ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
et du
MUSÉUM D'HISTOIRE NATURELLE
de la Ville de Genève

tome 112
fascicule 1
2005

REVUE SUISSE DE ZOOLOGIE

SWISS JOURNAL OF ZOOLOGY

GENÈVE MARS 2005 ISSN 0035 - 418 X

REVUE SUISSE DE ZOOLOGIE

TOME 112—FASCICULE 1

Publication subventionnée par:
ACADÉMIE SUISSE DES SCIENCES NATURELLES (SCNAT)
VILLE DE GENÈVE
SOCIÉTÉ SUISSE DE ZOOLOGIE

Comité de lecture

Il est constitué en outre du président de la Société suisse de Zoologie, du directeur du Muséum de Genève et de représentants des instituts de zoologie des universités suisses.

Les manuscrits sont soumis à des experts d'institutions suisses ou étrangères selon le sujet étudié.

La préférence sera donnée aux travaux concernant les domaines suivants: biogéographie, systématique, évolution, écologie, éthologie, morphologie et anatomie comparée, physiologie.

Administration

MUSÉUM D'HISTOIRE NATURELLE
1211 GENÈVE 6

Internet: http://www.ville-ge.ch/musinfo/mhng/page/rsz.htm

PRIX DE L'ABONNEMENT:

SUISSE Fr. 225.— UNION POSTALE Fr. 230.—
(en francs suisses)

Les demandes d'abonnement doivent être adressées
à la rédaction de la *Revue suisse de Zoologie*,
Muséum d'histoire naturelle, C.P. 6434, CH-1211 Genève 6, Suisse

ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
et du
MUSÉUM D'HISTOIRE NATURELLE
de la Ville de Genève

tome 112
fascicule 1
2005

REVUE SUISSE DE ZOOLOGIE

SWISS JOURNAL OF ZOOLOGY

GENÈVE MARS 2005 ISSN 0035 - 418 X

REVUE SUISSE DE ZOOLOGIE

TOME 112—FASCICULE 1

Publication subventionnée par:
ACADÉMIE SUISSE DES SCIENCES NATURELLES (SCNAT)
VILLE DE GENÈVE
SOCIÉTÉ SUISSE DE ZOOLOGIE

Comité de lecture

Il est constitué en outre du président de la Société suisse de Zoologie, du directeur du Muséum de Genève et de représentants des instituts de zoologie des universités suisses.

Les manuscrits sont soumis à des experts d'institutions suisses ou étrangères selon le sujet étudié.

La préférence sera donnée aux travaux concernant les domaines suivants: biogéographie, systématique, évolution, écologie, éthologie, morphologie et anatomie comparée, physiologie.

Administration

MUSÉUM D'HISTOIRE NATURELLE
1211 GENÈVE 6

Internet: http://www.ville-ge.ch/musinfo/mhng/page/rsz.htm

PRIX DE L'ABONNEMENT:

SUISSE Fr. 225.— UNION POSTALE Fr. 230.—
(en francs suisses)

Les demandes d'abonnement doivent être adressées
à la rédaction de la *Revue suisse de Zoologie*,
Muséum d'histoire naturelle, C.P. 6434, CH-1211 Genève 6, Suisse

REVUE SUISSE DE ZOOLOGIE 112 (1): 3-11; mars 2005

Evidence of spermatophores in Cyphophthalmi (Arachnida, Opiliones)

Ivo M. KARAMAN
Department of Biology and Ecology, Faculty of Sciences, Trg D. Obradovića 2, 21000 Novi Sad, Serbia and Montenegro.
E-mail: karaman@ib.ns.ac.yu

Evidence of spermatophores in Cyphophthalmi (Arachnida, Opiliones). - A spermatophore in Opiliones is for the first time observed and described from a specimen of *Cyphophthalmus serbicus* (Hadži, 1973), here transferred from *Siro*. Insemination by means of spermatophores seems typical for some groups of the Cyphophthalmi, the most primitive and the least species-rich suborder in the order Opiliones. Primitive but complex insemination by spermatophores was retained in this group, which is adapted to a cryptozoic way of life, where this mating strategy is still functional. This paper presents a hypothesis on the possible significance of a number of characteristic traits in Cyphophthalmi, which presumably have some function for insemination via spermatophores.

Keywords: Opiliones - Cyphophthalmi - spermatophores - sperm transfer - functional anatomy - Balkan.

INTRODUCTION

The Cyphophthalmi is a rare and not well studied group of small cryptobiotic animals. They are present on almost all continents, with discontinuous distribution patterns and high degrees of endemism and with 113 known species (Giribet, 2000). Although Juberthie (1960, 1961, 1965, 1967) explained many aspects of biology and anatomy of Cyphophthalmi using *Siro rubens* Latreille, 1804 as an example, function and significance of many specific characters are still not understood. The presence of penis and ovipositor, and copulation as a direct way of insemination are used as differential characteristics of the order Opiliones (Martens, 1976). Dogmatic influence of this widely accepted concept led numerous authors to neglect the assumption that insemination in Cyphophthalmi is through deposition of spermatophores, which could in turn explain the function of certain characters.

First speculations on spermatophore production in Cyphophthalmi were presented by Forster in his thesis (*vide* Juberthie, 1965; Savory, 1977; Shear, 1980). Forster (1948, 1952) conducted extensive and detailed faunistic and taxonomic research on Cyphophthalmi in New Zealand and was able to notice this extremely important trait. Unfortunately, Forster's observations and assumptions were not

Manuscript accepted 03.06.2004

accepted, with other authors being skeptical (Juberthie, 1965; Shear, 1980), or ignoring them entirely. However, the possibility that Cyphophthalmi might indeed form spermatophores was not ruled out (Juberthie & Manier, 1978; Martens, 1978). Regarding the penis anatomy in Cyphophthalmi, van der Hammen (1985) assumed its function to be deposition of spermatophores and used the appropriate term, spermatopositor. However, he did not give any further explanation and it can be assumed that this was the manifestation of adopting Forster's assumption. In his attempts to separate the Cyphophthalmi from the other Opiliones, Savory (1977) was the only one to point out the importance of Forster's findings and used them as a unique key trait of Cyphophthalmi to support his ideas (Savory's hypothesis was that Cyphophthalmi is an ancestral group of the remaining Opiliones and of the Ricinulei, and he suggested that they comprise an order of their own; this has been refused by other authors). With the exception of some differential traits that comprise a complex reproductive mechanism, there are indeed few characters which are not essentially opilionid characters (van der Hammen, 1985). In that respect, this paper has no ambition to discuss speculations about the phylogenetic position of Cyphophthalmi.

Studying and collecting Balkan sironids for a number of years led to the discovery of an important trait which supports Forster's assumption that sperm transfer in Cyphophthalmi is accomplished by means of spermatophores. In contrast to Forster, who had circumstantial evidence (Shear, 1980) and only assumed the existence of spermatophores, my evidence is an actual spermatophore attached to a female specimen. Except for the morphological description of the spermatophore (no histological details are given since this is the only complete sample available to date) and its attachment to an ovipositor, the rest of this paper is of speculative nature, relying on available facts and logical reasoning. Researchers collecting Cyphophthalmi know how hard it is to find them, while the collecting technique itself (soil and litter sieving) further significantly decreases the probability of finding a female with an attached spermatophore. After twenty years of research and with over 1000 specimens collected, only two females have been found with spermatophores attached. Therefore, and in spite of the scarcity of information, I have decided to publish these findings.

MATERIAL AND METHODS

Material: 1 female *Cyphophthalmus serbicus* (Hadži, 1973) **comb. n.**[1]: Serbia, Svrljiške planine Mts., above village Crnoljevica 14.07.1989. leg. I. Karaman.

1 female *Cyphophthalmus* sp. 1.: Serbia, Mt. Zlatibor, Šargan, 14.06.1991, leg. I. Karaman.

11 females of *Cyphophthalmus* sp. 2.: Montenegro, Danilovgrad, Milovićka vrela, 26.04.1997, leg. I. Karaman.

Methods: The material was preserved in 70% ethanol. Details of the spermatophore were observed and photographed in glycerine (LM microphotographs). SEM

[1] All known Balkan Cyphophthalmi belong to one genus (resurrected genus *Cyphophthalmus* Joseph, 1868), which is not closely related to the genus *Siro* Latreille. 1796 (Karaman, in prep.). To avoid possible later confusion, I decided to use the correct generic name for the species included in this paper.

photographs of material prepared in a Baltec SCD005 Sputter Coater (ovipositors where frozen before) were made with a JEOL-JSM-6460lv SEM microscope in high vacuum.

RESULTS AND DISCUSSION

Figure 1 shows a female of *C. serbicus* with an attached spermatophore as it was found in my collection where the specimen was kept for more than 10 years. The spermatophore is balloon-like in shape (Fig. 2A) and extends into a tube which ends freely in an amorphous mass that is well attached to the basal parts of the terminal lobes of the ovipositor. Entrances to receptacula seminis are widely opened (Fig. 2C). Figure 2B illustrates how the spermatophore is attached to the female ovipositor in the specimen of *Cyphophthalmus* sp. 1. Not understanding its importance in my earlier studies, the spermatophore on this specimen was regrettably cut off and lost later on. Specimens collected on the same occasion were my first finds of a new species of Cyphophthalmi, and thus the importance of this detail was overlooked. The tubular appendage, however, remained attached to the ovipositor. Interestingly, the tubular parts of spermatophore in *C. serbicus* and *Cyphophthalmus* sp. 1 differ considerably. The external layer of the spermatophore tube in *Cyphophthalmus* sp. 1 is twice as wide and more transparent (almost membrane-like) than in *C. serbicus*, where it is amber in colour and appears brittle (Fig. 4A, C) (terminal part missing probably due to this fragility). These two species are phylogenetically distant (based on yet unpublished data).

A globular structure is visible inside the spermatophore (Fig. 4B), with spherical contents which likely are encapsulated sperm. The dimensions of the individual spheres (30-45 mm) are in accordance with the encapsulated sperm described by Juberthie (1965). However, the diameter of the spermatophore tube is 9 μm (Fig. 4C), which is too narrow for the encapsulated sperm to pass through, nor can the opening of the receptaculum seminis ($\approx$ 15 μm) receive such encapsulated sperm cells. Therefore I suppose that females exert mechanical pressure on spermatophores, causing the capsules to break and release the sperm that can then pass through the tube easily (they are in fact pushed out). This assumption is also supported by the fact that the basal end of the spermatophore is depressed (Figs 1, 2A, 4).

The receptacula seminis may also play an active role in receiving the released spermatophore contents, with the muscles at the basal end of the receptacula possibly having such a function. These muscles were mentioned and illustrated for the first time by Rafalski (1958) in *Siro carpaticus* Rafalski, 1958. The same muscles were shown in an illustrations of the ovipositor longitudinal section of *Siro duricorius* Joseph, 1868 in Martens *et al.* (1981), but no explanation was given. The active function of the receptacula seminis in sperm reception might be another specific characteristic of the Cyphophthalmi.

The above-described way of sperm transfer requires certain anatomic adaptations (specific for Cyphophthalmi). The position of the ovipositor during sperm transfer is characteristic, with the apical part obliquely extended and set in the groove of the posterior edge of the genital opening (Fig. 2B). The posterior edge of the genital opening is itself protruded outward, enabling the oblique position of the ovipositor

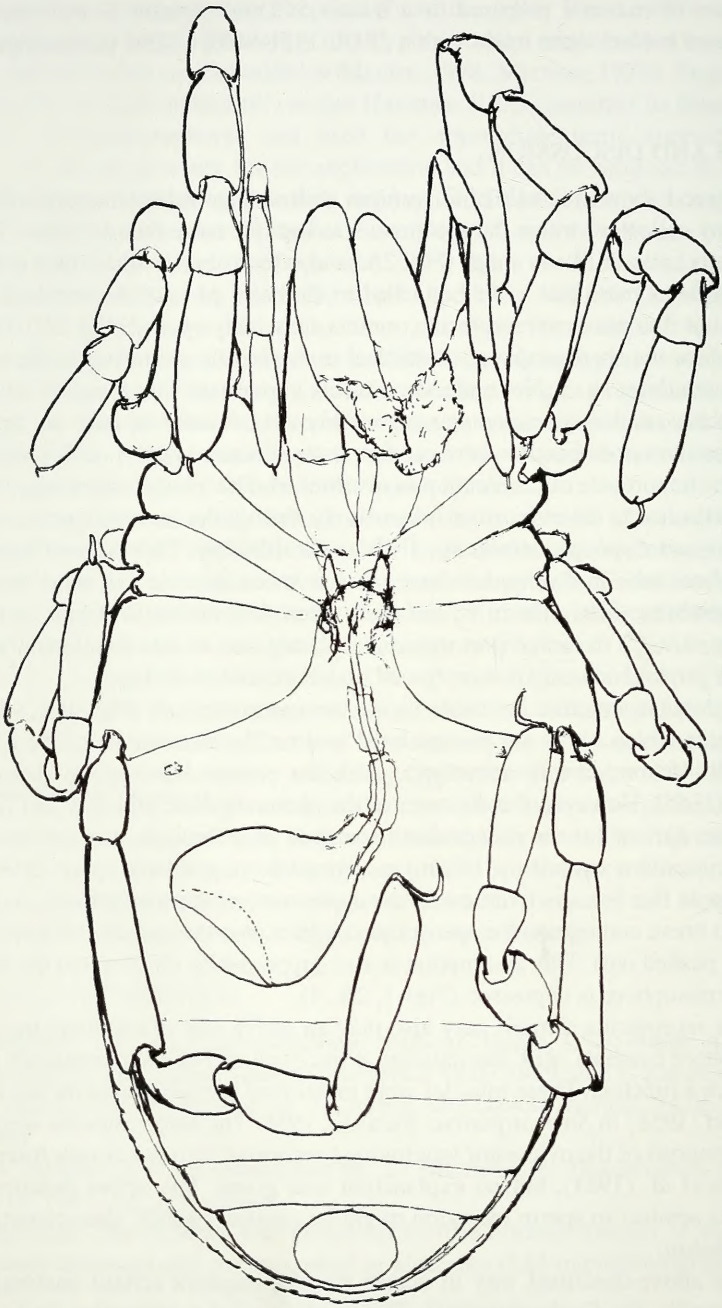


FIG. 1
A female of *Cyphophthalmus serbicus* with attached spermatophore, ventral view.

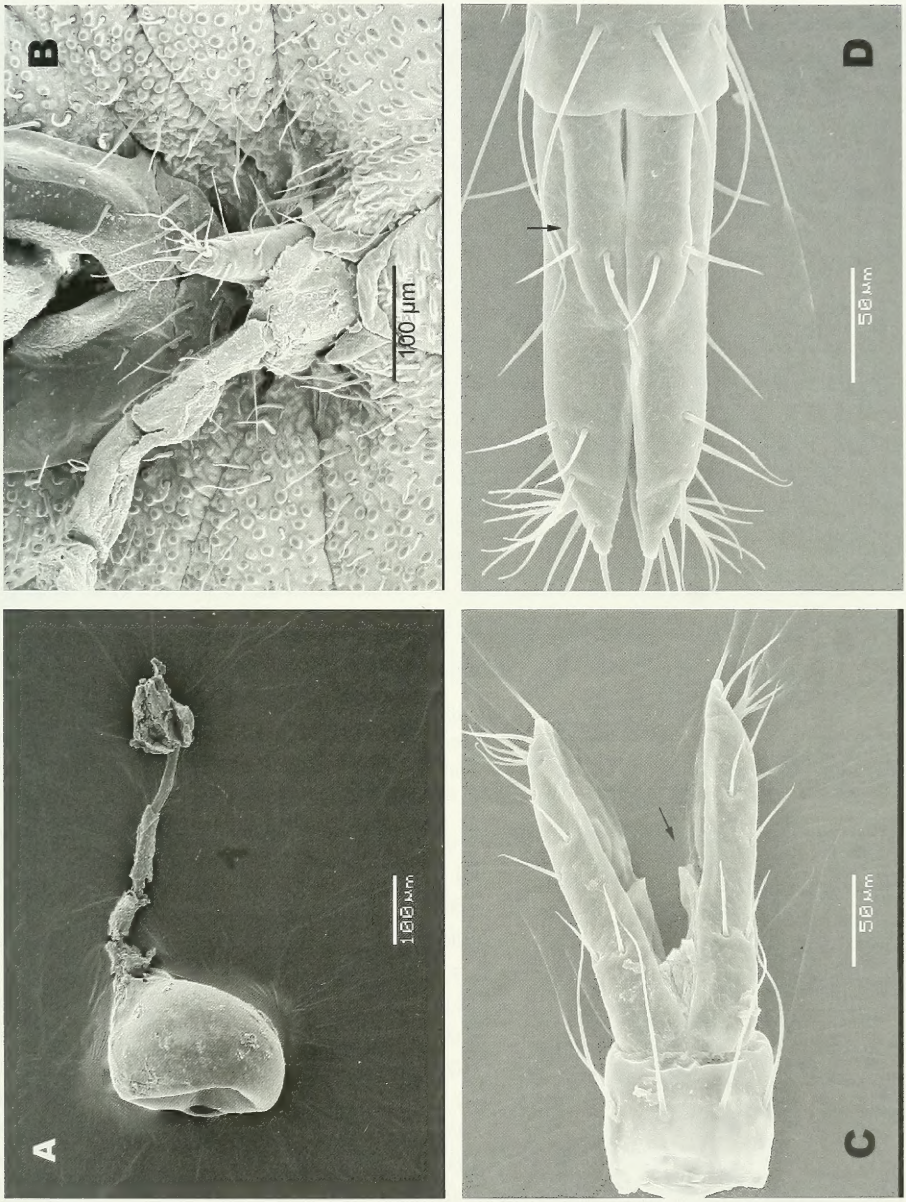


FIG. 2

A. Spermatophore of *Cyphophthalmus serbicus*. **B.** Terminal part of spermatophore of *Cyphophthalmus* sp. 1 attached in between terminal lobi of ovipositor. **C.** Terminal part of ovipositor of *C. serbicus* after removing the spermatophore, with widely opened entrance to receptacles (arrow). **D.** Ventral view on terminal part of ovipositor of *C. serbicus* (arrow marks swollen area of terminal lobus).

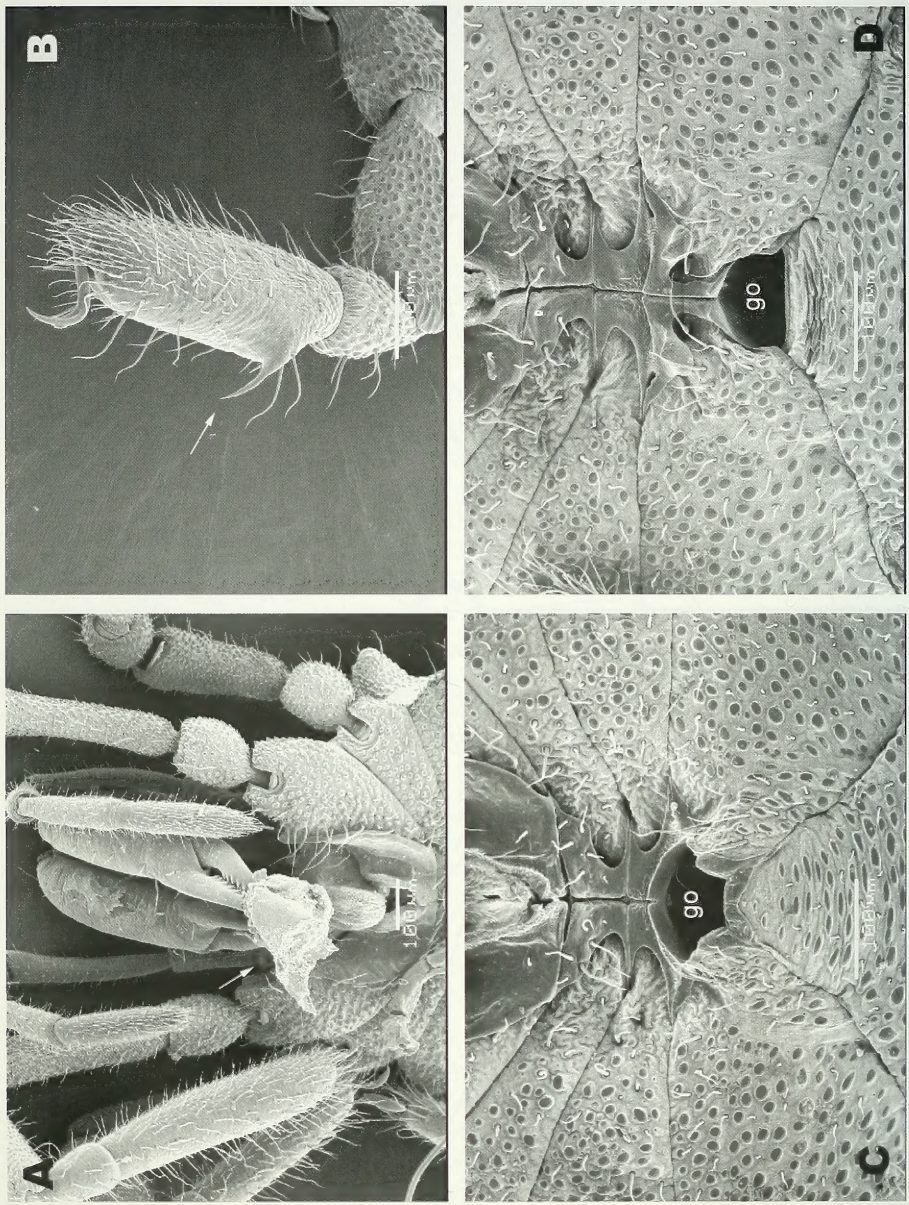


FIG. 3

A. Terminal parts of chela of *Cyphophthalmus* sp. 1 with amorphous mass (arrow), supposed to be the secretion of the ovipositor sticky glands. **B.** Male tarsus IV with posterodorsal adenostyle (arrow) terminally bearing opening of the tarsal gland. **C.** *Cyphophthalmus serbicus* female, genital opening (go) with coxosternal complex anterior to it. **D.** Genital opening with coxosternal complex of a male of *C. serbicus*.

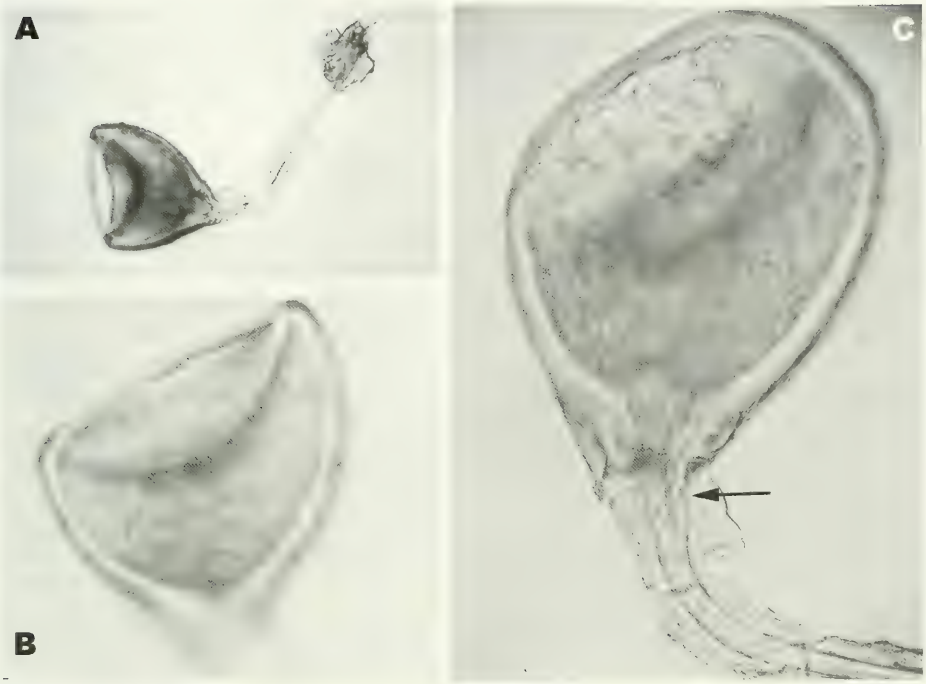


FIG. 4

A. LM microphotograph of the whole spermatophore of *Cyphophthalmus serbicus*. **B.** Main portion of spermatophore showing globular structure of its contents. **C.** Basal part of spermatophore tubular appendage with a content which could represent released sperm cells (arrow).

during sperm transfer (Figs. 2B, 3C). The ventral side of the terminal lobes of the ovipositor is "swollen" in the basal area (causing asymmetry in the frontal plane) (Fig. 2D), at the point where the end of the spermatophore is attached to the ovipositor. Likely this creates space for the spermatophore to attach and for sperm transfer.

The whitish amorphous mass that connects the terminal end of the spermatophore and the ovipositor lobes might be a secretion of the sticky glands ("Kittdrüse") placed in the terminal lobes of the ovipositor (Martens *et al.*, 1981). It is interesting to mention that a similar mass covers the tips of the chela in both specimens (Figs 1, 3A). Since nothing similar was observed in any of the other specimens in my collection, it is possible that the presence of this secretion on the chelicerae is somehow connected with the process of spermatophore transfer (manipulations for placing the terminal part of the spermatophore in the adequate position between the ovipositor lobes).

The lack of a genital operculum in both sexes is another character of Cyphophthalmi that might be explained by the specific way of insemination. The operculum would obstruct the complex process of spermatophore formation and transfer of its contents (for males and females).

The structure of spermatophore and its external layer suggest that there is no copula in the genus *Cyphophthalmus*. I believe that the primitive type of mating, by deposition of spermatophores without previous contact, was retained in this genus.

Encapsulated sperm and well-protected spermatophore imply that a male can lay the spermatophore on the ground even if a female is not present. Another specific character of some Cyphophthalmi is the presence of anal glands in males. The secretion of these glands by males of the genus *Cyphophthalmus* can be used to mark the place where a spermatophore has been deposited in order to attract females.

An active role of the ovipositor in receiving and maybe even finding spermatophores is also possible.

The fact that Juberthie never noticed spermatophores while studying the biology of *S. rubens* could be explained by the camouflage colour of spermatophores, which is yellowish amber in the specimen of *C. serbicus* in my collection. Spermatophores with such a colour are inconspicuous when on the ground.

The formation of the spermatophore is possibly supported by two annex glands that open in the lumen of the terminal end of the vas deferens (Juberthie, 1965). The thick external layer of the spermatophore could be the product of the gland on tarsus IV of males (Fig. 3B) (this could be its primary function). The complex structure of the voluminous tarsal glandular organ (Martens, 1979) supports this assumption.

It would be interesting to determine the exact location where spermatophores are formed. This could take place on the surface of the coxosternal complex of the male, and it is possible that this complex plays some role in the process of spermatophore production. The coxosternal complex shows distinct sexual dimorphism in Cyphophthalmi (Figs 3C, D), which is not expressed quite so distinctly in any other group of Opiliones. The coxosternal complex is largely reduced in females, while it is well-developed in males, and it is often species specific. In males this is a structured smooth surface covering the bottom of the depression in front of the genital opening, and the only such formation in its proximity. This depression lies immediately below the terminal end of the spermatopositor when it is extended.

As expected for endogean sironids from a temperate region, seasonality in mating was observed. The time of mating varies depending on latitude, altitude and exposition, and it may be species specific too. At one locality in southern Montenegro (50 m asl) specimens of a still undescribed species (*Cyphophthalmus* sp. 2) were mating at the end of April. This conclusion is based on the fact that about 25% of all collected females (45 specimens) had extended ovipositors with an amorphous mass between their terminal lobes, possibly the secretion from sticky glands in the terminal lobes of the ovipositor. It seems that specimens were caught during sperm transfer. In west Serbia and at 800 m asl a specimen of *Cyphophthalmus* sp. 1 was found with a spermatophore in the middle of June. The female of *C. serbicus* with a spermatophore attached to it was collected in the middle of July on the northern slopes of the Svrljiške planine Mountains (east Serbia), at altitudes higher than 800 m asl.

This primitive but very complex insemination mechanism, considered as a plesiomorphic trait, was retained by some Cyphophthalmi. It is a small group of opiliones, specialized for a cryptozoic way of life in small crevices, holes and similar microhabitats where this mating strategy can remain functional. It is clear that other Opiliones have acquired a direct way of insemination, i.e. the spermatopositor has developed into a penis. However, I believe that some form of transitional insemination (direct transfer of spermatophores or sperm packets) can be found in some Opiliones.

ACKNOWLEDGEMENTS

I thank Dr Adriano Kury from Rio de Janeiro for helpful comments and information, and Miša Bokorov from Novi Sad for his patience and for producing the nice SEM photographs.

REFERENCES

FORSTER, R. R. 1948. The suborder Cyphophthalmi in New Zealand. *Dominion Museum Records in Entomology* 1, (7): 79-119.

FORSTER, R. R. 1952. Supplement to the sub-order Cyphophthalmi. *Dominion Museum Records in Entomology* 1, (9): 179-211.

GIRIBET, G. 2000. Catalogue of the Cyphophthalmi of the world (Arachnida, Opiliones). *Revista Iberica de Aracnologia* 2: 49-76.

JUBERTHIE, C. 1960. Sur la biologie d'un Opilion endogé, Siro rubens Latr. (Cyphophthalmes). *Comptes rendus de l'Académie des Sciences* 251: 1674-1676.

JUBERTHIE, C. 1961. Structure des glandes odorantes et modalités d'utilisation de leur sécrétion chez deux opilions cyphophthalmes. *Bulletin de la Société Zoologique de France* 86 (1): 106-116.

JUBERTHIE, C. 1965. Données sur l'écologie, développement et la reproduction des Opilions. *Revue d'Écologie et de Biologie du Sol* 2: 377-396.

JUBERTHIE, C. 1967. *Siro rubens* (Opilion, Cyphophthalme). *Revue d'Écologie et de Biologie du Sol* 4: 155-171.

JUBERTHIE, C. &. MANIER, J. F. 1978. Étude ultrastructurale comparée de la spermiogenèse des Opilions et son intérêt phylétique. *Symposium of the Zoological Society of London* 42: 407-416.

MARTENS, J. 1976. Genitalmorphologie, System und Phylogenie der Weberknechte (Arachnida: Opiliones). *Entomologica Germanica* 3: 51-68.

MARTENS, J. 1978. Spinnentiere, Arachnida, Weberknechte, Opiliones. Die Tierwelt Deutschlands, Gustav Fischer, Jena, 64: 1-449.

MARTENS, J. 1979. Feinstruktur der Tarsal-Drüse von Siro duricorius (Joseph) (Opiliones, Sironidae). *Zoomorphologie* 92: 77-93.

MARTENS, J., HOHEISEL, U. & GÖTZE, M. 1981. Vergleichende Anatomie der Legerhöhren der Opiliones als Beitrag zur Phylogenie der Ordnung (Arachnida). *Zoologische Jahrbücher, Abteilung für Anatomie und Ontogenie der Tiere* 105:13-76.

RAFALSKI, J. 1958. A description of *Siro carpaticus* sp. n. with remarks on the morphology and systematics of the Cyphophthalmi (Opiliones). *Acta Zoologica Cracoviensia* 2: 521-556.

SAVORY, T. H. 1977. Cyphophthalmi: the case for promotion. *Biological Journal of the Linnean Society* 9: 299-304.

SHEAR, W. A. 1980. A review of the Cyphophthalmi of the United States and Mexico, with a proposed reclassification of the suborder (Arachnida, Opiliones). *American Museum Novitates* 2705: 1-34.

VAN DER HAMMEN, L. 1985. Comparative studies in Chelicerata III. Opilionida. *Zoologische Verhandelingen* 220: 1-60.

Revue suisse de Zoologie 112 (1): 13-20; mars 2005

Astyanax hermosus, a new species from the Primero River basin, Córdoba, Argentina (Characiformes, Characidae)

Amalia M. MIQUELARENA[1], Lucila C. PROTOGINO[1] & Hugo L. LÓPEZ[2]

[1] Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET); Instituto de Limnología "Dr. Raúl A. Ringuelet" y División Zoología Vertebrados, Museo de La Plata. Paseo del Bosque s/n 1900 La Plata, Buenos Aires, Argentina.
E-mail: miquelar@museo.fcnym.unlp.edu.ar

[2] Comisión de Investigaciones Científicas y Técnicas de la Provincia de Buenos Aires (CIC) y División Zoología Vertebrados, Museo de La Plata. Paseo del Bosque s/n 1900 La Plata, Buenos Aires, Argentina.

***Astyanax hermosus*, a new species from the Primero River basin, Córdoba, Argentina (Characiformes, Characidae).** - A new species of the characid genus *Astyanax* is described from the endorheic Primero River basin, in central Argentina: *Astyanax hermosus* sp. n. This species can be distinguished from all other in the genus by the following combination of characters: body relatively low (33.1-38.7% SL); head short (23.5-27.1% SL); snout short (18.3-26.6% HL); interorbital broad (34.9-41.5% HL); maxilla with 1-3 teeth, usually one; iv-v, 17-22 anal-fin rays; 35-38 perforated scales on the lateral line; transverse scales 7/6; and distinctive color pattern, with Y-shaped humeral spot, a broad grayish longitudinal stripe on the flanks, extending weakly onto the middle caudal-fin rays, and extremely dark opercular, subopercular and preopercular regions. In addition, the males of the new species are distinguished by the presence of bony hooks in all their fins.

Keywords: Ostariophysi - Characidae - *Astyanax* - new species- taxonomy - biodiversity - Central Argentina.

INTRODUCTION

The genus *Astyanax* Baird & Girard includes about one hundred nominal species and subspecies (Garutti & Britski, 2000). It is one of the most speciose and geographically widespread genus within the Characidae, occurring from southern North America to northern Patagonia in Argentina.

Eigenmann (1921, 1927) analyzed the genus and provided identification keys for species and subspecies. Géry (1977) provided keys for the species of subgenus *Astyanax*. In recent years several species belonging to this genus have been described (Azpelicueta & García, 2000; Garutti & Britski, 2000; Bertaco & Malabarba, 2001; Almirón *et al.*, 2002; Azpelicueta *et al.*, 2002 a, b; Casciotta *et al.*, 2003 a, b; Garutti, 2003; Triques *et al.*, 2003 and Mirande *et al.*, 2004). However, there are neither recent critical evaluations of the diversity within *Astyanax*, 86 species appear in Reis *et al.* (2003). Weitzman & Malabarba (1998) believe that there is no existing evidence for

Manuscript accepted 13.07.2004

the monophyly of the genus. In this paper, we describe a new species of *Astyanax* collected from San Francisco River. This stream is part of the endorheic Primero River basin and arises at the Sierras Grandes mountain range in Valle Hermoso, a locality in central Argentina.

MATERIAL AND METHODS

Measurements to the nearest 0.01 mm were made using a Digimess digital caliper following Fink & Weitzman (1974). Counts were made with a WILD M8 stereomicroscope. Osteological observations were made on eight specimens cleared and stained (c&s) for bone and cartilage following Taylor & Van Dyke (1985). All measurements are expressed as percentage of standard length (SL), except for head measurements, which are recorded as percentage of head length (HL). In all counts, frequencies are given in parentheses and the holotype is indicated by an asterisk.

Material is deposited in the Instituto de Limnología "Dr. Raúl A. Ringuelet", Argentina (ILPLA); Museo de La Plata, Argentina (MLP); and Museum d'histoire naturelle de Genève, Switzerland (MHNG).

Comparative material

Astyanax asuncionensis Géry, 1972: ILPLA 382, 2 ex., 44.4-64.8 mm SL, Urugua-í stream, Iguazú Department, Misiones Province, Argentina, coll.: C. R. Guillén, Apr. 1977.

Astyanax cordovae (Günther, 1880): ILPLA 44, 2 ex., 84.5-119.3 mm SL, Primero River, Córdoba Province, Argentina, coll.: H. Haro, Sep. 1988.

Astyanax eigenmanniorum (Cope, 1894): ILPLA 705, 5 ex., 53.8-77.1 mm SL, Laguna Chascomús (35°36' S-58°02' W), Buenos Aires Province, Argentina, coll.: C. Togo and H. López, May. 1979; ILPLA 716, 4 ex., 51.9-82.9 mm SL, Laguna Chascomús, Buenos Aires Province, Argentina, coll.: O. Padin and J. Iwaszkiw, Apr. 1984.

Astyanax cf. *fasciatus*: ILPLA 569, 6 ex., 70.7-80.6 mm SL, Brazo Chico stream, Entre Rios Province, Argentina, coll.: N. Landoni, Jan. 1985; ILPLA 596, 6 ex., 54.2-63.5 mm SL, Laguna de Lobos (35°17' S-59°07' W), Buenos Aires Province, Argentina, coll.: A. Miquelarena *et al.*, Jun. 1986.

Astyanax lineatus (Perugia, 1891): ILPLA 1487, 2 ex., 32.9-36.5 mm SL, Metán River (tributary of Juramento River), on Route 46, road between Punta del Agua and La Costosa, Salta Province, Argentina, coll.: A. Miquelarena *et al.*, Mar. 1987; ILPLA 1515, 10 ex., 50.0-74.5 mm SL, an unnamed creek before Huaico Mora creek, on the road between Zapla and Jujuy City, Jujuy Province, Argentina, coll.: A. Miquelarena *et al.*, Mar. 1987.

Astyanax ojiara Azpelicueta & García, 2000: MLP 9470, holotype ♂, 50.0 mm SL, Benítez stream, headwaters of Yaboty River, Uruguay basin, Misiones Province, Argentina, coll.: O. García, May. 1983; MLP 9472, 6 paratypes, 50.2-67.5 mm SL, collected with the holotype.

Astyanax troya Azpelicueta, Casciotta & Almirón, 2002: ILPLA 1152, 12 ex., 60.7-86.3 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: R. Filiberto & F. De Durana, Sep. 1997; ILPLA 1154, 3 ex., 52.4-67.0 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: R. Filiberto & L. Protogino, Nov. 1999; ILPLA 1156, 14 ex., 32.6-85.3 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: A. Miquelarena *et al.*, Sep. 2000.

RESULTS

Astyanax hermosus sp. n. Fig. 1; Table 1

Holotype: ILPLA 1690, ♂, 78.5 mm SL; San Francisco River, Primero River basin, Valle Hermoso (31° 07' S - 64° 29' W), Punilla Department, Córdoba Province, Argentina, coll.: O. de Ferreri, Jan. 1965.

Paratypes: ILPLA 1691, 19 ex.: 6 ♂ (2c&s) and 13 ♀, 48.7-77.9 mm SL; ILPLA 1692, 6 ♀ (c&s), 47.0-51.1 mm SL; MHNG 2647.68, 4 ex. ♀, from the same locality as holotype.

Diagnosis

Astyanax hermosus sp. n. differs from other species of the genus by the following combination of characters: body relatively low (33.1-38.7% SL); head short (23.5-27.1% SL); snout short (18.3-26.6% HL); mouth superior; maxilla with 1 to 3 (usually 1) teeth, with 1 to 4 cusps; interorbital broad (34.9-41.5% HL); anal-fin rays iv-v, 17-22; perforated scales on lateral line 35-38; transversal scales 7/6 and distinctive color pattern: Y-shaped humeral spot, a wide longitudinal grayish stripe extending weakly onto the middle caudal-fin rays, and very dark opercular, subopercular and preopercular regions. *Astyanax hermosus* sp. n. is also distinguished by the presence of bony hooks on all fins of the males.

Description

Body relatively low, with maximum body depth at dorsal-fin origin. Head short. Mouth superior. Thick lips. Snout short. Eye larger than snout length (29.7-34.7 % HL vs.18.3-26.6 % HL). Interorbital broad. Dorsal profile of body slightly convex from snout tip to dorsal-fin origin; descending smoothly from dorsal-fin base origin to adipose-fin base origin. Dorsal profile of caudal peduncle slightly straight, ventral profile slightly concave or straight. Ventral profile of body slightly convex from tip of snout to pelvic-fin origin, almost straight between pelvic and anal-fin origins. Caudal peduncle relatively high. Dorsal-fin origin almost equidistant from tip of snout and base of caudal-fin rays. Anal-fin origin clearly behind level of last dorsal-fin ray. Pelvic-fin origin situated slightly anterior to vertical level of dorsal-fin origin. In males the pectoral-fin tip may reach or not the origin of pelvic fin (extending beyond pelvic-fin origin in two specimens only). In females the pectoral-fin tip does not reach the pelvic-fin origin by a considerable distance, except for a few small specimens. Tip of pelvic fin not reaching anal-fin origin in males and females. Presence of bony hooks on rays of all fins in males.

Dorsal-fin rays iii, 8 (1); iii, 9 (17*); iii, 10 (2). Margin of dorsal fin approximately straight or rounded, last unbranched ray and first three branched rays are longest. Bony hooks of males small scattered on the branches of the first to sixth fin rays.

Pectoral-fin rays i, 9, i (2); i,10, i (5); i,11, i (12*); i, 12, i (1). Bony hooks of large specimens are also small and scarce, 2-4 hooks on a few branched rays.

Pelvic-fin rays i, 6 (3); i, 7 (17*). Bony hooks short, broad and abundant, one on each segment of the posterior branch of each branched ray; though in some specimens hooks are present on both anterior and posterior branches. Pelvic axillary scale without hooks.

Anal-fin rays iv, 17 (1); iv, 18 (3); iv, 19 (7); iv, 20 (4); iv, 21 (1); iv, 22 (*); v, 20 (2); v, 21 (1), males having distal margin straight and females concave, with inflexion point almost in the first third of fin length. Bony hooks are conspicuous as in the pelvic fins and appear from the last unbranched ray to approximately the 15th branched ray.

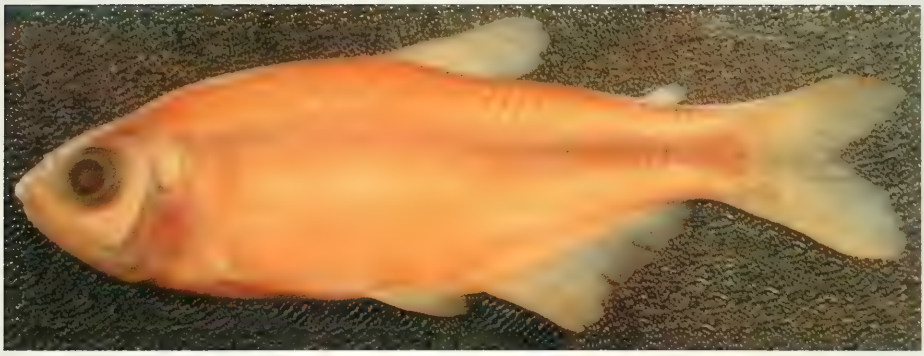


Fig.1
Astyanax hermosus sp. n., ILPLA 1690. Holotype male, 78.5 mm SL.

