with the two known species of the genus. Diagnostic characters are supported with electron micrographs. The key to the subgenera of Angus (1992) is briefly discussed.

KEY WORDS: Coleoptera, Helophoridae, *Helophorus*, new species, Turkey

The Helophoridae are a family comprising only a single subfamily of a single genus, *Helophorus*. This genus comprises more than 190 species, represented in three major zoogeographical regions (Palearctic, Nearctic, and Ethiopian) (Balfour-Browne, 1958; Chiesa, 1959; Angus, 1984-1992; Smetana, 1985; Hebauer, 1994; Hansen, 1991, 1999).

In Turkey, 51 species have been recorded, placed in six subgenera (*Atracthelophorus, Rhopalhelophorus, Transithelophorus, Empleurus, Eutrichelophorus, Trichelophorus, Helophorus* s. str.) (Mart and Erman, 2001; Incekara et al., 2002, 2004, 2005).

The subgenus *(Orphelophorus)* d'Orchymont comprises only two species (*H. obscurellus* Poppius, 1907 and *H. arcticus* Brown, 1937). A new species, *Helophorus turca* sp. n., is described from Turkey and the number of *Helophorus* species belonging to the subgenus *Orphelophorus* increased up to three, together with this new species.

METHODS

Specimens were collected in different surveys of the aquatic Coleoptera of the North Anatolian region since 2004, and this study is based entirely on private collections. The beetles were killed by using ethyl acetate or in 96% ethanol. Aedeagophores of beetles, cleaned with brushes, were dissected under a stereo microscope and left in 10% KOH for 1-2h at room temperature. The photographs of main diagnostic characters were taken using an SMZ-U 1500 Nikon type 104 microscope.

---

[1] Received in December 1, 2007. Accepted on February 5, 2008.

[2] Ümit Incekara, Ataturk University, Science and Arts Faculty, Department of Biology, 25240 Erzurum, Turkey. E-mail: incekara@atauni.edu.tr

Mailed on November 12, 2008

SYSTEMATIC ENTOMOLOGY

Helophorus (Orphelophorus) turca sp. n.

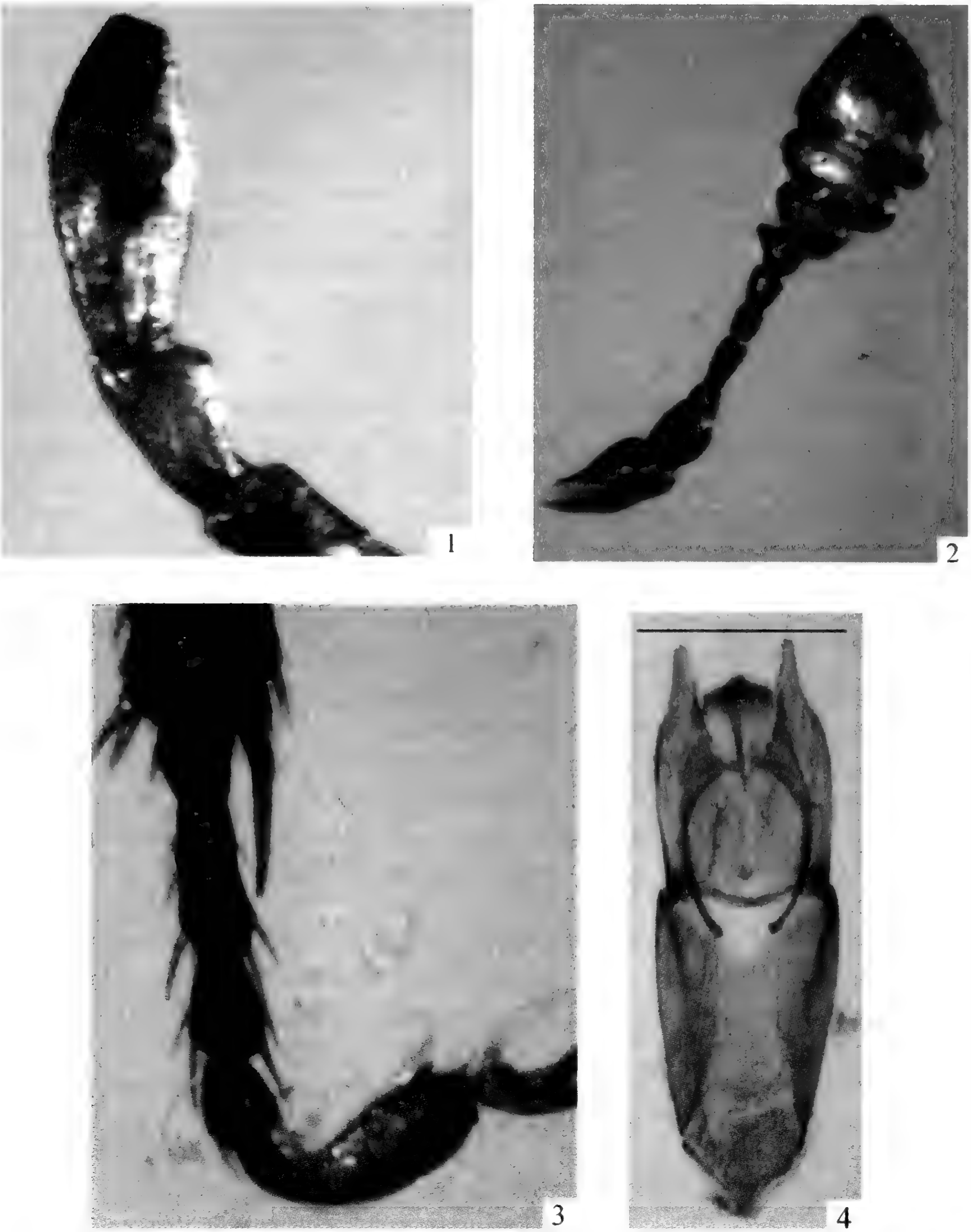
Material Examined

Type Material: Holotype ♂ (Zoology Museum of Ataturk University): "TR: Giresun, Aksu Yaylası, Essek Meydanı, near Istanbul Suyu, 3000 m a.s.l. Leg. Incekara, 15.VIII.2004. The type locality is stagnant, with a muddy bottom and without vegetation. Paratypes: from the Holotype locality, 18. VII. 2005, 2♂♂; 7.VI.2006, 1♂, 3♀.

Description

Length: 4.2-4.5 mm; breadth: 2.2-2.5 mm. General appearance: black (dark brown in one specimen). Head: black with metallic reflections. All surface covered with large granules. "Y" groove distinct, its stem expanded anteriorly and floor of stem with fine granules. Maxillary palpi short and robust, last segment symmetrical and its apex darker (Fig. 1). Antennae 9-segmented (Fig. 2), dark brown and surprisingly with only the 6th segment (cupule) pubescent, with scarcely visible short hairs – the club is glabrous. Pronotum: colouration as head, moderately arched, widest at 1/3 anterior base. Lateral margins raised, slightly serrate, and straightened posteriorly. Anterior angles rather deflexed and not visible from above. Intervals with large rounded granules. Internal intervals obtusely angled. Middle intervals distinctly depressed at posterior third. Externals with larger granules. Mid groove deep, slightly expanded medially. Submedians narrow and deep, submarginals widest. Floor of all grooves covered with fine and scattered granules. Elytra: black, mottled and with intercalary striae of 2-3 punctures (holotype and one paratype have two punctures on left elytron, and three punctures on right elytron. Remaining five paratypes have two punctures on both elytra. Interstices (2, 4, 6, and 8) raised and twice the width of striae. Humeral angles rather raised, curved towards abdomen. Scutellum oval and darker. Legs: Brown, femur distinctly darkened basally. Tarsi 5-segmented, with stiff setae (only the claw segments bears a few long and fine hairs), claw segments of metatarsi swollen and curved at base (Fig. 3).

Aedeagophore: 0.9 mm in length. Parameres slightly shorter than basal piece, their lateral margins strongly sinuate one-third from apex, and apical third of parameres strongly narrowed. Median lobe broad and shorter than parameres (Fig. 4).



Figures 1-4. 1. Right maxillary palpus from ventral side. 2. Right antenna. 3. Right metatarsus. 4. Aedeagophore. The scale bar represents 0.3 mm.

DISCUSSION

The new species, *Helophorus turca* sp. n., is placed in the subgenus *Orphelophorus* due to four main characters: a) elytra with intercalary striae of 2-3 punctures (see Discussion), b) tarsi with stiff setae, c) upper surface with conspicuous erect recurved setae, and d) head and pronotum with large rounded granules.

Helophorus (Orphelophorus) turca sp. n. is similar to *H. aquaticus* externally (*H. turca* sp. n. is more convex and darker), but easily distinguishable from *H. aquaticus* and *H. terminassianae* by its characteristic aedeagophore, swollen last segment of tarsi, pubescent 6th segments of antennae (club is glabrous and this character is an exceptional character for this group beetles) and with intercalary striae of 2-3 punctures. Similarly, other members of the subgenus *Orphelophorus* (*H. obscurellus* Poppius, 1907 and *H. arcticus* Brown, 1937) can be easily separated from the *H. turca* sp. n. by its aedeagophore, and with the other morphological characters. The aedeagophore of *H. turca* sp.n. is almost twice the size of those of *H. obscurellus* and *H. arcticus*.

Angus (1992) constitutes one of most extensive studies on *Helophorus*. There, the diagnosis of the subgenus *Orphelophorus* is: "elytra without intercalary striae of two or fewer punctures, and..." (see page 9). The same statement is also used in Angus (1970b). The holotype and one paratype of *H. turca* new species have two punctures on the left elytron, and three punctures on the right elytron. Remaining specimens have two punctures on both elytra. Therefore, the pertinent portion of the subgenera key in Angus (1992) should be changed to: "elytra without intercalary striae of three or fewer punctures, and..."

LITERATURE CITED

Angus, R. B. 1970b. A revision of the beetles of the genus *Helophorus* F. (Coleoptera: Hydrophilidae), subgenera *Orphelophorus* d'Orchymont, *Gephelophorus* Sharp and *Meghelophorus* Kuwert. Acta Zoologica Fennica 129: 1-62.

Angus, R. B. 1984. Towards a Revision of the Palearctic Species of *Helophorus* F. (Coleoptera, Hydrophilidae) I. Entomological Review 63 (3): 89-119.

Angus, R. B. 1985a. A new species of *Helophorus* (Coleoptera: Hydrophilidae) from Mongolia. Results of the Mongolian-German Biological Expeditions since 1962, No. 148. Mitteilungen aus dem Zoologschen Museum in Berlin 61: 163-164, pl. I.

Angus, R. B. 1985b. A new species of *Helophorus* F. (Col., Hydrophilidae) from northern Spain. Entomologist's Monthly Magazine 121: 89-90.

Angus, R. B. 1985c. Towards a Revision of the Palearctic Species of *Helophorus* F. (Coleoptera, Hydrophilidae) II. Entomological Review 64 (4): 128-162.

Angus, R. B. 1987. A revision of the species of *Helophorus* Fabricius, subgenus *Atracthelophorus* Kuwert, occurring in France, the Iberian Peninsula and North Africa, with a note on *H. discrepans* Rey in Morocco (Coleoptera, Hydrophilidae). Nouvelle Revue d' Entomologie (Nouvelle Série) 4: 45-60.

Angus, R. B. 1988. Notes on the *Helophorus* (Coleoptera, Hydrophilidae) occuring in Turkey, Iran and neighbouring territories. Revue Suisse de Zoologie 95 (1): 209-248.

Angus, R. B. 1992. Süsswasserfauna von Mitteleuropa (Insecta: Coleoptera: Hydrophilidae: Helophorinae). Gustav Fischer Verlag. Jena, New York. 144 pp.

Balfour-Browne, F. 1958. British Water Beetles III. Ray Society, London, England, U.K. 210 pp.

Chiesa, E. 1959. Hydophilidae Europe. A. Forni, Bologna, Italy. 199 pp.

Hansen, M. 1991. The Hydrophiloid Beetles. Phylogeny, Classification and a Revision of the Genera. Biologiske Skrifter 40. Copenhagen, Denmark. The Royal Danish Academy of Science and Letters. 368 pp.

Hansen, M. 1999. World Cataloque of Insects. Hydrophiloidea (Coleoptera). Apollo Books. Stenstrup, Denmark. Volume 2. 416 pp.

Incekara Ü., A. Mart, and O. Erman. 2002. Three unrecorded *Helophorus* Fabricius, 1775 (Coleoptera, Hydrophilidae) species for the Turkish fauna. Turkish Journal of Zoology 26: 289-292.

Incekara, Ü., A. Mart, and O. Erman. 2004. Distribution of Turkish *Helophorus* Fabricius, 1775 (Coleoptera, Helophoridae) I. Subgenus *Rhopalhelophorus*, with two new records. Gazi Entomological Research Society 6 (2): 51-62.

Incekara, Ü., A. Mart, and O. Erman. 2005. *Helophorus erzurumica* sp. n. A New Species from Turkey and Some Notes on *H. Ponticus* Angus, 1988 (Coleoptera: Hydrophilidae). Aquatic Insects 27 (1): 43-46.

Mart, A. and O. Erman. 2001. A Study on *Helophorus* Fabricus, 1775 (Coleoptera, Hydrophilidae) Species. Turkish Journal of Zoology 25 (1): 35-40.

Smetana, A. 1985. Revision of the subfamily Helophorinae of the Nearctic Region (Coloptera: Hydrophilidae). Memoirs of the Entomological Society of Canada 131: 1-151.

SCIENTIFIC NOTE

STALKING OF STATIONARY PREY BY A PRAYING MANTID (*HIERODULA PATELLIFERA* SERVILLE) (MANTODEA: MANTIDAE)[1]

Dzung T. Nguyen [2] and Michael R. Maxwell[2]

The predatory behavior of mantids has received much attention over the past several decades, including studies on visual prey recognition, distance estimation, and prey capture (reviewed in Kral, 1999, Prete, 1999, Prete and Hamilton, 1999, Prete, et al., 1999, Kral and Prete, 2004, Yamawaki, 2006). This work has focused on mantids in captivity, typically striking at moving targets. We report a mantid *(Hierodula patellifera* Serville) that approached and stalked prey that had come to rest outdoors. To our knowledge, this is the first detailed observation of stalking behavior by a wild mantid in an outdoor setting, as field accounts of predation typically describe prey items, but not the preceding stalking behavior (e.g., Barrows, 1984, Ramsay, 1990, Hurd, et al., 1994, Maxwell and Eitan, 1998).

On 2 Jan. 08 in Kailua-Kona, Hawaii, HI (19° 34' N, 155° 58' W), at c. 2300 hrs, the observer (DTN) turned on an outside balcony light of a building overlooking a garden. Ambient temperature was c. 24° C. Within a few minutes, an airborne green male *H. patellifera* landed on the wall c. 50 cm from the light (c. 8 cm body length). The observer moved the mantid to a table c. 2 m from the light for identification purposes. The mantid was left on the table.

At c. 2315, a large brown moth landed on the wall c. 40 cm from the light (black witch moth, *Ascalapha ordorata* L.). The mantid quickly turned its head in the moth's direction. This particular moth was c. 18 cm at greatest wingspan and c. 12 cm from tip of head to posterior tip of abdomen. Once landed, the moth remained stationary over the next c. 20 minutes; it did not crawl, fly, or flutter its wings as the mantid approached. The illuminated large moth was conspicuous against the white wall. At c. 2330, the mantid flew to the wall and landed c. 1 m from the moth. After a few minutes, the mantid began crawling towards the moth, moving upward along the wall, towards the moth's posterior. The mantid's approach behavior involved frequent back-and-forth rocking, or "peering" movements (Kral and Poteser, 1997; Kral, 1999; Yamawaki 2006). Typically, the mantid took a step, then rocked 2-3 times before taking another step. The mantid crawled the c. 1 m distance to the stationary moth within c. 5 minutes.

---

[1] Received on February 3, 2008. Accepted on February 25, 2008.

[2] Department of Mathematics and Natural Sciences, National University, 11255 North Torrey Pines Road, La Jolla, California 92037-1011 U.S.A. E-mail: dnguyen@nu.edu, mmaxwell@nu.edu, respectively.

Mailed on November 12, 2008

Once next to the moth, the mantid extended its left foreleg and touched the moth's left hindwing. In response, the moth fluttered its wings and moved c. 2 cm away. The mantid waited c. 1 minute, approached, and probed near the moth's abdomen with the left foreleg. As before, the moth fluttered to c. 2 cm away, with the mantid approaching and probing with its foreleg. This sequence of touching followed by displacement occurred six times in total.

At c. 2340, a dipteran fly landed c. 30 cm from the mantid and moth. Immediately, the mantid turned to face the fly and approached it, using the same back-and-forth "peering" movements. When the mantid was c. 10 cm from the fly, the fly flew away. The mantid then crawled to c. 1 m from the moth and remained stationary until 2345, when observation ended.

These observations support the notion that mantids can fixate on and approach prey that become stationary, as suggested by captive studies using stationary targets (Poteser and Kral, 1995; Hyden and Kral, 2005; Yamawaki, 1998, 2000). In the present study, the moth was stationary during the mantid's aerial approach and subsequent stalking, although we cannot rule out subtle movements of the antennae, mouthparts, or other body parts. We note that prey alighting and coming to rest on a surface is most analogous to Yamawaki's studies wherein dark targets are initially flashed onto a screen and then remain stationary. In both the present study and Yamawaki (1998, 2000), the mantid continues to attend to a stationary object after initial visual stimulation. In this study, the mantid presumably detected the moth's arrival from 2 m away. We note that this distance is greater than 50 cm, which is typically a maximum distance employed in captive studies of prey recognition and capture (e.g., Kral, 1999, Prete, 1999). Through the "peering" movements during stalking, the mantid most likely detected the contrast of the brown moth on the white wall (Kral, 1999). Dark-on-white contrast has been found to facilitate image recognition in the mantid *Sphrodomantis lineola* Burmeister (Prete and McLean, 1996). Finally, it was curious that the mantid touched or probed the moth several times without striking. Lack of feeding motivation might explain this apparent reluctance to strike, although the mantid quickly approached the fly, possibly to attack. Alternatively, the large moth may have simply been too large for the mantid to regard as viable prey (Rilling, et al., 1959; Iwasaki, 1990; Prete, 1990; Yamawaki, 2000), rendering his stalking an exercise in observation.

ACKNOWLEDGMENTS

We thank Gavin Svenson (New York State Museum) and Frank Howarth (Bishop Museum, Honolulu, Oahu, Hawaii, U.S.A.) for assistance in species identification. Karl Kral, Yoshifumi Yamawaki, and anonymous reviewers provided valuable comments on this paper.

LITERATURE CITED

Barrows, E. M. 1984. Perch sites and food of adult Chinese mantids (Dictyoptera: Mantidae). Proceedings of the Entomological Society of Washington 86: 898-901.

Hurd, L. E., R. M. Eisenberg, W. F. Fagan, K. J. Tilmon, W. E. Snyder, K. S. Vandersall, S. G. Datz, and J. D. Welch. 1994. Cannibalism reverses male-biased sex ratio in adult mantids: female strategy against food limitation? Oikos 69: 193-198.

Hyden, K. and K. Kral. 2005. The role of edges in the selection of a jump target in *Mantis religiosa.* Behavioural Processes 70: 122-131.

Iwasaki, T. 1990. Predatory behavior of the praying mantis *Tenodera aridifolia sinensis.* I. Effect of prey size and prey density. Journal of Ethology 8: 75-79.

Kral, K. 1999. Binocular vision and distance estimation. pp. 114-140. *In,* F. R. Prete, H. Wells, P. H. Wells, and L. E. Hurd (Editors). The praying mantids. Johns Hopkins University Press. Baltimore, Maryland, U.S.A. 362 pp.

Kral, K. and M. Poteser. 1997. Motion parallax as a source of distance information in locusts and mantids. Journal of Insect Behavior 10: 145-163.

Kral, K. and F. R. Prete. 2004. In the mind of a hunter: the visual world of the praying mantis. pp. 75-116. *In,* F. R. Prete (Editor). Complex worlds from simpler nervous systems. MIT Press. Cambridge, Massachusetts, U.S.A. 387 pp.

Maxwell, M. R. and O. Eitan. 1998. Range expansion of an introduced mantid *Iris oratoria* and niche overlap with a native mantid *Stagmomantis limbata* (Mantodea: Mantidae). Annals of the Entomological Society of America 91: 422-429.

Poteser, M. and K. Kral. 1995. Visual distance discrimination between stationary targets in praying mantis: an index of motion parallax. Journal of Experimental Biology 198: 2127-2137.

Prete, F. R. 1990. Configural prey recognition by the praying mantis, *Sphodromantis lineola* (Burr.); effects of size and direction of movement. Brain, Behavior and Evolution 36: 300-306.

Prete, F. R. 1999. Prey recognition. pp. 141-179. *In,* F. R. Prete, H. Wells, P. H. Wells, and L. E. Hurd (Editors). The praying mantids. Johns Hopkins University Press. Baltimore, Maryland, U.S.A. 362 pp.

Prete, F. R. and K. Hamilton. 1999. Prey capture. pp. 194-223. *In,* F. R. Prete, H. Wells, P. H. Wells, and L. E. Hurd (Editors). The praying mantids. Johns Hopkins University Press. Baltimore, Maryland, U.S.A. 362 pp.

Prete, F. R. and T. McLean. 1996. Responses to moving small-field stimuli by the praying mantis, *Sphodromantis lineola* (Burmeister). Brain, Behavior and Evolution 47: 42-54.

Prete, F. R., H. Wells, and P. H. Wells. 1999. The predatory behavior of mantids: historical attitudes and contemporary questions. pp. 3-18. *In,* F. R. Prete, H. Wells, P. H. Wells, and L. E. Hurd (Editors). The praying mantids. Johns Hopkins University Press. Baltimore, Maryland, U.S.A. 362 pp.

Ramsay, G. W. 1990. Mantodea (Insecta), with a review of aspects of functional morphology and biology. Fauna of New Zealand, Number 19. DSIR Publishing. Wellington, New Zealand. 96 pp.

Rilling, S., H. Mittelstaedt, and K. D. Roeder. 1959. Prey recognition in the praying mantis. *Behaviour* 14: 164-184.

Yamawaki, Y. 1998. Responses to non-locomotive prey models by the praying mantis, *Tenodera angustipennis* Saussure. Journal of Ethology 16: 23-27.

Yamawaki, Y. 2000. Effects of luminance, size, and angular velocity on the recognition of nonlocomotive prey models by the praying mantis. Journal of Ethology 18: 85-90.

Yamawaki, Y. 2006. Visual object recognition in the praying mantis and the parasitoid fly. pp. 147-170. *In,* K. Fujita and S. Itakura (Editors). Diversity of cognition. Kyoto University Press. Kyoto, Japan. 414 pp.

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

1. Publication Title: *ENTOMOLOGICAL NEWS.* Publication Number: 022-293
2. Date of filing (Form 3526): October 28, 2008.
3. Frequency of issue: Five times per year, bimonthly except July and August
4. Location of known office of publication: American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 U.S.A.
5. Location of the headquarters of general business offices of the publishers: American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 U.S.A.
6. Name and address of the Publisher, Editor, and Business Manager:
   Publisher: American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 U.S.A.
   Editor and Business Manager: Jorge A. Santiago-Blay, American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 U.S.A.
7. Owner: American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 U.S.A.
8. Known bondholders, mortgagees, and other security holders owning or holding one percent or more of the total amounts of bonds, mortgages, and other securities: None
9. For completion by nonprofit organizations authorized to mail at special rates: The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes: Have not changed during the preceding 12 months. American Entomological Society U.S.A. Federal ID No.: 23-1599849.
10. Extent and Nature of Circulation:

	Average No. Copies Each Issue During Preceding 12 Months	*Actual No. Copies of Single Issue Published Nearest to Filing Date*
A. Total number of copies (net press run)	612	626
B. Paid and/or requested circulation		
1. Paid/requested outside-county mail subscriptions (includes exchange copies)	520	524
2. Paid/requested inside-county mail subscriptions (includes exchange copies)	0	0
3. Sales through dealers and carriers, etc.	0	0
4. Other classes mailed through USPS	0	0
C. Total paid and/or requested circulation [sum of 10b (1), (2), (3), and (4)]	520	524
D. Free distribution by mail (samples, complimentary, and other free)	14	14
E. Free distribution outside the mail	0	0
F. Total free distribution (sum of 10D and 10E)	14	14
G. Total distribution (sum of C and F)	534	538
H. Copies not distributed (office use)	78	88
I. Total (sum of G and H)	612	626
J. Percent paid/requested circulation (10C/10G x 100)	97%	97%

11. I certify that the above statements are correct and complete.

William James Cromartie, Vice-president Entomological Society

---

MAILING DATES FOR VOLUMES 118(5) 2007 AND 119(1-4) 2008

No.	Date of Issue	Pages	Mailing Date
5	November and December 2007	433-540	January 18, 2008
1	January and February 2008	1-108	March 14, 2008
2	March and April 2008	109-216	May 14, 2008
3	May and June 2008	217-324	June 24, 2008
4	September and October 2008	325-432	November 12, 2008
5	November and December 2008	To be listed in next Statement of Ownership	

SCIENTIFIC NOTE

NEW DISTRIBUTIONAL RECORDS AND NOTES ON THE GENUS *PALMACORIXA* ABBOTT (HETEROPTERA: CORIXIDAE) IN COLORADO, U.S.A.[1]

Richard S. Durfee,[2] S. Mark Nelson,[3] and John T. Polhemus[4]

Ongoing faunal surveys and water quality studies in Colorado have revealed the presence of *Palmacorixa buenoi* Abbott and *P. nana walleyi* Hungerford, both previously unknown to occur in the state.

Palmacorixa buenoi was collected from both Sawhill Ponds in Boulder County and the South Fork Republican River in Yuma County. These locations are east of the Rocky Mountains and fall within the expected range of this species, as it is widely distributed in eastern and Midwestern North America and has been reported from Quebec to Florida, and west to Texas, Kansas, eastern Montana and eastern Alberta (Brooks and Kelton, 1967; Roemhild, 1976; Polhemus et al., 1988).

Palmacorixa nana walleyi was collected recently from a slow backwater area of the Arkansas River in Pueblo County. This record represents a significant range extension, as this subspecies has been reported only from eastern Kansas, southeastern Texas, southeastern New Mexico, and Ft. Sill, Oklahoma (Hungerford, 1948; Zuellig et al., 2006).

Palmacorixa gillettei gillettei Abbott, the only species and (subspecies) of *Palmacorixa* previously reported for Colorado, has not been collected in the state since 1900. Abbott (1912) described this subspecies based on a series of specimens collected in Ft. Collins. This area of Colorado has been well collected due to its proximity to Colorado State University, so it is surprising that *P. gillettei gillettei* has not been collected since its initial discovery. However, it has a more northern distribution, and Colorado likely represents the southern limit of its range. Therefore, it may occur only sporadically in areas of northeastern Colorado.

Material Examined: *P. buenoi*; Boulder County, Sawhill Ponds, nr. Boulder, 9 October 1984, J. T. Polhemus, 1 male, J. T. Polhemus Collections, Englewood, Colorado. Yuma County, South Fork of the Republican River at state line, 31 October 2005, Colorado River Watch Program, 4 males, 3 females, C. P. Gil-

---

[1] Received on January 9, 2008. Accepted on February 5, 2008.

[2] Department of Bioagricultural Sciences and Pest Management, Colorado State University, Ft. Collins, Colorado 80523 U.S.A. E-mail: rdurfee@cybernet1.com

[3] Ecological Research and Investigations Group, Technical Service Center, Bureau of Reclamation, Denver, Colorado 80225 U.S.A. E-mail: MSNELSON@do.usbr.gov

[4] Colorado Entomological Museum, 3115 South York Street, Englewood, Colorado 80113 U.S.A. E-mail: jtpolhemus@msn.com

Mailed on November 12, 2008

lette Museum of Arthropod Diversity, Colorado State University, Ft. Collins, Colorado. *P. nana walleyi*; Pueblo County, Arkansas River, just upstream of confluence with Fountain Creek, 31 May 2007, S. M. Nelson, 1 male, 1 female, C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Ft. Collins, Colorado, U.S.A.

LITERATURE CITED

Abbott, J. E. 1912. A new genus of Corixidae (Hemiptera). Entomological News 23:337-339, plate 18.

Brooks, A. R. and L. A. Kelton. 1967. Aquatic and semiaquatic Heteroptera of Alberta, Saskatchewan, and Manitoba (Hemiptera). Memoirs of the Entomological Society of Canada 51: 1-92.

Hungerford, H. B. 1948. The Corixidae of the Western Hemisphere (Hemiptera). University of Kansas Science Bulletin 32: 1-827.

Polhemus, J. T., R. C. Froeschner, and D. A. Polhemus. 1988. Family Corixidae Leach, 1815, pp. 93-118. *In*, T. J. Henry and R. C. Froeschner (Editors). Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. E. J. Brill. Leiden, The Netherlands. xix + 958 pp.

Roemhild, G. 1976. Aquatic Heteroptera (true bugs) of Montana. Montana Agricultural Experiment Station Research Report. No. 102. 70 pp.

Zuellig, R. E., B. C. Kondratieff, J. P. Schmidt, R. S. Durfee, D. E. Ruiter, and I. E. Prather. 2006. An annotated list of aquatic insects of Fort Sill, Oklahoma, excluding Diptera with notes on several new state records. Journal of the Kansas Entomological Society 79 (1): 34-54.

SCIENTIFIC NOTE

NEOALLOCERAEA NOM. NOV., A REPLACEMENT NAME FOR THE SUBGENUS *ALLOCERAEA* BENICK, 1934 (COLEOPTERA: STAPHYLINIDAE) NON SCHULZE, 1918[1]

Hüseyin Özdikmen[2] and Mustafa C. Darilmaz[2]

In an effort to reduce the number of homonyms in Staphylinidae, we found a genus group name which had been previously published for another taxon, making it a junior homonym. In accordance with Article 60 of the International Code of Zoological Nomenclature (1999), we propose a substitute name for this genus name.

Family Staphylinidae
Genus *Plataraea* Thomson, 1858
Subgenus *Neoalloceraea* nom. nov.

Alloceraea Benick, 1934. Ent. Blätter, 31, 164. (Coleoptera: Staphylinidae). Preoccupied by *Alloceraea* Schulze, 1918. S.B. Ges. naturf. Freunde Berlin, 1918, 62 (Acari: Ixodida).

Benick (1934) proposed the subgenus *Alloceraea* (type species, *Atheta fiorii* Bernhauer, 1908 by original designation) and placed it in the rove beetle genus *Plataraea* Thomson, 1858 (Coleoptera: Staphyliniformia: Staphylinoidea: Staphylinidae: Aleocharinae: Athetini: *Plataraea*). *Alloceraea* is still used as a valid genus group in the Coleoptera (e.g. Löbl and Smetana, 2004). Currently *Alloceraea* includes only one species, *Alloceraea fiorii* (Bernhauser, 1907) (formerly *Atheta fiorii* Bernhauser, 1908) as the type, from Italy.

Unfortunately, the generic name, *Alloceraea,* was already preoccupied by Schulze (1918), who had described *Alloceraea* (type species *Haemaphysalis inermis* Birula, 1895) as a genus of tick (Acari: Ixodida: Ixodina: Amblyommidae: Rhipicephalinae). Currently, *Alloceraea* is considered a subgenus of the speciose genus *Haemaphysalis* Koch, 1844.

Thus, the subgenus name *Alloceraea* Benick, 1934 is a junior homonym of the subgenus name *Alloceraea* Schulze, 1918. Under the Zoological Code (ICZN, 1999), it must be rejected and replaced, and so a new replacement name *Neoalloceraea* **nom. nov.** for *Alloceraea* Benick, 1934 is herein proposed in the present work.

---

[1] Submitted on September 17, 2007. Accepted on October 18, 2007.

[2] Gazi University, Arts and Sciences Faculty, Department of Biology, 06500-Teknikokullar Ankara, Turkey. E-mails: ozdikmen@gazi.edu.tr, mdarilmaz@yahoo.com (corresponding author), respectively.

Mailed on November 12, 2008

Etymology: From the preexisting subgenus name *Alloceraea*.
Distribution: Europe (Italy).

Summary of nomenclatural changes:
Genus *Plataraea* Thomson, 1858
Subgenus *Plataraea* (*Neoalloceraea*) **nom. nov.**
= *Plataraea* (*Alloceraea*) Benick, 1934 (non Schulze, 1918)

Species *Plataraea* (*Neoalloceraea*) *fiorii* (Bernhauer, 1908) **comb. nov.**
= *Atheta fiorii* Bernhauer, 1908
= *Plataraea* (*Alloceraea*) *fiorii* (Bernhauer, 1908)

LITERATURE CITED

Benick, G. 1934. Revision der Untergattungen Plataraea Thoms. Und Aerostiba Bernh. (Gattung Atheta, Staphyl.) Entomologische Blätter 31: 161-166.

ICZN. 1999. International Code of Zoological Nomenclature. Fourth Edition. The International Trust for Zoological Nomenclature, London.

Löbl, I. and A. Smetana. 2004. Catalogue of Palaearctic Coleoptera, Vol. 2. Apollo Books 942 pp.

Schulze, P. 1918. Ein Beitrag zur Zeckenfauna Mazedoniens. Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin 1918 (2): 61-66.

Agreement. By submitting a paper for publication, authors tacitly agree to not submit in parallel the same manuscript to another journal. For published papers, authors agree to accept responsibility for all page, illustration, and requested reprint or .pdf charges. Rejected manuscripts will be discarded.

Scientific Notes and Book Reviews. These are much shorter contributions, typically not exceeding one (Book Review) or two (Scientific Notes) printed pages. The main difference between these types of contributions and longer papers is that scientific notes and book reviews lack an abstract and most of the main headings, except for the acknowledgments and the literature cited sections.

Reviewers. When submitting papers, all authors are requested to provide the names of two qualified individuals who have critically reviewed the manuscript before it is submitted to *Entomological News*. All papers, except book reviews and American Entomological Society business, are forwarded to experts for final review before acceptance. In order to expedite the review process when submitting papers, the authors are also asked to suggest the name, address, and e-mail of at least five published experts in the subject matter of the submitted paper who may be able to review this paper and who has not seen this contribution before. In order to attempt avoiding the appearance of conflict of interests, the suggested reviewers must not share work affiliations with any of the authors. Ideally, the review process should be completed within 30 days. If additional reviews are necessary, authors will be requested to suggest the name, address, and e-mail of other colleagues to whom the article may be sent. The Editor reserves his prerogative of sending the manuscript to other reviewers. Authors are also welcomed to list the names of colleagues to whom the article should not be sent, with a brief explanation. Upon return of reviews, authors will be asked to modify their papers to accommodate suggestions of the reviewers and the Editor as well as to conform to requirements of *Entomological News*. If authors do not modify their papers, they should specifically address, on a point by point basis, why they are not doing that.

Page Proofs. The printer will send page proofs to the Editor and then the proofs will be sent to the corresponding authors as .pdf files. The computer that authors use must be able to receive files of at least 5MB. Within three days, authors must e-mail the proofs to the Editor, with corrections indicated precisely to the page, paragraph, and line. Authors who anticipate being absent are urged to provide forwarding addresses or to provide a temporary address with dates. Proofs not received on time from authors may be published at a later date. The Editor will collect the page proofs and send them to the printer.

Page and Reprint Charges. Contact the Editor for current page and reprint charges. Authors will be mailed invoices for their total page(s) and reprints, including shipping charges. After receiving invoice, please remit payment, or address questions, to the known Office of Publication. Articles longer than 20 printed pages of *Entomological News* may be published in two or more installments, unless the author is willing to pay the entire cost of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Entomological News is widely indexed. *Entomological News* is listed in the Science Citation Index Expanded (updated on February 26, 2005). In addition, the Ulrich's Periodical Index for 2005 lists *Entomological News* as being indexed by dozens of sources, including Agricola (Agricola (CRIS), Agricultural Engineering Abstracts (AEA), Agroforestry Abstracts (AgrForAb), Aquatic Sciences & Fisheries Abstracts (ASFA), BIOBASE, BiolAb), Biology Digest (BiolDig), BIOSIS Previews (BIOSIS Prev), Chemical Abstracts (ChemAb), Current Awareness in Biological Sciences (BIABS), Current Contents (CurrCont), Field Crop Abstracts (FCA), Faba Bean Abstracts (FaBeAb), Fisheries Review (SFA), Forestry Abstracts (ForAb), Grasslands and Forage Abstracts (HerbAb), Horticultural Science Abstracts (HortAb), Index Veterinarius (indVet), MEDLINE, Nematological Abstracts (NemAb), Nutrition Abstracts and Reviews (NutrAb), Personal Alert (ASCA), Plant Breeding Abstracts (PBA), Post Harvest News and Information (PHN&I), Poultry Abstracts (PoultAb), Protozoological Abstracts (ProtozoAb), Review of Aromatic and Medicinal Plants (RA&MP, Referativnyi Zhurnal (RefZh), Review of Applied Entomology (RevApplEntom), Review of Medical and Veterinary Mycology (RM&VM), Rice Abstracts (RiceAb), Seed Abstracts (SeedAb), Soils & Fertilizers (S&F), Soybean Abstracts (SoyAb), Tropical Diseases Bulletin (TDB), Vitis - Viticulture and Oenology Abstracts (VITIS), Weed Abstracts (WeedAb), Wheat Barley and Triticale Abstracts (TritiAb), Wildlife Review Abstracts (WildRev), Zoological Record (ZoolRec), among others.

Entomological News is printed by Dover Litho Printing Company, 1211 North DuPont Highway, Dover, Delaware 19901 U.S.A. Telephone (302) 678-1211; fax: (302) 678-8091; web page: www.doverlitho.com. Dover Litho has been recognized by DENREC and DELRAP Green Industries as "The Most Environmentally Conscious Printer in the State of Delaware." *Entomological News* is printed on acid free and archival quality, elemental chlorine free (ECF), or totally chlorine free (TCF) recycled paper that meets EPA and FTC guidelines for recycled coated papers.

Mailed on November 12, 2008

continued from front cover

SCIENTIFIC NOTES

AMERICAN ENTOMOLOGICAL SOCIETY BUSINESS

THE AMERICAN ENTOMOLOGICAL SOCIETY

www.acnatsci.org/hosted/aes

Number 5

cember 2008

Entomological News

continued on back cover

USISSN 0013-872X

Mailed February 19, 2009

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS
ISSN 0013-872X

Entomological News is a fully refereed scientific international journal published by The American Entomological Society (AES). Manuscripts on systematics, ecology, evolution, morphology, physiology, behavior, biodiversity, conservation, paleobiology, and other aspects of insect and terrestrial arthropod life as well as nomenclature, biographies and history of entomology, among others, are appropriate topics for papers submitted to *Entomological News*. Papers on applied, economic, and regulatory entomology or on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields. In accordance with the spirit and letter of international codes of biological nomenclature, the Editor of *Entomological News* recommends that name-bearing types and representative (voucher) specimens be deposited in collections where such specimens are well curated and available to qualified researchers.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February, and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pennsylvania (U.S.A.), while the October and March meetings are held at the Department of Entomology of the University of Delaware in Newark, Delaware (U.S.A.). Society members who reside in southeastern Pennsylvania, southern New Jersey, and Delaware are urged to attend the meetings whenever possible. Members outside this area as well as guests are cordially invited and welcomed. Information on the Calvert Award for insect-related study by a young person in the Delaware River Valley region sponsored by The American Entomological Society can be found at: http://www.udel.edu/chem/white/Odonata/CalvertAwd.html.

Membership (http://www.ansp.org/hosted/aes/Acrobat/Membership_Form.pdf): Membership to the AES is open to anyone. Annual dues are US$20.00 (regular members) and US$12.00 (student members).

United Stated Postal Service (USPS) Identification Statement: *Entomological News* (ISSN 0013-872X) is published bimonthly, except July-August, by The American Entomological Society. The subscription is not included with the annual dues. The subscription price is US$15.00 per year, prepaid, for members, US$30.00 per year, prepaid for institutional library subscribers located in the U.S.A. and US$34.00 per year, prepaid for institutional library subscribers located out of the U.S.A. Periodicals Postage Paid at Philadelphia, Pennsylvania 19103 U.S.A. and additional mailing offices. The known **Office of Publication** is: Office Manager, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195 United States of America. **POSTMASTER:** Send address changes to the Office of Publication.

Subscriptions to current issues, back issues, and microforms of *Entomological News*. Please send inquiries or send completed membership form to the Office of Publication, e-mail: aes@acnatsci.org, or call (215) 561-3978. *Entomological News* is available in microform from ProQuest Information and Learning. Call toll-free (800) 521-3042, (800) 521-0600, (734) 761-4700. Mail inquiry to: ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106-9866 U.S.A. The webpage of ProQuest is: www.proquest.com.

Any author may submit papers. Manuscripts will be accepted from any author, although, papers from members of the American Entomological Society are given priority. Authors are urged to read the guidelines to the authors carefully (http://www.geocities.com/entomologicalnews/instructions.html) and contact the Editor for any changes that may not have been uploaded. It is suggested that all prospective authors join the AES.

Send manuscripts, books for review, and all editorial correspondence to the Editor. All manuscripts, including scientific notes and book reviews, submitted for publication in *Entomological News* as well as all associated editorial communications must be sent electronically to the Editor, Jorge A. Santiago-Blay at: blayjorge@gmail.com. E-mail is the preferred way to contact the Editor and the fastest way to get a reply. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible.

Previous Editors of *Entomological News*: 1(1) January 1890 and 1(2) February 1890, Eugene Murray Aaron (1852-1940); 1(3) March 1890 to 21(10) December 1910, Henry Skinner (1861-1926); 22(1) January 1911 to 54(9) November 1943, Phillip P. Calvert (1871-1961); 54(10) December 1943 to 57(10) December 1946, Editorial Staff with A. Glenn Richards (1909-1993) and R. G. Schmieder (1898-1967) as co-Editors; 58(1) January 1947 to 79(7) July 1968, R. G. Schmieder; 79(8) October 1968 to 83(10) to December 1972, Ross H. Arnett, Jr. (1919-1999); 84(1) January 1973 to 85(4) April 1974, R. W. Lake; 85(5-6) May & June 1974 to 113(3) May & June 2002, Howard P. Boyd; 113(4) September & October 2002 to 113(5) November & December 2002, F. Christian Thompson and Michael Pogue.

Cover Design by Jane Spencer

Mailed on February 19, 2009

A NEW SPECIES OF *ANASA* (HEMIPTERA: HETEROPTERA: COREIDAE) FROM JAMAICA[1]

Harry Brailovsky[2]

ABSTRACT: A new species of *Anasa* from Jamaica (West Indies) is described and illustrated. *Anasa bellator* (Fabricius) is recorded for the first time from Jamaica. A revised key to known species of *Anasa* from Jamaica is presented.

KEY WORDS: Hemiptera, Heteroptera, Coreidae, Jamaica

Brailovsky (1985) reviewed the genus *Anasa* Amyot and Serville and recognized, described, or redescribed each of 63 species. Drawings of the head, pronotum, male genital capsule, parameres, female genitalia and spermatheca were provided, as well as a key to the known taxa. Later Brailovsky (1990, 2001) and Brailovsky and Barrera (2000) added five new species from México, El Salvador, Dominican Republic, French Guyana, and Ecuador.

The genus *Anasa* is characterized by having the hind femur usually armed with one or more subdistal spines, the humeral angles not acutely spined, the tylus not compressed and raised above the juga, the rostrum reaching or extending beyond the middle third of the mesosternum, and the head below the antenniferous tubercles lacking a raised shelf-like plate.

Previous to this paper only the species *A. scorbutica* (Fabricius) was known from Jamaica. In this contribution *A. bellator* (Fabricius) is recorded for the first time, one new species is described, and a key to the Jamaican species is included.

Acronyms used: Canadian National Collection of Insects, Ottawa, Canada (CNCI); Florida State Collection of Arthropods, Gainesville, Florida (FSCA); Colección Entomológica, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM); and Zoologische Staatsammlung München, Germany (ZSMC). All measurements are given in millimeters.

SYSTEMATIC ENTOMOLOGY

Anasa bellator (Fabricius)

Cimex bellator Fabricius, 1787, Man. Ins. II: 286.

This species is distinguished by the following characters: Head behind base of each antenniferous tubercle armed with short acute spine that reaches base of antennal segment I, spine shorter than diameter of eye; humeral angles slightly exposed, weakly angulate; femora unarmed; antennal segments II-III yellow

---

[1] Received on November 14, 2007. Accepted on January 9, 2008.

[2] Instituto de Biología, UNAM, Departamento de Zoología, Apdo Postal 70153, México D. F., 04510 México. e mail: coreidae@servidor.unam.mx

ENTOMOLOGICAL NEWS 119 (5): 433 November and December 2008
Mailed on February 19, 2009

with two wide black rings and antennal segment IV black with apical third yellow.

Distribution. Widely distributed throughout México, Central America, West Indies, and South America. In the West Indies it is recorded from Cuba, Dominican Republic, Guadeloupe Island, St. Vincent Island, Dominica Island, Grenada Island, and Trinidad (Brailovsky 1985, 2001).

New Records. This is the first record from Jamaica. West Indies, Jamaica: 1 male, Parish of St. Catherine, Linstead, 7-IV-1991, R. M. Baranowski (FSCA).

Anasa jamaicensis Brailovsky, NEW SPECIES

Figures 1-2

Description. Structure. Male. Head wider than long, pentagonal, dorsally flat, non-declivent; tylus unarmed, extending anteriorly to juga, slightly raised in lateral view; juga unarmed, thickened; antenniferous tubercle unarmed; preocellar pit deep; postocular tubercle protuberant; vertex with deep longitudinal furrow; buccula rounded, without teeth, short, elevated, not projecting beyond antenniferous tubercles; rostrum reaching middle third of mesosternum.

Thorax. Pronotum wider than long, trapezoid, declivent; collar wide; anterolateral margins conspicuously dentate with four to five large and stout conical expansions; posterolateral margins sinuate, smooth; posterior border almost straight, smooth; triangular process short, subacute; callar region flat; frontal angles with broad conical lobe; humeral angles exposed, expanded laterally, directed upward, apically truncated and smooth. Anterior lobe of metathoracic peritreme reniform; posterior lobe acute.

Legs. Femora unarmed.

Scutellum. Triangular, wider than long, flat; apex acute.

Hemelytra. Macropterous, reaching apex of last abdominal segment.

Abdomen. Connexivum widely exposed, with posterior angles complete, not projected into spines.

Genital Capsule. Posteroventral edge with small U-shaped concavity at middle third, and lateral lobes rounded (Fig. 2).

Integument. Surface dull with short decumbent to suberect setigerous hairs; posterior lobe of pronotal disk, scutellum, clavus, corium, pro-meso-and metapleura densely punctuate; head, anterior lobe of pronotal disk, pro-meso and metasternum, and abdominal sterna scattered punctate; connexivum without punctures; tylus, juga, antenniferous tubercles, inner face of eyes, postocular tubercles, buccula, head ventrally, and abdominal sterna sparsely tuberculate.

Dorsal Coloration. Ground color dark orange, tubercles black, and punctures dark orange to reddish brown; antennal segments yellow, scattered with reddish brown tubercles; ocellar tubercle black; outer margin of humeral plate dark brown; endocorium with yellow discoidal mark; hemelytral membrane dark yellow with pale brown to black irregular spots between veins; basal angle almost black; connexivum black with anterior third yellow; dorsal abdominal segments II to VI shiny reddish orange, and VII shiny to dark reddish orange with posterior margin black.

Ventral Coloration. Ground color pale yellowish orange, punctures dark orange; rostral segments (apex of IV pale brown), prosternum, and mesosternum yellow; coxae, femora and tibiae pale yellow, with black discoidal spots; trochanters and tarsi entirely yellow; anterior and posterior lobe of metathoracic peritreme creamy yellow; abdominal sterna and genital capsule yellowish orange tinged with shiny reddish orange marks; pleural abdominal margin yellowish orange with shiny reddish orange marks, and posterior third entirely yellow.

Female. Habitus and color similar to male holotype. Humeral plates exposed, expanded laterally, and bilobed; apex of scutellum black; connexival segments VIII and IX almost black with upper margin yellow; dorsal abdominal segments VIII and IX black, with anterior third dark reddish orange; abdominal sterna and genital plates yellow, scattered with reddish orange to black spots.

Measurements. First male, then female. Head length 1.42, 1.55, width across eyes 1.75, 1.92, interocular space 0.95, 0.97, interocellar space 0.40, 0.48, preocular distance 0.82, 0.90; length of antennal segments: I, 2.22, 2.25, II, 2.60, 2.70, III, 2.46, 2.60, IV, 2.03, 2.15. Pronotum: Length 2.65, 3.00, width across humeral angles 5.00, 5.00. Scutellar length 1.75, 2.00, width 2.00, 2.20. Body length 13.27, 14.30.

Type Material: Holotype: male, West Indies, Jamaica: Spring Garden / S. James (Westlich Montego Bay), 30 m, 11-20-I-1997, L. Rezhanyaireser (ZSMC). Paratypes. 1 female, West Indies, Jamaica: Spring Garden / S. James (Westlich Montego Bay), 30 m, 21-30-XI-1996, L. Rezhanyaireser (UNAM); 1 female, West Indies, Jamaica: St. Thomas, Penlyne Castle, 20-VII-1966, Howden and Becker (CNCI).

Distribution. Known only from the type locality.

Discussion. This species resembles *A. denticulata* Stål, *A. lunicollis* (Stål), and *A. permutata* Brailovsky in having the antenniferous tubercle unarmed, head dorsally without two black longitudinal stripes running lateral to midline, antennal segments II and III without black rings, anterior and posterior lobe of metathoracic peritreme creamy yellow, and anterolateral margins of pronotum conspicuously dentate with four or more large and stout spinelike projections.

In *A. lunicollis* the humeral angles are remarkably developed, expanded forward, with apex black and scutellar disk with black longitudinal stripe crossing the middle third. In the other species the humeral angles are not as above, and the scutellum never has a black longitudinal stripe.

In *A. permutata* and *A. denticulata* the antennal segment IV is bicolor, the humeral angles slightly expanded, dorsal abdominal segments III to VI black, hemelytral membrane whitish, translucid, with black to pale brown spots, and antennal segment I robust. In *A. jamaicensis* antennal segment IV is yellow with pale brown spots, the humeral plate exposed, expanded laterally, directed upward, and apically truncated, dorsal abdominal segments shiny reddish orange, hemelytral membrane dark yellow with pale brown to black irregular spots between veins (basal angle almost black), and antennal segment I elongate and slender.

The habitus and color of *A. scorbutica* (Fabricius) resembles *A. jamaicensis*, but the antenniferous tubercle and femora are armed, and the anterolateral margin of the pronotum lacks broad and large conical tubercles, characteristic of the new species in which the antenniferous tubercle and femora are unarmed.

Etymology. Named after the type locality.