TABLE 1. Morphometric data of *Astyanax hermosus* sp. n. SD: standard deviation.

Characters	Holotype	Paratypes					
	♂	♂ (n=6)			♀ (n=13)		
		Range	Mean	SD	Range	Mean	SD
Standard length (mm)	78.5	53.0-71.1	66.7		48.7-77.9	55.6	
As a percentage of SL							
Head length	24.6	23.5-25.9	24.7	1.0	24.3-27.1	25.9	0.8
Body depth	33.1	33.9-37.8	36.1	1.5	34.8-38.7	36.3	1.4
Predorsal distance	47.0	47.5-51.0	48.8	1.2	47.1-52.2	49.2	1.4
Prepectoral distance	24.3	21.0-24.5	22.9	1.4	20.9-25.6	24.2	1.2
Prepelvic distance	41.9	41.5-45.4	43.2	1.5	42.8-47.0	44.6	1.3
Preanal distance	59.3	59.5-63.9	61.4	1.5	62.3-66.9	63.7	1.4
Caudal peduncle length	9.9	6.8-10.0	8.9	1.2	7.5-10.4	9.2	0.8
Caudal peduncle depth	12.7	13.5-14.3	13.7	0.3	12.6-14.7	13.6	0.7
Dorsal fin base	14.9	15.2-16.5	15.9	0.5	14.5-17.0	16.2	0.8
Anal fin base	28.2	26.0-29.5	28.3	1.3	25.1-28.6	27.1	1.2
Pectoral-pelvic distance	20.2	19.8-21.7	20.8	0.6	20.1-25.2	21.5	1.6
Pelvic-anal distance	17.7	18.8-20.3	19.3	0.6	18.2-21.0	19.8	0.7
Pectoral length	22.0	19.6-22.2	20.9	1.0	16.5-22.5	20.1	1.7
Pelvic length	17.3	16.0-17.9	17.1	0.9	15.5-19.2	17.6	1.0
As a percentage of HL							
Caudal peduncle length	40.1	26.5-41.1	36.1	5.9	30.9-39.8	35.3	2.6
Caudal peduncle depth	51.6	52.4-58.7	55.6	2.4	47.8-55.9	52.4	2.8
Orbital diameter	33.0	31.3-34.7	32.7	1.1	29.7-33.0	31.7	1.0
Snout	26.6	20.0-25.9	22.8	2.4	18.3-23.2	20.1	1.7
Interorbital width	37.3	37.0-40.0	38.8	1.1	34.9-41.5	38.2	2.2
Postorbital length	40.9	38.7-47.6	44.5	3.0	39.0-47.8	44.1	2.1
Upper jaw length	38.1	36.2-42.9	39.4	2.3	36.8-41.9	39.8	1.5
Maxillary length	30.0	30.9-33.0	32.0	0.8	30.8-34.0	32.2	1.1

Caudal-fin principal rays, ii 17. Dorsal procurrent rays 8-10; ventral procurrent rays 8-9. Bony hooks are fine but visible, present in the distal tip of almost all branched rays in males larger than 60 mm SL; in smaller specimens there are a few scattered hooks.

All the fins are short with slightly rounded edges.

Cycloid scales regularly distributed on body. Lateral line complete, perforated scales 35 (2); 36 (11*); 37 (6); 38 (1). Predorsal scales 9 (1); 10 (6*); 11 (13). Rows of scales from dorsal-fin origin to lateral line 6 (6); 7 (14*), and from lateral line to anal-fin origin 6 (16*); 7 (4). Single row of scales at base of anal fin, 7 (1); 8 (*); 9 (3); 10 (4); 11 (5); 12 (4); 13 (1); 14 (1).

Maxilla short with 1 to 3 (usually 1) teeth, with 1 to 4 cusps (Fig. 2a). Posterior tip of the maxilla extending beyond the middle of a vertical line traced through the second suborbital. Premaxilla with narrow pointed ascendent process and relatively short lateral process, bearing two rows of teeth. Outer row with 4 evenly arranged teeth, with 3 to 5 cusps, typically pentacuspid (5 teeth observed in one specimen); inner row with 5 teeth, a symphysial tooth, narrowest and highest, with 4 or 5 cusps, followed by two very broad teeth with 5 to 7 cusps, typically with 6 cusps. Fourth tooth with 4 or 6 cusps and fifth tooth with 1 to 4 cups, typically tricuspid (Fig. 2b). Dentary with 4 or 5 (usually 4) teeth, with 4 to 7 cusps, followed by a series of 3 to 7 smaller monocuspid teeth (Fig. 2c). All teeth on premaxilla, maxilla and dentary have smooth rounded cusps.

Vertebrae 34-36. Supraneurals 5-6, typically 5. Upper gill rakers 7-8, lower gill rakers 10-13. Infraorbitals 6, third suborbital contacting at some point with the preopercular sensory canal.

Color in alcohol

Background light yellowish. Dorsal area of head and body darker. Y-shaped humeral spot, the upper arms of the Y above the lateral line, at the level of upper-posterior edge of opercle, and the lower arm extending ventrally onto 2 or 3 scales, including the perforated lateral-line scale. Gray broad lateral stripe along the sides, above the lateral line, expanded at base of caudal fin and thinner over middle caudal fin rays. Scales of sides with dark chromatophores on the central area and sometimes arranged on scale margins. Ventrolateral region of the body uniformly colored. Opercular, subopercular, and preopercular regions dark brown. This dark area is due to densely arranged chromatophores on the inner surface of these bones. Dark chromatophores scattered on premaxilla, maxilla and lower jaw. Dorsal fin with small dark chromatophores on membrane and rays. Adipose fin with small dark chromatophores. Pectoral and pelvic fins hyaline, with small dark chromatophores on membrane. Caudal and anal fins with chromatophores scattered on membrane, more abundant on distal margin.

Etymology

The specific epithet hermosus refers to the town of Valle Hermoso where the new species was found.

Distribution and habitat

Astyanax hermosus sp. n. is known only from San Francisco River, of the endorheic Primero River basin in Valle Hermoso (31° 07' S - 64° 29' W), Córdoba Province, Argentina. The locality, situated at 900 m a.s.l. is a typical mountain stream with fast-flowing current and gravelly, rocky and sandy bottoms.

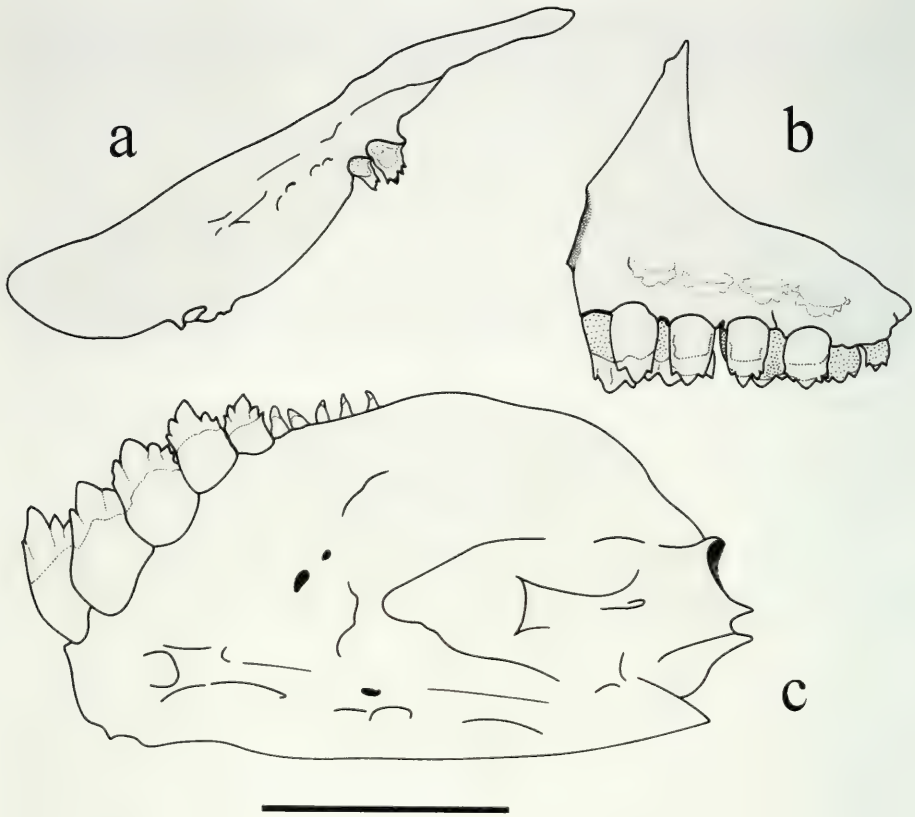


FIG. 2

Astyanax hermosus sp. n., ILPLA 1691. Paratype male, 71.1 mm SL: a. Left maxilla, internal view; b. Left premaxilla, external view; c. Left hemimandible, external view. Scale bar = 1 mm.

DISCUSSION

Of all the species of *Astyanax* described for the Paranoplatensean basin, *Astyanax hermosus* sp. n. is similar to a small group of species in which the males have bony hooks on all fins, namely: *A. leonidas* Azpelicueta, Casciotta & Almirón, 2002; *A. ojiara*; *A. pynandi* Casciotta, Almirón, Bechara, Roux & Ruiz Diaz, 2004; and *A. troya* (*A. leonidas* lacks bony hooks on the dorsal fin). However, the new species differs from these by several morphometric characters, the most remarkable of which is the presence of a wider interorbital (34.9-41.5% HL vs. 26.9-30.4; 31.0-35.6; 27.7-34.0; 27.6-33.4% HL, respectively); different color pattern (single humeral spot vs. two humeral spots) and also by its different geographical distribution. *Astyanax hermosus* sp. n. occurs in an endorheic basin in central Argentina, whereas *A. leonidas*, *A. pynandi* and *A. troya* have been described for the Paraná River basin and *A. ojiara* for the Uruguay River basin, all from Northeastern Argentina.

The new species is also distinguished from *A. leonidas* by lesser prepelvic distance (41.5-47.0% SL vs. 46.0-52.3% SL) and larger caudal peduncle depth (47.8-58.7 % HL vs. 34.9-41.0% HL). From *A. ojiara* by lesser number of branched anal-fin rays (17-22 vs. 20-23) and maxillary teeth (1 to 3 with 1to 4 cusps vs.1 with 7 cusps). From *A. pynandi* by the shorter head (23.5-27.1 vs. 27.5 -30.8 % SL); lesser orbital diameter (29.7-34.7 vs. 36.7-43.5 % HL); larger caudal peduncle depth (12.6-14.7 vs. 10.5-12.3 % SL); lesser anal-fin branched rays (17-22 vs.21-26) and maxillary teeth (1to 3 with 1to 4 cusps vs.1 with 5 or 7 cusps). From A. troya by the shorter head (23.5-27.1 % SL vs. 26.9-30.9% SL) and smaller eye (29.7-34.7 % HL vs. 35.0-44.6% HL).

Other species of *Astyanax* reported in the distribution range of *Astyanax hermosus* sp. n. are *A. asuncionensis* (sub *A. bimaculatus*), *A. cordovae*, and *A. eigenmanniorum* (Bistoni & Hued, 2002). The new species differs from *A. asuncionensis*, by the lesser number of anal-fin rays (21-27 vs. 30-32) and by having a vertically elongated vs. horizontally elongated humeral spot. From *A. cordovae* by the lesser number of scales on the lateral series (35-38 vs. 43-45) and by the presence of teeth on maxilary vs. absence. From *A. eigenmanniorum*, among other characters, by the position of the mouth (superior vs. terminal); more maxillary teeth (1 to 3 vs. 1); short rounded fins vs. long falcate fins. Also by the different color pattern and the presence of bony hooks on all fins of males vs. pelvic and anal fins only.

According to Bistoni & Hued (2002), *A. eigenmanniorum*, *A. cordovae* and *A. asuncionensis* have different altitudinal distribution ranges. *A. hermosus* sp. n. occurs at 900 m a.s.l., therefore it would belong in 'level 3' as proposed by these authors.

Astyanax hermosus sp. n. along with *A. cordovae* are endemic species for the endorheic Primero River basin. From an ichthyogeographical standpoint, this area is part of the Paranoplatensean Province (Ringuelet, 1975) and the Central Endorheic Ecoregion (López *et al.*, 2002) of Argentina.

ACKNOWLEDGEMENTS

We are grateful to Roberto Menni (MLP) for his critical review and for checking the English. Thanks are also due to Carlos Tremouilles (MLP), who completed the final drafts of the figures and Justina Ponte Gómez (MLP) for technical assistance.

REFERENCES

Almirón, A. E., Azpelicueta, M. M. & Casciotta, J. R. 2002. *Astyanax ita* sp. n.-a new species from the Río Iguazú basin, in Argentina (Teleostei, Characiformes, Characidae). *Zoologische Abhandlungen* 52: 3-10.

Azpelicueta, M. M. & García, J. O. 2000. A new species of *Astyanax* (Characiformes, Characidae) from Uruguay river basin in Argentina, with remarks on hook presence in Characidae. *Revue suisse de Zoologie* 107(2): 245-257.

Azpelicueta, M. M., Almirón, A. E. & Casciotta, J. R. 2002 a. *Astyanax paris:* a new species from the Río Uruguay basin of Argentina (Characiformes, Characidae). *Copeia* 4: 1052-1056.

Azpelicueta, M. M., Casciotta, J. R. & Almirón, A. E. 2002 b. Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná River basin in Argentina. *Revue suisse de Zoologie* 109(2): 243-259.

BERTACO, V. A. & MALABARBA, L. R. 2001. Description of two new species of *Astyanax* (Teleostei: Characidae) from headwater streams of Southern Brazil, with comments on the "*A. scabripinnis* species complex". *Ichthyological Exploration of Freshwaters* 12(3): 221-234.

BISTONI, M. A. & HUED, A. C. 2002. Patterns of fish species richness in rivers of the central region of Argentina. *Brazilian Journal of Biology* 62 (4 B): 753-764.

CASCIOTTA, J. R., ALMIRÓN, A. E. & AZPELICUETA, M. M. 2003. A new species of *Astyanax* from río Uruguay basin, Argentina. *Ichthyological Exploration Freshwaters* 14(4): 329-334.

CASCIOTTA, J. R., ALMIRÓN A. E., BECHARA, J. A., ROUX, J. P. & RUIZ DIAZ, F. 2003. *Astyanax pynandi* sp.n. (Characiformes, Characidae) from the Esteros del Iberá wetland, Argentina. *Revue suisse de Zoologie* 110 (4): 807-816.

EIGENMANN, C. H. 1921. The American Characidae. Part 3. *Memoirs of the Museum of Comparative Zoology, Harvard University,* 43: 208-310.

EIGENMANN, C. H. 1927. The American Characidae. Part 4. *Memoirs of the Museum of Comparative Zoology, Harvard University,* 43: 311-428.

FINK, W. L. & WEITZMAN, S. H. 1974. The so-called Cheirodontin fishes of Central America with descriptions of two new species (Pisces: Characidae). *Smithsonian Contributions to Zoology* 172: 1-46.

GARUTTI, V. 2003. Revalidação de *Astyanax rupunini* Fowler, 1914 (Teleotei, Characidae) e descrição de duas espécies novas para o gênero. *Papéis Avulsos de Zoología, Museo de Zoología da Universidade de São Paulo* 43 (1):1-9.

GARUTTI, V. & BRITSKI, H. A. 2000. Descrição de uma epécie nova de Astyanax (Teleostei: Characidae) da bacia do Alto Rio Paraná e considerações sobre as demais espécies do gênero na bacia. *Comunicações do Museu Ciências e Tecnologia da PUCRS, Série Zoología, Porto Alegre*, 13: 65-88.

GÉRY, J. 1977. Characoids of the world. *T.H.F. Publications, Neptune City, New Jersey*, 672 pp.

LÓPEZ, H. L., MORGAN, C. C. & MONTENEGRO, M. J. 2002. Ichthyological ecoregions of Argentina. *Documents Series, Probiota, Online version*, (ISSN 1666-7328).

MIRANDE, J. M., AGUILLERA, G. & AZPELICUETA, M. M. 2004. A new species of *Astyanax* (Characiformes, Characidae) from the upper río Bermejo basin, Salta, Argentina. *Revue suisse de Zoologie* 111(1): 213-223.

REIS, R. E., KULLANDER, S. O. & FERRARIS, JR., C. J. (org.). 2003. Check list of the freshwater fishes of South and Central America. *EDIPUCRS, Porto Alegre*, 742 pp.

RINGUELET, R. A. 1975. Zoogeografía y ecología de los peces de aguas continentales de la Argentina y consideraciones sobre las áreas ictiológicas de América del sur. *Ecosur* 2 (3): 1-151.

TAYLOR, W. R. & VAN DYKE, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium* 9: 107-119.

TRIQUES, M. L., VONO, V. & CAIAFA, E. V. 2003. *Astyanax turmalinensis*, a new species from the Rio Jequitinhonha basin, Minas Gerais, Brazil (Characiformes: Characidae: Tetragonopterinae). *Aqua, Journal of Ichthyology and Aquatic Biology* 7(4): 145-150.

WEITZMANN, S. H. & MALABARBA, L. R. 1998. Perspectives about the phylogeny and classification of the Characidae (Teleostei: Characiformes) (pp. 161-170). *In*: MALABARBA, L. R., REIS, R. E., VARI, R. P., LUCENA, Z. M. S. & LUCENA, C. A. S. (eds). Phylogeny and classification of neotropical fishes. *EDIPUCRS, Porto Alegre,* 603 pp.

REVUE SUISSE DE ZOOLOGIE 112 (1): 21-45; mars 2005

Pronomaeini del Borneo (Coleoptera, Staphylinidae)*

Roberto PACE
Via Vittorio Veneto, 13, I-37032 Monteforte d'Alpone (Verona), Italia.
E-mail: pace.ent@tiscali.it

Pronomaeini from Borneo (Coleoptera, Staphylinidae). - The genera and species of the tribe Pronomaeini are studied for the first time. The genera *Myllaena* Erichson and *Paramyllaena* Pace include seventeen species and eight species, respectively. All the *Myllaena* species and five of the *Paramyllaena* species are new to science. The genus *Paramyllaena* is attributed to Pronomaeini, based on the similary of the mouthparts with those of *Myllaena* and *Pronomaea*. *Myllaena affinis* Cameron, *Myllaena laticollis* Cameron and *Mimoxypoda rougemonti* Pace, are transferred to *Paramyllaena*. All new species are described and illustrated. Keys to all species of Borneo of the genera *Myllaena* and *Paramyllaena* are presented.

Keywords: Coleoptera - Staphylinidae - Aleocharinae - Pronomaeini - taxonomy - Borneo.

INTRODUZIONE

Il genere *Myllaena* Erichson, 1937, era finora sconosciuto per il Borneo. È ben vero che Cameron (1933) descrisse due specie del Monte Kinabalu attribuendole a questo genere, ma, in seguito a mio esame delle serie tipiche, entrambe risultano appartenere al genere *Paramyllaena* Pace, 1984, soprattutto a motivo della formula tarsale 4-5-5, invece di 4-4-5 come in *Myllaena*. *Paramyllaena* è qui per la prima volta attribuita alla tribù Pronomaeini, essendo stato da me riconosciuto che quella dei Myllaenini è suo sinonimo (Pace, 1999). Questa nuova attribuzione è un'altra conferma della sinonimia tribale proposta. La formula tarsale, infatti, non costituisce un carattere decisivo ai fini dell'attribuzione tribale, come si verifica ad esempio in quella dei Deinopsini studiata da Klimaszewski (1979). È la forma delle parti boccali che costituisce carattere importante nell'attribuzione tribale. La forma delle parti boccali delle specie di *Myllaena* e di *Paramyllaena* si presenta simile nei due generi: ligula intera e corta, palpi labiali lunghissimi, lobo interno delle maxille strettissimo e lunghissimo, angoli anteriori del mento prolungati in avanti, di più in *Myllaena*, meno in *Paramyllaena*.

Grazie alle ripetute ricerche del Dr. Aleš Smetana di Ottawa e dei Drr. Ivan Löbl e Daniel Burckhardt, il primo già del Museo di Storia naturale di Ginevra, il secondo del Museo di Storia Naturale di Basilea, ora è stato possibile apportare nuovi chiari-

---

* 188° Contributo alla conoscenza delle Aleocharinae.

Manoscritto accettato il 16.03.2004

menti sulla tassonomia dei Pronomaeini e conoscere ben ventidue nuove specie per la scienza appartenenti a questa tribù.

Gli olotipi delle nuove specie sono conservati nel Museo di Storia naturale di Ginevra (MHNG), tranne uno nell' Institut royal des Sciences naturelles de Belgique (IRSN).

COMBINAZIONI NUOVE

Paramyllaena affinis (Cameron, 1933), **comb. n.**
Myllaena affinis Cameron, 1933: 350, nec *Myllaena affinis* Cameron, 1939: 22

NOTA. La nuova combinazione è effettuata grazie a mio esame dell'holotypus ♀ così etichettato. Type, B.N. Borneo, Mt. Kinabalu, Kamborangah, 7200 ft, 27.III.1929, *M. (Myllaena) affinis* Cam., type, M. Cameron bequest, B.M 1955-147, Not a *Myllaena*, P.M. Hammond det. 1982.

Paramyllaena laticollis (Cameron, 1933), **comb. n.**
Myllaena laticollis Cameron, 1933: 349

NOTA. Combinazione nuova effettuata dopo mio esame dell'holotypus ♂ così etichettato: B.N. Borneo, Mt. Kinabalu, Kamborangah, 7200 ft, 26.III:1929, *Myllaena laticollis* Cam., M. Cameron bequest, B.M 1955-147, type.

Paramyllaena rougemonti (Pace, 1986), **comb. n.**
Mimoxypoda rougemonti Pace, 1986: 200

NOTA. I generi *Mimoxypoda* Cameron, 1925 e *Paramyllaena* Pace, 1984, sono tra loro affini. Tuttavia, mentre gli articoli dei palpi labiali in *Mimoxypoda* sono composti di due articoli e la ligula è larga e lunga, quelli in *Paramyllaena* sono composti di tre articoli e la ligula è minuscola. La forma del lobo interno delle maxille permette di attribuire i due generi, insieme al genere *Myllaena* Erichson, 1837, alla tribù Pronomaeini Mulsant & Rey, 1873 (=Myllaenini Ganglbauer, 1895), nonostante la formula tarsale 4-5-5 (in *Myllaena* 4-4-5).

ELENCO DELLE SPECIE NOTE

Paramyllaena affinis (Cameron, 1933)
Myllaena affinis Cameron, 1933: 350, nec *Myllaena affinis* Cameron, 1939: 22

1 ♂, Borneo-Sabah, Mt. Kinabalu N.P., Layang Layang, 2610 m, 2.V.1987, leg. A. Smetana; 4 es., Borneo-Sabah, Mt. Kinabalu N.P., Layang Layang, 2600 m, 9-20.V.1987, leg. A. Smetana.

DISTRIBUZIONE. Specie finora nota di Kamborangah.

Paramyllaena laticollis (Cameron, 1933)
Myllaena laticollis Cameron, 1933: 349

1 ♀, Sabah, Kinabalu N.P., 25.VII.1982, leg. G. De Rougemont.

Pronomaea thaxteri Bernhauer, 1915
Pronomaea thaxteri Bernhauer, 1915: 148

12 es., Borneo, Sabah, Mt. Kinabalu Nat. Pk., Poring Hot Springs, 480 m, 10.V.1987, leg. A. Smetana; 29 es., Sabah, Mt. Kinabalu, Poring Hot Springs, 485 m, 29-30.VIII.1987, leg. A. Smetana; 2 es., Sabah, Mt. Kinabalu, Poring Hot Springs, 500-600 m, 10-11.V.1987, leg. Burckhardt & Löbl; 5 es., Sabah, Mt. Kinabalu, Poring Hot Springs, 500 m, 7.V.1987, leg. Burckhardt & Löbl; 1 es., Sabah, Mt. Kinabalu, Poring Hot Springs, 500 m, 13.V.1987, leg. Burckhardt & Löbl; 1 es., Sabah, Mt. Kinabalu, Poring Hot Springs, 500 m, 11.V.1987, leg. Burckhardt & Löbl.

DISTRIBUZIONE. Finora nota del Borneo, Bali, Malaysia, Thailandia, Cina, Filippine, India, Cameron Highlands, Sumatra, Celebes e dei dintorni di Singapore (Cameron, 1920: 245).

ELENCO DELLE NUOVE SPECIE

1. *Myllaena layangensis* sp. n.
2. *Myllaena semicaeca* sp. n.
3. *Myllaena terricola* sp. n.
4. *Myllaena semiannularis* sp. n.
5. *Myllaena kinabaluicola* sp. n.
6. *Myllaena multiplicationis* sp. n.
7. *Myllaena ularensis* sp. n.
8. *Myllaena fontium* sp. n.
9. *Myllaena semiconvexa* sp. n.
10. *Myllaena fluminiphila* sp. n.
11. *Myllaena multisquamosa* sp. n.
12. *Myllaena vepres* sp. n.
13. *Myllaena longesetipes* sp. n.
14. *Myllaena globitheca* sp. n.
15. *Myllaena claricornis* sp. n.
16. *Myllaena claripyga* sp. n.
17. *Myllaena gibbasimplex* sp. n.
18. *Paramyllaena anterufa* sp. n.
19. *Paramyllaena flexuosa* sp. n.
20. *Paramyllaena fasciatipyga* sp. n.
21. *Paramyllaena affinoides* sp. n.
22. *Paramyllaena longelytrata* sp. n.

DESCRIZIONI

Myllaena Erichson

Myllaena layangensis sp. n. Figg. 1-5

Holotypus ♂, Borneo-Sabah, Mt. Kinabalu N.P., below Layang Layang, 2595 m, 2.V.1987, leg. A. Smetana (MHNG).

Paratypus: 1 ♀, Borneo-Sabah, Mt. Kinabalu N.P., Layang Layang, 2600 m, 2-8.V.1987, leg. A. Smetana.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido e giallo-bruno, con margine posteriore degli uroterghi liberi e pigidio rossicci; antenne e zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea. Edeago figg. 2-3, spermateca figg. 4 e 5, quest'ultima ruotata di 90° rispetto alla precedente.

ETIMOLOGIA. La nuova specie prende nome dalla località tipica Layang Layang.

COMPARAZIONI. La nuova specie è distinta da *M. semicaeca* sp. n., sotto descritta per avere il pronoto più stretto delle elitre e per la spermateca non avvolta in numerose spire.

Myllaena semicaeca sp. n Figg. 6-7

Holotypus ♀, Sabah, Poring Hot Springs, Langanan river, 850 m, 14.V.1987, leg. Burckhardt & Löbl (MHNG).

DESCRIZIONE. Lungh. 1,3 mm. Avancorpo debolmente opaco, addome lucido. Corpo interamente giallo-rossiccio; antenne e zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Spermateca (incompleta) fig. 6.

ETIMOLOGIA. La nuova specie prende nome di «Quasi cieca» a motivo della sua forte riduzione oculare.

COMPARAZIONI. La nuova specie è distinta da *M. layangensis* sp. n. sopra descritta, per la minore taglia corporea e la differente forma della spermatica.

Myllaena terricola sp. n. Figg.8-10

Holotypus ♂, Sabah, Poring Hot Springs, 500 m, 8.V.1987, leg. Burckhardt & Löbl (MHNG).

DESCRIZIONE. Lungh. 1,7 mm. Corpo lucido e giallo, comprese le antenne e le zampe. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 8-9.

ETIMOLOGIA. La nuova specie prende nome di «abitante il terreno» perché, come tutte le specie di *Myllaena*, vive nel terreno come predatrice.

COMPARAZIONI. La nuova specie è distinta da *M. semicaeca* sp. n. sopra descritta per avere le elitre meno ridotte e gli occhi più sviluppati.

Myllaena semiannularis sp. n. Figg. 11-13

Holotypus ♂, Sabah, Crocker Range, 1550-1650 m, 16.V.1987, leg. Burckhardt & Löbl (MHNG).

DESCRIZIONE. Lungh. 1,9 mm. Corpo lucido e rossiccio, con elitre e lati dell'addome bruni e con pigidio giallo-rossiccio; antenne giallo-rossicce con i due antennomeri basali e l'undicesimo gialli; zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 12-13.

ETIMOLOGIA. La nuova specie prende nome di «Con mezzo anello» per avere le elitre brune su corpo rossiccio che simulano un mezzo anello

COMPARAZIONI. La nuova specie è distinta da *M. terricola* sp. n. sopra descritta, per avere il decimo antennomero lungo quanto largo e non più lungo che largo, come in *terricola*, e per l'armatura genitale interna dell'edeago esile (robusta in *terricola*).

Myllaena kinabaluicola sp. n. Figg. 14-17

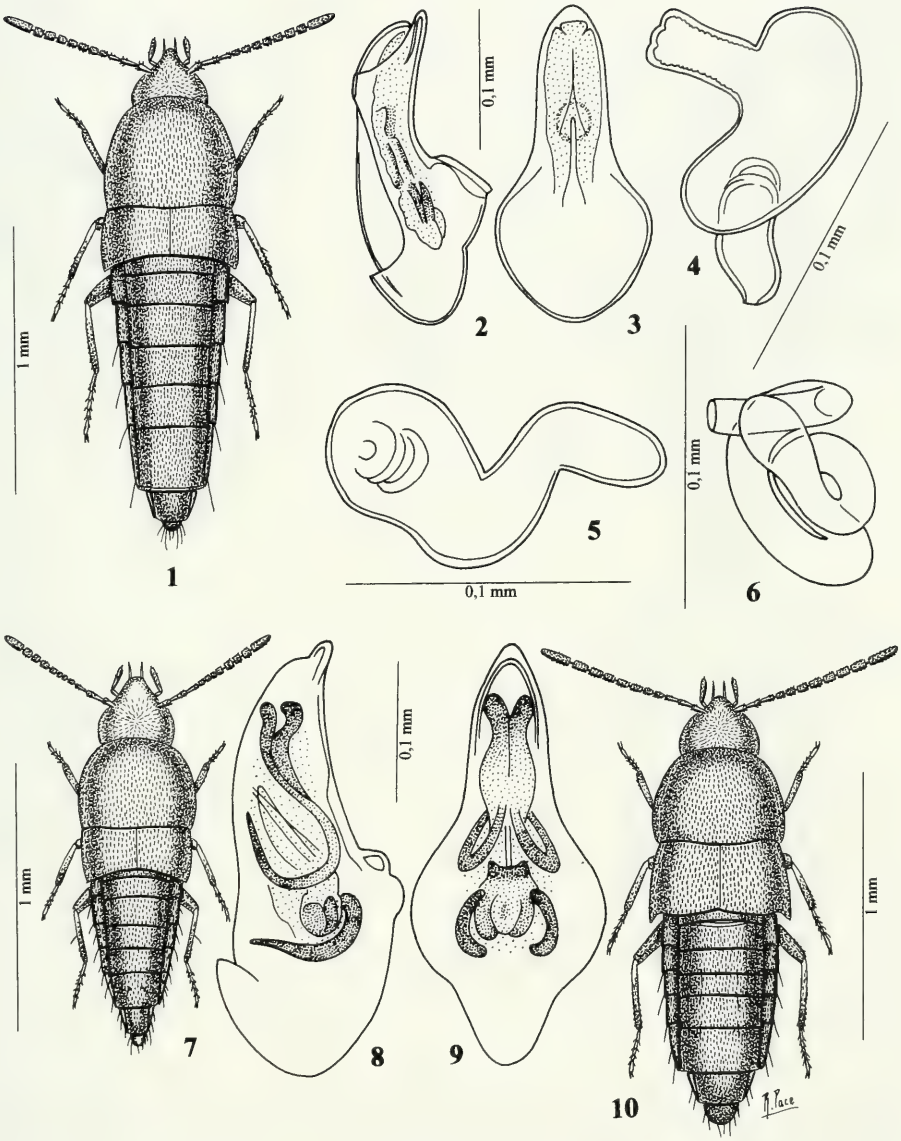
Holotypus ♂, Sabah, Mt. Kinabalu, 1550-1650 m, 24.IV.1987, leg. Burckhardt & Löbl (MHNG).

Paratypi: 11 es., stessa provenienza; 6 es., Sabah, Mt. Kinabalu,1750 m, 27.IV.1987, leg. Burckhardt & Löbl; 1 ♀, Borneo, Sabah, Crocker Ra., 1600 m, 18.V.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Crocker Ra., 1600 m, Km 51 rte. Kinabalu-Tambunan, 18.V.1987, Burckhardt & Löbl leg.

DESCRIZIONE. Lungh. 1,9 mm. Corpo debolmente lucido e giallo-bruno, con elitre brune e pigidio rossiccio; antenne di un giallo sporco con antennomero basale e apice dell'undicesimo gialli; zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 15-16, spermateca fig. 17.

ETIMOLOGIA. La nuova specie prende nome di «Abitante del Kinabalu» ovviamente perché rinvenuta su questo monte.

COMPARAZIONI. La nuova specie è simile a *M. terricola* sp. n., sopra descritta, ma il corpo è diversamente colorato e l'armatura genitale interna dell'edeago è più robusta di quella della specie a confronto.



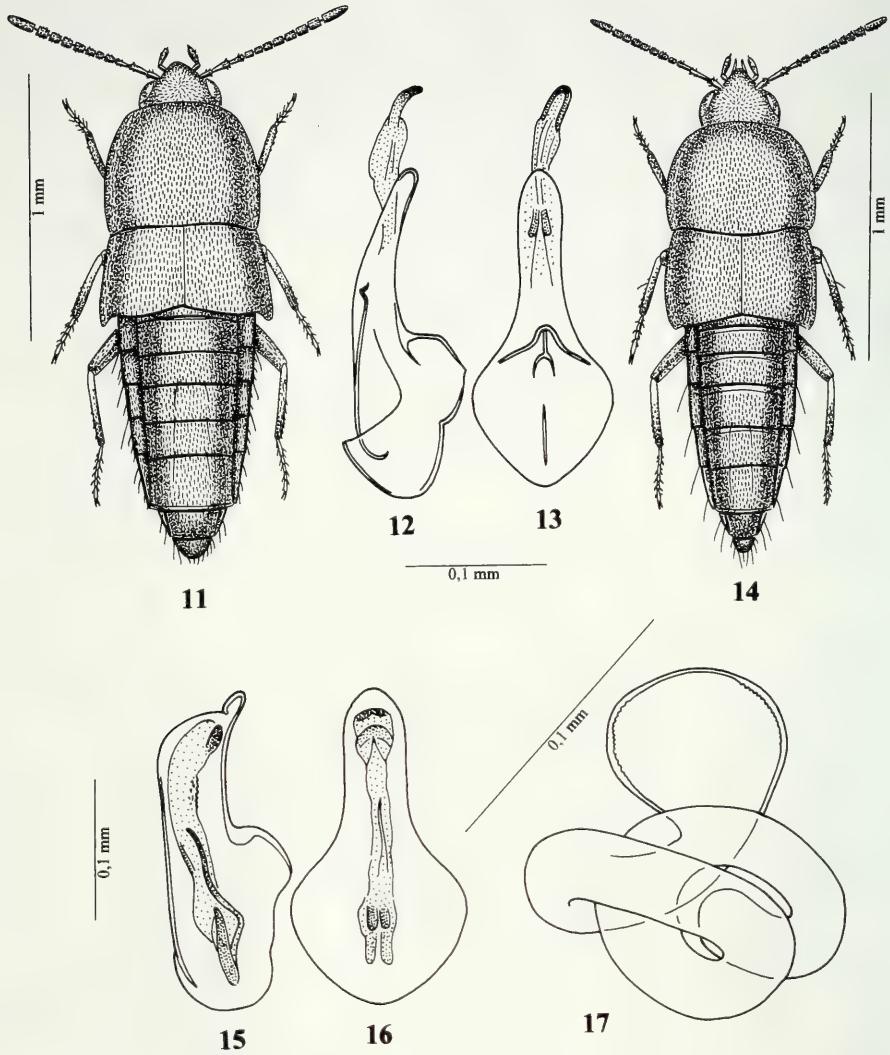
FIGG. 1-10

Habitus, edeago in visione laterale e ventrale e spermateca (fig. 5 spermateca ruotata di 90° rispetto quella di fig. 4). 1-5: *Myllaena layangensis* sp. n..; 6-7 : *Myllaena semicaeca* sp. n.; 8-10: *Myllaena terricola* sp. n.

Myllaena multiplicationis sp. n. Figg. 18-21

Holotypus ♂, Sabah, Mt. Kinabalu, 1550 m, 29.IV.1987, leg. Burckhardt & Löbl (MHNG).

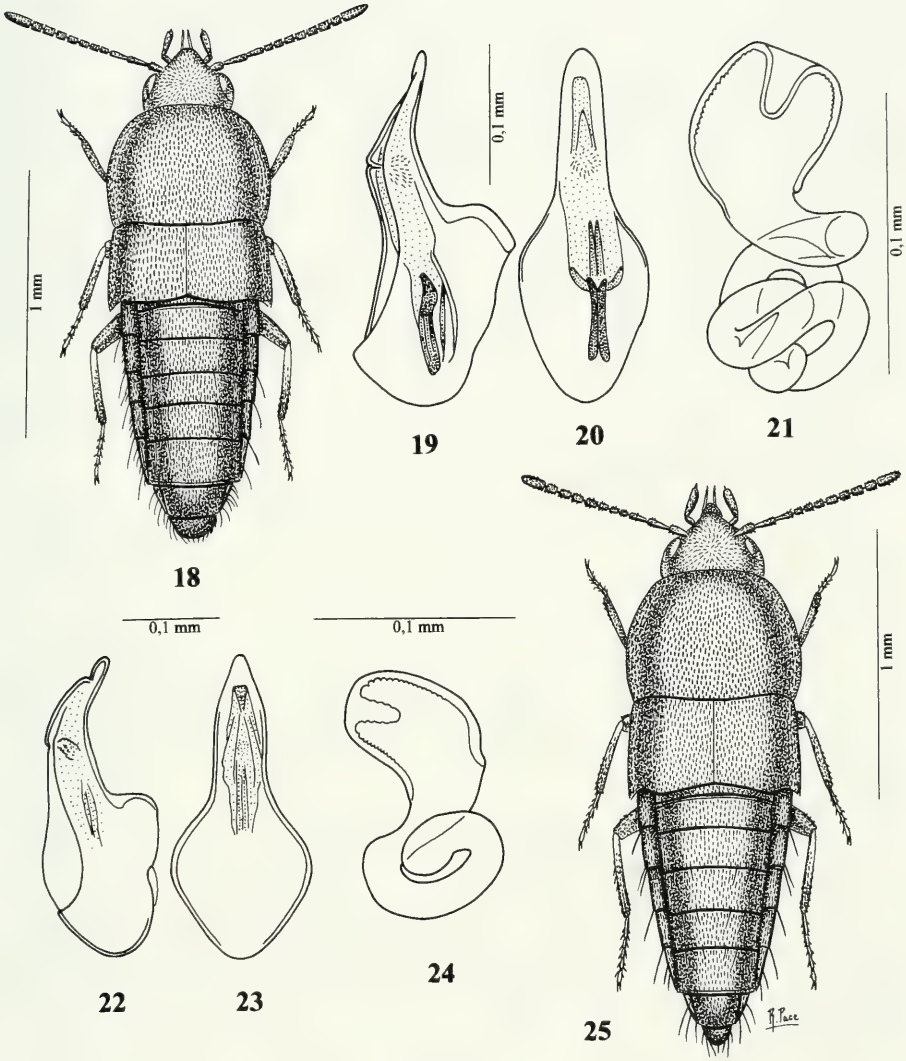
Paratypi: 1 ♂ e 1 ♀, stessa provenienza; 1 ♀ e 7 es., Borneo-Sabah, Crocker Ra., 1550-1650 m, 16.V.1987, leg. Burckhardt & Löbl.



FIGG. 11-17
Habitus, edeago in visione laterale e ventrale e spermateca. 11-13: *Myllaena semiannularis* sp. n.; 14-17; *Myllaena kinabaluicola* sp. n.

DESCRIZIONE. Lungh. 1,9 mm. Corpo lucido e rossiccio, con capo ed elitre bruno-rossicci e pigidio giallo-rossiccio; antenne e zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 19-20, spermateca fig. 21.

ETIMOLOGIA. La nuova specie prende nome di «*Myllaena* della moltiplicazione» per avere le spire della spermateca moltiplicate o aumentate di numero rispetto a quelle della spermateca di *M. kinabaluicola* sp. n.



FIGG. 18-25

Habitus, edeago in visione laterale e ventrale e spermateca. 18-21: *Myllaena multiplicationis* sp. n.; 22-25: *Myllaena ularensis* sp. n.

COMPARAZIONI. La nuova specie è simile a *M. kinabaluicola* sp. n. sopra descritta, ma il colore del corpo e delle antenne è differente, l'edeago ha l'armatura genitale interna dell'edeago più lunga e la spermateca ha un'introflessione apicale, assente nella spermateca di *kinabaluicola*.

Myllaena ularensis sp. n. Figg. 22-25

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu Nat.Pk., HQ Bukit Ular Trail, 1750 m, 29.IV.1987, A. Smetana leg (MHNG).

Paratypi: 1 ♂, stessa provenienza; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., summit trail, 1890 m, (senza data), A. Smetana leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1495 m, 12.V.1987, A. Smetana leg.

DESCRIZIONE. Lungh. 2,0 mm. Corpo lucido e rossiccio, con capo bruno e addome giallo-rossiccio con base rossiccia; antenne rossicce; zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 22-23, spermateca fig. 24.

ETIMOLOGIA. La nuova specie ovviamente prende nome dalla località di Ular, dove è stata rinvenuta.

COMPARAZIONI. La nuova specie è distinta da *M. multiplicationis* sp. n. per il differente colore del corpo, per un'esile armatura genitale interna dell'edeago e per la parte prossimale della spermateca non avvolta in numerose spire.

Myllaena fontium sp. n. Figg. 26-29

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., above Poring Hot Springs, 550 m, 9.V.1987, leg. A. Smetana (MHNG).

Paratypi: 2 ♀♀, stessa provenienza, ma anche 500 m, 10.V.1987.

DESCRIZIONE. Lungh. 1,9 mm. Corpo lucido, ben convesso e giallo-rossiccio; antenne e zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 27-28, spermateca fig. 29.

ETIMOLOGIA. La nuova specie prende nome di «*Myllaena* delle sorgenti» perché rinvenuta alle Poring Hot Springs.

COMPARAZIONI. La nuova specie è ben distinta da *M. ularensis* sp. n. sopra descritta per il differente colore del corpo, per la più robusta armatura genitale interna dell'edeago e per il bulbo distale della spermateca globulare e non ellittico-arcuato.

Myllaena semiconvexa sp. n. Figg. 30-33

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu Nat. Pk., HQ Liwagu Rv. Tr., 1655 m, 11.VIII.1988, A. Smetana leg (MHNG).

Paratypus: 1 ♀, stessa provenienza.

DESCRIZIONE. Lungh. 3,0 mm. Corpo debolmente lucido e giallo-rossiccio sporco, con capo e uroterghi liberi terzo e quarto bruni e con elitre bruno-rossicce con base rossiccia; antenne bruno-rossicce con l'undicesimo antennomero giallo; zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 30-31, spermateca fig. 32.

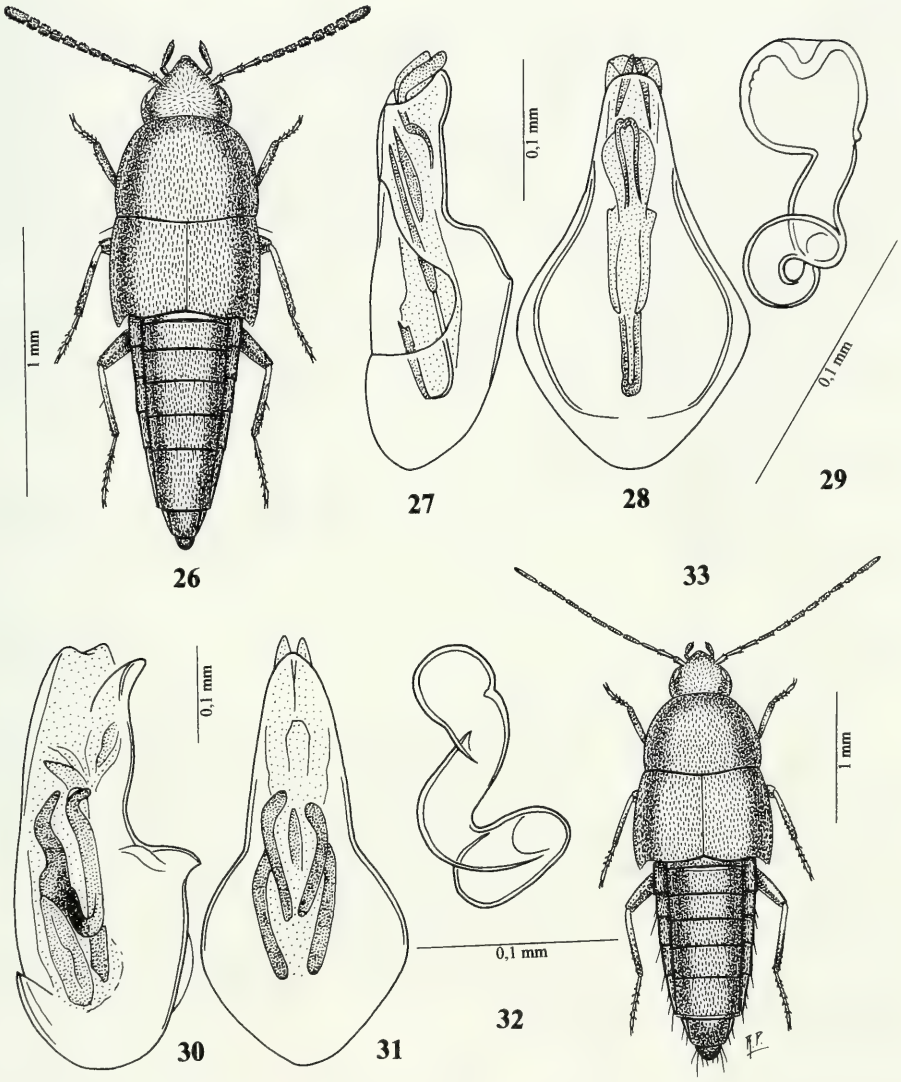
ETIMOLOGIA. La nuova specie prende nome di «Semiconvessa» perché il suo corpo è poco convesso.

COMPARAZIONI. La nuova specie è ben distinta dalle specie sopra descritte per avere le antenne filiformi, l'armatura genitale interna dell'edeago forte e la spermateca con forma differente.

Myllaena fluminiphila sp. n. Figg. 34-35

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu Nat. Pk., HQ Liwagu River, 1550 m, 27.IV.1987, A. Smetana leg (MHNG).

DESCRIZIONE. Lungh. 2,2 mm. Corpo lucido e giallo-bruno, con elitre brune; antenne giallo-rossicce; zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Spermateca fig. 35.



FIGG. 26-33
Habitus, edeago in visione laterale e ventrale e spermateca. 26-29: *Myllaena fontium* sp. n.; 30-33: *Myllaena semiconvexa* sp. n.

ETIMOLOGIA. La nuova specie prende nome di «Amica del fiume» perché è stata scoperta lungo un fiume, il Liwagu.

COMPARAZIONI. La nuova specie è simile a *M. semiconvexa* sp. n. sopra descritta, ma le elitre sono nettamente più lunghe, le antenne sono diversamente colorate e la parte prossimale della spermateca è meno prolungata.

Myllaena multisquamosa sp. n. Figg. 36-39

Holotypus ♂, Sabah, Crocker Range, 1550-1650 m, 16.V.1987, leg. Burckhardt & Löbl (MHNG).

Paratypi: 44 es., stessa provenienza; 20 es., Sabah, Crocker Ra., 1200 m, Km 63 r.te Kota Kinabalu-Tambunan, 19.V.1987, leg. Burckhardt & Löbl, 1 ♀ Sabah, Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, leg. Burckhardt & Löbl; 2 ♂♂ e 2 ♀♀, Borneo, Sabah, Crocker Ra., 1600 m, Km 51 rte. Kinabalu-Tambunan, 18.V.1987, Burckhardt & Löbl leg.; 2 ♂♂, Borneo-Sabah, Crocker Ra., 1550-1650 m, 16.V.1987, leg. Burckhardt & Löbl; 2 ♂♂, Sabah, Crocker Ra., 1200 m, Km 63 r.te Kota Kinabalu-Tambunan, 19.V.1987, leg. Burckhardt & Löbl; 1 ♂, Sabah, Poring Hot Springs, Langanan river, 850 m, 14.V.1987, leg. Burckhardt & Löbl.

Descrizione. Lungh. 2,2 mm. Corpo lucido e rossiccio, con elitre brune aventi il margine posteriore e la base rossicci; uroterghi liberi quarto e la base del terzo bruni; antenne gialle; zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 37-38, spermateca fig. 39.

Etimologia. La nuova specie prende nome di «Portatrice di molte squame», quelle dell'armatura genitale interna dell'edeago.

Comparazioni. La nuova specie si distingue da *M. fluminiphila* sp. n. sopra descritta per avere il pronoto largo quanto le elitre e la parte prossimale della spermateca molto assottigliata.

Myllaena vepres sp. n. Figg. 40-42

Holotypus ♂, Sabah, K.K-Pulau Gaya, 27.X.1990, leg. G. de Rougemont (IRSN).
Paratypi: 2 ♂♂, stessa provenienza.

Descrizione. Lungh. 2,1 mm. Corpo lucido e giallo-bruno, con capo, la fascia longitudinale mediana del pronoto, lati esterni delle elitre e quarto urotergo libero bruni; antenne di un giallo paglierino con i quattro antennomeri basali di un giallo sporco; zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 41-42.

Etimologia. La nuova specie prende nome di «Cespuglio di spine» per il gruppo di spine dell'armatura genitale interna dell'edeago.

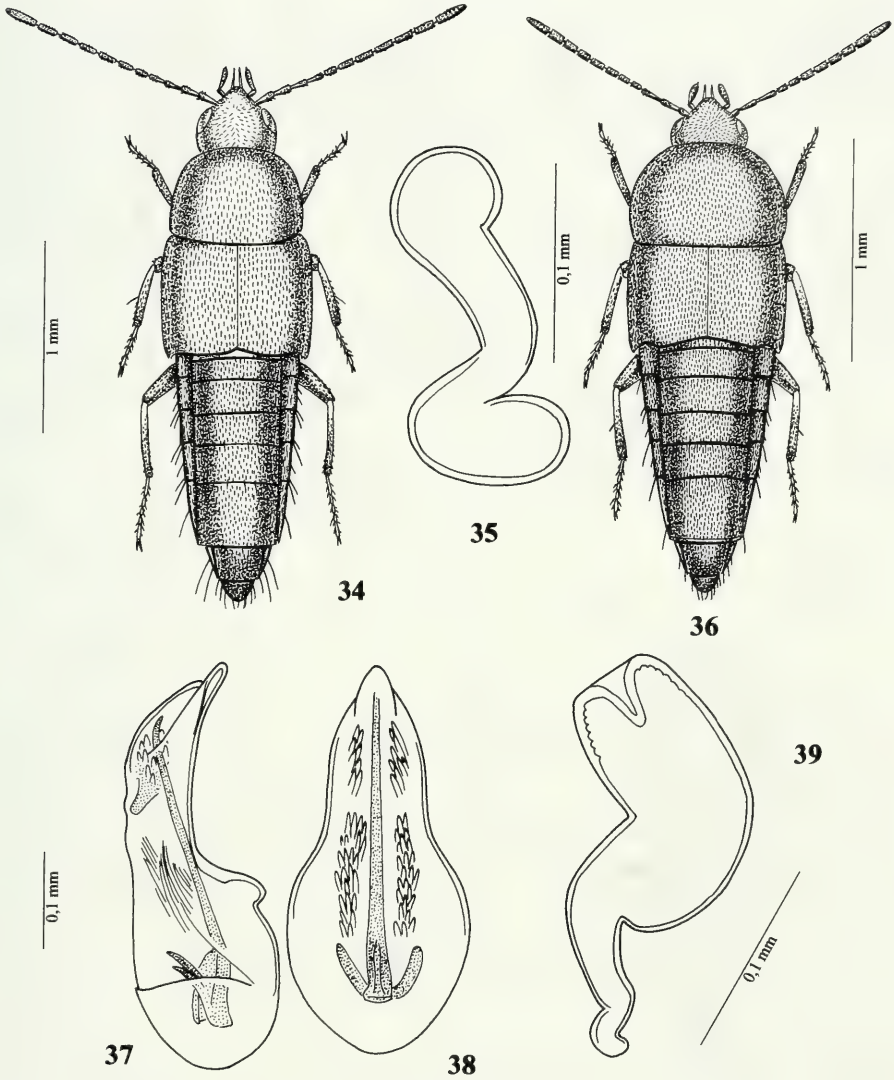
Comparazioni. Tra le specie del Borneo ad antenne sottili, la nuova specie si distingue per l'armatura genitale interna dell'edeago composta di una struttura arricciata e di un ciuffo di otto spine.

Myllaena longesetipes sp. n. Figg. 43-45

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Por[ing] H[ot] S[prings], area Kipungit Cnk 1, 530 m, 26.VIII.1988, leg. A. Smetana (MHNG).
Paratypus: 1 ♂, stessa provenienza.

Descrizione. Lungh. 3,1 mm. Corpo lucido e nero-bruno, con pronoto e pigidio bruni; antenne brune con i due antennomeri basali e l'apice dell'undicesimo giallo-rossicci; zampe giallo-rossicce e con una lunga setola esterna su ciascuna tibia media e posteriore. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 44-45.

Etimologia. La nuova specie prende nome di «Piedi lungamente setolosi» a motivo della presenza di una lunga setola sulle tibie medie e posteriori.

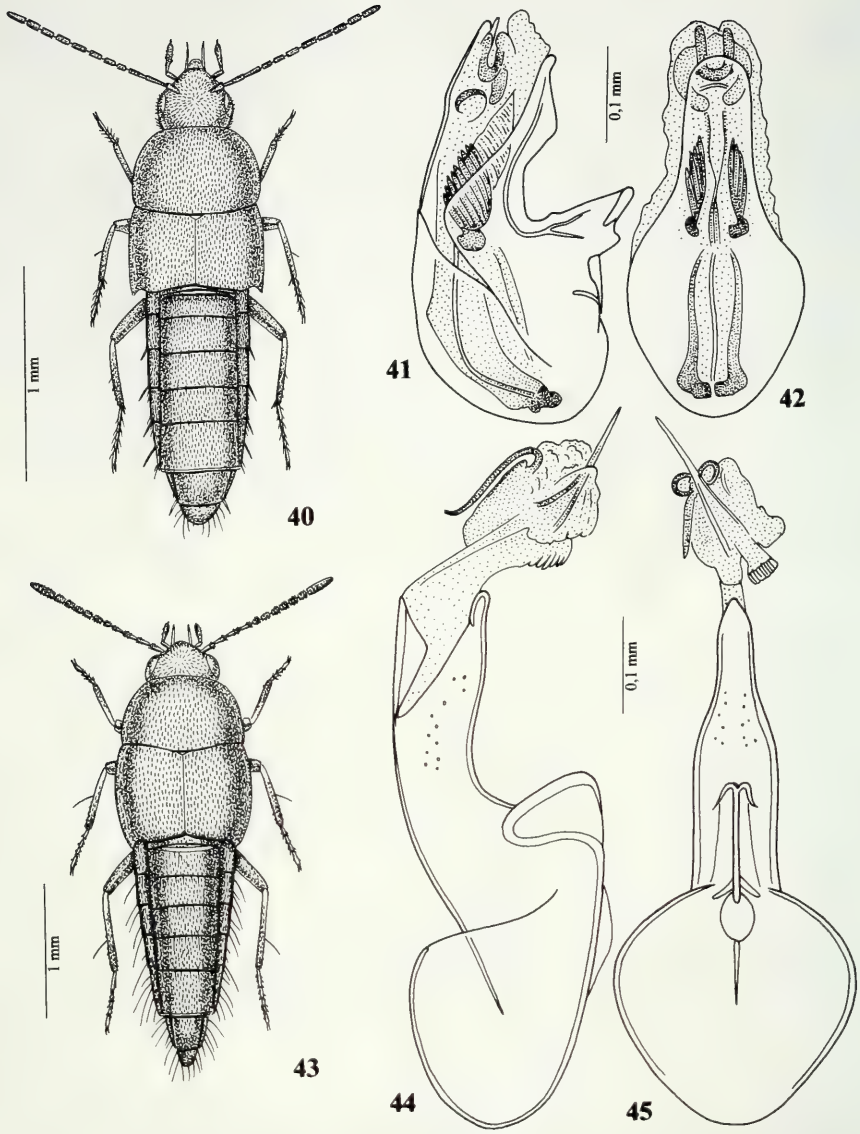


FIGG. 34-39
Habitus, spermateca e edeago in visione laterale e ventrale. 34-35: *Myllaena fluminiphila* sp. n.; 36-39: *Myllaena multisquamosa* sp. n.

COMPARAZIONI.. La nuova specie si distingue da tutte le specie del Borneo per il grande sviluppo del suo edeago e per la presenza di lunghe setole inserite esternamente alle tibie mediane e posteriori.

Myllaena globitheca sp. n. Figg. 46-48

Holotypus ♀, Sabah, Mt. Kinabalu, 1450-1550 m, 23.V.1987, leg. Burckhardt & Löbl (MHNG).



FIGG. 40-45
Habitus e edeago in visione laterale e ventrale. 40-42: *Myllaena vepres* sp. n. ; 43-45 : *Myllaena longesetipes* sp. n.

Paratypus: 1 ♀, Borneo-Sabah, Mt. Kinabalu, 1500 m, 25.IV.1987, leg. Burckhardt & Löbl.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido e bruno-rossiccio, con capo ed elitre bruni e uroterghi liberi terzo a settimo giallo-rossicci; antenne giallo-brune con l'undicesimo antennomero giallo; zampe giallo-rossicce. L'intero corpo è coperto di pubescenza sericea fittissima. Spermateca figg. 47 (holotypus) e 48 (paratypus).

ETIMOLOGIA. La nuova specie prende nome di «Spermateca globulare» per avere il bulbo distale di questo suo organo questa forma.

COMPARAZIONI. L'undicesimo antennomero giallo e il bulbo distale della spermateca globoso con la parte prossimale esile dello stesso organo, sono caratteri che non si riscontrano insieme in altre specie del Borneo.

Myllaena claricornis sp. n. Figg. 49-50

Holotypus ♀, Sabah, Poring Hot Springs, Langanan river, 850 m, 14.V.1987, leg. Burckhardt & Löbl (MHNG).

DESCRIZIONE. Lungh. 1,7 mm. Corpo lucido e bruno-rossiccio, con elitre brune; antenne gialle con undicesimo antennomero giallo chiaro; zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Spermateca fig. 50.

ETIMOLOGIA. La nuova specie prende nome di «Antenne chiare», ovviamente perché le ha di un giallo chiaro.

COMPARAZIONI. La spermateca della nuova specie è simile a quella di *M. globitheca* sp. n. sopra descritta, ma manca l'introflessione apicale del bulbo distale della stessa spermateca, presente in *globitheca*.

Myllaena claripyga sp. n. Figg. 51-54

Holotypus ♂, Borneo-Sabah, Mt. Kinabalu Nat. Pk., HQ Silau-Silau Tr., 1560 m, 3.VIII.1988, leg. A. Smetana (MHNG).

Paratypus: 1 ♀, stessa provenienza.

DESCRIZIONE. Lungh. 2,0 mm. Corpo lucido e rossiccio, con elitre brune e pigidio rossiccio; antenne e zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Il capo è più stretto del pronoto, come si vede da fig. 51; il pronoto è poco più largo che lungo, come si vede da fig. 51; le elitre sono lunghe quanto i due terzi della lunghezza del pronoto che ha la massima larghezza dietro la metà, come si vede da fig. 51; l'addome è ristretto all'indietro come si vede da fig. 51 e delle setole isolate sporgono ai lati dello stesso addome e al margine posteriore degli uroterghi liberi terzo e quarto, come si vede da fig. 51, altre setole sul margine posteriore degli uroterghi liberi primo e secondo forse sono andate perdute, in fase di raccolta o manipolazione degli esemplari. Edeago figg. 52-53, spermateca fig. 54.

ETIMOLOGIA. La nuova specie prende nome di «Pigidio chiaro» per il colore rossiccio del pigidio.

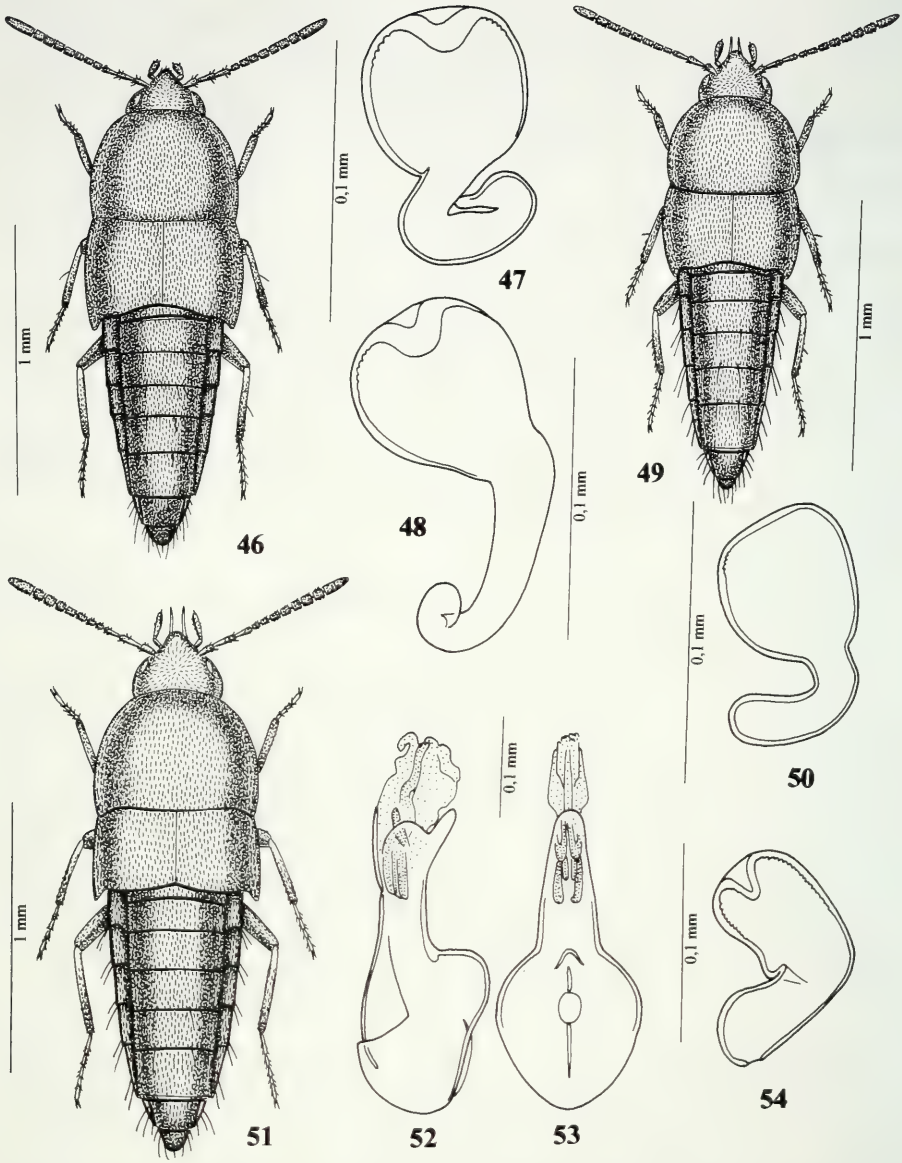
COMPARAZIONI. Le elitre più corte del pronoto, la forma dell'armatura genitale interna dell'edeago e la spermateca poco sviluppata sono caratteri sufficienti a distinguere la nuova specie dalle note del Borneo.

Myllaena gibbasimplex sp. n. Figg. 55-57

Holotypus ♂, Sabah, Poring Hot Springs, Langanan river, 850 m, 14.V.1987, leg. Burckhardt & Löbl (MHNG).

Paratypi: 1 ♂, stessa provenienza; 1 ♂, Sabah, Crocker Ra., 1200 m, Km 63 r.te Kota Kinabalu-Tambunan, 19.V.1987, leg. Burckhardt & Löbl; 1 ♂, Borneo-Sabah, E Mt. Kinabalu,1150 m, rte. Ranau-Kota Kinabalu, 24.V.1987, leg. Burckhardt & Löbl.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido e rossiccio, con capo, elitre, tranne la loro base che è rossiccia, e uroterghi liberi terzo e quarto bruni; antenne e zampe gialle. L'intero corpo è coperto di pubescenza sericea fittissima. Edeago figg. 56-57.



FIGG. 46-54
Habitus, spermateca e edeago in visione laterale e ventrale. 46-48: *Myllaena globitheca* sp. n.; 49-50: *Myllaena claricornis* sp. n.; 51-54: *Myllaena claripyga* sp. n.

ETIMOLOGIA. La nuova specie prende nome di «Gobba e semplice» per la presenza di questi caratteri del suo edeago.

COMPARAZIONI. Finora due erano le specie del genere *Myllaena* Erichson, 1937 segnalate per il Borneo: *M. affinis* Cameron, 1933 e *M. laticollis* Cameron, 1933, ma

esse non appartengono al genere loro attribuito dato che presentano formula tarsale 4-5-5, invece di 4-4-5. Sono trasferite al genere *Paramyllaena* Pace, 1984. Le 17 nuove specie sopra descritte sono le prime scoperte nel Borneo. Esse si distinguono per i caratteri dati nella seguente chiave.

CHIAVE DELLE SPECIE BORNEENSI DEL GENERE *MYLLAENA* ERICHSON

1 Elitre più corte del pronoto 2
- Elitre lunghe quanto il pronoto o più lunghe 13
2 Elitre lunghe circa un quarto del pronoto e occhi assai ridotti 3
- Elitre lunghe circa tre quarti del pronoto e occhi grandi o poco ridotti 4
3 Corpo uniformemente giallo-rossiccio; parte prossimale della spermateca avvolta in ampie spire. Lungh. 1,3 mm . . . . . *M. semicaeca* sp. n.
- Corpo giallo-bruno con margine posteriore degli uroterghi liberi e pigidio rossicci; parte prossimale della spermateca semplicemente flessa. Lungh. 1,8 mm . . . . . *M. layangensis* sp. n.
4 Antenne unicolori gialle o giallo-rossicce 5
- Antenne bicolori 9
5 Capo e pronoto unicolori gialli o rossicci 6
- Capo bruno e pronoto rossiccio 7
6 Decimo antennomero più lungo che largo; armatura genitale interna dell'edeago forte. Lungh. 1,7 mm . . . . . *M. terricola* sp. n.
- Decimo antennomero trasverso; armatura genitale interna dell'edeago debole. Lungh. 2,0 mm . . . . . *M. claripyga* sp. n.
7 Addome rossiccio con una fascia bruna al quarto urotergo libero; edeago con «crista apicalis» evidente. Lungh. 1,8 mm . . . . . *M. gibbasimplex* sp. n.
- Addome giallo-rossiccio o rossiccio senza fascia bruna al quarto urotergo libero; edeago senza «crista apicalis» 8
8 Antenne, pronoto ed elitre rossicci; armatura genitale interna del bulbo basale dell'edeago, debole. Lungh. 2,0 mm . . . . . *M. ularensis* sp. n.
- Antenne gialle; pronoto rossiccio ed elitre bruno-rossicce; armatura genitale interna del bulbo basale dell'edeago, forte. Lungh. 1,9 mm . . . . . *M. multiplicationis* sp. n.
9 Undicesimo antennomero giallo o giallo chiaro, in contrasto con i precedenti antennomeri giallo-bruni, giallo-rossicci o gialli 10
- Undicesimo antennomero interamente o parzialmente del colore dei precedenti antennomeri 12
10 Addome bicolore giallo-rossiccio, con base bruno-rossiccia. Lungh. 1,8 mm . . . . . *M. globitheca* sp. n.
- Addome unicolore, al massimo solo i paratergiti sono diversamente colorati 11
11 Pronoto poco trasverso; elitre a lati esterni divergenti all'indietro; addome rossiccio con paratergiti bruni. Lungh. 1,9 mm . . . . *M. semiannularis* sp. n.
- Pronoto molto trasverso; elitre a lati esterni arcuati; addome unicolore bruno-rossiccio. Lungh. 1,7 mm . . . . . *M. claricornis* sp. n.

12 Undicesimo antennomero interamente giallo; pronoto giallo-bruno con fascia mediana bruna; edeago fortemente arcuato all'interno. Lungh. 2,1 mm . . . . . *M. vepres* sp. n.
- Undicesimo antennomero giallo-bruno, con apice giallo; pronoto uniformemente giallo-bruno; edeago debolmente arcuato all'interno. Lungh. 1,9 mm . . . . . *M. kinabaluicola* sp. n.
13 Antenne unicolori gialle o giallo-rossicce 14
- Antenne bicolori 16
14 Corpo unicolore giallo-rossiccio; decimo antennomero trasverso. Lungh. 1,9 mm . . . . . *M. fontium* sp. n.
- Corpo bicolore 15
15 Antenne giallo-rossicce; elitre unicolori brune; pronoto nettamente più stretto delle elitre. Lungh. 2,2 mm . . . . . *M. fluminiphila* sp. n.
- Antenne gialle, elitre brune con base e margine posteriore degli urotergbi liberi, rossicci; pronoto appena più stretto delle elitre. Lungh. 2,2 mm . . . . . *M. multisquamosa* sp. n.
16 Capo ed elitre nero-bruni; decimo antennomero poco più lungo che largo; apice dell'undicesimo antennomero, giallo-rossiccio; edeago molto stretto all'apice in visione ventrale. Lungh. 3,1 mm . . . . *M. longesetipes* sp. n.
- Capo bruno, elitre bruno-rossicce con base rossiccia; decimo antennomero molto più lungo che largo; undicesimo antennomero giallo, in contrasto con i precedenti antennomeri che sono giallo-rossicci; edeago largo all'apice in visione ventrale. Lungh. 3,0 mm . . . . . *M. semiconvexa* sp. n.

KEY TO THE BORNEAN SPECIES OF THE GENUS *MYLLAENA* ERICHSON

1 Elytra shorter than the pronotum 2
- Elytra as long as the pronotum or longer 13
2 Elytra about a quarter as long as pronotum, eyes very small 3
- Elytra about three quarters as long as pronotum, eyes big or moderately small 4
3 Body uniformly yellow-reddish; proximal part of the spermatheca forming ample coils. Length 1.3 mm . . . . . *M. semicaeca* sp. n.
- Body yellow-brown with posterior margin of the free urotergites and pigydium reddish; proximal part of the spermatheca simply flexed. Length 1.8 mm . . . . . *M. layangensis* sp. n.
4 Antennae unicolorous yellow-reddish 5
- Antennae bicoloured 9
5 Head and pronotum yellow or unicoloured reddish 6
- Head brown and pronotum reddish 7
6 Tenth antennomere longer than wide; inside genital armature of the aedoeagus strongly sclerotized. Length 1.7 mm . . . . . *M. terricola* sp. n.
- Tenth antennomere transverse; internal genital armature of the aedoeagus weakly sclerotized. Length 2.0 mm . . . . . *M. claripyga* sp. n.
7 Abdomen reddish with a brown stripe on the fourth free urotergous; aedoeagus with «crista apicalis». Length 1.8 mm . . . . . *M. gibbasimplex* sp. n.

- Abdomen yellow-reddish or reddish without brown stripe on the fourth free urotergous; aedoeagus without «crista apicalis» 8

8 Antennae, pronotum and elytra reddish; inside genital armor of the basal bulb of the aedoeagus, weak. Length 2.0 mm . . . . . *M. ularensis* sp. n.

- Antennae yellow; pronotum reddish; internal genital armature of the basal bulb of the aedeagus weakly sclerotized. Length 1.9 mm . . . . . *M. multiplicationis* sp. n.

9 Eleventh antennomere pale yellow or yellow, contrasting with the preceding yellow-brown, yellow-reddish or yellow antennomere 10

- Eleventh antennomere concolorous or slightly discolorous with the preceding antennomere 12

10 Abdomen bicolous, yellow-reddish, with brown-reddish base. Long. 1.8 mm . . . . . *M. globitheca* sp. n.

- Abdomen unicolous or, at most,with discolorous paratergites 11

11 Pronotum slightly transverse; elytral lateral margins straight; abdomen reddish with brown paratergites. Length 1.9 mm . . . . . *M. semiannularis* sp. n.

- Pronotum very transverse; elytral lateral margins arcuate; abdomen unicoulous, brown-reddish. Length 1.7 mm . . . . . *M. claricornis* sp. n.

12 Eleventh antennomere entirely yellow; pronotum yellow-brown with median brown band; aedeagus conspicuously bent internally. Length 2.1 mm . . . . . *M. vepres* sp. n.

- Eleventh antennomere yellow-brown, with apex yellow; pronotum uniformly yellow-brown; aedoeagus inconspicuously bent internally. Length 1,9 mm . . . . . *M. kinabaluicola* sp. n.

13 Antennae unicolous, yellow or yellow-reddish 14

- Antennae bicolous 16

14 Body unicolous, yellow-reddish; tenth antennomerous transverse. Length. 1,9 mm . . . . . *M. fontium* sp. n.

- Body bicolous 15

15 Antennae yellow-reddish; elytra unicolous brown; pronotum conspicuously narrower than the elytra. Length 2.2 mm . . . . . *M. fluminiphila* sp. n.

- Antennae yellow, elytra discolorous, brown, with base posterior margin of the free urotergites reddish; pronotum inconspicuously narrower than the elytra. Length 2.2 mm . . . . . *M. multisquamosa* sp. n.

16 Head and elytra black-brown; tenth antennomere a little longer that wide; apex of the eleventh antennomere yellow-reddish; aedoeagus conspicuously narrowed to apex in ventral view. Length 3.1 mm . . . . . *M. longesetipes* sp. n.

- Head brown, elytra brown-reddish with reddish base; tenth antennomere longer than wide; eleventh antennomere yellow, contrasting with the preceding yellow-reddish antennomere; aedoeagus widened to the apex, in ventral view. Length 3.0 mm . . . . . *M. semiconvexa* sp. n.

Paramyllaena Pace

Paramyllaena anterufa sp. n. Figg. 58-61

Holotypus ♂, Borneo-Sabah, Mt. Kinabalu Nat. Pk., HQ Silau-Silau Tr., 1560 m, 3.VIII.1988, leg. A. Smetana (MHNG).

Paratypi: 1 ♂, stessa provenienza, ma 1550 m, 2.IX.1988; 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1495 m, 22.V.1987, A. Smetana leg.; 2 ♂♂ e 2 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., 1580 m, 27.IV.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 2,6 mm. Parte anteriore del corpo lucida e giallo-rossiccia; elitre brune aventi la base, gli omeri, la sutura e il margine posteriore rossicci; addome rossiccio, con quarto urotergo libero rossiccio e pigidio giallo-rossiccio; antenne gialle con i due antennomeri basali giallo chiaro; zampe giallo-rossicce. La punteggiatura del capo è indistinta, quella della base degli uroterghi liberi è forte. La granulosità del pronoto è finissima e assai superficiale, quella delle elitre è saliente e quella dell'addome è distinta e assente al margine posteriore di ciascun urotergo libero. Edeago figg. 59-60, spermateca fig. 61.

Etimologia. La nuova specie prende nome di «Rossiccia davanti» per il colore giallo-rossiccio della parte anteriore del suo corpo.

Comparazioni. La nuova specie presenta pronoto largo quanto le elitre e spermateca ben sviluppata, con bulbo prossimale globulare. Questi caratteri sono sufficienti a distinguerla dalle specie note del Borneo e da quelle sotto descritte che mostrano pronoto più stretto delle elitre e spermateca a struttura e dimensione differenti.

Paramyllaena flexuosa sp. n. Figg. 62-65

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu Nat.Pk., HQ Liwagu River, 1495 m, 13.VIII.1988, A. Smetana leg (MHNG).

Paratypi: 4 es., stessa provenienza; 1 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1655 m, 11.VIII.1988, A. Smetana leg.; 1 ♀, Borneo-Sabah, Mt. Kinabalu Nat. Pk., HQ Silau-Silau Tr., 1540 m, 14.VIII-1.IX.1988, leg. A. Smetana.

Descrizione. Lungh. 2,7 mm. Corpo lucido e giallo-rossiccio, con elitre e uroterghi liberi terzo e quarto bruno-rossicci; antenne rossicce con i tre antennomeri basali e l'undicesimo giallo-rossicci; zampe giallo-rossicce. La granulosità del capo, delle elitre e dell'addome è fine e distinta, quella del pronoto è superficiale. Assente è la reticolazione sul corpo. Edeago 63-64, spermateca fig. 65.

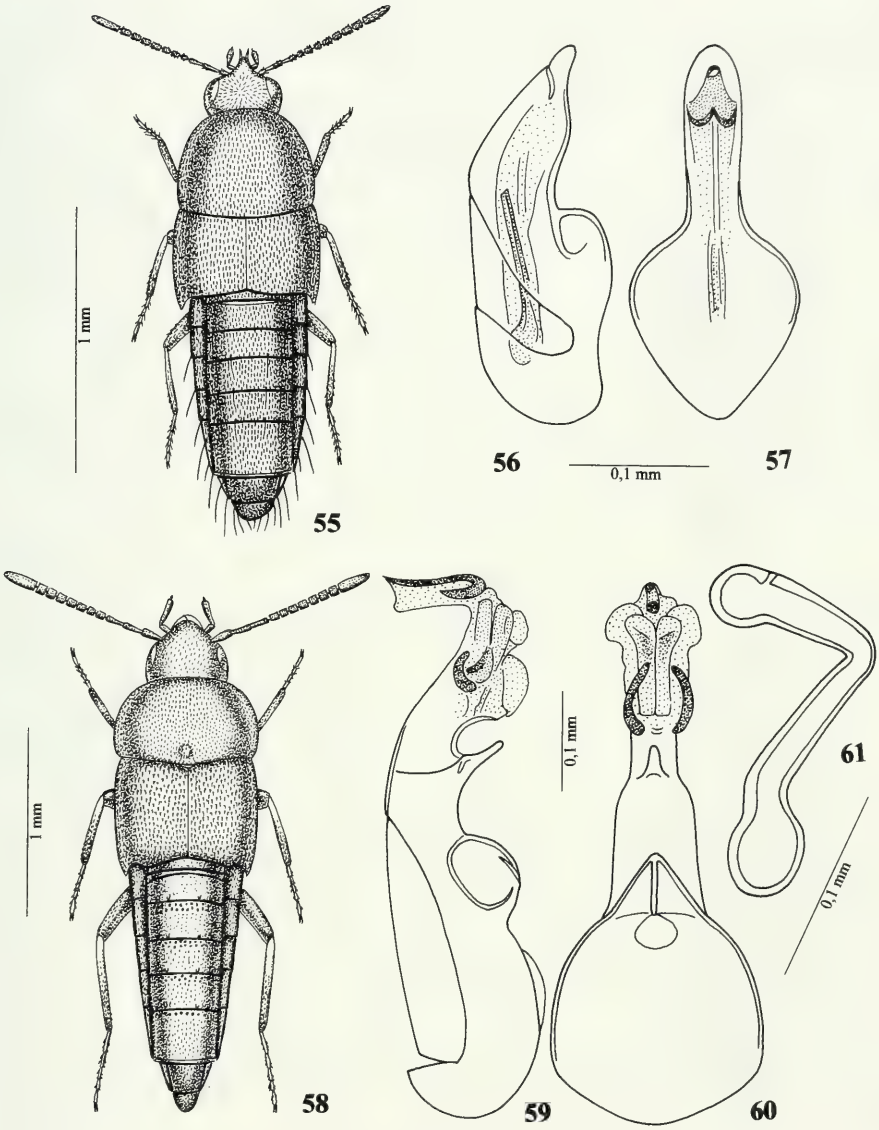
Etimologia. La nuova specie prende nome di «Flessuosa» per la forma flessa del suo edeago.

Comparazioni. La parte distale dell'edeago della nuova specie è fortemente flesso al lato ventrale. Questo carattere non si osserva in altre specie del Borneo con pronoto più stretto delle elitre.

Paramyllaena fasciatipyga sp. n. Figg. 66-69

Holotypus ♀, Borneo-Sabah, Mt. Kinabalu Nat. Pk., HQ 1560-1660 m, 24.IV.1987, leg. A. Smetana (MHNG).

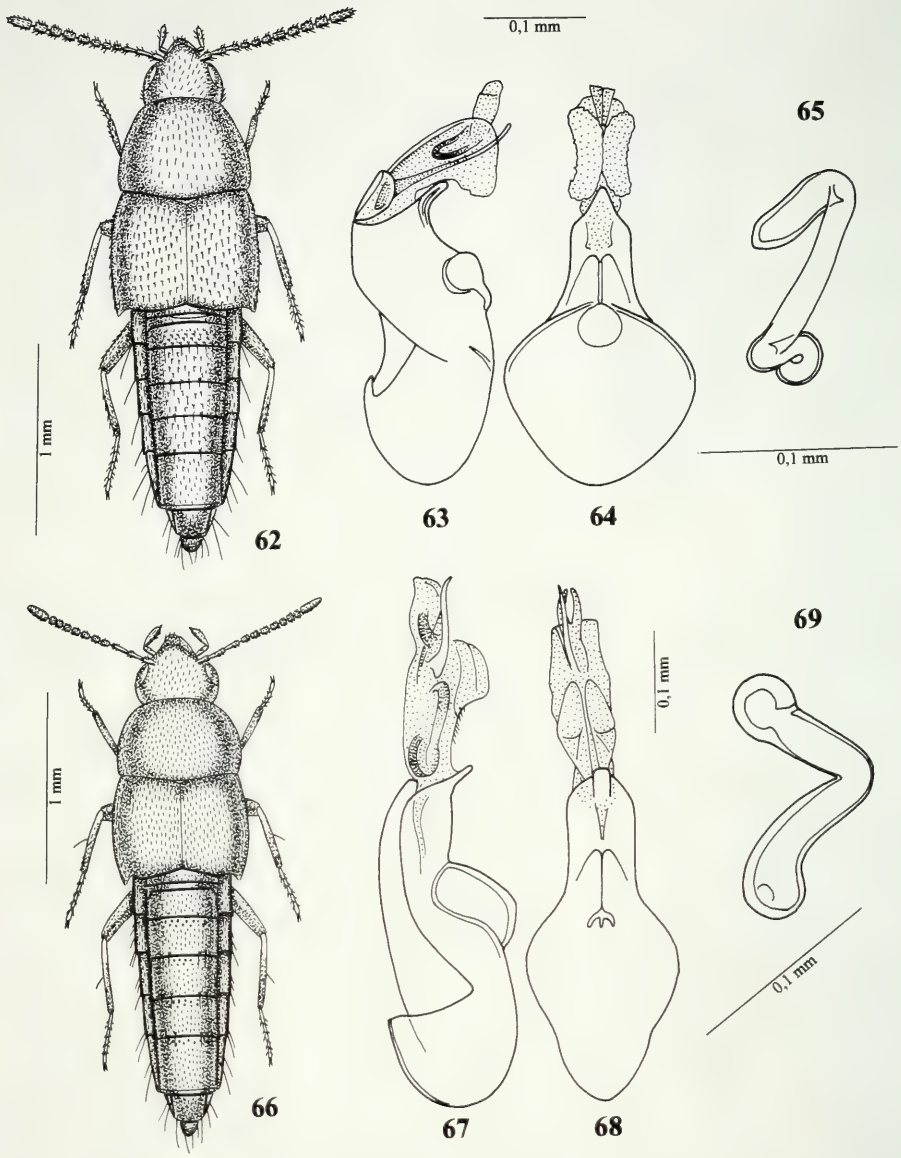
Paratypi: 1 ♀, Borneo-Sabah, Mt. Kinabalu Nat. Pk., HQ Bukit Ular Tr., 1750 m, 29.IV.1987, leg. A. Smetana; 1 ♀, Sabah, Crocker Ra., 1200 m, Km 63 r.te Kota Kinabalu-Tambunan, 19.V.1987, leg. Burckhardt & Löbl; 1 ♀, Sabah, Mt. Kinabalu, 1580 m, 27.IV.1987,



FIGG. 55-61

Habitus, edeago in visione laterale e ventrale e spermateca. 55-57: *Myllaena gibbasimplex* sp. n.; 58-61: *Paramyllaena anterufa* sp. n.

leg. Burckhardt & Löbl; 42 es., Borneo, Sabah, Crocker Ra., 1600 m, 18.V.1987, Burckhardt & Löbl leg.; 41 es., Borneo, Sabah, Crocker Ra., 1600 m, Km 51 rte. Kinabalu-Tambunan, 18.V.1987, Burckhardt & Löbl leg.; 2 es., Sabah, Mt. Kinabalu, 1550-1650 m, 24.IV.1987, leg. Burckhardt & Löbl; 4 es., Sabah, Mt. Kinabalu, 1550 m, 28.IV.1987, leg. Burckhardt & Löbl; 1 es., Borneo, Sabah, Crocker Ra., 1600 m, Km 51 rte. Kinabalu-Tambunan, 18.V.1987, Burckhardt & Löbl leg.; 2 ♀♀, Sabah, Mt. Kinabalu, 1550-1650 m, 24.IV.1987, leg. Burckhardt & Löbl.