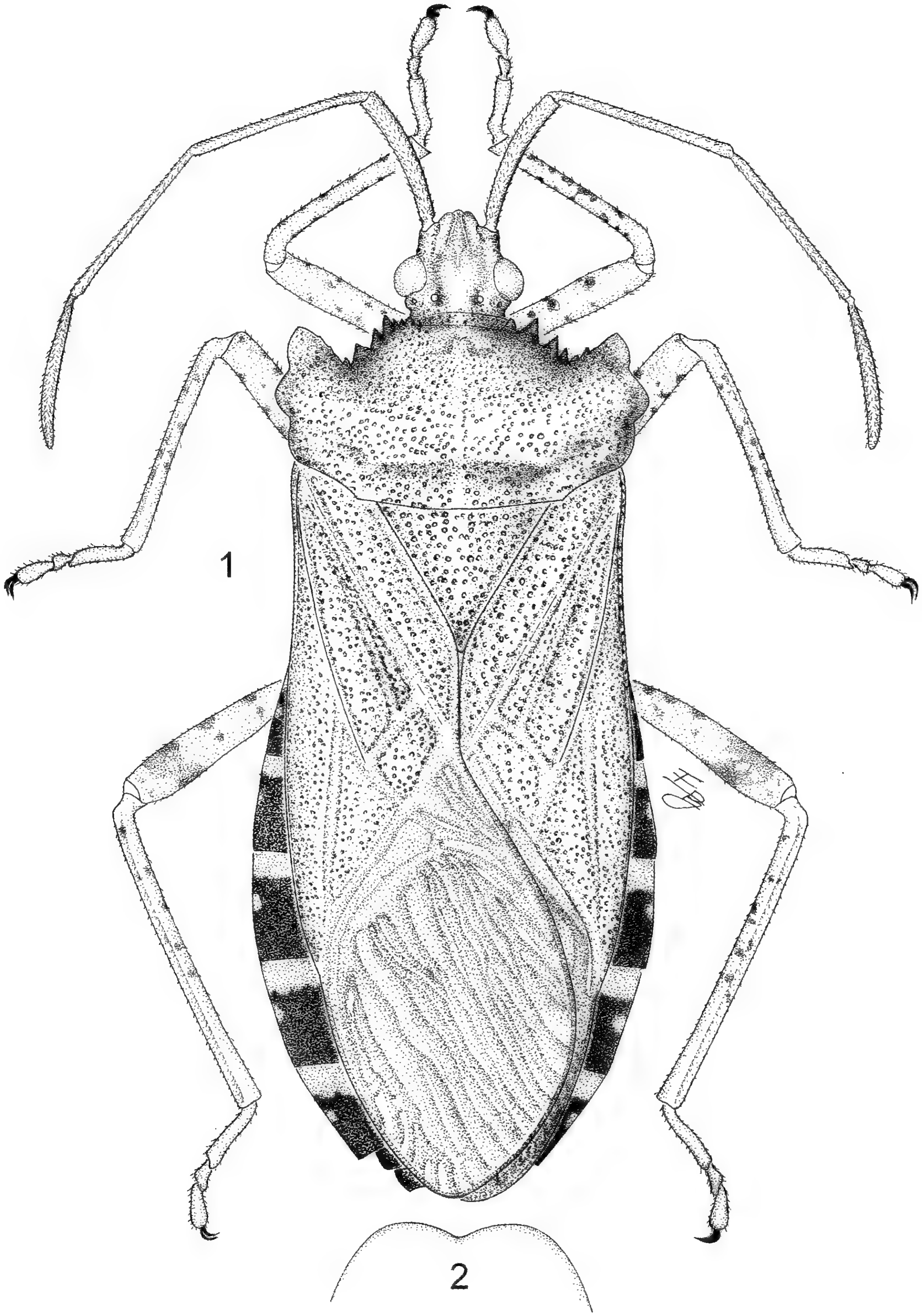
Anasa scorbutica (Fabricius)

Cimex scorbuticus Fabricius, 1775, Syst. Ent.: 706

This species can be distinguished by having the head behind base of each antenniferous tubercle armed with prominent spine, spine longer than diameter of eye, pronotum strongly declivent, bearing numerous erect setigerous hairs that contrast with semidecumbent hairs of clavus and corium, humeral angles rounded, slightly exposed, femora armed, antennal segments II-III uniformly yellow to pale orange, IV dark orange, and dorsal abdominal segments shiny to dull orange.

Distribution. This species is widely distributed, occurring in the United States, Mexico, Central America, West Indies, South America, and the Galapagos Archipelago. It has been recorded in Jamaica from St. Catherine (Old Harbour), St. Andrews (Hope Botan Gardens), Golden Groove (St. Thomas Park), and St. Thomas (Iyssons, Port Antonio and Ocho Rios) (Brailovsky 1985, 2001).

New Records. 3 males, 8 females: West Indies, Jamaica: Spring Garden / S. James (Westlich Montego Bay), 30 m, 10-31-VII-1992, 1-10-VIII-1994, 21-30-XI-1996, 1-10-VI-1997, 1-10-II-2000, and 1-8-III-2000, L. Rezhanyaireser (ZSMC).



Figures 1-2. *Anasa jamaicensis* Brailovsky. 1. Dorsal view (female). 2. Male genital capsule, caudal view.

KEY TO THE SPECIES OF *ANASA* FROM JAMAICA

1. Antennal segments II-III distinctly annulate, alternating yellow and black .... *A. bellator* (Fabricius)

1'. Antennal segments II-III, usually yellow to dark 2

2. Head behind base of each antenniferous tubercle unarmed; femora unarmed; humeral angles of pronotum exposed, expanded laterally and apically truncated; anterolateral margins of pronotum conspicuously dentate, with 4 to 5 large and stout conical tubercles.......................... *A. jamaicensis*, new species

2'. Head behind base of each antenniferous tubercle armed with prominent spine; femora armed; humeral angles rounded, slightly exposed; anterolateral margins of pronotum without large conical tubercles....*A. scorbutica* (Fabricius)

ACKNOWLEDGMENTS

I wish to thank the following persons and institutions for the loan of material: Michael Schwartz (CNCI), Julieta Brambila (FSCA), and Klaus Schönitzer (ZSMC). Special thanks to Ernesto Barrera (UNAM) for the illustrations.

LITERATURE CITED

Brailovsky, H. 1985. Revisión del género *Anasa* Amyot-Seerville (Hemiptera-Heteroptera-Coreidae-Coreinae-Coreini). Monografías. Instituto de Biología, Universidad Nacional Autónoma de México 2: 1-266.

Brailovsky, H. 1990. Un género nuevo y seis especies nuevas de coreidos neotropicales (Hemiptera-Heteroptera-Coreidae-Coreinae). Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 61: 257-278.

Brailovsky, H. 2001. A new species of *Anasa* (Hemiptera: Coreidae) from the Dominican Republic. Entomological News 112 (1): 42-49.

Brailovsky, H. and E. Barrera. 2000. Four new species of Neotropical Coreidae (Insecta: Hemiptera: Heteroptera). Reichenbachia 33 (34): 271-280.

DISCOVERY OF *OCHLEROTATUS JAPONICUS JAPONICUS* (THEOBALD) (DIPTERA: CULICIDAE) IN SOUTHERN NEW HAMPSHIRE, U.S.A. AND ITS SUBSEQUENT INCREASE IN ABUNDANCE IN USED TIRE CASINGS[1]

John F. Burger[2] and Harry Davis[3]

ABSTRACT: Following the discovery of the introduced mosquito, *Ochlerotatus japonicus* in western New Hampshire in 2000, a series of twelve used tire casings in southeastern New Hampshire was sampled, beginning in 2001, to study the occurrence of *O. japonicus* and its abundance over a five year period. Prior to 2003, *Ochlerotatus triseriatus*, a native species, was the numerically dominant mosquito species found in older water-filled tire casings. By 2004, *O. japonicus* had replaced *O. triseriatus* as the dominant mosquito species in this habitat, and by 2006 comprised 83% of the 2 species collected from the tires. *Ochlerotatus japonicus* has two larval population peaks annually in southeastern New Hampshire during the breeding season: mid-April to mid-May in spring, and early August to mid-September in mid- to late summer. Eggs continue to hatch and some larvae are present until freezing (ice over) occurs, usually in late October to early November. *Ochlerotatus triseriatus* has a single larval population peak from early May to mid-June. Eggs cease to hatch by late July to mid-August.

KEY WORDS: *Ochlerotatus japonicus japonicus,* Diptera, Culicidae, New Hampshire, U.S.A., abundance, tire casings

Ochlerotatus japonicus japonicus (Theobald), hereinafter designated *O. japonicus*, was first reported in the United States by Peyton *et al.* (1999), based on specimens collected on August 13 and September 18, 1998, from light traps in Suffolk County, New York and Ocean County, New Jersey. Subsequently, Andreadis et al. (2001) published the earliest known record for *O. japonicus* in North America, July 17, 1998, based on an archival specimen collected in a suburban area near Hamden, Connecticut. They also documented the subsequent spread of *O. japonicus* in Connecticut. Jay and Sullivan (2005) have documented the spread of *O. japonicus* in West Virginia. *Ochlerotatus japonicus* is now recorded from at least 24 states, mainly in the eastern third of the country and from Quebec, Canada. There are also disjunct records from Washington state.

On August 5 and August 12, 2000, one of us (HD) collected larvae of *O. japonicus* from an enamel pan filled with rainwater in Marlborough, Cheshire County, in southwestern New Hampshire, and reared adults. These are the earliest records of *O. japonicus* from New Hampshire. The appearance of this mosquito in New Hampshire only 2 years after its initial discovery in New York, New Jersey, and Connecticut suggests either that its spread has been remarkably rapid, or that it possibly remained undetected for some time after its initial arrival in the U.S.

---

[1] Received on July 25, 2007. Accepted on December 14, 2007.

[2] Department of Zoology, University of New Hampshire, Durham, New Hampshire 03824 U.S.A. E-mail: jfb@ cisunix.unh.edu

[3] Department of Biology, Franklin Pierce College, Rindge, New Hampshire 03462 U.S.A. E-mail: davishg@fpc.edu

Mailed on February 19, 2009

In 2001, one of us (JFB) collected 88 larvae of *O. japonicus* from several water-filled tire casings in Durham, Strafford County, New Hampshire from mid-June to mid-September, and reared 19 females and 15 males. On September 25-26, 2001, a female and a male of *O. japonicus* were collected from a light trap in Dover, New Hampshire. Since *O. japonicus* clearly was established in New Hampshire by 2000-2001, we decided to monitor the occurrence and increasing abundance of this introduced mosquito in a forested area of southeastern New Hampshire.

METHODS

In 1977, 12 used tire casings were placed at the study site to provide a consistent source of container-breeding mosquitoes for teaching and research activities. By 1990, sampling of the tires for mosquitoes was discontinued, although the tires were not removed, and continued to function as oviposition sites for mosquitoes. Following the discovery of *O. japonicus* in western New Hampshire in 2000, monitoring and sampling of the tires began in mid-June, 2001, to determine if *O. japonicus* was present in southeastern New Hampshire.

The study area is located in Durham, Strafford County, New Hampshire, southeast of the town center. The tires are located just inside the edge of a mixed oak, maple, and white pine woodland, and the area is partially shaded during the day. The tires were positioned nearly vertically so that precipitation would collect naturally in the casings. Organic matter (mostly leaves and pine needles) accumulated naturally in the tires.

A short-handled aluminum dipper was used to sample larvae and pupae. A sampling event consisted of one dip from each of the 12 tires. The tires were sampled irregularly from mid-June to September in 2001. Additional sampling events over time commenced in mid-May, 2002 (9 sampling events once every 2-3 weeks) and 2003 (17 sampling events once every 1-2 weeks). Unfortunately, sampling was not consistent from 2001-2003 because we were unaware of how much earlier *O. japonicus* begins to hatch, compared to *Ochlerotatus triseriatus* (Say). By 2004, it was clear that *O. japonicus* begins to hatch in very early spring, and persists until late fall, so in 2004 and 2005, we began sampling earlier in spring. In 2004 (24 sampling events once a week), sampling began as soon as larvae were detected. In 2005 (29 sampling events once a week), sampling began as soon as ice was gone in early April, before any larvae hatched, and continued until the water froze in mid-November. During periods of low precipitation, the tires were recharged with well water to maximize the breeding potential of mosquitoes throughout the breeding season, and to study the seasonal distribution and abundance of *O. japonicus* and *O. triseriatus*. Periodically, some leafy material and pine needles were removed from the tires to increase water-holding capacity. Samples were returned to the laboratory and all larvae counted and identified to species. Pupae were held in a cage until adults emerged and could be identified. Water temperature in the tires was recorded with a digital thermometer at the time of sampling.

RESULTS AND DISCUSSION

Nine species of mosquitoes in five genera were collected during the five years of sampling. Of these, only five species were collected consistently. *Ochlerotatus japonicus* and *O. triseriatus* were the dominant species throughout the sampling period. *Anopheles punctipennis* (Say), *Culex restuans* Theobald, and *Culex territans* Walker comprised 2-3% of the total mosquitoes collected each year. *Ochlerotatus canadensis* (Theobald) and *Aedes vexans* (Meigen) larvae usually occur in ground pools, and were collected from tires only after the depression in which some of the tires are located was flooded by heavy precipitation in 2005. *Culiseta melanura* (Coquillett) was collected in four samples from a single tire in 2005. Only 6 larvae of *Culex pipiens* Linnaeus were collected.

Table 1. Species of mosquito collected from tire casings in Durham, Strafford County, New Hampshire, 2001-2005.

Species	Larvae and pupae
Aedes vexans (Meigen)*	2
Anopheles punctipennis (Say)	54
Culex pipiens Linnaeus*	6
Culex restuans Theobald	663
Culex territans Walker	112
Culiseta melanura (Coquillett)*	27
Ochlerotatus canadensis (Theobald)*	2
Ochlerotatus japonicus (Theobald)	17,256
Ochlerotatus triseriatus (Say)	7,394
TOTAL:	25,486

* Uncommon/Single Collection

Table 2 summarizes the increasing abundance of *O. japonicus* relative to *O. triseriatus* during the five years of sampling. The increase in abundance of *O. japonicus* was most dramatic in 2004, and may be partly due to the initiation of sampling at the beginning of the hatching period soon after ice out, compared to 2002-2003, when sampling commenced much later.

Table 2. Abundance of *O. japonicus* and *O. triseriatus* in tire casings, 2001-2005, Durham, New Hampshire.

Year	Samples	Dates	Species	Specimens	Number/ Sample	%
2001	6	VI/15-IX/22	*japonicus*	88	14.7	-
2002	9	VI/17-IX/15	*japonicus*	244	27.1	18
			triseriatus	1,091	121.2	82
2003	17	V/18-X/26	*japonicus*	1,245	73.2	47
			triseriatus	1,391	81.8	53
2004	24	IV/10-X/24	*japonicus*	6,007	250.3	70
			triseriatus	2,644	110.2	30
2005	31	IV/3-XI/17	*japonicus*	9,672	312.0	81
			triseriatus	2,268	73.2	19

Figure 1 summarizes the seasonal distribution and abundance of *O. japonicus* and *O. triseriatus.*

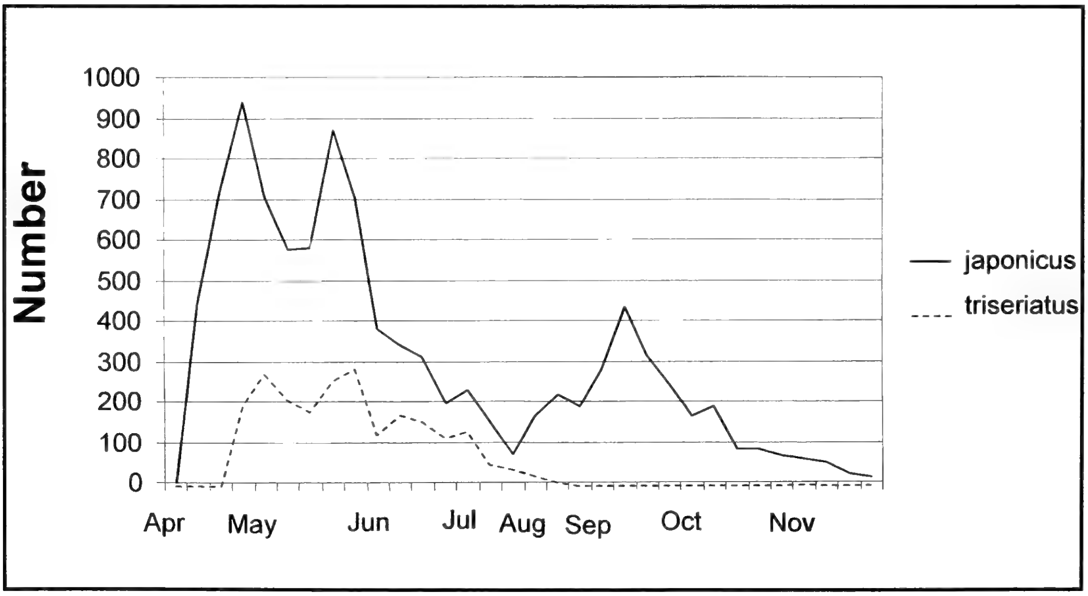


Fig. 1. Seasonal distribution and abundance of *O. japonicus* and *O. triseriatus*, in Durham, New Hampshire, U.S.A. from April to November, 2005.

Figure 2 summarizes the percentage change in the abundance of *O. japonicus* and *O. triseriatus* over four years (2002-2005). The percentages are nearly reversed after four years, with *O. triseriatus* comprising 82% of the specimens collected in 2002, and *O. japonicus* comprising 81% of the specimens collected in 2005.

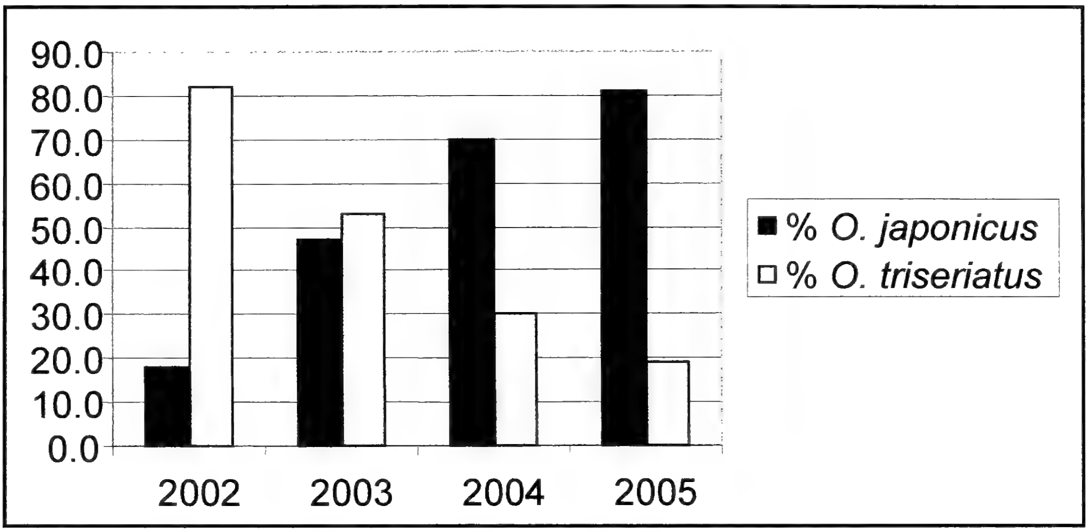


Fig. 2. Percent change in abundance of *O. japonicus* and *O. triseriatus*, 2002-2005, Durham, New Hampshire, U.S.A.

The yearly increase of *O. japonicus* in the samples relative to *O. triseriatus* from 2003-2005 can be attributed to three interacting factors. First, sampling events in 2003 began a month earlier than in 2001-2002. Second, samples were taken throughout the breeding season in 2004-2005, as soon as thawing (ice out) occurred in early spring until freezing (ice over) occurred in late fall. As a result, more samples were taken in 2004-2005 than in 2001-2003. Third, there is a major difference in the seasonal distribution of *O. japonicus* and *O. triseriatus* larvae. *Ochlerotatus japonicus* has two larval population peaks during the breeding season, while *O. triseriatus* has a single larval population peak (fig. 1). Collections in 2004-2005 included all of the early population peak of *O. japonicus.*

Ochlerotatus japonicus larvae begin hatching at the end of March or in early April, depending on when ice out occurs, when water temperature in the tires reaches 4.5° - 5.0°C. Adults begin to emerge from early May to early June, depending on year-to-year temperature variation. The first population peak of *O. japonicus* larvae occurs from mid-April to mid-May. The second population peak occurs from early August to mid-September. Numbers of *O. japonicus* larvae gradually decline throughout October, and the last larvae usually occur in late October to mid-November, depending on when the first hard freeze (ice over) occurs.

Ochlerotatus triseriatus larvae begin to hatch in mid- to late April when the water temperature reaches 8.5°C. Adults begin to emerge from early to mid-June. The population peak for larvae occurs from mid-May to mid-June. After the main population peak, small numbers (5-10) of larvae continue to hatch and develop until late July or early August, and disappear entirely by mid- to late August, about the time when the second population peak of *O. japonicus* occurs. Restricted sampling in 2002-2003 was effective in capturing relative abundance of *O. triseriatus*. Expanded sampling in 2004-2005 to each side of the *O. triseriatus* peak led to a large increase in *O. japonicus* numbers due to the early and late *japonicus* population peaks.

Earliest and latest dates of collection for *O. japonicus* depends on dates of ice out in spring and ice over in the fall. Ice out occurred on May 2 in 2003, April 10 in 2004, April 3 in 2005 and March 30 in 2006. Ice over occurred on September 20 in 2002, November 9 in 2003, October 30 in 2004, November 6 in 2005, and December 2 in 2006. At least some larvae of *O. japonicus* are present for the entire breeding season when ice is not present in the tires.

Data for 2006 (April 2 – December 2) show that the relative abundance of *O. japonicus* and *O. triseriatus* has remained nearly the same as in 2005. *Ochlerotatus japonicus* comprised 83% of the 9,129 larvae and pupae collected, and *O. triseriatus* comprised 17%, and the seasonal distribution of both species did not change.

ACKNOWLEDGEMENTS

I wish to thank Paul C. Johnson, Department of Natural Resources, University of New Hampshire, for assistance in formatting the table and figures and for reviewing the manuscript, and Donald S. Chandler, Department of Zoology, University of New Hampshire, for reviewing the manuscript.

LITERATURE CITED

Andreadis, T. G., J. F. Anderson, L. E. Munstermann, R. J. Wolfe, and D. A. Florin. 2001. Discovery, distribution, and abundance of the newly introduced mosquito *Ochlerotatus japonicus* (Diptera: Culicidae) in Connecticut, USA. Journal of Medical Entomology 38: 774-779.

Joy, J. E. and S. Nichelle Sullivan. 2005. Occurrence of tire inhabiting mosquito larvae in different geographic regions of West Virginia. Journal of the American Mosquito Control Association 21: 380-386.

Peyton, E. L., S. R. Campbell, T. M. Candeletti, M. Romanowski, and W. J. Crans. 1999. *Aedes (Finlaya) japonicus japonicus* (Theobald). A new introduction into the United States. Journal of the American Mosquito Control Association 15: 238-241.

A NEW *ALEIODES* (=*TETRASPHAEROPYX*) (=*A. PILOSUS* GROUP), WITH A HOST RECORD FROM MISSOURI, U.S.A., BIOLOGICAL REMARKS, AND PREVIOUS TYPE DEPOSITORY CORRECTIONS[1]

Joseph Fortier[2] and Carleton Sherman[3]

ABSTRACT: *Aleiodes reisi*, a new species of parasitoid wasp with an enlarged, heavily sculptured, carapace-like metasomal tergite IV was reared from the geometrid *Macaraia multilineata* Packard collected from Eastern Red Cedar (*Juniperus virginiana* L) in Missouri. It is described from both female and male specimens. Illustrations are provided of the mummy, the wasp habitus, and a color pattern sexual dimorphism on the first metasomal tergite.

KEY WORDS: Parasitoid, Braconidae, Rogadinae, Geometridae, *Aleiodes reisi*, *Juniperus virginiana*, *Macaraia multilineata*, United States, Missouri

Aleiodes Wesmael is a large group of parasitic wasps, comprising about 300 species worldwide and found on every continent except Antarctica (Chen and He 1997). Like other members of the tribe Rogadini, *Aleiodes* are koinobiont endoparasitoids of lepidopteran larvae that mummify the host larva when it dies and pupate inside the mummy. The mummy is composed of the larval host's skin, which hardens and darkens into a characteristically shaped structure (Fig. 1), often lined inside with an inner silken cocoon (Shaw and Huddleston 1991). Before it pupates, the parasitoid larva usually cuts a hole in the ventral thoracic region of the host mummy, through which the mummy is glued to a substrate (leaf, twig, etc.). The adult *Aleiodes* exit hole is smoothly, roundly cut in the dorsoposterior area of the mummy (Shaw 1997).

The *Aleiodes* (Wesmael) [*Tetrasphaeropyx* (Ashmead)] subgenus shares the above pupation characters with *Aleiodes* (Fortier 2006a, b; Fortier 2008). The group is defined by the carapace-like fourth abdominal tergite that covers all tergites posterior to it, occasionally with the apex of tergite V showing underneath (Fig. 6). *Aleiodes* (*Tetrasphaeropyx*) species are known only from the Nearctic. Records are known from as far south as Oaxaca State, Mexico, north to the Yukon Territory, Canada, and east to Labrador (Fortier 2006b, 2007a, b). *A. (Tetrasphaeropyx)* specimens are infrequently collected (Shaw 1997), and their host associations remained unknown until recently (Fortier 2006a, b; 2007a, b, 2008a). The group attacks only inchworm caterpillars (Geometridae) so far as known.

When specimens of four undescribed *A. pilosus*-group species were included in a morphological phylogenetic analysis of *Aleiodes*, they were recovered as a

---

[1] Received on August 3, 2008. Accepted on September 14, 2008.

[2] Gonzaga University, 502 East Boone Avenue, Spokane, Washington 99258 U.S.A. E-mail: josephfortier@gmail.com

[3] Department of Biology, Saint Louis University, Saint Louis, Missouri 63103 U.S.A. E-mail: carletonsherman@gmail.com

Mailed on February 19, 2009

monophyletic group within *Aleiodes* based on the carapace-like, sculptured 4th metasomal tergite (Fortier and Shaw 1999). The monophyly of the subgenus has recently been verified by morphological phylogentic analyses conducted by author J F (unpublished data). *Aleiodes* (*Tetrasphaeropyx*), including the specimens currently reported, shares the following synapomorphies with other *Aleiodes* species: 1) basal portion of tarsal claw rounded with a pectin of spines (Shaw 1995); 2) tergite II carinate and anteromedial area with a polished triangular region that continues posteriad as a median carina (Shaw 1995); 3) median carina of propodeum not forking before anterior half of the segment and never diverging posteromedially into an areola (Shaw 1995); 4) forewing RS+Mb vein long (Shaw 1995); 5) emergence hole from host mummy even and circular (Shaw 1995); 6) ovipositor sheath widened and flattened (van Achterberg 1991).

The purpose of this paper is to describe a new *A. pilosus*-group species that is also the first record of the group in Missouri U.S.A. Host information is also provided.

METHODS

Species cited in this paper can be identified as belonging to the subfamily Rogadinae by using the keys of Shaw (1995), Shaw and Huddleston (1991), or Wharton et. al (1997). My definition of *Aleiodes* follows that of Fortier and Shaw (1999), Shaw (1995), Shaw et al. (1997), and van Achterberg (1991). Specimens can be identified as *Aleiodes* by using the keys of van Achterberg (1991) or Wharton et al. (1997).

For purposes of comparison, specimens of previously described species borrowed from the following museums were used: The American Entomological Institute (AEI), the Academy of Natural Sciences at Philadelphia (ANSP), the Albert J. Cook Arthropod Research Collection at Michigan State University (ARC), the Canadian National Collection (CNC); the Cornell University Insect Collection (CUIC), the Insect Research Collection at the University of Wisconsin, Madison (IRC), the Snow Entomological Museum (SEMC), the Smithsonian National Museum of Natural History (NMNH), the National Museum of Scotland (NMS), the Rocky Mountain Systemic Entomology Laboratory (RMSEL), the Texas A&M University Entomology Collection (TAMU), the Essig Museum of Entomology at the University of California at Berkeley (EMEC), and the Bohart Museum of Entomology at the University of California at Davis (UCDC).

Observations and measurements were made with a Leica MZ 12.5 stereomicroscope. An ocular micrometer in the eyepiece of the microscope was used for measurements. Images were made with a Syncroscopy Automontage photoimaging system. Morphological terms follow Sharkey and Wharton (1997). Sclerite surface sculpturing terminology follows Harris (1979). The term 'carapace' refers to the 4th metasomal tergite. The term "longitudinal angle" is defined and illustrated in Figs. A and B.

The paratype (male) specimen (see Fig. 5) of the new species herein described was reared from host material collected in the field. It was obtained as follows. One hundred twenty geometrid caterpillars were collected from red cedar (*Juniperus virginiana* L.) using a beating sheet at Reis Biological Station of Saint Louis University in Crawford County, Missouri, U.S.A. Each caterpillar was photographed and then reared separately with a host plant clipping in a plastic Clear View Sell Out hinged lid 1 compartment tray manufactured by PACT IV Corporation. These caterpillar 'cages' were situated outdoors under a roofed enclosure without walls under conditions of ambient temperature and humidity. They were cleaned weekly, at which times fresh moist paper toweling and *J. virginiana* clippings were added. One of the caterpillars was transformed into a mummy (Fig. 1) from which the paratype male emerged. The holotype female specimen (Figs. 2-4) was collected by sweeping *J. virginiana* about 0.25 mile (0.4 km) from the location where the paratype host had been collected.

The host was identified as follows. The photograph of the paratype host geometrid that was taken at the time of its capture was forwarded to Dr. David Wagner (University of Connecticut, Storrs, Connecticut, U.S.A.) for identification, as well as photographs of four reared adult geometrids whose larval photographs at the time of capture matched that of the paratype host. Images of larvae were taken with a Nikon DS 70 SLR digital camera with one section of an extension tube and a Nikon DX 18-70 zoom lens. Images of the mummy and morphological features were taken with a Leica MZ12.5 stereomicroscope and AutoMontage imaging system. Morphological terms follow Sharkey and Wharton (1997). Sclerite surface sculpturing terminology follows Harris (1979).

SYSTEMATIC ENTOMOLOGY

Aleiodes (Tetrasphaeropyx) reisi n. sp.

Female. **Body Color**: head yellow-orange except black inter-ocellar triangle; antennae black, prothorax yellow-orange; mesoscutum bicolored, yellow-orange except also with black on lateral lobes; scutellum yellow-orange; mesopleuron yellow-orange except venter also with black; metapleuron bicolored with black; propodeum almost entirely black except yellow in postero-lateral corners; metasomal tergite I yellow with a pair of black spots, one on each side of median carina (Fig. 3); tergite II entirely yellow; tergite III black except yellow along basal and lateral edges; tergite IV entirely black; foreleg yellow-orange basally, tibia infumate, tarsus black, middle and hind legs yellow-orange basally, apices of femora black, tibiae and tarsi entirely black; fore- and hind-wings lightly infumate, veins yellow at wing base, otherwise veins and stigma black. **Body Length**: 4.1 mm. Forewing length: 3.1 mm. **Head**: ocelli medium sized, ocell-ocular distance 1.1 length of longest diameter of lateral ocellus; 42 flagello meres, all distinctly longer than wide, all with width: length ratio less than 0.8; malar space short, 0.9 width of mandibular base and 0.35 length of eye height; oral space small, vertically oblong, clypeus medial height 0.9 length of oral space medial height, oral space horizontal diameter 0.95 width of mandibular base; occipital carina incomplete at vertex; face coriaceous. **Mesosoma:** each side of pronotum transversely bisected by porcate sulcus; pronotum coriaceous-carinate ventro-laterally, coriaceous dorso-laterally; mesoscutum coriaceous, notauli scrobiculate, terminating at lateral edges of posterior-medial rugose area; mesopleuron with a faintly convex, vaguely defined sternaular area, mesopleuron coriaceous; propodeum rugose-areolate, median carina complete. **Legs**: tarsal claws without apical pectination, dorsal surfaces of metacoxa coriaceous. **Wings** (Fig. 7): forewing vein r 0.7 length of 3RSa, second submarginal cell trapezoidal, 1CUa 0.36 length of 1CUb; hind wing vein RS slightly sinuate, marginal cell narrowest at middle, 1r-m 0.6 length of 1M, 1M 0.6 length of M+CU, m-cu pigmented, 0.7 length of 1r-m. **Metasoma**: tergites I and II rugocostate, tergites III and IV densely rugulocostulate, tergite IV a dorso-posteriorly curved carapace not entirely covering apical tergites.

Male. As in female except with more extensive black coloration on mesopleuron, scutellum, propodeum, and metasoma (Fig. 4).

Type Data. Holotype. Female: USA: MISSOURI, Crawford County, Reis Biological Station, Sweep of *Juniperus virginianus*, 21 June 2007, J. Fortier, coll. Deposited in NMNH. *Paratype. Male*: USA: MISSOURI, Crawford County, Reis Biological Station, N 37°56.956', W91°10.145', reared from geometrid *Macaraia multilineata* Packard that had been collected from *Juniperus virginianus* (Eastern Red Cedar) on 23 June 2007. Wasp emerged after July 15 and before 15 August 2007. C. Sherman and J. Fortier, colls. Deposited in NMNH.

Distribution. Known only from type locality in southeastern Missouri.

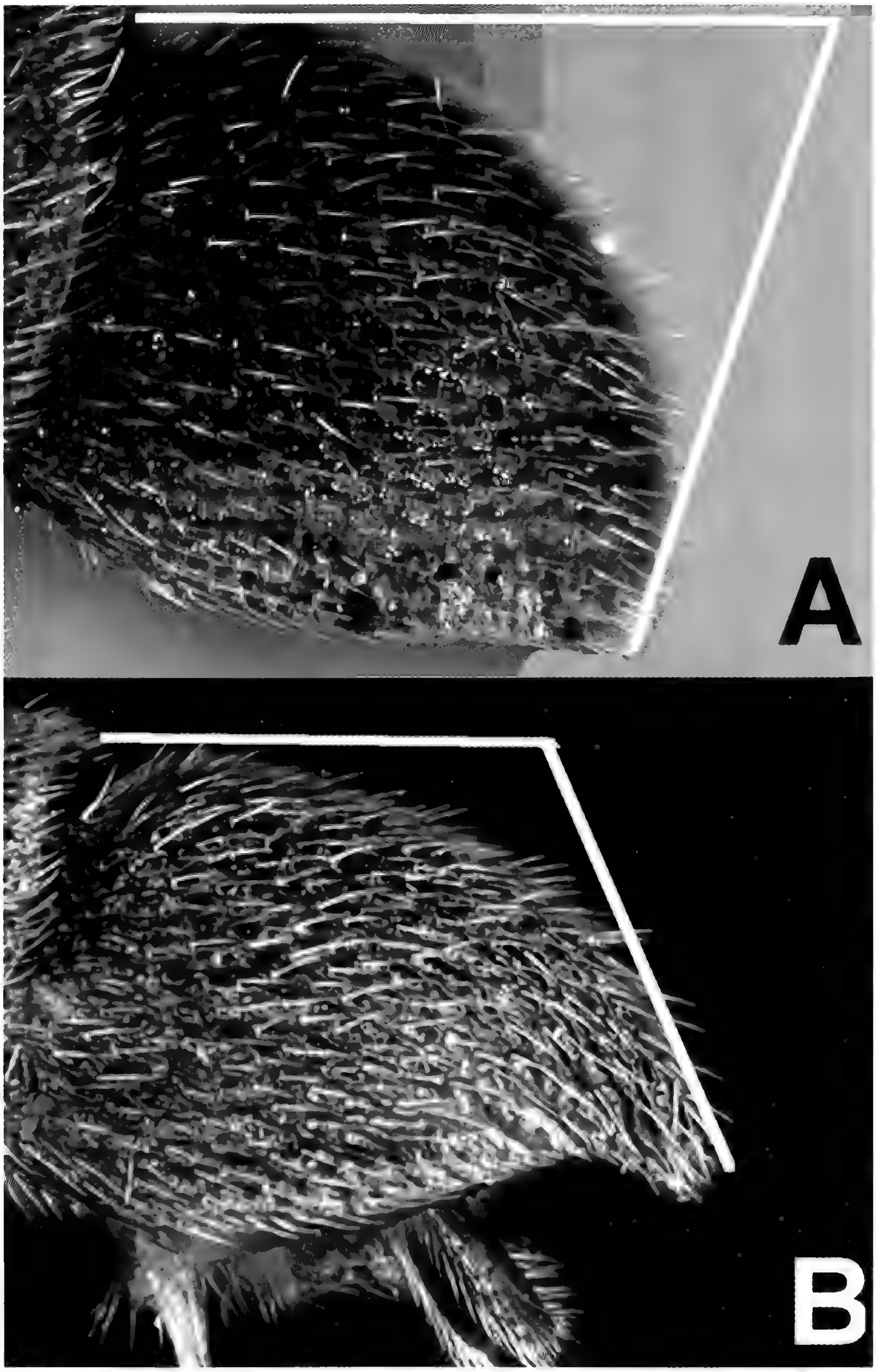
Biology. Reared from geometrid *Macaraia multilineata* collected from *Juniperus virginiana*.

Comments. This species is distinguished from other *Aleiodes* species with an entirely heavily sculptured metasomal tergite IV not entirely covering apical tergites by the following combination of characters: 1) yellow-orange mesosomal coloration and bicolored metasoma in contrast to entirely black; 2) all tibiae, and tarsi of middle and hind legs black, in contrast to yellow-orange, and 3) tergite IV more nearly entirely covering all apical tergites (Figs. 5-6).

Etymology. The specific name is after Raymond Reis, S. J., who taught in the Biology Department at Saint Louis University.

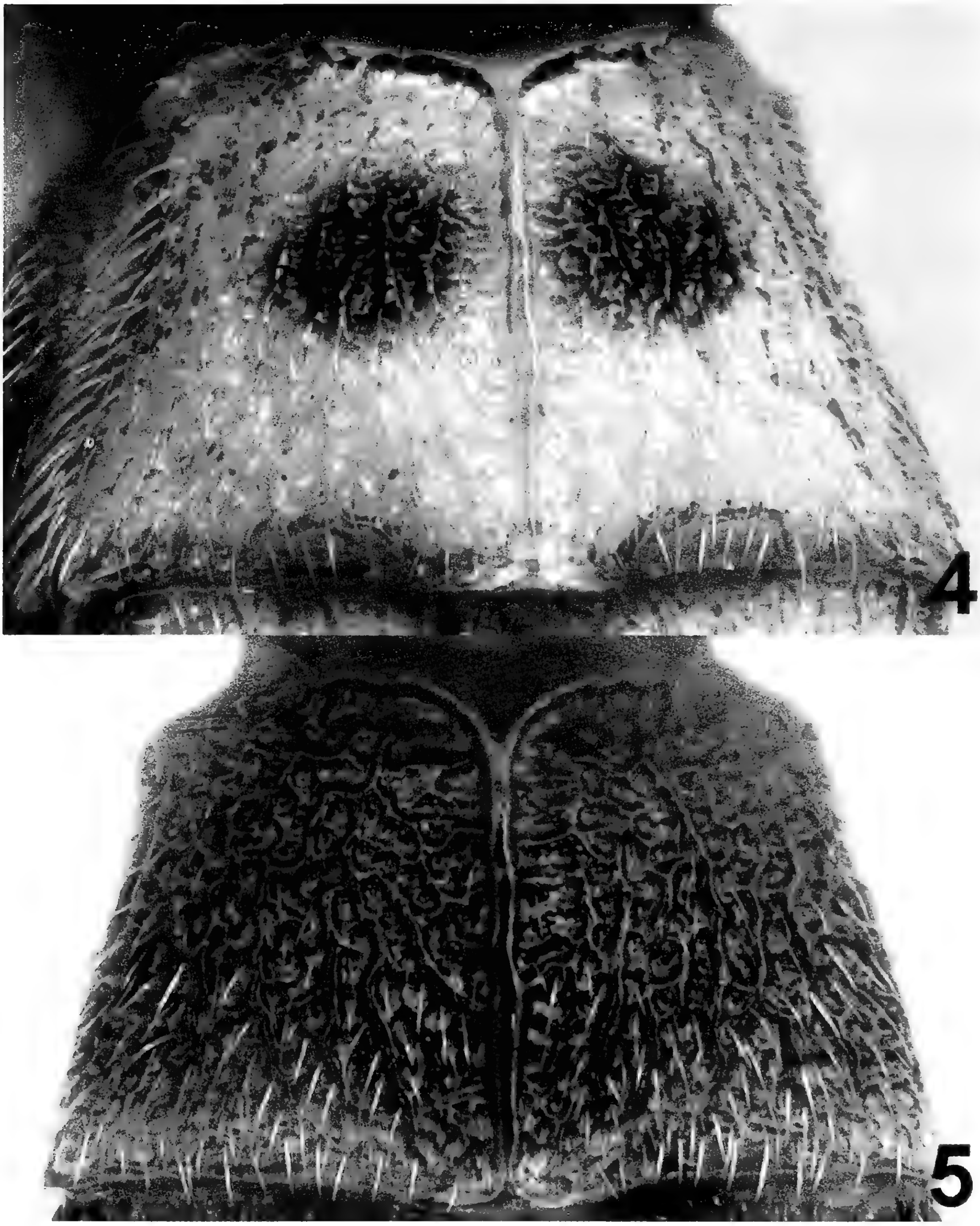
CORRECTIONS

The following are corrections by author JF to previous articles regarding voucher specimen depositions. In *Entomological News* 117(5) 465-484, the following collections are depositories for the following specimens rather than NMNH as stated in that article: *A. areolatus* type and paratype: TAMU; *A. citriscutum* holotype: AEI; 1 *A. citriscutum* paratype: SNOW; 2 *A citriscutum* paratypes: TAMU; *A. cochisensis* holotype: SNOW; *A. dorsofoveolatus* holotype and paratype: BOHART; *A. oaxacensis* holotype: TAMU; and *A. tulensis* holotype and 2 paratypes: TAMU. In *Entomological News* 118(1): 11-30, voucher designation should be changed from NMNH to the following collections for the following voucher specimens: *A. jaliscoensis* holotype and 1 paratype: TAMU; *A. quickei* holotype and 4 paratypes: TAMU; and *A. shawi* 2 paratypes: RMSEL.



Figs. A and B. Interior angle of curvature of carapace. The interior angle of curvature is the angle at which a line extending from the apical edge of the 3rd tergite and touching the basal hump of the carapace will intersect a line drawn parallel to the apex of the carapace. A. less than 90°; B. greater than 90°.

Figs. 1-3. 1. Mummy formed by paratype male of *Aleiodes reisi.* Note exit hole cut by emerging adult at right (dorso-posterior of mummy). 2-3. Holotype female of *Aleiodes reisi.* 2, habitus; 3, wings.



Figs. 4-5. Color pattern sexual dichromatism on metasomal tergite I of *Aleiodes reisi*. 4, holotype female; 5, paratype male.

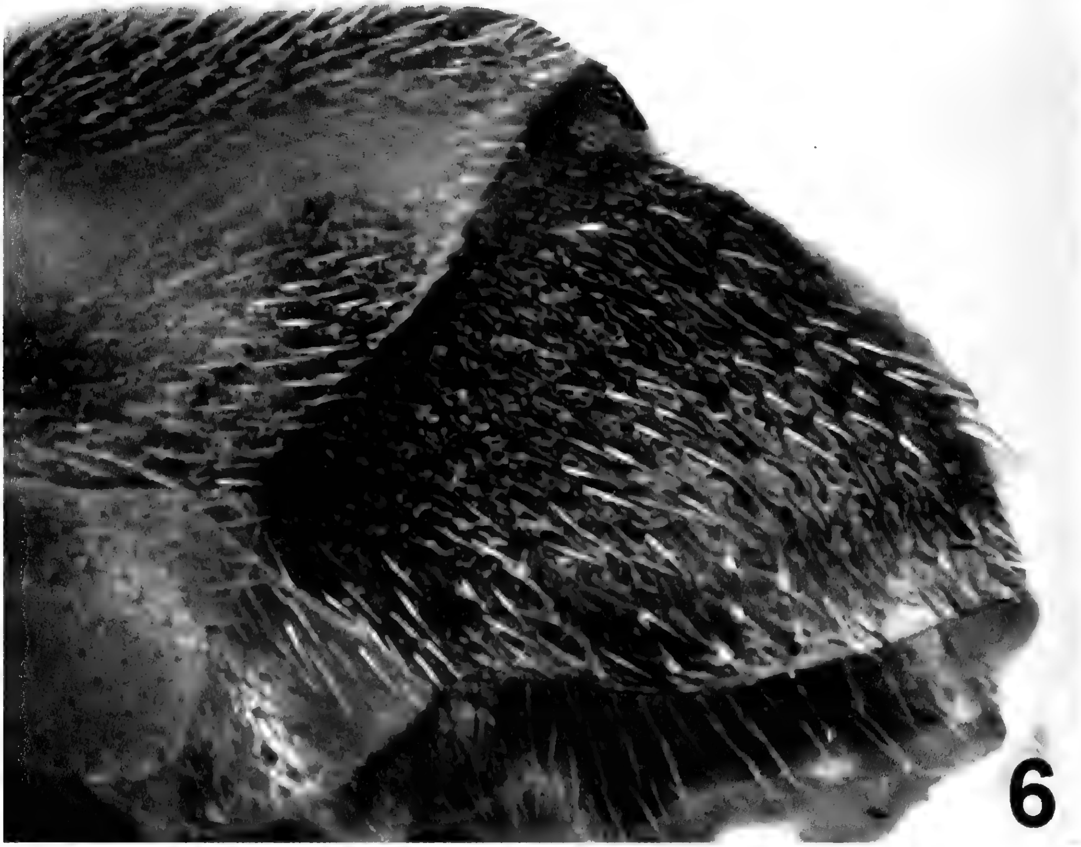


Fig. 6. Carapace (metasomal tergite IV) of holotype female of *Aleiodes reisi*.

ACKNOWLEDGMENTS

We are grateful to Mark Hoelsken, S. J. for his instruction and assistance with larval photography. We want to thank David Wagner for his identification of the lepidopteran host. We also want to thank Betsy Bardon for her contribution to the AutoMontage illustrations. Also, we are appreciative of the following curators and collections managers for loaned material used in this study: Dr. Jason Weintraub, (ANSP), Dr. David Wahl (AEI), Dr. Gary Parsons (ARC), Dr. John Huber (CNC), Dr. E. R. Hoebeke (CUIC), Dr. Doug Yaneda (UCR), Dr. Steven Krauth (IRC), Dr. Zachary Falin (University of Kansas, Natural History Museum, Lawrence, Kansas), Dr. David Furth (NMNH), Dr. Mark Shaw (NMS), Dr. Scott Shaw (RMSEL), Dr. Edward Riley (TAMU), Dr. Robert Zuparko (EMEC), and Dr. Steven Heydon (UCDC). Also, thanks to SLU graduate students Ms. Tara Herring and Ms. Aurora Lugo for assistance with the illustrations in this paper. This research was funded by NSF grant award #0516515.

LITERATURE CITED

Achterberg, K. van. 1991. Revision of the genera of the Afrotropical and W. Palearctic Rogadinae Foerster (Hymenoptera: Braconidae). Zoologische Verhandelingen 273: 3-102.

Chen, X. and J. He. 1997. Revision of the subfamily Rogadinae (Hymenoptera: Braconidae) from China. Zoologische Verhandelingen 308: 1-187.

Fortier, J. C. and S. R Shaw. 1999. Cladistics of the *Aleiodes* lineage of the subfamily Rogadinae (Hymenoptera: Braconidae). Journal of Hymenoptera Research 8(2): 204-237.

Fortier, J. C. 2006a. The first host association for *Aleiodes pilosus* (=*Tetrasphaeropyx* Ashmead) (Hymenoptera: Braconidae: Rogadinae). Entomological News 117(4): 457-459.

Fortier, J. C. 2006b. Twelve new species and a new combination of the *Aleiodes pilosus* species-group (=*Tetrasphaeropyx* Ashmead) (Hymenoptera, Braconidae, Rogadinae) in North America: Part 1. Entomological News 117(5): 465-484.

Harris, R. A. (1979): A glossary of surface sculpturing. – Occasional Papers in Entomology, Department of Food and Agriculture, California 28: 1-31.

Fortier, J. C. 2007a. Eight new species and a key to species of the *Aleiodes pilosus* species-group (=*Tetrasphaeropyx* Ashmead) (Hymenoptera, Braconidae, Rogadinae) in North America, Part 2. Entomological News 118(1): 11-30.

Fortier, J. C. 2007b. The *Aleiodes pilosus* group (=*Tetrasphaeropyx* Ashmead) species of Canada, including seven new species and a key (Hymenoptera: Braconidae, Rogadinae). Transactions of the American Entomological Society 133(1+2): 1-20.

Fortier, J. C. 2008. The first host association for *Aleiodes shawi* (Hymenoptera: Braconidae: Rogadinae). Entomological News 119(2): 214-216.

Harris, R. A. 1979. A glossary of surface sculpturing. Occasional Papers in Entomology, California Dept. of Food and Agriculture, California 28: 1-31.

Sharkey, M. J. and R. A. Wharton. 2007. Morphology and Terminology. pp. 19-37. *In*, R. A. Wharton, P. M. Marsh, and M. J. Sharkey (Editors). Manual of New World Genera of the Family Braconidae (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.

Shaw, M. R. and T. Huddleston. 1991. Classification and Biology of Braconid Wasps. Handbooks for the Identification of British Insects. Volume 7. Part II. 7: 1-126.

Shaw, S. R. 1995. Family Braconidae. pp. 431-463. *In*, P. Hanson and D. Gauld (Editors). The Hymenoptera of Costa Rica. Oxford University Press. 893 pp.

Shaw, S. R. 1997. Subfamily Rogadinae *s.s.* pp. 403-408. *In,* R. A. Wharton, P. M. Marsh, and M. J. Sharkey (Editors). Manual of New World Genera of the Family Braconidae (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.

Wharton, R. A., P. M. Marsh, and M. J. Sharkey (Editors). Manual of New World Genera of the Family Braconidae (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.

REDESCRIPTION OF THE FEMALE AND VARIABILITY OF *CRYPTOCEPHALUS* (*ASIONUS*) *PSEUDOREITTERI* TOMOV, 1976 (COLEOPTERA, CHRYSOMELIDAE, CRYPTOCEPHALINAE) IN TURKEY[1]

Ali Gök,[2] Üzeyir Çağlar,[3] Serdar Bilginturan,[2] and Mehmet Ali Tabur[2]

ABSTRACT: *Cryptocephalus* (*Asionus*) *pseudoreitteri* Tomov, 1976 is a poorly known species. Recently, seven additional specimens of this rare species were collected out of the type locality. The little known female of this species is redescribed in detail and also males are redescribed on the basis of 7 specimens (4 males and 3 females) collected from Kayseri and Aksaray provinces of Central Anatolia. The male and female genital structures, abdomen, variations of the pronotal and elytral patterns are illustrated.

KEY WORDS: Cryptocephalinae, *Cryptocephalus* (*Asionus*) *pseudoreitteri*, female, redescription, taxonomy, Turkey

The Cryptocephalinae of Turkey have been revised based on their distribution and some ecological information (Sassi and Kısmalı, 2000). According to Sassi and Kısmalı (2000), the genus *Cryptocephalus* is represented by 67 species in Turkey; 5 of them belong to the subgenus *Asionus*. Among them, *C. pseudoreitteri* and *C. amasiensis* are endemic to Turkey. The subgenus *Asionus* comprises 22 species in Europe and the Mediterranean area (Warchalowski, 2003), 5 of which are distributed in Turkey (Sassi and Kısmalı, 2000): *Cryptocephalus* (*Asionus*) *amasiensis* Weise, *Cryptocephalus* (*Asionus*) *apicalis* Gebler, *Cryptocephalus* (*Asionus*) *curda* Jacobson, *Cryptocephalus* (*Asionus*) *pseudoreitteri* Tomov and *Cryptocephalus* (*Asionus*) *quatuordecimmaculatus* Schneider. *Cryptocephalus* (*Asionus*) *pseudoreitteri* Tomov, 1976 is a member of subgenus *Asionus* which is characterized by the combination of the following characters: Fourth tarsal segment slim, at least one half of its length projecting out of lobes of third segment, elytra at least on posterior parts with sparse erect hairs (Lopatin, 1984; Sassi and Kısmalı, 2000; Warchalowski, 2003). Within the subgenus *Asionus, C. pseudoreitteri* most closely resembles *C. reitteri* Weise, but it can be easily separated from *C. reitteri* mainly by having a single little sharp tooth at the basis of the last anal sternite of male, whereas *C. reitteri* has two toothlike convexities at basis of the anal sternite of male.