FIGG. 62-69
Habitus, edeago in visione laterale e ventrale e spermateca. 62-65: *Paramyllaena flexuosa* sp. n.; 66-69: *Paramyllaena fasciatipyga* sp. n.

DESCRIZIONE. Lungh. 2,4-2,8 mm. Corpo lucido e bruno-rossiccio, con elitre brune marginate di rossiccio alla sutura, agli omeri e al margine posteriore; quarto urotergo libero bruno-rossiccio; antenne bruno-rossicce con i tre antennomeri basali giallo-rossicci e l'undicesimo rossiccio; zampe rossicce. La granulosità del capo e del

pronoto è finissima e superficiale, quella delle elitre e dell'addome è distinta. La base degli uroterghi liberi secondo a quinto è fortemente punteggiata. Edeago figg. 67-68, spermateca fig. 69.

ETIMOLOGIA. La nuova specie prende nome di «Pigidio fasciato», per estensione a motivo del suo addome fasciato di bruno.

COMPARAZIONI. Le elitre della nuova specie sono marginate di rossiccio, l'addome ha un fascia bruna e l'edeago ha la parte apicale corta. Questi caratteri non si osservano insieme in nessuna altra specie del Borneo.

Paramyllaena affinoides sp. n. Figg. 70-72

Holotypus ♂, Sabah, Mt. Kinabalu, 2600 m, 2.V.1987, Burckhardt & Löbl leg (MHNG).

DESCRIZIONE. Lungh. 2,7 mm. Corpo lucido e rossiccio, con capo e urotergo libero quarto bruni; antenne brune con i tre antennomeri basali e la metà apicale dell'undicesimo gialli; zampe giallo-rossicce. La punteggiatura del capo e del pronoto è fine e superficiale, quella delle elitre è saliente e quella dell'addome è fine. La base degli uroterghi liberi secondo a quinto è fortemente punteggiata. Edeago figg. 71-72.

ETIMOLOGIA. La nuova specie prende nome di «Simile ad *affinis*» per la sua affinità con *P. affinis* (Cameron).

COMPARAZIONI. La nuova specie per la forma dell'edeago si presenta affine a *P. rougemonti* Pace, pure del Borneo, ma quest'ultima specie presenta quest'organo fortemente ricurvo al lato ventrale e «crista apicalis» molto più sviluppata.

Paramyllaena longelytrata sp. n. Figg. 73-75

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu Nat.Pk., HQ Liwagu Rv. Tr., 1655 m, 11.VIII.1988, A. Smetana leg (MHNG).

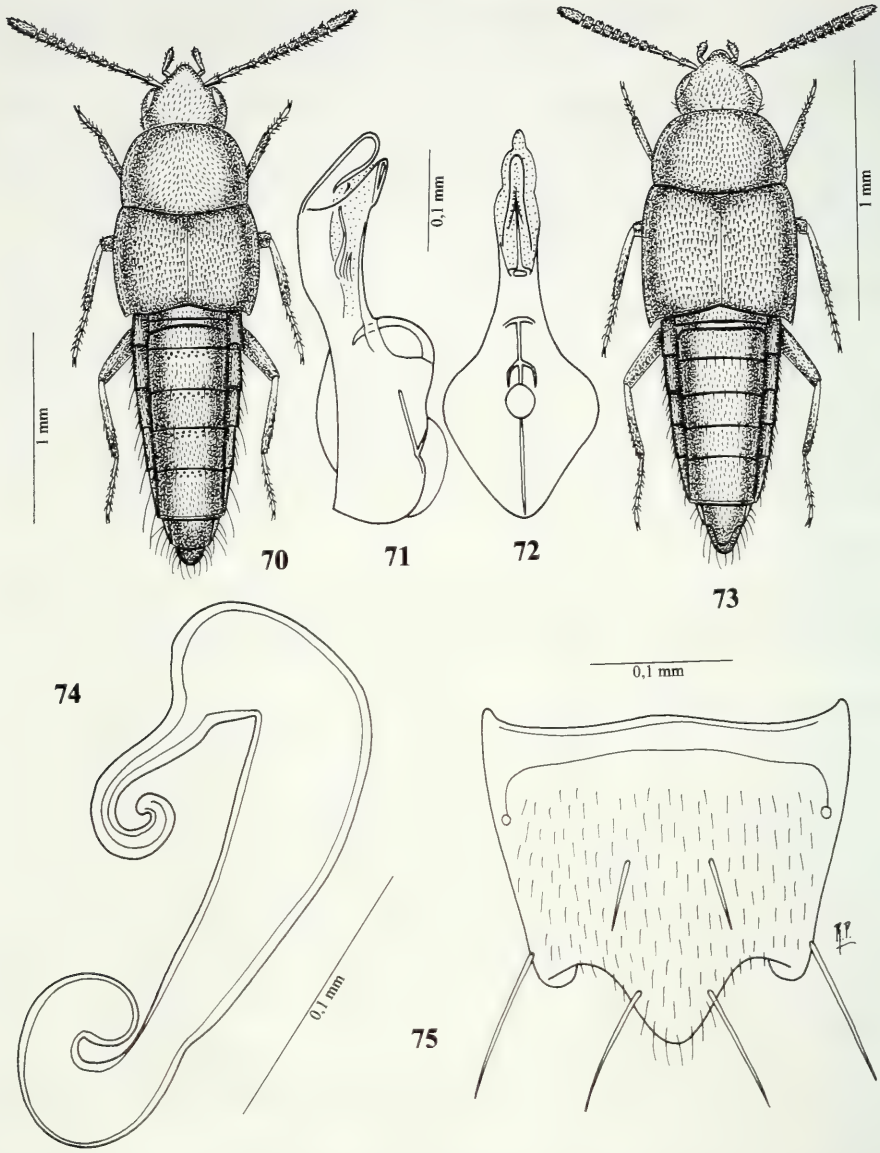
DESCRIZIONE. Lungh. 1,9 mm. Corpo lucido e bruno, con gli uroterghi liberi quarto e quinto nero-bruni; antenne nero-brune con i due antennomeri basali giallo-rossicci; zampe gialle. La granulosità del capo e del pronoto è fine, fitta e saliente, quella delle elitre è distinta. Le elitre sono molto lunghe, misurate dalla sommità della curva dell'omero all'angolo posteriore esterno, sono un terzo più lunghe della linea longitudinale mediana del pronoto. Spermateca fig. 74, sesto urotergo libero della ♀ fig. 75.

ETIMOLOGIA. La nuova specie prende nome di «Con elitre lunghe» perché presenta con evidenza questo carattere.

COMPARAZIONI. Le sopra descritte nuove specie borneensi del genere *Paramyllaena* Pace, 1984, si distinguono dalle tre note del Borneo per i caratteri dati nella seguente chiave.

CHIAVE DELLE SPECIE BORNEENSI DEL GENERE *PARAMYLLAENA* PACE

1 Decimo antennomero più lungo che largo 2
- Decimo antennomero trasverso 4
2 Solchi trasversi basali degli uroterghi primo a quinto, fortemente punteggiati. Lungh. 2,8 mm . . . . . *P. affinis* (Cameron)
- Solchi trasversi basali degli uroterghi non o debolmente punteggiati 3
3 Antenne nere con base rossiccia; capo bruno, pronoto bruno-rossiccio; parte apicale dell'edeago assai lunga. Lungh. 3,0 mm . . *P. laticollis* (Cameron)



FIGG. 70-75

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero della ♀. 70-72: *Paramyllaena affinoides* sp. n.; 73-75: *Paramyllaena longelytrata* sp. n.

- Antenne nere con base e undicesimo antennomero giallo-rossicci; capo e pronoto giallo-rossicci; parte apicale dell'edeago assai corta. Lungh. 2,7 mm . . . . . *P. flexuosa* sp. n.

4 Avancorpo unicolore bruno; antenne nero-brune con base giallo-rossiccia; elitre molto più lunghe del pronoto. Lungh. 1,9 mm . . *P. longelytrata* sp. n.

- Avancorpo bicolore; antenne mai nero-brune; elitre poco più lunghe del pronoto 5
5 Capo e pronoto unicolori giallo-rossicci o bruno-rossicci; elitre brune marginate di rossiccio alla sutura e ai lati 6
- Capo bruno o bruno-rossiccio; pronoto giallo-bruno o rossiccio; elitre unicolori 7
6 Capo e pronoto giallo-rossicci; antenne gialle; una fossetta mediana posteriore del pronoto; parte apicale dell'edeago arcuata in visione laterale . . . . . *P. anterufa* sp. n.
- Capo e pronoto bruno-rossicci; antenne bruno-rossicce con base giallo-rossiccia; assenza di fossetta mediana posteriore del pronoto; parte apicale dell'edeago sinuosa in visione laterale . . . . . *P. fasciatipyga* sp. n.
7 Antenne gialle; base degli uroterghi liberi senza punteggiatura forte; edeago profondamente arcuato al lato ventrale. Lungh. 2,1 mm . . . . . *P. rougemonti* (Pace)
- Antenne brune con i tre antennomeri basali e l'apice dell'undicesimo gialli; base degli uroterghi con punteggiatura forte; edeago assai poco arcuato al lato ventrale. Lungh. 2,7 mm . . . . . *P. affinoides* sp. n.

KEY TO THE BORNEAN SPECIES OF THE GENUS *PARAMYLLAENA* PACE

1 Tenth antennomere longer than wide 2
- Tenth antennomere transverse 4
2 Basal transverse furrows of the first to fifth urotergites conspicuously punctuate. Length 2.8 mm . . . . . *P. affinis* (Cameron)
- Basal transverse furrows of the urotergites not or inconspicuously punctuate 3
3 Antennae black with reddish base; head brown, pronotum brown-reddish; apical portion of the aedoeagus very long. Length 3.0 mm . . . . . *P. laticollis* (Cameron)
- Antennae black, its base and eleventh antennomere yellow-reddish; head and pronotum yellow-reddish; apical portion of the aedoeagus very short. Length 2.7 mm . . . . . *P. flexuosa* sp. n.
4 The fore part of body brown unicolous, brown; antennae black-brown with yellow-reddish base; elytra longer than the pronotum. Length 1.9 mm . . . . . *P. longelytrata* sp. n.
- The fore part of body bicolous; antennae never black-brown; elytra a little longer than pronotum 5
5 Head and pronotum unicolourous, yellow-reddish or brown-reddish; elytra brown margined of reddish to the suture and the sides 6
- Head brown or brown-reddish; pronotum yellow-brown or reddish; elytra unicolous 7
6 Head and pronotum yellow-reddish; antennae yellow; pronotum with a medio-posterior fovea; apical portion of aedoeagus arcuate in lateral view . . . . . *P. anterufa* sp. n.

- Head and pronotum brown-reddish; antennae brown-reddish with base yellow-reddish; pronotum lacking a medio-posterior fovea; apical portion of the aedoeagus sinuate in lateral view ..... *P. fasciatipyga* sp. n.

7 Antennae yellow; base of the free urotergites without strong punctuation; aedoeagus deeply arched ventrally. Length 2.1 mm . . *P. rougemonti* (Pace)

- Antennae brown with the three basal antennomeres and the apex of the eleventh antennomere yellow; base of the urotergites with conspicuous punctuation; aedoeagus slightly arched ventrally. Length 2.7 mm ..... *P. affinoides* sp. n.

RINGRAZIAMENTI

Rivolgo i miei più cordiali ringraziamenti a coloro che mi hanno affidato in studio il raro materiale oggetto del presente lavoro: il dott.. Aleš Smetana di Ottawa e il dott. Ivan Löbl, già del Museo di Storia Naturale di Ginevra. Un grazie anche al dott. Daniel Burkhardt del Museo di Storia naturale di Basilea per aver raccolto insieme ai due precedenti colleghi il materiale oggetto del presente lavoro e al collega Guillaume de Rougemont di Londra per avermi ceduto un esemplare.

Per il prestito di tipi ringrazio il Dr. P.M. Hammond e il Dr. M. Brendell del Museo di Storia Naturale di Londra, il Dr. L. Zerche del DEI di Eberswalde (Berlino) e il Dr. A.F. Newton del *Field Museum of Natural History* di Chicago.

Un ringraziamento rivolgo al dott. Giulio Cuccodoro del Museo di Ginevra per la correzione delle mie traduzioni in inglese delle chiavi di determinazione.

BIBLIOGRAFIA

BERNHAUER, M.1915. Neue Staphyliniden der indo-malaiischen Fauna, insbesondere der Sunda-Insel Borneo. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 65: 134-158.

CAMERON, M. 1920. New species of Staphylinidae from Singapore. *Transaction of the Entomological Society of London,* 1920: 212-284.

CAMERON, M. 1925. New Staphylinidae from the Dutch Essì Jndies. *Treubia,* Buitenzorg, 6: 174-198.

CAMERON, M. 1933. Staphylinidae (Col.) from Mount Kinabalu. *Journal of the Federated Malay States Museums* 17(2): 338-360.

CAMERON, M. 1939. The Fauna of British India including Ceylon and Burma: Coleoptera Staphylinidae, vol. IV, part I and II. - 961 pp. *Taylor and Francis, London.*

ERICHSON, W.F. 1837. Die Käfer der Mark Brandenburg I: 1-384. *Berlin.*

GANGLBAUER, L. 1895. Die Käfer Mitteleuropa. VoI. I., 881 pp. *Wien.*

MULSANT, M.E. & REY, C. 1873. Histoire naturelle des Coléoptères de France: Brévipennes (Aléochariens), 155 pp. *Paris.*

KLIMASZEWSKI, J. 1979. A revision of the Gymnusini and Deinopsini of the world. *Agriculture Canada, Monograph* 25: 169 pp.

PACE, R. 1984a. Aleocharinae dell'Himalaya (Coleoptera Staphylinidae) (LI Contributo alla conoscenza delle Aleocharinae). *Annales de la Société entomologique de France* (N.S.) 20: 309-339.

PACE, R. 1984b. Aleocharinae della Thailandia e della Birmania riportate da G. de Rougemont (Coleoptera Staphylinidae). (LIX Contributo alla conoscenza delle Aleocharinae). *Bollettino del Museo civico di Storia naturale di Verona* 11: 427-468.

PACE, R. 1986. Aleocharinae dell'Asia sudorientale raccolte da G. de Rougemont (Coleoptera, Staphylinidae) (LXXII Contributo alla conoscenza delle Aleocharinae). *Bollettino del Museo civico di Storia naturale di Verona* 23: 139-237.

PACE, R. 1999. Aleocharinae della Namibia raccolte dalla spedizione entomologica "Namibia 1992" del Museo di Storia Naturale di Berlino (Coleoptera, Staphylinidae). *Memorie della Società entomologica italiana* 77: 161-212.

Revue suisse de Zoologie 112 (1): 47-64; mars 2005

Two new *Gammarus* species from Benxi Water Cave, China (Crustacea, Amphipoda, Gammaridae)

Zhong-e HOU & Shuqiang LI
Institute of Zoology, Chinese Academy of Sciences, Beijing 100080, P. R. China.
E-mail: lisq@ioz.ac.cn (all correspondence to Shuqiang Li)

Two new *Gammarus* species from Benxi Water Cave, China (Crustacea, Amphipoda, Gammaridae). - Two new *Gammarus* species, *Gammarus pexus* sp. n. and *Gammarus stalagmiticus* sp. n., are described from Benxi Water Cave, Liaoning Province, China. *Gammarus pexus* sp. n. is characterized by the peduncular articles 4 and 5 with groups of long setae and outer margin of outer ramus of uropod 3 only with simple setae. *Gammarus stalagmiticus* sp. n. differs from the congeneric species in the accessory flagellum of antenna 1 with 6 articles and uropod 3 densely provided with plumose and simple setae.

Keywords: Amphipoda - *Gammarus* - taxonomy - new species - China.

INTRODUCTION

Benxi Water Cave (41.3°N, 124.1°E), a karst cave formed some five millions years ago, is located in Benxi County, 35 kilometers from Benxi City of Liaoning Province, China. Stretching approximately 3,000 meters long, covering an area of 36,000 square meters and with a volume of 36,0000 cubic meters, Benxi Water Cave is the longest limestone cave in northern China. The cave's entrance is on the shore of Taizi River, 7 meters high and 25 meters wide in the shape of a crescent. In the cave wonderful views of various shapes of stones can be found, with a crystal-clear underground river running throughout the year.

We know that the freshwater amphipods were already present in Benxi Water Cave about ten years ago, since we received material from Mr Dezeng Liu that was collected from the cave at that time. He had also found some "transparent fish" in the cave. Because his material is not in a good condition, we cannot identify this amphipod from that collection. In August 2003 we finally had the chance to enter Benxi Water Cave, but when we got there we found out that it had changed into a touristical attraction. Neither "transparent fish" nor freshwater Amphipoda was found in the cave. One of the tourguides however indicated that just outside the cave shrimp like animals had been seen, and we did indeed find amphipods. They belong to the genus *Gammarus* and there are two different species.

Gammarus is one of largest epigean freshwater genera of amphipods in the world. Barnard & Barnard (1983) reviewed the freshwater Amphipoda worldwide and

Manuscript accepted 18.05.2004

117 species were listed under the genus *Gammarus*. After 1983, more than 30 species have been recorded by several authors (Karaman & Pinkster, 1987; Morino & Whitman, 1995; Stock *et al.*, 1998), and 28 species have been reported from China (Hou & Li, 2002a, b, c, 2003a, b, c, d, e; Hou, Li & Koenemann, 2002; Hou, Li & Morino, 2002; Hou, Li & Zheng, 2002; Meng *et al.*, 2003). Yet, the diversity of this genus is only partly known in China, and a large area of this country awaits intensive taxonomical surveys.

Detailed drawings of taxonomic characters and descriptions of these two *Gammarus* species are given in the present paper. Differences with related species are discussed.

MATERIAL AND METHODS

The specimens were collected by a fine-mesh hand-net and preserved in 75% ethanol. Prior to dissection, body length was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antennae to the base of the telson. For each species three to five specimens of each sex were dissected and appendages were mounted on slides according to the methods described by Holsinger (1967). The drawings were made with the aid of a drawing tube mounted on an Olympus BX-41 compound microscope.

All holotypes treated in this study are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing, China. Paratypes are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZCAS), and in the Muséum d'histoire naturelle, Geneva (MHNG).

TAXONOMY

Gammarus pexus sp. n. Figs 1-4

Material. Holotype, male (IZCAS-I-A0100), outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003. Paratypes: 35 males, 33 females and 15 juveniles (IZCAS), 10 males and 10 females (MHNG), same data as for the holotype.

Etymology. The species is named for the peduncular articles and flagellum of antenna 2 densely armed with setae.

Diagnosis. Accessory flagellum of antenna 1 with 4 articles. Peduncular articles 4 and 5 of antenna 2 densely with long setae, flagellum with brush-like setae and calceoli absent. Outer margin of outer ramus of uropod 3 with simple setae.

Description of male. Body 12.0 mm in length. Eyes reniform, medium in size (Fig. 1A).

Antenna 1 (Fig. 1J): peduncular articles 1-3 in length ratio 1 : 0.8: 0.5, bearing some groups of marginal setae; flagellum with 32 articles, most of which with aesthescs; accessory flagellum with 4 articles.

Antenna 2 (Figs 1K-M): peduncular article 4 about as long as article 5, bearing 5-8 groups of long setae on anterior margin and 2-5 groups of long setae on posterior margin; flagellum with 11 articles, bearing long brush-like setae, calceoli absent.

Upper lip convex (Fig. 1C), with minute setae.

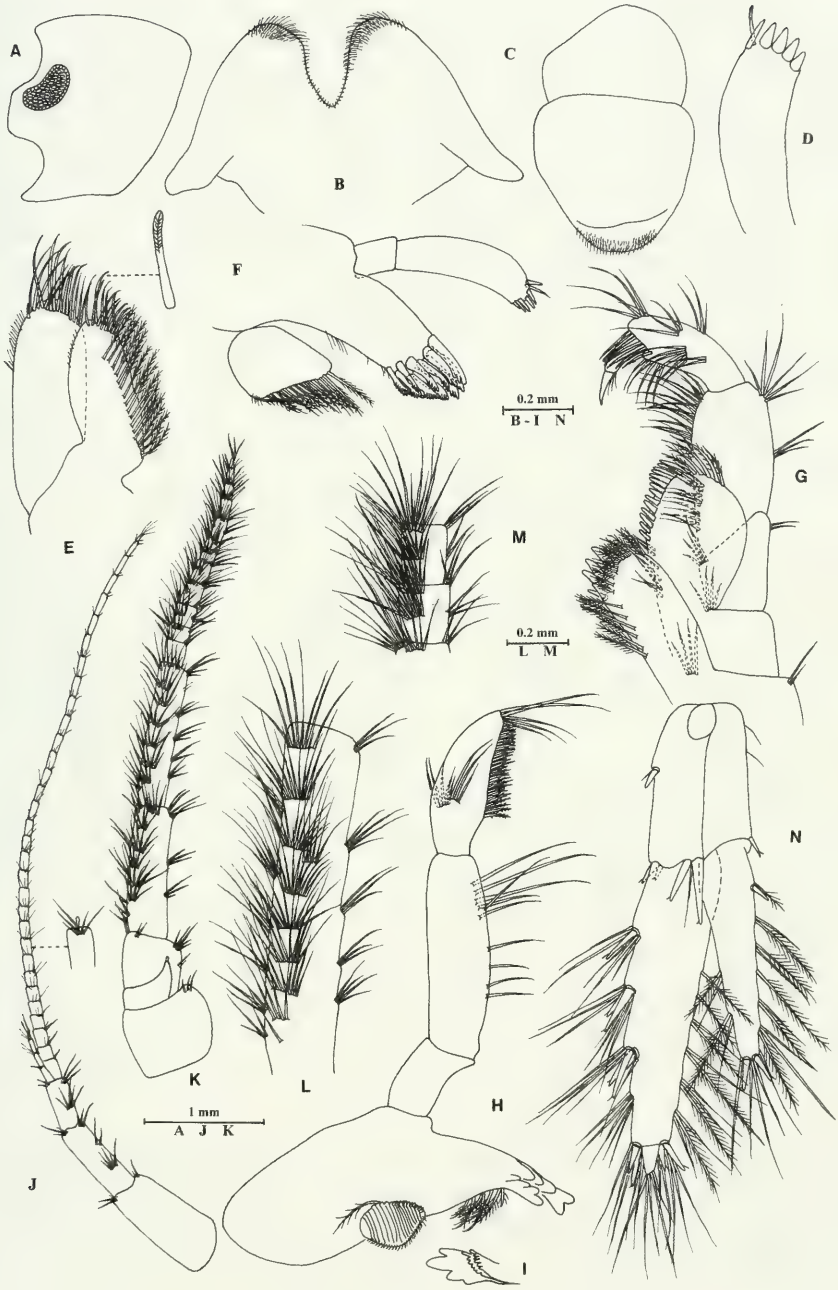


FIG. 1

Gammarus pexus sp. n., holotype, male: A-M; allotype, female: N. A, head; B, lower lip; C, upper lip; D, palp of right maxilla 1; E, maxilla 2; F, left maxilla 1; G, maxilliped; H, left mandible; I, right incisor; J, antenna 1; K, antenna 2; L, peduncular article 5 of antenna 2; M, flagellum of antenna 2; N, uropod 3.

Mandibles (Figs 1H, I): left incisor with 5 teeth; lacinia mobilis with 4 dentitions; article 2 of palp bearing 10 long setae on inner margin, article 3 reaching 75% length of article 2, bearing 5 A-setae on outer surface, 3 B-setae on inner surface, a row of short plumose D-setae and 5 long E-setae. Right mandible incisor with 4 teeth; lacinia mobilis bifurcate, with small crenations.

Lower lip (Fig. 1B): inner lobe absent.

Maxilla 1 (Figs 1D, F): asymmetrical, inner plate bearing 15 plumose setae on inner margin; outer plate with 11 serrated spines apically and some setules medially; article 2 of left palp with 6 spines accompanied by 1 slender seta; article 2 of right palp with 4 blunt spines accompanied by 2 stiff setae.

Maxilla 2 (Fig. 1E): inner plate bearing a diagonal row of 17 plumose setae on inner margin, several long apical setae and some setules on outer margin; outer plate bearing long apical setae and some setules on outer margin.

Maxilliped (Fig. 1G): inner plate bearing 1 subapical spine, 3 apical spines and 6 plumose setae on medial margin; outer plate with 14 spines on inner margin and 5 apical pectinate setae; palp with 4 articles, armed with long setae.

Coxal plates: coxal plates 1-3 subrectangular (Figs 2A-C), bearing 3-4 setules on anterior corner and 1 setule on posterior corner; coxal plate 4 excavated on posterior margin (Fig. 2D), with 2 setules on anterior corner and 5 setules on posterior margin; coxal plates 5 and 6 with small anterior lobe (Figs 3A, B), bearing one or no setule on anterior corner, posterior lobe with 2-3 setules on posterior margin; coxal plate 7 (Fig. 3C) with a group of 5 long setae on anterior margin and 5 setules on posterior margin.

Coxal gills (Figs 2A-D, 3A-C): coxal gills of gnathopod 2 and pereopods 3-7 progressively small.

Gnathopod 1 (Figs 2A, G): basis with long naked setae along anteroproximal and posterior margins; carpus reaching 70% of length of propodus, bearing 2 groups of long setae on anterior margin and a row of long setae on posterior margin; propodus oval, palm strongly oblique, bearing 1 medial spine, 6 spines on posterior margin and 4 spines on medial surface, associated with groups of long medial setae and long marginal setae; dactylus with 1 naked seta on outer margin.

Gnathopod 2 (Figs 2B, H): larger than gnathopod 1, basis similar to that of gnathopod 1, bearing 4 serrated setae accompanied by 4 long naked setae; carpus about 80% of length of propodus; propodus subrectangular, palm transverse, bearing 1 medial spine, 2 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner.

Pereopod 3 (Figs 2C, E): basis with a pair of long setae and 3 groups of short setae on anterior margin and 5 groups of long setae on posterior margin; merus to propodus with long, weakly curled setae on posterior margins, propodus accompanied by 4 short spines on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 4 (Figs 2D, F): basis with 4 groups of long setae on posterior margin; merus with 5 groups of short setae on posterior margin and 2 short spines on anterior margin; carpus bearing 3 groups of spines accompanied by short setae; propodus bearing 4 single short spines accompanied by short setae; dactylus with 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

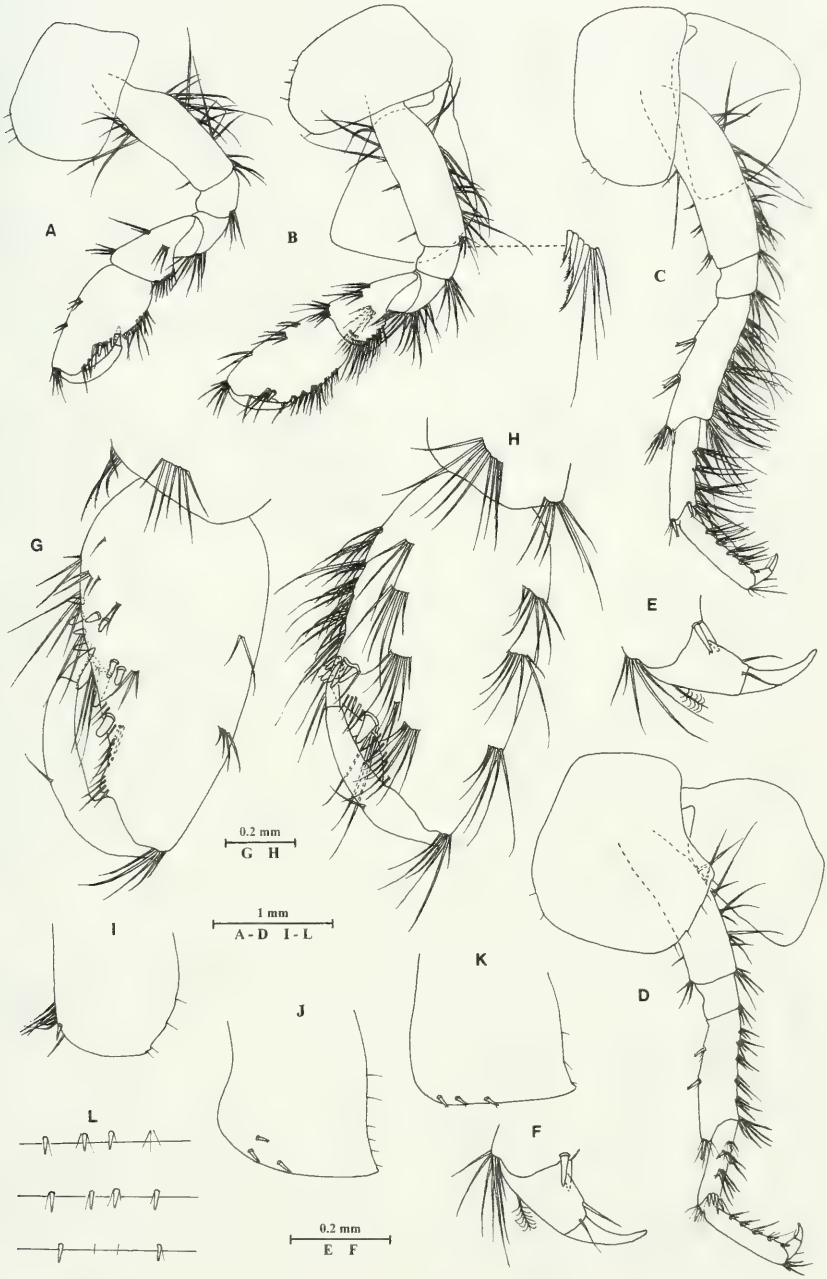


FIG. 2

Gammarus pexus sp. n., holotype, male. A, gnathopod 1; B, gnathopod 2; C, pereopod 3; D, pereopod 4; E, dactylus of pereopod 3; F, dactylus of pereopod 4; G, propodus of gnathopod 1; H, propodus of gnathopod 2; I-K, epimeral plates 1, 2 and 3; L, urosomites (dorsal view).

Pereopod 5 (Figs 3A, H): posterior margin of basis nearly straight, bearing a row of 12 setules, anterior margin with 4 single spines associated with setules; merus with 3 groups of short setae on anterior margin and 2 single spines on posterior margin; carpus with 2 pairs of spines accompanied by short setae on anterior margin and 2 groups of 3 spines on posterior margin; propodus with one single and 3 groups of spines on anterior margin and a group of long setae on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 6 (Figs 3B, I): basis longer than that of pereopod 5, weakly attenuated distally on posterior margin, bearing a row of 14 setules, anterior margin with 4 single spines; merus and carpus with 2 groups of spines accompanied by short setae on anterior margins; propodus with 4 groups of spines on anterior margin and 3 groups of setae on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 7 (Figs 3C, J): basis processed medially on posterior margin, bearing a row of 12 setules, anterior margin with 5 long setae proximally and 4 single spines; merus and carpus with 2 groups of spines on anterior margins accompanied by short setae; propodus with 4 groups of spines on anterior margin and one single seta and 2 groups of setae on posterior margin; dactylus bearing 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

Epimeral plates: each posterior margin with 3-6 setules; plate 1 ventrally rounded (Fig. 2I), bearing a short spine and 8 setae on anteroventral corner; plates 2 and 3 weakly pointed posterodistally (Figs 2J, K), bearing 1 subventral spine and 2 spines on ventral margin in plate 2; plate 3 with 3 spines on ventral margin.

Pleopods (Fig. 3F): pleopods 1-3 subequal in length, peduncles bearing 2 retinacula accompanied by 3 setae on anterodistal corner, and several long setae on medial surface; inner and outer rami with 15-20 articles, armed with plumose setae.

Urosomites (Fig. 2L): dorsally flat, urosomite 1 bearing 3 single spines accompanied by short setules and a group of 3 short setae on posterodorsal margin; urosomite 2 bearing 4 single spines accompanied by short setules; urosomite 3 bearing 2 single spines on both sides and 2 single setules medially.

Uropod 1 (Fig. 3D): outer ramus 52% and inner ramus 65% of length of peduncle, peduncle bearing 1 dorsolateral spine, with 2 spines on outer margin, 2 spines on inner margin, 2 spines on laterodistal corner and 1 spine on medial distal corner; inner ramus with 2 spines on inner margin; outer ramus with 2 spines on inner margin and 2 spines on outer margin.

Uropod 2 (Fig. 3E): outer ramus 69% and inner ramus 88% of length of peduncle, peduncle bearing marginal spines; inner ramus with 2 spines on outer margin; outer ramus with 2 spines on outer margin and 1 spine on inner margin.

Uropod 3 (Fig. 3G): peduncle bearing 1 spine on lateral margin and 4 long setae on medial margin, with a pair of spines apico-laterally, 1 spine apico-medially and a pair of spines on the mid-ventral margin; inner ramus about 75% of length of article 1 of outer ramus, bearing 3 marginal spines and 1 distal spine accompanied by long plumose setae; article 1 of outer ramus with 4 pairs of spines on outer margin and 2 pairs of spines distally, article 2 about as long as adjacent spines, 8% of length of article 1; both margins of inner ramus and inner margin of outer ramus armed with plumose setae, while outer margin of outer ramus only has simple setae.

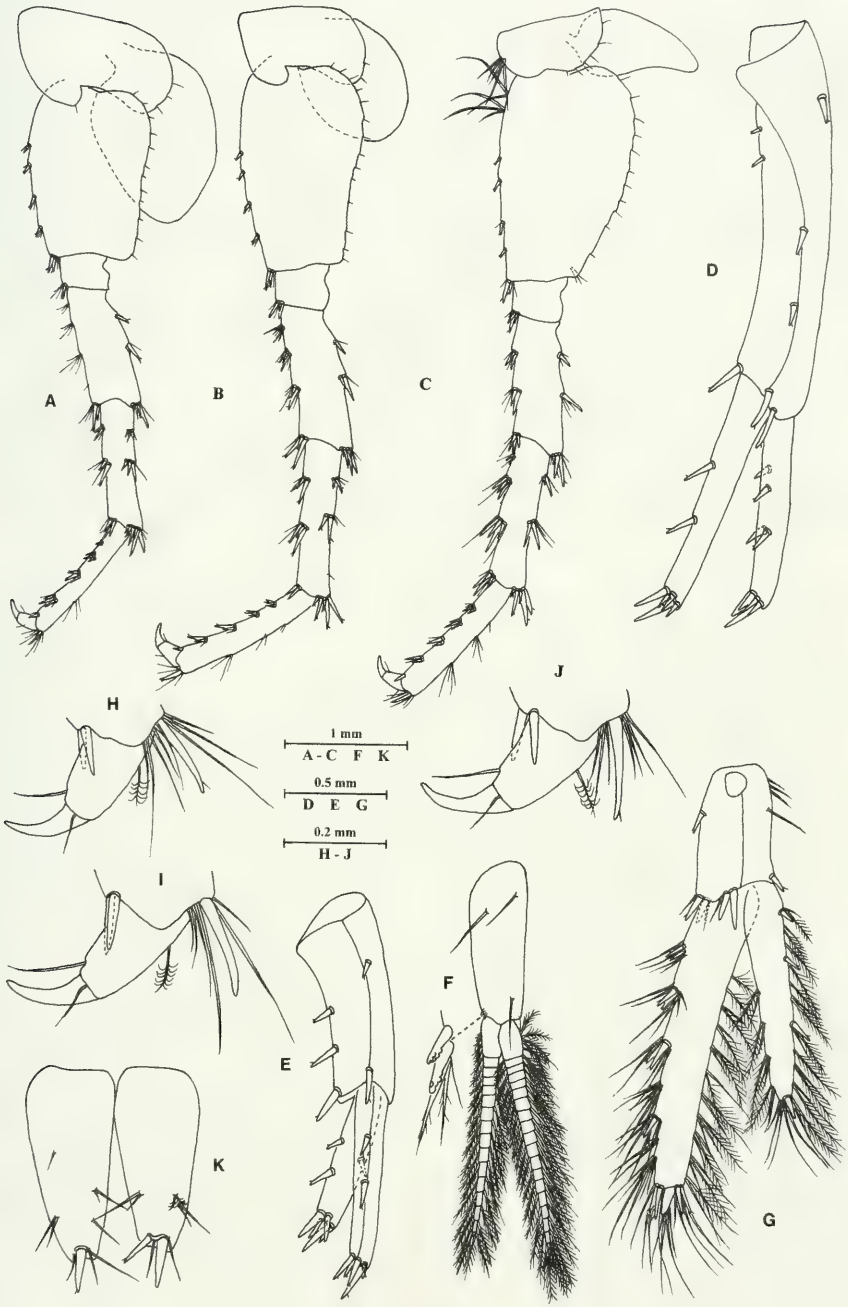


FIG. 3

Gammarus pexus sp. n., holotype, male. A, pereopod 5; B, pereopod 6; C, pereopod 7; D, uropod 1; E, uropod 2; F, pleopod 1; G, uropod 3; H-J, dactyli of peroepods 5, 6 and 7; K, telson.

Telson deeply cleft (Fig. 3K), left lobe bearing 1 distal spine, right lobe bearing 2 distal spines, both with some facial setae.

Description of female. Body 9.2 mm in length, ovigerous, with 28 eggs.

Gnathopod 1 (Fig. 4F): propodus ovate, bearing long and short setae on palmar margin, 7 spines on posterior margin associated with long setae; dactylus bearing 1 seta on outer margin.

Gnathopod 2 (Fig. 4G): propodus subrectangular, palm truncate, bearing 2 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner, with 5 groups of long setae on posterior margin and 6 groups of long setae on medial surface.

Pereopods 3 and 4 with long straight setae on posterior margin (Figs 4A, B). Merus and carpus of pereopods 5-7 (Figs 4C-E) with 2-3 groups of spines accompanied by long setae on anterior and posterior margins.

Uropod 3 (Fig. 1N): similar to that of male, inner ramus 75% of length of article 1 of outer ramus, bearing 1 marginal spine and 2 distal spines; outer ramus bearing 3 pairs of spines on outer margin; inner margin of outer ramus and both margins of inner ramus with plumose setae, while outer margin of outer ramus with simple setae.

Telson deeply cleft (Fig. 4H), each lobe bearing 2-3 distal spines and some facial setae.

Oostegites on gnathopod 2 to pereopod 5 (Fig. 4I), progressively smaller, fringed with long marginal setae.

Variation. Epimeral plate 1 bearing one spine or no spine on anteroventral corner. Each lobe of telson with 1-3 distal spines and variable setae.

Remarks. *Gammarus pexus* sp. n. is readily distinguishable from its congeners by the setose antenna 2 and outer margin of outer ramus of uropod 3 with simple setae. *G. pexus* is similar to *G. pulex* (Linnaeus, 1758) (data based on Karaman & Pinkster, 1977) in the flagellum of antenna 2 which is densely set with brush-like setae and the ratio of inner and outer ramus being about 75 : 100. *G. pexus* differs from *G. pulex* (*G. pulex* character states in parentheses) by (1) slender body, 9-11 mm in length (stout, 15-23 mm); (2) peduncular articles 4 and 5 densely set with groups of long setae and calceoli absent (with tufts of short setae and calceoli present); (3) anterior margins of merus and carpus of pereopods 5-7 bearing short setae (without setae); (4) outer margin of outer ramus only with simple setae (densely set with plumose setae).

G. pexus sp. n. is also similar to *G. nipponensis* Ueno, 1940 in (1) peduncular articles 4 and 5 and flagellum of antenna 2 densely set with setae, and calceoli absent; (2) anterior margins of merus and carpus of pereopods 5-7 with short setae; (3) the ratio of inner and outer ramus being about 75 : 100, and outer margin of outer ramus with simple setae. *G. pexus* can be distinguished from *G. nipponensis* (character states in parentheses) by (1) eyes relatively large, reniform (small, subrounded); (2) terminal article of outer ramus of uropod 3 about as long as adjacent spines, 8% of length of article 1 (distinctly shorter than adjacent spines, less than 5% of lengths of article 1); (3) pereopod 3 densely with long weakly curled setae on posterior margin (with less straight setae); (4) urosomites with short setae (relatively long setae).

Distribution. The new species is only known from the outfall of the underground river in Benxi Water Cave. The water temperature is 6-10? throughout the year and PH is 6.

FIG. 4

Gammarus pexus sp. n., allotype, female. A, pereopod 3; B, pereopod 4; C, pereopod 5; D, pereopod 6; E, pereopod 7; F, propodus of gnathopod 1; G, propodus of gnathopod 2; H, telson; I, oostegite of gnathopod 2.

Gammarus stalagmiticus sp. n. Figs 5-8

Material. Holotype, male (IZCAS-I-A0089), outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003. Paratypes: 40 males, 8 females and 8 juveniles (IZCAS), 10 males and 7 females (MHNG), same data as for the holotype.

Other material: 271 males, 95 females (35 ovigerous) and 95 juveniles (IZCAS), a small branch of Taizi River that connected to outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003.

Etymology. The specific name is derived from the biotope of the holotype, Benxi Water Cave, where the well developed stalactites and stalagmites on the roof and walls take on various shapes and forms.

Diagnosis. Accessory flagellum of antenna 1 with 5-7 articles. Peduncular articles 4 and 5 of antenna 2 poorly with long setae, flagellum with short setae, calceoli present. Pereopods 5-7 almost without setae on anterior margin. Uropod 3 densely set with plumose and simple setae. Telson with dorsolateral spine.

Description of male. Body 16.2 mm in length. Eyes reniform, medium in size (Fig. 5A).

Antenna 1 (Fig. 5B): peduncular articles 1-3 in length ratio 1 : 0.67 : 0.38, bearing some setae on posterior margin; flagellum with 41 articles, most of which with aesthetascs; accessory flagellum with 5-7 articles.

Antenna 2 (Fig. 5C): peduncular article 4 about as long as article 5, bearing 3-4 groups of short setae along anterior margin, 2-4 groups of short setae along posterior margin and 3-4 groups of short setae on medial surface; flagellum with 16 articles, bearing short setae, calceoli present.

Upper lip convex (Fig. 5D), with minute setae.

Mandibles (Figs 5E-G): left incisor with 5 teeth; lacinia mobilis with 4 teeth; article 2 of palp bearing 14 long setae on inner margin, article 3 reaching 70% of length of article 2, bearing 7 A-setae on outer surface, 6 B-setae on inner surface, a row of short plumose D-setae and 6 E-setae. Right mandible incisor with 4 teeth; lacinia mobilis bifurcate, with small crenations; article 3 of palp with two groups of A-setae and two groups of B-setae.

Lower lip (Fig. 5H): inner lobe absent.

Maxilla 1 (Figs 5I-K): asymmetrical, inner plate bearing 15 plumose setae on inner margin and many setules on medial surface; outer plate bearing 11 serrated spines apically and some setules medially; article 2 of left palp with 8 spines accompanied by 4 setae; article 2 of right palp with 6 blunt spines accompanied by 1 seta.

Maxilla 2 (Fig. 5L): inner plate bearing a diagonal row of 14 plumose setae on inner margin, several long apical plumose setae and some setules on outer margin; outer plate bearing long apical setae and some setules on outer margin.

Maxilliped (Figs 5M, N): inner plate bearing 1 subapical spine, 3 apical spines and a row of plumose setae on medial and apical margins; outer plate bearing a row of 12-15 blade spines and 5 apical pectinate setae; palp with 4 articles, article 4 claw-formed, bearing 1 seta on outer margin and 5 setae on inner margin.

Coxal plates: coxal plate 1 weakly dilated distally (Fig. 6A), bearing 1 setule on anterior corner and 1 setule on posterior corner; coxal plates 2 and 3 subrectangular (Figs 6B, 7A), bearing 2 setules on anterior corner and 1 setule on posterior corner;

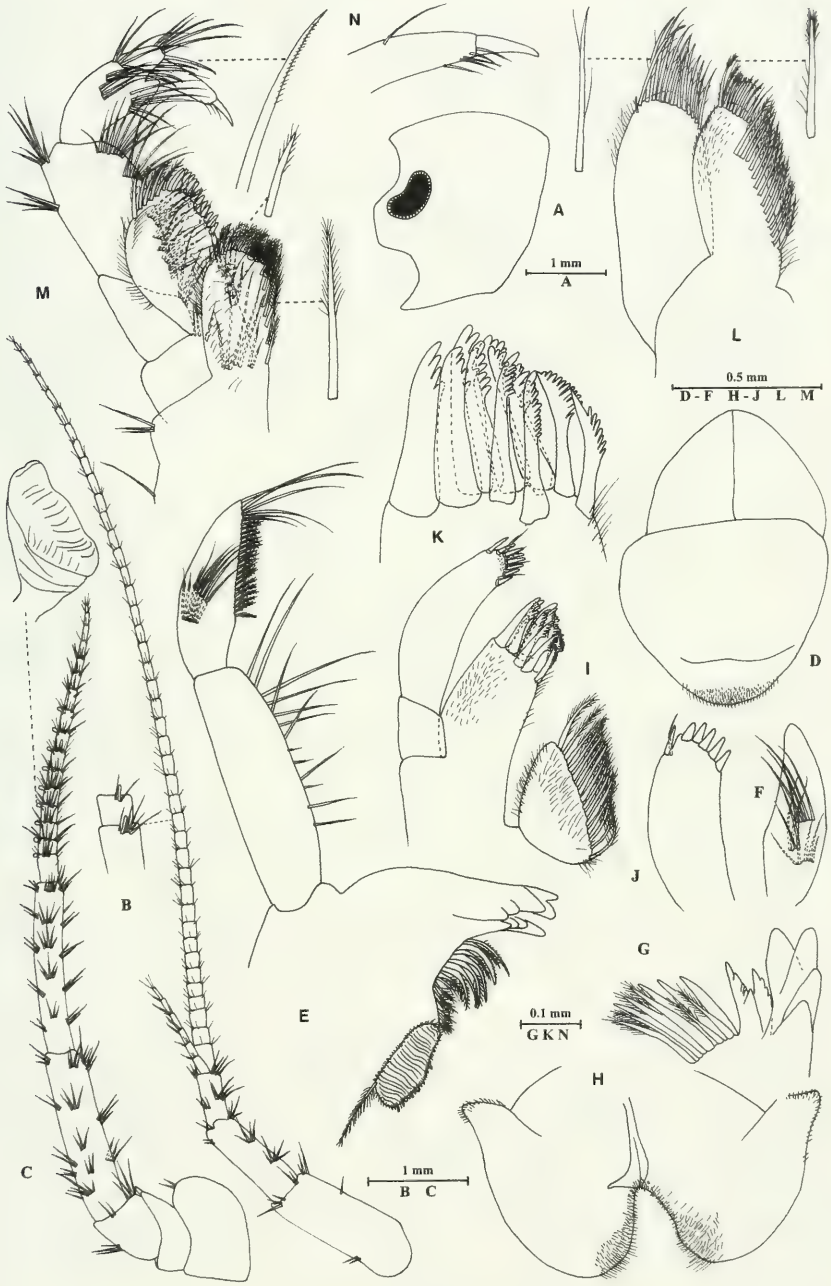


FIG. 5

Gammarus stalagmiticus sp. n., holotype, male. A, head; B, antenna 1; C, antenna 2; D, upper lip; E, left mandible; F, palp of right mandible; G, incisor of right mandible; H, lower lip; I, left maxilla 1; J, palp of right maxilla 1; K, outer plate of left maxilla 1; L, maxilla 2; M, maxilliped; N, palp article 4 of maxilliped.

coxal plate 4 with excavation on posterior margin (Fig. 7B), bearing 2 setules on anterior corner and 4 setules on posterior margin; coxal plate 5-7 shallow (Figs 7C-E), with 2-3 setules on posterior margin.

Coxal gills (Figs 6B, 7A-E): coxal gills of gnathopod 2 and pereopods 3-7 progressively smaller.

Gnathopod 1 (Figs 6A, C): basis with long naked setae along anteroproximal and posterior margins, and several serrated setae distally; carpus reaching 70% of length of propodus, bearing 2 groups of setae on anterior margin and a row of long setae on posterior margin; propodus pyriform, palm strongly oblique, bearing 1 medial spine, 11 spines on posterior margin and 8 spines on medial surface, associated with groups of long medial setae and long marginal setae; dactylus with 1 seta on outer margin.

Gnathopod 2 (Figs 6B, D): larger than gnathopod 1, basis similar to that of gnathopod 1; carpus reaching 82% length of propodus, with parallel margin; propodus subrectangular, palm tranverse, bearing 1 medial spine, 3 spines on lateral posterodistal corner and 3 spines on medial posterodistal corner; dactylus with 1 seta on outer margin.

Pereopod 3 (Figs 7A, F): basis with a pair of long setae on anterior margin and about 25 long setae on posterior margin; merus to propodus with long weakly curled setae on posterior margin, propodus accompanied by 5 single short spines on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 4 (Figs 7B, G): basis with 1 long seta on anterior margin and many long setae on posterior margin; merus to propodus with long straight setae on posterior margin, propodus with 5 single short spines on posterior margin.

Pereopod 5 (Figs 7C, H): posterior margin of basis nearly straight, bearing a row of 10 setules, anterior margin bearing 1 long seta and 5 single short spines; merus to propodus with 2-4 groups of spines accompanied by short setae, setae not longer than spines; dactylus with 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

Pereopod 6 (Figs 7D, I): longer than pereopod 5, basis elongate, weakly attenuated distally on posterior margin, bearing a row of 15 setules, anterior margin with 6 single short spines; merus to propodus bearing 3-5 groups of spines, almost without setae.

Pereopod 7 (Figs 7E, J): basis processed medially on posterior margin, bearing a row of 16 setules, anterior margin bearing a group of 4 long setae proximally and 6 single short spines, inner surface with 1 short spine accompanied by 2 setules on posterodistal corner; the armature of merus to propodus similar to that of pereopod 6.

Epimeral plates (Figs 8A-C): each posterior margin bearing 3-5 setules; plate 1 ventrally horizontal, bearing 10 setae on anteroventral corner; plates 2 and 3 with blunt posterodistal corner, bearing 2 and 3 spines on ventral margins in plate 2 and 3, respectively.

Pleopods 1-3 subequal in length (Fig. 8E), peduncles bearing 2 retinacula accompanied by 3 setae on anterodistal corner, and a few long setae on medial surface; inner and outer rami with about 20-30 articles, both fringed with plumose setae.

Urosomites dorsally flat (Fig. 8D), urosomites 1 and 2 bearing 4 groups of spines accompanied by setae on posterodorsal margins; urosomite 3 bearing 2 pairs of

FIG. 6

Gammarus stalagmiticus sp. n., holotype, male. A, gnathopod 1; B, gnathopod 2; C, propodus of gnathopod 1; D, propodus of gnathopod 2.

FIG. 7

Gammarus stalagmiticus sp. n., holotype, male. A, pereopod 3; B, pereopod 4; C, pereopod 5; D, pereopod 6; E, pereopod 7; F, dactylus of pereopod 3; G, dactylus of pereopod 4; H, dactylus of pereopod 5; I dactylus of pereopod 6; J, dactylus of pereopod 7; K: telson.

setae medially, 2 spines accompanied by 4 setae in the left and 1 single spine accompanied by 2 setae in the right.

Uropod 1 (Fig. 8F): outer ramus 58% and inner ramus 67% of length of peduncle, peduncle bearing 1 dorsolateral spine, 3 spines on outer margin, 2 spines on inner margin, 2 spines on laterodistal corner and 1 spine on medial distal corner; inner ramus with 3 spines on inner margin; outer ramus with 2 spines on outer margin and 3 spines on inner margin.

Uropod 2 (Fig. 8G): outer ramus 60% and inner ramus 80% of length of peduncle, peduncle bearing marginal spines; inner ramus with 1 spine on outer margin and 3 spines on inner margin; outer ramus with 2 spines on inner margin and 2 spines on outer margin.

Uropod 3 (Fig. 8H): peduncle bearing 1 spine on lateral margin, 3 long setae on medial margin, 3 spines on mid-ventral margin, 3 spines on medial ventral margin and 2 spines apico-medially; inner ramus about 80% of length of article 1 of outer ramus, bearing 3 spines on inner margin and a pair of distal spines; article 1 of outer ramus with 1-2-2 spines on outer margin and two pairs of distal spines, article 2 about 5% of length of article 1; inner and outer margins of both rami densely armed with plumose and simple setae.

Telson deeply cleft (Fig. 7K), each lobe bearing 1 basolateral spine, 2-3 distal spines and some facial setae.

Description of female. Body 14.0 mm in length, ovigerous, with 25 eggs.

Gnathopod 1 (Fig. 8J): propodus ovate, palm not as oblique as that of male, bearing long and short setae on palmar margin, 12 spines on posterior margin associated with long setae; dactylus with 1 seta on outer margin.

Gnathopod 2 (Fig. 8K): propodus subrectangular, palm truncate, bearing 3 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner, with groups of serrate setae on posterior margin, 9 groups of long setae on medial surface.

Uropod 3 (Figs 8L, M): inner ramus reaching 83% of length of article 1 of outer ramus, bearing 2 spines on inner margin and 1 distal spine; outer ramus bearing 2-1-2 spines on outer margin; both rami armed densely armed with plumose and simple setae.

Oostegites present on gnathopod 2 (Fig. 8I) and pereopods 3-5, second oostegite broad, bearing long marginal setae.

Variation. Accessory flagellum of antenna 1 with 5-7 articles, but never with less than 4 articles. Epimeral plates 2 and 3 bearing 2-4 short spines on ventral margins. The ratio of inner ramus and article 1 of outer ramus varies, from 70-90%. Each lobe of telson bearing 2-3 spines accompanied by various setae.

Remarks. *Gammarus stalagmiticus* sp. n. is similar to *G. nekkensis* Uchida, 1935 (data based on Karaman, 1989) in (1) accessory flagellum of antenna 1 with 5-7 articles, not less than 4 articles; (2) peduncular articles of antenna 2 with short setae, and calceoli present; (3) pereopod 3 densely set with long weakly curled setae. *G. stalagmiticus* differs from *G. nekkensis* (character states in parentheses) by (1) eyes reniform, relatively large (small, semicircular); (2) inner ramus reaching 80% of length of article 1 of outer ramus of uropod 3 (50%); (3) outer margin of outer ramus densely

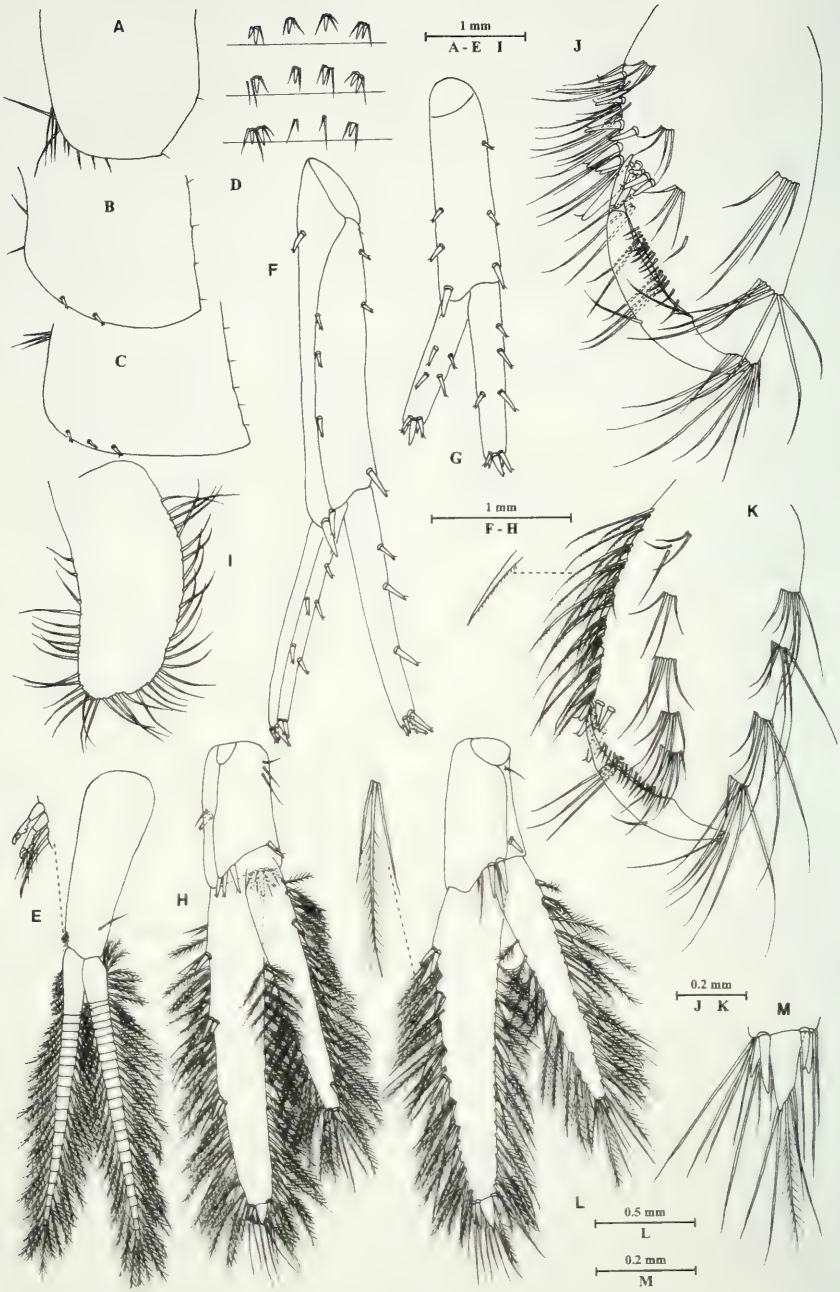


FIG. 8

Gammarus stalagmiticus sp. n., holotype, male: A-H; allotype, female: I-M. A, epimeral plate 1; B, epimeral plate 2; C, epimeral plate 3; D, urosomites; E, pleopod 1; F, uropod 1; G, uropod 2; H, uropod 3; I, oostegite of gnathopod 2; J, propodus of gnathopod 1; K, propodus of gnathopod 2; L, uropod 3; M, terminal article of uropod 3.

armed with plumose and simple setae (with numerous long simple setae); (4) the uropods 1 and 2 reaching half of outer ramus of uropod 3 (reaching the end of peduncle of uropod 3).

G. stalagmiticus sp. n. is also similar to *G. decorosus* Meng *et al.*, 2003 in (1) pereopods 3 and 4 with long setae on posterior margins; (2) epimeral plates 2 and 3 with blunt posterodistal corners; (3) inner ramus reaching more than 70% of length of outer ramus, and both rami armed with plumose and simple setae. *G. stalagmiticus* is distinguished from *G. decorosus* (character states in parentheses) in (1) accessory flagellum of antenna 1 with 5-7 articles (4 articles); (2) antenna 2 calceoli present (absent); (3) telson with a few short distal and facial setae (many long distal and facial setae).

G. pexus sp. n. and *G. stalagmiticus* sp. n. apparently are able to coexist in the same environment. *G. pexus* is distinguished from *G. stalagmiticus* (character states in parentheses) in (1) body slender, 8-12 mm in length (stout 15-18 mm); (2) accessory flagellum of antenna 1 with 4 articles (5-7 articles, no less than 4 articles); (3) peduncular articles 4 and 5 armed with groups of long setae, flagellum with brush-like setae, and calceoli absent (peduncular articles with short setae, flagellum without brush-like setae, and calceoli present); (4) outer margin of outer ramus only with simple setae (densely with plumose and simple setae).

Distribution. The new species can be found in the outfall of the underground river in Benxi Water Cave and a small branch of Taizi River that connected to this outfall. Distribution in Taizi River, Liaoning Province is possible.

ACKNOWLEDGEMENTS

The authors would like to express their thanks to Dr Dirk Platvoet (University of Amsterdam, the Netherlands) for providing advice in the course of this study and for critically reading the manuscript.

This study was supported by the National Natural Sciences Foundation of China (NSFC-30270183, 30370263, 30310464, 30470213, 30499341), by the National Science Fund for Fostering Talents in Basic Research (NSFC-J0030092), by the Beijing Natural Science Foundation (6052017) and partly also by the Kadoorie Farm and Botanic Garden, Hong Kong Special Administrative Region, China.

REFERENCES

Barnard, J. L. & Barnard, C. M. 1983. Freshwater Amphipoda of the World I, II. *Hayfield Associates, Mt. Vernon, Virgina*, 830 pp.

Holsinger, J. R. 1967. Systematics, speciation, and distribution of the subterranean amphipod genus *Stygonectes* (Gammaridae). *United States National Museum Bulletin* 259: 1-176.

Hou Z. E. & Li, S. Q. 2002a. A new species of the genus *Gammarus* from Yunnan, China (Crustacea: Amphipoda: Gammaridae). *Acta Zootaxonomica Sinica* 27(1): 65-73.

Hou, Z. E. & Li, S. Q. 2002b. Descriptions of two new species of Genus *Gammarus* (Crustacea: Amphipoda: Gammaridae) from Yunnan, China. *Raffles Bulletin of Zoology* 50(1): 37-52.

Hou, Z. E. & Li, S. Q. 2002c. Freshwater amphipod crustaceanas (Gammaridae) from Chishui and its adjacent regions, China. *Raffles Bulletin of Zoology* 50(2): 407-418.

Hou, Z. E. & Li, S. Q. 2003a. *Gammarus glabratus*, a new cave Amphipoda from Guizhou, China (Amphipoda: Gammaridae). *Crustaceana* 76(3): 433-442.

HOU, Z. E. & LI, S. Q. 2003b. Two new freshwater gammarids (Crustacea: Amphipoda: Gammaridae) from Lake Lugu, China. *Revue Suisse de Zoology* 110(3): 547-564.

HOU, Z. E. & LI, S. Q. 2003c. *Gammarus electrus*, a new species of Amphipoda from Beijing, China (Crustacea: Amphipoda: Gammaridae). *Acta Zootaxonomic Sinica* 28(2): 241-248.

HOU, Z. E. & LI, S. Q. 2003d. A new species of blind Amphipoda from China (Crustacea: Amphipoda). *Acta Zootaxonomic Sinica* 28(3): 448-454.

HOU, Z. E. & LI, S. Q. 2003e. A new cave amphipod of the genus *Gammarus* from Yunnan, China. *Crustaceana* 76(8): 917-925.

HOU, Z. E., LI, S. Q. & KOENEMANN, S. 2002. *Gammarus emeiensis*, a new species of amphipod crustacean from Sichuan Province, China. *Beaufortia* 52: 37-43.

HOU, Z. E., LI, S. Q. & MORINO, H. 2002. Three new species of the genus *Gammarus* (Crustacea: Amphipoda: Gammaridae) from Yunnan, China. *Zoological Sciences* 19: 939-960.

HOU, Z. E., LI, S. Q. & ZHENG, M. Q. 2002. A new species of freshwater Amphipoda from China (Crustacea: Amphipoda: Gammaridae). *Acta Zootaxonomic Sinica* 27(3): 456-465.

KARAMAN, G. S. 1989. One freshwater *Gammarus* species (Gammaridea, Fam. Gammaridae) from China (Contribution to the knowledge of the Amphipoda 189). *Poljoprivreda I Sumarstvo* 35(1-2): 19-36.

KARAMAN, G. S. & PINKSTER, S. 1977. Freshwater *Gammarus* species from Europe, North Africa and adjacent regions of Asia (Crustacea-Amphipoda) Part I. *Gammarus pulex*-group and related species. *Bijdragen tot de Dierkunde* 47(1): 1-97.

KARAMAN, G. S. & PINKSTER, S. 1987. Freshwater *Gammarus* species from Europe, North Africa and adjacent regions of Asia (Crustacea-Amphipoda). Part III. *Gammarus balcanicus*-group and related species. *Bijdragen tot de Dierkunde* 57(2): 207-260.

MENG, K., HOU, Z. E. & LI, S. Q. 2003. A new species from Xinjiang, China (Crustacea: Amphipoda: Gammaridae). *Acta Zootaxonomic Sinica* 28(4): 621-628.

MORINO, H. & WHITMAN, N. 1995. A new species of the genus *Gammarus* (Crustacea: Amphipoda) from fresh waters of Russian Far East. *Publications of Itako Hydrobiological Station* 8: 27-36.

STOCK, J. H., MIRZAJANI, A. R., VONK, R., NADERI, S. & KIABI, B. H. 1998. Limnic and brackish water Amphipoda (Crustacea) from Iran. *Beaufortia* 48: 173-234.

UCHIDA, H. 1935. Crustacea of Jehol freshwater Amphipoda. *Report of the first scientific expedition to Manchoukuo* section 5, division 1, part 2, article 9: 1-6.

UENO, M. 1940. Some freshwater Amphipoda from Manchoukuo, Corea and Japan. *Bulletin of the Biogeographical Society of Japan* 10: 63-85.

REVUE SUISSE DE ZOOLOGIE 112 (1): 65-82; mars 2005

New species of *Coleophora* (Lepidoptera) from Katanga, Central Africa*

Giorgio BALDIZZONE[1] & Hugo VAN DER WOLF[2]
[1] Via Manzoni, 24, I-14100 Asti, Italy.
E-mail: giorgiobaldizzone@tin.it
[2] Wermersland 22, NL 5673 PT Nuenen, The Netherlands.
E-mail: h.vanderwolf@onsnet.nu

New species of *Coleophora* (Lepidoptera) from Katanga, Central Africa. - Eight new species of *Coleophora* (Lepidoptera) are described from the province of Katanga, Democratic Republic of Congo: *Coleophora frivolella* sp. n., *C. bantuella* sp. n., *C. terebrans* sp. n., *C. discopunctata* sp. n., *C. katangica* sp. n., *C. romieuxi* sp. n., *C. tetrodonta* sp. n. and *C. fragilella* sp. n.

Keywords: Moths - new species - *Coleophora* - Democratic Republic of Congo - Katanga.

INTRODUCTION

The Coleophoridae moths in Central Africa are poorly known. Four species were described or reported from the Congo by Meyrick: *Coleophora crossanthes* Meyrick, 1938, *C. ptilocharis* Meyrick, 1938, *C. epiphanopa* Meyrick, 1937 and *C. scaleuta* Meyrick, 1911. We will revise these in our forthcoming revision of the Afrotropical Coleophoridae.

Among material kept in the Museum of Natural History, Geneva, 40 specimens of *Coleophora* were found, collected by J. Romieux. Dr Jean Romieux (1893-1951), a geologist by profession, worked as a prospector in many parts of the world. As a voluntary worker for the Geneva Museum he collected many minerals and ethnological objects, which form part of the Museum collection. He was also a keen entomologist. The small moths, described in this paper, were collected in 1930-31 when Romieux worked for the Tshinkolobwe uranium mine in what was then called "Haut Katanga", "Congo belge". He died suddenly in 1951, in Marseille, on his way home from the Far East. His Lepidoptera collection is deposited in the Geneva Museum.

Of the 40 Coleophoridae specimens in this collection eight belong to *Coleophora scaleuta* Meyrick, 1911, a widespread species in the Afrotropical region. Of two male specimens, probably undescribed species, the genitalia were too badly damaged to enable description. The remainder of the specimens belong to eight new species, which are described below.

---

* Contribution to the knowledge of Coleophoridae CVIII.

Manuscript accepted 17.08.2004

ABBREVIATIONS

BLDZ coll. Giorgio Baldizzone, Asti, Italy.
MHNG coll. Muséum d'histoire naturelle, Genève, Suisse. (Museum of Natural History, Geneva, Switzerland).
WF coll. Hugo van der Wolf, Nuenen, The Netherlands.

SYSTEMATIC TREATMENT

We have tried to follow Toll's group system for the Coleophoridae (Toll, 1953, 1962) as far as possible. However, many Afrotropical species cannot be placed according to that system. In our forthcoming revision of the Afrotropical Coleophoridae we aim to present a systematic review of the species of this fauna.

Coleophora frivolella sp. n. Figs 7-10

Material examined: Holotype ♂ (GP Bldz 13408) "Ht Katanga, Tshinkolobwe 23.12.[19]30, J. Romieux" , coll. MHNG. Paratype: 1 ex. without abdomen, ibidem, 19.3.[19]31, coll. MHNG.

Diagnosis: The creamy white forewings slightly resemble those of Toll's 8th group. The male genitalia, however, resemble those of *Coleophora byrsostola* (Meyrick, 1931), a species described from India (Baldizzone & van der Wolf, 2003).

Description: Adult (Fig 10). Wingspan 8 mm. Head white. Labial palps internally white, externally almost totally light ochreous; second segment about as long as eye diameter and half length of third segment. Antennae without basal scale tuft; flagellum ringed white and rather light brown, with little contrast between the two colours. Thorax creamy white. Forewings uniformly creamy white, with very light grey fringes. Hindwings and fringes rather light grey (as fringes of forewings). Abdomen dirty white.

Male genitalia (Figs 7-8): Spinose part of gnathos globular. Tegumen medially constricted, with two widened arms with outer right angle. Transtilla slender, long, medially joined. Valvula absent. Cucullus short, stout, with broad base. Sacculus broad, on lateral margin ending in a rounded process. Phallotheca short, helmet-shaped, ending in a beak-shaped point. Vesica short, transparent. No cornuti.

Structure of abdominal supports (Fig 9): No posterior lateral struts; transverse strut slender, slightly curved. Tergal disks about twice longer than wide, with many short conical spines.

Female genitalia: Not known.

Distribution: This small species is only known from the type locality.

Biology: Not known. Specimens were collected in December and March.

Etymology: Latin frivolus: insignificant, tiny.

Coleophora bantuella sp. n. Figs 1, 12-15

Material examined: Holotype ♂ (GP Bldz 13398) "Ht Katanga, Tshinkolobwe 25.12.[19]30, J. Romieux", coll. MHNG. Paratypes: 1 ♂ (GP Bldz 13411) ibidem, 17.12.[19]30; 1 ♂ (GP Bldz 13399) ibidem, 1.3.[19]31; 1 ♂, ibidem, 21.1.[19]31; 1 ♂, 26.1.[1931]. Paratypes in coll. MHNG, BLDZ and WF.

Diagnosis: This light-coloured species belongs to a group that does not occur in the palearctic region and cannot be placed in any group of Toll's system. However,

several related sp. n. from the afrotropical region await description. For the moment, the only species which resembles *C. bantuella* is *Coleophora crossanthes* Meyrick, 1938, a species described from the Congo, which has a much larger sacculus, a longer phallotheca and smaller and shorter cornuti than *C. bantuella*.

Description: Adult (Fig 1). Wingspan 13-14 mm. Head creamy white, dorsally tinged ochreous. Labial palps internally creamy white, externally dark brown; length second segment about half eye diameter and length third segment. Antennae without basal scale tuft; first segment dorsally white, ventrally brown; flagellum dirty white. Thorax creamy white. Forewings creamy white, on dorsal margin lighter at base, tinged ochreous towards apex; costal fringes ochreous, dorsal fringes rather light grey-brown. Hindwings light grey with very light grey-brown fringes. Abdomen creamy white.

Male genitalia (Figs 12-14): Spinose part of gnathos globular. Tegumen medially constricted, with slightly widened arms. Transtilla slender, medially joined. Valvula small, elongated, strongly chitinised. Cucullus long, narrow, with rounded apex. Sacculus with strongly chitinized straight lateral margin, a rounded ventro-caudal angle and a square dorso-caudal angle. Phallotheca a short, compact single weakly sclerotized structure ; cornuti forming a long and wide chain of spines.

Structure of abdominal supports (Fig 15): No posterior lateral struts; transverse strut slender, slightly curved and medially thickened. Tergal disks about 4-5 times longer than wide, with very small conical spines.

Female genitalia: Not known.

Distribution: The species is only known from the type locality.

Biology: Not known. The specimens were collected in December, January and March.

Etymology: The species is named after the Bantus, the indigenous inhabitants of the region.

Coleophora terebrans sp. n. Figs 2, 16-19

Material examined: Holotype ♂ (GP Bldz 13401) "Ht Katanga, Tshinkolobwe 10.6. [19]31, J. Romieux" , coll. MHNG. Paratypes: 1 ♂ (GP Bldz 13412) idem; 1 ♂ (GP Bldz 13418) ibidem, 4.11.[19]30; 2 ♂♂ (GP Bldz 13393, 13396) ibidem, 5.11.[19]30; 1 ♂ (GP Bldz 13400) ibidem, 15.2.[19]31. Paratypes in coll. MHNG, BLDZ and WF.

Diagnosis: The species cannot be placed in any group of Toll's system. It resembles *Coleophora fraternella* Toll & Amsel, 1967, described from Afghanistan, and in the afrotropical fauna *Coleophora halmodes* Meyrick, 1911, differing in a more pointed cucullus and a phallotheca with fewer teeth.

Description: Adult (Fig 2). Wingspan 8-10 mm. Head light brown, dorsally tinged dark brown. Labial palps internally light brown, externally almost totally dark brown, but for the first segment, which is dirty white; length of second segment about half eye diameter and 1,5 times longer than third. Antennae: first segment without basal scale tuft, dorsally light brown, ventrally dark brown; flagellum ringed dirty white and light brown. Forewings with light brown ground colour, with hazel streaks along nerves; costal fringes light brown, dorsal fringes light grey-brown. Hindwings and fringes light grey-brown.

Male genitalia (Figs 16-18): Spinose part of gnathos globular. Tegumen rather short. Transtilla short, slender, medially joined. Valvula small, subtriangular. Cucullus very short, rounded at apex. Sacculus with curved margin, in dorso-caudal angle

ending in subtriangular process. Phallotheca with two flattened rods, distally with many short teeth. No cornuti.

Structure of abdominal supports (Fig 19): No posterior lateral struts. Transverse strut slender, straight. Tergal disks about 2,5 times longer than wide, with small conical spines.

Female genitalia: Not known.

Distribution: The species is only known from the type locality.

Biology: Not known. The specimens were collected in November, February and June.

Etymology: The name (Latin *terebrans*= drill) reflects the shape of the phallotheca.

Coleophora discopunctata sp. n. Figs 3, 20-24

Material examined: Holotype ♂ (GP Bldz 13397) "Ht Katanga, Tshinkolobwe 11.3.[19]31, J. Romieux" , coll. MHNG. Paratypes: 2 ♂♂ (GP Bldz 13414), ibidem, 9.3.[19]31; 1 ♂, ibidem, 29.3.[19]31. Paratypes in coll. MHNG and BLDZ.

Diagnosis: The species, with creamy white ochreous-tinged forewings with a reddish hue and a brown speck in the cell, does not resemble any species from the palearctic or afrotropical region.

Description: Adult (Fig 3). Wingspan 14-15 mm. Head ivory white, dorsally tinged ochreous. Labial palps internally creamy white, externally almost totally dark brown, but for the first segment and the ventral margin of the second, which are creamy white; length second segment about twice eye diameter and 1,5 times longer than third. Antennae without basal scale tuft, uniformly light ochreous; flagellum about 1/8th longer than wing. Thorax light ochreous. Forewings creamy white, tinged ochreous, darker towards apex and costal half, with reddish hue; a small brown oval speck in cell; fringes creamy white, costal ones darker. Hindwings brown, with light brown fringes. Abdomen light ochreous.

Male genitalia (Figs 20-23): Spinose part of gnathos small, globular. Tegumen medially constricted, with widened arms. Transtilla finger-like. Valvula small, narrow, with beak-like apex. Cucullus long, curved downwards, with rounded apex. Sacculus with strongly chitinized ventral margin, ending in an oblique point in ventral angle. Phallotheca a single rod, folded into a long canal, widening slightly towards apex, which is covered in small teeth. Cornuti 2 to 4 bundles of spines.

Structure of abdominal supports (Fig 24): No posterior lateral struts; proximal margin of transverse strut slender, slightly sinuous; distal margin gradually widening, medially excavated. Tergal disks about 4 times longer than wide, with small conical spines.

Female genitalia: Not known.

Distribution: The species is only known from the type locality.

Biology: Not known. The specimens were collected in March.

Etymology: The name refers to the brown speck in the cell.

Coleophora katangica sp. n. Figs 4, 25-30

Material examined: Holotype ♂ (GP Bldz 13403) "Ht Katanga, Tshituru éclosion 12.5.[19]30, J. Romieux", coll. MHNG. Paratype: 1 ♂ (GP Bldz 13413) ibidem, 2.5.[19]30, coll. MHNG.

Diagnosis: The adult resembles *Coleophora flavipennella* Dup., but the genitalia show affinity to the 30th group of Toll's system and resemble *Coleophora pandionella* Baldizzone, 1988, a species described from eastern Siberia.

Description: Adult (Fig 4). Wingspan 10 mm. Head laterally dirty white, dorsally ochreous. Labial palps internally creamy white, externally almost totally hazel, lower margin of second segment dirty white; second segment as long as eye diameter and twice length of third. Antennae: first segment dorsally creamy white, ventrally dark ochreous, with tuft of short scales. Thorax light ochreous. Forewings ochreous, darker towards apex, and lighter, creamy white, at basal half of costa; fringes light ochreous. Hindwings light brown with light grey-brown fringes. Abdomen light ochreous.

Male genitalia (Figs 25-29): Spinose part of gnathos small, oval. Tegumen medially constricted, with widened arms. Transtilla long, crooked, with beak-like apex. Valvula more or less rectangular with sclerotized outer margin. Cucullus straight with rounded apex. Sacculus narrow, long, characterized in ventral angle by a long subtriangular point, in dorsal angle by a small tooth. Phallotheca with two rods: one long and stout, more sclerotized at base; the second, separating from the first half-way, more slender and chitinized, ending in a tooth at apex. Cornuti one or two long spines.

Structure of abdominal supports (Fig 30): No posterior lateral struts. Proximal margin of transverse strut medially thickened, slightly sinuous; distal margin slender. Tergal disks 1,5 times longer than wide, covered with small specks and triangular spines.

Female genitalia: Not known.

Distribution: The species is only known from the type locality.

Biology: The paratype was collected in March; the holotype was bred in May; the larval case and information on the foodplant are absent.

Etymology: The name of the species refers to the province of Katanga in the Democratic Republic of Congo.

Coleophora romieuxi sp. n. Figs 5, 31-35

Material examined: Holotype ♂ (GP Bldz 13410) "Ht Katanga, Tshinkolobwe 13.3.[19]31, J. Romieux", coll. MHNG. Paratypes: 1 ♂ (GP Bldz 13415) idem; 1 ♂ ibidem, 4.3.[19]31; 1 ♂ (GP Bldz 13395) ibidem, 11.3.[31]. Paratypes in coll. MHNG and BLDZ.

Diagnosis: The species, with dirty white forewings streaked with hazel lines, does not resemble any known afrotropical species. The male genitalia (a phallotheca with two long rods) point to a position in the 30th group of Toll's system.

Description: Adult (Fig 5). Wingspan 10-11 mm. Head laterally dirty white, dorsally hazel. Labial palps internally dirty white variegated brown, externally dirty white, brown on dorsal half of second segment and ventral part of third; second segment about as long as eye diameter and twice length of third. Antennae without basal scale tuft; flagellum ringed dirty white and brown. Thorax dirty white variegated with hazel. Forewings ground colour dirty white, streaked with hazel lines; costal fringes dirty white, dorsal fringes light grey-brown. Hindwings brown with light grey-brown fringes. Abdomen brown.

Male genitalia (Figs 31-33): Spinose part of gnathos big, globular. Tegumen medially constricted, with widened arms. Transtilla broad, ending in anvil-shaped

apices. Valvula weakly delineated. Cucullus short, with rounded apex. Sacculus broad, ventral margin slightly sinuous, with right ventro-caudal angle, slightly sinuous; distal margin with some small teeth; an acute point in dorsal angle at cucullus base. Phallotheca with two long rods of unequal lengths: the shorter one slender, the longer one stouter, at 3/4th with chitinized bar topped by a triangular tooth; apex of rod acute, surpassing distal margin of sacculus. Cornutus a strong spine.

Structure of abdominal supports (Fig 35): No posterior lateral struts. Transverse strut with convex margins. Tergal disks 6 times longer than wide, with small conical spines.

Female genitalia: Not known.

Distribution: The species is only known from the type locality.

Biology: Not known. Adults were collected in March.

Etymology: The species is named after Dr Jean Romieux, who collected the eight species described in this paper and whose collection is kept in the Natural History Museum of Geneva.

Coleophora tetrodonta sp. n. Figs 6, 36-43

Material examined: Holotype ♂ (GP Bldz 13417) "Ht Katanga, Tshinkolobwe 13.2.[19]31, J. Romieux", coll. MHNG. Paratypes: 1 ♂ (GP Bldz 13419) ibidem, 13.12.[19]30; 1 ♀ (GP Bldz 13409) ibidem, 26.12.[19]30, in coll. MHNG.

Diagnosis: The species belongs to the 30th group of Toll's system and is not related to any afrotropical species known. The apices of the phallotheca more or less resemble those of the palearctic species *Coleophora taygeti* Baldizzone, 1983 and *C. alticolella* Zeller, 1849.

Description: Adult (Fig 6). Wingspan 9-10 mm. Head dirty white, dorsally variegated brown. Labial palps internally dirty white, third segment dorsally brown, whereas externally the second segment is dorsally brown and ventrally white; second segment about as long as eye diameter and twice length of third. Antennae without basal scale tuft, the basal segments ventrally brown; flagellum ringed dirty white and light brown. Thorax dirty white variegated with hazel. Forewings ground colour dirty white, streaked with some hazel lines; costal fringes dirty white, dorsal fringes light grey-brown. Hindwings brown with fringes light grey-brown. Abdomen light brown.

Male genitalia (Figs 36-39): Spinose part of gnathos globular. Tegumen medially constricted, with widened arms. Transtilla slender, apices divided. Valvula very small, rounded. Cucullus club-like, narrower at base, with rounded apex. Sacculus broad, with more or less straight ventral margin, ending in a ventro-caudal subtriangular process; distal margin concave, in dorso-caudal angle ending in a finger-like process reaching cucullus; a chitinous ridge topped by a subtriangular stout tooth at cucullus base. Phallotheca with two strongly chitinized rods of equal lengths slightly surpassing sacculus, each ending in a strongly chitinized cleft; cornuti two or three spines basally reunited.

Structure of abdominal supports (Fig 40, 43): No posterior lateral struts; transverse strut with convex margins. Tergal disks about 4 times longer than wide, covered with small conical spikes.

Female genitalia: (Figs 41-42): Papillae anales broken off. Apophyses posteriores about 4 times longer than anteriores. Sterigma subtrapezoid, its distal margin

medially divided along the ogival ostium bursae; colliculum big, wide, sack-like, its distal margin less chitinized, its proximal part at entrance ductus bursae inflated; two robust chitinous bands covered with very small spines issue from bottom of colliculum into first section of ductus bursae; second segment sinuous, slightly inflated and chitinized; third segment slender, transparent, gradually widening into bursa copulatrix, which is rounded, with a leaf-like signum carrying a slender spine.

Distribution: The species is only known from the type locality.

Biology: Not known. Specimens were collected in December and February.

Etymology: The name tetrodonta (Greek τετρα οδοντα = four teeth) refers to the two teeth on each of the two phallotheca rods, it is a noun in apposition (plural form).

Coleophora fragilella sp. n. Figs 11, 44-47

Material examined: Holotype ♂ (GP Bldz 13416) "Ht Katanga, Tshinkolobwe 3.4. [19]31, J. Romieux", coll. MHNG.

Diagnosis: The species belongs to the 30th group of Toll's system and is not related to any afrotropical species known. The male genitalia resemble more or less those of the palearctic species *Coleophora scabrida* Toll, 1959.

Description: Adult (Fig 11). Wingspan 8 mm. Head dirty white, dorsally light brown. Labial palps internally white, externally brown variegated darker on ventral margin; second segment about as long as eye diameter and half length of third. Antennae without basal scale tuft, basal segment ventrally dark brown; flagellum ringed dirty white and rather light brown. Thorax light grey-brown. Forewings glossy light beige; fringes concolorous. Hindwings and fringes coloured as forewings. Abdomen light grey. (The specimen is in poor condition).