Cryptocephalus pseudoreitteri was originally described on the basis of a single male specimen collected from Beypazarı, Ankara, Turkey. Since then, no additional samples of the species have been reported for years, however, Özdikmen et al. (2007) reported six specimens (4 males, 2 females) of this species col-

---

[1] Received on October 7, 2007. Accepted on December 14, 2007.

[2] Süleyman Demirel University, Faculty of Arts and Science, Biology Department 32260 Isparta, Turkey. E-mails: (AG, corresponding author) aligok@fef.sdu.edu.tr, (SB) smallpire@gmail.com, and (MAT) mehmet@fef.sdu.edu.tr.

[3] Ahi Evran University, Faculty of Education, Department of Science Education, 40100 Kırsehir, Turkey. E-mail: ucaglar@gazi.edu.tr.

Mailed on February 19, 2009

lected from Ayaş (Ankara) by Özdikmen and the species was reexamined by Özdikmen et al. (2007). During faunistic surveys of the phytophagous beetles conducted in Akşaray and Kayseri provinces of Central Anatolia during 2006, 7 additional specimens (4 males, 3 females) of *C. pseudoreitteri* were collected. This gave us the opportunity to reinvestigate the species. Herein, we redescribe the females and give additional descriptive data of males with several remarkable variations.

METHODS

This study was based on seven specimens collected from Aksaray and Kayseri provinces (38° 24' N; 34° 01' E; 38° 24' N; 34° 02' E) of Central Anatolia, by the second author. Samples were collected from an afforested steppe-like terrain covered with young pine trees and herbal vegetation by using an aspirator and sweep net. Genitalia were photographed with a Camedia C-5060 digital camera attached to an Olympus SZX12 stereomicroscope. Seven specimens (4 males and 3 females), including the largest and smallest ones of each sex were used for measurements. Specimens are deposited at the Department of Biology, Faculty of Arts and Sciences, Gazi University, Ankara, Turkey.

SYSTEMATIC ENTOMOLOGY

Cryptocephalus (Asionus) pseudoreitteri Tomov, 1976 (Fig. 1 A-G)

Material Examined. Central Anatolia, Turkey, Aksaray-Kayseri (38° 24' N; 34° 01' E) 1084 m, 25.05.2006, 1 male, 2 females; same location and date (38° 24' N; 34° 02' E) 1112 m, 3 males, 1 female.

Redescription of the Female. Total body length: 6.2 – 6.4 mm. *Head.* Generally black, with exception of a little yellow spot under eyes, frontoclypeal suture, with obscure brownish-yellow tiny spots, mandibles reddish. Vertex distinctly convex; frons slightly depressed between eyes, covered with rough, dense, prominent dots and with long, dense white hairs; dorsal parts of the antennae bases distinctly raised, glabrous, rarely pubescence and punctated; frontoclypeal suture small, densely and deeply punctated and with scarce, long hairs; the first segments of antenna blackish brown, second, third and fourth segments yellowish brown, others completely black, the first segment as long as second and third together, third segment 1.8 times longer than second segment, fourth segment 1.3 times longer than third segment, antennal segment ratios: (17: 6: 11: 15: 15: 15: 15: 15: 15: 15: 18).

Pronotum. Reddish-brown, with 4 black spots (2 larger spots near disc and 2 smaller spots laterally), basal margins with black stripe. Strongly convex in dorsal view, at base 1.4 times wider than its length and gradually narrowing towards anterior margin; lateral sides narrowly marginated, only visible at base dorsally; densely and deeply punctated, basal margin denticulated in a row.

Scutellum. Black, obtusely triangular, scarcely punctated, almost as long as wide, truncate at apex.

Elytra. Yellow with 3 black spots (2 in posthumeral + 1 on clivus); not covering the last sternite of abdomen; anterior margin and suture of elytra with black stripe, sutural stripe not reaching the apex; elytra 2.2 times longer than pronotum, about 1.3 times as long as shoulder width, almost parallel-sided and slightly narrowed toward apex. Elytra coarsely and densely punctuated, punctures of elytra larger than that of pronotum, clivus with distinct short silver hairs towards apex, humeral tubercles prominent, lengthened, margins of elytra narrow, slightly visible from above; epipleura, in lateral view, visible in anterior ½, with scarce, deep punctures.

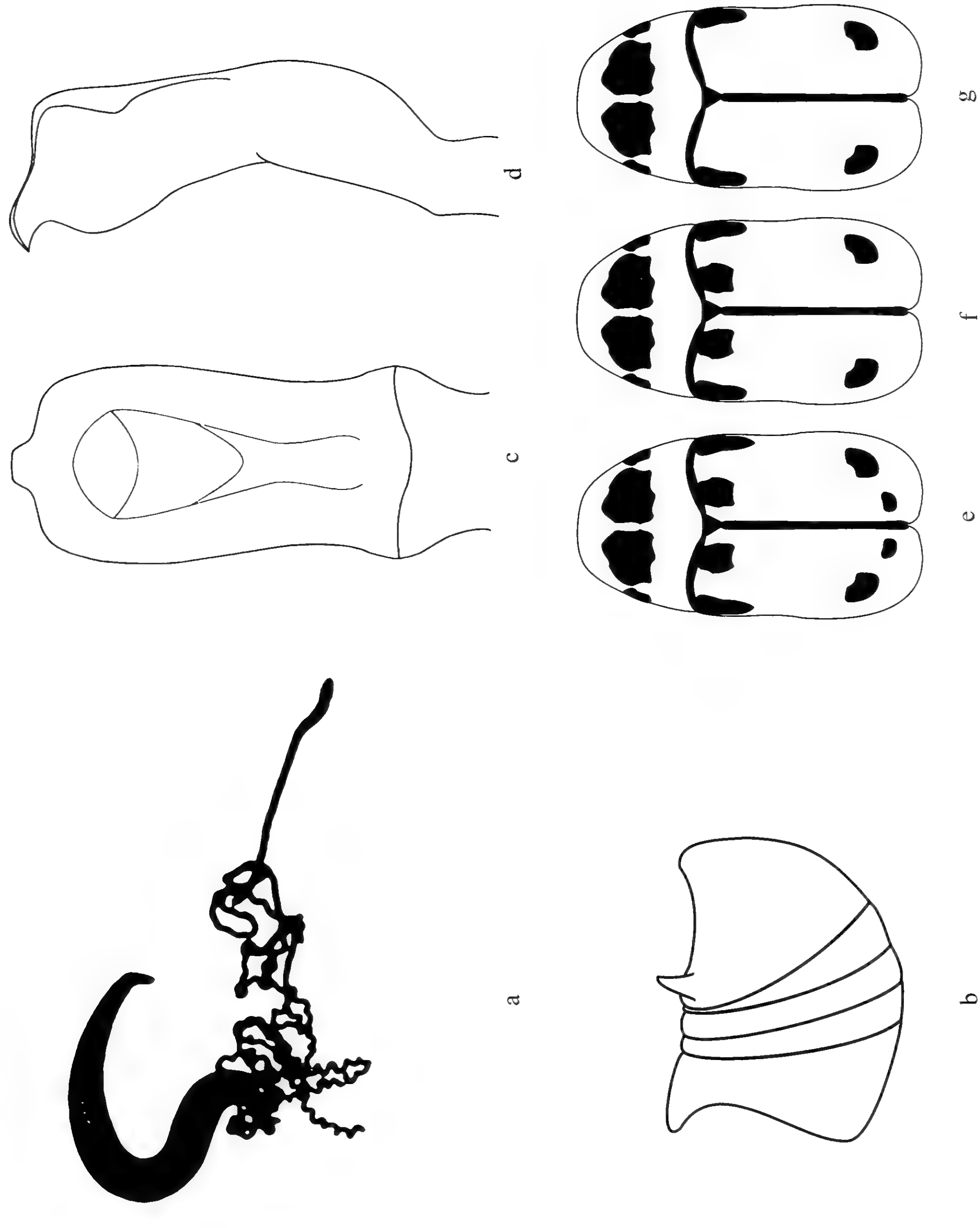
Venter. Ventral parts completely black, covered with long, dense and silver hairs, ventral part of fore tibia yellowish-brown, dorsal part black, ventral part of middle tibia yellowish-brown only basally, remaining parts completely black, hind tibia and the other parts of legs completely black, first tarsal segments 1.4 times longer than second, second tarsal segments 1.2 times longer than third. Anal sternite with a striking, large, oval pit. Inner side of the pit, glabrous, deeply punctated.

Spermatheca. Entirely black, sickle shaped, with short recurved base, the proximal parts of ductus evidently coiled, distal parts straight and long (Fig. 1A).

Redescription of the Male. Male resembles females, except for following characters: total body length 5.2-6.1 mm, third segment of antennae 1.7 times longer than second, segment ratios: (16: 6: 10: 13: 18: 18: 18: 18: 18: 18: 20); elytra with variable black patterns (generally 2 in posthumeral + 2 on clivus) (see Variation, below), twice as long as pronotum, about 1.2 times as long as shoulder width; anal sternite, in ventral view, evidently broadened in the middle and shallowly depressed, glabrous and deeply punctated on depression; the last sternite in male with a single little sharp tooth at basis (Fig. 1B) .

Aedeagus. Rather characteristic, in dorsal view gradually narrowing in the middle, apex obtusely truncated, with rounded lateroapical border, with rectangular median denticle (Fig. 1C); in lateral view median denticle barely bifurcated terminally, apex slightly curved downward and lateral margins covered with long hairs (Fig. 1D).

Variation. Because *C. pseudoreitteri* was initially described on the basis of only one male specimen, any notes on the variability of this species could not be given (Tomov, 1976). However, examination of the new specimens shows that this species is variable in the number of spots on elytra. Elytra generally with 4 black spots (2 in posthumeral area + 2 on clivus). However, in two male specimens, elytra with 3 black spots (2 in posthumeral area + 1 on clivus) and in one male, with 2 black spots (1 in posthumeral area + 1 on clivus) (Fig. 1E-G). Females have 3 black elytral spots (2 in posthumeral area + 1 on clivus) (as the male's variation shown in Fig 1F). Also, the body of females is slightly longer than that of males.



Figs. 1 A-G. *Cryptocephalus (Asionus) pseudoreitteri* Tomov. A. Spermatheca. B. Lateral view of a single sharp tooth at basis of the last abdominal segment in male. C. Aedeagus dorsal view. D. Aedeagus lateral view. E-G. Variation of the pronotal and elytral spots.

DISCUSSION

Cryptocephalus pseudoreitteri was described by Tomov (1976) from a single male specimen collected from Beypazarı, Ankara (Turkey) by K. M. Guichard in

1960 and deposited in Museum of Manchester University. After its original description, it was cited briefly in subsequent studies (Sassi and Kısmalı, 2000; Warchalowski, 2003). In the mentioned studies, it is emphasized that this species is known only from the holotype. However, recently, 6 samples (4 male and 2 female) of this species were collected from Ayas (Ankara) near its type locality (Beypazarı, Ankara) by Özdikmen et al. (2007). They have given a fairly short description about the female of *C. pseudoreitteri*. However, they have improved the description of holotype by reporting variation among males. Rediscovery of the females and additional male specimens from current localities which are out of the type locality provide new taxonomical and geographical data that extend the knowledge about this poorly known species. In addition, to both the study of Özdikmen et al. (2007) and the original description of *C. pseudoreitteri* made by Tomov in 1976, some variability is observed on head and elytral spots of collected specimens (see variation section). It is known that there are remarkable variations in the pronotal and elytral markings in many species of *Cryptocephalus*. The slight variability of elytral colour patterns is not considered a reliable character in the diagnosis of species in the genus *Crytocephalus* species. Instead, the structure of aedeagus should be used in diagnosis rather than colour patterns. The remaining morphological characters are similar to the first and second descriptions. Forthcoming surveys are needed to outline the colour variation and geographical distribution of this species, since the collection of this species in new localities suggest that its geographical distribution may be wider than originally thought.

LITERATURE CITED

Lopatin, I. K. 1984. Leaf-beetles (Chrysomelidae) of Middle Asia and Kazakhstan, Oxanion Press. New Delhi, India. 413 pp.

Özdikmen, H., M. Güven, and S. Turgut. 2007. A study on *Cryptocephalus pseudoreitteri* Tomov, 1976 (Chrysomelidae: Cryptocephalinae) with allotype designation. Munis Entomology and Zoology 2: 493-498.

Sassi, D. and S. Kısmalı. 2000. The Cryptocephalinae of Turkey, with information on their distribution and ecology. Memorie della Società Entomologica Italiana 78: 71-129.

Tomov, V. 1976. Eine neue *Cryptocephalus*-Art (Coleoptera, Chrysomelidae) aus der Turkei. Acta Zoologica Bulgarica 5: 83-85.

Warchalowski, A. 2003. Chrysomelidae: The leaf-beetles of Europe and the Mediterranean area. Natura optima dux Foundation. Warszawa, Poland. 600 pp.

A NEW SPECIES OF THE GENUS *TMARUS* AND DISCOVERY OF THE MALE *TMARUS TAIWANUS* (ARANEAE: THOMISIDAE) FROM CHINA[1]

Guangxin Han[2] and Mingsheng Zhu[2]

ABSTRACT: A new species, *Tmarus songi* spec. nov. is described with both sexes from Guangxi Province, China. The condition of genital organ of the new species indicates its close relationship with *T. digitiformis* Yang, Zhu and Song, 2005. The male *Tmarus taiwanus* is described and illustrated for the first time.

KEY WORDS: Araneae, Thomisidae, *Tmarus*, Thomisidae, new species, China

The family Thomisidae Sundevall, 1833 is one of the largest spider families containing 171 genera and 2062 known species worldwide (Platnick, 2007). The genus *Tmarus* was erected by Simon, 1875. Currently, 214 species of *Tmarus* have been described worldwide (Platnick, 2007); 18 of them have been reported for China (Song and Zhu, 1997; Song et al., 1999; Yin et al., 2004; Yang et al., 2005; Platnick, 2007).

During an examination of the collections of Thomisidae deposited in the Museum of Hebei University, two new species, *Tmarus songi* and *T. taiwanus* were recognized. They are described and illustrated below. The male of *T. taiwanus* is described for the first time.

METHODS

All specimens were preserved in 75% ethanol and examined, drawn and measured under a Tech XTL-II stereomicroscope equipped with an Abbe drawing device. The epigyne of one female paratype was removed and placed in 10 percent hot solution of potassium hydroxide for 5-10 minutes.

All measurements are given in millimeters. The leg measurements are given in the following sequence: Total (femur, patella + tibia, metatarsus, tarsus). Type specimens are deposited in the Museum of Hebei University (MHBU), Baoding, China. Abbreviations used, as follows: Somatic morphology: AER = anterior eye row; ALE = anterior lateral eye; AME = anterior median eye; MOA = median ocular area; PER = posterior eye row; PLE = posterior lateral eye; PME = posterior median eye. Male palp: E = embolus; T = tegulum; C = cymbium; RTA = retrolateral tibial apophysis; VTA = ventral tibial apophysis; ITA = intermediate tibial apophysis; BTA = basal tegular apophysis. Female genitalia: FD = fertilization duct; CD = copulatory duct; S = spermatheca.

---

[1] Received on January 15, 2008. Accepted on February 6, 2008.

[2] College of Life Sciences, Hebei University, Baoding, Hebei 071002 P. R. China. E-mails: guangxin-han@163.com; mingshengzhu@263.net (corresponding author), respectively.

Mailed on February 19, 2009

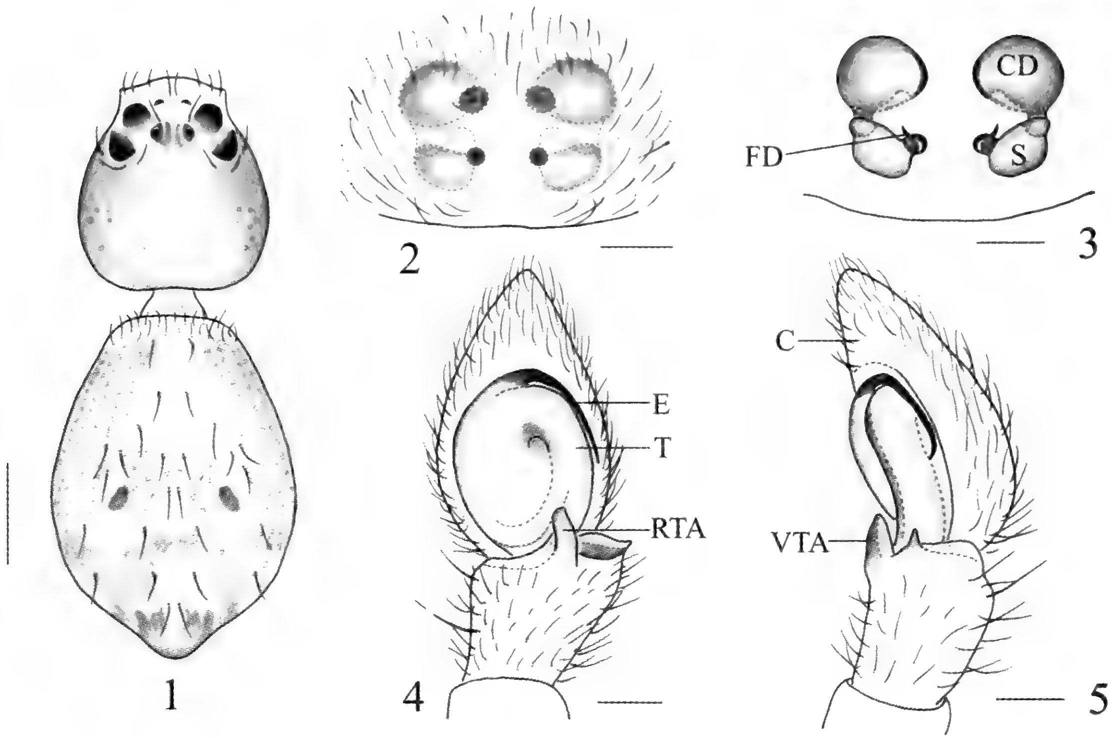
SYSTEMATIC ARANEOLOGY

Tmarus songi, new species

Figs. 1–5

Male (base on Ar-01-0032): Total length 3.51. Carapace 1.39 long, 1.36 wide; abdomen 2.01 long, 0.99 wide. Carapace brown, length almost equal to width, and covered with small setae. Cephalic region light brown, dark brown on two sides, and the middle region light brown. Eye region with fine setae, both eye rows recurved, and diameters of eyes: AME 0.08, ALE 0.15, PME 0.10, PLE 0.15. Distances between eyes: AME-AME 0.10, AME-ALE 0.10, PME-PME 0.18, PME-PLE 0.25, ALE-PLE 0.20. MOA 0.30 long, anterior width 0.25, posterior width 0.33. Base of the lateral eye tubercle separated. Clypeus yellowish brown, furnished with long spiniform setae, height longer than the diameter of PLE. Chelicerae orange; both promargin and retromargin lacking teeth. Labium longer than wider. Sternum yellowish brown, posterior margin narrow and extending between coxae IV.

Abdomen long and narrow, white with numerous gray spots, furnished with some long spiniform setae, and bases of the setae with brown speckles; posterior part of dorsum a little wider, tending narrower and lower and forming ramp-shape; two sides of dorsum almost straight; the surface of sides and posterior part with



Figs. 1–5. *Tmarus songi*, new species. 1. Female body, dorsal view; 2. Epigyne, ventral view; 3. Same, dorsal view; 4. Left male palp, ventral view; 5. Same, retrolateral view. Scale bars: 1. 1.0 mm; 2-5. 0.1 mm.

many crinkles; venter yellow. Leg formula: 2143. Measurements of legs: I 7.52 (2.33+2.65+1.69+0.85), II 7.73 (2.33+2.70+1.80+0.90), III 3.56 (1.17+1.38+0.57+0.44), IV 3.65 (1.33+1.25+0.60+0.47).

Male palp (Figs. 4, 5): With ventral and retrolateral tibial apophyses: ventral apophysis thick, long and digitiform; retrolateral apophysis small and dentiform. Bulb simple, longer than wide. Embolus thick and pointed, originating on distal part of bulb.

Female (based on Ar-01-0033)**:** Total length 5.04. Carapace 1.77 long, 1.67 wide; abdomen 2.86 long, 2.01 wide. Diameters of eyes: AME 0.08, ALE 0.15, PME 0.10, PLE 0.15. Distances between eyes: AME-AME 0.13, AME-ALE 0.15, PME-PME 0.20, PME-PLE 0.35, ALE-PLE 0.28. MOA 0.39 long, anterior width 0.29, posterior width 0.42. Eye tubercles of ALE and PLE separated. Leg formula: 2143. Measurements of legs: I 7.17 (2.21+2.89+1.15+0.92), II 7.68 (2.31+2.82+1.56+0.99), III 4.09 (1.33+1.63+0.60+0.53), IV 4.24 (1.53+1.48+ 0.68+0.55). The posterior end extends beyond spinnerets. Other characteristics same as those in male.

Female genitalia (Figs. 2, 3): Without distinct margin; copulatory ducts widely originated and nearly spherical; spermatheca small and oval.

Diagnosis: The new species is similar to *Tmarus* digitiformis Yang, Zhu and Song 2005 (Yang et al., 2005: 96, Figs. 1-5), but differs from the latter by: (1) VTA of the male palp erect and long, RTA nail-shape (Figs. 4, 5); (2) the beginning of the female copulatory duct almost round (Fig. 3).

Material Examined: Holotype-male, Tongmian Town, Ningming County, Guangxi Province, China (22°6'N, 107°0'E), 8 May 2006, Mingsheng Zhu leg. (MHBU-Ar-01-0032). Paratypes-1 female, same data as for the holotype (MHBU-Ar-01-0033); 1 female and 1 male, Daqing Mountain, Pingxiang County, Guangxi province, China (22°6'N, 106°42'E), 14 May 2006, Mingsheng Zhu leg. (MHBU-Ar-01-0034); 2 females, Limu Mountain, Qiongzhong County, Hainan Province, China (19°0'N, 109°48'E), 20 August 2007, Feng Zhang and Guangxin Han leg. (MHBU-Ar-01-0035).

Variation: Body length: males 3.06-3.51, females 4.05-5.04.

Distribution: China: Guangxi, Hainan.

Etymology: The specific name is a patronym in honor of the late Professor Da-Xiang Song.

Tmarus taiwanus **Ono, 1977**

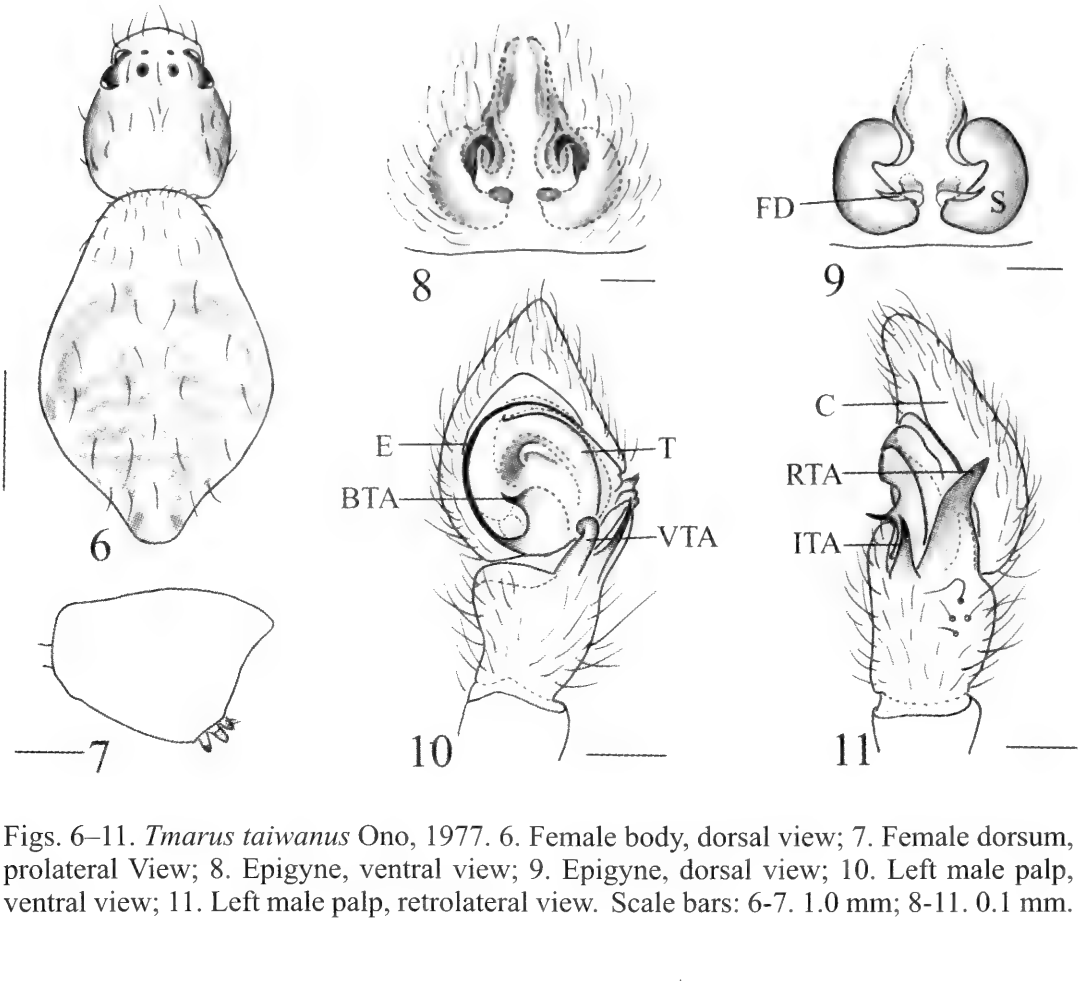
Figs. 6–11

Male (base on Ar-01-0036)**:** Total length 5.40. Carapace 2.24 long, 2.14 wide; abdomen 2.28 long, 1.67 wide. Carapace brown, length equal to width. Both eye rows recurved, and diameters of eyes: AME 0.10, ALE 0.20, PME 0.13, PLE 0.20. Distances between eyes: AME-AME 0.28, AME-ALE 0.15, PME-PME 0.35, PME-PLE 0.30, ALE-PLE0.25. MOA 0.48 long, anterior width 0.45, posterior width 0.58. Base of the lateral eye tubercle separated. Clypeus yellowish brown, the anterior margin furnished with six long spiniform setae, height longer than the diameter of PLE. Chelicerae orange; inner side with some small setae, both promargin and retromargin lacking teeth. Labium longer than wide. Sternum yellowish brown, posterior margin narrow and extending between coxae IV.

Abdomen long and narrow, gray with three transverse yellowish brown bands, scattered with a few brown speckles; posterior part of dorsum a little wider, tending narrower and lower and forming ramp-shape; two sides of dorsum almost straight; the surface of sides and posterior part with many crinkles; venter is yellow. Legs I-II reddish brown, III-IV yellowish brown. Leg formula: 2143. Measurements of legs: I 13.04 (3.82+4.77+3.18+1.27), II 13.24 (3.92+4.77+3.28+1.27), III 5.51 (1.70+2.01+1.06+0.74), IV 5.72 (1.80+2.01+1.06+0.85).

Male palp (Figs. 10, 11): With ventral, intermediate and retrolateral tibial apophyses: ventral apophysis thick, long and digitiform; intermediate apophysis thin and pointed; retrolateral apophysis large and horn-shape. Bulb simple, longer than wide. Embolus thin and pointed, originating on the bottom of bulb, basal tegular apophysis is short and pointed.

Female (based on Ar-01-0036)**:** Total length 4.59. Carapace 1.90 long, 2.28 wide; abdomen 3.09 long, 1.84 wide. Diameters of eyes: AME 0.10, ALE 0.18, PME 0.13, PLE 0.18. Distances between eyes: AME-AME 0.23, AME-ALE



Figs. 6–11. *Tmarus taiwanus* Ono, 1977. 6. Female body, dorsal view; 7. Female dorsum, prolateral View; 8. Epigyne, ventral view; 9. Epigyne, dorsal view; 10. Left male palp, ventral view; 11. Left male palp, retrolateral view. Scale bars: 6-7. 1.0 mm; 8-11. 0.1 mm.

0.18, PME-PME 0.33, PME-PLE 0.40, ALE-PLE 0.28. MOA 0.43 long, anterior width 0.40, posterior width 0.53. Eye tubercles of ALE and PLE separated. Legs yellowish brown. Leg formula: 2143. Measurements of legs: I 8.90 (2.65+3.39+2.01+0.85), II 9.12 (2.76+3.50+1.91+0.95), III 4.66 (1.43+1.80+0.78+0.65), IV 4.69 (1.63+1.70+0.75+0.61). The posterior end occasionally extends beyond spinnerets. Other characteristics as in male.

Female genitalia (Figs. 8, 9): Lacks distinct copulatory ducts, spermatheca almost reniform.

Diagnosis: All the characters of *Tmarus taiwanus* accord with that of the genus *Tmarus*, but this species can be distinguished from all other *Tmarus* species by: (1) male palpal tegulum with an intermediate tegular apophysis and a basal tegular apophysis (Figs. 10, 11); (2) the median ocular area is longer than wide.

Material Examined: 1 male and 1 female, Wuming County, Guangxi Province, China (23°6'N, 108°10'E), 19 May 2002, Mingsheng Zhu leg (MHBU-Ar-01-0036). 1 female, Yingjiang County, Yunnan Province, China (24°25'N, 97°34'E), 17 May 2004, Zhisheng Zhang leg.(MHBU-Ar-01-0037). 1 female, Taizhong City, Taiwan (24°48'N, 120°24'E), 10 July 2000, Hengcheng Wu leg (MHBU-Ar-01-0038).

Variation: Body length: male 5.40 mm, females 4.59-8.73.

Distribution: China: Taiwan, Guangxi, Yunnan.

ACKNOWLEDGEMENTS

We thank Dr. Hirotsugu Ono, Japan, for helpful suggestions. Many thanks are also due to Dr. Guo-Fang Jiang for his assistance. This study was supported by The Ministry of Science and Technology of the People's Republic of China (2006FY110500-3).

LITERATURE CITED

Ono, H. 1977. Thomisidae aus Japan I. Das Genus *Tmarus* Simon (Arachnida: Araneae). Acta Arachnologica Tokyo 27 (Special Number): 61-84.

Song, D. X. 1987. Spiders from agricultural regions of China (Arachnida: Araneae). Agriculture Publishing House. Beijing, China. 376 pp.

Song, D. X. and M. S. Zhu. 1997. Fauna Sinica: Arachnida: Araneae: Thomisidae, Philodromidae. Science Press. Beijing, China. 259 pp.

Yang, Z. Z., M. S. Zhu, and D. X. Song. 2005. Two new species of the spider genus *Tmarus* Simon 1875 (Araneae: Thomisidae) from China. Acta Arachnologica (Tokyo, Japan) 54: 95-98.

Zhang, J. X., M. S. Zhu, and I. M. Tso. 2006. Four new crab spiders from Taiwan (Araneae, Thomisidae). Journal of Arachnology 34: 77-86.

Zhu, C. D. and Z. G. Wen. 1981. Chinese spiders of genus *Tmarus* (Araneae: Thomisidae). Journal of Bethune Medical University 7: 24-27.

Zhu, M. S., Z. S. Zhang, and H. M. Chen. 2005. A new species of the genus *Tmarus* from China (Araneae: Thomisidae). Journal of Hebei University (Natural Science Edition) 25: 520-522.

NINE NEW SPECIES OF *CORONIGONIELLA* FROM COLOMBIA AND PERU, SOUTH AMERICA (HEMIPTERA: CICADELLIDAE: CICADELLINAE)[1]

Paul H. Freytag[2]

ABSTRACT: Nine new species are added to the genus *Coronigoniella* Young. They include *C. bartletti* from Peru, *C. cornuta*, *C. circula*, *C. elongata*, *C. ancora*, *C. bella*, *C. cerulata*, *C. extenda* and *C. undulata* from Colombia. The female seventh sternum of *C. caquetana* Young is also illustrated for the first time.

KEY WORDS: *Coronigoniella*, new species, Hemiptera, Cicadellidae, Cicadellinae, Colombia, Peru, South America

The genus *Coronigoniella* was described by Young (1977) and 18 species were included. Three species were added by Felix and Mejdalani (2003). At this time nine new species can be added from Colombia and Peru. All species have a similar appearance and differ mostly in size and genital characteristics.

The codes used in this paper are as follows: IHVL = Instituto von Humboldt, Villa de Leyva, Colombia; MUSM = Museo Nacional Mayor de San Marcos, Lima, Peru; and UKYL = University of Kentucky Collection, Lexington, Kentucky, USA.

The first four species described are in the group of species which have a lobe on the ventral margin of the male pygofer (see figure 8, 11, and 14). The described species in this group include *C. ostenta* Young 1977, known from Colombia, Ecuador, Panama and Peru; *C. metana* Young 1977, known from Colombia; *C. rubrahua* Young 1977, known from Peru and *C. caquetana* Young 1977, known from Colombia.

Coronigoniella bella Freytag, new species

Figures 8-10

Description: Length of males 5.5-5.6 mm., females unknown. Head with median posterior area nearly triangular, grayish green with black markings; anterior area extending to eyes, yellowish orange; eyes yellowish orange above margin, yellow below margin; face purplish yellow. Pronotum mostly green, anterior area yellowish green with black spots, lateral areas yellowish orange; pleural area yellowish green. Scutellum grayish green with black markings overall. Forewings green with costal edge yellowish orange to apical cells, which are also entirely yellowish orange as is the apex of the appendix; basal area of appendix transparent. Base of hind tibia yellowish orange, remainder of all legs and ventral area of body, yellow. Male genitalia: Pygofer (Fig. 8) broadly rounded apically, with lobe on ventral margin, with elongate, slender, acute process arising

---

[1] Received on November 27, 2007. Accepted on February 5, 2008.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 40546 U.S.A. E-mail: freytag2104@windstream.net

Mailed on February 19, 2009

from lobe , extending to apex of pygofer. Subgenital plate (Figs. 8 and 9) triangular, with bluntly pointed apex, extending nearly length of pygofer. Style (Fig. 9) short, acute at apex. Connective (Fig. 9) T-shaped. Aedeagus (Fig. 8 and 10) tubular, nearly straight, without processes, bifurcate at apex.

Type Data: Holotype male: Colombia: Putumayo, PNN La Paya, Cabaña La Paya, 0°2'S 75°12'W, 330 m., Malaise, XI-15-30-2001, R. Cobete, M 2653 (IHVL). Paratype male: Colombia: Meta, PNN Sumapaz, Qda. La Cristalina, 3°48'N 73°50'W, 614 m., Red, III-27-28-2004, D. Arias & T. Arias, M 4339 (UKYL).

Remarks: This species is closest to *C. caquetana* as the aedeagus lacks processes in both species. It differs in that the aedeagus is straight, not roundly angled as in *C. caquetana*. Also, the notch on the ventral margin of the pygofer is near the middle whereas in *C. caquetana* it is closer to the base (as shown in figure 14). It is named for its beautiful appearance.

Coronigoniella circula Freytag, new species

Figures 1, 4, and 11-13

Description: Length of males 6.8-7 mm., females 7-7.2 mm. Head (Fig. 1) with median posterior area grayish green with black markings; anterior margin to eyes, reddish orange; without black median spot on anterior margin; eyes reddish orange above margin, green below margin; face yellow. Pronotum (Fig. 1) mostly green, with anterior area yellowish green with black markings; lateral areas reddish orange; plural area greenish yellow. Scutellum (Fig. 1) yellowish green, with black speckles overall. Forewing bright green, with bold reddish orange along costal margin to outer apical cell; between costal margin and remainder of wing a line of blue from base to apical cell; appendix, inner apical cells, transparent. Hind tibia with base reddish orange, otherwise all legs and ventral surface of body mostly yellowish orange. Male genitalia: Pygofer (Fig. 11) elongate, acute at apex, with lobe on ventral margin, with elongate, slender, acute process arising from lobe, extending to apex of pygofer. Subgenital plate (Figs. 11 and 12) triangular, broader at base than *C. bella*, narrowing to nearly acute apex, shorter than length of pygofer. Style (Fig. 12) thin, curving to acute apex. Connective (Fig. 12) T-shaped. Aedeagus (Figs. 11 and 13) tubular, curving dorsad, with pair of curved, short processes at apex. Female seventh sternum (Fig. 4) nearly square, with posterior margin roundly emarginate on each side of median spine.

Type Data: Holotype male: Colombia: Norte de Santander, PNN Tamá Mun Toledo, Vda. La Camacha, Pozo Negro, 7°21'N 72°28'W, 2203 m., Malaise, XI-14-21-2003. C. Leal, M 4052 (IHVL). Paratypes: One male, one female, same data as holotype, except 2213 m., M 4049 (UKYL); two males, one female, same data as holotype, except X-23-XI-2-2003, M 4029 (one male, UKYL, one male, one female IHVL); one male, same data as holotype, except Anu Los Estoraques, Qda. La Media, 8°13'N 73°14'W, 1480 m., Malaise, X-15-29-2003, J. Vargus, M 4089 (IHVL)

Remarks: This species is closest to *C. ostenta* and *C. rubrahua*. It differs by having sharply pointed styles and very short curved processes on the aedeagus, as well as a pointed apex to the pygofer. It is named for the gradually curving aedeagus.

Coronigoniella ancora Freytag, new species

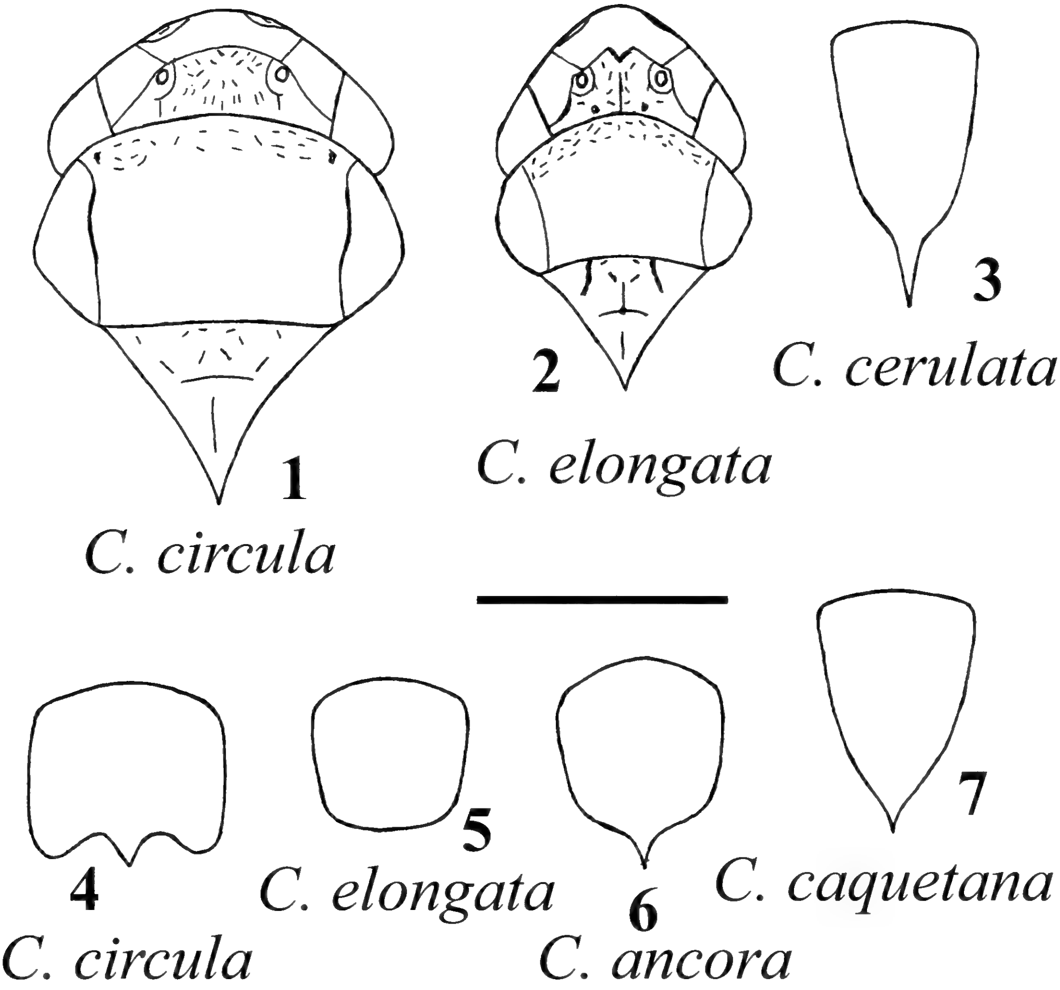
Figures 6 and 14-16

Description: Length of males 5.9-6 mm., females 6-6.1 mm. Head median posterior area grayish green, marked with black, nearly triangular; anterior area orange to eyes; black spot not present on anterior margin; face mostly yellow; eyes orange above margin, green below margin. Pronotum mostly green, with anterior margin grayish green with black markings, lateral areas, orange; plural area mostly yellow. Scutellum green, with black markings overall. Forewing mostly green with orange along costal margin to outer apical cell; between costal margin and remainder of wing a band of blue; appendix and inner apical cells, transparent. Hind tibia with base orange, otherwise all legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 14) rounded at apex, with lobe on ventral margin, with long slender, acute process, extending to apex of pygofer. Subgenital plate (Figs. 14 and 15) triangular, narrowing to acute apex, two thirds length of pygofer. Style (Fig. 15) sinuate, acute at apex, over half length of subgenital plate. Connective (Fig. 15) T-shaped. Aedeagus (Figs. 14 and 16) tubular, curved dorsad at base, then straight, with subapical pair of short processes, curved basad, acute at apex. Female seventh sternum (Fig. 6) little longer then width, with posterior margin with median, short spine.

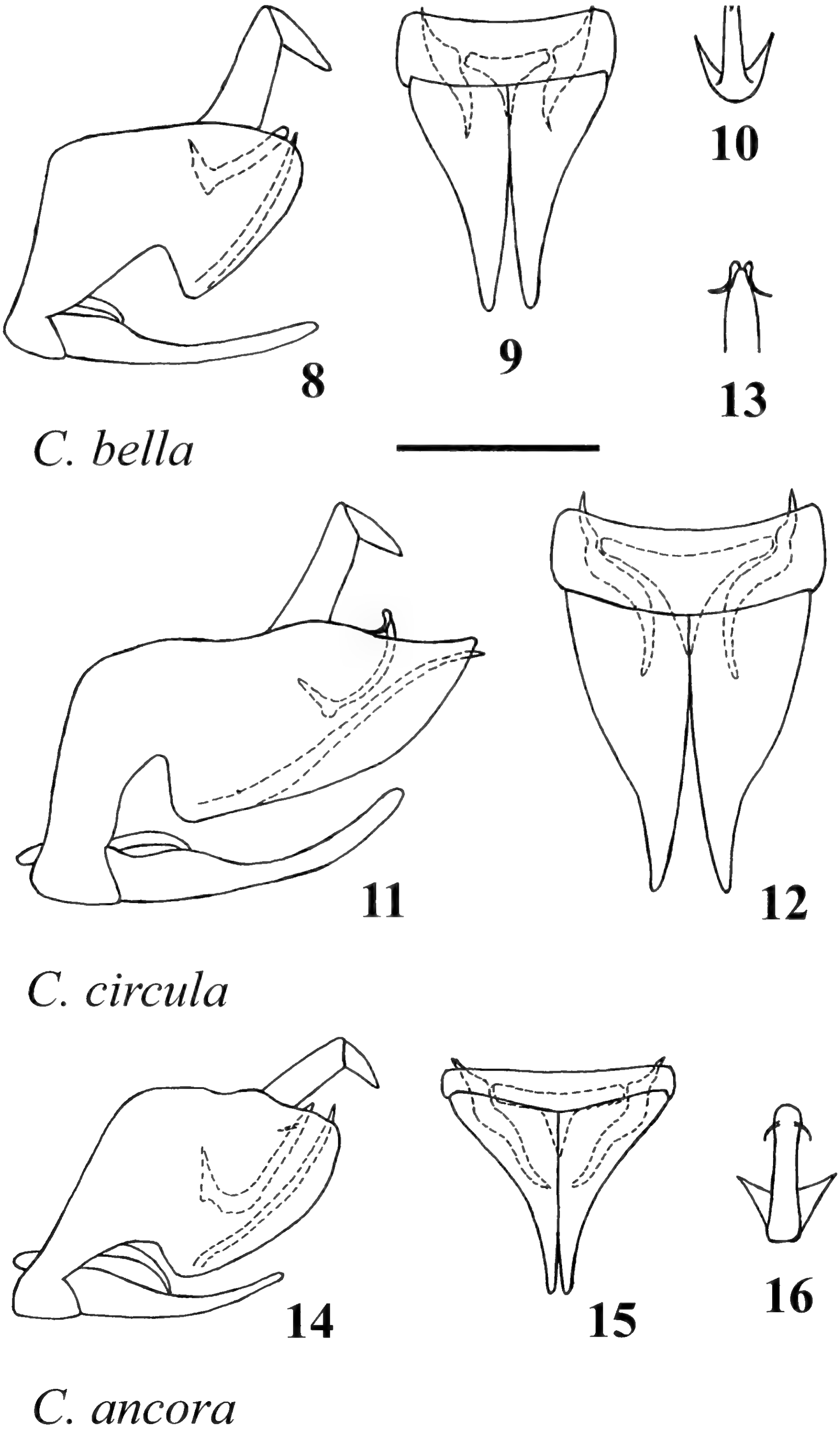
Type Data: Holotype male: Colombia: Magdalena, PNN Tayrona, Cerro San Lucas, La Antena, 11°20'N 74°2'W, 700 m., Malaise, VII-19-24-2002, M. Sharkey, D. Arias & E. Torres, M 3258 (IHVL). Paratypes: Two males, two females, same data as holotype (one male, one female, UKYL; one male, one female, IHVL).

Additional Specimens: One male, same data as holotype, except Borde Camino, Pueblito-Cañaveral, 30 m., Red, VII-18-25-2002, M 3268 (IHVL); one male, same data as holotype, except 550 m., I-11-16-2003, C. Sarmiento, M 3425 (IHVL); three females, same data as last, except M 3426 (IHVL); one male, same data as last, except 450 m., 11°19'N 73°59'W, I-11-16-2003, M 3428 (IHVL); one female, same data as last, except 600 m., I-6-11-2003, M 3429 (IHVL); and one male, same data, except 500 m., M 3430 (IHVL).

Remarks: This species is closest to *C. ostenta*. It differs from that species in having an aedeagus that the shaft is straighter with very small curved processes. This species is named for the aedeagus looking like an anchor.



Figures 1 and 2. Dorsal views of head, thorax and scutellum. Fig. 1 *Coronigoniella circula* n. sp. Fig. 2. *C. elongata* n.sp. Figures 3-7. Ventral view of last female abdominal sternum. Fig. 3. *C. cerulata* n. sp. Fig. 4. *C. circula* n. sp. Fig. 5. *C. elongata* n. sp. Fig. 6. *C. ancora* n. sp. and 7. *C. caquetana* Young. All drawn to the same scale which equals 1 mm.



Figures 8-16. Male genital structures. Figs. 8-10. *Coronigoniella bella* n. sp. Figs. 11-13. *C. circula* n. sp. Figs. 14-16. *C. ancora* n. sp Figs. 8, 11, 14. Lateral view of genital capsule (setae not shown). Figs. 9, 12, 15. Ventral view of valve, subgenital plates, styles and connective. Figs. 10, 13, 16. Posterior ventral view of aedeagus. All drawn to the same scale which equals 0.5 mm.

Coronigoniella bartletti Freytag, new species

Figures 17-19

Description: Length of male 6 mm., female unknown. Head with median posterior area triangular, grayish green with black markings; anterior area to eyes, orange; eyes orange above margin, greenish yellow below margin; face yellow. Pronotum mostly green, with anterior area yellowish green marked with black speckles, lateral areas, orange; plural area greenish yellow. Scutellum yellowish green, with black markings overall. Forewing green, with costal area orange, extending to and over apical cells; appendix transparent. Hind tibia with base orange, remainder of legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 17) rounded at apex, with extensive lobe on ventral margin, with long, slender, acute process, extending to near apex of pygofer. Subgenital plate (Figs. 17 and 18) triangular, long, narrow, nearly acute at apex, half length of pygofer. Style (Fig. 18) short, curving to acute apex. Connective (Fig. 18) T-shaped, longer than styles. Aedeagus (Fig. 17 and 19) tubular, without processes, U-shaped in lateral view, with a small bifurcate apex.

Type Data: Holotype male: Peru: Madre de Dios, Tambopata Res. Zone, Tambopata Research Cntr. On Rio Tambopata, 13°08'30"S 69°36'502"W, 190 m., X-3-7-2004, Malaise, C. R. Bartlett (MUSM).

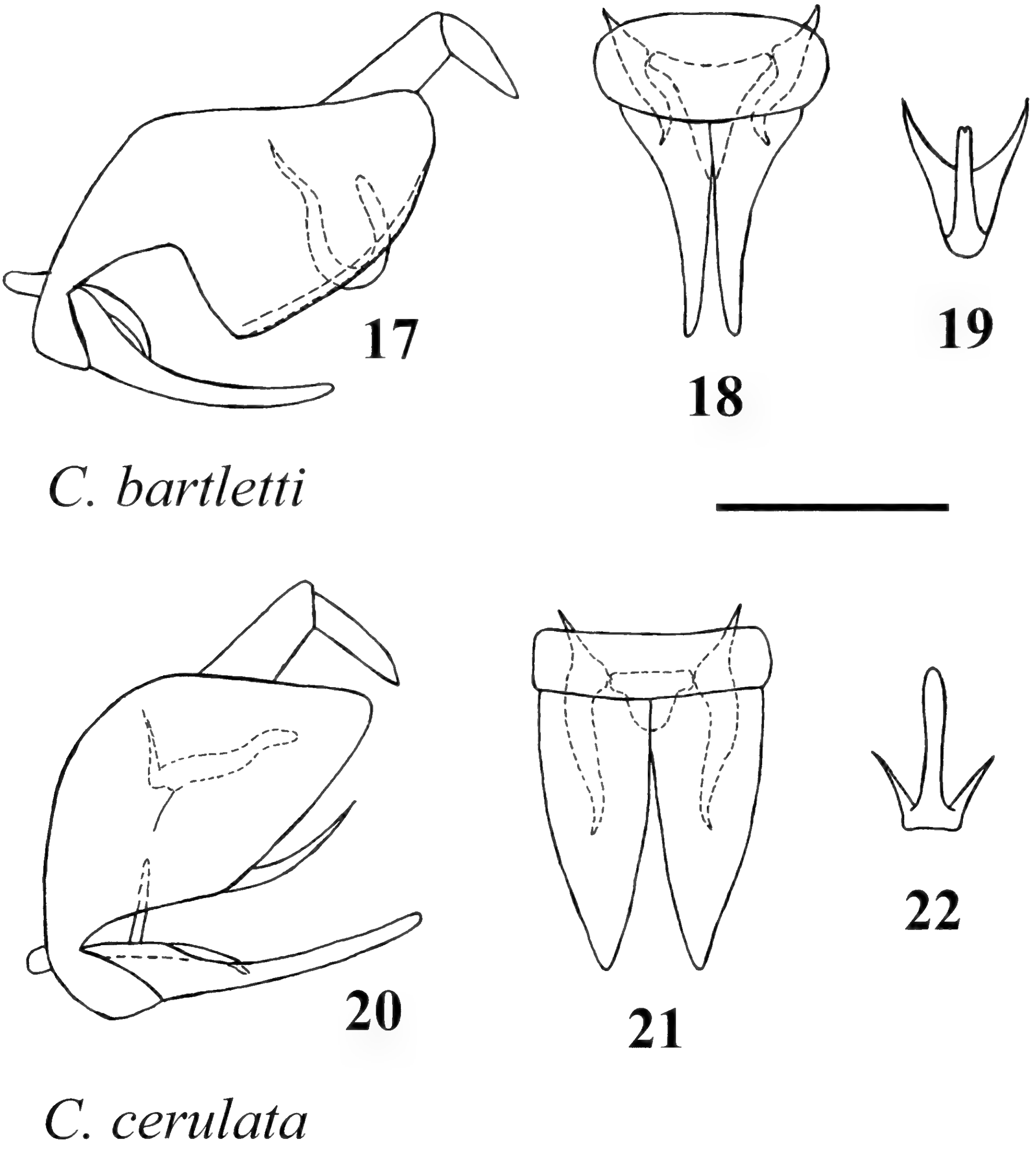
Remarks: This species is closest to *C. caquetana*. It differs by having a| U-shaped aedeagus in lateral view, while in *C. caquetana* the shaft is at a right angle to the base. This species is named for the collector of this species.