Male genitalia: (Figs 44-46): Spinose part of gnathos globular. Tegumen medially constricted, with widened arms. Transtilla slender, apices divided. Valvula well-defined, rounded. Cucullus short, wide, not surpassing sacculus. Sacculus broad, with straight ventral margin ending in subtriangular ventro-caudal angle; distal margin concave, at dorso-caudal angle with long horn-like process reaching dorsal margin of cucullus. Phallotheca with two long rods, weakly sclerotized, the longer with rounded apex, with small triangular lateral tooth; the shorter more slender with chitinized apical claw. Six slender cornuti form a long row.

Structure of abdominal supports: (Fig 47): No posterior lateral struts. Transverse strut with slender convex proximal margin; distal margin thick, slightly concave.

Female genitalia: Not known.

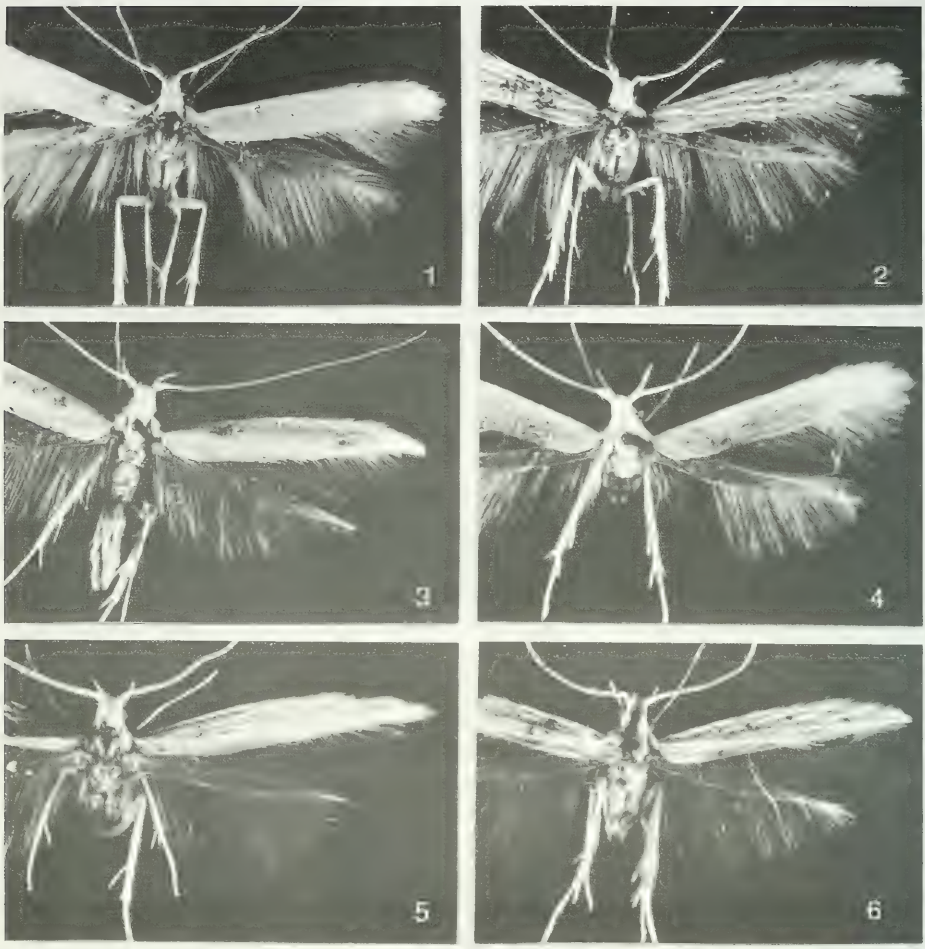
Distribution: The species is only known from the type locality.

Biology: Not known. The specimen was collected in April.

Etymology: The name fragilella (Latin *fragilis* = fragile) refers to the puny aspect of this small species.

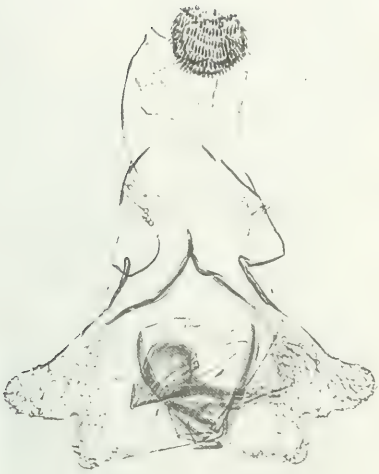
ACKNOWLEDGEMENT

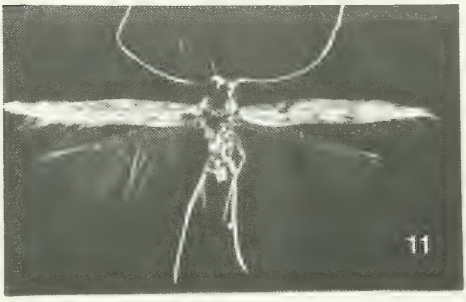
We are grateful to Bernard Landry of the Muséum d'histoire naturelle de Genève for enabling us to study the Katanga Coleophoridae in the collection in his care.



FIGS 1-6

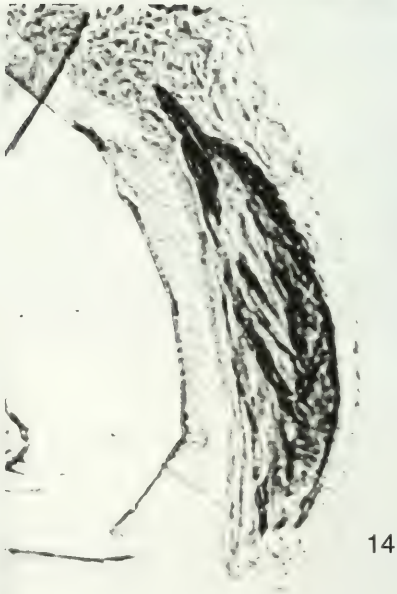
Coleophora spp., imagos. 1. *C. bantuella* sp. n. 2. *C. terebrans* sp. n. 3. *C. discopunctata* sp. n. 4. *C. katangica* sp. n. 5. *C. romieuxi* sp. n. 6. *C. tetrodonta* sp. n.





FIGS 7-11

Coleophora spp. 7. *C. frivolella* sp. n., male genitalia (GP Bldz 13408). 8. Idem, enlarged detail of male genitalia. 9. Idem, abdomen. 10. Idem, imago. 11. *C. fragilella* sp. n., imago.

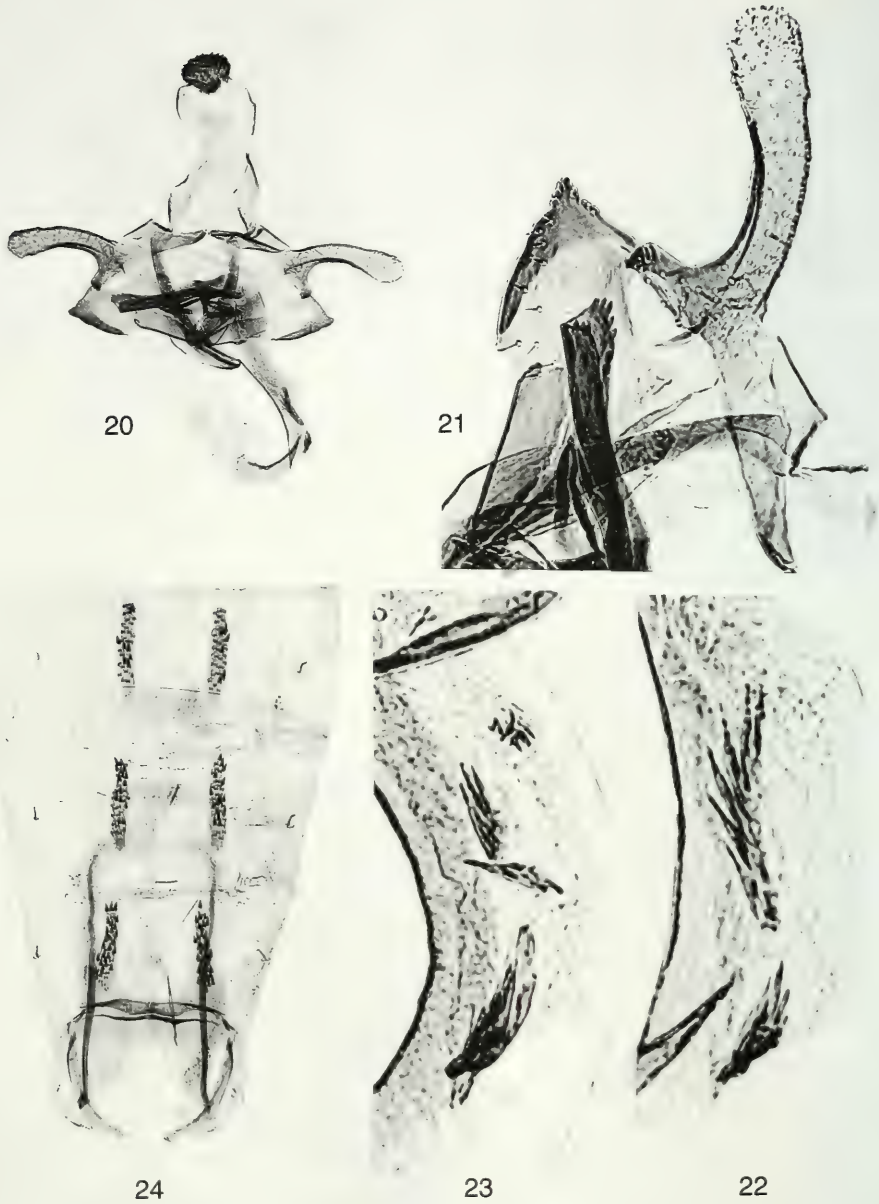


FIGS 12-15

C. bantuella sp. n. 12. Male genitalia (GP Bldz 13411). 13. Enlarged detail of male genitalia. 14. Cornuti, much enlarged. 15. Abdomen.

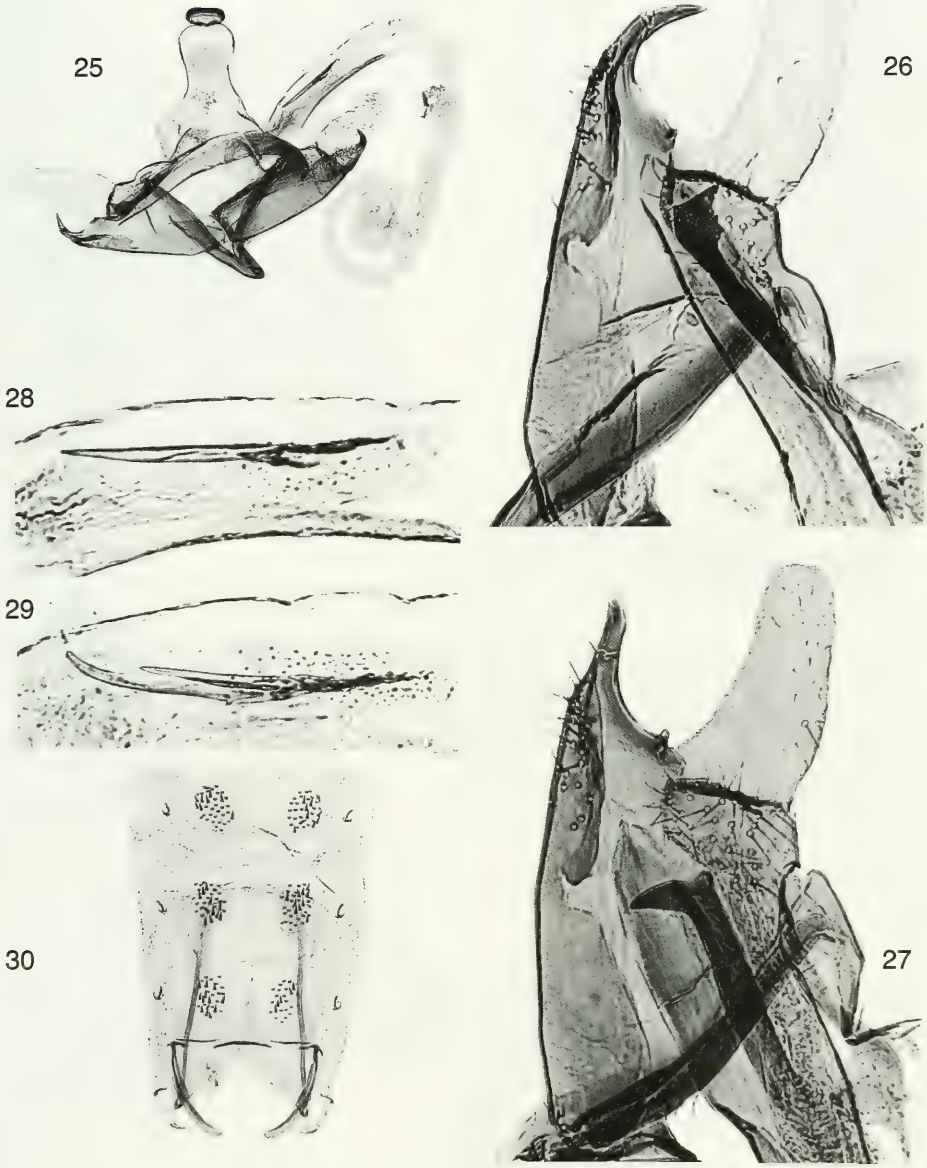
FIGS 16-19

C. terebrans sp. n. 16. Male genitalia (GP Bldz 13400). 17. Male genitalia (GP Bldz 13412). 18. Enlarged detail of male genitalia. 19. Abdomen.



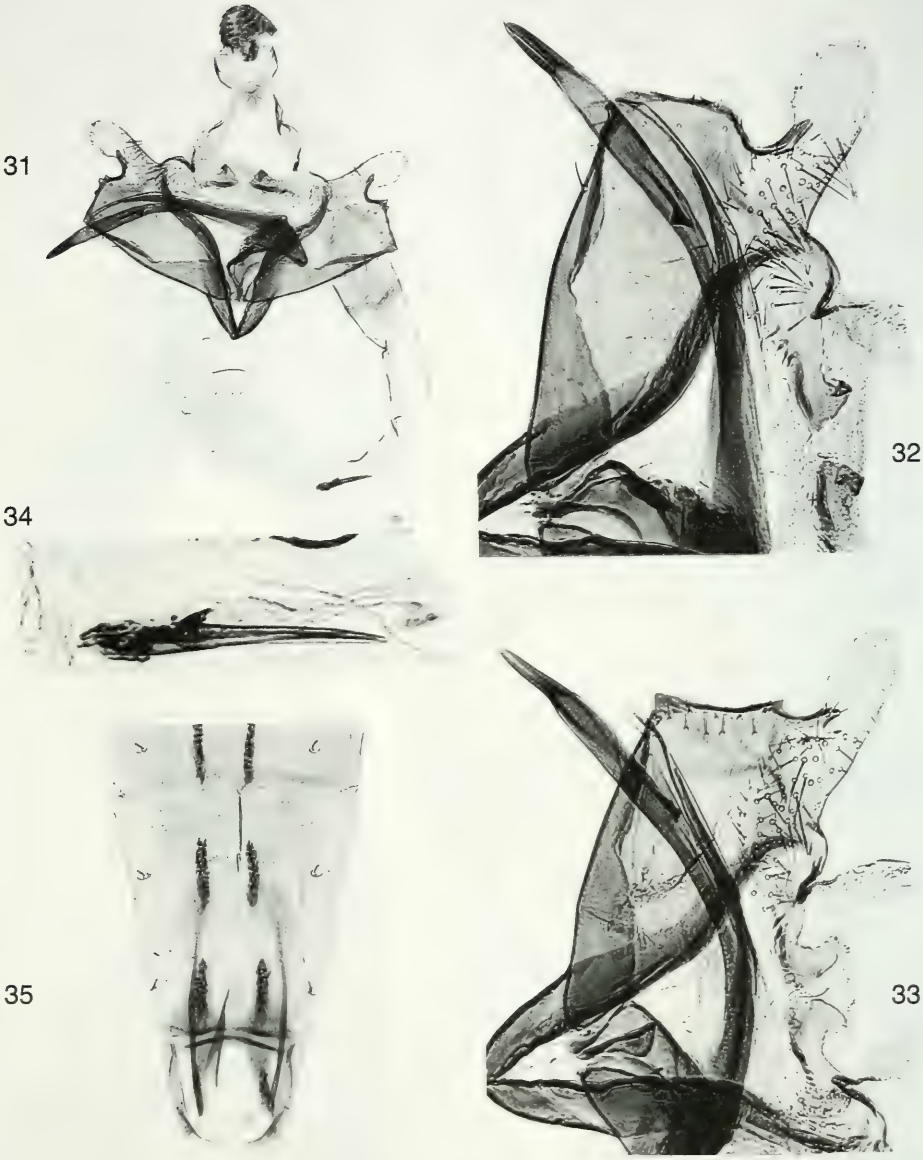
FIGS 20-24

C. discopunctata sp. n. 20. Male genitalia (GP Bldz 13414). 21. Enlarged detail of male genitalia. 22. Cornuti, much enlarged. 23. Same detail (GP Bldz 13397). 24. Abdomen.



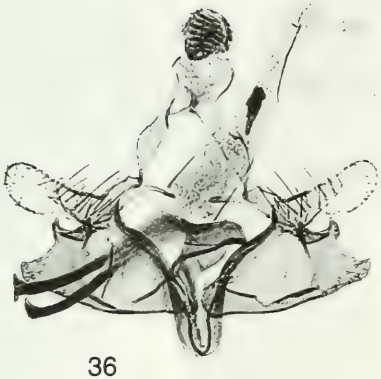
FIGS 25-30

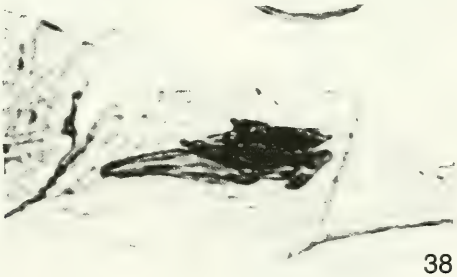
C. katangica sp. n. 25. Male genitalia (GP Bldz 13403). 26. Enlarged detail of male genitalia. 27. Same detail (GP Bldz 13413). 28. Cornuti, much enlarged (GP Bldz 13403). 29. Same detail (GP Bldz 13413). 30. Abdomen.

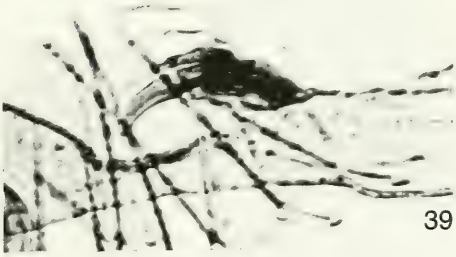


FIGS 31-35

C. romieuxi sp. n. 31. Male genitalia (GP Bldz 13410). 32. Enlarged detail of male genitalia. 33. Same detail (GP Bldz 13395). 34. Cornutus, much enlarged (GP Bldz 13410). 35. Abdomen.

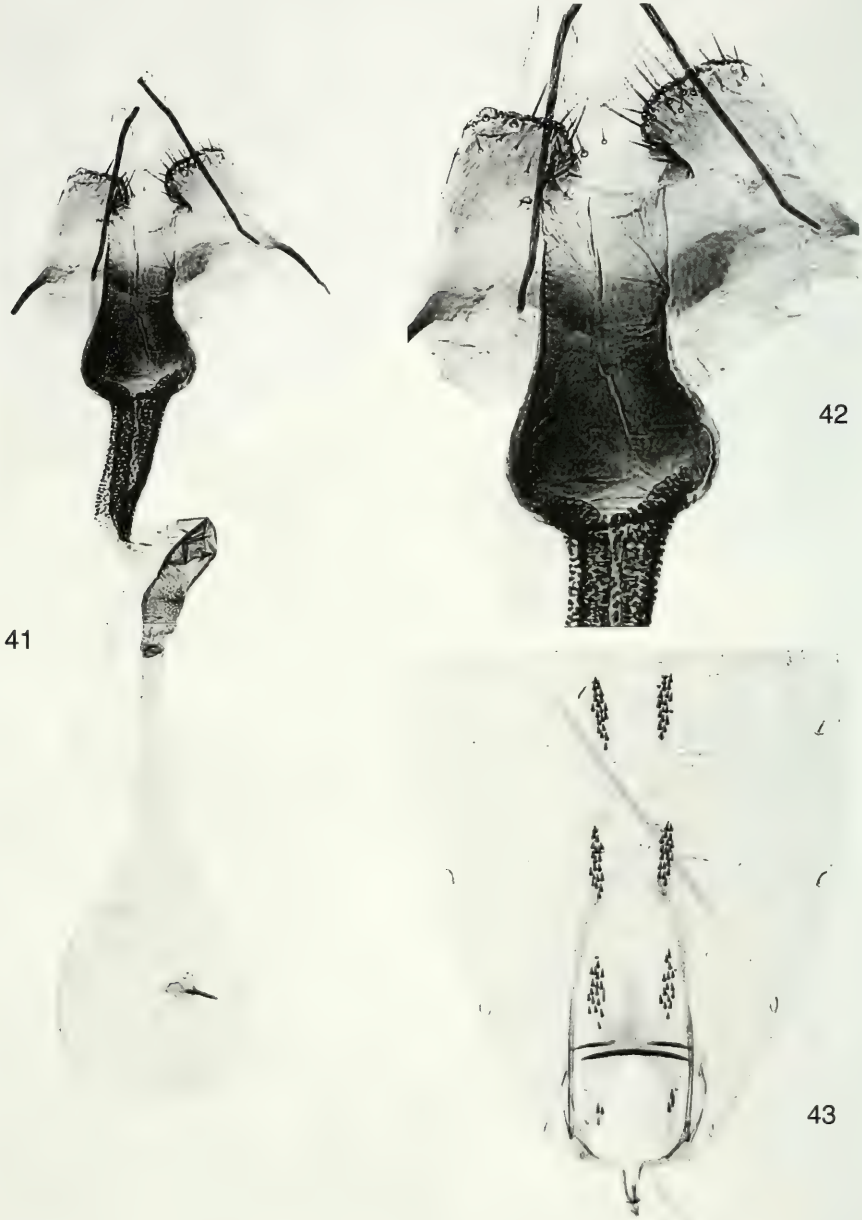






FIGS 36-40

C. tetrodonta sp. n. 36. Male genitalia (GP Bldz 13419). 37. Enlarged detail of male genitalia (GP Bldz 13417). 38. Cornutus, much enlarged (GP Bldz 13419). 39. Same detail (GP Bldz 13417). 40. Abdomen.

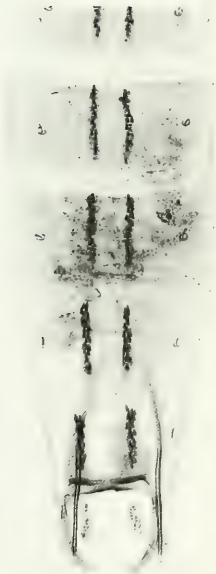


FIGS 41-43

C. tetrodonta sp. n. 41. Female genitalia (GP Bldz 13409). 42. Enlarged detail of female genitalia. 43. Abdomen.

44

45



47

46

FIGS 44-47

C. fragilella sp. n. 44. Male genitalia (GP Bldz 13416). 45. Enlarged detail of male genitalia. 46. Cornuti, much enlarged. 47. Abdomen.

REFERENCES

BALDIZZONE, G. 1988. Contributions à la connaissance des Coleophoridae XLVIII. Quadre (sic) nouvelles espèces du genre *Coleophora* Hübner de l'URSS. *Beiträge zur Entomologie* 38 (1): 74-82, figs 1-21.

BALDIZZONE, G. & VAN DER WOLF, H.W. 2003. A taxonomic review of the Coleophoridae (Lepidoptera) of the Indian subcontinent and Sri Lanka described by Edward Meyrick. *Tijdschrift voor Entomologie* 146: 1-31, figs 1-89.

MEYRICK, E. 1911. Descriptions of Transvaal Microlepidoptera. *Annals of the Transvaal Museum* 2: 218-240.

MEYRICK, E. 1931. [No title]. Exotic Microlepidoptera 4 (2/6): 33-192.

MEYRICK, E. 1937. [No title]. Exotic Microlepidoptera 5 (3/5): 65-160.

MEYRICK, E. 1938. New Pterophoridae, Tortricina and Tineina. *Exploration du Parc Naturel Albert (1, mission G.F. de Witte, 1933-35)* 14: 3-28, 3 pls.

TOLL, S. 1952 [1953]. Rodzina Eupistidae (Coleophoridae) Polski. *Materialy do fizjografii kraju* 32: 1-292, 38 pls.

TOLL, S. 1962. Materialien zur Kenntnis der paläarktischen Arten der Familie Coleophoridae (Lepidoptera). *Acta zoologica Cracoviensia* 7(16): 577-720, 133 pls.

TOLL, S. & AMSEL, H.G., 1967. Coleophoriden aus Afghanistan (Lepidoptera: Coleophoridae). *Beiträge zur naturkundlichen Forschung in Südwest Deutschland* 26 (3): 5-16, 5 pls.

REVUE SUISSE DE ZOOLOGIE 112 (1): 83-86; mars 2005

Redescription of *Parammoecius osseticus* (Iablokoff-Khnzorian, 1972) with a new synonymy and notes on the genus *Parammoecius* Seidlitz, 1891 (Coleoptera: Scarabaeoidea: Aphodiidae)

Stefano ZIANI
Via S. Giovanni, 41/a, I-47014 Meldola (Forlì), Italy.
E-mail: stefanoziani@aliceposta.it

Redescription of *Parammoecius osseticus* (Iablokoff-Khnzorian, 1972) with a new synonymy and notes on the genus *Parammoecius* Seidlitz, 1891 (Coleoptera: Scarabaeoidea: Aphodiidae). - The Aphodiidae species *Parammoecius osseticus* (Iablokoff-Khnzorian, 1972) is redescribed, the synonymy with *P. interfinius* (Ziani, 2001) is proposed and a key for the *Parammoecius* species is given.

Keywords: Coleoptera - Scarabaeoidea - Aphodiidae - Parammoecius - taxonomy - biology - new synonymy - Palearctic Region.

INTRODUCTION

In 1972 Iablokoff-Khnzorian described *Aphodius* (*Parammoecius*) *osseticus* based on a female specimen, wrongly considered as a male by the author, collected in a Caucasian locality not very far from the Turkish border. From then on, the species remained little known to subsequent authors (Stebnicka & Galante, 1991; Baraud, 1992; Ziani, 2001) mostly because of the impossibility to obtain its holotype on loan or to trace other specimens in public or private collections. *Parammoecius osseticus* seems to have been seldom collected most probably due to its particular biology (see below).

The study of the holotype, now at last available, gives me the opportunity to redescribe Iablokoff-Khnzorian's species and to propose the new synonymy *Parammoecius osseticus* (Iablokoff-Khnzorian, 1972) = *Aphodius* (*Parammoecius*) *interfinius* Ziani, 2001. It is herein followed Aphodinae systematics proposed by Dellacasa *et al.* (2001)

ABBREVIATIONS OF COLLECTIONS

MCSN Museo Civico di Storia Naturale "Giacomo Doria", Genova (Italy)
MHNG Muséum d'histoire naturelle, Genève (Switzerland)
MKCY Mark Kalashian private collection, Yerevan (Armenia)

Manuscript accepted 23.04.2004

DESCRIPTION

Parammoecius osseticus (Iablokoff-Khnzorian, 1972) **comb. n.**

Aphodius (Parammoecius) osseticus Iablokoff-Khnzorian, 1972: 281.
Aphodius (Agoliinus) osseticus: Stebnicka & Galante, 1991: 727 (female specimen: identity not confirmed).
Aphodius (Parammoecius) interfinius Ziani, 2001: 1 [type locality: "Turchia, Artvin/Kars, Cam Geçidi [Turkey, Cam Pass, between the provinces of Artvin and Kars]; type material in MCSN] **(new synonymy)**.

Type locality. "Gruzinskaya SSR: Ermani (yugo-vostochnaya Osetiya)" [Georgia: Ermani (South-Eastern Ossetia)].

Material examined. Holotype female, fixed by original designation, in Iablokoff-Khnzorian collection, now in MKCY: 1st, white, handwritten, in Cyrillic (transliterated): "Dzhava 2400 / Ermani / Osetiya"; 2nd, red, handwritten: "HT Aphodius / osseticus Khnz.". The holotype is stated as male in the original description.

Other material examined. 2 specimens, as follows. GEORGIA: Krestovyj pass, the Military-Georgian road, 23.V.1969, 1 specimen ♂ (MHNG). TURKEY: Artvin-Kars, Cam Geçidi 2800 m, 26.VI. – 1.VII.1997, M. Malmusi leg. 1 specimen ♂ (holotype of *A.* (*P.*) *interfinius* Ziani, 2001, MCSN).

Redescription. Holotype. Length 6.4 mm, from the tip of the clypeus to the elytral apex; greatest width 3.1 mm; strongly convex, stout, nearly glabrous; colour black, upper side shining, legs, antenna, maxillary palpi and elytral apex reddish.

Head large, with epistoma slightly gibbous, irregularly punctured; clypeus distinctly sinuate at middle, rounded at sides, very thinly bordered; genae auriculate, more protruding than eyes, with few long bristles; frontal tubercles barely perceptible.

Pronotum transverse, strongly convex, widest at base, slightly wider than elytral base, with double, subregular, coarse, not very dense punctation; base distinctly margined; sides slightly but clearly sinuate before hind angles; hind angles broadly rounded, front angles prominent, rounded apically.

Scutellum triangular, approximately as long as wide, with few punctures on basal half.

Elytra convex, widest at middle, very strongly and sharply denticulate at shoulder; striae moderately impressed, shallowly punctured; interstriae very slightly convex, both on disc and apically, with fine and irregular punctation; epipleurae with few long bristles on basal third.

Hind tibiae apically fimbriate with spinules alternatively unequal; first segment of hind tarsi as long as upper tibial spur and as the three following segments combined.

Male: pronotum with irregular punctation, clearly wider than elytral base; apical third of elytra with very short pubescence; inferior spur of middle tibiae blunt (for a detailed description and for the drawings of habitus, aedeagus and epypharynx, see Ziani, 2001).

Distribution. Recorded from Georgia (Iablokoff-Khnzorian, 1972) and Northern-Eastern Turkey (Ziani, 2001, as *Aphodius* (*Parammoecius*) *interfinius*).

Biology. The 2nd label of the male specimen from Georgia provides relevant information on the up to now unknown biology of this species. According to that label it was collected in a burrows of *Prometheomys schaposchnikovi*, the long-clawed molevole, a Caucasian Cricetidae. *P. osseticus*, as well as two other species (Ziani, 2003) of the genus *Parammoecius*, *pyrenaeus* (Jacquelin du Val, 1859) and *gibbus* (Germar,

1817), may be regarded as nidicolous, i.e., species that live obligatorily (pholeobiont), preferentially (pholeophile) or only occasionally (pholeoxene) in burrows of small mammals, feeding on their dejections.

Remarks. Since the holotype of *Aphodius osseticus*, a male according to the author, was at that time not available, Stebnicka & Galante (1991) made a complementary description of the female of *A. osseticus*, a specimen collected in Turkey, "Kars, Col entre Damal Posof, 2400-2500 m, 13.VI.1986, leg. Besuchet, Löbl & Burckhardt (MHNG)", and ascribed it to the subgenus *Agoliinus* A. Schmidt, 1913. Unfortunately the specimen studied by Stebnicka & Galante could not be found in the Geneva Museum, and from the description and the drawing of epipharynx it is not possible to confirm whether it belongs to the genus *Parammoecius*.

DISCUSSION

Besides its type species, *Aphodius gibbus* Germar, 1817 (subsequent designation by Balthasar, 1964) there are currently four more species assigned to the genus *Parammoecius* Seidlitz, 1891: *asphaltinus* (Kolenati, 1846), *corvinus* (Erichson, 1848), *osseticus* (Iablokoff-Khnzorian, 1972) and *pyrenaeus* (Jacquelin du Val, 1859). In 1978 Stebnicka described *Aphodius amanicus* on the basis of a male from Turkey, "Amanus Daglari, Belen Pass 640 m, 21 vii 1977" [Hatay prov.] and ascribed it to the subgenus *Parammoecius* Seidlitz. According to Stebnicka (pers. comm.) the holotype can not be found in the collection of the Institute of Systematic and Experimental Zoology of the Polish Academy of Sciences in Cracow. Anyway, from the original description and the drawing of the aedeagus, I believe that it is safe to affirm that *amanicus* does not belong to the genus *Parammoecius*. The genus is well characterized by the distinct shape of the aedeagus of these species, with the paramera bent downwards at a right angle. In addition, they also share some characters of external morphology, namely the elytra strongly denticulate at shoulder. Details on their ephipharynges, on the contrary, do not seem to show particular characters useful to separate the genus.

Within *Parammoecius* there are two distinct species groups which could have a phylogenetic significance: the "*asphaltinus* group" (*P. asphaltinus* and *P. osseticus*), with Ponto-Caucasian endemic species characterized by a medium body size and by the aedeagus, in dorsal vision, wider both in paramera and tegmen, and the "*gibbus* group" (*P. gibbus*, *P. corvinus* and *P. pyrenaeus*), with Central-Western European species characterized by a small body size and by the aedeagus, in dorsal vision, relatively narrow, particularly in paramera.

KEY TO THE SPECIES OF PARAMMOECIUS

1 Medium body size (length more than 6 mm) 2
- Small body size (length less than 6 mm) 3
2 Base of pronotum distinctly margined . . *osseticus* (Iablokoff-Khnzorian, 1972)
- Base of pronotum not margined at middle . . . . . *asphaltinus* (Kolenati, 1846)
3 Clypeus denticulate at sides. Base of pronotum margined 4
- Clypeus rounded at sides. Base of pronotum not margined at middle . . . . . *corvinus* (Erichson, 1848)

4 Elytra shiny on disc. Frontal suture tuberculate
. . . . . *pyrenaeus* (Jacquelin du Val, 1859)
- Elytra dull on disc. Frontal suture not tuberculate . . . . . *gibbus* (Germar, 1817)

ACKNOWLEDGEMENTS

Thanks are due to Tristão Branco (Porto) for useful discussions on the subject, Giulio Cuccodoro (Muséum d'histoire naturelle, Genève) for the loan of material under his care, Giovanni Dellacasa (Genova) who first pointed out to me the probable synonymy between *osseticus* and *interfinius*, Mark Kalashian (Yerevan) for the loan of the holotype of *osseticus*, Maurizio Pavesi (Museo Civico di Storia Naturale, Milano) for support on geographic names, Roberto Poggi (Museo Civico di Storia Naturale, Genova) for the loan of the holotype of *interfinius*, Zdzislawa Stebnicka (Polish Academy of Sciences, Krakow) for information on the whereabouts of the type material of *Aphodius amanicus*, and finally Vadim Zinchenko (Siberian Zoological Museum, Novosibirsk) for the translation of Russian texts.

REFERENCES

BALTHASAR, V. 1964. Monographie der Scarabaeidae und Aphodiidae der palaearktischen und orientalischen Region. Coleoptera Lamellicornia. Band 3. *Tschechoslowakische Akademie der Wissenschaften, Prag*, 652 pp.

BARAUD, J. 1992. Coléoptères Scarabaeoidea d'Europe. Faune de France et régions limitrophes. 78. *Fédération Française des Sociétés de Sciences Naturelles & Société Linnéenne de Lyon, Paris-Lyon*, ix + 856 pp., 11 pls.

DELLACASA, G., BORDAT, P. & DELLACASA, M. 2001. A revisional essay of world genus-group taxa of Aphodiinae (Coleoptera Aphodiidae). *Memorie della Società entomologica italiana*, Genova, 79: 1-482.

IABLOKOFF-KHNZORIAN, S. M. 1972. Dva novykh vida zhukov navoznikov iz SSSR (Coleoptera, Scarabaeidae). *Doklady Akademii Nauk Armyanskoi SSR*, Yerevan, LIV (5): 281-285.

STEBNICKA, Z. 1978. New *Aphodius*-Species and Description of the Larva *Aphodius apicalis* Har. (Coleoptera, Scarabaeidae. Aphodiinae). *Bulletin de l'Académie Polonaise des Sciences, Série des sciences biologiques Cl. II*, Varsovie, 26 (4): 257-261.

STEBNICKA, Z. & GALANTE, E. 1991. Studies on some Aphodiinae (Coleoptera: Scarabaeidae) from the Muséum d'Histoire naturelle in Geneva. *Revue suisse de Zoologie*, Genève, 98 (4): 725-729.

ZIANI, S. 2001. A new species of *Aphodius* Ill. of the subgenus *Parammoecius* Seidl. from North Eastern Anatolia: *A. (P.) interfinius* n. sp. (Coleoptera, Scarabaeoidea: Aphodiidae). *Doriana, supplemento agli Annali del Museo Civico di Storia Naturale "G. Doria"*, Genova, VII (316) (1999): 1-5.

ZIANI, S. 2003. *Onthophagus (Palaeonthophagus) semicornis* (Panzer, 1798) (Insecta Coleoptera Scarabaeidae) in Romagna, e considerazioni sugli Scarabaeoidea italiani che vivono associati alle tane di piccoli mammiferi. *Quaderno di Studi e Notizie di Storia Naturale della Romagna*, Cesena, 18: 69-84.

REVUE SUISSE DE ZOOLOGIE 112 (1): 87-114; mars 2005

New large-sized cave-dwelling *Heteropoda* species from Asia, with notes on their relationships (Araneae: Sparassidae: Heteropodinae)

Peter JÄGER
Forschungsinstitut und Naturmuseum Senckenberg, Senckenberganlage 25,
D-60325 Frankfurt am Main, Germany.

New large-sized cave-dwelling *Heteropoda* species from Asia, with notes on their relationships (Araneae: Sparassidae: Heteropodinae). - Four new cave-dwelling *Heteropoda* species are described: *H. fischeri* sp. n. from Meghalaya, N India (♂ ♀), *H. schwendingeri* sp. n. from Thailand (♂), *H. beroni* sp. n. from Sulawesi (♂ ♀) and *H. belua* sp. n. from Sarawak (♂ ♀). Notes on the variation and relationships of these species are provided. Additional illustrations and diagnoses are given for the following species: *H. afghana* Roewer, 1962, *H. kuekenthali* Pocock, 1897, *H. nigriventer* Pocock, 1897, *H. robusta* Fage, 1924 and *H. tetrica* Thorell, 1897. The latter species is recorded from Thailand for the first time. Several features found in cave-dwelling species are considered as plesiomorphic for the Heteropodinae (elongated hairs on metatarsus I-III of males) or as convergently developed due to troglobiontic life (large size, elongated appendages).

Keywords: Systematics - new species - variation.

INTRODUCTION

The genus *Heteropoda* Latreille, 1804 is by far the largest genus within the Heteropodinae. More than 180 nominal species were described so far (Platnick, 2004). The genus was intensively revised only with regard to the Australian territory where 38 species are known until now (Davies, 1994). However, as a result of my examination of an exhaustive material of the genus *Heteropoda* I assume that the largest diversity of the genus is present in tropical Southeast Asia (Jäger, 2002, unpubl. data). No comprehensive revision was done so far for Asian representatives. Sethi & Tikader (1988) listed 18 *Heteropoda* species for India and described three species as new (compare the note on *Heteropoda robusta* Fage in this paper and the note in Jäger & Ono, 2000: 45 on *Olios kiranae* Sethi & Tikader). Jäger (2000b) described two new species from Malaysia and Sumatra, Jäger & Ono (2000) one new species from Japan, and Jäger & Barrion (2001) described the male of *Heteropoda cyperusiria* Barrion & Litsinger from the Philippines. Several junior synonyms of the genus *Heteropoda* Latreille and of individual *Heteropoda* spp. were recognized, and some 20 species

Manuscript accepted 02.04.2004

were illustrated recently (Jäger, 2002). The recent discovery and description of *Heteropoda maxima* Jäger, the spider with the largest legspan ever found in the world, from caves in Laos (Jäger, 2001a) emphasizes our poor knowledge of this group. In this paper four new large-sized cave-dwelling *Heteropoda* species are described, some of them with almost 250 millimetres legspan. Five additional species are illustrated for comparison.

MATERIAL AND METHODS

In species diagnoses and descriptions only exceptions from the diagnostic and synapomorphic characters of the subfamily, genus and species groups are listed. For diagnoses and descriptions of family, subfamily and genus, see Jäger (1998, 2001b) and Jäger & Ono (2000). All measurements are in millimetres. Size classes are according to Jäger (2001b: 14), terminology of leg claws after Jäger (2004). Measurements of palps and legs are listed in the following order: Total length (femur, patella, tibia, metatarsus, tarsus). The origin of tegular appendices (i.e. embolus, conductor) is given as clock positions on the left palp in ventral view. In schematic illustrations of internal duct systems of female genitalia the following symbols are used: Open circle = copulatory opening, 'T'-shaped part = glandular region, arrow = fertilisation duct in direction of *uterus externus*. In the illustrations all hairs are omitted (exception Fig. 2), spines on palps are shown. Beside genital characters, which are considered for diagnoses and descriptions and are discussed in Jäger (2000a, 2001b), an additional taxonomic character is presented here: Slit sense organs close to the epigyneal field (compare with Barth, 2001: 40, fig. 1L). Different positions in relation to the epigyneal field may help to distinguish species. The pocket situated dorsal to the median septum of the epigyne is termed 'septal pocket'. The length of the epigyneal field does not include its anterior bands.

Abbreviations. ALE - anterior lateral eyes, AME - anterior median eyes, AW - anterior width of prosoma, CH - clypeus height, DS - dorsal shield of prosoma, FE - femur, MT - metatarsus, OL - opisthosoma length, OS - opisthosoma, OW - opisthosoma width; PA - patella, PH - height of dorsal shield of prosoma, PJ xx - serial number of Sparassidae examined by Peter Jäger, PL - length of dorsal shield of prosoma, PLE - posterior lateral eyes, PME - posterior median eyes, PP - palpus, PW - width of dorsal shield of prosoma, RTA - retrolateral tibal apophysis, TA - tarsus; TI - tibia; I, II, III, IV - leg I etc.