Coronigoniella caquetana Young

Figure 7

Coronigoniella caquetana Young 1977, p. 1017.

This species is included to illustrate the female seventh sternum, which was not included in the original description. The female seventh sternum (Fig. 7) is similar to other described species, with the length longer then the width, narrowing on posterior margin to median spine. This species was described from Caquetá, Colombia. It is now known from Amazonas, Caquetá, Putumayo and Vaupés, Colombia.



Figures 17-22. Male genital structures. Figs. 17-19. *Coronigoniella bartletti* n. sp. Figs. 20-22. *C. cerulata* n.sp. Figs. 17, 20. Lateral view of genital capsule (setae not shown). Figs. 18, 21. Ventral view of valve, subgenital plates, styles and connective. Figs. 19, 22. Posterior ventral view of aedeagus. All drawn to same scale which equals 0.5 mm.

The next species belongs in the group in which the male pygofer does not have a ventral lobe. Many of the described species belong to this group including the type of the genus, *C. spinosa* (Osborn) 1926. Included are *C. lineola* (Osborn), from Colombia and Venezuela; *C. formosula* Young, from Colombia, Costa Rica, Panama and Peru; *C. baguensis* Young, from Peru; *C. beieri* Young, from Peru: *C. bonita* Young, from Brazil; *C. maldonadoi* Young, from Venezuela; *C. marginella* (F.), from French Guiana; *partita* Young, from Ecuador; *C. rohweri* Young, from Ecuador; *C. rubiella* Young, from Costa Rica and Panama; *C. spinosa* (Osborn), from Brazil; *C. tiarae* Young, from Trinidad and Tobago and Venezuela and *C. yara* Young, from Brazil.

Coronigoniella cerulata Freytag, new species

Figures 3 and 20-22

Description: Length of males 6.8-7 mm., females 7 mm. Head with median posterior area triangular, grayish green, marked with black; anterior area orange; small black spot on anterior margin; eyes orange above margin, greenish yellow below margin; face yellow. Pronotum mostly green, with anterior area greenish yellow with black speckles; lateral areas, orange; plural areas greenish yellow. Scutellum greenish yellow, with black markings overall. Forewing mostly brownish green, with costal margin orange to base of outer apical cell; appendix and apical cells smoky transparent, two of the apical veins lined with orange. Hind tibia with base, orange, otherwise legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 20) bluntly pointed at apex, without lobe on ventral margin, with sharply acute process from middle of ventral margin, extending toward apex of pygofer. Subgenital plate (Figs. 20 and 21) roundly triangular, bluntly acute at apex, same length as pygofer. Style (Fig. 21) two-thirds length of subgenital plate, curving to acute apex. Connective (Fig. 20 and 21) T-shaped, bent at right angle near base, extending dorsad. Aedeagus (Fig. 20 and 22) tubular, without processes, sinuate in lateral view, with rounded apex, apodemes connect to anal tube. Female seventh sternum (Fig. 3) twice as long as width, narrowing on posterior margin to prominent median spine.

Type Data: Holotype male: Colombia: Tolima, Mun. Fresno, Vda. Colombia Fea. Las Perlas, 5°12'N 75°2'W, 1508 m., Pan trap, XII-12-26-2002, T. Arias, D. Arias & S. Arias, M 112 (IHVL). Paratypes: 11 males, 5 females, same data as holotype (5 males, 2 females, UKYL; 6 males, 3 females, IHVL).

Additional Specimen: One male, same data as holotype, except XII-23-26-2002. M 113 (IHVL).

Remarks: This species is close to *C. tiarae* in many aspects. It differs from *C. tiarae* by a pointed style and a wide, gradually angled subgenital plate. It is named for the darker color which looks somewhat bluish.

The next four species belong in the group in which the male pygofer is elongate ventrally and the last abdominal tergum or the last two terga are connected above the base of the genital capsule. One described species belongs to this group, *C. truncata* Young 1977, known from Peru. The species being described differ from *C. truncata* in two major characters, The four species below have a male pygofer without processes, and the aedeagus has a pair of basal processes, whereas *C. truncata* has a male pygofer process, and the aedeagus does not have basal processes.

Coronigoniella extenda **Freytag, new species**

Figures 23-25

Description: Length of male 5.9 mm, female unknown. Head with median posterior area nearly triangular, anterior median margin emarginate, grayish green with black markings; anterior area to eyes, orange; eyes orange above margin, green below margin; face, yellow. Pronotum mostly green, with anterior area speckled with black, lateral areas, orange; plural areas yellowish green. Scutellum yellowish green, with black markings overall. Forewing green, costal margin, orange, interrupted near base, also near base of anteapical cell with black, orange extending over base of outer apical cell; apex of apical cells and appendix transparent. Hind tibia with base orange, remainder of legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 23) long, without process, narrowing near rounded apex. Subgenital plate (Figs. 23 and 24) triangular, one-third length of pygofer. Style (Fig. 24) short, curving to acute apex. Connective (Fig. 24) T-shaped. Aedeagus (Figs. 23 and 25) with shaft long, tubular, with basal pair of long processes, curving toward median, extending just beyond shaft.

Type Data: Holotype male: Colombia: Vaupés, RN Mosiro-Itajura (Caparú), Centro Ambiental, 1°4'S 69°31'W, 60 m., Malaise, XII-1-8-2003, J. Pinzón, M 4442 (IHVL).

Remarks: This species differs from all other species in that the last two (7th and 8th) terga are above the base of the genital capsule.

Coronigoniella undulata **Freytag, new species**

Figures 26-28

Description: Length of male 5 mm., female unknown. Head with median posterior area nearly rectangular, anterior median margin emarginate, grayish green with black markings; anterior area to eyes, orange; eyes orange above margin, green below margin; face yellow. Pronotum mostly green, anterior area grayish green with black speckles, lateral areas orange, plural area green. Scutellum yellowish green with black markings. Forewing green, costal margin orange to apical cells, than to appendix apex, remainder of appendix transparent. Hind tibia with base orange, remainder of legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 26) long, without process, rounded at apex. Subgenital plate (Figs. 26 and 27) triangular, long as pygofer, narrowing to nearly acute apex. Style (Fig. 27) short, bent at right angle near middle then curving to a bluntly acute apex. Connective (Fig. 27) T-shaped, shorter than styles. Aedeagus (Figs. 26 and 28) with shaft short, tubular, with basal pair of long processes, nearly straight, extending twice length of shaft.

Type Data: Holotype male: Colombia: Vaupés, RN Mosiro-Itajura (Caparú), Centro Ambiental, 1°4'S 69°31'W, 60 m., Red, I-20-II-1-2003, M. Sharkey & D. Arias, M 3387 (IHVL).

Remarks: This species differs from *C. truncata* in lacking the male pygofer process, and the aedeagus having a pair of lateral processes that are twice as long as the shaft.

Coronigoniella elongata Freytag, new species

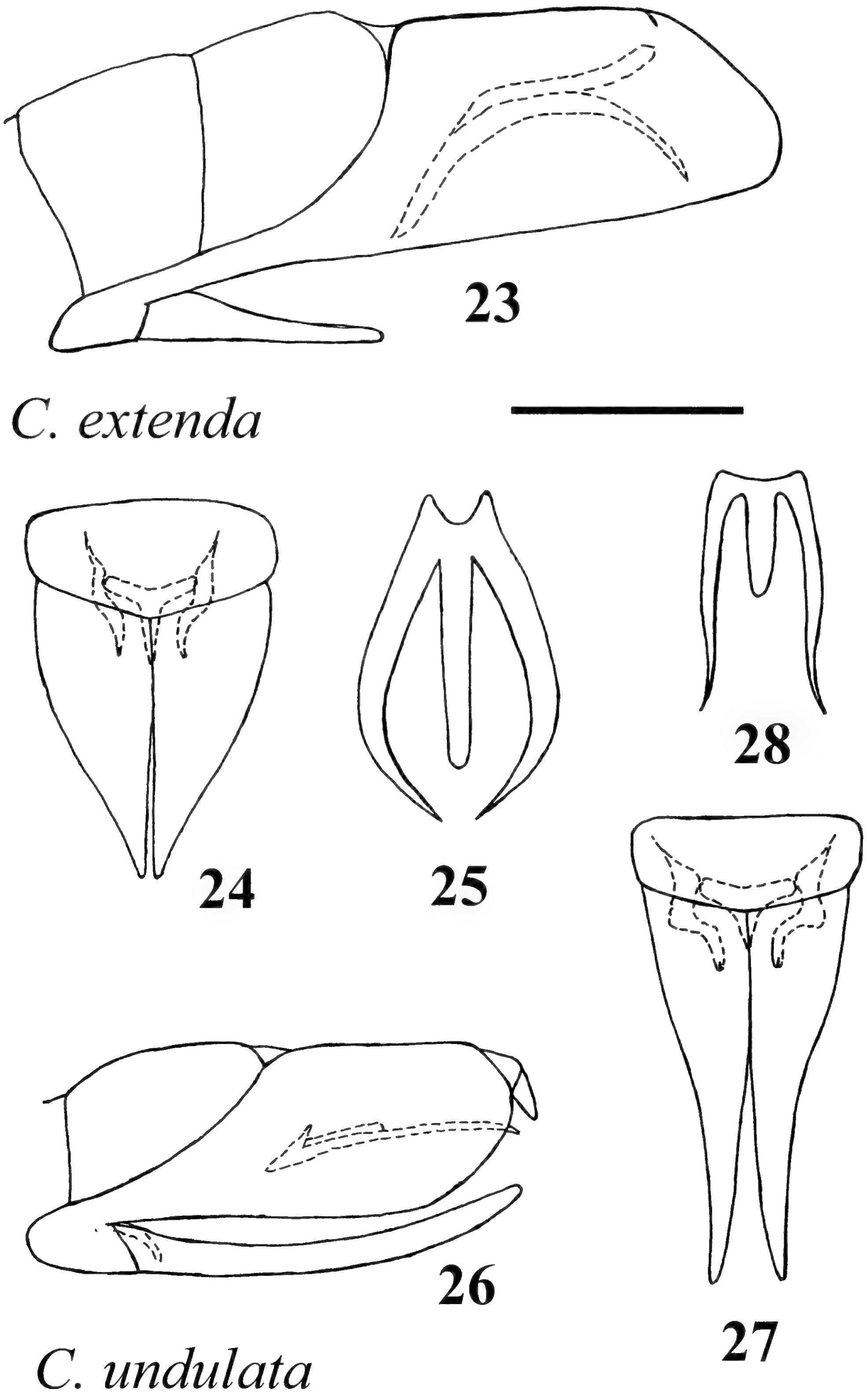
Figures 2, 5, and 29-31

Description: Length of males 5 mm., females 5-5.2 mm. Head (Fig. 2) with median posterior area grayish green with black markings, anterior margin of area rounded with median emargination; anterior area to eyes, orange; eyes orange above margin, greenish yellow below margin, face yellow. Pronotum (Fig. 2) mostly green, anterior area grayish green with black speckles, lateral areas orange, plural areas greenish yellow. Scutellum (Fig. 2) yellowish green with black markings overall. Forewing green with costal margin orange, broken near base of anteapical cell, extending over apical cells, appendix transparent. Base of all tibia, orange, remainder of legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 29) long, rounded at apex. Subgenital plate (Figs. 29 and 30) triangular, long, extending almost to apex of pygofer, bent dorsad near apex. Style (Fig. 30) very long, nearly as long as subgenital plate, thin, acute at apex. Connective (Fig. 30) T-shaped, short. Aedeagus (Figs. 29 and 31) with shaft short, tubular, with basal pair of processes, twice as long as shaft, straight, acute at apex. Female sixth sternum (Fig. 5) nearly square, posterior margin without median spine.

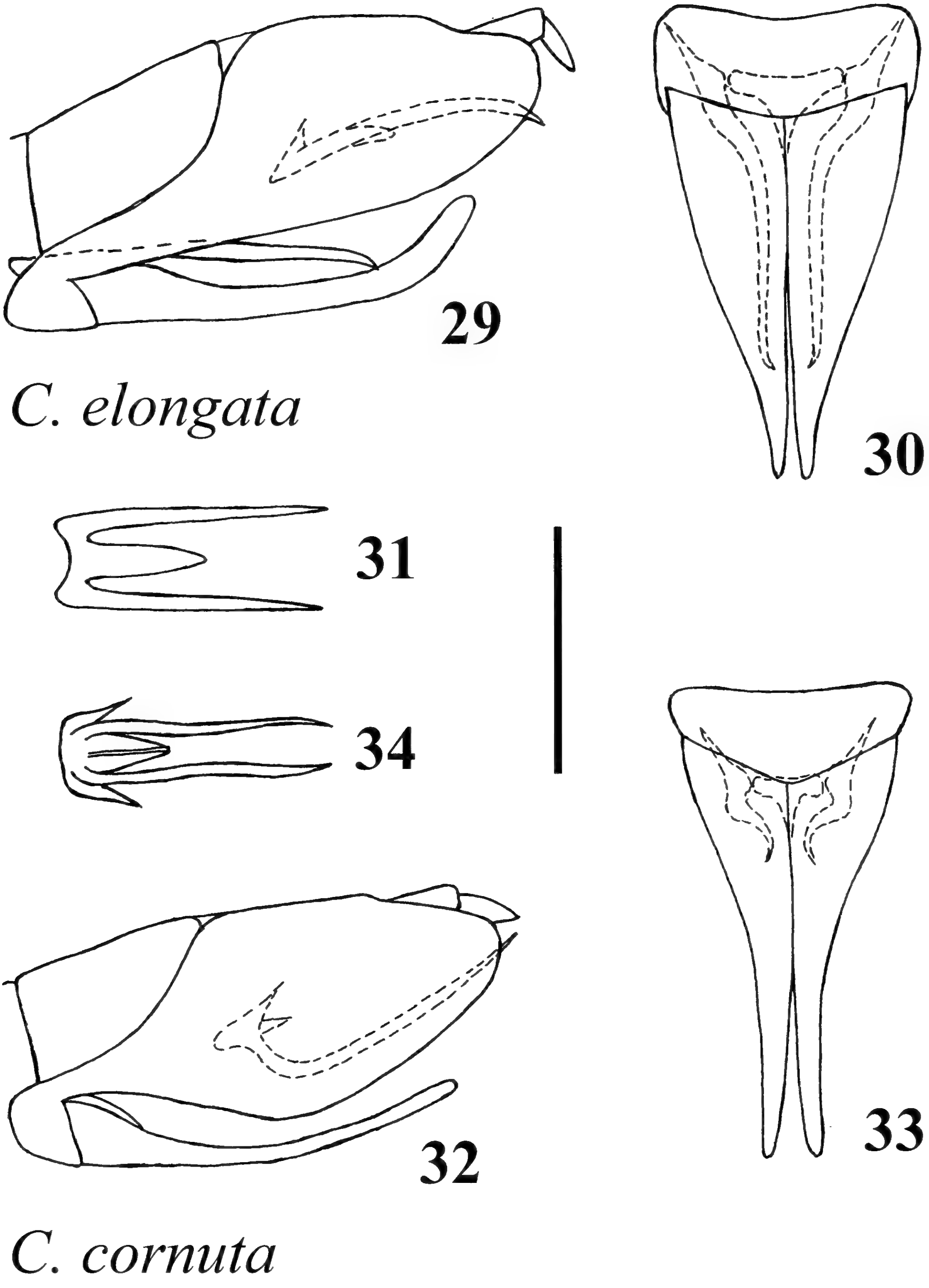
Type Data: Holotype male: Colombia: Amazonas, PNN Amacayacu, Cabaña Lorena, 3°0'S 69°59'W, 210 m., VIII-27-2001, Red, D. Campos, M 2234 (IHVL). Paratypes: One male, same data as holotype (UKYL); one male, same data as holotype, except IX-1-15-2001, Malaise, D. Deaza, M 2203 (IHVL); and one female, same data as holotype, except VIII-27-IX-1-2001, Malaise, D. Campos, M 2238 (IHVL).

Additional Specimen: One female, Colombia: Putumayo, PNN La Paya, Salao Grande, 0°1'S 74°56'W, 330 m., Red, XI-22-2001, D. Campos, M 2087 (IHVL).

Remarks: This species differs from *C. undulata* in having very long styles.



Figures 23-28. Male genital structures. Figs. 23-25. *Coronigoniella extenda* n. sp. Figs. 26-28. *C. undulata* n. sp. Figs. 23, 26. Lateral view of genital capsule (setae not shown). Figs. 24, 27. Ventral view of valve, subgenital plates, styles and connective. Figs. 25, 28. Ventral view of aedeagus. All drawn to the same scale which equals 0.5 mm.



Figures 29-34. Male genital structures. Figs. 29-31. *Coronigoniella elongata* n. sp. Figs. 32-34. *C. cornuta* n. sp. Figs. 29, 32. Lateral view of genital capsule (setae not shown). Figs. 30, 33. Ventral view of valve, subgenital plates, styles and connective. Figs. 31, 34. Ventral view of aedeagus. All drawn to the same scale which equals 0.5 mm.

Coronigoniella cornuta Freytag, new species

Figures 32-34

Description: Length of males 5 mm., female unknown. Head with median posterior area mostly rectangular with anterior median margin emarginated, grayish green with black markings; anterior area to eyes orange; eyes orange above margin, yellow below margin; face yellow. Pronotum mostly yellowish green, with anterior area grayish green with black speckles; lateral areas orange; plural areas yellow. Scutellum yellow green with black marking overall. Forewing green, with costal margin orange, interrupted near base of anteapical cell with black, extending over apical cells and apex of appendix; some blue along orange margin and anteapical cells; base of appendix transparent. Base of all tibia, orange, remainder of legs and ventral surface of body, yellow. Male genitalia: Pygofer (Fig. 32) long, apex narrowing but rounded. Subgenital plate (Figs. 32 and 33) triangular, long, narrow apical half, extending nearly to apex of pygofer. Style (Fig. 33) short, bent at right angle near middle then curving to acute apex. Connective (Fig. 33) short, T-shaped. Aedeagus (Figs. 32 and 34) with shaft short, narrowing to nearly pointed apex, with pair of long spinelike basal processes, bent near base, extending nearly straight three times length of shaft, short acute apodemes visible in ventral view.

Type Data: Holotype male: Colombia: Vaupés, RN Mosiro-Itajura (Caparú), Centro Ambiental, 1°4'S 69°31'W, 60 m., Red, I-20-II-1-2003, M. Sharkey & D. Arias, M 3387 (IHVL). Paratype male: Same data as holotype, except Antigua Cabaña, Malaise, II-25-III-3-2003, J. Pinzón, M 3618 (UKYL).

Remarks: This species differs from *C. undulata* by having the male aedeagus with a very short shaft that appears triangular and divided into two halves.

ACKNOWLEDGMENTS

I thank Michael J. Sharkey, Department of Entomology, University of Kentucky, whose National Science Foundation Grant No. DEB 0205982 made it possible to study these interesting species from Colombia. Also thanks to Charles R. Bartlett, Department of Entomology and Applied Ecology, University of Delaware, for the specimens he provided from his collecting in Peru, and Dicky S. Yu, Department of Entomology, University of Kentucky for the improvements to the illustrations.

LITERATURE CITED

Felix, M. and G. Mejdalani. 2003. Two new species of *Coronigoniella* Young from Brazil with taxonomic and distributional notes on the genus (Hemiptera: Cicadellidae: Cicadellinae). Studies on Neotropical Fauna and Enviroment 38 (3): 235-243.

Young, D. A. 1977. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 2. New World Cicadellini and the genus *Cicadella*. North Carolina Agricultural Experiment Station. Technical Bulletin 239. 1135 pp.

TWO NEW SPECIES OF *ROXITA* BLESZYNSKI (LEPIDOPTERA: CRAMBIDAE: CRAMBINAE) FROM CHINA[1]

Weichun Li[2] and Houhun Li[2]

ABSTRACT: Two new species of the genus *Roxita* Bleszynski are described from China: *R. acutispinata* sp. nov. and *R. capacunca* sp. nov. Images of the adults and the genitalia are provided, along with a key of the known world species.

KEY WORDS: Lepidoptera, Crambidae, *Roxita*, new species, China

Roxita was established as a monotypic genus by Bleszynski in 1963, with *R. eurydyce* Bleszynski, 1963 from China as the type. Gaskin (1984) revised the genus, described four new species: *R. apicella* and *R. mululella* from Malaysia, *R. fletcheri* from N. India, Nepal and Sikkim, and *R. reductella* from India, and transferred three species to the present genus: *R. adspersella* (Snellen, 1893) from Sri Lanka, *R. bipunctella* (Wileman and South, 1917) and *R. szetschwanella* (Caradja, 1931) from China. Inoue (1989) described *R. albipennata* from Japan. Chen et al. (2002) recorded *R. apicella* and described two new species of *Roxita* from China: *R. fujianella* and *R. yunnanella*. To date, *Roxita* comprises eleven species, confined mainly to the Indo-Oriental region.

In China, six species of *Roxita* were recorded previously. In this paper we add two new species to the genus and provide a key of the known world species. The terminology follows Gaskin (1984) except that the term phallus is used instead of aedeagus. All the studied specimens are deposited in the Insect Collection, College of Life Sciences, Nankai University, Tianjin, China.

Roxita Bleszynski, 1963

Roxita Bleszynski, 1963: 176. Type species: *Roxita eurydyce* Bleszynski, 1963, by monotypy.

Modestia Bleszynski, 1965: 64. Type species: *Culladia szetschwanella* Caradja, 1931, by original designation and monotypy.

Diagnosis. *Roxita* is characterized by the forewing with two terminal spots at apices of cubital veins and with vein M_1 absent; by the male genitalia with the valval costa usually produced into a long and strongly curved apical prong, and the ventral fold of the valva, if present, bearing one or two prong(s); by the female genitalia with the anterior apophysis much shorter than the posterior apophysis and the lamellae ante- and postvaginales often developed into a pronounced protrusion. Gaskin (1984) provided a differential diagnosis of *Roxita*

---

[1] Received on December 17, 2007. Accepted on February 5, 2008.

[2] College of Life Sciences, Nankai University, Tianjin 300071, China. E-mails: WL, weichunlee@126.com; HL, lihouhun@nankai.edu.cn (corresponding author).

Mailed on February 19, 2009

against superficially similar genera like *Glaucocharis*, and against the closely related genera *Tawhitia* and *Corynophora*.

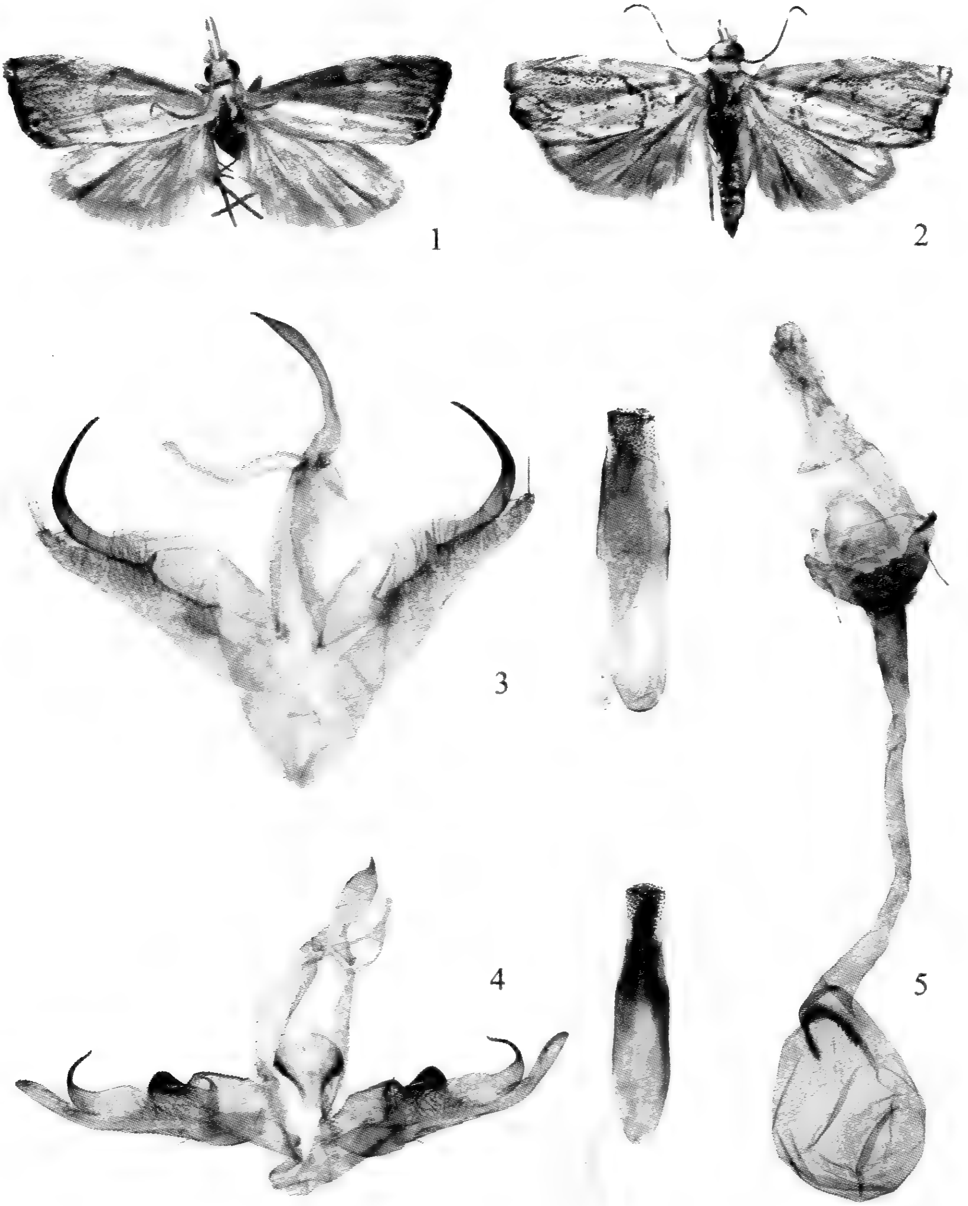
KEY TO WORLD SPECIES OF *ROXITA* BLESZYNSKI

1. Forewing with basal fascia 2
 - Forewing without basal fascia 7
2. Forewing antemedial fascia forming no angle .... *R. yunnanella* Sung and Chen
 - Forewing antemedial fascia forming an outward angle near costa 3
3. Valva bearing three long costal setae 4
 - Valva lacking long costal seta 5
4. Valval costa bearing an apical prong, cornutus present ....*R. apicella* Gaskin
 - Valval costa lacking apical prong, cornutus absent ....*R. mululella* Gaskin
5. Apical prong of valval costa conspicuously extending beyond tip of cucullus .... *R. fujianella* Sung and Chen
 - Apical prong of valval costa not extending beyond tip of cucullus 6
6. Apical prong of valval costa reaching about 2/3 of valva .... *R. eurydyce* Bleszynski
 Apical prong of valval costa reaching tip of cucullus...*R. capacunca* sp. nov.
7. Forewing antemedial fascia absent .... *R. reductella* Gaskin
 - Forewing antemedial fascia present 8
8. Forewing postmedial fascia angled twice 9
 - Forewing postmedial fascia angled once 12
9. Apical prong of valval costa conspicuously recurved 10
 - Apical prong of valval costa straight or slightly excurved 11
10. Valva without ventral fold, valval costa ending with two prongs, cornutus present; ductus bursae N-shaped, corpus bursae oval ..... *R. fletcheri* Gaskin
 - Valva with ventral fold, valval costa ending with a single prong, cornutus absent; ductus bursae nearly straight, corpus bursae gourdshaped .... *R. bipunctella* (Wileman and South)
11. Apical prong of valval costa nearly as long as uncus, apical prong of ventral fold extending beyond tip of cucullus .... *R. szetschwanella* (Caradja)
 - Apical prong of valval costa about half length of uncus, apical prong of ventral fold not extending tip of cucullus.......... *R. albipennata* Inoue
12. Forewing antemedial fascia angled at about 1/4; valva with costal region straight, apical prong of valval costa nearly straight and extending to tip of cucullus .... *R. adspersella* (Snellen)
 - Forewing antemedial fascia arched at about 1/2; valva costal region rounded, apical prong of valval costa conspicuously curved and extending beyond tip of cucullus.......... *R. acutispinata* sp. nov.

Roxita acutispinata sp. nov.

Figs. 1, 3

Type Material. Holotype ♂: [label 1, white] "Henan Province, Xixia, Huangshi'an (33°40'N, 111°37'E) / leg. Houhun LI, alt. 890 m/ 19 Jul. 1998"; [label 2, white] genitalia slide No. "ZDD01397"; [label 3, red] "*Roxita / acutispinata* / Li *et* Li / Holotype ♂". Paratypes: 1 ♂, Henan Province, Neixiang, Xiaguan (33°20'N, 111°47'E), alt. 650 m, 10 Jul. 1998, leg. Houhun LI; 1 ♂, Henan Province, Jiyuan, Mt. Wangwu (35°16'N, 112°10'E), alt. 800 m, 28 Jul. 2006, leg. Denghui KUANG and Hui ZHEN.



Figs. 1-5. *Roxita* spp. 1, 3: *R. acutispinata* sp. nov. 1. male, paratype, 3. male genitalia, holotype (gen. slide no. ZDD01397); 2, 4-5: *R. capacunca* sp. nov. 2. male, paratype, 4. male genitalia, holotype (gen. slide no. LWC07318), 5. female genitalia, paratype (gen. slide no. LWC07316).

Description. Adult (Fig. 1): Wingspan 12.0–13.0 mm. Vertex and frons white. Labial palpus porrect, yellowish brown laterally, white medially. Maxillary palpus with basal area pale yellow; apex white, with diverging scales. Antenna dorsally yellowish white, laterally golden, ciliate ventrally. Thorax white. Tegula pale yellow. Forewing ground colour white, mixed with yellowish brown scales; apex golden; termen golden except for apical area dark yellowish brown; basal fascia absent; antemedial fascia golden, broadly arched outward; postmedial fascia white, outwardly curved from just beyond 2/3 of costa to near 1/3 of termen and angled about 80°, thence running to 4/5 of dorsum, with two small teeth near terminal spots; cilia brown, shiny. Hindwing pale yellow; cilia yellowish white. Foreleg yellowish brown on outer side, yellowish white on inner side; mid- and hindlegs yellowish white.

Male genitalia (Fig. 3): Uncus long and slender, about as long as tegumen, slightly enlarged subapically, pointed at apex. Gnathos long and narrow, nearly as long as uncus, rounded apically. Tegumen narrow. Valva relatively broad, costal margin roundly arched, ventral margin nearly straight. Costal region broadly rounded and projecting, distally produced into a long and strongly recurved apical prong, pointed at apex, extending as far as tip of cucullus before recurving. Cucullus rounded apically. Ventral fold with distal 1/3 dentate dorsally, bearing long and thin spinelike prong at about 1/3 and a small triangular prong at about 2/3 respectively. Saccus broad, somewhat triangular, rounded apically. Juxta indistinct. Phallus tubular, straight, with many scobinations distally; vesica without cornutus.

Female: Unknown.

Etymology. The specific name is derived from the Latin prefix *acut-* = sharp and the word *spinata* = thorn, in reference to the costa ending with a long and strong prong.

Remarks. This species resembles *R. adspersella* in male genitalia, but it can be distinguished easily from the latter species by the broadly projecting costal region distally produced into a long apical prong recurving above the tip of cucullus. In *R. eurydyce*, the costal region is narrow and slightly arched, distally produced into a short prong that extends to only about 3/5 of the valva.

***Roxita capacunca* sp. nov.**

Figs. 2, 4-5

Type Material. Holotype ♂: [label 1, white] "Zhejiang Province, Taishun (27°33'N, 119°42'E), Wuyanling / alt. 930 m / 31 Jul. 2005 / leg. Yunli XIAO"; [label 2, white] genitalia slide No. "LWC07318"; [label 3, red] "*Roxita / capacunca* / Li *et* Li / Holotype ♂." Paratypes: 10 ♂♂, 21 ♀♀, same data as holotype except alt. 680-1050 m and dated 28 Jul. – 2 Aug. 2005; 8 ♂♂, 1 ♀, Zhejiang Province, Taishun, Wuyanling, alt. 790 m, 2-3 Aug. 2007, leg. Qing JIN; 2 ♂♂, Hunan Province, Zhangjiajie (29°49'N, 110°26'E), alt. 650 m, 7-11 Aug. 2001, leg. Houhun LI and Xinpu WANG; 1 ♂, Guangxi Zhuangzu Autonomous Region, Huaping (25°39'N, 109°55'E), alt. 1300 m, 1 Aug. 2006, leg.

Weichun LI; 4 ♂♂, Guangxi Zhuangzu Autonomous Region, Rongshui (25° 04'N, 109°13'E), Peixiu Village, alt. 579 m, 13 Jul. 2004, leg. Jiasheng XU; 1 ♂, Guizhou Province, Jiangkou (27°41'N, 108°50'E), Huixiangping, 1700 m, 29 Jul. 2001, leg. Houhun LI and Xinpu WANG.

Description. Adult (Fig. 2): Wingspan 11.0-12.0 mm. Vertex and frons white. Labial palpus slightly upward; basal segment whitish yellow; second segment orange yellow laterally, white medially; third segment dark brown ventrally, white dorsally. Maxillary palpus with basal area golden to yellowish brown; apex white, with diverging scales. Antenna dorsally yellowish white, laterally golden, ciliate ventrally. Thorax white to pale yellow. Tegula pale yellow to yellowish brown. Forewing ground colour white, mixed with yellow and brown scales; apex and termen golden; basal fascia pale yellowish brown, oblique; antemedial fascia white, broad, edged with dark brown scales along both sides, forming sharp outward angle near costa, then running to about 1/3 of dorsum in wide, roundish inward curve; postmedial fascia white to pale yellow, edged with yellowish brown to dark brown scales along both sides, forming sharp outward angle from about 2/3 of costa to near 1/4 of termen, thence running to about 2/3 of dorsum, with narrow tooth near 1/2 and 3/4 of termen; slender silvery gray metallic mark below apex nearly parallel with costa; cilia shiny grayish brown except for apex shiny white basally. Hindwing pale brown to dark brown; cilia pale gray to gray. Abdomen yellowish brown. Legs pale yellow.

Male genitalia (Fig. 4): Uncus broad at base, constricted at about 1/4 from base; distal 2/3 expanded to elongate oval, tapering to a small apical point. Gnathos slender, rounded apically. Tegumen narrow. Valva relatively narrow. Costal region broad, slightly shorter than valva; distally tapering and produced into recurved apical prong. Ventral fold distinctly projecting around medial area, forming a large dorsal process bearing strongly outcurved short spine dorsoproximally and large rounded process dorsalapically. Cucullus evenly slender to rounded apex. Vinculum triangular. Saccus moderate, triangular, rounded apically. Juxta with basal half narrow, distal half broadened, incurved at middle on posterior margin, forming a pair of posterolateral lobes. Phallus tubular, with many scobinations on distal half; vesica without cornutus.

Female genitalia (Fig. 5): Anal papilla strong, weakly fused dorsally, somewhat tapered distally. Posterior apophysis about twice length of anal papilla. Eighth abdominal tergite about 1/2 length of posterior apophysis. Anterior apophysis about 1/2 length of posterior apophysis. Ostium broad and large. Lamella postvaginalis nearly trapezoidal, height about 2/5 length of anterior apophysis, narrower than half width of eighth tergite; lamella antevaginalis broader than eighth tergite, crescent-shaped, caudal margin greatly arched inward. Ductus bursae slender, about twice length of posterior apophysis; ductus seminalis arising from near base of ductus bursae. Corpus bursae oval, obviously longer and wider than eighth tergite; signum inverted U-shaped, serrate on inner margin.

Etymology. The specific name is formed by the Latin prefix *capac-* = broad and the Latin name *uncus*, in reference to the broad uncus.

Remarks. There is slight variation in the male valva. It is longer in the specimen collected in the Guizhou Province than in the specimens collected at other localities.

This species resembles *R. eurydyce* in male genitalia, but it can be distinguished easily by the antemedial fascia of the forewing conspicuously curved medially, and the valval costa produced into a prong that extends to the tip of the cucullus. In *R. eurydyce*, the antemedial fascia of the forewing nearly straight medially, the valval costa produced into a prong that only extends to about 2/3 of the valva.

ACKNOWLEDGEMENTS

We express our cordial thanks to the members of the Lepidopterology Laboratory, College of Life Sciences, Nankai University, for their collecting efforts. The research was supported by the National Nature Science Foundation of China (J0630963).

LITERATURE CITED

Bleszynski, S. 1963. Studies on the Crambinae (Lepidoptera). Part 41. On some tropical Crambidae with descriptions of the new genera and species. Acta zoologica cracoviensia 8: 133-181.

Bleszynski, S. 1965. Crambinae, *In*, H. G. Amsel, H. Reisser, and F. Gregor (Editors), Microlepidoptera Palaearctica 1. Verlag Georg Fromme & Co., Wien. 553 pp.

Caradja, A. 1931. Dritter Beitrag zur Kenntnis der Pyraliden von Kwanhsien und Mokanshan (China). Bulletin de la Section Scientifique de l'Académie Roumaine 14: 203-212.

Chen, T. M., S. M. Song, and D. C. Yuan. 2002. A study on the genus *Roxita* Bleszynski from China, with descriptions of two new species (Lepidoptera: Pyralidae, Crambinae). Acta Entomologica Sinica 45 (1): 109-114.

Gaskin, D. E. 1984. The genus *Roxita* Bleszynski (Lepidoptera, Pyralidae, Crambinae): new species and combinations and a reappraisal of its relationships. Tijdschrift voor Entomologie 127 (2): 17-31.

Inoue, H. 1989. Notes on some species of the Crambinae from Taiwan and Japan, with descriptions of three new species (Lepidoptera: Pyralidae). Akitu 104: 1-8.

Snellen, P. C. T. 1893. Beschrijving en Afbeelding van eenige nieuwe of weinig bekende Crambidae. Tijdschrift voor Entomologie 36: 54-66.

Wileman, A. E. and R. South. 1917. New species of Lepidoptera from Japan and Formosa. The Entomologist, London 50: 145-148.

NEW RECORDS FOR *ACERIA ANTHOCOPTES (*ACARI: ERIOPHYIDAE*)* OCCURRING ON CANADA THISTLE IN COLORADO, NEBRASKA, AND WYOMING, U.S.A.[1]

G. J. Michels Jr.,[2] V. A. Carney,[2] J. Lydon,[3] R. Ochoa,[4] and R. L. Renn[5]

ABSTRACT: Canada thistle [*Cirsium arvense* (L.) Scop.] growing in eastern Colorado, Wyoming and western Nebraska were surveyed for the presence and distribution of *Aceria anthocoptes* (Nal.). Of the 34 sites surveyed in 2004, mites were abundant at 42%, present in lesser numbers at 52%, and not present at 6% of the sites. In 2005, two new sites were added and ten sites sampled in 2004 were revisited. Of these 12 sites, mites were abundant at 17%, present to a lesser extent at 58%, and not present at 25% of the sites. The results demonstrate that Canada thistle growing in this region commonly harbor *A. anthocoptes*. How long *A. anthocoptes* has been present in this region is unknown, however, anecdotal evidence demonstrating a dramatic decline in the population of Canada thistle at one Colorado site from 2000 to 2007 suggests that the mite may have been present since 2002.

KEY WORDS: *Aceria anthocoptes*, Canada thistle, biological control, state records

Canada thistle [*Cirsium arvense* (L.) Scop.], is a perennial composite that is native to southeastern Europe and the eastern Mediterranean. Presently it occurs throughout most temperate regions of the world (Moore 1975; Holm et al., 1997). While the date of its introduction into the United States is unknown, Canada thistle was recognized as a troublesome weed as early as 1795 when Vermont established legislation for its control (Moore 1975). Based on the review of weed lists from the United States and southern Canada, Canada thistle was the most frequently listed noxious weed out of 45 noxious weeds included in the study; demonstrating that it continues to be of concern in the temperate regions of North America (Skinner et al., 2000).

Because of the expense involved in the use of chemical and/or cultural methods for weed control, biological control agents are generally considered the primary option for invasive weed control in natural systems. Several insect enemies of Canada thistle have been developed and/or deployed in an effort to control this invasive weed, such as leaf- and bud-feeding beetles [*Altica carduorum* Guerin-Meneville, *Lema cyanella* (L.), and *Cassida rubiginosa* Muller, Coleoptera: Chrysomelidae], stem-boring beetles (*Ceutorhynchus litura* (F.), Coleoptera: Curcu-

---

[1] Received on February 6, 2008. Accepted on February 25, 2008.

[2] Texas Agricultural Experiment Station, 2301 Experiment Station Road, Bushland, Texas 79012 U.S.A. E-mails: gmichels@tamu.edu, vacarney@ag.tamu.edu, respectively.

[3] Sustainable Agricultural Systems Laboratory, U.S. Department of Agriculture, Agricultural Research Service, Beltsville Agricultural Research Center, Beltsville, Maryland 20705 U.S.A. E-mail: John.Lydon@ars.usda.gov

[4] Systematic Entomology Laboratory, U.S. Department of Agriculture, Agricultural Research Service, Beltsville Agricultural Research Center, Beltsville, MD 20705 U.S.A. E-mail: Ron.Ochoa@ars.usda.gov

[5] Department of the Army, Directorate of Environmental Compliance and Management, Fort Carson, CO 80913 U.S.A. E-mail: Robin.Renn@us.army.mil

Mailed on February 19, 2009

lionidae), seed-feeding beetles (*Rhinocyllus conicus* (F.), Coleoptera: Curculionidae), stem-galling flies (*Urophora* spp., Diptera: Tephritidae), and other insects (Rees 1991; Julien and Griffiths 1998; Campobasso et al., 1999; Gassmann 2005). The release and predation of these insect enemies of Canada thistle has had an effect, but satisfactory control has yet to be obtained (Michels, pers. obs).

Recently, an eriophyid mite, *Aceria anthocoptes* (Nal.), that attacks Canada thistle was reported in the United States (Ochoa et al., 2001). This is the only *Aceria* mite species known to attack Canada thistle (Petanoviæ et al., 1997; Magud et al., 2007) and preliminary results suggest that the mite is host specific (Ochoa et al., 2001). Infestations of *A. anthocoptes* on Canada thistle can result in leaf bronzing, epinasty, and dessication (Rancic et al., 2006). As part of an ongoing program to control noxious weeds on Federal installations in Colorado and Wyoming, consideration has been given to the release of *A. anthocoptes* in natural areas at these installations to further increase the predatory pressure on Canada thistle. Although *A. anthocoptes* is widely distributed in the Mid-Atlantic region and has been reported in the north-central states of Minnesota and North Dakota (Ochoa et al., 2001), it was unknown if the mite was present in Colorado, Wyoming, and Nebraska. The objective of this study was to assess the presence and distribution of *A. anthocoptes* in the Colorado-Wyoming-Nebraska region.

METHODS

Collection and processing of samples. Samples of Canada thistle were collected from a total of 36 different sites located in Colorado, Nebraska, and Wyoming during August of 2004 and 2005 (Table 1, Fig. 1). Samples consisted of the stems, leaves, and flowers from the top half of the above-ground portion of the plants. Upon collection, samples were placed in plastic bags and held over ice during transport to the laboratory; where they were held at 4°C until examined.

Approximately 25 g of plant material was transferred to a 2.5 L flask, 250 ml of water was added, and the contents of the flask were vigorously shaken for 15 s. The water suspension was vacuum filtered through a 0.8 μ Supra Gellman membrane. The suction was removed after all the water passed through the filter but before the membrane dried. A second wash as described above with a fresh membrane immediately followed. The two membranes were then examined under a dissecting microscope for the presence of eriophyid mites. When present, mite specimens were collected, transferred to 70% ethanol, and stored at 4°C. An additional 25 g sample of plant material was processed as above if no mites were observed on the first set of membranes. No attempt was made to obtain an exact count of the mites present on the membranes. However, the relative abundance of the mites was assessed as follows: not present (NP), no mites observed; present (P), mites present but careful and extensive searching of the membrane was required to retrieve mites, and abundant (A), high numbers of the mites were collected in a short period of time, many remained uncollected.

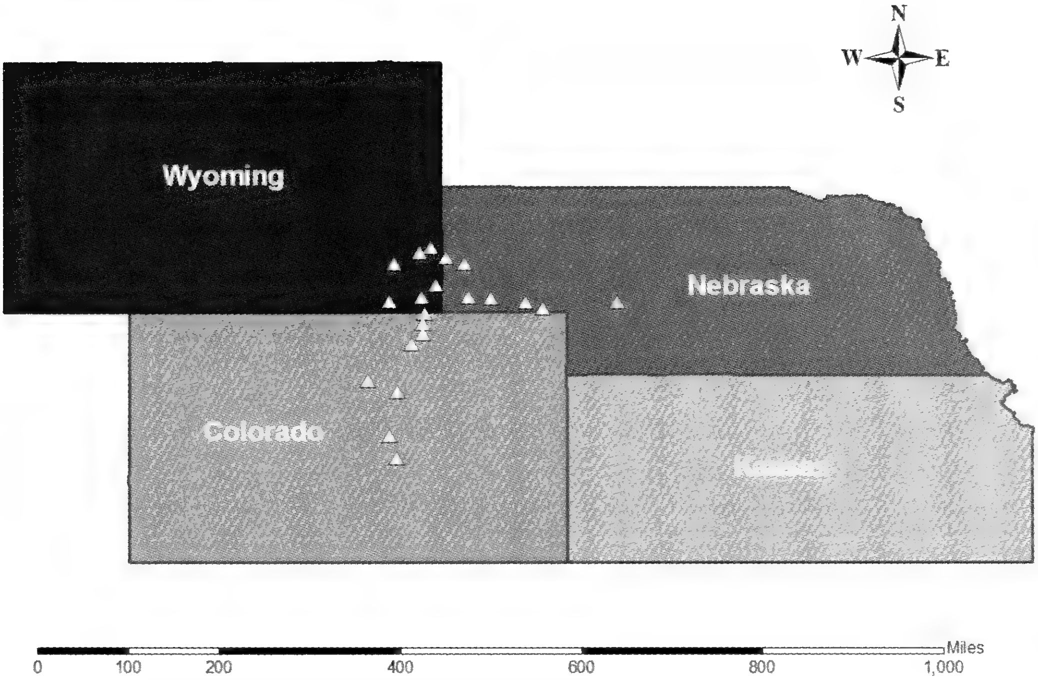


Fig. 1. Map showing sites in Wyoming, Colorado, and Nebraska where Canada thistle (*Cirsium arvense*) plant material was collected.

Canada thistle population density measurements. At one site, designated ARA1 at Ft. Carson, the population density of Canada thistle was monitored from 2000-2007. For each year, the perimeter of the Canada thistle infestation was mapped using either Satlock backpack (2000-2005) or Trimble GeoXT handheld GPS units (2006 and 2007). Once the perimeter was mapped, the area of the infestation was gridded using GPS data collection software, and samples were taken from each grid square by tossing a ½ meter PVC sampling square toward the center of the block. All Canada thistle plants within the sampling square were counted. The number of samples taken in a given year depended on the size of the infestation perimeter, with the grid size remaining constant at 25 m^2.

Microscopic examination of specimens. Mites collected from the Canada thistle samples and stored in 70% EtOH were prepared for microscopic examination as described in Amrine and Mason (1996). The prepared slides were examined under a compound microscope and the identification of the mites was based on standard mite taxonomic keys (Amrine et al., 2003) and specific morphological traits for the species as reported by Petanoviæ et al. (1997).

Table 1. Survey of *Aceria anthocoptes* on Canada thistle (*Cirsium arvense*) growing in Colorado (CO), Wyoming (WY), and Nebraska (NE) in 2004 and 2005. Shaded rows indicate sites that were visited once during both years.

Site no.	State	Location [2]	Year	Latitude			Longitude			Elev.	Mite abundance 2004 [1]			Mite abundance 2005 [1]		
				°	'	"	°	'	"	(m)	NP	P	A	NP	P	A
1	WY	Torrington	2004	42	1	26	104	12	47	1293	x					
2	WY	Torrington	2004	42	1	21	104	12	58	1288		x				
3	WY	Veteran	2004	41	56	36	104	22	56	1303		x				
4	WY	Chugwater	2004	41	46	16	104	47	59	1714		x				
5	WY	Albin	2004	41	25	7	104	7	34	1654		x				
6	WY	Burns	2004	41	13	30	104	20	57	1661			x			
7	WY	Warren Air Force Base	2004	41	9	25	104	52	23	1872		x				
8	WY	Warren Air Force Base, Nature Trail 3	2005	41	9	5	104	52	6	1847						x
9	NE	Stegall	2004	41	52	17	103	57	35	1275		x				
10	NE	Gering	2004	41	45	46	103	40	29	1228		x				
11	NE	Kimball	2004	41	14	9	103	36	37	1438			x			
12	NE	Potter	2004	41	12	33	103	14	39	1338			x			
13	NE	Lodgepole [3]	2004	41	9	20	102	42	6	1192		x				
14	NE	Lodgepole [3]	2004	41	9	20	102	42	6	1192			x			
15	NE	Sutherland	2004	41	8	39	101	13	28	928			x			
16	NE	Chappell	2004	41	3	5	102	24	49	1120			x			
17	CO	Hereford	2004	40	58	25	104	18	39	1651			x			
18	CO	Near Hereford	2004	40	48	5	104	20	5	1540		x				
19	CO	Briggsdale	2004	40	38	37	104	20	6	1493		x				
20	CO	Near Cornish	2004	40	28	44	104	31	19	1443		x				

Site no.	State	Location [2]	Year	Latitude °	Latitude '	Latitude "	Longitude °	Longitude '	Longitude "	Elev. (m)	Mite abundance 2004 [1] NP	Mite abundance 2004 [1] P	Mite abundance 2004 [1] A	Mite abundance 2005 [1] NP	Mite abundance 2005 [1] P	Mite abundance 2005 [1] A
21	CO	Rocky Flats, Lindsey Ranch	2004	39	54	7	105	12	54	1802			x			
21	CO	Rocky Flats, Lindsey Ranch	2005	39	54	7	105	12	54	1802					x	
22	CO	Buckley Air Force Base, Williams Lake	2004	39	42	56	104	45	13	1690			x			
23	CO	Buckley Air Force Base, Runway	2004	39	41	40	104	44	20	1718		x				
24	CO	Buckley Air Force Base, South Aspen Way	2004	39	42	30	104	46	44	1675			x			
25	CO	Air Force Academy Parade Loop	2004	39	1	1	104	52	22	2077			x			
25	CO	Air Force Academy Parade Loop	2005	39	1	1	104	52	22	2077					x	
26	CO	Air Force Academy, Ice Lake 1	2004	38	58	2	104	50	19	1954		x				
26	CO	Air Force Academy, Ice Lake 1	2005	38	58	2	104	50	19	1954				x		
27	CO	Air Force Academy Kettle Lake	2004	38	57	38	104	48	51	1947			x			
27	CO	Air Force Academy Kettle Lake	2005	38	57	38	104	48	51	1947					x	

Site no.	State	Location [2]	Year	Latitude			Longitude			Elev.	Mite abundance 2004 [1]			Mite abundance 2005 [1]		
				°	′	″	°	′	″	(m)	NP	P	A	NP	P	A
28	CO	Air Force Academy Ice Lake 2	2004	38	57	36	104	50	9	1928			x			
28	CO	Air Force Academy Ice Lake 2	2005	38	57	36	104	50	9	1928					x	
29	CO	Ft. Carson, Reservoir	2004	38	43	44	104	48	34	1841		x				
30	CO	Ft. Carson, Reservoir	2005	38	39	47	104	46	53	1745				x		
31	CO	Ft. Carson, ARA1 [3]	2004	38	39	38	104	46	13	1729			x			
31	CO	Ft. Carson, ARA1 [3]	2004	38	39	38	104	46	13	1729		x				
31	CO	Ft. Carson, ARA1	2005	38	39	36	104	46	10	1731				x		
32	CO	Ft. Carson, ARA2 [3]	2004	38	39	20	104	45	51	1713		x				
32	CO	Ft. Carson, ARA2 [3]	2004	38	39	20	104	45	51	1713		x				
32	CO	Ft. Carson, ARA2	2005	38	39	35	104	45	53	1711						x
33	CO	Ft. Carson, Hwy 115	2004	38	38	43	104	51	42	2002		x				
33	CO	Ft. Carson, Hwy 115	2005	38	38	43	104	51	42	2002					x	
34	CO	Ft. Carson, Duckpond	2004	38	35	48	104	51	51	1877	x					
34	CO	Ft. Carson, Duckpond	2005	38	35	48	104	51	51	1877					x	
Total											2	18	14	3	7	2
Percentage for year											6	52	42	25	58	17

[1] NP = mites not present; P = mites present but not abundant, significant searching of the membrane required to retrieve mites; A = mites abundant, high numbers of mites were collected in a short period of time, many remained uncollected.