Depositories (with curators). MCZ – Museum of Comparative Zoology, Massachusetts (H. Levy, G. Giribet), MHNG – Muséum d'histoire naturelle, Genève (P. Schwendinger), MNHN – Muséum national d'histoire naturelle, Paris (C. Rollard), MZBJ – Museum Zoologicum Bogoriense, Jakarta (Y.R. Suhardjono), MZLU – Museum of Zoology, Lund University (L. Lundquist), NHM – Natural History Museum, London (P. Hillyard), NMB – Naturhistorisches Museum, Bern (C. Kropf), SMF – Forschungsinstitut Senckenberg, Frankfurt (P. Jäger), ZMS – Zoological Museum, Sofia (P. Beron), ZMUC – Zoological Museum of the University, Copenhagen (N. Scharff).

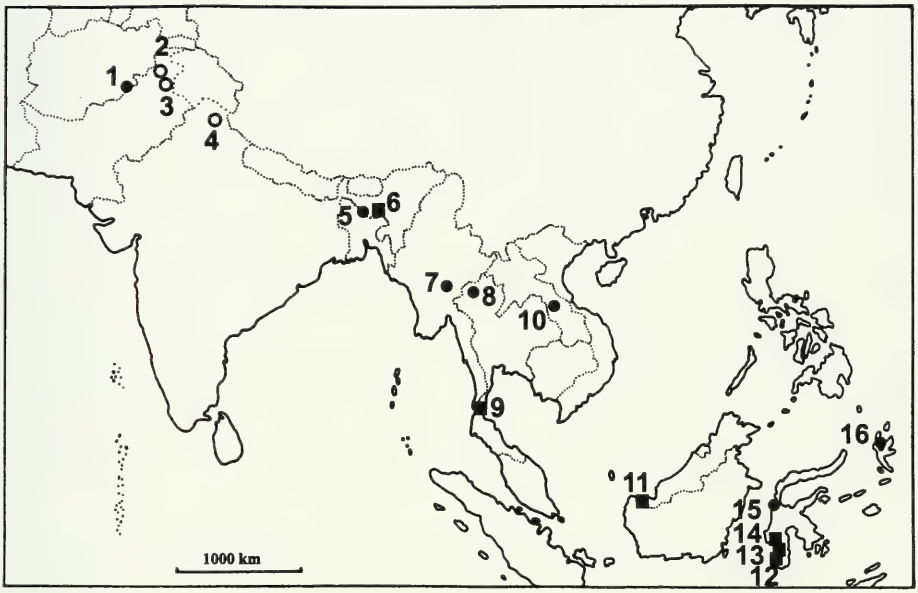


FIG. 1

Records of *Heteropoda* species treated in this paper: 1 Afghanistan, Grotto Tagheh, near Ibrahim Khel (Khouguiani) (*H. afghana* Roewer), 2 Pakistan, Swat, Miandam (*Heteropoda* sp. cf. *afghana* Roewer, PJ 1889), 3 Pakistan, Murree (*Heteropoda* sp. cf. *afghana* Roewer, PJ 407-408), 4 N-India, Kooloo Valley (*Heteropoda* sp. cf. *afghana* Roewer, PJ 222, 386-393, 399-406), 5 N-India, Assam, Garo Hills (*H. robusta* Fage), 6 India, Meghalaya, Jaintia Hills (*H. fischeri* sp. n.), 7 Myanmar, Kayah State (*H. tetrica* Thorell), 8 N-Thailand, Chiang Mai Province, Doi Suthep (*H. tetrica* Thorell), 9 S-Thailand, Chumphon Prov., Nam Lod Yai Cave (*H. schwendingeri* sp. n.), 10 Laos, Khammouane Prov. (*H. maxima* Jäger), 11 Malaysia, Sarawak, Jambusan (*H. belua* sp. n.), 12 Indonesia, Sulawesi, Maros (*H. beroni* sp. n.), 13 Indonesia, Sulawesi, Pangkajene (*H. beroni* sp. n.), 14 Indonesia, Sulawesi, Bone (*H. beroni* sp. n.), 15 Indonesia, Sulawesi, Donggala (*H. nigriventer* Pocock), 16 Indonesia, Halmahera, Soakonora (*H. kuekenthali* Pocock). Filled squares = new species described in this paper; filled circles = known species; open circles = forms with uncertain taxonomic status.

TAXONOMY

Heteropoda Latreille, 1804

Synonymies and diagnosis: See Jäger (2001b: 19, 2002: 40).
Type species: *Aranea venatoria* Linnaeus, 1767. Designated by Thorell (1870).

Taxonomic characters. When looking for valuable characters to group the species described here, one character of the males of almost all these species was very conspicuous: The metatarsi of the second legs have laterally elongated hairs, which are 3.5 to 8.0 as long as the metatarsus width (in few specimens the hairs were rubbed off and only remnants pointed to elongated hairs). In females most of these hairs are only 1 to 1.5 times longer than the width of the metatarsus, only single hairs are longer (2 to 2.5 times metatarsus width). Metatarsal hairs in males appear as a dense and flattened brush (Jäger, 2001: fig. 1E), which consists of lateral scopula hairs and stiff

lateral hairs in the dorsal half of the article. After a more detailed examination of more specimens of further *Heteropoda* spp. and different species from other genera it was clear that 1. elongated hairs occur not only on the second pair of legs, but also - in a less distinct form - on the first and third pair, whereas the fourth pair does not exhibit elongated hairs in comparison to females, and 2. that this sexual dimorphism occurs also in non cave-dwelling Sparassidae i.e. other *Heteropoda* spp., *Sinopoda* spp. and *Pseudopoda* spp., whereas in the latter genus this dimorphism is not very distinct.

The following four forms (*H. afghana*, *Heteropoda* sp. cf. *afghana*, *H. fischeri* sp. n., *H. robusta*) are grouped according to the course of the internal duct system of the female genitalia: 1. Short copulatory ducts, the first semicircular winding of which is directed transversally to body length axis. 2. Glandular structures situated at the end of this first winding (looped apex). 3. Median septum of epigyne clearly visible. 4. Epigyneal field with distinct anterior bands, which may be attached to the field or not. The only known ♂ of this group has a distinct acute appendage on the basal conductor. ♂♂ of other species have to confirm the potential diagnostic relevance of this character for the group.

Note: *Heteropoda lindbergi* Roewer, also described from Afghanistan (Roewer 1962: 8, fig. 87-88) can clearly be excluded from the subfamily Heteropodinae judging from the pictorial and written description of its cheliceral dentition. With two promarginal and five retromarginal cheliceral teeth it is most likely a member of the Sparassinae.

Heteropoda afghana Roewer, 1962 Figs 2-11

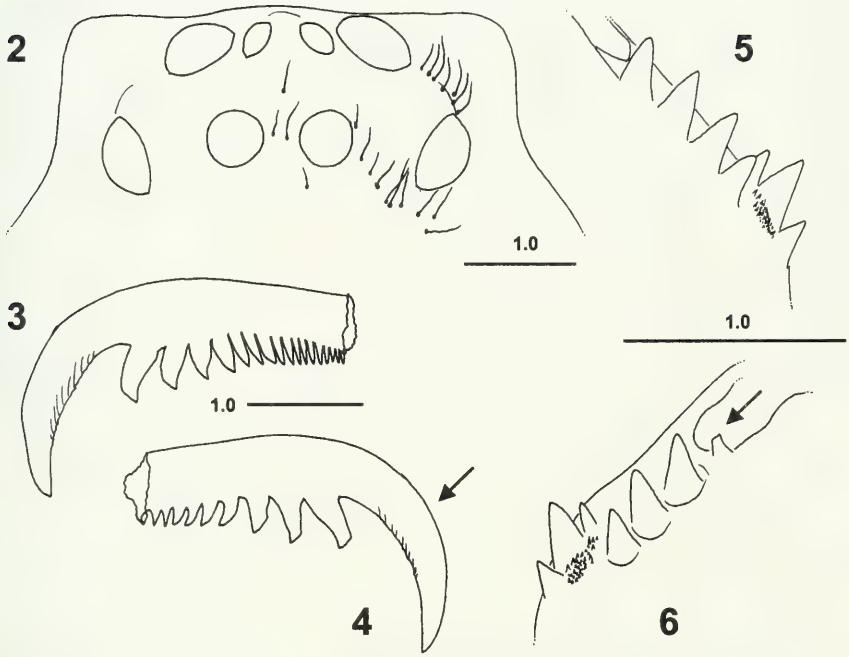
Heteropoda afghana Roewer, 1962: 7-8, figs 85-86.

Material examined: ♀ holotype (PJ 1887): Afghanistan, Grotte Tagh̄éh Tehinéh, near Ibrahim Khel (Khouguiani), 23.i.1958, Roewer det., Loc. A222, L958/3736, type No. 225:J. (MZLU). *Heteropoda ?afghana*. 1 subadult ♂ (PJ 1888): Afghanistan, Grotte des Tchehel Sotoun, near Djalrez, 20.iii.1958, Roewer det., L58/3353, A212, Kat. 1. (MZLU).

Diagnosis: Medium-sized spider with glandular region of internal genital duct system not elevated (Fig. 8, compare with *H. robusta*, Fig. 44), epigyneal field almost as long as wide and with two pairs of relatively large slit sense organs (Fig. 7).

Redescription of ♀ holotype (not all measurements could be taken due to the fragile holotype): PL 7.6, PW 7.1, AW 4.0, OL 10.7, OW 5.2. Eyes: AME 0.36, ALE 0.67, PME 0.46, PLE 0.64, AME-AME 0.22, AME-ALE 0.04, PME-PME 0.32, PME-PLE 0.57, AME-PME 0.55, ALE-PLE 0.60, CH AME 0.70, CH ALE 0.42.

Leg spination: PP 131, 101, 2121, 1014; FE I-II 323, III 333, IV 331; PA I-III 001, IV 100; TI I-II 2026, III-IV 2126; MT I 0004, II 1014, III 2014, IV 3036. Leg measurements: II ? (?, ?, 11.5, 9.6, 2.6), III ? (?, 3.5, 9.1, 7.6, 2.3), IV ? (?, 3.2, 9.5, 9.4, ?). Palpal claw with 6 teeth. Left chelicerae with distal retromarginal tooth distinctly smaller than usual for Heteropodinae (Fig. 6, see arrow). Dorsal shield of prosoma with stiff bristles close to eyes (Fig. 2). Tarsal claws of legs with dominant primary tooth and characteristic shape of distal secondary teeth (Figs 3-4, see arrow). Anterior bands attached to epigyneal field (Fig. 7). For further description see Roewer (1962).



FIGS 2-6

Heteropoda afghana Roewer, ♀ holotype. – Eye group, dorsal view (2), bristles omitted in left half; prolateral claw of right leg I, prolateral view (3), base broken off; retrolateral claw of same leg, retrolateral view (4; dominant primary tooth indicated by arrow), base broken off; chelicerae, ventral view, right (5), left (6; distal retromarginal tooth indicated by arrow).

Distribution: Only known from the type locality (Fig. 1: 1; see also note on the next form).

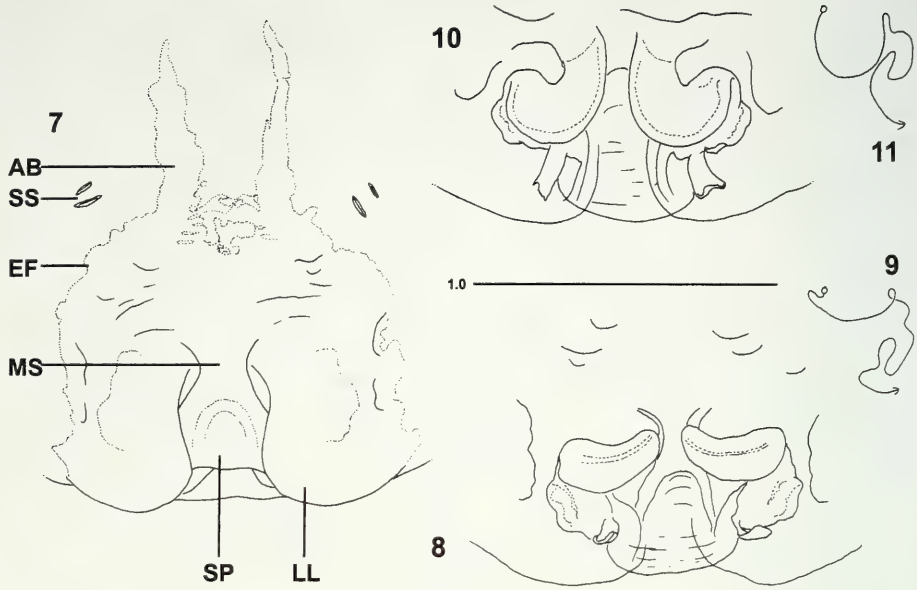
Biology: The holotype was found in a cave. It cannot be excluded that *H. afghana* represents a troglobiontic species (see also discussion).

Heteropoda sp. cf. ***afghana*** Roewer, 1962 Figs 12-28

Material examined: 1 ♀ (PJ 222): North India, Kooloo Valley, Carleton Coll. 8 ♀ (PJ 386-393): North India, Koolloo Valley,?1874, ?M.M.Carleton. 3 ♀ (PJ 399-401): North India, Kooloo (Valley?), 1876, M.M.Carleton. 3 ♀ (PJ 402-404): North India, Koolloo Valley, 1874, M.M.Carleton. 2 ♀ (PJ 405-406): N. India, Kooloo (Valley?), ?1870's, M.M. Carleton. 2 ♀ (PJ 407-408): Pakistan, Murree, 33°55'N, 73°26'E, 7500ft., 29.vi.1967, Coll. B.L. Haines. (All in MCZ). 1 ♀ (PJ 1889): Pakistan, Swat, Miandam, 1900m, sur la végétation dans un filet d'eau et à la lumière, 17.v.1983, leg. C. Besuchet & I. Löbl (16). (MHNG).

Variation (n=20): PL 6.3-11.0, PW 5.8-10.0, OL 8.0-16.3, OW 3.8-10.5. Leg spination (only variation): FE II 333, PA varying from I-IV 001 to I-II 001, III-IV 101, TI II 2126, MT II 0004. Palpal claw with 6 (n=2), 7 (n=17) or 8 (n=1) teeth.

Note: ♀ genitalia are similar to those of *H. afghana*, but show the following differences in direct comparison: Anterior bands attached to the epigyneal field (Figs 12, 28) or separated (Figs 17, 23, 25). Epigyneal field more variable in shape and size.



FIGS 7-11

Heteropoda afghana Roewer, ♀ holotype. – Epigyne, ventral view (7); internal genital duct system, dorsal view (8), anterior view (10); schematic course of internal genital duct system, dorsal view (9), anterior view (11). AB = anterior bands of epigyne; EF = epigyneal field; LL = lateral lobes; MS = median septum; SP = septal pocket; SS = slit sensillum.

Distance between septal pocket and epigastric furrow larger. Anterior margins of median septum more strongly bent. Median margins of median septum parallel or at least straighter than in *H. afghana*. Glandular region of internal genital duct system at least in some specimens slightly elevated (Fig. 13). As long as no ♂♂ are known, no further comments on the taxonomic identity of this form can be made.

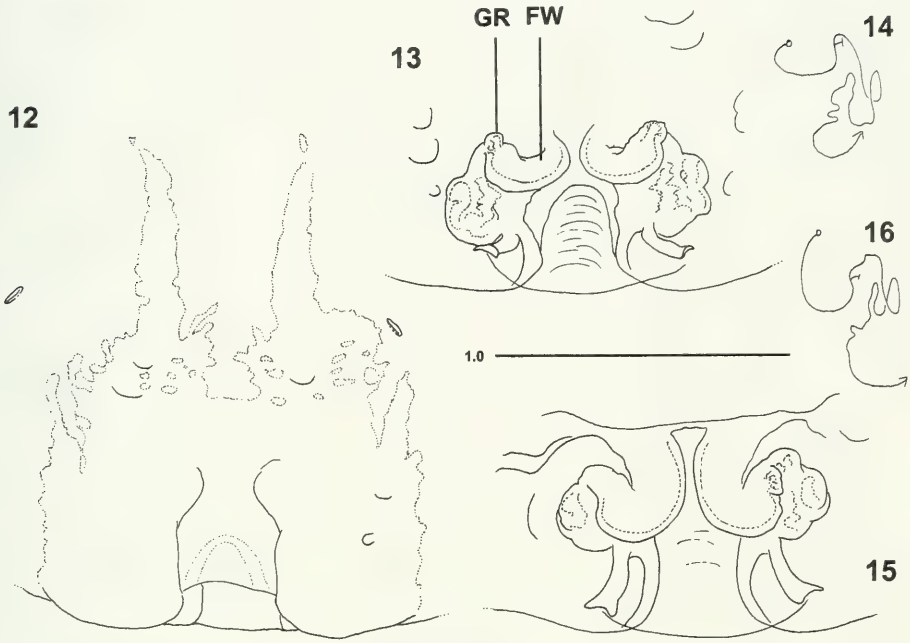
Distribution: N-Pakistan, N-India (Fig. 1: 2-4)

Heteropoda fischeri sp. n. Figs 29-42

Material examined: ♂ holotype (PJ 1756), ♀ paratype (PJ 1757): India, Meghalaya, Jaintia Hills, 'Krem Labbit 2' Cave near Sutnga, N 25°21'59.9", E 92°25'20.6", cave entrance at 1100 m ± 50 metres above sea level, Fischer leg., 25.ii.2001. (SMF). ♂ paratype (PJ 1758), ♀ paratype (PJ 1759): India, Meghalaya, Jaintia Hills, Shnongrim-Area, 'Krem Pyrda' Cave near Ladmyrsiang, N 25°20'30", E 92°29'20", cave entrance at ca. 980 metres above sea level, Fischer & Harris leg. 08.ii.2001. (MHNG). 1♀ (PJ 693): India, Meghalaya, Jaintia Hills, Lumshnong-Area, 'Krem Matom' near Mutang, N 25°10'57", E 92°22'01", ± 120m, WGS84, ca. 650 above sea level, 22.ii.1999, Fischer leg. (NMB).

Etymology: The specific name is a patronym in honour of the collector Christian Fischer; noun in genitive case.

Diagnosis: The species can be generally recognized by its impressive size (23-33 mm body length) and can be distinguished from the closely related and similarly sized *Heteropoda robusta* Fage, 1924 by its genital characters (compare also diagnosis



FIGS 12-16

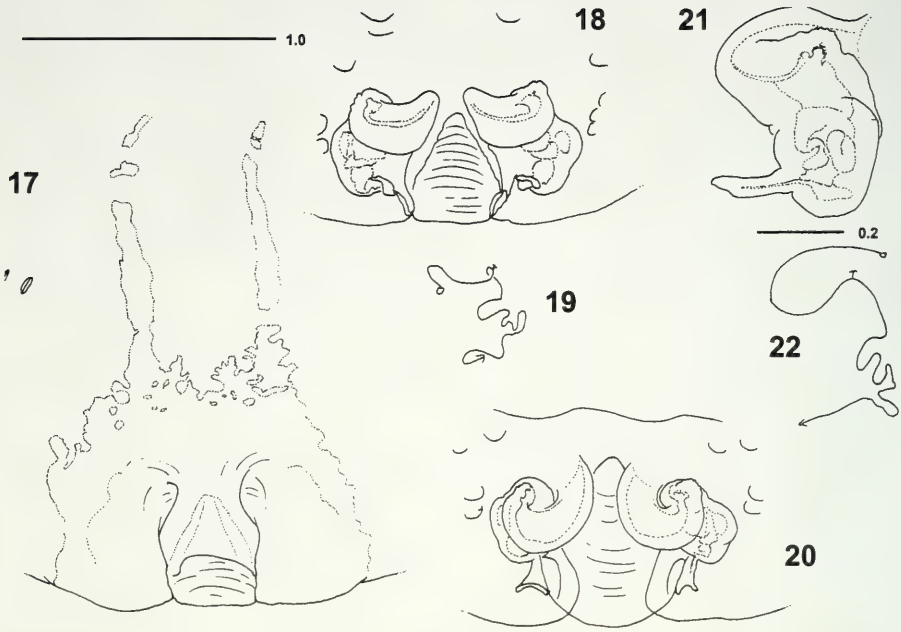
Heteropoda sp. cf. *afghana* Roewer, ♀ from Swat, Pakistan (PJ 1889). – Epigyne, ventral view (12); internal genital duct system, dorsal view (13), anterior view (15); schematic course of internal genital duct system, dorsal view (14), anterior view (16). FW = first winding of the internal genital duct system; GR = glandular region.

of *H. robusta* below): ♂♂: 1. Conductor with basal, acute tooth (Fig. 31), 2. Conductor short and compact, 3. Cymbium elongated (Figs 29, 33). ♀♀: 1. Epigyneal field wider than long, 2. Short anterior bands attached to epigyneal field, 3. Visible part of median septum broader than in other species of the group (Figs 35, 38), 4. First winding of the internal genital duct system compact (Figs 37, 39).

Description: ♂ (measurements of holotype first, those of paratype in parentheses). PL 12.4 (11.5), PW 11.2 (10.4), AW 5.5 (5.0), PH 2.7 (2.5), OL 15.2 (12.0), OW 9.6 (7.2). Eyes: AME 0.49, ALE 0.77, PME 0.62, PLE 0.79, AME-AME 0.25, AME-ALE 0.04, PME-PME 0.52, PME-PLE 0.57, AME-PME 0.55, ALE-PLE 0.63, CH AME 0.95, CH ALE 0.71.

Leg formula: 2143; spination: PP 131, 101, 2121; FE I-II 323, III 333, IV 331; PA 101; TI I-III 2226, IV 2126; MT I-II 1014, III 2014, IV 3036. Measurements of palps and legs: PP 23.0 (7.9, 3.4, 5.3, -, 6.4), I 96.7 (23.6, 7.8, 27.7, 31.7, 5.9), II 106.5 (26.6, 8.3, 31.2, 34.2, 6.2), III 82.2 (21.2, 7.1, 23.6, 25.1, 5.2), IV 89.7 (23.2, 6.7, 24.6, 29.5, 5.7). Ventral apical spine of MT IV as described for other species of Heteropodinae in Jäger (2001b: 14) here replaced by several bristles. Palp and legs elongated.

Tip of cymbium as long as basal part of cymbium. Embolus arising at 6 to 6.30 o'clock on the tegulum. Sperm duct slightly 'S'-shaped. Conductor stout, not reaching



FIGS 17-22

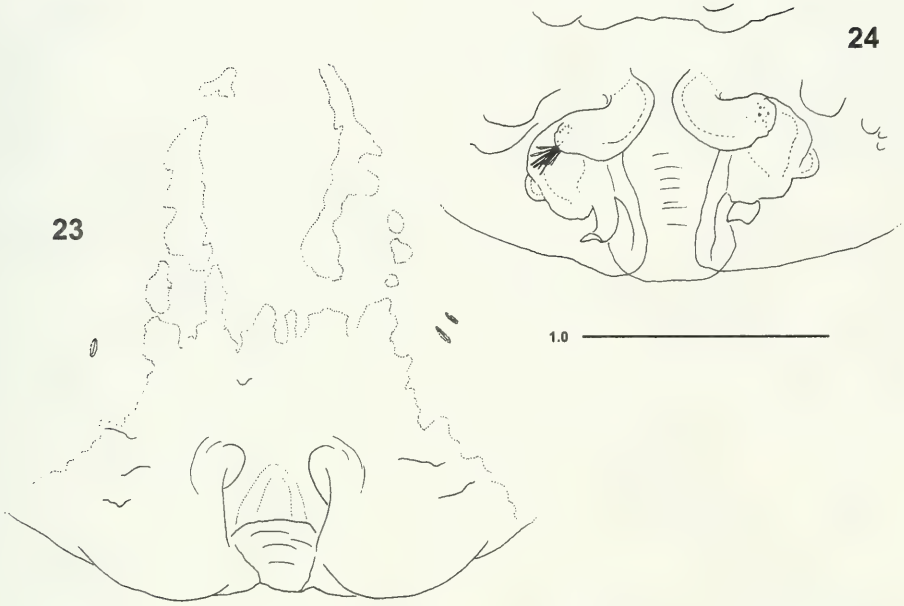
Heteropoda sp. cf. *afghana* Roewer, ♀ from Murree, Pakistan (PJ 407). – Epigyne, ventral view (17); internal genital duct system, dorsal view (18), anterior view (20), lateral view (21); schematic course of internal genital duct system, dorsal view (19), lateral view (22).

the cymbial margin in ventral view (Figs 29, 33). RTA simple, dorsal part slightly bent and with blunt tip in retrolateral view (Figs 30, 34).

Colour: Yellowish brown, with brown to dark brown markings, these partly consisting of short black hairs. Chelicerae deep reddish brown to black. DS with two dark transversal bands, one in front of fovea and one behind, and additional irregular patches. Head region and margin of DS dark. Gnathocoxae and labium reddish brown, sternum, ventral coxae and trochanter yellowish brown, without pattern. Legs yellowish brown with distal segments darker (i.e. reddish brown). FE with dark spine patches; PA with basal half dark; TI slightly annulated. Dorsal OS with sigillae darkened. A dark transversal bar in the posterior half of OS, behind that a pale brown area. Lateral sides of OS with irregular dark patches. Ventral side of OS yellowish brown, without pattern.

♀ (measurements of paratypes). PL 12.1-14.5, PW 11.0-12.7, AW 6.1-7.2, PH 2.3-3.1, OL 15.6-18.5, OW 9.5-12.2. Eyes: AME 0.56, ALE 0.87, PME 0.64, PLE 0.85, AME-AME 0.40, AME-ALE 0.07, PME-PME 0.64, PME-PLE 0.81, AME-PME 0.71, ALE-PLE 0.80, CH AME 1.23, CH ALE 0.95.

Leg formula: 2143; spination: PP 131, 101, 2121, 1014; FE I-II 323, III 333, IV 331; PA 101; TI I-II 2226, III 22(1)26, IV 2126; MT I-II 1014, III 2014, IV 3036. Palpal claw with 9-10 teeth. Measurements of palps and legs: PP 25.0 (7.5, 3.8, 5.7, -, 8.0), I 85.0 (22.1, 8.3, 24.9, 24.2, 5.5), II 92.9 (25.0, 8.4, 27.9, 26.2, 5.4), III 78.6 (22.0, 7.4, 22.6, 22.1, 4.5), IV 84.4 (23.3, 7.1, 23.5, 25.8, 5.1). Ventral apical spine of MT IV



FIGS 23-24
Heteropoda sp. cf. *afghana* Roewer, ♀ from Kulu valley, N-India (PJ 387). – Epigyne, ventral view (23); internal genital duct system, dorsal view (24). Looped apex of right spermathecae with bands of tissue attached to the glandular region.

as described for other species of Heteropodinae in Jäger (2001b: 14) here replaced by several bristles. Palp and legs elongated.

Epigyneal field wider than long; anterior bands much shorter than epigyneal field. Internal genital ducts with one anterior winding. Spermathecae situated postero-lateral to first winding. Glandular area of internal genital duct system situated in a lateral position on the anterior winding (Figs 35-42).

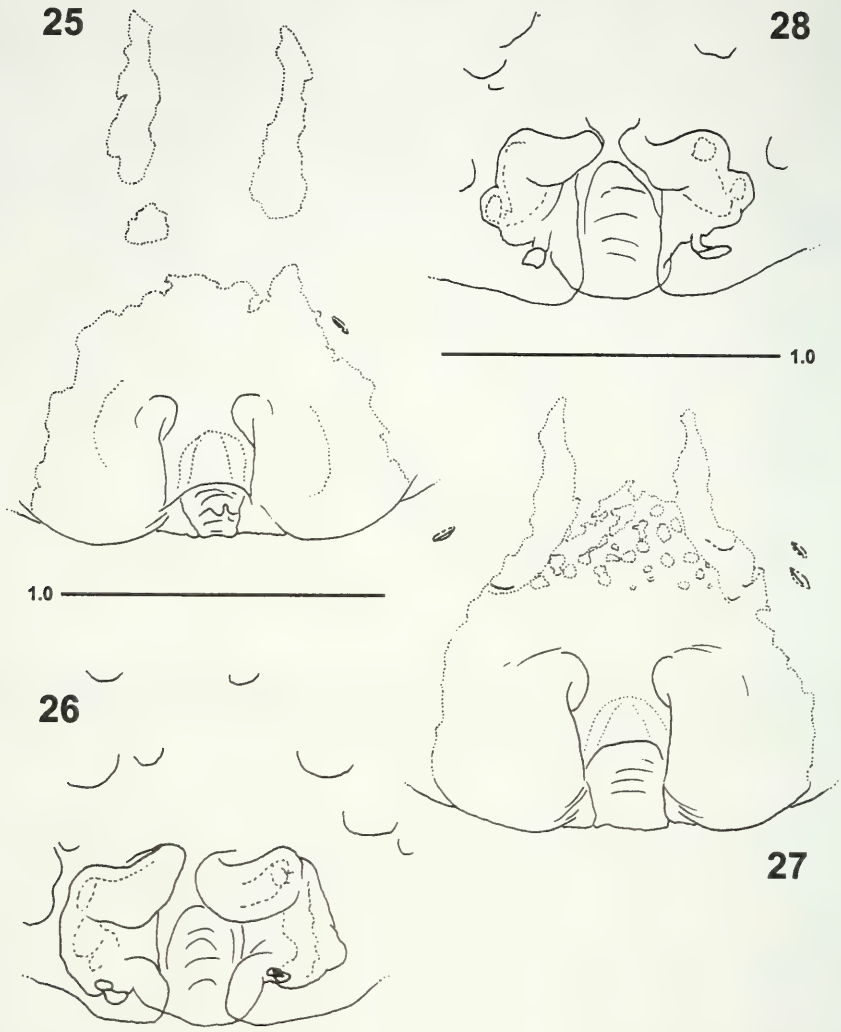
Colour: As in ♂, but ventral side of OS in one specimen (PJ 1759) darker brown.

Distribution: N-India, Meghalaya, Jaintia Hills: Caves near Sutnga, Ladmyrsiang and Mutang (Fig. 1: 6).

Biology: Adult and immature specimens can be found at the same time. All specimens examined were found at the entrance and in the transition area of the cave. Groups of three to eight individuals were observed sitting on the cave walls. Single spiders kept a distance of 30 to 100 centimetres from other spiders. All specimens were perching in the same position, facing downwards and ambushing for prey. As potential prey of *Heteropoda fischeri* sp. n. frogs, scorpions and snakes were observed inside the cave. The body size of the spiders is generally larger the lower the altitude of the cave.

Heteropoda robusta Fage, 1924 Figs 43-45

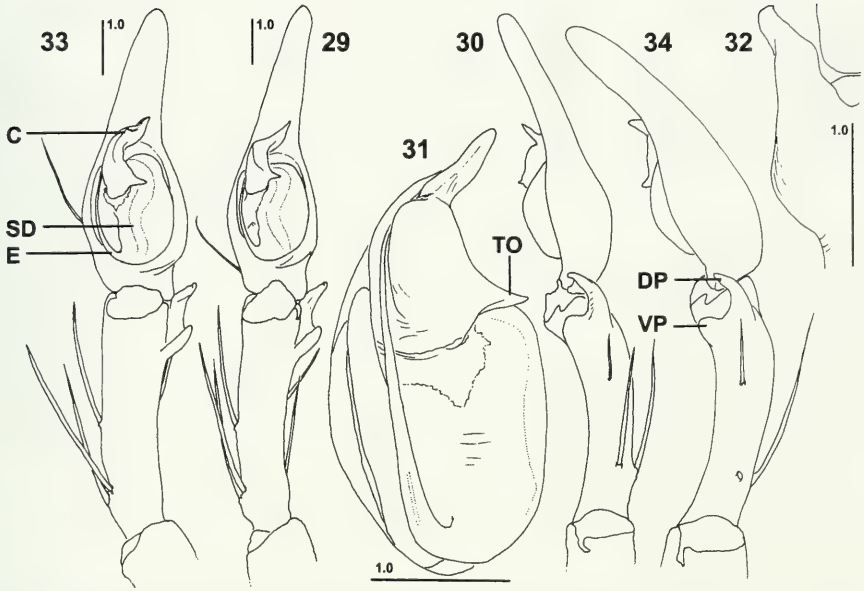
Heteropoda robusta Fage, 1924: 66, fig. 2.
?*Heteropoda robusta*.- Sethi & Tikader, 1988: 10, 17, figs 58-63 (see notes below).



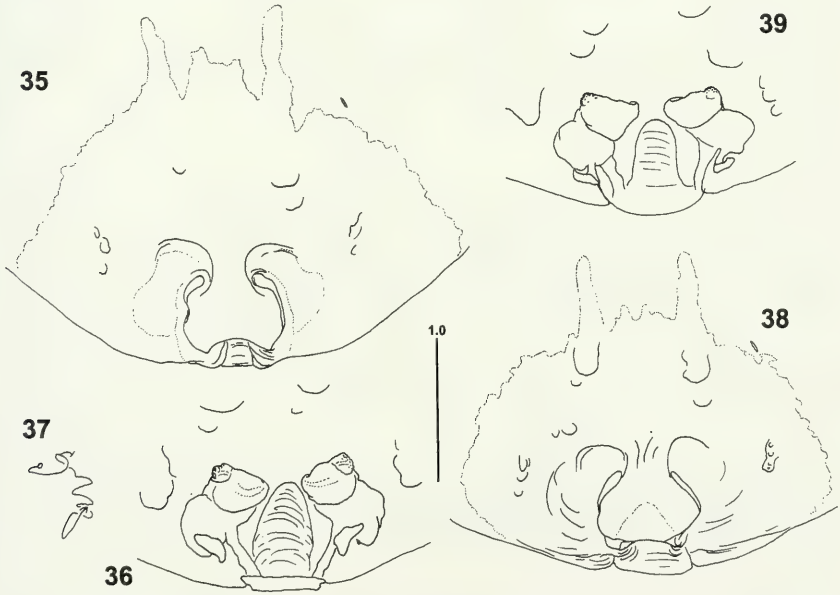
FIGS 25-28

Heteropoda sp. cf. *afghana* Roewer, ♀ from Kulu valley, N-India, PJ 222 (25-26), PJ 386 (27-28). – Epigyne, ventral view (25, 27); internal genital duct system, dorsal view (26, 28).

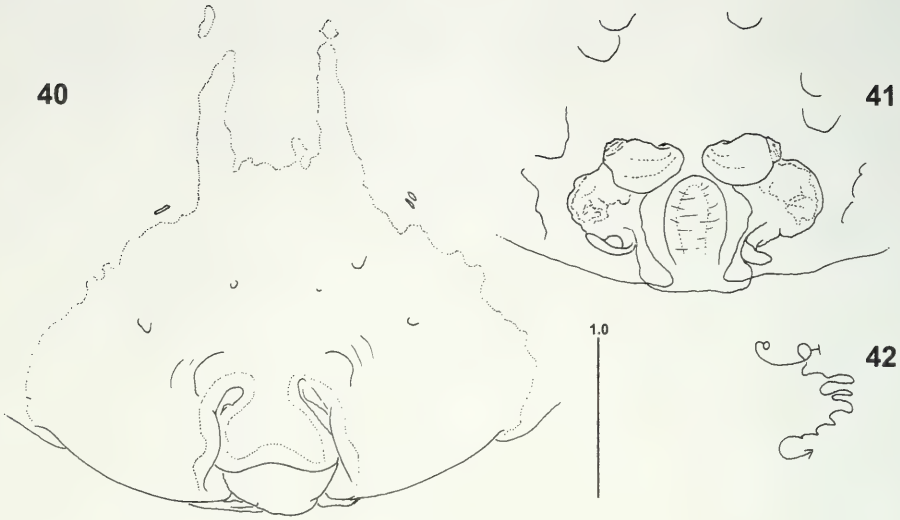
Material examined: 1♀ syntype (PJ 767): N-India, Assam, Garo Hills, Siju Cave, S.K. & B.N.C, ii.1922, 450-500ft. from entrance, 1734 D. (MNHN). 2 immature syntypes: N-India, Assam, Garo Hills, Siju Cave, S.K. & B.N.C, ii.1922, 350-500 ft. from entrance, 1734 A. (MNHN). 2 immature syntypes: N-India, Assam, Garo Hills, Siju Cave, S.K. & B.N.C, ii.1922, 1000 ft. from entrance, 1734 B. (MNHN). 3 immature syntypes: N-India, Assam, Garo Hills, Siju Cave, S.K. & B.N.C, ii.1922, 2200-2400 ft. from entrance, 1734 C. (MNHN). 3 ♀ syntypes, 6 immature syntypes: N-India, Assam, Garo Hills, Siju Cave, S.K. & B.N.C, ii.1922, 450-500ft. from entrance, 1734 E. (MNHN).



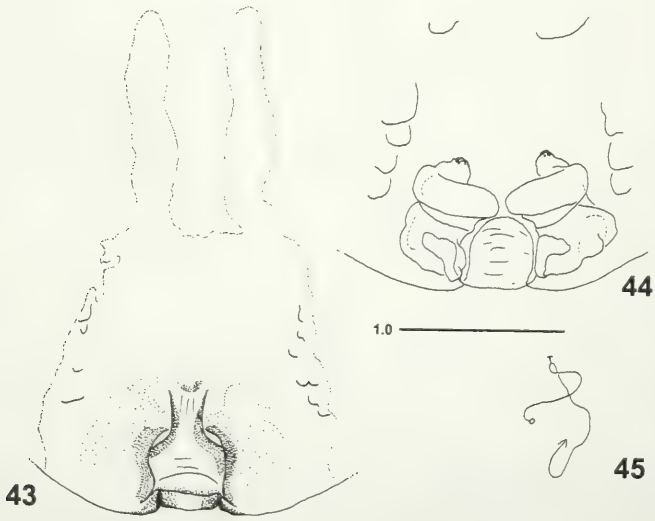
FIGS 29-34. *Heteropoda fischeri* sp. n., ♂ holotype (29-32), ♂ paratype (33-34). – Left palp, ventral view (29, 33), retrolateral view (30, 34); tegulum, prolateral view (31); RTA, dorsal view (32). C = conductor; DP = dorsal part of RTA; E = embolus; SD = sperm duct; TO = basal tooth of conductor; VP = ventral part of RTA.



FIGS 35-39. *Heteropoda fischeri* sp. n., 2 ♀ paratypes, from Sutnga, PJ 1757 (35-37), from Ladmyrsiang, PJ 1759 (38-39). – Epigyne, ventral view (35, 38); internal genital duct system, dorsal view (36, 39); schematic course of internal genital duct system, dorsal view (37).



FIGS 40-42
Heteropoda fischeri sp. n., ♀ from Mutang, PJ 693. – Epigyne, ventral view (40); internal genital duct system, dorsal view (41); schematic course of internal genital duct system, dorsal view (42).



FIGS 43-45
Heteropoda robusta Fage, ♀ syntype, PJ 767. – Epigyne, ventral view (43); internal genital duct system, dorsal view (44); schematic course of internal genital duct system, dorsal view (45).

Diagnosis: Large species (32 mm body length) with elongated appendages (length of second leg 90 mm). ♀♀ may be distinguished from those of the closely related *H. fischeri* sp. n. by their genitalia (Figs 43-45): 1. Epigyneal field slightly longer than wide. 2. Anterior bands almost as long as the epigyneal field. 3. Internal genital ducts similar to those of *H. fischeri* sp. n., but first winding longer. 4. Glandular structures more elevated and situated anterior to the first winding.

Description: See Fage (1924).

Distribution: Known only from the type locality (Fig. 1: 5; see notes below).

Biology: The original description by Fage (1924) gives only few statements on the biology of this species: The spiders were collected from the entrance area to 2,400 feet inside the cave. Apparently the species is abundant in the cave. ♀♀ with egg-sacs and juveniles were found together.

Notes: According to the original description by Fage (1924) 22 ♀ syntypes should be present. In the MNHN only 4 ♀ and 13 immatures could be located. According to the labels, all these specimens are considered as belonging to the syntype series. The whereabouts of the 5 missing specimens are unknown.

Sethi & Tikader (1988) described and illustrated ♂ and ♀ of *H. robusta*. Although they illustrated the palp of a ♂, no diagnostic characters are recognizable from that illustration and no such characters are described or mentioned in the text or in the determination key. The palpal cymbium is not elongated as in other troglomorphic cave-dwellers. The illustrations of ♀ genitalia show no correspondence with the examined type material. Sethi & Tikader (1988: 18) stated that the illustrations were made from a ♀ specimen collected in Kanha National Park and compared with an identified specimen from the collection of the Zoological Survey of India in Calcutta (Regd. No. 2105/18). The illustrated female may represent a subadult specimen (compare note on *Olios kiranae* Sethi & Tikader in Jäger & Ono 2000: 45). Therefore I doubt that the illustrated specimens are conspecific with *H. robusta*. Thus the ♂ of this species remains unknown.

Heteropoda tetrica Thorell, 1897 Figs 46-49

For diagnosis, description, type deposition see Jäger (2001b: 22).

Material examined: 1 ♂ (PJ 1893), N-Thailand: Doi Suthep near Chiang Mai, 1000 m, 11.i.1959, B. Degenbøl, Pr. 2093A, Journ. 1.7.59, # 287. 1♂ (PJ 1894), Doi Suthep, 1100 m, 17.xii.1958, B. Degenbøl, Pr. 2010A, 1.7.59, # 289. 1♂ (PJ 1895), Doi Suthep, 1000 m, 27.ix.1958, B. Degenbøl, Pr. 1384A, Journ. 1.7.59, # 297. (all in ZMUC).

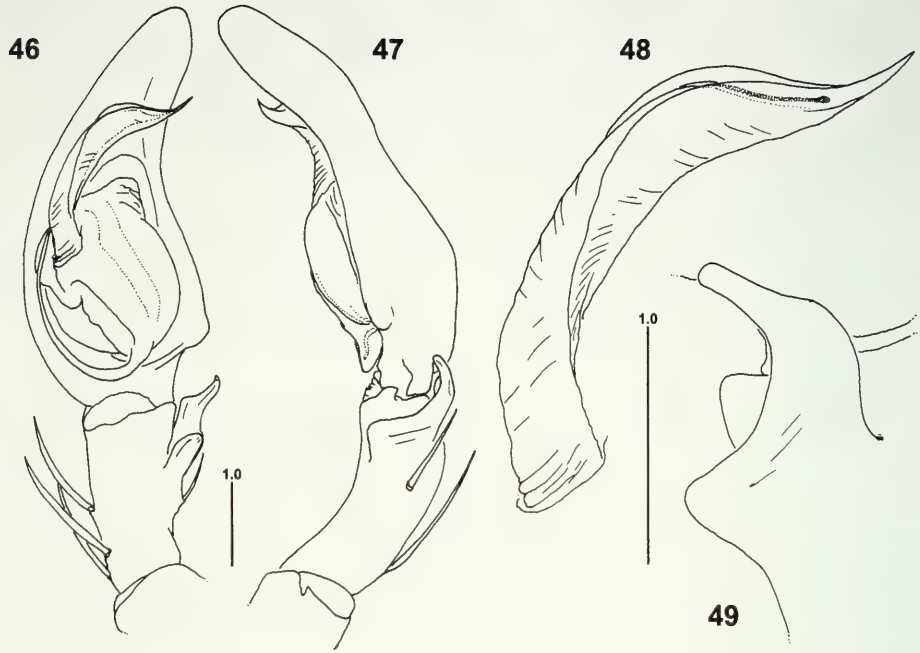
Variation: PL 8.9-9.1, OL 10.0-10.5.