[2] Warren Air Force Base, Cheyenne, WY; Rocky Flats National Wildlife Refuge - Northwest of Golden, CO; Buckley Force Air Base - Southeast of Aurora, CO; Air Force Academy - North of Colorado Springs, CO; Ft. Carson Military Reservation - Southern part of Colorado Springs, CO.

[3] Sites with the same name and GPS reference point were taken at different locations within the site but were not sufficiently separated to generate unique GPS locations.

RESULTS

Most plant samples collected from populations of Canada thistle located at 34 different sites in three different north-central states during 2004 and 2005 harbored mites and insects of various species. The eriophyid mites collected from the Canada thistle specimens were determined to be of the vagrant type as there were no gall formations present on any of the specimens examined. All eriophyid mites present on the plant tissue exhibited vermiform bodies with posterior opisthosoma annuli, continuous and subequal dorsoventrally (Fig. 2A). The adult females, varying from 130 – 190 µm, had a prodorsal shield with a median line that was complete, uninterrupted and usually straight; two admedian lines that were complete, uninterrupted and slightly curved at the posterior edge; and two submedian lines, one to each lateral side curved close to the bases of the dorsal tubercle of the scapular setae (Fig. 2B). The genital coverflap was ornamented with one rank of lineate ribbing (Fig. 2C). All the above characteristics are consistent with those of *A. anthocoptes* (Ochoa et al., 2001; Amrine et al., 2003; Rancic et al., 2006; Magud et al., 2007).

This mite species was found at 94% of the 34 Canada thistle populations sampled in 2004; it was abundant at 42% of the sites, present in low numbers at 52% of the sites, and not present at 6% of the sites (Table 1). Mite populations declined at 70% of the sites resurveyed in 2005. Of the two new sites surveyed in 2005, *A. anthocoptes* was abundant at one and not present at the other (Table 1). It should be noted that these were one-time samples for the entire year, and although they do give an indication of mite abundance, a thorough sampling of each site over the course of the growing season may have yielded different mite abundance results.

The Canada thistle population located at Ft. Carson, ARA 1 was monitored from 2000 to 2007. The average Canada thistle densities were 14, 13, 5, 1, 3, 4, 2, and 0 plants m^{-2}, respectively.

DISCUSSION

The surveys conducted in 2004 and 2005 confirmed the presence of *A. anthocoptes* in Colorado, Nebraska and Wyoming. Based on the high frequency of occurrence in Canada thistle populations reported here and in a previous survey conducted in the mid-Atlantic region (Ochoa et al., 2001), it appears that *A. anthocoptes* is widely distributed across the U.S. Whether it was introduced into the U.S. from Canada into the west and carried across the continent by the prevailing winds or inadvertently distributed from the east to the west via contaminated feed stock or movement of vehicles and/or people remains unknown.

Interestingly, earlier observations (2002) of plants at this site by one of the authors (Michels, unpublished) revealed damage similar to what was later associated with infestations of *A. anthocoptes* (i.e., leaf bronzing, epinasty, dessication and stunting). As no other biocontrol agent has become established in significant numbers at this site, the general decline over the years and ultimate disappearance of Canada thistle at this site may indicate that *A. anthocoptes* may have been present in Colorado earlier than 2004.

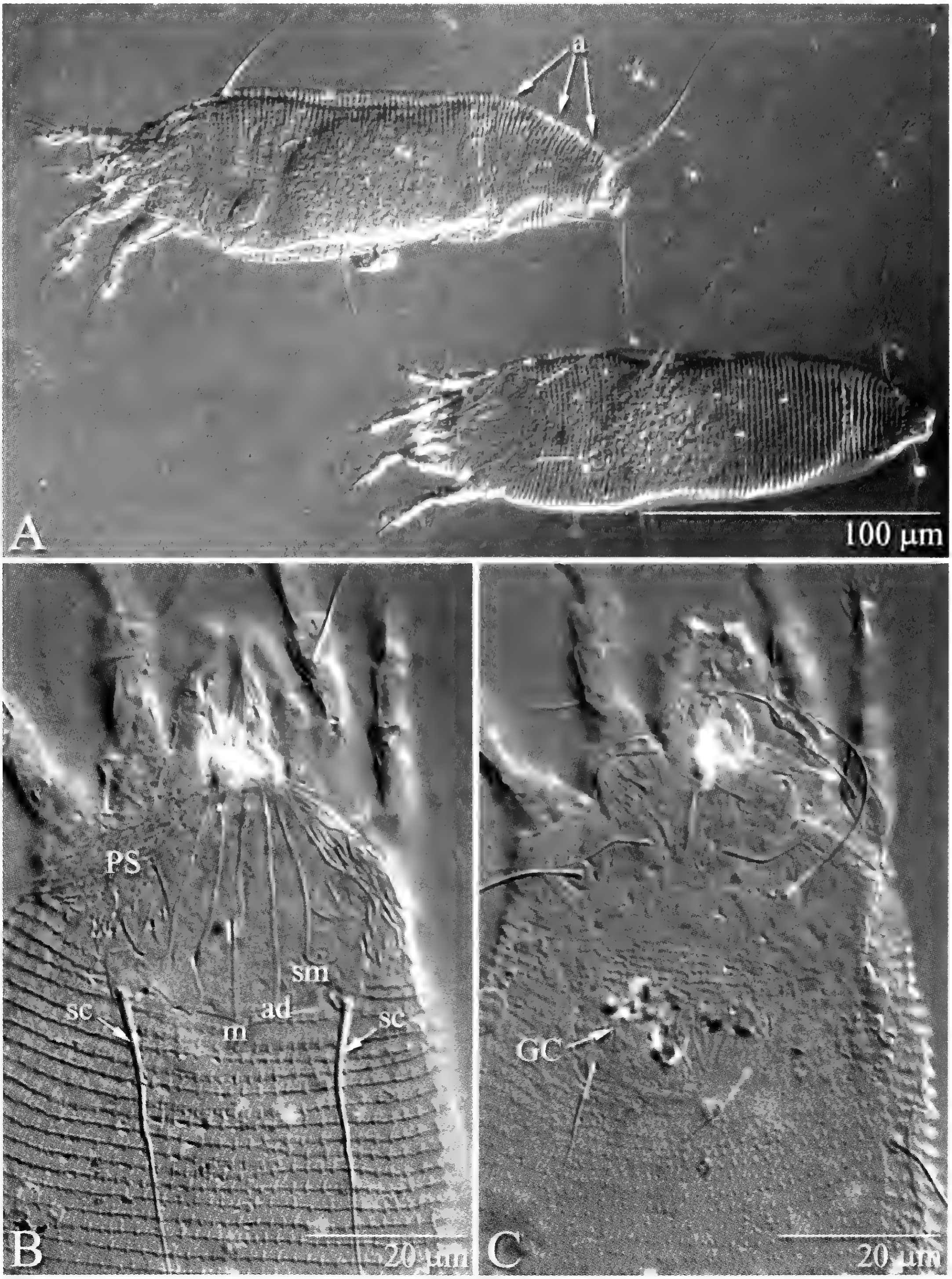


Fig. 2. Microphotograph of *Aceria anthocoptes* females displaying dorsal, ventral, and lateral views: A. general view of dorsal-ventral and lateral sides; B. view of prodorsal shield; and C. view of genital region. a = annuli; ps = prodorsal shield; m = median; ad = admedian; sm = submedian; sc = scapular setae; gc = genital coverflap.

The benefits of using *A. anthocoptes* in the biological control of Canada thistle have yet to be determined. Working within the geographical areas in Colorado where the mite has now been documented to be present, studies are underway to determine the impact of the mite on previously uninfested Canada thistle populations. In addition, studies by our group and others (Richard W. Hansen, USDA-APHIS-PPQ, Ft. Collins, CO, pers. comm.) are being conducted to determine the genetic relationship of *A. anthocoptes* to eriophyid mites found on closely related *Cirsium* species.

ACKNOWLEDGMENTS

Research reported in this paper was supported in part by a grant from the U.S. Department of Defense through the U.S. Fish and Wildlife Service (Agreement 601814J251). The authors thank Bruce Rosenlund, U.S. Fish and Wildlife Service, Project Leader, CO FWAO; Tom Warren, Director, Directorate of Environmental Compliance and Management at Ft. Carson; Dr. Brian Mihlbachler, Natural Resources Manager, U.S. Air Force Academy; Floyd Hatch, Natural and Cultural Resources Coordinator, Buckley Air Force Base; Cathy Pesenti, Environmental Management Flight, F. E. Warren Air Force Base; and Amy Thornburg, U.S. Fish and Wildlife Service, Rocky Flats National Wildlife Refuge site for their continued support and assistance in the noxious weed biological control implementation program.

LITERATURE CITED

Amrine J. W. and D. C. M. Manson. 1996. Preparation, mounting and descriptive study of eriophyid mites. pp. 383-396. *In*, E. E. Lindquist, M. W. Sabelis, and J. Bruin (Editors). Eriophyoid mites: Their biology, natural enemies and control. Volume 6. World Crop Pests. Elsevier Science BV. Amsterdam, The Netherlands. 822 pp.

Amrine, J. W. Jr., T. A. H. Stasny, and C. H. W. Flechtmann (Editors). 2003. Revised keys to world genera of Eriophyoidea (Acari: Prostigmata). Indira Publishing House. West Bloomfield, Michigan, U.S.A. 244 pp.

Campobasso, G., E. Colonel, L. Knutson, G. Terragitti, and M. Cristofaro. 1999. Wild plants and their associated insects in the Palearctic Region, primarily Europe and the Middle East. U.S. Department of Agriculture, Agricultural Research Service No. ARS-147. Springfield, Virginia, U.S.A. 243 pp.

Gassmann, A. 2005. Classification of thistle species and potential for biological control of *Cirsium arvense* in New Zealand. Annual Report. CABI Bioscience Switzerland Centre. 25 pp.

Holm, L., J. Doll, E. Holm, J. Pancho, and L. Herberger. 1997. World Weeds, Natural Histories and Distribution. J. Wiley & Sons, Inc. New York, NY, U.S.A. 1129 pp.

Julien, M. H. and M. W. Griffiths. 1998. Biological Control of Weeds: A World Catalogue of Agents and their Target Weeds. 4th Edition. CABI Publishing. Oxon, England, UK. 223 pp.

Magud, B. D., Z. L. Stanisavljević, and R. U. Petanović. 2007. Morphological variation in different populations of *Aceria anthocoptes* (Acari: Eriophyoidea) associated with the Canada thistle, *Cirsium arvense*, in Serbia. Experimental and Applied Acarology 42:173-183.

Moore, R. J. 1975. The biology of Canadian weeds. 13. *Cirsium arvense* (L.) Scop. Canadian Journal of Plant Sciences 55:1033-1048.

Ochoa, R., E. F. Erbe, W. P. Wergin, C. Frye, and J. Lydon. 2001. The presence of *Aceria anthocoptes* (Nalepa) (Acari: Eriophyidae) on *Cirsium* species in the United States. International Journal of Acarology 27:179-187.

Petanović, R., J. Boczek, and B. Stojniæ. 1997. Taxonomy and bioecology of eriophyids (Acari: Eriophyoidea) associated with Canada thistle, *Cirsium arvense* (L.) Scop. Acarologia 38:181-191.

Rancic, D., B. Stevanovic, R. Petanoviæ, B. Magud, I. Tosevski, and A. Gassmann. 2006. Anatomical injury induced by the eriophyid mite *Aceria anthocoptes* on the leaves of *Cirsium arvense.* Experimental and Applied Acarology 38:243-253.

Rees, N. E. 1991. Biological control of thistles. pp. 264-273. *In*, L. F. James, J. O. Evans, M. H. Ralphs, and R. D. Child (Editors). Noxious Range Weeds. Westview Press, Inc. Boulder, Colorado, U.S.A. 466 pp.

Skinner, K., L. Smith, and P. Price. 2000. Using noxious weed lists to prioritize targets for developing weed management strategies. Weed Science 48:640-644.

A NEW CRETACEOUS MAYFLY FROM BURMESE AMBER (EPHEMEROPTERA: AUSTRALIPHEMERIDAE)[1]

W. P. McCafferty[2] and Jorge A. Santiago-Blay[3]

ABSTRACT: The new genus and species, *Nanophemera myanmarensis* McCafferty and Santiago-Blay, is described from an adult mayfly of the extinct family Australiphemeridae imbedded in Burmese amber, probably of Upper Cretaceous age. *Nanophemera* is the fifth genus known in the Australiphemeridae (a Pangaean, Cretaceous family), which is hypothesized to represent a primitive group of small-sized, tusked, burrowing mayflies (Scapphodonta), possibly closely related to the extant family Potamanthidae. *Nanophemera* is among the smallest known burrowing mayflies at slightly over four millimeters in length, and it differs from related genera by details of its cubital and anal venation systems in the forewings. The newly described fossil is the second mayfly discovered from Burmese amber.

KEY WORDS: Ephemeroptera, Australiphemeridae, *Nanophemera*, fossil, Burmese amber, Cretaceous, new genus and species

The family Australiphemeridae was erected by McCafferty (1991) for the fossil genera *Australiphemera* McCafferty and *Microphemera* McCafferty from Lower Cretaceous [Santana Group, Crato Member or Formation, circa 108-92 Ma; late Aptian to Cenomanian (Martill 1993, Rasnitsyn and Zherikhin 2002) Brazilian shale impressions (McCafferty 1990)]. McCafferty (1997a) placed the genus *Palaeoanthus* Kluge from Upper Taimyr Peninsula (Siberian, age data controversial, exact location of deposits within Upper Cretaceous unclear; Eskov 2002) amber (Kluge 1993) in this family and Sinitshenkova (2000a) included the genus *Borephemera* Sinitshenkova from Upper Cretaceous New Jersey amber (Sinitshenkova 2000a) in the Australiphemeridae. Thus, the family has been known as a strictly extinct, broadly distributed group from the Cretaceous. The family is known only from alate mayflies, but based on wing venation, it has a basal phyletic position within the ephemeropteran suborder Furcatergalia (infraorder Scapphodonta - the tusked burrowing mayflies, McCafferty 2004) and may be most closely related to the extant family Potamanthidae. The family Australiphemeridae includes mayflies with a relatively small body size for Scapphodonta, and in the forewings a somewhat weakened MP_2 basal arch, and an A_1 with no attaching veinlets distally and none or only one basally.

We have recently discovered and herein describe an additional new genus of Australiphemeridae represented by an adult individual fossilized in Cretaceous Burmese amber. Sinitshenkova (2000b) considered the age of another Burmese mayfly fossil specimen as Upper Cretaceous. Age range estimates for Burmese amber have varied (Eskov 2002) from early Upper Cretaceous (Grimaldi et al.,

---

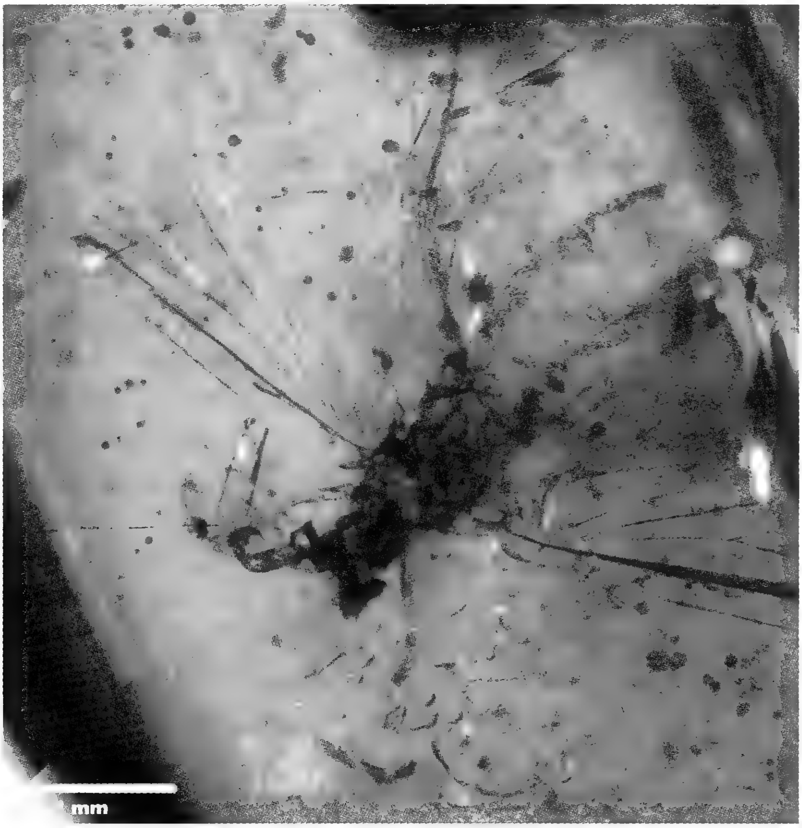
[1] Received on January 31, 2008. Accepted on March 11, 2008

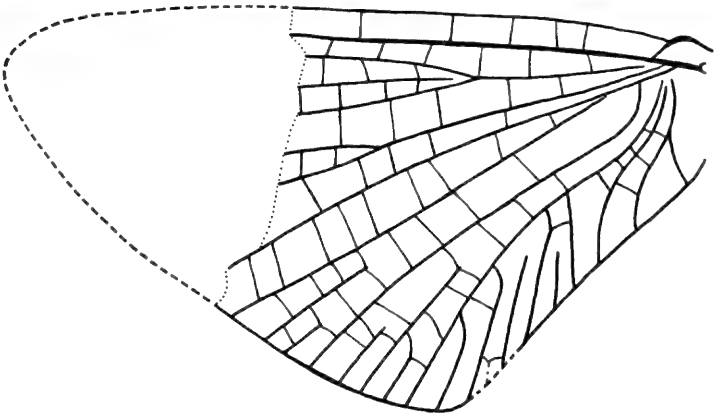
[2] Department of Entomology, Purdue University, West Lafayette, Indiana 47907 U.S.A. E-mail: mccaffer@purdue.edu. Corresponding Author.

[3] Washington, District of Columbia U.S.A. E-mail: blayjorge@gmail.com

Mailed on February 19, 2009

2002, Zherikhin and Ross 2000; Cenomanian, approximately 90-100Ma) to late Lower Cretaceous (Cruickshank and Ko 2003, Ross and York 2004, Rasnitsyn to Santiago-Blay, pers. comm. March 2008; Upper Albian, approximately 100 Ma). Among a rather extensive arthropod fauna that has been found from Burmese amber (Rasnitsyn and Ross 2000), only one mayfly had been known, and it was described as a new genus of the extant mayfly family Prosopistomatidae by Sinitshenkova (2000b). Prosopistomatidae are members of the suborder Carapacea (McCafferty 1997b, McCafferty and Wang 2000, Sun et al., 2006), along with Baetiscidae (extant and Tertiary) and the extinct family Cretomitarcyidae.





Figures 1-2. 1. *Nanophemera myanmarensis* fossil habitus. R_1 evidently folded underneath Sc in both forewings. 2. *Nanophemera myanmarensis* forewing. R_1 evidently folded underneath Sc in both forewings.

Nanophemera, NEW GENUS

Diagnosis. Adult, sex unknown. Very small sized for mayflies with typical scapphodont wing venation, i.e., with forewing with MP_2 and CuA with arched base (Figs. 1 and 2). Forewing with MA forked near mid-length of wing; MP_2 basal arch moderate; CuA with intercalaries not sigmoidal, with some intercalary veins attached and some not attached, with some crossveins present between some intercalaries, and with basal attached intercalary not forked; CuA and CuP attached basally by crossveins; A_1 with one attached marginal veinlet in basal half, and without any other veinlets; additional A veins not discernible. Mesonotal sutures, hindwing, and numerous other thoracic and abdominal structures not decipherable. Terminalia not known.

Type Species. *Nanophemera myanmarensis*, n. sp.

Nanophemera myanmarensis, NEW SPECIES

Description. Adult, sex indeterminable. Body length 4.26 mm; forewing length 4.5 mm; foreleg length ca. 2.6 mm; head width including compound eyes 0.55 mm, not including eyes 0.32 mm. Compound eyes well separated on head; length of compound eye greater than length of head; compound eyes degraded laterally in fossil, with width unknown. Details of legs undecipherable. Forewing with some attached marginal intercalaries; CuA and CuP attached by four basal crossveins; six elongate cubital intercalaries present, with first not forked, with first, third, fifth, and sixth attaching CuA with hindmargin, with second and fourth not attached to CuA, with first and third attached to each other basally by crossvein, with fifth and sixth arched basally from CuA, and with fifth attached to CuA sub-basally by crossvein; CuP and A_1 attached by three crossveins; anal system represented only by A_1 and one crossvein attaching it to hindmargin. Hindwing well developed, with MA_2 not detached basally, and with numerous marginal veinlets. Terminalia not present.

Type Data. Adult, sex unknown, in Burmese amber; Tanai Village (on Ledo Road, 105 km NW of Myitkyna), Hukawng Valley, Kachin, Myanmar (Burma), coll. Leeward Capital Corporation, 2003. Probably Upper Cretaceous. Deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana, U.S.A.

DISCUSSION

Nanophemera body size (ca. 4.25 mm) is similar to *Palaeoanthus minutus* Kluge (4.0 mm), and somewhat similar to *Borephemera* (slightly more than 5.0 mm). Other members of the family Australiphemeridae range from 8.5 to ca. 11.0 mm (still small compared to extant burrowers). The cubital intercalary system of the forewings of *Nanophemera* is more complex than that of any other genera of Australiphemeridae, in that some crossvenation is present. Also, CuA is attached basally to CuP by a series of crossveins in *Nanophemera*. Such crossveins are not apparent in *Borephemera* and *Microphemera*, but are most similar to those of

Australiphemera. The first cubital intercalary is forked in *Australiphemera*, *Microphemera*, and *Palaeoanthus*, but is not forked in *Nanophemera* and *Borephemera*. All cubital intercalaries are attached between the CuA and the hindmargin of the wing in *Australiphemera* and *Microphemera* (the geologically older genera), whereas at least some are unattached to CuA in the other genera. The MP_2 arch is also more weakly arched in these older genera (Sinitshenkova 2000a). A_1 is not attached to the hindmargin by a crossvein in *Australiphemera*, *Borephemera*, and *Palaeoanthus*; however, there is one such crossvein in *Nanophemera* and *Microphemera*. There is a distinct difference in the A_1 attaching crossvein in the latter two genera, however, in that the crossvein in *Microphemera* is very slightly arched toward the wing base, and the crossvein in *Nanophemera* is very slightly arched toward the outer part of the wing.

Because there are no larvae known in this family, it remains a presumption that the Australiphemeridae are indeed scapphodont mayflies. Although there is no evidence from the alate stages to suggest they are not scapphodonts, there remains the slight possibility that the family is a pannote group having retained relative primitive wing venation that would have been present in the most recent common ancestor of Pannnota and Scapphodonta (as does the most phyletically basal family of pannote mayflies, the Neoephemeridae) but not yet having evolved the tusked burrowing larvae that apomorphically define the Scapphondonta (see McCafferty and Wang 2000). If the larvae of Australiphemeridae prove to be a tusked burrowing mayfly (probably reminiscent of Potamanthidae), then they are clearly primitive scapphodonts. If they prove not to possess tusks, but have basally fused forewing pads and recumbent abdominal gills (probably reminiscent of Neoephemeridae) then they would be primitive pannotes. If the larvae are without any of the larval apomorphies mentioned, then they likely represent a group similar to the most recent common ancestor of the Scapphodonta and Pannota.

ACKNOWLEDGMENTS

We thank Arwin Provonsha (Purdue University) for rendering the wing drawing. Scott Whitaker (Electron Microscope Laboratory, National Museum of Natural History, Smithsonian Institution, Washington, DC) helped us with imaging.

LITERATURE CITED

Cruickshank, R. D. and K. Ko. 2003. Geology of an amber locality in the Hukawng Valley, northern Myanmar. Journal of Asian Earth Sciences 21: 441-445.

Eskov. K. Yu. 2002. pp. 444-446. 4.2. Fossil Ressins. *In,* History of Insects. A. P. Rasnitsyn and D. L. Quicke (Editors). 4. Appendix: Alphabetic list of selected insect fossil sites. Kluver Academic Publishers. Dordrecht, The Netherlands. 517 pp.

Grimaldi, D. A., M. S. Engel, and P. C. Nascimbene. 2002. Fossiliferous Cretaceous amber from Myanmar (Burma): its rediscovery, biotic diversity, and paleontological significance. American Museum Novitates 3361, 1-71.

Kluge, N. 1993. New data on mayflies (Ephemeroptera) from Mesozoic and Cenozoic resins. Paleontological Journal 27: 35-49.

Martill, D. M. 1993. Fossils of the Santana and Crato Formations, Brazil. Field Guide to Fossils 5. The Palaeontological Association. London, England, United Kingdom. 159 pp.

McCafferty, W. P. 1990. Ephemeroptera. pp. 20-50. *In*, D. Grimaldi (Editor). Insects from the Santana Formation, Lower Cretaceous, of Brazil. Bulletin of the American Museum of Natural History 195: 1-191.

McCafferty, W. P. 1991. Toward a phylogenetic classification of the Ephemeroptera (Insecta): a commentary on systematics. Annals of the Entomological Society of America 84: 343-360.

McCafferty, W. P. 1997a. Discovery and analysis of the oldest mayflies (Insecta, Ephemeroptera) known from amber. Bulletin de la Sociéte Histoire Naturelle, Tolouse 133: 77-82.

McCafferty, W. P. 1997b. Ephemeroptera. pp. 89-117. *In*, R. Poole and P. Gentili (Editor). Nomina Insecta Nearctica, a checklist of the insects of North America. Volume 4: Non-holometabolous Orders. Entomological Information Services. Rockville, Maryland, U.S.A. 731 pp.

McCafferty, W. P. 2004. Higher classification of the burrowing mayflies (Ephemeroptera: Scapphodonta). Entomological News 115: 84-92.

McCafferty, W. P. and T. Q. Wang. 2000. Phylogenetics of the major lineages of pannote mayflies (Ephemeroptera: Pannota). Transactions of the American Entomological Society 126: 9-101.

Rasnitsyn, A. P. and A. J. Ross. 2000. A preliminary list of arthropod families present in the Burmese amber collection at the Natural History Museum, London. Bulletin of the Natural History Museum of London (Geology) 56: 21-24.

Rasnitsyn, A. P. and V. V. Zherikhin. 2002. pp. 437-444. 4.1. Impression Fossils. *In*, History of Insects. A. P. Rasnitsyn and D. L. Quicke (Editors). 4. Appendix: Alphabetic list of selected insect fossil sites. Kluver Academic Publishers. Dordrecht, The Netherlands. 517 pp.

Ross, A. J. and P. V. York. 2004. The Lower Cretaceous (Albian) arthropod fauna of Burmese amber, Myanmar: Forward. Journal of Systematic Palaeontology 2 (2): 95-100.

Sinitshenkova, N. D. 2000a. New Jersey amber mayflies: the first North American Mesozoic members of the order (Insecta; Ephemeroptera). pp. 111-125. *In*, D. Grimaldi (Editor). Studies on fossils in amber, with particular reference to the Cretaceous of New Jersey. Backhuys. Leiden, The Netherlands. 498 pp.

Sinitshenkova, N. D. 2000b. The first fossil prosopistomatid mayfly from Burmese amber (Ephemeroptera: Prosopistomatidae). Bulletin of the Natural History Museum of London (Geology) 56: 25-28.

Sun, L., A. Sabo, M. D. Meyer, R. P. Randolph, L. M. Jacobus, W. P. McCafferty, and V. R. Ferris. 2006. Tests of current hypotheses of mayfly (Ephemeroptera) phylogeny using molecular (18s rDNA) data. Annals of the Entomological Society of America 99: 241-252.

Zherikhin, V. V. and A. J. Ross. 2000. A review of the history, geology and age of Burmese amber (Burmite). Bulletin of the Natural History Museum of London (Geology) 56: 3-10.

FIRST DISCOVERY OF BITTACIDAE (MECOPTERA) IN HAINAN ISLAND, CHINA, WITH DESCRIPTION OF A NEW SPECIES[1]

Jiang-li Tan[2] and Bao-zhen Hua[2]

ABSTRACT: *Bittacus hainanicus,* sp. nov., the first hangingfly species discovered from Hainan Island, south China, is described as new to science. Its wing venations and genitaliae are also illustrated.

KEY WORDS: Mecoptera, Bittacidae, *Bittacus*, Hainan Island, China

Bittacus Latreille, 1805, the largest and cosmopolitan genus in the family Bittacidae, is the only hangingfly genus distributed in China. To date, 26 species of *Bittacus* have been reported from China (Cheng, 1957; Penny and Byers, 1979; Hua and Chou, 1998; Huang and Hua, 2005; Cai et al., 2006; Hua and Tan, 2007). No species, however, has been reported from the tropical Hainan Island, which is the second largest island in China and located in the South China Sea. During a recent entomological expedition in Hainan Island, four specimens of hanging-flies (Bittacidae) were collected and found to be a new species. It is also the first Bittacidae discovered from Hainan Island.

Bittacus hainanicus Tan et Hua, NEW SPECIES

(Figures 1-10)

Diagnosis. The new species is very peculiar for its complexity of genital structure, hard to find close relatives among its congeners. On wing patterns it slightly resembles *Bittacus flavidus* Huang et Hua, 2005, from Shaanxi, but can be separated from the latter by one pterostigmal cross-vein (Pcv). As for the male epiandrial appendages, it somewhat resembles *Bittacus appendiculatus* Esben-Petersen, 1927, from Yunnan, China, but can be differentiated by two ventral processes.

Description (based on one male and three female specimens, preserved in 70% alcohol). *Head:* Vertex, occiput and frons amber-brown; rostrum and maxillary palps dark brown; eyes black; ocellar triangle black. Antenna brown with 19 flagellomeres hairy.

Thorax: Pronotum unevenly dark brown, without distinct setae; anterior two-third of mesonotum nearly black with a pale brown median streak, the remaining part and metanotum yellowish brown. Pleura unevenly darkish to yellowish brown. A few short black setae present on the yellowish brown femora, tibiae and tarsi; femur blackish brown apically.

---

[1] Received on December 12, 2007. Accepted on February 5, 2008.

[2] Key Laboratory of Plant Protection Resources and Pest Management. Ministry of Education; Entomological Museum, Northwest A & F University, Yangling, Shaanxi 712100 China. E-mails: huabzh@nwsuaf.edu.cn (corresponding author), tanjiangli@sina.com, respectively.

Mailed on February 19, 2009

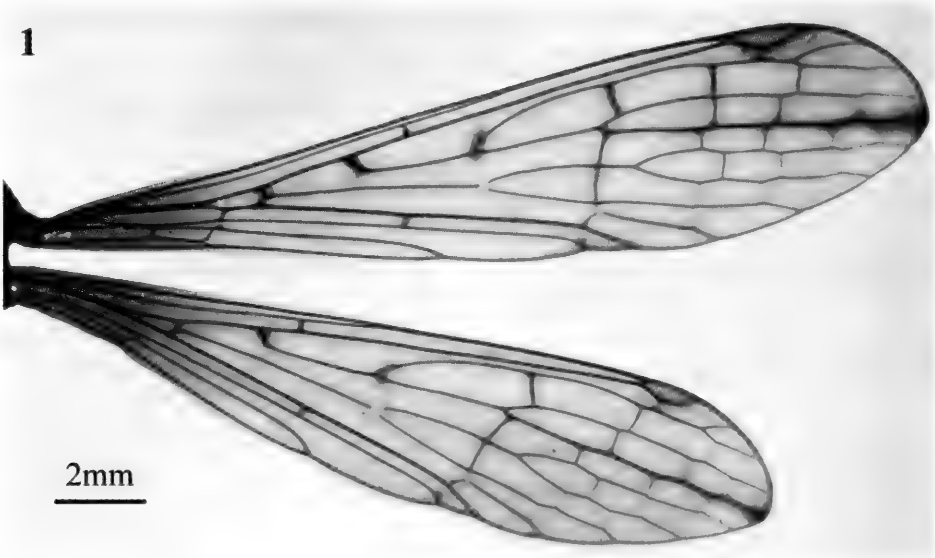
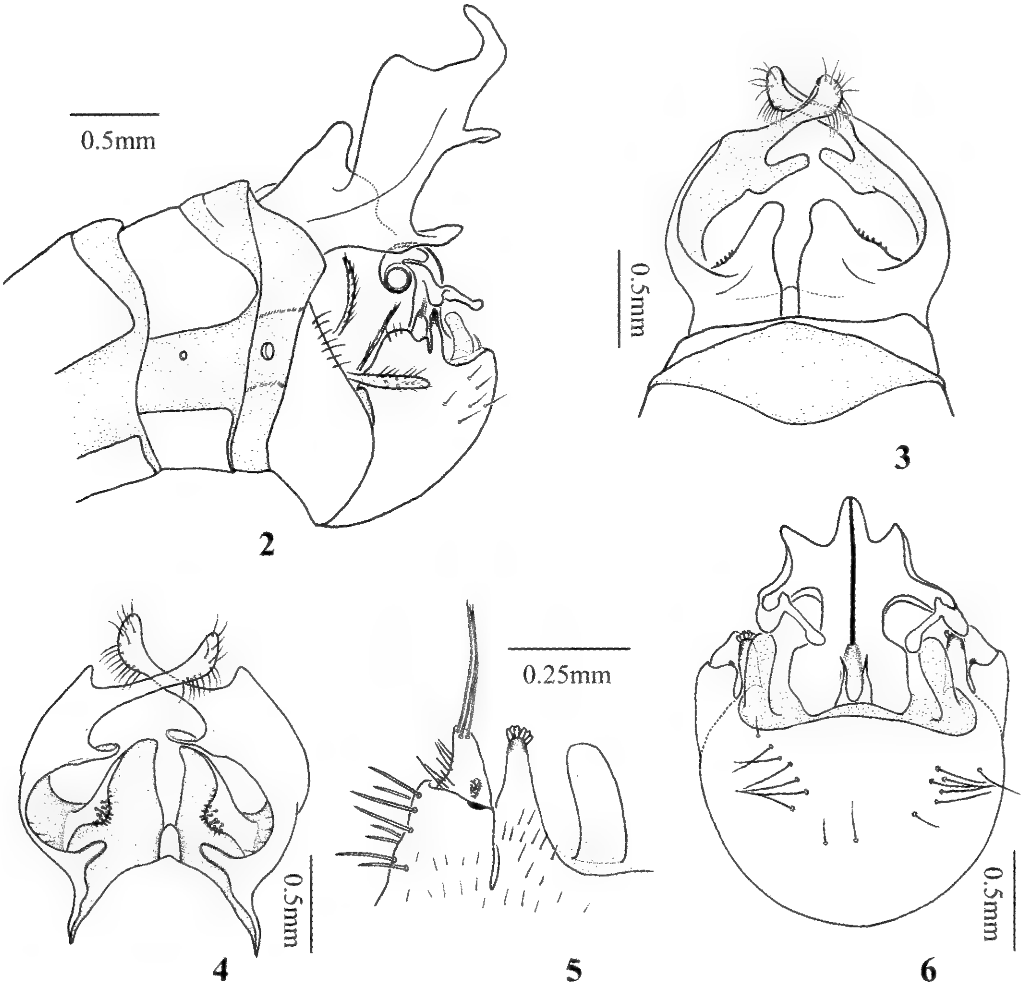


Fig. 1. Wings of *Bittacus hainanicus* Hua et Tan, sp. n.

Wings (Fig. 1). Forewing 20 mm long, 4.0 mm wide. Wings membrane hyaline with yellow tinge. Pterostigma prominent with a pterostigmal cross-vein (Pcv); two pale brown nygmata each present on cells R_{4+5} and $1R_5$; a large thyridium at first fork of media (FM), and a small thyridium at base of M_4. Three distinct dark brown clouding flecks at origin of radial sector (ORs), first fork of radial sector (FRs), and origin of media from cubitus (OM), respectively; a noticeable cuneiform clouding along the whole length of vein R_5, increasingly widened toward apex. Vein 1A terminating a little before FM; cubical cross-vein (Cuv) before FM; no anal cross-vein.

Hindwing 17 mm long, 3.5 mm wide; similar to forewings.

Abdomen of male: General coloration light brown, darkened at segmental junctions by strong sclerotization of acrotergites. The posterior margins of terga 7 and 8 deeply concaved in V-shaped; intersegmental membrane extending and covering the posterior mid-margin of tergum 8. Epiandrial appendages (tergum 9) highly modified; complicated by a subtriangular main lobe, whose posterior margin and an oval ventral process bearing numerous small black spines, and a lateral complex prolongation, whose basal two-third broad with two large ventral processes, while the apical one-third turning slender, extending caudo-dorsad with long setae along its apical ventral margin and on its tip (Figs. 2-4). Tergum 10 very narrow, subquadrangle in shape, hidden in the cavity surrounded by tergum 9 and genitalia, invisible from outside. Upper and lower branches of proctiger setiferous, short, and rather slender; not protruding between bases of epiandrial appendages. Cerci short, club-shaped. Gonocoxite brown, shorter than epiandrial appendage; deeply inclined dorsocephalad; middle of its posterior margin round; two processes each terminating with a cluster of small tubercles near the base of gonostyle. A small translucent linguiform membranous sheet borne on the membranous area between base of aedeagus and distal margin of gonocoxite, just next to each process. Gonostyle small, broad and thick basally bearing sparse short brown hairs; gradually tapering towards apex, with three long yellow setae (Fig. 5). The base of aedeagus broad, with two small processes on posterior margin; aedeagal lobes broad; near apex a long arm extending latero-caudad; turning slender at its midway. Penisfilum coiled into a rather small ring (Fig. 6).



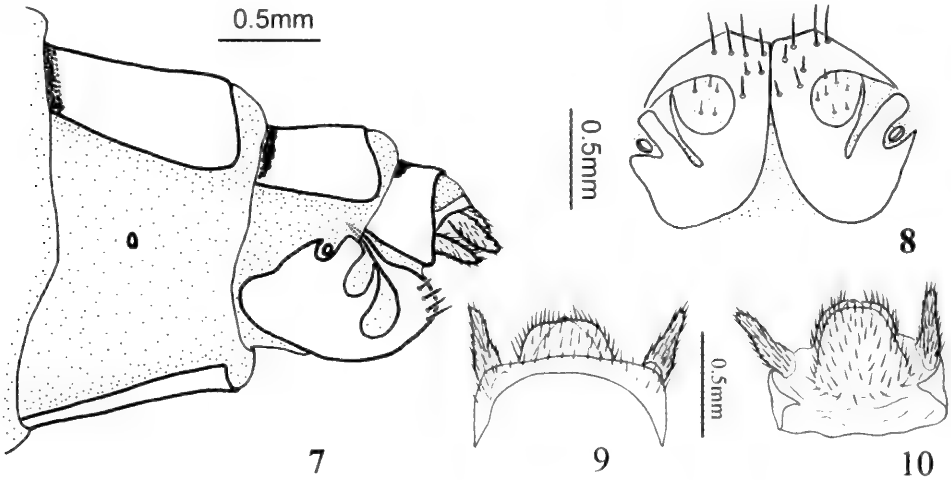
Figs. 2-6. Male of *Bittacus hainanicus* sp.n. 2, terminalia, lateral view; 3, epiandrial appendages, dorsal view; 4, same, ventral view; 5, gonostyle and apical part of gonocoxite, showing the process of gonocoxite and membranous sheet; 6, genitalia, ventrocaudal view.

Abdomen of female (Figs 7-10): Tergum 9 with a broad but short black trace of antecosta. Subgenitale dark brown, proximally oval in lateral view, with the dorsal margin deeply concave; the two halves separated to the very apex by a very narrow suture; a number of black stiff setae present. Tergum 10 brown, narrow, extending a little ventrad. Supraanale, subanale and cerci pale brown; supraanale narrow, with posterior margin roughly truncate; subanale longer than supraanale; Cerci of moderate length.

Etymology. The new species is named for its type locality, Hainan Island, China.

Type Data. China: Hainan Island: Holotype ♂, Bawangling (660 m), 109° 03'E, 19°10'N, 18.v.2007, coll. Li Yan-kai. Paratypes: 1♀, same data as holotype;

2♀♀, Wuzhishan (680 m), 109°38'E, 18°52'N, 9.v.2007, coll. Li Yan-kai and Zai Qing. Preserved in the Entomological Museum, Northwest A & F University.



Figs 7-10. Female of *Bittacus hainanicus* sp. n. **7**, end of abdomen, lateral view; 8, subgenitale, ventral view; **9**, segment X, dorsal view; **10**, same, ventral view.

Remarks. This species is unique by its gonocoxites highly inclined dorsocephalad, with two processes near each base of gonostyle, and two additional membranous sheets near the base of aedeagus. Proctiger not protruding between bases of epiandrial appendages was first report among all its Chinese congeners. But the other characters fit *Bittacus* very well, especially the wing venations.

ACKNOWLEDGEMENTS

This research was financially supported in part by the National Natural Science Foundation of China (no. 30370179) and Biological Resource Expedition (Insect Group) to Hainan Island and Xisha Islets, Ministry of Science and Technology.

LITERATURE CITED

Cai, L. J., P. Y. Huang, and B. Z. Hua. 2006. Two new Chinese *Bittacus* Latreille (Mecoptera: Bittacidae) from Michangshan Mountains. Entomotaxanomia 28(2): 127-130.

Cheng, F. Y. 1957. Revision of the Chinese Mecoptera. Bulletin of the Museum of Comparative Zoology 116: 1-118.

Esben-Petersen, P. 1927. New and little-known species of Mecoptera and Neuroptera in the Zoological Museum of Helsingfors. Notulae Entomologicae 7: 13-18.

Hua, B. Z. and I. Chou. 1998. The Bittacidae of Funiu Mountain in Henan (Mecoptera). *In,* Shen, X-C and Shi, Z-Y (Editors), Insects of the Funiu Mountains Region (1): 64-67.

Hua, B. Z. and J. L. Tan. 2007. A new species of *Bittacus* Latreille (Mecoptera, Bittacidae) from Daba Mountain in China. Acta Zootaxonomica Sinica 32: 455-458.

Huang, P. Y. and B. Z. Hua. 2005. Four new species of the Chinese *Bittacus* Latreille (Mecoptera, Bittacidae). Acta Zootaxonomica Sinica 30(2): 393-398.

Penny, N. D. and G. W. Byers. 1979. A checklist of the Mecoptera of the world. Acta Amazonica 9(2): 365-388.

CONTRIBUTIONS TO THE SYRPHIDAE FAUNA OF TURKEY (DIPTERA: SYRPHIDAE)[1]

Süleyman Sarıbıyık[2]

ABSTRACT: Preferred habitats and plants visited are noted for 37 species of Turkish syrphid flies of which six, *Eristalis alpina* (Panzer), 1798, *Pipiza noctiluca* (L.), 1758, *Platycheirus aurolateralis* Stubbs, 2002, *Platycheirus nielseni* Vockeroth, 1990, *Platycheirus occultus* Goeldlin, Maibach and Speight, 1990 and *Platycheirus tarsalis* (Schummel), 1836 are new records.

KEY WORDS: Diptera, Syrphidae, new records, Turkey, preferred habitats, plants visited

This paper provides biological information, including host plants and habitat preference, on 37 Turkish species of hoverflies belonging in 19 genera. Six of the species are new to the Turkish fauna: *Eristalis alpina, Pipiza noctiluca, Platycheirus aurolateralis, P. nielseni, P. occultus,* and *P. tarsalis.*

Table 1. Hoverfly species collected in this study. New species records are boldfaced.

No	Genus	Species	References pertaining to Turkey
1	*Anasimyia*	*Anasimyia transfuga* (L.), 1758	Speight (2006), Reemer and Smit (2007).
2	*Bacca*	*Baccha elongata* (Fabricius), 1775	Sarıbıyık (2000).
3	*Caliprobola*	*Caliprobola speciosa* (Rossi), 1790	Sarıbıyık, and Özgür (2000), Speight (2006).
4	*Ceriana*	*Ceriana conopsoides* (L.), 1758	Sarıbıyık (2001), Reemer and Smit (2007).
5	*Didea*	*Didea fasciata* Macquart, 1843	Sarıbıyık (2000).
		Didea intermedia Loew, 1854	Sarıbıyık (2000).
6	*Epistrophe*	*Epistrophe grossulariae* (Meigen), 1822	Sarıbıyık (2000), Speight (2006).
7	*Eristalis*	***Eristalis alpina* (Panzer), 1798**	**New Record**
		Eristalis arbustorum (L.), 1758	Aktas and Sarıbıyık (1996), Sarıbıyık (1999b, 2001), Sarıbıyık and Hasbenli (2006), Reemer and Smit (2007).
		Eristalis interrupta (Poda), 1761	Speight (2006).
		Eristalis jugorum Egger, 1858	Sarıbıyık (2001), Speight (2006).
		Eristalis pertinax (Scopoli), 1763	Sarıbıyık (2001), Speight (2006).
		Eristalis rupium Fabricius, 1805	Sarıbıyık (2001), Speight (2006).

---

[1] Received on January 11, 2007. Accepted on June 3, 2007.

[2] Kastamonu University, Education Faculty, 37200 Kastamonu, Turkey. E-mails: suleymansaribiyik@hotmail.com, suleyman4665@gmail.com.

Mailed on February 19, 2009

		Eristalis similis (Fallén), 1817	Aktas and Sarıbıyık (1996), Sarıbıyık (1999b, 2001), Sarıbıyık and Hasbenli (2006), Speight (2006), Reemer and Smit (2007).
8	*Ferdinandea*	*Ferdinandea cuprea* (Scopoli), 1763	Sarıbıyık and Hasbenli (2006), Speight (2006).
9	*Heringia*	*Heringia brevidens* (Egger), 1865	Saribiyik (2004).
10	*Lejops*	*Lejops vittata* (Meigen), 1822	Aktas and Sarıbıyık (1996), Sarıbıyık and Hasbenli (2006).
11	*Milesia*	*Milesia crabroniformis* (Fabricius), 1775	Sack (1932), Sarıbıyık and Hasbenli (2006), Speight (2006), Reemer and Smit (2007).
		Milesia semiluctifera (Villers), 1789	Sack (1932), Aktas and Sarıbıyık (1996), Sarıbıyık and Hasbenli (2006), Reemer and Smit (2007).
12	*Pelecocera*	*Pelecocera scaevoides* (Fallén), 1817	Sarıbıyık (2004).
13	*Pipiza*	***Pipiza noctiluca* (L.), 1758**	**New Record**
14	*Platycheirus*	*Platycheirus albimanus* (Fabricius), 1781	Sarıbıyık and Aktas (1996), Sarıbıyık (1999a, 2000), Speight (2006).
		Platycheirus ambiguus (Fallén), 1817	Aktas and Sarıbıyık (2001).
		Platycheirus angustatus (Zetterstedt), 1843	Aktas and Sarıbıyık (2001).
		***Platycheirus aurolateralis* Stubbs, 2002**	**New Record**
		Platycheirus immaculatus Ôhara, 1980	Nielsen (2004).
		Platycheirus manicatus (Meigen), 1822	Aktas and Sarıbıyık (2001), Speight (2006).
		***Platycheirus nielseni* Vockeroth, 1990**	**New Record**
		***Platycheirus occultus* Goeldlin, Maibach and Speight, 1990**	**New Record**
		Platycheirus peltatus (Meigen), 1822	Sarıbıyık (2000).
		Platycheirus scutatus (Meigen), 1822	Sarıbıyık and Hasbenli (1997), Sarıbıyık (2000), Speight (2006), Reemer and Smit (2007).
		***Platycheirus tarsalis* (Schummel), 1836**	**New Record**
15	*Rhingia*	*Rhingia campestris* Meigen, 1822	Sarıbıyık and Özgür (2000), Sarıbıyık (1999b).
16	*Sericomyia*	*Sericomyia silentis* (Haris), 1776	Sarıbıyık and Özgür (2000).
17	*Syritta*	*Syritta flaviventris* Macquart, 1842	Sack, (1932), Peck (1988), Speight (2006), Reemer and Smit (2007).
18	*Temnostoma*	*Temnostoma vespiforme* (L.), 1758	Sarıbıyık and Özgür (2000).
19	*Xanthandrus*	*Xanthandrus comtus* (Haris), 1780	Sarıbıyık (1999a), Sarıbıyık and Hasbenli (1997, 2006).

METHODS

A survey of syrphids was undertaken from April 1995 to September 2007. The samples were collected from 30 stations between the months of April and September, with 10-15 days intervals by conducting surveys. The specimens were caught in the morning with malaise trap and hand netting (killing in bottles containing ethyl acetate). Flies were prepared and labeled following standard protocols for museum material. The following works were used for species identification: Sack (1932), Bańkowska (1963), Van Der Goot (1981), Stubbs and Falk (1983), Violovich (1983), and Verlinden (1991). Listing follows the classification of Speight (2006). The samples were collected by the author (Leg. S. SARIBIYIK). The specimens are preserved in the personal collection of the author.

SYSTEMATIC ENTOMOLOGY

1. ***Anasimyia transfuga* (L.), 1758**
   Material Examined: 1 ♂ in Kahramanmaras, Andirin, Catak village, 600m., 25 May. This species was collected on the white flowers of Umbelliferae.

2. ***Baccha elongata* (Fabricius), 1775**
   Material Examined: 7 ♂, 4 ♀ in Kahramanmaras and Kastamonu, 750 - 1900m., between 12 May – 13 August. These samples were collected on the white flowers Umbelliferae.

3. ***Caliprobola speciosa* (Rossi), 1790**
   Material Examined: 2 ♂, 3 ♀ in Kastamonu, Bostan village, 1400m., 12 May. This species was found on *Tamarix* sp. (Tamaricaceae).

4. ***Ceriana conopsoides* (L.), 1758**
   Material Examined: 1 ♂, 2 ♀ in Cankırı and Kahramanmaras, 700 - 1250 m., 15 June – 10 August. These samples were collected on the yellow flowered Umbelliferae.

5. ***Didea fasciata* Macquart, 1834**
   Material Examined: 5 ♂, 8 ♀ in Kastamonu, Yukarı Ismailli village, 1400 m., 18 June. These samples were collected on the flowered *Cistus* sp. (Cistaceae).

6. ***Didea intermedia* Loew, 1854**
   Material Examined: 14 ♂, 7 ♀ in Kastamonu, Yukarı Ismailli village, 1400 m., 18 June. These samples were collected on the flowered *Cistus* sp. (Cistaceae).

7. ***Epistrophe grossulariae* (Meigen), 1822**
   Material Examined: 5 ♂, 3 ♀ in Bolu, 1700m., 25 June – 10 August. These samples were collected on white flowered Umbelliferae.

8. ***Eristalis alpina* (Panzer), 1798**
   Material Examined: 8 ♂, 3 ♀ were collected in Cankırı and Kastamonu, 800 - 1400 m., 5 July – 7 August. These samples were collected on *Sambucus ebulus* and *Heracleum paphlagonicum* (Umbelliferae). This species is usually found on flowers of Umbelliferae. These plants are located in forests, near lakes and rivers.

9. ***Eristalis arbustorum* (L.), 1758**
   Material Examined: 8 ♂, 3 ♀ in Ankara, Bolu and Kastamonu, 750 - 1900 m., 20 May – 19 July. These samples were collected on *Anthyriscus nemorosa*, *Heracleum paphlagonicum* (Umbelliferae), *Sambucus ebulus* (Caprifoliaceae), and *Rubus* sp. (Rosaceae).

10. ***Eristalis interrupta* (Poda), 1761**
    Material Examined: 1 ♀ in Kastamonu, Bostan village, 1400 m., 12 July. This species was found on flowers of *Heracleum paphlagonicum* (Umbelliferae) and *Sambucus ebulus* (Caprifoliaceae).

11. ***Eristalis jugorum* Egger, 1858**
    Material Examined: 5 ♂, 2 ♀ in Kastamonu, 1875 m., 27 June – 8 August. These samples were collected on the *Valeriana alliariifolia* (Valerianaceae) and *Knautia* sp. (Dipsacaceae) found in the clear areas of *Abies* sp. (Pinaceae) forests.

12. ***Eristalis pertinax* (Scopoli), 1763**
    Material Examined: 20 ♂, 7 ♀ in Ankara, Bolu, Kahramanmaras, Karabuk and Kastamonu, 700 - 1900 m., 27 June – 11 October. These samples were collected on the flowers of *Anthyriscus nemorosa*, *Heracleum paphlagonicum,* (Umbelliferae), *Sambucus ebulus* (Caprifoliaceae), and *Rubus* sp. (Rosaceae).

13. ***Eristalis rupium* Fabricius 1805**
    Material Examined: 3 ♂, 2 ♀ in Kastamonu, 1200 m., 18 June. These samples were collected on the *Anthyriscus nemorosa*, *Heracleum paphlagonicum* (Umbelliferae), *Sambucus ebulus* (Caprifoliaceae), and *Rubus* sp. (Rosaceae).

14. ***Eristalis similis* (Fallén), 1817**
    Material Examined: 12 ♂, 3 ♀ in Ankara, Bolu and Kastamonu, 100 - 1900 m., 25 May – 17 August. These samples were collected on *Anthyriscus nemorosa*, *Heracleum paphlagonicum* (Umbelliferae), *Sambucus ebulus* (Caprifoliaceae), and *Rubus* sp. (Rosaceae).

15. ***Ferdinandea cuprea* (Scopoli), 1763**
    Material Examined: 1 ♀ in Kahramanmaras, Andirin, Basdoğan village, 250 m., 23 April. This sample was collected on *Crataegus* sp. (Rosaceae).

16. ***Heringia brevidens*** **(Egger), 1865**
Material Examined: 7 ♂ in Kastamonu, Küre, Catak village, 1700 m., 18 June – 9 August. These samples were collected on *Rubus* sp. (Rosaceae) and white flowered Umbelliferae.

17. ***Lejops vittata*** **(Meigen), 1822**
Material Examined: 2 ♂, 1 ♀ in Kayseri, Sultansazlıgı National Park, 1100 m., 12 June. This species was collected from the species of Graminae plants found near the lakes.

18. ***Milesia crabroniformis*** **(Fabricius), 1775**
Material Examined: 4 ♂, 7 ♀ in Kahramanmaras, Andırın, Akifiye village, 1700 m., 1 August – 10 August. These samples were collected on white flowered Umbelliferae.

19. ***Milesia semiluctifera*** **(Villers), 1789**
Material Examined: 4 ♂, 7 ♀ in Kastamonu and Kahramanmaras, Andırın, Akifiye village, 1700 m., 25 June – 10 August. These samples were collected on white flowers of Umbelliferae.

20. ***Pelecocera scaevoides*** **(Fallén), 1817**
Material Examined: 14 ♂, 10 ♀ in Kastamonu, 1700 m., 22 May – 28 June. These samples were collected on flowers of Umbelliferae and *Euphorbia* sp. (Euphorbiaceae).

21. ***Pipiza noctiluca*** **(L.), 1758**
Material Examined: 1 ♂, 1 ♀ in Kastamonu, Seydiler, Sabuncular village, 1600 m., 11 July. These samples were collected on the flowers of *Ranunculus* sp. (Ranunculaceae).

22. ***Platycheirus albimanus*** **(Fabricius), 1781**
Material Examined: 20 ♂, 3 ♀ in Bolu, Kahramanmaras and Kastamonu, 700 - 1900 m., 23 April – 7 August. This species were caught from white flowered *Heracleum* sp. (Umbelliferae) found near the small water flows in the *Abies* sp. (Pinaceae) forests. The flies found on *Abies* sp. forests were caught on the *Urtica* sp. (Urticaceae), in the clears of the forests, *Rumex* sp. (Polygonaceae) were found in moist habitats where *Polygonum* sp. (Polygonaceae) plants are dominant.

23. ***Platycheirus ambiguus*** **(Fallén), 1817**
Material Examined: 1 ♂, 1 ♀ were collected in Kastamonu and Konya, 700 - 800 m., between 20 April – 23 April. This species was collected from members of the Umbelliferae sp., *Mentha* sp. (Lamiaceae) and *Urtica* sp. (Urticaceae). These plants are dominant in the *Pinus* sp. (Pinaceae) forests.

24. ***Platycheirus angustatus*** **(Zetterstedt), 1843**
Material Examined: 1 ♂ in Ankara, 1100 m., 25 May. This species were

collected from plants in the Graminae, *Rumex* sp. (Polygonaceae) and *Tamarix* sp. (Tamaricaceae) found near rivers.

25. *Platycheirus aurolateralis* Stubbs, 2002
Material Examined: 2 ♂, in Çankırı and Kastamonu, 1700 m., 27-30 June. This species were collected from the *Sanicula europaea* (Umbelliferae) found in the humid areas in the *Abies* sp. (Pinaceae) forests.

26. *Platycheirus immaculatus* Ôhara, 1980
Material Examined: 5 ♂, 41 ♀ in Kastamonu, 1400 - 1800 m., 10 June – 27 June. These samples were collected from *Sanicula europaea* (Umbelliferae) found in the humid areas in the *Abies* sp. (Pinaceae) forests.

27. *Platycheirus manicatus* (Meigen), 1822
Material Examined: 1 ♀ in Kastamonu, 1875 m., 6 August. These samples were collected on *Anchusa* sp. (Boraginaceae), *Geranium* sp. (Geraniaceae), *Heracleum* sp. (Umbelliferae), *Mentha* sp. and *Nepeta* sp. (Lamiaceae), *Ranunculus* sp. (Ranunculaceae), *Rumex* sp. and *Polygonum* sp. (Polygonaceae), and *Urtica* sp. (Urticaceae). These plants are dominant in the humid clear areas in the *Abies* sp. (Pinaceae) forests.

28. *Platycheirus nielseni* Vockeroth, 1990
Material Examined: 2 ♂, 1 ♀ in Kastamonu, 1900 m., between 3 July – 24 July. These samples were collected on the *Anchusa* sp. (Boraginaceae) *Geranium* sp. (Geraniaceae), *Heracleum* sp. (Umbelliferae), *Mentha* sp. and *Nepeta* sp. (Lamiaceae), *Polygonum* sp. and *Rumex* sp. (Polygonaceae), *Ranunculus* sp. (Ranunculaceae), and *Urtica* sp. (Urticaceae). These plants are dominant in the humid clear areas in the *Abies* sp. (Pinaceae) forests.

29. *Platycheirus occultus* Goeldlin, Maibach and Speight, 1990
Material Examined: 1 ♀ in Kastamonu, Ilgaz Mountain National Park, 1900 m., 23 August. This sample was collected on the *Heracleum* sp. (Umbelliferae).

30. *Platycheirus peltatus* (Meigen), 1822
Material Examined: 2 ♂ in Kastamonu, Ilgaz Mountain National Park, 1900 m., 12 June – 8 August. This species was collected on the white flowered Umbelliferae.

31. *Platycheirus scutatus* (Meigen), 1822
Material Examined: 6 ♂ in Kastamonu, 775 - 1900 m., between 23 April – 9 May. These samples were collected on white flowered Umbelliferae, *Ranunculus* sp. (Ranunculaceae), and *Rosa* sp. (Rosaceae).

32. *Platycheirus tarsalis* (Schummel), 1836
Material Examined: 1♂, in Konya, 1100 m., 5 May. This species were collected from the *Sanicula europaea* (Umbelliferae) plants found in the humid areas in the *Abies* sp. (Pinaceae) forests.

33. ***Rhingia campestris*** **Meigen, 1822**
Material Examined: 2 ♂, 1 ♂ in Kastamonu, 750 - 1500 m., 25 May – 27 June. These samples were collected on the *Ranunculus* sp. (Ranunculaceae).

34. ***Sericomyia silentis*** **(Harris), 1776**
Material Examined: 1 ♂ in Kastamonu, Dadaı, Ballıdağ, 1700m., 27 June. This sample was collected on the *Cirsium* sp. (Asteraceae).

35. ***Syritta flaviventris*** **Macquart, 1842**
Material Examined: 1 ♂ in Kahramanmaras, Andirin, Catak village, 700 m., 25 May. This sample was collected on white flowers of Umbelliferae.

36. ***Temnostoma vespiforme*** **(L.), 1758**
Material Examined: 1 ♀ in Kastamonu, Biden high plateau, Kızılkese valley, 1200 m., 27 June. This sample was collected on the yellow flowered Compositae.

37. ***Xanthandrus comtus*** **(Harris), 1780**
Material Examined: 9 ♂, 4 ♀ in Kastamonu, Yukarı Ismailli village, 1400 m., 11 July. This sample was collected on the *Cistus* sp. (Cistaceae).

DISCUSSION

The syrphid flies studied usually inhabit areas humid areas in forests in high mountains as well as habitats on river banks in forests where flowering plants grow. They usually prefer plants in the families Umbelliferae with white flowers, as well as yellow-flowered Ranunculaceae, Rosaceae, and Compositae.

ACKNOWLEDGEMENTS

I would like to thank Tore Nielsen for the identification of some of the species. I thank Erkan Yanarates and Dr. Bahattin Aydınlı for help during field work.

LITERATURE CITED

Aktas, M. and S. Sarıbıyık. 1996. Contribution to the Syrphidae fauna of Turkey (Diptera: Syrphidae) (II), Milesiinae. Journal of the Institute of Science and Technology of Gazi University 9 (1) 15-27. [In Turkish.]

Aktas, M. and S. Sarıbıyık. 2001. New Records of Syrphinae (Diptera: Syrphidae) from Turkey. Journal of Entomological Research Society 3 (1-2): 41-46.

Bańkowska, R. 1963. Syrphidae. *In*, Klucze do Oznaczania Owadów Polski, 28, 34. Warszawa, Poland. 236 pp.

Nielsen, T. R. 2004. European species of the *Platycheirus ambiguus* group (Diptera: Syrphidae), with description of new species. Volucella 7: 1-30.

Peck, L. V. 1988. Family Syrphidae, pp. 11-230. *In*, A. Soos and L. Papp (Editors). Catalogue of Palaeartic Diptera, Volume 8. 363 pp.

Reemer, M. and J. T. Smit. 2007. Some hoverfly records from Turkey (Diptera: Syrphidae), Volucella 8: 135-146.

Sack, P. 1928-1932. Syrphidae. *In*, Lindner, E. Die Fliegen der paläarktischen Region, IV (6). Stuttgart, Germany. +451 pp. 18 pls.

Sarıbıyık, S. 1999a. Syrphinae Fauna of the West Blacksea Region, (Diptera: Syrphidae), Gazi University, Kastamonu Education Journal, 7, (1): 185-194.

Sarıbıyık, S. 1999b. Milesiinae Fauna of the West Blacksea Region (Diptera: Syrphidae). Kastamonu Education Journal 7(1): 195-204. [In Turkish.]

Sarıbıyık, S. 2000. Fauna of Syrphidae in Ilgaz and Isık Mountains and their vicinity (Diptera-Syrphinae). Journal of the Institute of Science and Technology of Gazi University 13 (1): 55-70. [In Turkish.]

Sarıbıyık, S. 2001. New Records of the Subfamily Milesiinae (Diptera: Syrphidae) from Turkey. Journal of Entomological Research Society 3 (3): 43-51.

Sarıbıyık, S. 2004. Three new records for Turkish Milesiinae fauna (Diptera: Syrphidae) Journal of Entomological Research Society 6 (1): 19-22.

Sarıbıyık, S. and M. Aktas. 1996. Contribution to the Syrphidae fauna of Turkey (Diptera: Syrphidae) (I) Syrphinae. Journal of the Institute of Science and Technology of Gazi University 9 (1): 1-13. [In Turkish.]

Sarıbıyık, S. and A. Hasbenli. 1997. New Records for fauna of Turkish Syrphidae, (Diptera). Turkish Journal of Entomology 21 (3): 225-232.

Sarıbıyık, S. and A. F. Özgür. 2000. New Records of Milesiinae (Diptera: Syrphidae) from Turkey, Journal of Entomological Research Society 2 (3): 5-13.

Sarıbıyık, S. and A. Hasbenli. 2006. Fauna of Syrphinae and Milesiinae (Diptera, Syrphidae) in the Region of South-West Anatolia. Journal of Entomological Research Society 8 (1): 43-52.

Speight, M. C. D. 2006. Species accounts of European Syrphidae (Diptera) Ferrara 2006. *In*, M. C. D. Speight , E. Castella, J. P. Sarthou, C. Monteil (Editors). Syrph the Net, the database of European Syrphidae, Syrph the Net publications. Dublin, Ireland. 252 pp.

Stubbs, A. E. and S. J. Falk. 1983. British Hoverflies. British Entomological and Natural History Society. London, England, U.K. 153 pp.

Van Der Goot, V. S. 1981. De Zweefliegen van Noordwest-Europa en Europees Rusland, in het bijzonder van de Benelux, Koninklijke Nederlandse Naturhistorishe Verenigig. Amsterdam, The Netehrlands. 275 pp.

Verlinden, L. 1991. Fauna van Belgie, Zweefvliegen (Syrphidae). Koninklijk Belgisch Instituut voor Natuurwetenschappen. Brussel, Belgium. 298 pp.

Violovitsh, N. A. 1983. Siberian Syrphidae (Diptera, Syrphidae) Nauka, Novosibirsk, Russia. 242 pp.

UPDATED CHECKLIST OF GROUND SPIDERS (ARANEAE: GNAPHOSIDAE) OF TURKEY, WITH ZOOGEOGRAPHICAL AND FAUNISTIC REMARKS[1]

Osman Seyyar,[2] Nusret Ayyıldız,[2] and Aydın Topçu[3]

ABSTRACT: This faunistic list of ground spider fauna from Turkey includes published records and original data. Eleven species are new to Turkish araneofauna. With this study, a total of 107 species belonging to 26 genera of Gnaphosidae have been recorded from Turkey until the present time. For each species zoogeographical distribution is given. A zoogeographical classification is constructed according to the current distribution of species. The largest groups are those of the widely distributed Palearctic and Europian-Asian.

KEYWORDS: Araneae, Gnaphosidae, New records, Checklist, Turkey

Although studies of the araneofauna of Turkey began at the end of the 19th century, the spider fauna of Turkey is still little known. The Gnaphosidae is the most investigated family of all spider families in Turkey. The first datas on Turkish gnaphosids were characterized by brief visits made by non-Turkish scientists, such as Simon 1878; Pickard-Cambridge 1874; Pavesi 1876; Dalmas 1920,1921; Di Caporiacco 1935, Rower 1960, Kulczyński 1903, Nosek 1905, Reimoser 1913 (see Karol 1967). In 1967, Dr. Sevinç Karol prepared a list compiling all published spider records, 36 gnaphosid species belonging to 10 genera. Thereafter, several Turkish authors have made systematic and ecological studies of Turkish gnaphosid fauna. Dr. Abdullah Bayram (2002) listed 59 gnaphosid species placed in 12 genera. In 2005, a comprehensive study of Turkish spider fauna that contained a third checklist of all publications on Turkish spiders was published by Topçu and his co-workers (Topçu et al., 2005b). In this work, 73 species of gnaphosid in 16 genera were recorded. Recently, studies on gnaphosid fauna of Turkey have gradually increased (Ovtsharenko et al., 1995; Özdemir et al., 2006; Topçu et al., 2005a, b, 2006, 2007; Seyyar et al., 2006a, b, c, 2007a, b; Varol et al., 2006).

The checklist published herein is compiled from the literature. Eleven gnaphosid species are recorded for the first time from Turkey; some zoogeographic remarks regarding this fauna are included.

METHODS

As Turkey is a bridge between Asia and Europe, its geographical location is very important in Palearctic region. Turkey consists of two general parts, Thrace and Anatolia. The European section of Turkey is Thrace, which forms the borders of Turkey with Greece and Bulgaria. The Asian part of the country, Anatolia, consists of a high central plateau with narrow coastal plains. Turkey is geographically divid-

---

[1] Received on December 4, 2007. Accepted on March 11, 2008.

[2] Erciyes University, Science and Arts Faculty, Department of Biology, TR-38039 Kayseri, Turkey. E-mails: osmanseyyar@hotmail.com, nayildiz@erciyes.edu.tr, respectively.

[3] Niğde University, of Science and Arts Faculty, Department of Biology, TR-51200 Niğde, Turkey. E-mail: atopcu3@msn.com

Mailed on February 19, 2009

ed into seven regions: Marmara, Aegean, Black Sea, Central Anatolia, Eastern Anatolia, Southeastern Anatolia and the Mediterranean (Fig 1). Turkey has a great variability in topography and climate. The fact that Anatolia is surrounded on three sides by sea, its situation in the temperate climatic zone, its geological and geomorphic structure, and topography are contributing factors among the main factors affecting diversity of species in terrestrial ecosystems.

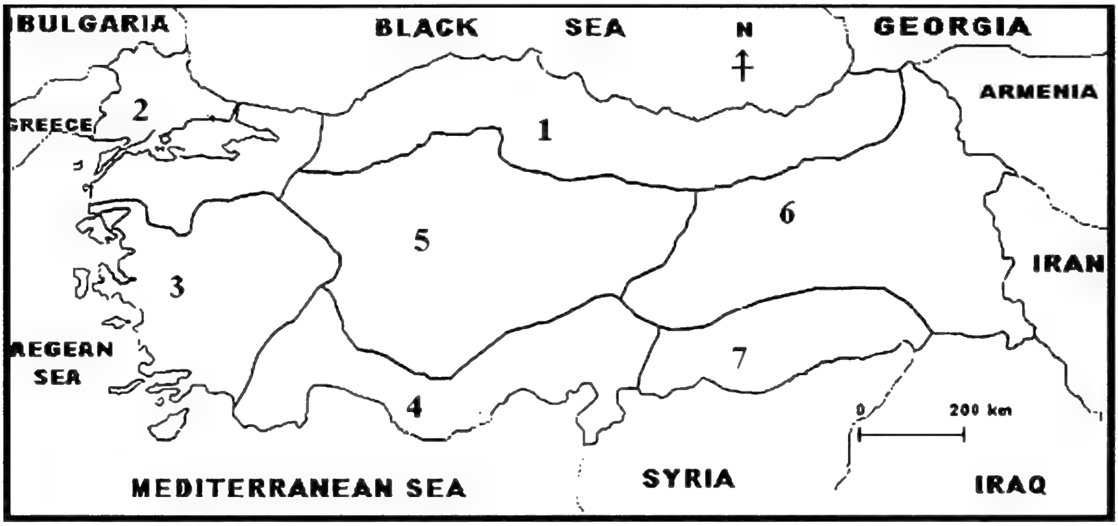


Fig. 1. Geographical regions of Turkey. 1= Black Sea Region, 2= Marmara Region, 3= Aegean Region, 4= Mediterranean Region, 5= Central Anatolia Region, 6= East Anatolia Region, 7= Southeastern Anatolia Region. (based on http://www.theodora.com/maps/new4/world_color.gif)

The checklist of the ground spider fauna of Turkey is compiled using published records and original data garnered by author's fieldwork. Only published papers are used. Species referred to in postgraduate theses and scientific meetings are not formal publications and are consequently not considered herein. When referring to author's fieldwork, ground spiders were collected directly or with pitfall traps. The specimens were preserved in 70% ethanol. Microscopic examinations were made with a SZ61-TR Olympus stereomicroscope. The works of Ovtsharenko et al. (1992), Bosmans and Blick (2000), Chatzaki, et al. (2002a, b), and Levy (1995, 1998, 1999), were consulted for species identification. The examined material is deposited in the Niğde University Arachnology Museum (NUAM).

SYSTEMATIC ARANEOLOGY

Table 1. Updated checklist of Turkish gnaphosid spider species and their distribution. A single asterisk, *, represents species published after Turkish Spider Checklist (Topçu et al., 2005b); two asterisks, **, represent new records for the Turkish gnaphosid fauna; no asterisks represent species recorded in Topçu et al. (2005b). Species represented in the NUAM collection are boldfaced.

SPECIES	WORLD DISTRIBUTION	REFERENCES
Anagraphis pallens Simon, 1893	Mediterranean	Platnick, 2008
Aphantaulax trifasciata (O. P.-Cambridge, 1872)	Palearctic	Platnick, 2008
Aphantaulax trifasciata trimaculata Simon, 1878	West European	Platnick, 2008
Arboricaria koeni (Bosmans & Blick, 2000)**	Greece, Crete, and Turkey	Platnick, 2008 and this study
Berinda ensiger (O. P.-Cambridge, 1874)	Balkan-Asia Minor	Platnick, 2008
Berinda amabilis Roewer, 1928*	Crete, Russia, Central Asia and Turkey	Platnick, 2008; Seyyar et al., 2007
Berlandina plumalis (O. P.-Cambridge, 1872)	South Palearctic	Platnick, 2008
Berlandina pulchra (Nosek, 1905)	Turkey	Platnick, 2008
Callilepis cretica (Roewer, 1928)*	Greece, Crete, Turkey, Azerbaijan	Platnick, 2008
Callilepis nocturna (Linnaeus, 1758)*	Palearctic	Platnick, 2008
Cesonia aspida Chatzaki 2002*	Crete, Turkey	Platnick, 2008, Seyyar et al., 2007
Cryptodrassus creticus Chatzaki, 2002*	Crete, Turkey	Platnick, 2008
Drassodes difficilis (Simon, 1878)	West European	Platnick, 2008
Drassodes lacertosus (O. P.-Cambridge, 1872)**	Israel, Syria, Russia, Turkey	Platnick, 2008 and this study
Drassodes lapidosus (Walckenaer, 1802)	Palearctic	Platnick, 2008
Drassodes lutescens (C. L. Koch, 1839)	Mediterranean	Platnick, 2008
Drassodes pubescens (Thorell, 1856)	Palearctic	Platnick, 2008
Drassodes serratichelis (Roewer, 1928)**	Crete, Israel, USA, Turkey	Platnick, 2008 and this study
Drassodes similis Nosek, 1905	Turkey	Platnick, 2008
Drassodes villosus (Thorell, 1856)	Palearctic	Platnick, 2008
Drassyllus lutetianus (L. Koch, 1866)	European-Asian	Platnick, 2008
Drassyllus praeficus (L. Koch, 1866)	European-Asian	Platnick, 2008
Drassyllus pusillus (C. L. Koch, 1833)	Palearctic	Platnick, 2008
Drassyllus pumilus (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Drassyllus vinealis (Kulczyński, 1897)	Palearctic	Platnick, 2008
Drassyllus villicus (Thorell, 1875)	European	Platnick, 2008
Gnaphosa bicolor (Hahn, 1833)	European	Platnick, 2008
Gnaphosa bithynica Kulczyński, 1903	Balkan-Asia Minor	Platnick, 2008
Gnaphosa corticola Simon, 1914	West European	Platnick, 2008
Gnaphosa dolosa Herman, 1879*	Palearctic	Platnick, 2008
Gnaphosa lapponum (L. Koch, 1866)	European-Asian	Platnick, 2008
Gnaphosa leporina (L. Koch, 1866)	Palearctic	Platnick, 2008
Gnaphosa lucifuga (Walckenaer, 1802)	Palearctic	Platnick, 2008
Gnaphosa lucifuga minor Nosek, 1905	Turkey	Platnick, 2008
Gnaphosa lugubris (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Gnaphosa microps Holm, 1939	Holarctic	Platnick, 2008
Gnaphosa modestior Kulczyński, 1897	European-Asian	Platnick, 2008
Gnaphosa mongolica Simon, 1895**	Hungary to China and Turkey	Platnick, 2008 and this study

Gnaphosa montana (L. Koch, 1866)*	Palearctic	Platnick, 2008
Gnaphosa muscorum (L. Koch, 1866)*	Holarctic	Platnick, 2008
Gnaphosa opaca Hermann, 1879	European-Asian	Platnick, 2008
Gnaphosa petrobia L. Koch, 1872	European	Platnick, 2008
Gnaphosa steppica Ovtsharenko, Platnick & Song, 1992	Asian	Platnick, 2008
Gnaphosa tigrina Simon, 1878	Mediterranean-Asian	Platnick, 2008
Haplodrassus dalmatensis (C. L. Koch, 1866)	Palearctic	Platnick, 2008
Haplodrassus invalidus (O. P.-Cambridge, 1872)**	Spain, Corsica, Sicily, Italy, Israel and Turkey	Platnick, 2008 and this study
Haplodrassus kulczyńskii Lohmander, 1942*	Palearctic	Platnick, 2008
Haplodrassus macellinus (Thorell, 1871)	Mediterranean	Platnick, 2008
Haplodrassus morosus (O. P.-Cambridge, 1872)**	Israel and Turkey	Platnick, 2008 and this study
Haplodrassus signifer (C. L. Koch, 1838)	Holarctic	Platnick, 2008
Haplodrassus soerenseni Strand, 1900*	Palearctic	Platnick, 2008
Haplodrassus umbratilis (C. L. Koch, 1866)	European-Asian	Platnick, 2008
Micaria albovittata (Lucas, 1846)	Palearctic	Platnick, 2008
Micaria coarctata (Lucas, 1846)	Mediterranean-Asian	Platnick, 2008
Micaria dives (Lucas, 1846)	Palearctic	Platnick, 2008
Micaria formicaria (Sundevall, 1831)*	Palearctic	Platnick, 2008
Micaria pulicaria (Sundevall, 1831)	Holarctic	Platnick, 2008
Micaria rossica Thorell, 1875	Holarctic	Platnick, 2008
Nomisia aussereri (L. Koch, 1872)	Palearctic	Platnick, 2008
Nomisia exornata (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Nomisia orientalis Dalmas, 1921	Turkey	Platnick, 2008
Nomisia palaestina (O. P.-Cambridge, 1872)*	Greece, Syria, Israel and Turkey	Platnick, 2008; Seyyar et al., 2007
Nomisia ripariensis (O. P.-Cambridge, 1872)	European-Asian	Platnick, 2008
Parasyrisca turkenica Ovtsharenko, Platnick & Marusik, 1995*	Turkey	Platnick, 2008
Parasyrisca vinosa (Simon, 1878)*	Europe and Turkey	Platnick, 2008; Özdemir et al., 2006
Phaeocedus braccatus (L. Koch, 1866)*	Palearctic	Platnick, 2008
Poecilochroa senilis (O. P.-Cambridge, 1872)*	Corsica to Turkmenistan, Turkey	Platnick, 2008; Seyyar et al., 2006
Poecilochroa variana (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Pseudodrassus ricasolii Caporiacco, 1935	Turkey	Platnick, 2008
Pterotrichia conspersa (O. P.-Cambridge, 1872)	South Palearctic	Platnick, 2008
Pterotrichia kochii (O. P.-Cambridge, 1872)	Asia Minor-Levantine	Platnick, 2008
Pterotrichia lentiginosa (C. L. Koch, 1837)	Mediterranean	Platnick, 2008
Pterotricha lesserti Dalmas, 1921*	Egypt, Israel, Saudi Arabia and Turkey	Platnick, 2008; Seyyar et al., 2007
Scotophaeus blackwalli Thorell, 1871*	Cosmopolitan	Platnick, 2008
Scotophaeus scutulatus (L. Koch, 1866)	Palearctic	Platnick, 2008
Setaphis carmeli (O. P.-Cambridge, 1872)**	Mediterranean	Platnick, 2008
Setaphis fuscipes (Simon, 1885)**	Morocco to Israel	Platnick, 2008
Sosticus loricatus (L. Koch, 1866)**	Holarctic	Platnick, 2008
Synaphosus palearcticus Ovtsharenko, Levy & Platnick, 1994	Asian	Platnick, 2008
Trachyzelotes barbatus (L. Koch, 1866)	Mediterranean-Asian	Platnick, 2008

Trachyzelotes lyonnetii (Audouin, 1826)**	Mediterranean to Central Asia, USA, Brazil, Peru	Platnick, 2008
Trachyzelotes malkini Platnick & Murphy, 1984	Mediterranean-Asian	Platnick, 2008
Trachyzelotes pedestris (C. L. Koch, 1837)	European-Asian	Platnick, 2008
Urozelotes rusticus (L. Koch, 1872)*	Cosmopolitan	Platnick, 2008
Zelotes aeneus (Simon, 1878)*	Europe and Turkey	Platnick, 2008; Özdemir et al., 2006
Zelotes apricorum (L. Koch, 1876)	European-Asian	Platnick, 2008
Zelotes atrocaeruleus (Simon, 1878)	Palearctic	Platnick, 2008
Zelotes aurantiacus Miller, 1967	European-Asian	Platnick, 2008
Zelotes caucasius (L. Koch, 1866)	European-Asian	Platnick, 2008
Zelotes cingarus (O. P.-Cambridge, 1874)	Mediterranean-Asian	Platnick, 2008
Zelotes clivicola (L. Koch, 1870)	Palearctic	Platnick, 2008
Zelotes electus (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Zelotes gracilis (Canestrini, 1868)	European-Asian	Platnick, 2008
Zelotes ilotarum (Simon, 1884)**	Greece and Crete	Platnick, 2008
Zelotes latreillei (Simon, 1878)	European-Asian	Platnick, 2008
Zelotes longipes (L. Koch, 1866)	Palearctic	Platnick, 2008
Zelotes longestylus Simon, 1914	West European	Platnick, 2008
Zelotes oblongus (C. L. Koch, 1833)	European	Platnick, 2008
Zelotes olympi (Kulczyński, 1903)	Turkey and Crimea	Platnick, 2008; Kovblyuk, 2005
Zelotes petrensis (C. L. Koch, 1839)	European-Asian	Platnick, 2008
Zelotes puritanus Chamberlin, 1922*	Holarctic	Platnick, 2008
Zelotes segrex (Simon, 1878)	Palearctic	Platnick, 2008
Zelotes similis (Kulczyński, 1887)	European	Platnick, 2008
Zelotes solstitialis Levy, 1998*	Bulgaria, Turkey, Crete, Israel	Platnick, 2008
Zelotes strandi (Nosek, 1905)	Turkey	Platnick, 2008
Zelotes subterraneus (C. L. Koch, 1833)	Palearctic	Platnick, 2008
Zelotes tenuis (L. Koch, 1866)	Mediterranean to Ukraine, USA	Platnick, 2008

Zoogeography

A zoogeographic classification of the gnaphosid spiders in Turkey has been generated on the basis of literature data (Fig. 2). Currently, the spider family Gnaphosidae is represented in Turkey by 107 species belonging to 26 genera. Ground spiders occur almost in all regions of Turkey, inhabiting lowlands, forests, and mountains. According to their current distribution, the Turkish ground spiders are classified in eleven zoogeographical categories, i.e. Cosmopolitan, Holarctic, Palearctic, Asian, European, European-Asian, European-Middle East, Mediterranean, Mediterranean-Asian, Endemic (only in Turkey) and others.

Distribution of Turkish ground spiders in each zoogeographical category

Cosmopolitan (COS): *Scotophaeus blackwalli* Thorell, 1871, *Urozelotes rusticus* (L. Koch, 1872).

Holarctic (HOL): *Gnaphosa microps* Holm, 1939, *Gnaphosa muscorum* (L. Koch, 1866), *Haplodrassus signifer* (C. L. Koch, 1838), *Micaria pulicaria* (Sundevall, 1831), *Micaria rossica* Thorell, 1875, *Sosticus loricatus* (L. Koch, 1866) and *Zelotes puritanus* Chamberlin, 1922.

Palearctic (PAL): *Aphantaulax trifasciata* (O. P.-Cambridge, 1872), *Berlandina plumalis* (O. P.-Cambridge, 1872) (in only South Palearctic), *Callilepis nocturna* (Linnaeus, 1758), *Drassodes lapidosus* (Walckenaer, 1802), *Drassodes* *pubescens* (Thorell, 1856), *Drassodes villosus* (Thorell, 1856), *Drassyllus pusillus* (C. L. Koch, 1833), *Drassyllus vinealis* (Kulczyński, 1897), *Gnaphosa dolosa* Herman, 1879 (Not all Palaearctic – to Kazakhstan in east only), *Gnaphosa leporina* (L. Koch, 1866), *Gnaphosa lucifuga* (Walckenaer, 1802) (Not all Palaearctic – to Kazakhstan and Middle Asia in east only), *Gnaphosa montana* (L. Koch, 1866), *Haplodrassus dalmatensis* (C. L. Koch, 1866), *Haplodrassus kulczyńskii* Lohmander, 1942, *Haplodrassus soerenseni* Strand, 1900, *Micaria albovittata* (Lucas, 1846), *Micaria dives* (Lucas, 1846), *Micaria formicaria* (Sundevall, 1831), *Nomisia aussereri* (L. Koch, 1872), *Phaeocedus braccatus* (L. Koch, 1866), *Pterotrichia conspersa* (O. P.-Cambridge, 1872) (in only South Palearctic), *Scotophaeus scutulatus* (L. Koch, 1866), *Zelotes atrocaeruleus* (Simon, 1878), *Zelotes clivicola* (L. Koch, 1870), *Zelotes longipes* (L. Koch, 1866), *Zelotes segrex* (Simon, 1878), and *Zelotes subterraneus* (C. L. Koch, 1833).

Asian (A): *Gnaphosa mongolica* Simon, 1895 (Not all Asia – from Hungary to China), *Gnaphosa steppica* Ovtsharenko, Platnick and Song, 1992, and *Synaphosus palearcticus* Ovtsharenko, Levy and Platnick, 1994.

European (E): *Aphantaulax trifasciata trimaculata* Simon, 1878 (Not all Europe – in West Europe only), *Drassodes difficilis* (Simon, 1878) (Not all Europe – in West Europe only), *Drassyllus villicus* (Thorell, 1875), *Gnaphosa bicolor* (Hahn, 1833), *Gnaphosa corticola* Simon, 1914 (Not all Europe – in West Europe only), *Gnaphosa petrobia* L. Koch, 1872, *Parasyrisca vinosa* (Simon, 1878), *Zelotes aeneus* (Simon, 1878), *Zelotes longestylus* Simon, 1914 (Not all Europe – in West Europe only), *Zelotes oblongus* (C. L. Koch, 1833), and *Zelotes similis* (Kulczyński, 1887).

European-Asian (E-A): *Drassyllus lutetianus* (L. Koch, 1866), *Drassyllus praeficus* (L. Koch, 1866), *Drassyllus pumilus* (C. L. Koch, 1839), *Gnaphosa lapponum* (L. Koch, 1866), *Gnaphosa lugubris* (C. L. Koch, 1839), *Gnaphosa modestior* Kulczyńskii, 1897, *Gnaphosa opaca* Hermann, 1879, *Haplodrassus umbratilis* (C. L. Koch, 1866), *Nomisia exornata* (C. L. Koch, 1839), *Nomisia ripariensis* (O. P.-Cambridge, 1872), *Poecilochroa variana* (C. L. Koch, 1839), *Trachyzelotes pedestris* (C. L. Koch, 1837), *Zelotes apricarum* (L. Koch, 1876), *Zelotes aurantiacus* Miller, 1967, *Zelotes caucasius* (L. Koch, 1866), *Zelotes electus* (C. L. Koch, 1839), *Zelotes gracilis* (Canestrini, 1868), *Zelotes latreillei* (Simon, 1878), and *Zelotes petrensis* (C. L. Koch, 1839).

European-Middle East (E-M): *Nomisia palaestina* (O. P.-Cambridge, 1872) and *Zelotes solstitialis* Levy, 1998.

Mediterranean (MED): *Anagraphis pallens* Simon, 1893, *Drassodes lutescens* (C. L. Koch, 1839), *Haplodrassus invalidus* (O. P.-Cambridge, 1872), *Haplodrassus macellinus* (Thorell, 1871), *Pterotrichia lentiginosa* (C. L. Koch, 1837), and *Setaphis carmeli* (O. P.-Cambridge, 1872).

Mediterranean-Asian (MED-A): *Berinda amabilis* Roewer, 1928, *Callilepis cretica* (Roewer, 1928), *Gnaphosa tigrina* Simon, 1878, *Micaria coarctata* (Lucas, 1846), *Trachyzelotes barbatus* (L. Koch, 1866), *Trachyzelotes malkini* Platnick and Murphy, 1984, and *Zelotes cingarus* (O. P.-Cambridge, 1874).

Turkey (TUR): *Berlandina pulchra* (Nosek, 1905), *Drassodes similis* Nosek, 1905, *Gnaphosa lucifuga minor* Nosek, 1905, *Nomisia orientalis* Dalmas, 1921, *Parasyrisca turkenica* Ovtsharenko, Platnick and Marusik, 1995, *Pseudodrassus ricasolii* Caporiacco, 1935, and *Zelotes strandi* (Nosek, 1905).

Other: *Berinda ensiger* (O. P.-Cambridge, 1874), *Cesonia aspida* Chatzaki 2002, *Cryptodrassus creticus* Chatzaki, 2002, *Drassodes lacertosus* (O. P.-Cambridge, 1872), *Drassodes serratichelis* (Roewer, 1928), *Gnaphosa bithynica* Kulczyński, 1903, *Haplodrassus morosus* (O. P.-Cambridge, 1872), *Arboricaria koeni* (Bosmans and Blick, 2000), *Poecilochroa senilis* (O. P.-Cambridge, 1872), *Pterotricha lesserti* Dalmas, 1921, *Pterotrichia kochi* (O. P.-Cambridge, 1872), *Setaphis fuscipes* (Simon, 1885), *Trachyzelotes lyonnetii* (Audouin, 1826), *Zelotes ilotarum* (Simon, 1884), *Zelotes olympi* (Kulczyński, 1903), and *Zelotes tenuis* (L. Koch, 1866).

New records of gnaphosid spider to Turkey

Eleven species mentioned in this paper, *Drassodes lacertosus, D. serratichelis, Gnaphosa mongolica, Haplodrassus invalidus, H. morosus, Arboricaria koeni, Setaphis carmeli, S. fuscipes, Sosticus loricatus, Trachyzelotes lyonnetii* and *Zelotes ilotarum* are new records for Turkey. So far, no species of genera *Arbori-*

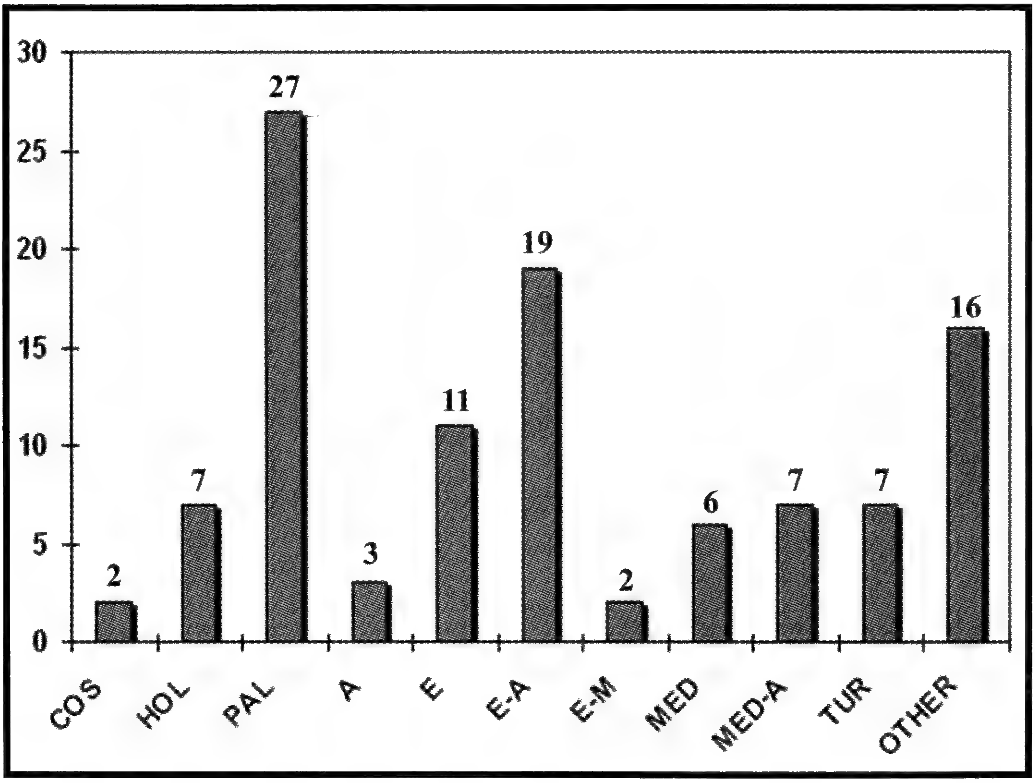


Fig. 2. Classification of Turkish ground spiders in eleven zoogeographical categories. Abbreviations: COS=cosmopolitan; HOL=Holarctic; PAL= Palearctic; A= Asian; E= European; E-A= European-Asian; E-M= European-Middle East; MED= Mediterranean; MED-A= Mediterranean-Asian; TUR= Turkey (endemic).

caria, Setaphis and *Sosticus* had been reported before from Turkey. Most of species were found during collecting in the south of Turkey using pitfall traps and manual collecting during the years 2005-2008.

Arboricaria koeni (Bosmans and Blick, 2000)

Material: TURKEY: 1♀, Nevsehir province, Derinkuyu district, Özlüce village, 21.VI.2005, leg. T. Türkes; 1♀, Kahramanmaras province, Türkoğlu district, Kızılenis village (37°20'N, 36°46'E), 655m, 22.V. 2007, leg. O. Seyyar.

Comments: This species was originally described in genus *Arboricaria* which was established as a new genus by Bosmans (Bosmans & Blick, 2000), but he provided no evidence that it constitutes the sister group of all other *Micaria*, therefore it is synonymized with *Micaria* (Platnick, 2008). Although Platnick (2008) disregards the validity of the genus, in our opinions, the independent status of *Arboricaria* is fully justified and we therefore consider *Arboricaria* separately from *Micaria*. The spider of genera *Micaria* and *Arboricaria* resemble each other by having small and slender bodies. In addition, both genera are similar in the structure of the spinnerets and chelicerae, but *Arboricaria* can be distinguished by having a more flattened, wider cephalothorax, significantly fewer leg spines and in the structure of its copulatory organs (Tuneva, 2006, for further details see Bosmans & Blick, 2000). This species was only known from *Olea* orchard and under bark in Greece, but we found this species under stones in both Nevsehir province in Central Anatolia and Kahramanmaras province in the south of Turkey. Also, our samples are similar to the samples of Greece but their bodies are bigger (total length 4-4.2mm). It is its first record outside Europe.

Drassodes lacertosus (O. P.-Cambridge, 1872)

Material: TURKEY: 2♀♀, Niğde province, Ulukısla district, Meydan plateau (37°35'N, 34°33'E), 2300m, 28.VI.2007, leg. O. Seyyar; 1♂, Gümüs village, (37°29'N, 34°37'E), 2200m, 28.VI.2007, leg. O. Seyyar; 3♀♀, Osmaniye province, Yarpuz valley (37°03'N, 36°25'E), 1030m, 01.V.2007, leg. O. Seyyar and H. Demir; 1♂3♀♀, Kahramanmaras province, Andırın-Geben districts (37°37'N, 36°24'E), 1281m, 25.VI.2007, leg. O. Seyyar.

Comments: All specimens were found above altitude of 1000m. This species thus probably prefers high altitudes.

Drassodes serratichelis (Roewer, 1928)

Material: TURKEY: 1♀, Kahramanmaras province, Andırın-Geben districts (37°37'N, 36°24'E), 1281m, 25.VI.2007, leg. O. Seyyar.

Comments: *Drassodes serratichelis* is one of the smallest members of the genus *Drassodes* in Turkey. We collected only a female at the bottom of short *Quercus* plant. We think that this species is uncommon in Turkey because we could not find it before during our trips in different parts of Turkey.

Gnaphosa mongolica Simon, 1895

Material: TURKEY: 1♂ 2♀♀, Nevsehir province, Derinkuyu district, Özlüce village, 27.VII.2006, leg. T. Türkes; 1♂1♀, Kahramanmaras province, Türkoğlu district, Kızılenis village (37°20'N, 36°46'E), 655m, 22.V. 2007, leg. O. Seyyar.

Comments: This species shows a general distribution in steppe zone of Eurasia and from Hungary to China. The recording of this species from Turkey widens its distribution. We found all specimens under stones in steppe zone in Central Anatolia and eastern Mediterranean region of Turkey.

Haplodrassus invalidus (O. P.-Cambridge, 1872)

Material: TURKEY: 2♂♂ 2♀♀, Mersin province, Gülek pass, Sarıısık village (37°12'N, 34°48'E), 16.VII.2005, leg. A. Topçu and T. Türkes; 2♂♂ Kahramanmaras province, Göksun district, Püren pass (37°56'N, 36°30'E), 1581m, 25.VI.2007, leg. O. Seyyar.

Comments: This species is widely distributed in Mediterranean countries, i.e. Spain, Corsica, Sicily, Italy, and Israel. The recording of this species from Turkey shows that this species is distributed along the Mediterranean region.

Haplodrassus morosus (O. P.-Cambridge, 1872)

Material: TURKEY: 1♂, Osmaniye province, Yarpuz valley (37°03'N, 36°25'E), 903m, 01.V.2007, leg. O. Seyyar and H. Demir; 1♂, Kayseri province, Yahyalı district, Kapuzbası, 26.V.2007, leg. A. Topçu; 1♀, Kayseri province, Yahyalı district, 22.VII.2007, leg. H. Demir.

Setaphis carmeli (O. P.-Cambridge, 1872)

Material: TURKEY: 1♂, Osmaniye province, Yarpuz valley (37°03'N, 36°25'E), 903m, 01.V.2007, leg. O. Seyyar and H. Demir; 1♂, Hatay province, Hassa district, Akbez village (36°50'N, 36°32'E), 450m, 02.V.2007, leg. O. Seyyar and H. Demir; 1♂, Kahramanmaras province, Andırın district, Yesilova village (37°27'N, 36°20'E), 202m, 24.V.2007, leg. O. Seyyar; 5♂♂, Muğla province, Marmaris district (These samples were collected by pitfall traps), 15.IV.2006, leg. T. Türkes.

Setaphis fuscipes (Simon, 1885)

Material: TURKEY: 2♀♀, Kahramanmaras province, Andırın district, Sarımollalı village (37°35'N, 36°35'E), 1184m, 15.V.2008, leg. O. Seyyar.

Sosticus loricatus (L. Koch, 1866)

Material: TURKEY: 1♀, Mersin province, Belemedik village (37°20'N, 34°34'E), 18.V.2007, leg. O. Seyyar.

Trachyzelotes lyonnetii (Audouin, 1826)

Material: TURKEY: 1♀, Kahramanmaras province, Andırın district, Torun village (37°29'N, 36°21'E), 611m, 26.VI.2007, leg. O. Seyyar; 1♂, Osmaniye province, Hierapolis Castabala ruins (37°10'N, 36°11'E), 1590m, 24.V.2007, leg. O. Seyyar; 2♂♂1♀, Sumbas district, Alibeyli village (37°24'N, 36°03'E), 62m, 24.V.2007, leg. O. Seyyar and H. Demir; 2♂♂1♀, Kayseri province, Yahyalı district, Kapuzbası, 26.V.2007, leg. A. Topçu; 1♂12♀♀, Mersin province, Mut district, 22.VI.2006, leg. T. Türkes.

Zelotes ilotarum (Simon, 1884)

Material: TURKEY: 1♀, Osmaniye province, Toprakkale district (37°03'N, 36°08'E), 70m, 01.V.2007, leg. O. Seyyar; 3♀♀, Osmaniye province, Yarpuz valley (37°03'N, 36°25'E), 903m, 23.V.2007, leg. O. Seyyar; 1♀, Osmaniye province, Zorkun plateau (37°01'N, 36°17'E), 705m, 13.V.2008, leg. O. Seyyar; 2♀♀, Gaziantep province, Nurdağı district, Fevzipasa (37°05'N, 36°37'E), 514m, 02.V.2007, leg. O. Seyyar and H. Demir; 1♀ Kahramanmaras province, Türkoğlu district, Kaledıbi village (37°22'N, 36°49'E), 508m, 22.V.2007, leg. O. Seyyar; 1♀1♂, Adana province, Aladağ district, Eğner village (37°25'N, 35°26'E), 243m, 19.VI.2008, leg. O. Seyyar; 2♀♀1♂, Adana province, Feke district, Akkaya village (37°42'N, 35°53'E), 870m, 12.V.2008, leg. O. Seyyar.

The progress in our taxonomic knowledge of Turkish gnaphosid fauna is summarized in (Fig 3).

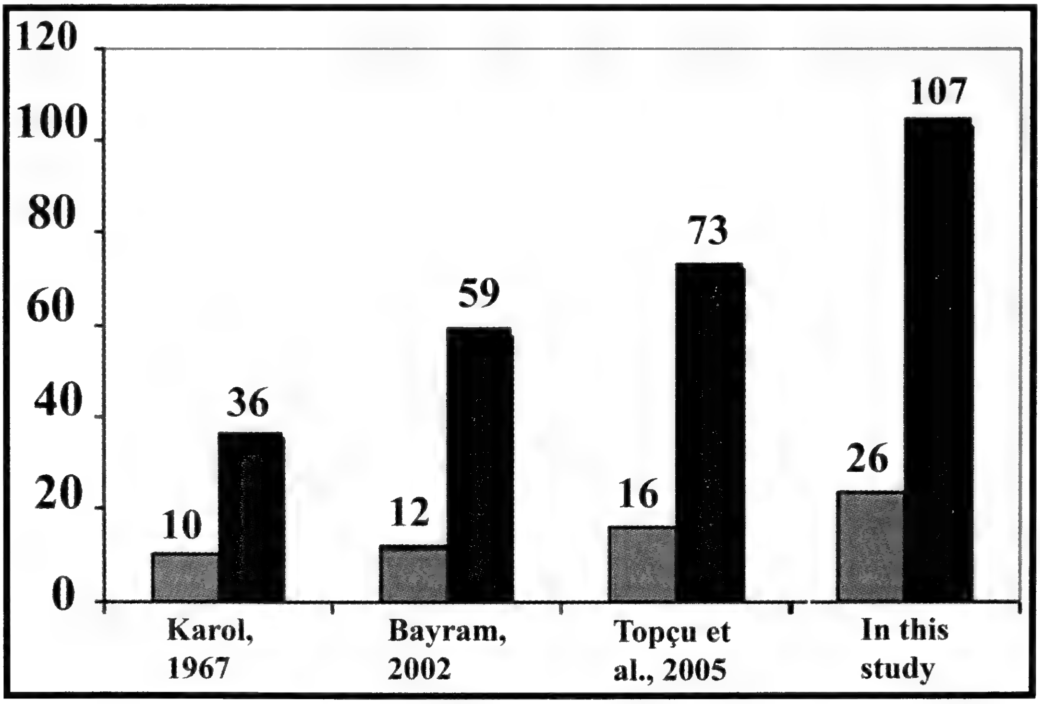


Fig. 3. The numbers of Turkish gnaphosid genera (in gray) and species (in black) in preceding lists and in this study.

DISCUSSION

Turkish ground spiders are classified in eleven zoogeographical categories. The percentages of the spiders in this classification are found as follows: Cosmopolitan

1.86%, Holarctic 6.54%, Palearctic 25.23%, Asian 2.80%, European 10.28%, European-Asian 17.75%, European-Middle East 1.86%, Mediterranean 5.60%, Mediterranean-Asian 6.54%, Endemic (Turkey) 6.54% and others 14.95%. The character of the ground spiders of Turkey is therefore Palearctic and mainly European-Asian.

These seven species are endemic to Turkey: *Berlandina pulchra* (Nosek, 1905), *Drassodes similis* Nosek 1905, *Gnaphosa lucifuga minor* Nosek 1905, *Nomisia orientalis* Dalmas 1921, *Pseudodrassus ricasolii* Caporiacco 1935, *Parasyrisca turkenica* Ovtsharenko, Platnick, and Marusik 1995 and *Zelotes strandi* (Nosek, 1905). The species of *Zelotes olympi* (Kulczyński, 1903) was considered a Turkish endemic but this species are described from Crimea by Kovblyuk in 2005 (see Kovblyuk 2005). Amongst the Turkish endemic species, only *Parasyrisca turkenica* Ovtsharenko, Platnick and Marusik 1995 and *Nomisia orientalis* Dalmas 1921 species have been recorded outside its type locality, none of the other endemic species have been recorded in the araneological studies since their first description.

The species of *Cesonia aspida* Chatzaki 2002, *Cryptodrassus creticus* Chatzaki 2002, *Haplodrassus morosus* (O. P.-Cambridge, 1872) and *Arboricaria koeni* (Bosmans & Blick, 2000) are distributed only in Turkey apart from their type localities. The largest groups of ground spider are the widely distributed Palearctic and European-Asian. The character of the ground spiders of Turkey is therefore palearctic and mainly European-Asian.

The knowledge of gnaphosid spiders in countries adjacent to Turkey (except Iran, Iraq, and Syria), is better developed. For instance, the number of ground spider species of Bulgaria, Greece, and Central Europe are 99 (Deltshev and Blagoev, 2001), 114 (Bosmans and Chatzaki, 2005) and 105 species (Blick et al., 2004), respectively. We suspect that the actual ground spider fauna of Turkey is considerably larger, as there are a variety of environments, different both in geomorphology and vegetation. Research on this family is still in progress as a large part of Turkey is still to be investigated.

ACKNOWLEDGEMENTS

The authors acknowledge the Scientific and Technological Research Council of Turkey (TUBITAK) (Project No.106T133) and Erciyes University Scientific Research Project Unit (Project No. FBT-07-81) for financial support of this work. This paper includes some data of the doctoral thesis of the first author. We also thank Mr. Hakan Demir (Gazi University, Turkey), who collected some of the material presented in this paper. Maps courtesy of www.theodora.com/maps, used with permission.

LITERATURE CITED

Bayram, A. 2002. Distribution of Turkish spiders. pp. 638-657. *In*, Demirsoy, A. (Editor). Zoogeography of Turkey. Meteksan Publ., Ankara, Turkey. 1005 pp. (in Turkish).

Blick, T., R. Bosmans, J. Buchar, P. Gajdos, A. Hänggi, P. Van Helsdingen, V. Rùzicka, W. Starêga, and K. Thaler. 2004. Checkliste der Spinnen Mitteleuropas. Checklist of the spiders of Central Europe (Arachnida: Araneae). Version 1. December 2004. http://www.arages.de/checklist.html#2004_Araneae

Bosmans, R. and T. Blick. 2000. Contribution to the knowledge of genus *Micaria* in the West-palaeartic region, with description of the genus Arboricaria and three new species. Memorie società entomologica italiana 78 (2): 443-476.

Bosmans R. and M. Chatzaki. 2005. A catalogue of the spiders of Greece. Newsletter of the Belgian Arachnological Society 20 (Supplement 2): 1-124.

Chatzaki, M., K. Thaler, and M. Mylonas. 2002a. Ground spiders (Gnaphosidae; Araneae) of Crete (Greece). Taxonomy and distribution. I. Revue suisse de Zoologie, 109: 559–601.

Chatzaki, M., K. Thaler, and M. Mylonas. 2002b. Ground spiders (Gnaphosidae: Araneae) of Crete and adjacent areas of Greece. Taxonomy and distribution. II. Revue suisse de Zoologie, 109: 603-633.

Deltshev C. and G. Blagoev. 2001. A critical checklist of Bulgarian spiders (Araneae). Bulletin of the British Arachnological Society 12: 110-138.

Karol S. 1967. Türkiye Örümcekleri I. Ön Liste. Ankara Üniversitesi Fen Fakültesi Yayınları. Ankara, Turkey. 109: 1-37.

Kovblyuk M. M. 2005. Little-known species of the genus *Zelotes* from Crimea. Vestnik zoologii. 39(5): 3-14 [in Russian with English summary].

Levy, G. 1995. Revision of the spider subfamily Gnaphosinae in Israel (Araneae: Gnaphosidae). Journal of Natural History 29: 919-981.

Levy, G. 1998. The ground-spider genera *Setaphis*, *Trachyzelotes*, *Zelotes* and *Drassyllus* (Araneae: Gnaphosidae) in Israel. Israel Journal of Zoology, 44: 93-158.

Levy, G. 1999. Spiders of six uncommon drassodine genera (Araneae: Gnaphosidae) from Israel. Israel Journal of Zoology 45: 427-452.

Ovtsharenko, V. I., N. I. Platnick, and Y. Marusik. 1995. A review of the Holarctic Ground Spider Genus *Parasyrisca* (Araneae, Gnaphosidae). American Museum Novitates 3147. 55 pp.

Ovtsharenko, V. I., N. I. Platnick, and D. X. Song. 1992. A review of the North Asian ground spiders of the genus *Gnaphosa* (Araneae, Gnaphosidae). Bulletin of the American Museum of Natural History 212: 1-88.

Özdemir, A., I. Varol, Z. Akan, M. Kütük, F. Kutbay, and M. Özaslan. 2006. The Fauna of Spider (Araneae) in the Nizip and Karkamıs – Gaziantep (Turkey). Biotechnology & Biotechnological Equipment. Vol. 20(1), pp. 74-77.

Platnick, N. I. 2008. The world spider catalog, version 8.5 American Museum of Natural History, online at http://research.amnh.org/entomology/spiders/catalog/index.html.

Platnick, N. I. and B. Baehr. 2006. A revision of the Australasian ground spiders of the family Prodidomidae (Araneae, Gnaphosoidea). Bulletin of the American Museum of Natural History 298: 1-287.

Seyyar, O., A. Topçu, and H. Demir. 2006. H. New records of ground spiders (Araneae: Gnaphosidae) from Anatolia. Zoology in the Middle East, 38: 118-120.

Seyyar,O., H. Demir, and A. Topçu. 2006. A contribution to the gnaphosid spider fauna of Turkey (Araneae: Gnaphosidae). Serket 10(2) :49-52.

Seyyar, O., H. Demir, A. Topçu, and A. Tasdemir. 2006. *Phaeocedus* is a new genus of ground spider (Araneae, Gnaphosidae) in Turkey, Scientific Research and Essay Vol. 1(1), pp. 026-027 (October).

Seyyar, O., H. Demir, and A. Topçu. 2007. Three new ground spider (Araneae: Gnaphosidae) records for the Turkish Spider Fauna. Serket 10(4): 123-124.

Seyyar, O., N. Ayyıldız, and A. Topçu. 2007. Notes on *Cesonia* Simon 1983, a newly recorded genus for Asian Araneofauna (Araneae, Gnaphosidae). Arachnologische Mitteilungen 34: 25-26.

Topçu, A., O. Seyyar, H. Demir, and K. B. Kunt. 2005. *Anagraphis pallens* Simon, 1893, a new record from Turkey (Araneae : Prodidomidae). Serket 9(3): 85-86.

Topçu, A., H. Demir, and O. Seyyar. 2005. A Checklist of the spiders of Turkey. Serket 9(4): 109-140.

Topçu, A., H. Demir, O. Seyyar, and T. Türkes. 2006. The spider fauna of the Gülek Pass (Turkey) and its environs (Araneae), European Arachnology 2005 C. Deltshev and P. Stoev (Editors), Acta zoologica bulgarica, Supplementum 1: 287-295.

Topçu, A., H. Demir, and O. Seyyar. 2007. Seven new records for the Turkish Araneofauna (Arachnida: Araneae), with zoogeographical remarks. Entomological News 118(4): 429-430.

Varol, M. I., C. Mart, M. Özaslan, A. Bayram, Z. Akan, and A. Özdemir. 2006. Investigation on spiders Fauna of Hancağız Dam-Nizip (Turkey). Journal of Biological Sciences 6: 344-346.

FITCH'S *APHIS MALI* VARIETIES ARE *RHOPALOSIPHUM OXYACANTHAE* (HEMIPTERA: APHIDIDAE)[1]

Colin Favret,[2] Gary L. Miller,[2] and Andrew S. Jensen[3]

ABSTRACT: The types of *Aphis mali* var. *fulviventris*, var. *nigricollis*, var. *nigriventris*, var. *obsoleta*, var. *pallidicornis*, var. *tergata*, var. *thoracica*, and var. *triseriata* (all Fitch 1855) were rediscovered in the aphid collection of the United States of America National Museum of Natural History. Previously considered *nomina dubia*, we here establish them, along with Fitch's other two *A. mali* varieties, var. *bivincta* and var. *immaculata*, as junior synonyms of *Rhopalosiphum oxyacanthae* (Schrank) [=*R. insertum* (Walker)].

KEY WORDS: Asa Fitch, *Aphis mali, Rhopalosiphum oxycanthae, R. insertum,* Hemiptera, Aphididae, new synonymy

Asa Fitch (1809-1879) was one of America's first leading entomologists. Working in New York State, he named 429 insect species and published 222 popular and scientific entomological papers (Barnes 1988). Fitch described 52 species and subspecies of aphids, 33 of which remain valid (as of Barnes 1988). Among his aphid species-groups were 10 varieties of *Aphis mali* Fabricius. *Aphis mali* is today a junior synonym of *Aphis pomi* DeGeer, but Fitch's concept of *A. mali* was recognized as a distinct species and named *Aphis fitchii* Sanderson (1902). *Aphis fitchii*, was in turn made a synonym of a *Rhopalosiphum insertum* (Walker) (Eastop and Hille Ris Lambers 1976), which is today a synonym of *R. oxyacanthae* (Schrank) (García Prieto et al., 2004).

Fitch described his ten varieties of *A. mali* in 1855 (pp. 759-760): *A. mali* var. *bivincta*, var. *fulviventris*, var. *immaculata*, var. *nigricollis*, var. *nigriventris*, var. *obsoleta*, var. *pallidicornis*, var. *tergata*, var. *thoracica*, and var. *triseriata*. Unfortunately, Fitch mounted most of his aphid specimens on pins, points, or glueboards, and many have been destroyed or rendered otherwise unusable over the years. Examination of Fitch's unpublished aphid notes (Miller et al., 2006) did not provide any additional information for further clarification of his *Aphis mali* varieties. Due to inadequate descriptions and missing types, the names of these ten varieties have been considered *nomina dubia* (Smith and Parron 1978, Remaudière and Remaudière 1997).

Theodor Pergande, the first curator of the United States of America National Aphid Collection from 1878 to 1915, slide-mounted some of Fitch's specimens in 1903 (Pergande's notes in the National Aphid Collection, Beltsville, Mary-

---

[1] Received on March 6, 2008. Accepted on April 1, 2008.

[2] United States Department of Agriculture, Agricultural Research Service, Systematic Entomology Laboratory, 10300 Baltimore Ave, Building 005 BARC-WEST, Beltsville, Maryland 20705 U.S.A. E-mails: ColinFavret@AphidNet.org, Gary.Miller@ars.usda.gov, respectively.

[3] 9344 Road S NE, Moses Lake, WA 98837, U.S.A. and Adjunct Faculty, Department of Entomology, Washington State University, Pullman, Washington 99164 U.S.A. E-mail: ajensen@televar.com.

Mailed on February 19, 2009

land, USA) but could not locate *A. mali* var. *immaculata*. During a recent audit of the National Museum of Natural History's Aphid Type Collection (Beltsville, Maryland, USA), we rediscovered the type slides of eight of the ten *nomina dubia*. We determined them as *Rhopalosiphum oxyacanthae* (Schrank) and here establish them as synonyms. Although we found only eight of the ten missing types, because Fitch's (1855) descriptions indicate that all ten varieties were very similar and from the same host plant species, we here also regard the other two varieties as synonyms of *R. oxyacanthae*.

Rhopalosiphum oxyacanthae (Schrank 1801: 116) (*Aphis*)

Aphis mali var. *bivincta* Fitch 1855: 760. **New synonymy** (Fitch number 4,992, mounted by Pergande, but not located in the collection).

Aphis mali var. *fulviventris* Fitch 1855: 760. **New synonymy** (Fitch number 5,000, NMNH catalog number 399,000, alate male).

Aphis mali var. *immaculata* Fitch 1855: 760. **New synonymy** (type missing, per Pergande's notes).

Aphis mali var. *nigricollis* Fitch 1855: 760. **New synonymy** (Fitch number 4,993, NMNH catalog number 399,001, alate female).

Aphis mali var. *nigriventris* Fitch 1855: 760. **New synonymy** (Fitch number 4,997, NMNH catalog number 399,002, alate female).

Aphis mali var. *obsoleta* Fitch 1855: 760. **New synonymy** (Fitch number 4,990, NMNH catalog number 399,003, alate female).

Aphis mali var. *pallidicornis* Fitch 1855: 759. **New synonymy** (Fitch number 4,987, NMNH catalog number 399,004, alate female).

Aphis mali var. *tergata* Fitch 1855: 760. **New synonymy** (Fitch number 4,994, NMNH catalog number 399,005, alate male).

Aphis mali var. *thoracica* Fitch 1855: 760. **New synonymy** (Fitch number 4,995, NMNH catalog number 399,006, alate female).

Aphis mali var. *triseriata* Fitch 1855: 760. **New synonymy** (Fitch number 4,988, NMNH catalog number 399,007, alate male).

ACKNOWLEDGMENTS

We thank Doris Lagos (University of Illinois, Urbana-Champaign), Norm Woodley and Ron Ochoa (USDA, Systematic Entomology Laboratory), and four anonymous reviewers for helpful suggestions on the manuscript.

LITERATURE CITED

Barnes, J. K. 1988. Asa Fitch and the emergence of American entomology. New York State Museum Bulletin 461. 120 pp.

Eastop, V. F. and D. Hille Ris Lambers. 1976. Survey of the World's Aphids. Dr. W. Junk. The Hague, The Netherlands. 573 pp.

Fitch, A. 1855. The first report on the noxious, beneficial, and other insects of the state of New York. Transactions of the New York State Agricultural Society 14: 705-880.

García Prieto, F., N. Pérez Hidalgo, M. P. Mier Durante, and J. M. Nieto Nafría. 2004. Updated check-list of Iberian-Balearic Aphidini (Hemiptera, Aphididae). Graellsia 60: 197-214.

Miller, G. L., E. C. Kane, J. Eibl, and R. W. Carlson. 2006. Resurrecting Asa Fitch's aphid notes: Historical entomology for application today. http://www.ars.usda.gov/Services/docs.htm?docid=12851 [accessed 19 February 2008].

Remaudière, G. and M. Remaudière. 1997. Catalogue of the World's Aphididae. INRA. Paris, France. 473 pp.

Sanderson, E. D. 1902. Report of the entomologist. Annual Report of the Delaware College Agricultural Experiment Station 13: 127-199.

Schrank, F. v. P. 1801. Blattlaus. Fauna Boica. Durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere. Johann Wilhelm Krüll. Ingolstadt, Germany, 2: 102-140.

Smith, C. F. and C. S. Parron. 1978. An annotated list of Aphididae (Homoptera) of North America. North Carolina Agricultural Experiment Station Technical Bulletin 255. 428 pp.

ACKNOWLEDGMENTS TO POST-SUBMISSION REVIEWERS AND TO ALL WHO HAVE CONTRIBUTED TOWARDS THE COMPLETION OF *ENTOMOLOGICAL NEWS*, VOLUMES 114 TO THE PRESENT

Jorge A. Santiago-Blay

During the time I have served as editor of *Entomological News* [Volumes 114 (2003) to the present], over 800 post-submission reviewers from all continents, except Antarctica, have generously donated their time and expertise. Herein, I also wholeheartedly and gratefully acknowledge all who have contributed towards the completion of these volumes, to pre-submission reviewers, and to reviewers who prefer to remain anonymous for help to maintain and improve the scientific quality standards of *Entomological News.*

Jorge A. Santiago-Blay, Washington, District of Columbia, U.S.A.
E-mail: blayjorge@gmail.com

SPERMATHECAL MORPHOLOGY OF *ENOPLOPS DISCIGER* (KOLENATI, 1845) (HETEROPTERA: COREIDAE)[1]

Selami Candan[2]

ABSTRACT: The morphology of the spermatheca *Enoplops disciger* (Kolenati, 1845) (Heteroptera: Coreidae) was examined by optical and scanning electron microscopy (SEM). The spermatheca of *E. disciger* is characterized by the presence of a T-shaped or reniform, sclerotized spermathecal bulb, whose surface is covered by many pores, a fairly short, spirally twisted spermathecal duct; a single flanged spermathecal pump; and two lateral sclerotized rings.

KEY WORDS: Heteroptera, Coreidae, *Enoplops disciger*, spermatheca, scanning electron microscopy

The insect spermatheca, a female reproductive accessory organ present in all hexapodan orders except Protura and Collembola (Matsuda, 1976), stores spermatozoa, provides conditions to sustain sperm viability often over prolonged periods (Davey 1965) and, in some species, it controls the sex of her progeny by selective release of spermatozoa during fertilization (Gupta and Smith 1969).

The first study on the spermatheca in the Heteroptera was carried out by Dufour (1833), who erroneously regarded it as a sebaceous gland. Siebold (1837) published the earliest correct description of a spermatheca (as receptaculum seminis) in Pentatomomorpha. More recently, three fundamental works on the structure of the female genitalia in Heteroptera were completed by Dupuis (1955), Pendergrast (1957), and Scudder (1959). Additionally, two important works on the female and male genitalia of Pentatomoidea were published by Kumar (1962) and McDonald (1966). Servadei (1964) provided a detailed description of spermathecae of Acanthosomatidae, Pentatomidae, and Scutelleridae, with an original key to subfamilies and genera. The spermathecae of 25 central European species of Coreoidea were studied by Vavrinova (1988). The spermathecae of 12 species representing 9 genera and 2 subfamilies of Korean Coreidae were studied by Lee et al. (1989). The spermathecae of other Coreidae were described by Kumar (1965); Bravilovsky (1984, 1987, 1998) as well as Bravilovsky and Barrera (2001). As a result of all these studies, it is safe to state that the structure of the spermatheca in the Heretoptera is complex and diverse, being the source of valuable systematic characters. Curiously, some Heteroptera lack spermatheca, and in some other species, the spermatheca has lost its primary function of storing sperm (Dupuis 1970, Schuh and Slater 1995).

---

[3] Received on September 24, 2007. Accepted on March 17, 2008.

[4] Gazi University, Faculty of Arts and Sciences, Department of Biology 06500 Teknikokullar, Ankara, Turkey. E-mail: scandan@gazi.edu.tr

Mailed on February 19, 2009

Herein I present a detailed examination of the spermatheca of *Enoplops disciger* (Coreidae) using both light and SEM and compare the results with that of other Coreidae and of other heteropteran families.

METHODS

Six specimen examined were selected from dried museum material obtained from the field (Orhaniye village, Kazan, Ankara, Turkey, 22. VII. 2005). The spermatheca was prepared by first softening the abdomen in 10% KOH for 5-10 minutes. Thereafter, tissues were carefully removed and the spermathecae was placed in glycerin. Observations were made using a stereomicroscope (Olympus SZX12 photomicroscope at 40X). For scanning electron microscopy (SEM), rinsed and dried spermathecae were mounted with double-sided carbon tape on SEM stubs, coated with gold using a Polaron SC 502 sputter coater, and examined with a Jeol JSM 6060 SEM operated at 15 kV.

Nomenclature follows Pendergrast (1957), Scudder (1959), and McDonald (1966). The following morphological characters of the spermatheca were examined: shape of the spermathecal bulb (apical receptacle), shape of the pump, size of the flange of the pump (located between spermathecal pump and spermathecal duct), shape and size of the distal part of the spermathecal duct, shape and size of the proximal part of the spermathecal duct, shape of the ring sclerites (genital chamber).

RESULTS

Description of the spermatheca of *Enoplops disciger* (Figs. 1a-f, 2a-d)

The spermatheca of *E. disciger* consists of the spermathecal bulb, a spermathecal pump, an intermediate flange associated with the pump, the spermathecal ducts, and a genital chamber (Figs. 1a, b). The heavily sclerotized spermathecal bulb is brown and reniform or kidney-shaped (Figs. 1a-c). The surface of the bulb is covered with many pores. The spermatozoa are stored in the bulb (Figs. 1c, d). The lightly sclerotized spermathecal pump consists of a long twisted tube, entwined upon itself, whose surface lacks pores. The spermatheca has a single pump flange (Figs. 2a, b). The pumping flange is a combination of a muscular structure (Fig. 2b) and sclerite, which is connected to the distal part of the spermathecal duct. On the surface of the pumping flange are many small pores (Figs. 2a, b). Below the pump, the muscular spermathecal duct is relatively short and spirally twisted (Fig. 2c). The muscle fibers are attached to the coiled mass near the distal region of the spermathecal duct. Proximad, the spermathecal duct is closely associated with the opening of the vagina (Fig. 2d). There are two ring sclerites, one at each side of the genital chamber. These structures are horseshoe shaped (Figs. 1a, 2d).

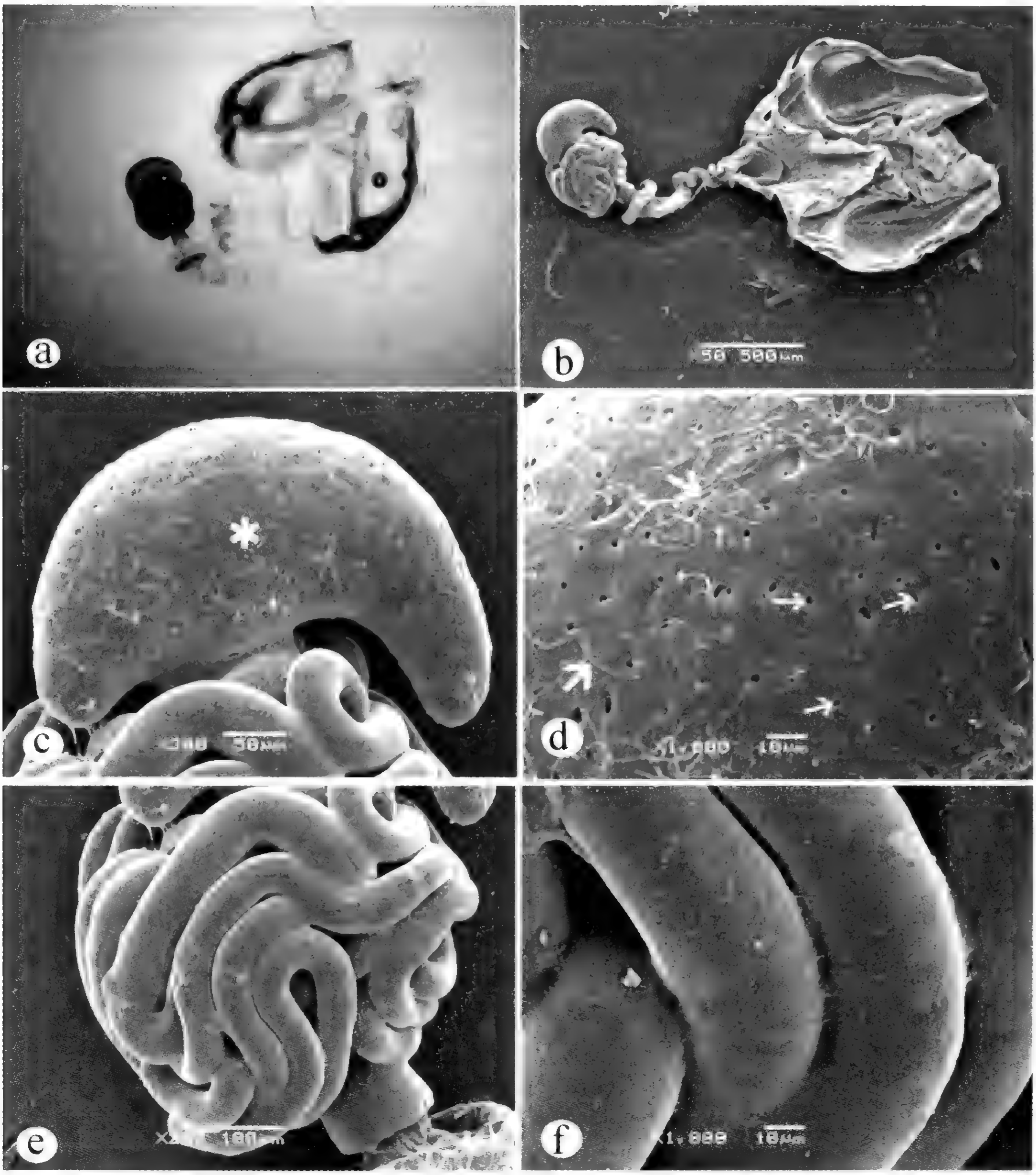


Figure 1 a-f. Light and SEM micrographs of *Enoplops disciger* (Kolenati) spermatheca. Spermatheca, overview utilizing, a. light microscopy, and b. scanning electron microscopy. c. Spermathecal bulb (✱). d. Surface of spermathecal bulb illustrating of pores (→) and presence of sperm tails (➔). e. Pump. f. Surface of pump.

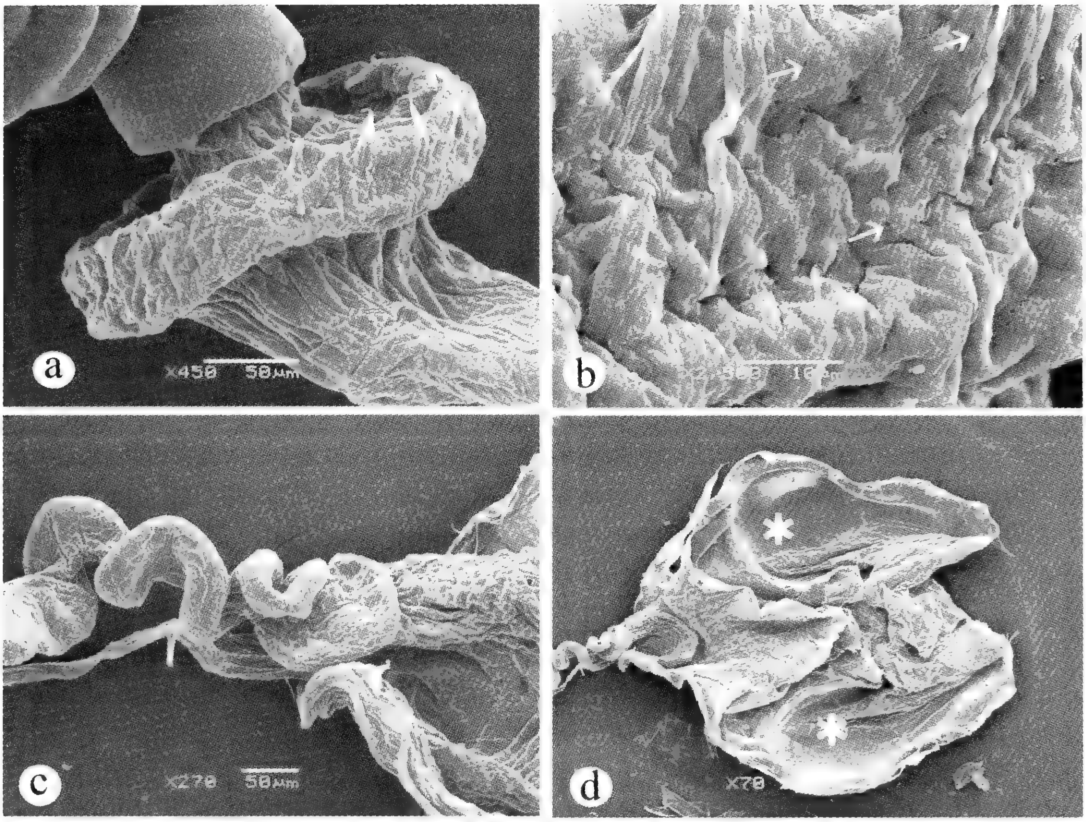


Figure 2 a-d. Scanning electron micrographs of *Enoplops disciger* spermatheca. a. Flange of pump. b. Surface of pump flange, pores (→). c. Spermathecal duct with spiral, twisted shaped coil. d. Two ring sclerites (✱).

DISCUSSION

A spermatheca is present in all heteropteran Pentatomoidea, including the Coreidae, and it usually consists of a spermathecal duct, leading from the vagina to a dilated spermathecal bulb (seminal receptacle, distal bulb). In these insects, the spermatheca is characterized by a well marked pump in the intermediate part with both proximal and distal flanges (Pendergrast, 1957, McDonald, 1966, Pluot and Lis 2008). However, in some Heteroptera the spermathecal morphology is different. For example, in the Pentatomidae (Podopinae, Asopinae) the spermatheca is composed of a spermathecal bulb, a pump with two flanges, a median spermathecal dilation with sclerotized rod, and one or two sclerites (McDonalds 1966, Kumar 1962). In some Pentatomidae (e.g. Podopinae), the spermathecal bulb is spherical (*Scotinophara lurida*, *S. scotti, S. horvathi*), semioblong (*Graphosoma rubrolineatum*) oblong-ovate (*Dybowskyia reticulate*) and have one or three spermathecal processes, but in other Pentatomidae (e.g. Asopinae), the spermathecal bulb is spherical (*Arma chinensis*, *Picromerus bidens*, *P. lewisi*), semioblong (*Pinthaeus sanguinipes*), semiovoidal (*Zicrona caerulea*) and all species of the Asopinae do not have spermathecal processes. The function of these processes is not clear, but the presence of spermathecal processes is an important taxonomic character used at the generic level (Kim and Lee, 1994, Lagaspi et al. 1994). The spermathecal duct in Scutelleridae is medially expanded into a heavily sclerotized globular chamber with a series of fine markings; the externally pumping region is well developed and connected to the spermathecal dilation by a short duct; and the spermathecal bulb is elongated and apically expanded into a spherical bulb (Scudder 1959, Mc Donald 1966). Candan et al. (2007) pointed out that in *Odontotarsus purpurreolineatus* (Scutelleridae) the spermathecal processes and median spermathecal dilation with sclerotized rod are missing. In the Acanthosomidae, the spermatheca lacks a diverticulum, differing in this respect from the general pentatomid type (Scudder 1959, Pendergrast 1957).

The spermathecae of the Coreidae are remarkably varied at various taxonomic levels (Vavrinova 1988). For instance, Lee et al. (1989) says that the bulb of the Pseudophloeinae is elongate to oval-shaped and opens laterally into the spermathecal duct, whereas in *Hygia* and *Colpura* (Coreinae), the spermathecal bulb is globular and short, with a convoluted membranous duct and without duct dilation. In most species of Coreidae, except *Coriomeris,* there is a well-developed convoluted duct, but there are two kinds of bulbs: membranous and dilated. Accordingly, the spermatheca of Coreidae are divided in three groups: 1) with globular bulb and large membranous duct with regular coil, 2) with small terminal bulb and extremely long membranous duct, and 3) reniform bulb and distinctly dilated duct. Schaefer (1965) reported that the spermathecal bulb (Capsula seminalis) of Coreinae is spherical (*Gonocerus acuteangulatus* and *G. juniperi*) or ellipsoidal (*Coreus marginatus, Spathocera lobato* and *S. laticornis*), occasionally reniform (*Enoplops scapha*), and all lack a typical distal flange. The proximal flange is developed and differs in structure in different species of Coreinae subfamily. Interestingly, Carayon (1964) states that spermathecae may sometimes exhibit differences even between different geographic races of a species.

The spermathecal bulb of *E. disciger* is reniform and similar to that of *E. scapha*. While *E. disciger* has a distal flange, the spermatheca of some Coreidae lacks a distal flange. Additionally, muscle fibrils are attached to a coiled mass at the distal parts of the spermathecal duct. The spermatheca of *E. disciger* is similar to that of some Coreini but lacks the thin, scantly coiled vermiform duct and the basal bulb curvature followed by a long membranous process (Bravilovsky 1987, Lee et al., 1989). The spermatheca of *E. disciger* differs from that of *Amblyomia bifasciata* (Coreidae: Coreinae), which has an oval spermatheca bulb, a moderately coiled sclerotized duct leading from bulb, a slightly widened proximal duct near the distal flange, and a narrowed membranous distal duct (Bravilovsky 1998). Bravilovsky and Barrera (2001) also noted that in the Meropachydini (Coreidae), the spermathecal bulb is elongated and the spermathecal duct is conspicuously coiled proximally with two to four distal coils while the flank is distinct with a more or less globular chamber. Obviously, the spermathecal structure in *E. discger* is significantly different from those found in other Coreidae and Pentatomoidea. In addition, the distal and proximal regions of the spermathecal duct of *E. disciger* are narrow, very thin, muscular, and convoluted, which is different from all other investigated Heteroptera.

With the use of SEM, I have demonstrated the presence of pores in the surface of the spermathecal bulb and on the distal spermathecal flange, the lack of pores on the pump coils, and the twisting of the spermathecal duct. Other seemingly unique characters of *E. disciger* are the single pump flange and the short, spirally twisted spermathecal duct. Additionally, two sclerotized rings are present, one at each side of the opening into the genital chamber. These characters could be important in the higher classification of *E. disciger*. More work is needed to establish clear trends within this Coreidae group.

ACKNOWLEDGEMENTS

I wish to acknowledge Dr. Robert Lavigne (Professor Emeritus, University of Wyoming, Laramie, Wyoming, U.S.A.) for linguistic improvement. This project was supported by Gazi University (Turkey) (Project no: 05/2006-24).

LITERATURE CITED

Brailovsky, H. 1984: Revisión del género *Latochrimnus* Brailovsky (Hemiptera-Heteroptera Lygaeidae-Lygaeinae). Anales del Instituto de Biología, Universidad Nacional Autónoma de México 55, Serie zoología (2): 111-128. [In Spanish]

Brailovsky, H. 1987: La tribu Hydarini Stål, en el continente americano con descripción de dos nuevos géneros, una nueva especie y una nueva subspecie (Hemiptera-Heteroptera) (Coreidae). **Anales** del Instituto de Biología, Universidad Nacional Autónoma de México 55, Serie zoología (2): 623-650. [In Spanish]

Brailovsky, H. 1988. A revision of the genus *Amblyomia* Stål (Heteroptera: Coreidae: Coreinae: Leptoscelini). Florida Entomologist 81(4): 475-482.

Brailovsky, H. and E. Barrera. 2001. Six new species of *Mozena* (Heteroptera: Coreidae: Coreinae: Nematopodini). Florida Entomologist 84(1): 99-111.

Candan, S., Z. Suludere, and M. Erbey. 2007. Morphology of eggs and spermatheca of *Odontotarsus purpureolineatus* (Heteroptera: Scutelleridae). Biologia 62/6: 763-769.

Carayon, J. 1964: La spermathèque et les voies génitales femelles des Lygaeidés Oxycareninae (Heteroptera). Revue Française D'Entomologie 3:196-218. [In French]

Davey, K. G. 1965. Reproduction in the insects. Oliver and Boyd. Edinburg, England 96 pp.

Dufour, L. 1833. Recherches anatomiques et physiologiques sur les Hemipteres accompagnees de considerations relatives a l'histoire naturelle et a la. Mémoires présentés par divers Savans à l'Académie Royale des Sciences de l'Institut de France, Paris 4:33-461. [In French]

Dupuis, C. 1955. Les genitalia des hemipteres Heteropteres (Genitalia externes des deux sexes; Voies ectodermiques femalles). Revue de la morphologie. Lexique de la nomenclature. Index bibliographique analytique. Memoires Memoirs du Museum d'Histoire Naturelle, Paris 6: 183-278. [In French]

Dupuis, C. 1970. Heteroptera, pp. 190-208. *In*, S. L. Tuxen (Editor). Taxonomist´s glossary of insects. Copenhagen, Munksgaard, Denmark 359 pp.

Gupta, B. L. and D. S. Smith. 1969. Fine structural organization of the spermatheca in the cockroach, *Periplaneta americana*. Tissue & Cell 1: 295-324.

Kim, R. H. and C. E. Lee. 1994. Morphological studies on the spermathecae of Korean Podopinae and Asopinae (Heteroptera: Pentatomidae). Korean Journal of Entomology 24: 217-223.

Kumar, R. 1962. Morphotaxonomical studies on the genitalia and salivary glands of some Pentatomoidea. Entomologisk Tidskrift 83: 44-84.

Kumar, R. 1965. Aspects of the morphology of Coreoidea and their value in its higher classification. Proceedings of the Royal Society of Queensland 76: 27-91.

Legaspi, J. C., V. Russell, and B. C. Legaspi. 1994. Microscopic examination of the spermatheca as an indicator of mating success in *Podisus maculiventris*. Southwestern Entomologist 19: 189-190.

Lee, C. E. and J. G. Pendergrast. 1983. The spermathecae of New Zealand Aradidae (Hemiptera: Heteroptera). Journal of Natural Histology 17: 113-122.

Lee, K. Y., Ch E. Lee, and H. Ch Park. 1989: A comparative study on the spermathecae of the Coreidae from Korea (Heteroptera, Hemiptera). Nature and Life (Korea) 19: 7-14.

Matsuda, R. 1976. Morphology and evolution of the insect abdomen with special reference to developmental patterns and their bearing upon systematics. Pergamon Press New York, NY, U.S.A. 534 pp.

McDonald, F. J. D. 1966. The genitalia of North American Pentatomoidea (Hemiptera: Heteroptera). Quaestiones Entomologicae 2: 7-150.

Pendergrast, J. G. 1957. Studies on the reproductive organs of the Heteroptera with a consideration of their bearing on classification. Transactions of the Royal Entomological Society, London 109: 1-63.

Pluot-Sigwalt, D. and J. A. Lis. 2008: Morphology of the spermatheca in the Cydnidae (Hemiptera: Heteroptera): bearing of its diversity on classification and phylogeny. European Journal of Entomology 105: 279-312.

Schaefer, C. W. 1965. The morphology and higher classification of the Coreoidea (Hemiptera: Heteroptera). Parts III. The families Rhopalidae, Alydidae, and Coreidae. Miscellaneous Publications of the Entomological Society of America 5: 1-76.

Schuh, R. T. and J. A. Slater. 1995. True Bugs of the World (Hemiptera: Heteroptera). Classification and Natural History. Cornell University Press. Ithaca, New York, U.S.A. xii + 336 pp.

Scudder, G. G. E. 1959. The female genitalia of the Heteroptera: Morphology and bearing on classification. Transactions of the Royal Entomological Society, London 111: 405-467.

Servadei, A. 1964. Il valore tassonomico delle spermateche degli Emitteri Eterotteri (Fam. Pentatomidae e Acanthosomatidae) [Taxonomic value of spermatheca in Pentatomidae and Acanthosomatidae on generic and specific levels]. Atti dell'Accademia Nazionale Italiana di Entomologia 11: 58-86.

Siebold, von C. Th. 1837. Fernere Beobachtungen über die Spermatozoen der wirbellosen Tiere. Archiv für. Anatomie Physiologie Und Wissenschaftliche Medicin, 1837: 381-439. [In German]

Vavrinova, I. 1988: Spermathecae of Central European species of the families Rhopalidae, Alydidae and Coreidae (Heteroptera: Coreoidea). Casopis Moravskcho Musea v Brnì 73: 203-215.

THE INTRODUCTION, ESTABLISHMENT, AND SPREAD OF THE OLIVE-SHADED BIRD-DROPPING MOTH, *TARACHIDIA CANDEFACTA* (HÜBNER, 1831) (LEPIDOPTERA, NOCTUIDAE), IN SOUTHERN RUSSIA AND THE UKRAINE[1]

A. N. Poltavsky,[2] V. I. Shchurov,[3] and K. S. Artokhin[4]

ABSTRACT: The Olive-shaded bird-dropping moth (*Tarachidia candefacta*, Noctuidae) was introduced from Canada and the U.S.A. into southern Russia in 1966 to control an invasive North American weed, *Ambrosia artemisiifolia* (Asteraceae). *Tarachidia candefacta* has become an invasive species in this region.

KEY WORDS: *Tarachidia candefacta, Ambrosia artemisiifolia*, Russia, Ukraine, Crimea, introduced species, invasive species, biological control, weeds, Lepidoptera, Noctuidae, climate warming

In 1966, the All-Union Institute of Plant Protection of Leningrad (presently – All-Russian Institute of Plant Protection, Sankt-Petersburg) began studying the Olive-shaded bird-dropping moth [*Tarachidia candefacta* (Hübner, 1831), Noctuidae] with the express purpose of controlling the introduced and invasive weed *Ambrosia artemisiifolia* L. (Asteraceae) in Russia (Fig. 1).

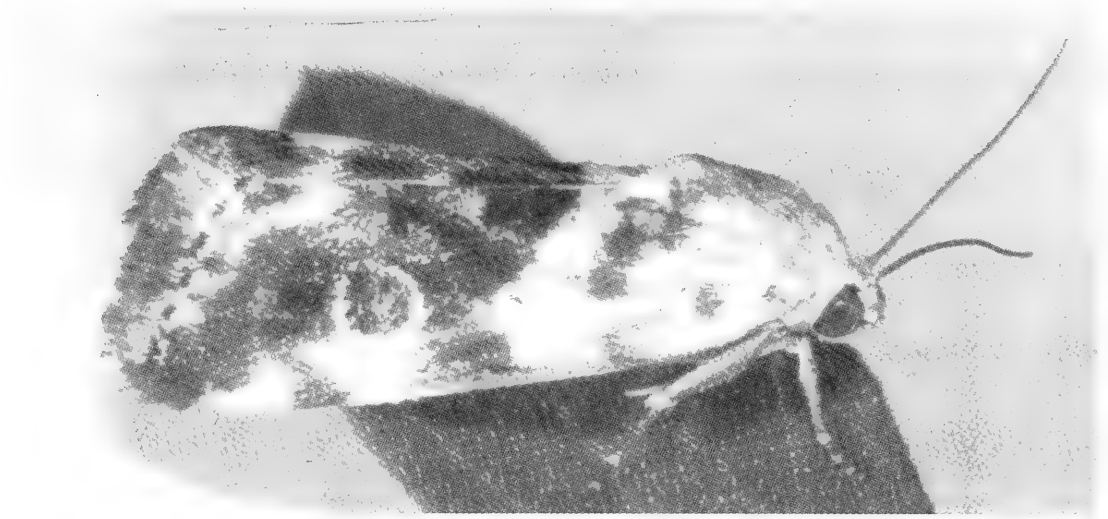


Fig. 1. Olive-shaded bird-dropping moth from Rostov-on-Don area of Russia.

---

[1] Received on February 6, 2008. Accepted on March 11, 2008.

[2] Botanical Garden of the Southern Federal University, Rostov-on-Don, Botanical spusk 7 Russia 344041. E-mail: poltavsky54@mail.ru

[3] Branch of Federal State Department "Rusforestprotection," Krasnodar, Ignatova 47, 12 Russia 350061. E-mail: meotida@mail.kuban.ru

[4] Agroliga of Russia Inc., Rostov-on-Don, Tchehova, 71 Russia 344010. E-mail: artohin@mail.ru

Mailed on February 19, 2009

The southern region of Russia, adjoining the Black Sea – the Krasnodar area – was chosen for field tests of this biological control agent. The area's climate is similar to moth's habitats in the southeast of Canada, but somewhat more moderate than in California of the U.S.A. where this species occurs. There, the *T. candefacta* Hb. (Ambrosia moth) can develop in 3-4 generations during one year in the Krasnodar area (Kovalev and Samus, 1972).

The initial population of Ambrosia moths was delivered to the Plant Protection Institute (Sankt-Petersburg) in 1967-1969 from U.S.A. and Canada in a few parcels. The moths were originally collected and reared on *Ambrosia artimisiifolia* in Belleville, Canada, by Dr. P. Harris (5 males + 5 females 28.08.1967; 30 males + 30 females 22.07.1968); then collected and reared on *Ambrosia psilostachya* in Riverside, California (U.S.A.), by Dr. R. Goeden (10 males + 10 females 8.05.1969). The moths were then reared in laboratory conditions on *Ambrosia artimisiifolia* in a chamber of an artificial climate: 22-26 degrees Celsius, 16-hours day long and humidity 80-100% in Russia (Kovalev and Samus, 1972), and studied during 11 generations (Kovalev and Runeva, 1970).

Approximately in 1969 (no published reports), Oleg Kovalev transferred some of the procreated moths to Krasnodar's North Caucasus Institute of Phytopatology (presently Scientific Research Institute of Biological Protection of Plants). However, the caterpillars were lost due to a viral disease (Shchurov, 1998). There is no detailed report about this failure but, thereafter, O. Kovalev himself released some (unknown number) of *T. candefacta* Hb. imagoes in a few localities of Krasnodar and Lazarevskoe. They were reared in his laboratory in the town of Lazarevskoe located on the Black Sea coast of the Krasnodar area (Oleg Kovalev, pers. comm.). The moth's released sites were suburbs of Krasnodar and Lazarevskoe (Fig. 2).

After a few years of Ambrosia moth studies conducted by the Russian researchers, they predicted: "It is possible to expect a fast increase in the number of moths and *Ambrosia* suppression during the first few months due to a slow increase in the vegetative weight of the weed" (Kovalev and Runeva, 1970). As a result in 1970, the State Committee of the USSR on affairs of inventions and discoveries issued the copyright certificate for development: "The way of biological control of weed vegetation," #276622. Up to the mid-1990s, there was no information about *T. candefacta* Hb. in Russia.

METHODS

We carried out a monitoring program for moths of the superfamily Noctuoidea using light-traps with "Osram-160 W" mercury lamp during the night and by aerial net catching during the day in the Krasnodar and Rostov-on-Don areas from 1995 to 2007, when the Olive-shaded bird-dropping moth became the object of special scientific interest. As the *T. candefacta* moths are active both night and day, it was possible to capture them with a sturdy net-sweeping through the green foliage. This method gave us the opportunity to find many populations of *T. candefacta* in agroecosystems. We also collected larvae by sweeping the herbage with a sweeping net. We were monitoring altogether 70 points in the Krasnodar area, 60 points in the Rostov-on-Don area, and detected *T. candefacta* by both methods in 26 and 19 points in those areas, respectively.

RESULTS AND DISCUSSION

The Olive-shaded bird-dropping moth became a well-known species on the Black seacoast and foothills of North-West Caucasus in 1995-1997 (Shchurov, 2004). *Tarachidia candefacta* Hb. had penetrated deeply into mountain ranges up to heights of 600-1800 meters above sea level, following the main valleys (Shchurov, 2004). A large concentration of the Ambrosia moth (25 specimens per light-trap during one hour) was observed near the town of Krasnodar (Shchurov, 1998). However, not one specimen was trapped in the Rostov-on-Don area, despite intensive light-trapping in many points during 1995-2000.

In the first years of the 21st century, the Olive-shaded bird-dropping moth has "jumped" to the north, east, and west distances up to 500 km (Fig. 2). A few of the moths were noticed in the Lugansk and Donetsk areas and in the Crimean Peninsula of the Ukraine in 1999-2002 (Kljuchko et al., 2004); and three specimens were detected in the northern part of the Rostov-on-Don area in 2001 (Poltavsky and Artokhin, 2006).

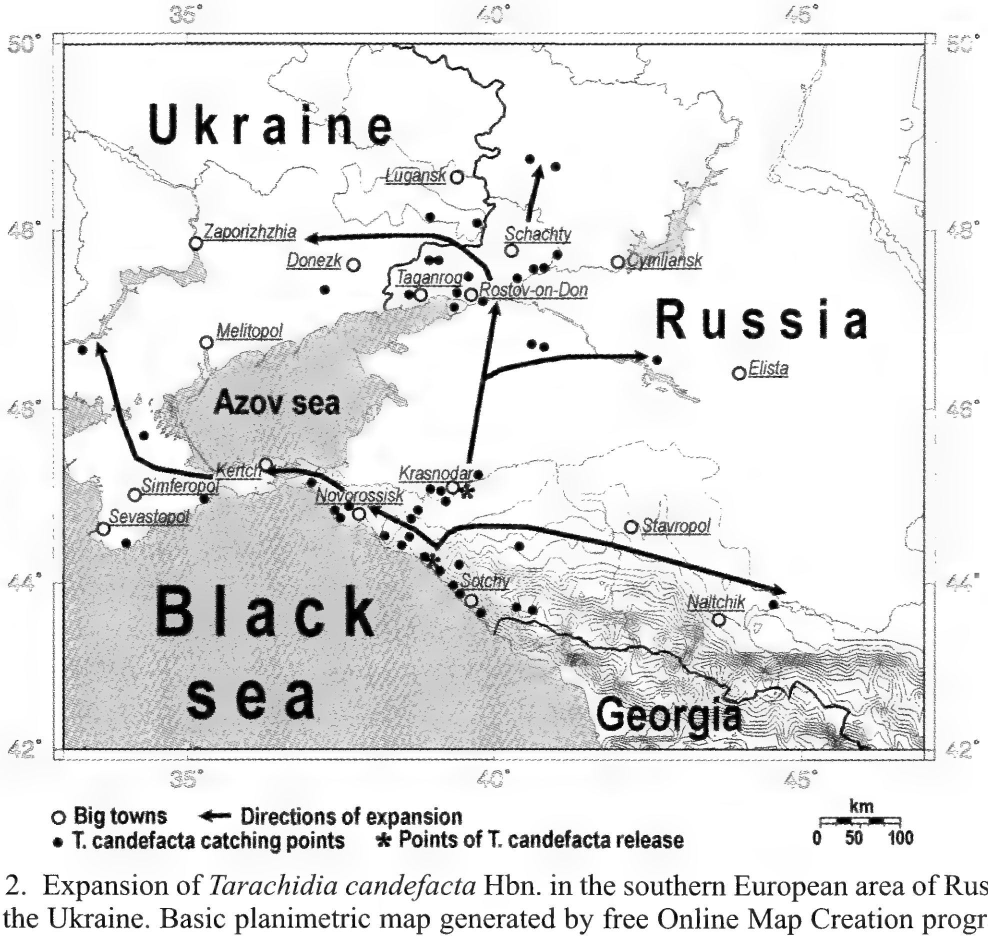


Fig. 2. Expansion of *Tarachidia candefacta* Hbn. in the southern European area of Russia and the Ukraine. Basic planimetric map generated by free Online Map Creation program (http://www.aquarius.geomar.de/omc/make_map.html).

Since 2005, we began to regularly detect the presence of *T. candefacta* Hb. by sweeping samplings of steppes and low-growing vegetation with *Ambrosia artemisiifolia* L. in herbage and by light-trapping in many districts of the southern part of the Rostov-on-Don area (19 points). The total number of specimens caught per night-trapping reached 60. According to the catching dynamics in 2005-2007, the *T. candefacta* Hb. population could represent several overlapping generations per year with peaks in late May, mid-July, and late August (Fig. 3).

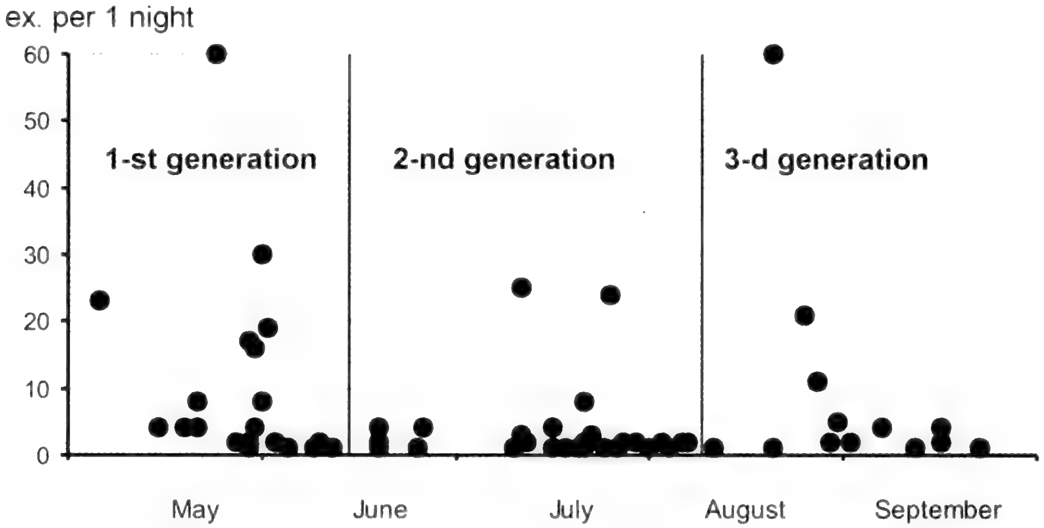


Fig. 3. *Tarachidia candefacta* Hb. imagoes activity detected by light-trapping in the Rostov-on-Don area during 2005-2007.

To the west of the present area, the Olive-shaded bird-dropping moth is known from the Kherson area of the Ukraine and in the east from Kabardino-Balkariya, Republic of Russia (Alexey Matov, pers. comm.). Although it is not known exactly why the moth has suddenly started to spread since its introduction in the late 1960s, the rise in the average temperature may partially explain this phenomenon. During this century the average annual air temperature in Russia has exceeded norm by 0.5-1.2°C (Reports by Institute of Global Climate and Ecology, Moscow, http://www.igce.comcor.ru/). In January 2008, the midday temperature in the south of Russia was 12°C higher than is average for this month (http://www.smi.kuban.ru/). The mild winters make better survival for the Ambrosia moth in the continental climate of the South Russian Plain. Our observations in 2006-2007 show that the *T. candefacta* Hb. is now an invasive species in Russia. In agroecosystems of the south of Russia and the Ukraine, the species has found a good amount of its food plant - *Ambrosia artemisiifolia.* Moreover, during the years of *T. candefacta*'s population growth (2001-2007), there were mild winters in the Rostov-on-Don area. It also has hot and dry summers that are typical to the region.

A drop in the use of insecticides is another possible factor for the adaptation of *T. candefacta*. Because of the harsh economic situation following the fall of the Soviet Union (mid-1980s), 20th century Russian agricultural enterprises and Russian farmers have used pesticides minimally for plant protection. In the years 1960 to 1985, during the zenith of the Soviet Union, organochlorinated, as well as other broad spectrum insecticides were used extensively. These pesticides are known to accumulate in sediments, plants, and animals, and have a wide range of acute and chronic health effects, including cancer, neurological damage, and birth defects, and were in wide use without appropriate controls (Fedorov and Yablokov, 1999). Except for bees and a few pestiferous insects, the degree of resistance to different pesticides is unknown. For instance, in 1990, use of the dangerous (reasonably believed to be a human carcinogen) dichlorodiphenyltrichloroethane (DDT) in Russia went down to actual zero (Li et al., 2006). The decrease in pesticide use may have released the ecological pressure on this species, resulting in its rapid spread.

It appears that the initial optimistic hopes of the Ambrosia moth's trophic potential, capable of essentially reducing the amount of *Ambrosia* sp. in the fields, were overestimated. Currently, the weed control in the crop fields in the southern areas of European Russia still proceeds with the help of herbicides (Zaharenko and Zaharenko, 2004). Investigations by Oleg Kovalev and his colleagues have shown that there are no alternate host plants for the Ambrosia moth in Russia, except *Ambrosia* sp. (Kovalev O. V. and T. D. Runeva. 1970). But the reproduction dynamics of *T. candefacta* are much lower than required for efficient suppression of quickly rising *Ambrosia* weeds. At the same time, the Ambrosia moth is now spreading into new areas in the south of Russia. That is why it is an invasive species.

There are other recent examples of arthropod invasions into southern Russia. After 2001, the Mediterranean Black Widow spider (*Latrodectus tredecimguttatus* (P. Rossi, 1790) (Araneae: Theridiidae) began its westward expansion. By 2004 it was found on the territory of Taganrog. During the beginning of the 21st century, several high density populations of the Black Widow were found in agricultural districts of the Rostov-on-Don area (Arzanov and Ponomarev, 2007). Also, in 2001-2006 the Chinese mitten crab (*Eriocheir sinensis* H. Milne Edwards, 1853) appeared in the waters of the Azov Sea, next in the Don River and later in the Volga River (Shakirova et al., 2007).

ACKNOWLEDGMENTS

The authors were supported by the colleagues Oleg Kovalev and Alexey Matov, who provided some valuable information about the Ambrosia moth. John Petric helped in the text translation. The helpful comments from two anonymous reviewers were also highly appreciated.

LITERATURE CITED

Arzanov Ju. G. and A. V. Ponomarev. 2007. Modern migrants in the south of the European part of Russia. Natural and invasive processes of biovariety of water and ground ecosystems formation. The Abstracts of Reports of the International Scientific Conference June 5-8, 2007, Rostov-on-Don 29-31. (In Russian)

Fedorov L.A. and A. V. Yablokov. 1999. Pesticides - toxic blow at biosphere and human. Moscow. 462. (In Russian)

Kljuchko, Z. F., J. I. Budashkin, and R. P. Gerasimov. 2004. New and little-known species of noctuids (Lepidoptera) of Ukraine's fauna. Bulletin of Zoology 38 (1):94. (In Russian)

Kovalev O. V. and T. D. Runeva. 1970. *Tarachidia candefacta* Hubn. moth (Lepidoptera, Noctuidae) - perspective phytophage in biological control weeds of genus *Ambrosia* L. Entomological Review 49(1):23-36. (In Russian)

Kovalev O. V. and V. I. Samus. 1972. The biology of *Tarachidia candefacta* Hubn. moth and prospects of its use to control common ragweed. Agricultural Biology 7(2):281-284. (In Russian)

Li, Y. F., A. V. Zhulidov, R. D. Robart, L. G. Korotova, D. A. Zhulidov, T. Yu. Gurtovaya, and L. P. Ge. 2006. Dichlorodiphenyltrichloroethane usage in the former Soviet Union. Science of the Total Environment 357:138-145.

Poltavsky, A. N. and K. S. Artokhin. 2006. *Tarachidia candefacta* (Lepidoptera: Noctuidae) in the south of European Russia. Phegea 34 (2):41-44.

Panov, V. E. and P. F. Clark. 2007. New records of the Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853, from the Volga River, Russia. Aquatic Invasions 2(3):169-173.

Shakirova, F. M., V. E. Panov, and P. F. Clark. 2006. New records of the Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853, from the Volga River, Russia. Aquatic Invasions 2(3):169-173.

Shchurov, V. I. 1998. Acclimatization of American bird-dropping moth. The protection and quarantine of plants 12:31-32. (In Russian)

Shchurov, V. I. 2004. Additions to butterflies and moths fauna (Insecta, Lepidoptera) of the Caucasian state biosphere reserve and adjacent territories. Biodiversity of Caucasus 1:222-245. (In Russian)

Zaharenko V. A. and A. V. Zaharenko. 2004. The weed control. Supplement to the journal The protection and quarantine of plants 4:62-144. (In Russian)

SCIENTIFIC NOTE

CRITIQUE OF THE ARTICLE "COLLEMBOLA (SPRINGTAILS) (ARTHROPODA: HEXAPODA: ENTOGNATHA) FOUND IN SCRAPINGS FROM INDIVIDUALS DIAGNOSED WITH DELUSORY PARASITOSIS"[1]

Kenneth A. Christiansen[2] and Ernest C. Bernard[3]

In a recently published paper, Altschuler et al. (2004) argued that Collembola (springtails) can cause "stinging/biting and/or crawling" sensations. The collembological community has been highly critical of this report, but has discussed this issue primarily among the members of this community. However, allegations that springtails cause various dermatological problems, severe itching, and related symptoms have made it into the widely read on-line encyclopedia Wikipedia (http://en.wikipedia.org/wiki/Delusory_parasitosis, accessed August 8, 2008: "People with delusional parasitosis are likely to ask for help not from psychiatrists but from dermatologists, pest control specialists, or entomologists."). The medical community has firmly rejected the linkage of insects and widespread dermatitis (Berrios 1985, De Leon et al., 1982, Gupta & Voorhees 1990, Wykoff 1987). Janssens and Christiansen (2007) do acknowledge that an allergic reaction to Collembola tissue or integument on the part of some sensitive people is possible and might lead to the crawling-on-skin irritation symptoms. Various sources and publications, however, have gone much farther and have alleged that some springtails may parasitize humans. This allegation is entirely inconsistent with springtail biology, and no such phenomenon has ever been scientifically confirmed. (For a summary of the literature on this subject, see <www.collembola.org>.) Springtails sometimes can be abundant indoors in damp places such as bathrooms and basements, and under such circumstances may be found on one's person, but this is only accidental. Claims of persistent human skin infection by springtails may indicate a neurological problem, or else delusory parasitosis, a psychological not entomological problem. Berenbaum (2005) commented on the Altschuler et al. paper, suggesting that the report was based on pareidolia; that is, the researchers simply imagined that they saw springtail-like shapes in the images when there were no springtails actually present. In this paper, we more specifically and categorically refute the contention of Altschuler et al. (2004).

---

[1] Received on August 8, 2008. Accepted on November 6, 2008.

[2] Biology Department, Grinnell College, Grinnell, Iowa 50112-0886 U.S.A. E-mail: christak@grinnell.edu.

[3] Entomology and Plant Pathology Department, The University of Tennessee, 2431 Joe Johnson Drive, 205 Ellington, Knoxville, Tennessee 37996-4560 U.S.A. E-mail: ebernard@utk.edu.

Mailed on February 19, 2009

None of the images presented in Altschuler et al. (2004), except possibly the "enhanced" version of Figure 2 (p. 91), bear the slightest resemblance to any springtail or springtail body parts, nor can the pieces in Figs. 1 and 3 be reasonably construed to represent a part of any particular organism. Having examined many Collembola from Canadian and Burmese Cretaceous amber, as well as thousands of preserved pitfall trap and Tullgren funnel-extracted specimens, we can categorically state that the fossils and collected specimens are far more recognizable as Collembola than are these photographed scrapings. As the specimens were freshly taken from new human skin scrapings, the remnants of Collembola should have been distinct. Thus, the statement that "The findings of Collembola in images of scrapings from 18 of the 20 symptomatic study participants supports their contention that they actually have something crawling on or under their skin and are not delusional" (p. 89) is not supported. Under the assumption that the best images were chosen for the article, the assertion that Collembola are the material cause of "delusory parasitosis" is not supported by the evidence.

If Collembola were crawling on the subjects, then these specimens or their distinct parts should have been observed. It is certainly possible that Collembola may have actually walked briefly on the skin of affected persons, just as other insects and spiders occasionally do on everyone, and induced the same kind of crawling sensations; but the claim that they induced continuing symptoms is not supported by the paper. Apparently, no Collembola expert was consulted before publication, and the more than 300 slides of scrapings made in this study have never been made available to a Collembola expert for examination of the supposed specimens.

Figure 2 is purported to represent a springtail, but this image received contrast enhancement to bring out a springtail-like blob. The authors also stated that "Identification of Collembola in scrapings…required intensive scrutiny of the photographs and was initially very difficult" (p. 89). Collembola simply are not that difficult to detect and if present should have been readily visible. Collembola are arthropods and have exoskeletons composed of a head and usually nine distinct body segments; the mouthparts, especially, are sclerotized and should have been easily visible at the magnifications mentioned in the paper. The mere labeling of a vaguely recognizable blob, as in Fig. 2, does not validate the identification of the parts, which in this case is more similar to identifying animals by looking at clouds. Berenbaum (2005), referring to the Altschuler et al. paper, recognized this mistaken identification as an example of pareidolia: a type of illusion or misperception involving a vague or obscure stimulus being perceived as something clear and distinct (Carroll 2008). Therefore, neither the original nor enhanced Figure 2 can be accepted as proof of springtails inhabiting human skin lesions.

There are many records of Collembola found on humans (Janssens and Christiansen, 2007). Almost all of the validated cases have involved Collembola in head hair. In most but not all of these cases, the people involved have been associated with horses, and it has been suggested, although never proven, that fungi associated with horses were growing on the hair and that Collembola were feeding on the fungi. In another interesting case in Sweden, a number of springtails were reported to inhabit the genital region of a woman experiencing a "nervous disorder," including weak but annoying itching (Bryk 1955). Bryk's review of the case suggests that the initial source of this infestation was poor hygiene or housekeeping, as the floor of the bathroom was damp and "the toilet brush was teeming with these parasites;" and Bryk himself discounted the ability of springtails to bite people. In all the above-mentioned cases, the springtails involved were one or more members of the family Entomobryidae, several members of which are often found in drier environments, including homes and hospitals, than most Collembola prefer. There is a single clearly validated case of a biologist, who had been actively aspirating springtails in the Arctic, getting an infestation of Collembola in his nasal passages. In all of the cases mentioned above, large numbers of active Collembola were seen and could be collected easily. (The nasal passage infection became apparent when Collembola appeared abundantly in nasal discharge.) Other apparently dispassionate reports have lacked the necessary scientific rigor to be taken seriously. For instance, Amin (2003) presented an image (Fig. 5) of a supposed springtail from a human lesion, but this arthropod does not seem to have been examined by a specialist in the group, and certainly is no springtail. If live Collembola are involved in the various infections, then the springtails should be visible to the unaided eye on the surface. To our knowledge, there is no recorded case of a Collembola burrowing in anything, anywhere, or found imbedded in any tissue.

Only a few species of Collembola are known to live even commensally with other animals: two species of Coenaletidae with hermit crabs in the spaces between the animal and the adopted shell (Bellinger 1985); Cyphoderidae, commensal with bees, ants, or termites (Hopkin 1997); and *Axelsonia johnstoni* (Isotomidae) from the gill chambers of a land crab on Java (Jordana 1997).

Collembola are morphologically and physiologically ill-suited for burrowing. Their respiration requires gaseous exchange through the cuticle, impossible if the specimen is surrounded by tissue. If there were forms burrowing in human tissue, they certainly would be highly specialized in form. Those that live in the soil are limited to the interstices of the soil between soil grains; those living on plants restrict themselves entirely to the surfaces. Where soil particles have very small spaces between grains (e.g. some clays), Collembola do not occur. Thus, if Collembola were in fact the cause of the crawling sensation, they should be on the surface of the human skin, visible to the naked eye, and collectible.

We have been deeply involved with analysis of these supposed infections for years. Between us, we have studied hundreds of photographs and received over 200 samples of specimens and allegedly infected tissues; many of our colleagues here and overseas have had similar experiences. The samples have only one thing in common: none involved whole Collembola or, among the specimens and tissue samples, even springtail fragments. The photographs in Altschuler et al., supposedly of Collembola, require considerable imagination and cannot be taken as definitive evidence of human infestation by Collembola.

LITERATURE CITED

Altschuler, D. Z., M. Crutcher, N. Dulceanu, B. A. Cervantes, C. Terinte, and L. N. Sorkin. 2004. Collembola (Springtails) (Arthropoda: Hexapoda: Entognatha) found in scrapings from individuals diagnosed with delusory parasitosis. Journal of the New York Entomological Society 112(1):87-95. (http://www.headlice.org/report/research/jnyes.pdf).

Amin, O. M. 2001. Neuro-cutaneous syndrome (NCS): A new disorder. Explore! 10(2).

Bellinger, P. F. 1985. A new family of Collembola (Arthropoda, Tracheata). Caribbean Journal of Science 21:117-123.

Berenbaum, M. 2005. Face time. American Entomologist 51:68-69.

Berrios, G. E. 1985. Delusional parasitosis and physical disease. Comprehensive Psychiatry 26: 396-403.

Bryk, F. 1955. Hoppstjärten Sira för första gången konstaterad I Sverige som besvärlig parasit på människa. [The springtail Sira, a pesky human parasite, confirmed for the first time in Sweden.] Läkartidningen 52(29):1822-1826 (article available at www.headlice.org/news/2005/august/tiny_bugs_wreak_havoc.htm).

Carroll, R. T. 2008. The skeptic's dictionary. <http://skepdic.com/pareidol.html>, updated 1 August 2008.

De Leon, J., R. E. Antelo, and G. Simpson. 1992. Delusion of parasitosis or chronic tactile hallucinosis: Hypothesis about their brain physiopathology. Comprehensive Psychiatry 33:25-33.

Gupta, M. A. and J. J. Voorhees. 1990. Psychosomatic dermatology. Archives of Dermatology 126:90-93.

Hopkin, S. P. 1997. Biology of the springtails (Insecta: Collembola). Oxford University Press, New York. 330 pp.

Janssens, F. and K. A. Christiansen. 2007. Checklist of the Collembola - Synanthropic Collembola, springtails in association with man. (http://www.collembola.org/publicat/sidney.htm) Version of 22 November 2007. Retrieved 11 July 2008.

Jordana, R. 1997. New habitat for a species of *Axelsonia* Börner, 1907. Pedobiologia 41:35-39.

Wykoff, R. E. 1987. Delusions of parasitosis: A review. Reviews of Infectious Diseases 9:433-437.

The Editor sent electronic requests for review to the authors of Altschuler et al. (2004). No reviews were received.

SCIENTIFIC NOTE

OBSERVATIONS ON AGRESSION IN LEAF-CUTTING ANT FEMALES, *ATTA MEXICANA* (HYMENOPTERA: FORMICIDAE) IN MEXICO[1]

Sergio R. Sánchez-Peña[2]

Atta mexicana fertilized females (foundress queens) establish new colonies solitarily (i.e. they are haplometrotic) like most species of *Atta*; the known exceptions are the Texas leaf-cutting ant, *Atta texana* (Mintzer 1990b) and possibly *Atta laevigata* (Mintzer 1990a). After the nuptial flight, and while in the process of seeking a place for incipient colony establishment, the females of *A. mexicana* are reported to be extremely aggressive among them, attacking and killing each other (Mintzer 1990b, Mintzer et al., 1991, Sánchez-Peña 2005). Conversely, the closely related species, *A. texana*, is facultatively polygynous, and queens can coexist peacefully at the time of colony establishment and indefinitely afterwards; up to five fertilized females have been found in mature colonies of this species (Mintzer 1990b). Founding queen number in incipient colonies is a key strategy in the natural history of ants (Hölldobler and Wilson 1990), and it is not simple to interpret the existence of these very dissimilar aggression behaviors in *A. mexicana* and *A. texana*, two closely related and nearly sympatric species in parts of their range (Mintzer et al., 1990b, Mintzer et al., 1991, Sánchez-Peña 2005). Here, I report two sets of observations on *A. mexicana*: one pertaining to aggression among virgin females, and the second regarding female aggression towards workers. All observations were carried out in the laboratory, housing the ants in artificial nests as described in Sánchez-Peña (2005). This last work reported the lack of aggressiveness among females collected from the surface of nests prior to the nuptial flight and held collectively in containers. Females were maintained in groups and coexisted peacefully for weeks until death. However, females in these groups originated from the same nest. It is thus very possible that recognition as sisters or nestmates precluded the expression of aggression among these females. Workers of *A. mexicana* are extremely territorial and will immediately recruit to attack and kill *Atta* individuals from other colonies (and of other *Atta* species) (unpublished observations), suggesting that inter-female aggression in *A. mexicana* can possibly result from their discrimination of members of different colonies. Thus, experiments were performed by mixing virgin females from different nests to observe the possible effects of colony of origin on aggression.

---

[1] Received on January 21, 2008. Accepted on February 5, 2008.

[2] Departamento de Parasitología Agrícola, Universidad Autónoma Agraria Antonio Narro, Saltillo, México C.P. 25315. Emails: elcheco@usa.net, sanchezcheco@gmail.com.

Mailed on February 19, 2009

Atta mexicana females were collected overnight in the outskirts of the metropolitan area of Monterrey, Nuevo Leon, Mexico during the nocturnal nuptial flight of the early hours (12:00 midnight - 5:00 AM) on 2 July 2006.

Winged females were collected prior to their flight from the surface of three nests separated by about 5 km. In the laboratory, females were placed in plastic containers (2 liters, 15 cm diameter) with a piece of clean moistened synthetic sponge. Four groups of 10 females from the same nest were placed in the plastic containers, and a female belonging to a different nest was added; this female was marked with a spot on each forewing using a permanent marker. Under these conditions, virgin females from the same nest survive up to four weeks without food (unpublished observations).

There was no aggression between the females from the same nest and the alien female. They coexisted peacefully (like nestmates) for three weeks until observations were discontinued. Thus, aggression between *A. mexicana* females appears to be triggered by events during the mating flight and is apparently not related to colony origin of coexisting females. Significant physiological changes (glycerol-3-phosphate-dehydrogenase-1 activity, protein banding pattern, fat content, and flight muscle hystolisis) have been reported to occur within days after the mating flight in founding queens of the myrmicine *Solenopsis invicta* (Goodisman and Ross 1999); flight muscle degeneration and hystolisis started as soon as two hours after insemination (Jones et al., 1978). Physiological changes as fast as this last one could induce the rapid behavioral change from non-aggression to aggression referred to here.

The following (second) set of observations describes apparent discrimination of nestmates and flexible behavior in an *A. mexicana* founder female, apparently mated. This female was placed in a plastic box nest. She was used in cultivar acceptance studies, and she had been provided with different fungal cultivars from different attines, that she did not accept. This female was discarded for further testing, and in order to keep her alive, she was provided with a fungal fragment (about 12 cm^3) and about 15 pupae and large larvae taken from a conspecific laboratory colony. She quickly accepted fungus and brood, and within 24 hours she was taking care of both as her own, grooming and tending them and increasing garden size by applying fecal droplets to fungal fragments (Weber 1972).

To facilitate the survival of this queen, which had been living on her body reserves for more than a month longer than normal, she was also provided with workers experienced in brood care but never exposed to a queen (queen-naïve). Adult emergence of these workers from pupae took place in a colony fragment or mini-nest, which consists of a nest box containing workers, a small fungus garden, and brood but containing no queen (Sánchez-Peña 2005). In these colony fragments, workers perform normal nest maintenance tasks, especially if brood is present. These queen-naïve workers will readily accept and work for an introduced queen as their own.

Five queen-naïve workers were added to the nest box with the queen. When she detected the "intruders" the queen appeared to be very wary. However, after workers and queen touched antennae, it eventually became evident that they were not aggressive towards the female and that they were indeed examining and accepting her as their queen. The female maintained her attention on them, and she stayed very close to the brood in the garden.

Queen, workers, and brood coexisted peacefully for about two hours when one of the workers inspected the brood and suddenly grabbed a pupa, crushed it with its mandibles, and started dragging it out of the fungus garden. These workers had been exposed to brood in their previous nest, and they appeared to recognize the brood in this new nest as non-nestmates. When the queen detected this brood-killing (perhaps due to a pheromone released when the pupa was crushed) she darted towards the worker, grabbed it with her mandibles, and immediately killed it. She then proceeded to kill all five workers, which she accomplished within one hour.

This second observation includes two behaviors: aggression of the workers towards the brood, and that of the queen towards the workers. There are many examples of non-nestmate brood acceptance in ants (Hölldobler and Wilson 1990); interspecific brood adoption can be induced in *Atta* (Sánchez-Peña 2005), but workers possess the capability of recognizing non-nestmate brood (e.g. Carlin 1988). In the second observation here, conscious decision making by the female was at least mimicked. It is possible that the behavioral sequence (from acceptance to aggression) in this queen towards the introduced workers was induced by chemical signals (i.e., a "brood damage" pheromone). On the other hand, these behaviors were precise, timely tuned, and conveyed an appearance of logic: the female apparently chose not to keep workers that would help her as a queen but that also may destroy her successive brood. By killing all these workers and subsequently rearing a naïve, faithful brood on her own, the queen appeared to tie her own survival to the future emergence of new naïve workers. Detailed observations on *Atta* females are warranted to investigate their behavioral capabilities, since they are, at least for the first weeks after colony inception, the directors of these.

ACKNOWLEDGEMENTS

The critical comments of Dr. Alex Mintzer, Dr. Carlos Blanco, K. M. Wall, and two anonymous reviewers on the manuscript are gratefully acknowledged.

LITERATURE CITED

Carlin, N. F. 1988. Species, kin and other forms of recognition in the brood discrimination behavior of ants. pp 267-275. *In*, J. C. Trager (Editor). Advances in Myrmecology. E. J. Brill. Leiden, The Netherlands. 551 pp.

Goodisman, M. A. D. and K. G. Ross. 1999. Queen recruitment in a multiple-queen population of the introduced fire ant *Solenopsis invicta*. Behavioral Ecology 10: 428-435.

Hölldobler, B. and E. O. Wilson. 1990. The Ants. Harvard University Press. Cambridge, Massachusetts, U.S.A. 746 pp.

Jones, R. G., W. L. Davis, A. C. F. Hung, and S. B. Vinson. 1978. Insemination-induced hystolisis of the flight musculature in fire ants (*Solenopsis* spp.). American Journal of Anatomy 151: 603-10.

Mintzer, A. 1990a. Colony foundation in leaf-cutting ants: the perils of foundation in *Atta laevigata* (Hymenoptera: Formicidae). Psyche 98: 1-5.

Mintzer, A. 1990b. Foundress female weight and cooperative foundation in *Atta* leaf-cutting ants. pp. 180-183. *In*, R. K. Vander Meer, K. Jaffe, and A. Cedeño (Editors). Applied myrmecology: a world perspective. Westview Press. San Francisco, California, U.S.A. 741 pp.

Mintzer, A., R. L. Quiroz, and C. Deloya. 1991. Foundation of colonies of *Atta mexicana* (Fr. Smith) (Hymenoptera: Formicidae) in the laboratory. Folia Entomologica Mexicana 82: 133-138.

Sánchez-Peña, S. R. 2005. Essays on organismal aspects of the fungus-growing ant symbiosis: ecology, experimental symbiont switches and fitness of *Atta*, and a new theory on the origin of ant fungiculture. Ph.D. Dissertation. The University of Texas at Austin. 170 pp.

Weber, N. A. 1972. Gardening ants, the attines. Transactions of the American Philosophical Society. Philadelphia, Pennsylvania, U.S.A. 146 pp.

SCIENTIFIC NOTE

REDISCOVERY AND NEW DATA FOR *OROPERIPATUS EISENII* (WHEELER, 1898) FROM MEXICO (ONYCHOPHORA: PERIPATIDAE)[1]

Fabio G. Cupul-Magaña[2] and José Luis Navarrete-Heredia[3]

Onychophora (velvet worms) are a small group of terrestrial invertebrates currently comprising about 200 species (Ruhberg and Hamer 2005). Onychophorans usually live in leaf litter and rotten logs in humid and relatively undisturbed habitats. Two major onychophoran subgroups are recognized: the pantropical Peripatidae (found in the Antilles, Mexico, Central America, northern South America, equatorial West Africa, and South-East Asia) and the southerly distributed Peripatopsidae (recorded from Chile, South Africa, and Australasia) (Bouvier 1905; Peck 1975; Gleeson 1996; Monge-Nájera 2000; Grimaldi and Engel 2005). This ancient pattern of distribution dates back to Gondwana (Monge-Nájera 1995; Reid 1996).

All known onychophorans are predators feeding on snails, worms, and small arthropods, including their larvae. The prey organisms are captured by using an adhesive, which is expelled from the slime papillae. The adhesive is used for defense as well (Gleeson 1996; Monge-Nájera 2000; Grimaldi and Engel 2005). The onychophoran body is covered with a thin cuticle and dermal papillae. The locomotory appendages, or oncopods, may vary in number interspecifically or intraspecifically and are of taxonomic value. At the anterior end of the body, the limbs are modified to paired slime papillae, jaws, and antennae, which have been suggested to be modified limbs of the cephalic region (Mayer and Koch 2005).

There is a paucity of information on Onychophora from Mexico (Monge-Nájera 2000). Three species are currently known for Mexico: (1) *Oroperipatus eisenii* (Wheeler, 1898), (2) *O. goudoti* (Bouvier, 1899), and (3) *Macroperipatus perrieri* (Bouvier, 1899). Some few morphological data are available for these species, but their distribution is not well documented. In particular, the type locality and distribution of *O. goudoti*, are unknown, whereas *M. perrieri* was found in the state of Veracruz, but the exact locality of this species is unknown (Monge-Nájera 2000).

Oroperipatus eisenii (Fig. 1) was initially described from 87 specimens (all females) collected in November 1894 in Tepic, Nayarit, Mexico (1200 m elev.).

---

[1] Received on December 4, 2007. Accepted on February 5, 2008.

[2] Posgrado en Ciencias para el Desarrollo Sustentable, Centro Universitario de la Costa, Universidad de Guadalajara, Av. Universidad de Guadalajara No. 203, Delegación Ixtapa, C.P. 48280, Puerto Vallarta, Jalisco, México. E-mail: fabio_cupul@yahoo.com.mx

[3] Entomología, Centro de Estudios en Zoología, CUCBA, Universidad de Guadalajara, Apartado Postal 234, 45100 Zapopan, Jalisco, México. E-mail: snavarre@cucba.udg.mx

Mailed on February 19, 2009

The specimens were found "under stones and pieces of wood in a shady spot along a ditch of water flowing from some baths on the outskirts of the town" (Wheeler, 1898). Unfortunately, no information on deposition of type specimens has been provided with the original description. The external and internal morphology of males was described by Rucker (1900) for specimens from the same locality. There are also additional records of *O. eisenii* from Brazil (Rio Purus) and Panama (El Cermeño and Panama City) (Peck, 1975). However, records from these countries remain questionable due to the typically restricted distribution of most species of Onychophora (Monge-Nájera 2000).

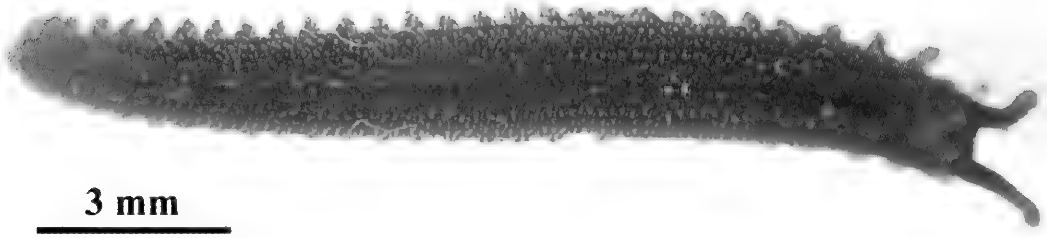


Figure 1. Dorsal view of *Oroperipatus eisenii* (Wheeler, 1898) from Puerto Vallarta, Jalisco, Mexico. Body length 15 mm.

As part of the field work done during the rainy season by the senior author in areas around Puerto Vallarta, Jalisco, Mexico, in September 2007, five specimens of Peripatidae were collected in a suburban area to the south of Puerto Vallarta City. The main vegetation type at this locality is a tropical, semideciduous disturbed forest with characteristic vegetation (Table 1). Detailed morphological examination of the specimens under the stereomicroscope revealed that all the specimens belong to *O. eisenii*. As diagnostic features for the species, all the specimens share: gonopore between the penultimate pair of oncopods, 28-29 pairs of oncopods, the position of the nephridial opening and associated foot pads and papillae on the fourth and fifth pairs of oncopods (Fig. 2). Based on this information, the specimens examined represent a new distributional record for *O. eisenii*, which is about 170 km from the type locality (Fig. 3).

Material Examined: Five specimens of unidentified sex. Body length for each of the five specimens studied: 40, 22, 20, 16, and 15 mm. Number of oncopods: 28-29 (three specimens, two with 28 leg pairs and one with 29 leg pairs; two damaged specimens were not evaluated). Two locality sites were surveyed between the 15th and 22nd September 2007: (1) 20° 35' 43.61" N, 105° 14' 14.89"W, 100 m elev. (one specimen), and (2) 20° 35' 47.93" N, 105° 14' 4.68" W, 300 m elev. (four specimens). Both sites are 326 m apart from each other and close to the seashore (300 m and 536 m, respectively). The color pattern is primarily dark brown dorsally (Fig. 1), brighter on the ventral surface. One specimen was collected under a plastic bag used in supermarkets whereas the remaining specimens were collected under plastic bags used to cultivate plants. Specifically, these bags contained *Cocos nucifera* (Arecaceae) plantlets. This unusual habitat (under plastic bags) instead of under stones, logs, or in leaf litter probably contains more appropriate humidity necessary for their life style.

We strongly recommend surveying carefully in disturbed habitats, such as the ones we report herein, to obtain additional field data. The five specimens are deposited in the Entomological Collection of the Centro de Estudios en Zoología, Universidad de Guadalajara (CZUG).

Table 1. The characteristic vegetation in a suburban area of Puerto Vallarta, Jalisco, Mexico, when the Onychophora specimens were collected.

Bignoniaceae
Pithecoctenium sp.
Tabebuia rosea (Bertol) DC.

Burseraceae
Bursera arborea (Rose) Riley
B. simaruba (L.) Sarg

Cecropiaceae
Cecropia obtusifolia Bertol

Compositae = Asteraceae
Eupatorium quadrangulare DC.
Melampodium perfoliatum (Cav.) Kunth
Pluchea salicifolia (Mill.) Blake
Verbesina greenmanii Urban

Convolvulaceae
Ipomea sp.

Cucurbitaceae
Momordica charantia L.

Euphorbiaceae
Acalypha delgadoana McVaugh
A. vallartae McVaugh

Gramineae = Poaceae
Olyra latifolia L.

Leguminosae = Fabaceae
Vigna liniaris (Kunth) Maréchal et al.

Moraceae
Ficus glabrata HBK
F. insipida Willd

Myrtaceae
Zyzygium jambos (L.) Alston

Nyctaginaceae
Pisonia aculeata L.

Palmae = Arecaceae
Acrocomia mexicana Kart. *ex* Mart.
Attalea cohune Martius

Polygonaceae
Antigonum leptopus Hook & Arn.
Adiantum fragile Sw.

Polypodiaceae
Asplenium sp.

Sterculiaceae
Guazuma ulmifolia Lam

Tiliaceae
Heliocarpus occidentales Rose

Turneraceae
Turnera caerulea DC.

Urticaceae
Urera caracasena (Jacq.) Griseb

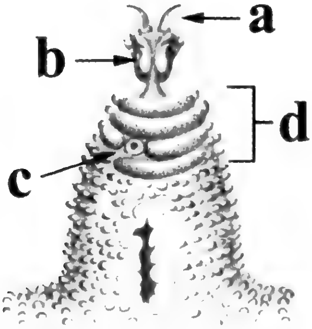


Figure 2. Ventral view of the fifth oncopod of *Oroperipatus eisenii* (Wheeler, 1898), showing the position of the nephridial opening. Redrawn from Wheeler (1898). a = claws, b = foot papillae, c = nephridial opening, and d = foot pads.

Figure 3. Distribution of *Oroperipatus eisenii* (Wheeler, 1898) in Mexico. ● = type locality Tepic, Nayarit; ■ = New record from Puerto Vallarta, Jalisco.

ACKNOWLEDGEMENTS

To Abraham Reyes for his help in field survey, Raymundo Ramírez for plant identification, Fernando Vega for reviewing an early version of the manuscript, and four anonymous reviewers for their comments and suggestions. This note is a contribution to the Project "Urban arthropods of peridomestic and domestic habitats of Puerto Vallarta, Jalisco, Mexico," as part of the PhD program of the senior author.

LITERATURE CITED

Bouvier, E. L. 1905. Monographie des Onychophores. I. Annales des Sciences Naturelles – Zoologie et Biologie Animale Ser. 9(2):1-383.

Gleeson, D. M. 1996. Onychophora of New Zealand; past, present and future. New Zealand Entomologist 19:51-55.

Grimaldi, D. and M. S. Engel. 2005. Evolution of the insects. Cambridge University Press. Cambridge, Massachusetts, U.S.A. 755 pp.

Mayer, G. and M. Koch. 2005. Ultrastructure and fate of the nephridial anlagen in the antennal segment of *Epiperipatus biolleyi* (Onychophora, Peripatidae) – evidence for the onychophoran antennae being modified legs. Arthropod Structure and Development 34:471-480.

Monge-Nájera, J. 1995. Phylogeny, biogeography and reproductive trends in the Onychophora. Zoological Journal of the Linnean Society 114:21-60.

Monge-Nájera, J. 2000. Onychophora. pp. 105-114. *In*, Llorente-Bousquets, J., E. González Soriano, and N. Papavero (Editors). Biodiversidad, taxonomía y biogeografía de artrópodos de México: Hacia una síntesis de su conocimiento. Volumen II. UNAM-CONABIO. México. 676 pp.

Peck, S. B. 1975. A review of the New World Onychophora with the description of a new cavernicolous genus and species from Jamaica. Psyche 82:341-358.

Reid, A. L. 1996. Review of the Peripatopsidae (Onychophora) in Australia, with comments on peripatopsid relationships. Invertebrate Taxonomy 10:663-936.

Ruhberg, H. and M. L. Hamer. 2005. A new species of *Opisthopatus* Purcell, 1899 (Onychophora: Peripatopsidae) from KwaZulu-Natal, South Africa. Zootaxa 1039:27-38.

Rucker, A. 1900. A description of the male of *Peripatus eisenii* Wheeler. The Biological Bulletin 1:215-250.

Wheeler, W. M. 1898. A new *Peripatus* from Mexico. Journal of Morphology 15:1-8.

BOOK REVIEW

The trees in my forest by Bernd Heinrich. 1997. CCCO. An Imprint of Harper-Collins Publishers, Inc. New York, NY, U.S.A. 237 pp. ISBN: 0-06-092942-1.

> "My observations only point out mysteries" (p. 104) "The greater the circle of knowledge, the deeper the surrounding [circumference of] darkness." William Thompson, Lord Kelvin [from Parker, J. G. 1907. Journal of the American Leather Chemical Association 29(10):361.]

Books, like trees, can teach us. I first read *The trees in my forest* in the winter of 2007, waiting for a teaching and spirituality workshop in northern California. At that time, I had filled the book with annotations, the most prominent of them, "I feel connected to this author." Last March 2008, I picked up *The trees in my forest* again on my return flight from southern California, where I was collecting plant exudates at several local botanical gardens and arboreta. From the jet, I waved farewell to the San Gabriel Mountain area, thankful for their giving me a little bit of their gooey stuff. As we headed east, I reopened Heinrich's book and was again filled with the joy akin to visiting an old friend. I wrote this review nonstop, full of appreciation for this goodness-laden work containing dozens of biological jewels for those who love nature and history.

The trees in my forest was written in a style reminiscent of Thoreau's *Walden Pond* and other early American books concerned with the environment. For Heinrich, his forest at Adams Hill, Vermont (northeastern U.S.A.), is a place for work, relaxation, learning, and spirituality. The author's intimate knowledge of the area through the seasons is reflected in his detailed, lucid descriptions, and unpretentious illustrations (some printed in color). Many of the topics discussed vividly represent the results of his collaborative investigations with his students at the Department of Biology of the University of Vermont (Burlington). Some of those topics include: behavior (e.g. numerous cases in plants), phenology, sexual systems, breeding (e.g. case of apple, *Malus* sp., Rosaceae), bioluminescence, functional morphology and physiology (apical dominance, hormonal control of plant growth), survivorship curves, microhabitats, succession, pollination, rules of community assemblage, symbioses (e.g. competition, as in the seedlings of maples, *Acer* sp., Aceraceae), forest gaps, multitrophic interactions (e.g. trees as photosynthetic appendages of plants), ecological and evolutionary strategies, constrains, and trade-offs (e.g. shape of conifers in snow-prone regions), evolutionary analogy, indicator species, acid rain, fossil fuels, invasive species, historical remarks [e.g. removal of Eastern White Pine, *Pinus strobus* (Pinaceae) forests in the land of the fallen leaves], bringing extinct species back, conservation biology, and calls for actions on behalf of nature. Numerous reported observations lend themselves for experimental hypothesis testing. A substantial list of references allows interested readers to pursue the topics further.

This work could also be a welcomed addition for non-science majors, introductory courses in ecology or biology. Reading *The trees in my forest* again, made me recall walks among the forests and brought me delightful memories of wonderful professors whose lessons remain in my heart with gratefulness, as when I saw the California Buckeye, *Aesculus californica* (Hippocastanaceae) at Rancho Santa Ana Botanical Garden. Then, I remembered the late Herbert G. Baker dutifully reminding us that it has the "largest fruit of any California native tree." I wholeheartedly recommend *The trees in my forest* to anyone yearning to connect with another system of values and learn of biology through a cogently written book.

Jorge A. Santiago-Blay, Washington, District of Columbia, U.S.A.
E-mail: blayjorge@gmail.com

Mailed on February 19, 2009

RECENTLY PUBLISHED BOOKS[1]

Adaptation and complex design by John C. Avise and Francisco J. Ayala (Editors) 2007 Volume 1 of the series In the light of evolution. Arthur M. Sackler Colloquia if the National Academy of Sciences. The National Academy Press. Washington, District of Columbia, U.S.A. 360 pp.

Breaking and shaping beastly bodies. Animals as material culture in the Middle Ages by Aleksander Pkuskowski (Editor) 2007 Oxbow Books. Oxford, England, United Kingdom. 239 pp.

Charles Darwin and Victorian visual culture by Jonathan Smith 2006 part of the series, Cambridge Studies in Nineteenth-Century Literature and Culture. Cambridge University Press. Cambridge, England, United Kingdom. 349 pp.

Chrysalis Maria Sibylla Merian and the secrets of metamorphosis by Kim Todd 2007 Harcourt, Inc. Orlando, Florida, U.S.A. 328 pp.

Darwinian Detectives. Revealing the natural history of genes and genomes by Norman A. Johnson. 2007 Oxford University Press. Oxford, England, UK. 220 pp.

Deep-time perspectives on climate change. Marying the signal from computer models and biological proxies by M. Williams, A. M. Haywood, F. J. Gregory, and D. N. Schmidt (Editors) 2007 The Micropalaeontological Society Special Publications. The Micropalaeontological Society. The Geological Society. London, England, United Kingdom. 589 pp.

Evolution and religious creation myths. How scientists respond by Paul F. Lurquin and Linda Stone 2007 Oxford University Press. Oxford, England, U.K. 224 pp.

Evolutionary ecology of social and sexual systems. Crustaceans as model organisms edited by J. Emmett Duffy Thiel and Martin Thiel, with illustrations by Marco Leon. 2007 Oxford University Press. Oxford, England, U.K. 502 pp.

Evolutionary pathways in nature. A phylogenetic approach by John Avise (illustrations by Trudy Nicholson). 2006 Cambridge University Press. Cambridge, England, UK. 286 pp.

Evolution in Action by Mathias Claubrecht, Annette Kinitz, and Uwe Moldrzyk. Prestel. 2007 Munich, Germany.

Evolution's first philosopher. John Dewey and the continuity of nature by Jerome A. Popp 2007 State University of New York Press. Albany, New York, U.S.A. 155 pp.

Imperial Nature. Joseph Hooker and the practices of Victorian scientists by Jim Endersby 2008 The University of Chicago Press. Chicago, Illinois, U.S.A. 429 pp.

Myth and Geology by L. Piccardi and W. B. Maise 2007 Geological Society Special Publication No. 273. The Geological Society. London, England, United Kingdom. 350 pp.

The Crato fossil beds of Brazil. Window into an ancient world. D. M. Martill, G. Bechly, and R. F. Loveridge (Editors). 2007 Cambridge University Press. Cambridge, England, United Kingdom. 625 pp.

The evolution of organ systems by A. Schmidt-Rhaesa 2007 Oxford University Press. Oxford, England, U.K. 385 pp.

The role of theory in advancing 21st-century biology. Catalyzing transformative research. Report of the Committee on Defining and Advancing the Conceptual Basis of Biological Sciences in the 21st Century by Board of Life Sciences by the Division on Earth and Life studies. National Research Council of the National Academies 2008 The National Academies Press. Washington, District of Columbia, U.S.A. 196 pp.

The vortex of life. Nature's patterns in space and time (Second edition) by Lawrence Edwards 2006 Floris Books. Edinburg, England, UK. 381 pp.

Trying Leviathan. The nineteenth-century New York court case that put the whale on trial *and* challenge the order of nature by D. Graham Burnett 2007 Princeton University Press. Princeton, New Jersey, U.S.A. 266 pp.

Whispers in the pines a naturalist in the Northeast by Joanna Burger, with drawings by the authors 2006 Revergate Books. An imprint of Rutgers University Press. New Brunswick, New Jersey, U.S.A. 345 pp.

Why Darwin Matters. The case against Intelligent Design by Michael Shermer 2006 Times Books. Henry Holt and Company. New York, NY, U.S.A. 199 pp.

World's oldest fossils by Bruce L. Stinchcomb 2007 Schiffer Publishing Ltd., Atglen, Pennsylvania, U.S.A. 159 pp.

---

[2] Jorge A. Santiago-Blay, Washington, District of Columbia U.S.A. E-mail: blayjorge@gmail.com.

Mailed on February 19, 2009

INDEX – VOLUME 119 (1-5) 2008

Jorge A. Santiago-Blay
Washington, District of Columbia, U.S.A.
E-mail: blayjorge@gmail.com

Agreement. By submitting a paper for publication, authors tacitly agree to not submit in parallel the same manuscript to another journal. For published papers, authors agree to accept responsibility for all page, illustration, and requested reprint or .pdf charges. Rejected manuscripts will be discarded.

Scientific Notes and Book Reviews. These are much shorter contributions, typically not exceeding one (Book Review) or two (Scientific Notes) printed pages. The main difference between these types of contributions and longer papers is that scientific notes and book reviews lack an abstract and most of the main headings, except for the acknowledgments and the literature cited sections.

Reviewers. When submitting papers, all authors are requested to provide the names of two qualified individuals who have critically reviewed the manuscript before it is submitted to *Entomological News*. All papers, except book reviews and American Entomological Society business, are forwarded to experts for final review before acceptance. In order to expedite the review process when submitting papers, the authors are also asked to suggest the name, address, and e-mail of at least five published experts in the subject matter of the submitted paper who may be able to review this paper and who has not seen this contribution before. In order to attempt avoiding the appearance of conflict of interests, the suggested reviewers must not share work affiliations with any of the authors. Ideally, the review process should be completed within 30 days. If additional reviews are necessary, authors will be requested to suggest the name, address, and e-mail of other colleagues to whom the article may be sent. The Editor reserves his prerogative of sending the manuscript to other reviewers. Authors are also welcomed to list the names of colleagues to whom the article should not be sent, with a brief explanation. Upon return of reviews, authors will be asked to modify their papers to accommodate suggestions of the reviewers and the Editor as well as to conform to requirements of *Entomological News*. If authors do not modify their papers, they should specifically address, on a point by point basis, why they are not doing that.

Page Proofs. The printer will send page proofs to the Editor and then the proofs will be sent to the corresponding authors as .pdf files. The computer that authors use must be able to receive files of at least 5MB. Within three days, authors must e-mail the proofs to the Editor, with corrections indicated precisely to the page, paragraph, and line. Authors who anticipate being absent are urged to provide forwarding addresses or to provide a temporary address with dates. Proofs not received on time from authors may be published at a later date. The Editor will collect the page proofs and send them to the printer.

Page and Reprint Charges. Contact the Editor for current page and reprint charges. Authors will be mailed invoices for their total page(s) and reprints, including shipping charges. After receiving invoice, please remit payment, or address questions, to the known Office of Publication. Articles longer than 20 printed pages of *Entomological News* may be published in two or more installments, unless the author is willing to pay the entire cost of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Entomological News is widely indexed. *Entomological News* is listed in the Science Citation Index Expanded (updated on February 26, 2005). In addition, the Ulrich's Periodical Index for 2005 lists *Entomological News* as being indexed by dozens of sources, including Agricola (Agricola (CRIS), Agricultural Engineering Abstracts (AEA), Agroforestry Abstracts (AgrForAb), Aquatic Sciences & Fisheries Abstracts (ASFA), BIOBASE, BiolAb), Biology Digest (BiolDig), BIOSIS Previews (BIOSIS Prev), Chemical Abstracts (ChemAb), Current Awareness in Biological Sciences (BIABS), Current Contents (CurrCont), Field Crop Abstracts (FCA), Faba Bean Abstracts (FaBeAb), Fisheries Review (SFA), Forestry Abstracts (ForAb), Grasslands and Forage Abstracts (HerbAb), Horticultural Science Abstracts (HortAb), Index Veterinarius (indVet), MEDLINE, Nematological Abstracts (NemAb), Nutrition Abstracts and Reviews (NutrAb), Personal Alert (ASCA), Plant Breeding Abstracts (PBA), Post Harvest News and Information (PHN&I), Poultry Abstracts (PoultAb), Protozoological Abstracts (ProtozoAb), Review of Aromatic and Medicinal Plants (RA&MP, Referativnyi Zhurnal (RefZh), Review of Applied Entomology (RevApplEntom), Review of Medical and Veterinary Mycology (RM&VM), Rice Abstracts (RiceAb), Seed Abstracts (SeedAb), Soils & Fertilizers (S&F), Soybean Abstracts (SoyAb), Tropical Diseases Bulletin (TDB), Vitis - Viticulture and Oenology Abstracts (VITIS), Weed Abstracts (WeedAb), Wheat Barley and Triticale Abstracts (TritiAb), Wildlife Review Abstracts (WildRev), Zoological Record (ZoolRec), among others.

Entomological News is printed by Dover Litho Printing Company (Division of Farley Printing Co.),1211 North DuPont Highway, Dover, Delaware 19901 U.S.A. Telephone (302) 678-1211; fax: (302) 678-8091; web page: www.doverlitho.com. Dover Litho has been recognized by DENREC and DELRAP Green Industries as "The Most Environmentally Conscious Printer in the State of Delaware." *Entomological News* is printed on acid free and archival quality, elemental chlorine free (ECF), or totally chlorine free (TCF) recycled paper that meets EPA and FTC guidelines for recycled coated papers.

Mailed on February 19, 2009

continued from front cover

SCIENTIFIC NOTE

BOOK REVIEW

AMERICAN ENTOMOLOGICAL SOCIETY BUSINESS

THE AMERICAN ENTOMOLOGICAL SOCIETY

www.acnatsci.org/hosted/aes