Distribution: Myanmar: Kayah State; N-Thailand: Chiang Mai Province: Doi Suthep (Fig. 1: 7-8).

Note: The following species (*H. schwendingeri* sp. n.) cannot be grouped with any other species due to the lack of conspecific females. According to male genital characters it could be related to *H. tetrica* Thorell, 1897, which was originally described from Myanmar ('Mons Carin' = Karen Mountains, Kayah State). New records of *H. tetrica* from N-Thailand are listed here for the first time.

Heteropoda schwendingeri sp. n. Figs 50-58

Material examined: ♂ holotype (PJ 1892), Thailand: Chumphon Prov., Nam Lod Yai Cave (=Than Lod Cave), 10°12'58.1" N, 98°56'21.1." E, 100 m, inside limestone cave, 7.v.2003, leg. P. Schwendinger. TH-03/04. (MHNG).



FIGS 46-49

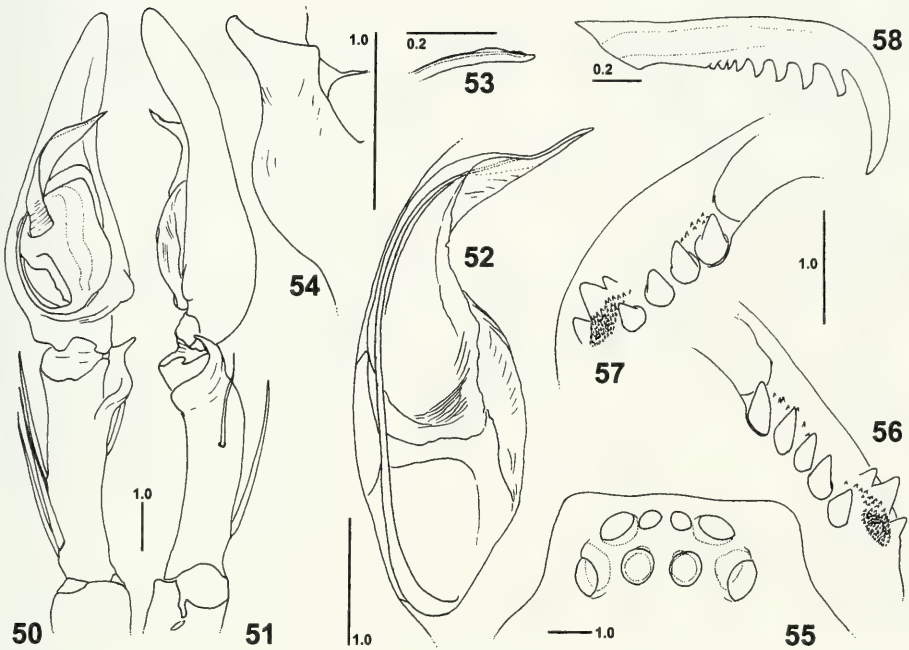
Heteropoda tetrica Thorell, ♂ from Doi Suthep, N-Thailand. – Left male palp, ventral view (46), retrolateral view (47); conductor and hidden tip of embolus, ventral view (48); RTA, orthogonal view (49).

Etymology: The specific name is a patronym in honour of the collector, Peter Schwendinger; noun in genitive case.

Diagnosis: The species seems to be closely related to *Heteropoda tetrica*. It is characterized by its impressive legspan (230 mm) and can be distinguished by male genital characters (Figs 50-54; compare *H. tetrica*: Figs 46-49 and Jäger, 2001b: figs 16a-g): ♂♂: 1. Cymbium elongated (tip of cymbium longer than tegulum), 2. Conductor broad, with sigmoid apical margin, 3. Dorsal RTA with distinct, almost rectangled bulge in dorsal view.

Description: ♂. PL 13.3, PW 11.6, AW 5.5, PH 3.2, OL 13.5, OW 7.3. Eyes: AME 0.59, ALE 0.90, PME 0.76, PLE 0.96, AME-AME 0.20, AME-ALE 0.07, PME-PME 0.31, PME-PLE 0.66, AME-PME 0.46, ALE-PLE 0.58, CH AME 1.10, CH ALE 0.90.

Leg formula: 2143; spination: PP 131, 000, 2111, FE I-III 323, IV 331(2), PA I 101, II 10(1)1, III-IV 101, TI 2226, MT I-II 1014, III 2014, IV 3036. Measurements of palps and legs: PP 47.5 (7.9, 3.2, 4.8, -, 7.0), I 97.6 (24.6, 7.8, 29.0, 30.2, 6.0), II 107.8 (27.1, 8.2, 32.1, 34.2, 6.2), III 82.2 (22.4, 7.1, 24.7, 23.3, 4.7), IV 89.7 (24.2, 6.7, 25.9, 5.2, 27.7). Cheliceral furrow with 4 and 5 posterior teeth on right and left side respectively (Figs 56-57). Ventral apical spine of MT IV as described for other species of Heteropodinae in Jäger (2001b: 14) replaced by a brush of bristles. Palp and legs elongated.



FIGS 50-58

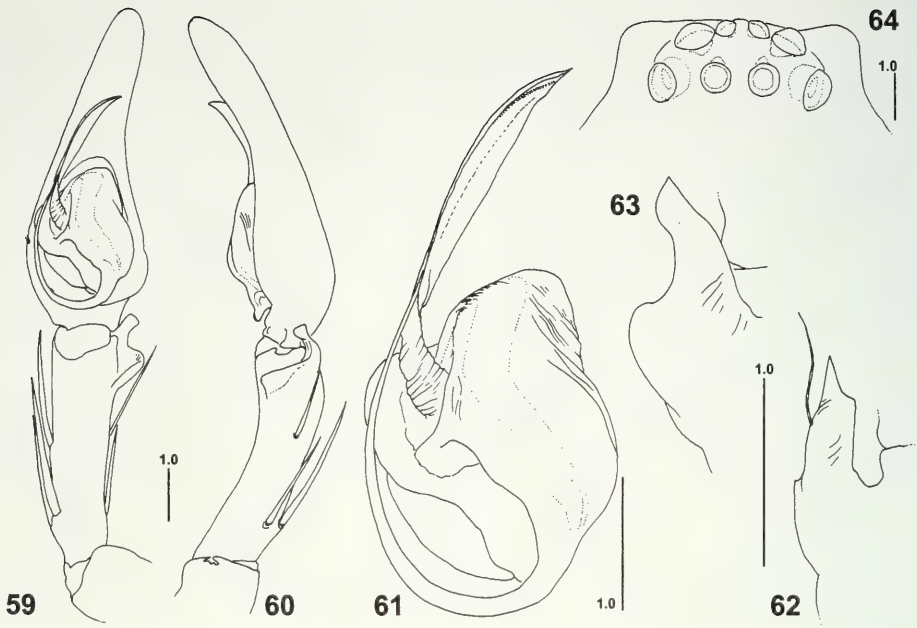
Heteropoda schwendingeri sp. n., ♂ holotype. – Left palp, ventral view (50), retrolateral view (51); tegulum, prolateral view (52); tip of embolus, ventral view (53); RTA, dorsal view (54); eye group, dorsal view (55); cheliceral furrow, ventral view, right (56), left (57); retrolateral claw of right leg I, retrolateral view (58).

Embolus arising at 6 o'clock on the tegulum (Fig. 50), its tip simple, with a subapical opening of the sperm duct (Fig. 53). Conductor long, reaching the cymbial margin in ventral view (Fig. 50). Sperm duct almost straight. RTA simple in retrolateral view, dorsal part widened in ventral and dorsal view.

Colour: Yellowish brown to light brown, with dark brown markings, these partly consisting of short black hairs. Chelicerae yellowish brown to dark brown. DS with irregular pattern of narrow radial bands and irregular marginal patches. Posterior DS with wide light transversal band. Gnathocoxae and labium light reddish brown, sternum, ventral coxae, trochanter and non-apical FE yellowish brown without pattern, except for indistinctly speckled ventral FE. Legs light brown with distal segments darker (i.e. reddish brown). Spine patches of dorsal FE fused to wide continuous annulations, apical annulation extending around dorsal and ventral side of femur; ventral and prolateral sides of PA with dark basal half; each TI distinctly annulated with two wide bands. Dorsal side of OS with sigillae darkened. Remaining pattern of OS irregular and indistinct. Ventral side of OS brown, without pattern.

♀ unknown.

Distribution: Only known from the type locality (Fig. 1: 9).



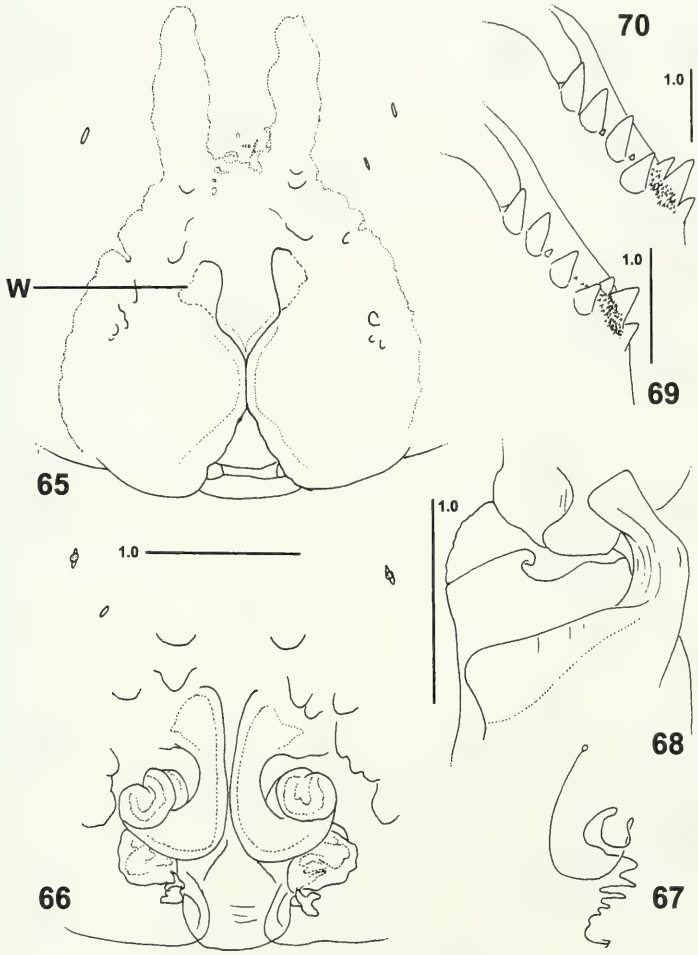
FIGS 59-64

Heteropoda beroni sp. n., ♂ holotype. – Left palp, ventral view (59), retrolateral view (60); tegulum, ventral view (61); RTA, dorsal view (62), orthogonal view (63); eye group, dorsal view (64).

Note: One of the legs patellae carries one dorsal spine. This is here recorded for the first time for the whole Sparassidae. However, it could be due to a deformity in ontogeny.

Heteropoda beroni sp. n. Figs 59-81

Material examined. ♂ holotype (PJ 1796): Indonesia, South Sulawesi (= Sulawesi Selatan), Karst Maros, Pangkajene, Gua (=Cave) Mattampa Bawah, 16.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI. (SMF). 1 ♀ paratype (PJ 1797), 1 juvenile ♀ (PJ 1884) with same data as for holotype (MZBI). 2 ♀ paratypes (PJ 1794, 1790): Gua S.1 Balangajea, 28.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0007, Aran.2002.0008 (MZBI). 1 ♀ paratype (PJ 1793): Gua Mimpi, 22.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0009 (MZBI). 1 ♀ paratype (PJ 1789): Gua Mimpi, 22.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0003 (MHNG). 1 ♀, 2 juv. paratypes (PJ 1792, PJ 1885-1886): Gua Rumbia, 21.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0014, Aran.2002.0015-16 (MZBI). 1 ♀ paratype (PJ 1791): Gua Pattunuang, 23.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0006 (MZBI). 1 ♀ paratype (PJ 1795): Gua Saripa, 18.iv.2002, Yayuk & Cajyo, Maros Project ARBC-LIPI, Aran.2002.0005 (MZBI). 1 subadult ♂: Bone, Kahu, Gua Sanggaleri, 20.vii.2001, L. Deharveng & R. Cahyo, Maros Project ARBC-LIPI, Aran.2001.0116. 1 juvenile: Bone, Kahu, Gua Batih, 20.vii.2001, R. Cahyo, Maros Project ARBC-LIPI, Aran.2001.0117. 2 ♀ paratypes (PJ 1206, 1207): Bantimurung, v. Lembatorang the dry cave Lembatorang, 2.ix.1995, P. Beron et T. Ivanova leg. (ZMS). 1 ♀ paratype (PJ 1760): Bantimurung, Gua Balantajia, 4.ix.1995, P. Beron et T. Ivanova leg. (ZMS). 1 ♀ paratype (PJ 1761), 1 juvenile (PJ 1762): Bantimurung, Gua Mimpi, 3.ix.1995, P. Beron et T. Ivanova leg. (SMF).

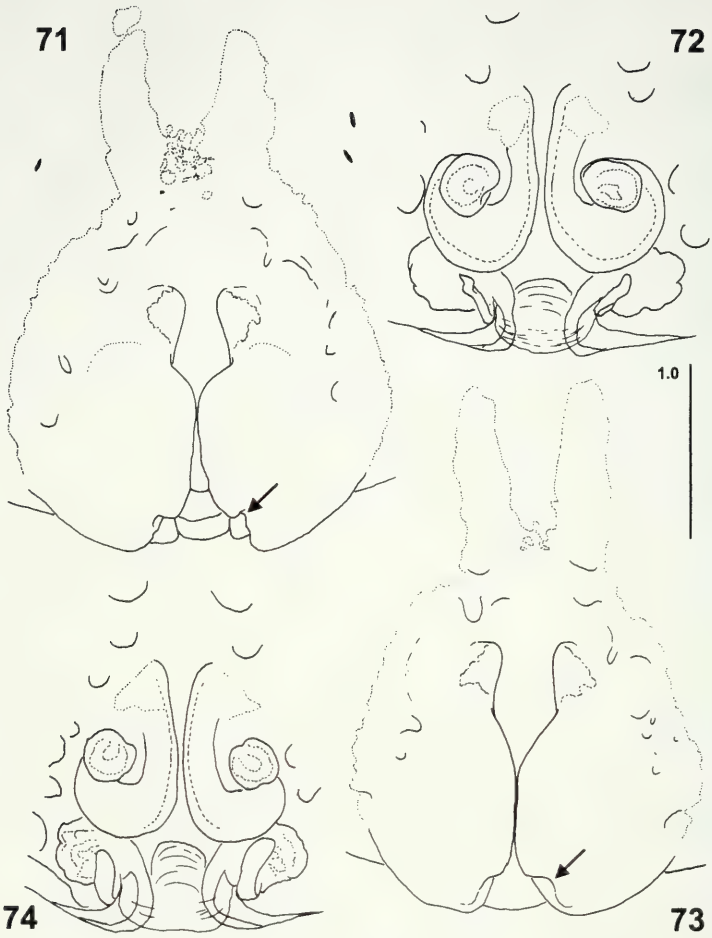


FIGS 65-70

Heteropoda beroni sp. n., ♂ holotype (68-69), 1 ♀ paratype from Pangkajene, PJ 1797 (65-67, 70). – Epigyne, ventral view (65); internal genital duct system, dorsal view (66); schematic course of internal genital duct system, dorsal view (67). RTA, retrolateral view (68); furrow of right chelicerae, ventral view (69-70). W = window, close to anterior median septum.

Etymology: The specific name is a patronym in honour of one of the collectors, Prof. Petar Beron, and in respect of his efforts in exploring the caves of Asia; noun in genitive case.

Diagnosis: The species seems to be related to several forms from Sulawesi and may be recognized by its large size and by the following combination of characters (Figs 59-63, 65-68, 71-74, 80-81): ♂♂: 1. Cymbium elongated, 2. Conductor narrow and its margin straight, i.e. not sigmoid, 3. Tip of RTA in prolatero-dorsal view with sharp edge. ♀♀: 1. Epigyneal field at its posterior lateral margins bent mediad, 2.

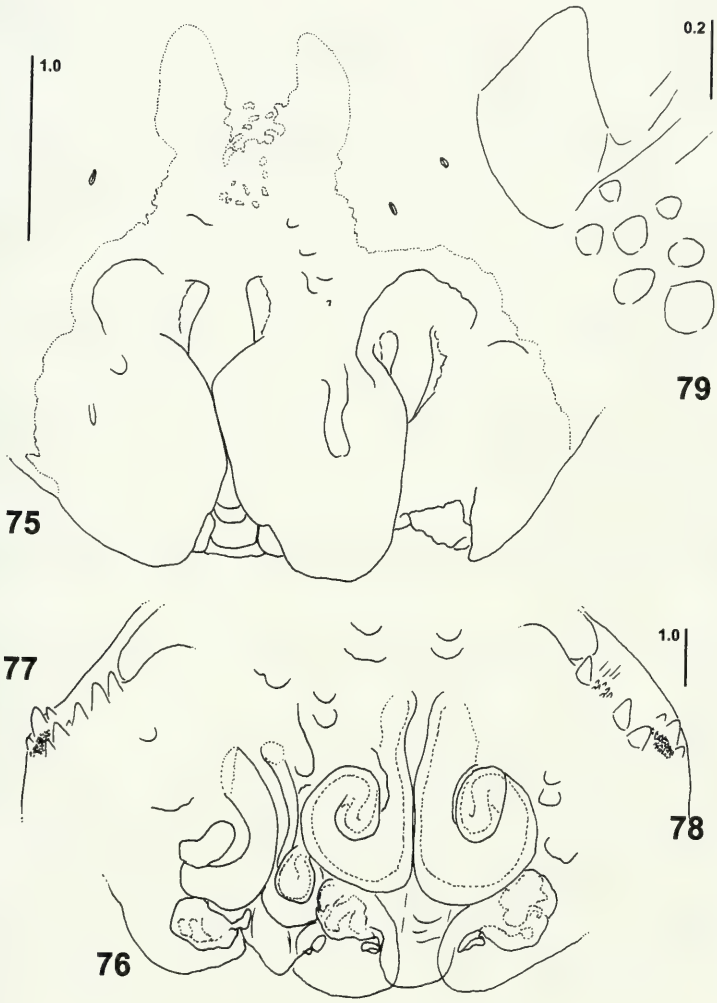


FIGS 71-74

Heteropoda beroni sp. n., 2 ♀ paratypes from Bantimurung, PJ 1761 (71-72), PJ 1206 (73-74). – Epigyne, ventral view (71, 73); internal genital duct system, dorsal view (72, 74). Arrows pointing to incision on posterior margin.

Anterior bands half as long as the epigyneal field, 3. Lateral lobes of epigyne touching each other, 4. Margins of median septum anteriorly converging, 5. Posterior part of first winding of internal genital duct system wide, 6. Looped apex spherical, situated at the margin of the first winding, 7. Anterior part of first winding only slightly diverging, directed orad (see arrows in Fig. 80; compare with *H. kuekenthali*, see arrows in Fig. 86).

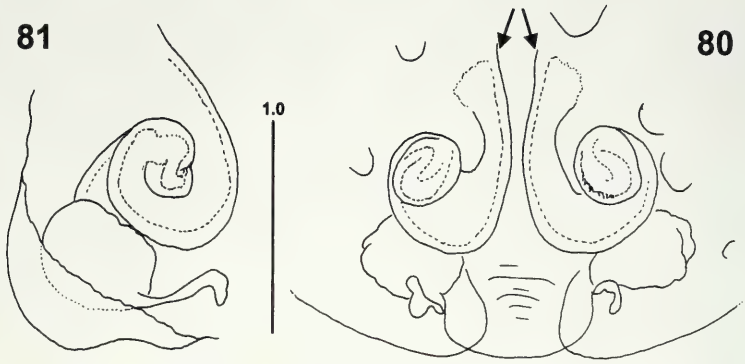
Description: ♂ PL 11.6, PW 10.6, AW 5.2, PH 2.8, OL 11.5, OW 6.1. Eyes: AME 0.50, ALE 0.83, PME 0.66, PLE 0.87, AME-AME 0.22, AME-ALE 0.03, PME-PME 0.39, PME-PLE 0.56, AME-PME 0.54, ALE-PLE 0.55, CH AME 0.84, CH ALE 0.55.



FIGS 75-79

Heteropoda beroni sp. n., ♀ paratype from Simbang, PJ 1795. – Double epigyne, ventral view (75); double internal genital duct system, dorsal view (76); cheliceral furrow, ventral view, left (77), right (78), detail from 78, showing replacement of a retromarginal tooth by larger denticels (79).

Leg formula: 2143; spination: PP 131, 101, 2121; FE I-II 323, III 333, IV 331; PA 101; TI I-II 2226, III-IV 2126; MT I-II 1014, III 2014, IV 3036. Measurements of palps and legs: PP 20.9 (7.1, 2.9, 4.6, -, 6.3), I 82.6 (21.5, 7.1, 25.1, 23.5, 5.4), II 91.7 (24.0, 7.5, 28.1, 26.6, 5.5), III 68.4 (18.9, 6.2, 21.3, 17.8, 4.2), IV 73.8 (20.3, 6.0, 21.8, 21.4, 4.3). Cheliceral furrow with 3 promarginal and 4 retromarginal teeth. One additional small retromarginal tooth present on the right chelicerae in between second and third tooth (Fig. 69).



FIGS 80-81

Heteropoda beroni sp. n., ♀ paratype from Bantimurung, PJ 1789. – Internal genital duct system, dorsal view (80), lateral view (81). Arrows pointing to quasi-parallel anterior parts of the internal genital duct system.

Embolus arising from tegulum at 4.30 o'clock, conductor at 10 o'clock. Sperm duct slightly sigmoid (Figs 59, 61). Ventral RTA with straight margin in lateral view (Fig. 60).

Colour: Light reddish brown, almost without pattern. Chelicerae darker brown. DS and legs light reddish brown, with only indistinct spine patches or annulations. Gnathocoxae and labium light red-brown with distal tip yellowish brown. OS lighter reddish brown and almost without markings.

♀ PL 14.1-18.5, PW 12.5-16.2, AW 6.8-9.4, PH 3.6-5.0, OL 16.5-24.8, OW 9.6-15.7. Eyes: AME 0.64-0.71, ALE 1.01-1.02, PME 0.83, PLE 0.98-1.05, AME-AME 0.31-0.36, AME-ALE 0.07-0.15, PME-PME 0.59-0.63, PME-PLE 0.86-0.94, AME-PME 0.70-0.76, ALE-PLE 0.85-0.96, CH AME 1.50-1.53, CH ALE 1.12-1.30.

Leg formula: 2143; spination: PP 131, 101, 2121, 1014; FE I-II, III 32(3)3, IV 331; PA I-III 000(101), IV 101; TI I-II 2026(2226), III-IV 2126(2226); MT I-II 1014, III 2014, IV 3036. Palpal claw with 7-9 teeth. Measurements of palps and legs: PP 28.0-30.2 (8.8-9.2, 4.1-4.2, 6.2-7.1, -,8.9-9.7), I 84.6-96.5 (22.4-25.3, 9.2-10.2, 25.4-27.8, 22.6-26.0, 5.0-7.2), II 91.8-104.0 (25.1-28.4, 9.8-11.0, 27.5-30.5, 24.3-28.5, 5.1-5.6), III 76.2-84.4 (21.4-24.3, 8.2-9.3, 23.0-24.3, 19.3-21.7, 4.3-4.8), IV 83.4-89.5 (23.0-24.7, 7.9-8.6, 24.1-25.7, 23.4-25.2, 5.0-5.3). Cheliceral furrow with 3 promarginal and 4 retromarginal teeth. Two additional small retromarginal teeth present on the right chelicerae, one between the first and the second, another between the second and the third tooth (Fig. 70).

Epigyne with rounded epigyneal field, distinct anterior bands and bright triangle-shaped 'windows' near the anterior median septum (Fig. 65). Posterior margin of lateral lobes with median incision (see arrows in Figs 71, 73).

Colour: Reddish brown almost without pattern. Chelicerae black. DS and legs reddish brown with only slight spine patches or annulations. Gnathocoxae and labium dark red-brown with distal tip yellowish brown. OS lighter reddish brown and almost without markings.

Variation and deformations: On the chelicerae of one ♀ (PJ 1797) two small additional retromarginal teeth are present (Fig. 77). In one ♀ (PJ 1795) one retromarginal tooth is replaced by larger denticles (Figs 78-79). One ♀ (PJ 1791) possesses a double epigyne and a double internal genital duct system (Figs 75-76). A smaller epigyne is situated on the left side of the normal-sized quasi-central epigyne.

Distribution: Indonesia, S-Sulawesi: caves near Maros, Pangkajene, and Bone (Fig. 1: 12-14).

Biology: The spiders were sitting on walls inside the cave, facing downwards. Gua Mimpi and Gua Balangajea are deep and wet caves.

Notes: According to our present knowledge, *H. beroni* sp. n. groups together with *H. bonthainensis* Merian, 1911 and other species from Sulawesi, some of which were illustrated by Jäger (2002). In order to facilitate a comparison two additional species are illustrated here, which either occur in Sulawesi as well (*H. nigriventer*) or apparently belong to the same phylogenetic lineage (*H. kuekenthali*). A good diagnostic character for this lineage seems to be the course of the internal duct system of ♀ genitalia: The plane of the first winding is directed parallel to the longitudinal axis of the body. The looped apex may be situated in the centre of the first winding or at its margin. The lateral lobes of the epigyne touch each other at one point or along a short distance. In males, known from two species, the tip of the dorsal RTA is widened in retrolateral view (Fig. 68, compare with other *Heteropoda* spp. e.g., Figs 30, 34, 47, 51). More species are needed to establish a diagnosis for a formal species group.

Heteropoda nigriventer Pocock, 1897 Figs 82-84

Heteropoda nigriventer Pocock, 1897: 617, pl. 26, fig. 20.

Material examined: ♀ holotype (PJ 1763; pinned specimen, formerly dry and recently transferred to alcohol): Indonesia, Sulawesi, Donggala, W. Kükenthal, 97.11.1.122. (NHM).

Diagnosis: Epigyneal field with only short and stout anterior bands. Median septum freely visible (Fig. 82). Posterior spermathecae covering parts of the first winding of the internal genital duct system in dorsal view (Fig. 83).

Description: PL 10.6, OL 13.7. For further details see Pocock (1897).

Distribution: Known only from the type locality (Fig. 1: 15).

Heteropoda kuekenthali Pocock, 1897 Figs 85-90

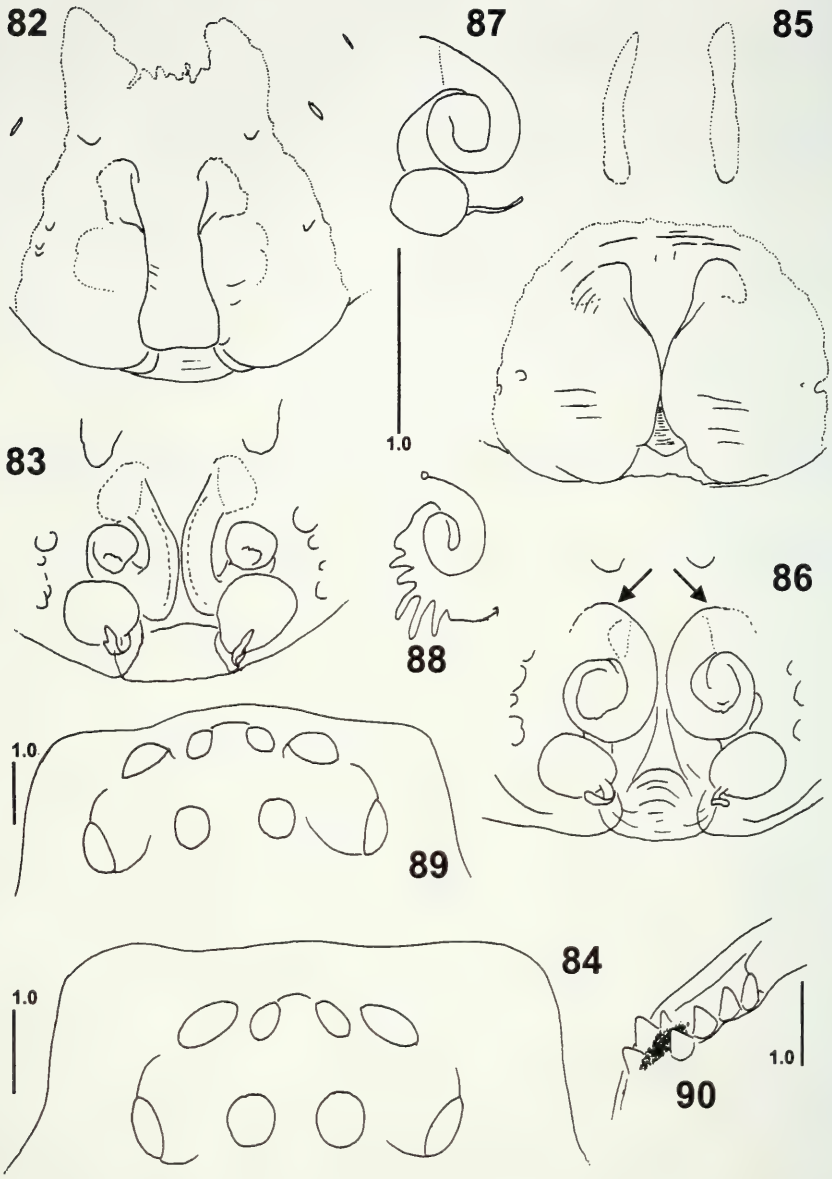
Heteropoda kuekenthali Pocock, 1897: 615, pl. 25, fig. 19.

Material examined: ♀ holotype (PJ 1764): Indonesia, Halmahera, Soa Kanorra (= Soakonora), 1897.11.1.121. (NHM).

Diagnosis: Epigyneal field with long anterior bands, i.e. two third of the length of the field, these separated from the field. Lateral lobes touching each other, their inner margins diverging in their anterior and posterior part (Fig. 85). Spermathecae appearing as round structures in dorsal view, without any overlap with the first winding of the genital duct in dorsal view. Looped apex situated almost in the centre of the first winding. Anterior part of the first winding more strongly bent than in *H. beroni* sp. n., directed laterad (see arrows in Fig. 86).

Description: PL 12.3, OL 14.9. For further details see Pocock (1897).

Distribution: Known only from the type locality (Fig. 1: 16).



FIGS 82-90

Heteropoda nigriventer Pocock, ♀ holotype (82-84), *Heteropoda kuekenthali* Pocock ♀ holotype (85-90). – Epigyne, ventral view (82, 85); internal genital duct system, dorsal view (83, 86), lateral view (87); schematic course of internal genital duct system, lateral view (88); eye group, dorsal view (84, 89); furrow of left chelicera, ventral view (90). Arrows pointing to the distinctly bent anterior part of the internal genital duct system.

Heteropoda belua sp. n. Figs 91-101

Material examined: ♂ holotype (PJ 1736), 2 ♀ paratypes (PJ 1737, 1738): Malaysia, Sarawak, Bau, G. Jambusan, Niang Cave, 26. Chapman, 21.xi.1980 (NHM).

Etymology: The specific name refers to the epigyne, which resembles the face of a monster, and the possibility that the cave could be full of these large-sized spiders, which are regarded as 'monsters' with their eyes shining in the light of a torch (Latin: belua – monster, beast); noun in apposition.

Diagnosis: ♂♂ with a distinct process at the base of the embolus (Figs 91, 93). Dorsal RTA with two processes, a thin pin-shaped one and a broad one (Fig. 94). Ventral RTA with a small and a large hump in lateral view (Fig. 92). ♀♀: Epigyne with tongue-shaped lateral lobes which are extending beyond the epigastric furrow. Lateral lobes in their posterior part with two small cavities (Fig. 96). Internal genital duct system with spermathecae situated posteriorly and close to each other. First windings in an antero-lateral position, looped apex situated at the median margin of the first windings (Figs 97-99).

Description: ♂ PL 8.9, PW 7.7, AW 3.7, PH 3.0, OL 9.0, OW 4.7. Eyes: AME 0.41, ALE 0.57, PME 0.45, PLE 0.55, AME-AME 0.25, AME-ALE 0.07, PME-PME 0.31, PME-PLE 0.49, AME-PME 0.38, ALE-PLE 0.43, CH AME 1.05, CH ALE 0.78.

Leg formula: 2143; spination: PP 131, 101, 2121; FE I 323, II-III 333, IV 331; PA 101; TI I-II 2226, III-IV 2126; MT I-II 1014, III 2024, IV 3036. Measurements of palps and legs: PP 15.8 (5.5, 2.1, 3.0, -, 5.2), I 68.1 (17.5, 5.4, 21.0, 19.7, 4.5), II 78.3 (20.9, 5.5, 24.3, 22.6, 5.0), III 55.3 (15.6, 4.5, 17.0, 14.6, 3.6), IV 66.6. (18.5, 4.6, 19.3, 19.8, 4.4). Cheliceral furrow with 5 posterior teeth and additional single denticles on the distal margin. Leg claw with long and slender primary tooth (Fig. 101).

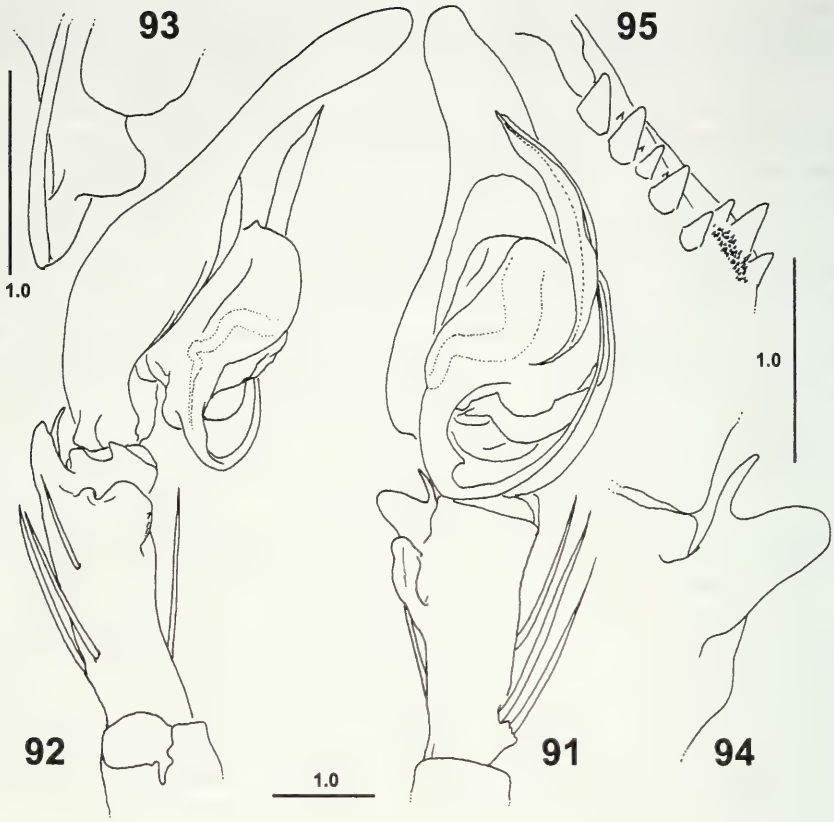
Embolus arising from the tegulum at 3 o'clock, conductor at 9-10 o'clock. Sperm duct wound. Conductor crescent-shaped (Fig. 91). Ventral and dorsal RTA distinctly separated in lateral view (Fig. 92).

Colour: As the ♂ holotype is not well preserved, only recognizable features of colouration are given. Body and legs generally yellowish brown. Chelicerae darker in their basal half. FE and TI slightly annulated.

♀ (measurements of paratypes). PL 14.2-15.2, PW 12.5-13.0, AW 6.4-6.8, PH 4.0-4.2, OL 15.1-16.2, OW 8.4-8.8. Eyes: AME 0.57, ALE 0.80, PME 0.61-0.64, PLE 0.76-0.77, AME-AME 0.45-0.48, AME-ALE 0.17-0.18, PME-PME 0.52-0.55, PME-PLE 0.84-0.86, AME-PME 0.67-0.69, ALE-PLE 0.68-0.73, CH AME 1.87-1.96, CH ALE 1.51-1.57.

Leg formula: 2413; spination: PP 131, 101, 2121, 1014; FE I 323, II-III 333, IV 331(2); PA 101; TI 2126; MT I-II 1014, III 2014, IV 3036. Palpal claw with 9-11 teeth. Measurements of palps and legs: PP 25.6-27.0 (7.5-8.0, 3.7-3.8, 5.8-6.5, -, 8.6-8.7), I 84.6-85.5 (22.6-23.0, 8.0, 25.7-25.8, 23.1-23.7, 5.1), II 92.9-93.8 (24.9-25.7, 8.2-8.4, 28.3-28.8, 25.4-25.6, 5.5-5.9), III 73.8-73.9 (21.0-21.3, 7.1-7.3, 22.1-22.0, 18.6-19.0, 4.6-4.7), IV 88.5-88.6 (24.4-25.2, 7.1-7.2, 26.0-26.2, 24.6-25.3, 5.5-5.6). Cheliceral furrow with 5-6 posterior teeth and additional single denticles on the distal margin.

Epigyneal field roundish, slightly separated from anterior bands (Fig. 96). First winding of internal genital duct system situated laterally, loops directed mediad (Figs 97-99).



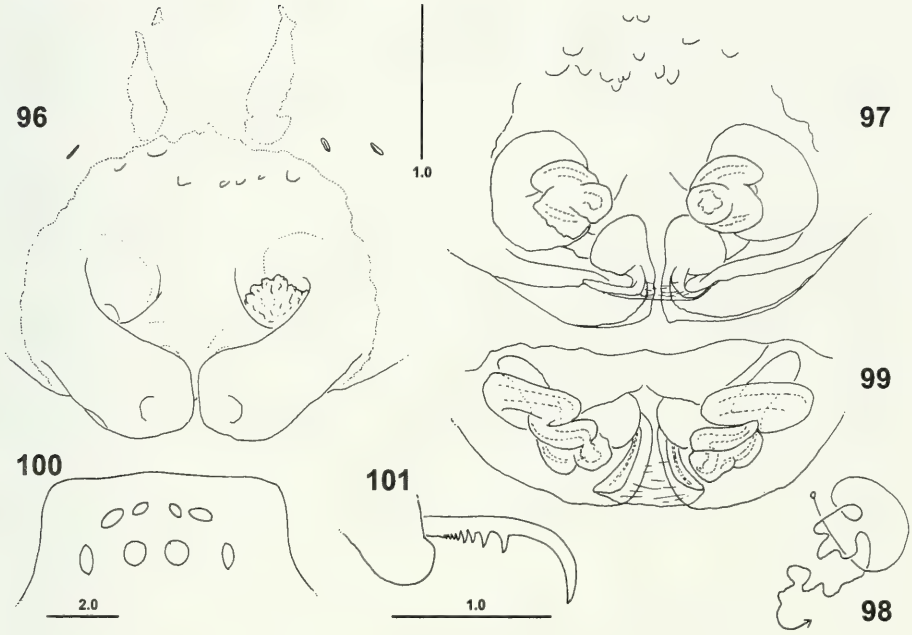
FIGS 91-95

Heteropoda belua sp. n., ♂ holotype. – Right palp, slightly expanded, ventral view (91), retrolateral view (92); base of embolus, prolateral view (93); RTA, dorsal view (94); furrow of right chelicera, ventral view (95).

Colour: Reddish brown, almost without distinct markings. Chelicerae dark reddish brown to black. FE with dark spine patches. Distal leg segments darker. DS and dorsal OS covered by short dark hairs.

Distribution: Known only from the type locality (Fig. 1: 11).

Notes: This species represents another large-sized cave-dwelling *Heteropoda* species. It cannot be grouped together with any other known species. Although the ♂ holotype is distinctly smaller than the ♀ paratypes, all three specimens are considered conspecific. This assumption is supported by the congruence of apomorphic characters as e.g. additional retromarginal cheliceral teeth and additional single denticles on the distal margin of the cheliceral furrow. From Australian *Heteropoda* species it is also known that ♂♂ may vary greatly in size (Davies 1994). This is confirmed by specimens of *Heteropoda maxima* (personal observations in Laotian caves) and of *Heteropoda beroni* sp. n. (this paper).



FIGS 96-101

Heteropoda belua sp. n., ♂ holotype (101), ♀ paratype, PJ 1737 (96-100). – Epigyne, ventral view (96); internal genital duct system, dorsal view (97), anterior view (99); schematic course of internal genital duct system, dorsal view (98); eye group, dorsal view (100); prolateral claw of leg IV, prolateral view (101).

DISCUSSION

It is astonishing that the largest labidognathous spiders – according to leg span (20-30 cm) and to body length (3-5 cm) – have become known just recently (Jäger, 2001a: *Heteropoda maxima*; this paper). All these species are known from cave habitats, which could be one reason for their late discovery. At present these large to very large species are known from North India (Meghalaya: *H. robusta* Fage, *H. fischeri* sp. n.), Thailand (*H. schwendingeri* sp. n.), Laos (*H. maxima*), Borneo (*H. belua* sp. n.) and Sulawesi (*H. beroni* sp. n.).

With regard to phylogenetic relationships among *Heteropoda* species, the genus is far from being well investigated. Although the sexual dimorphism of elongated hairs on metatarsi in male *Heteropoda* specimens seems to be more distinct in cave-dwelling species, it is not suitable for tracing phylogenetic relationships, as it occurs in several genera of Heteropodinae in cave-dwellers as well as in non-cave-dwellers. Moreover this kind of sexual dimorphism is known from other spider families e.g., Lycosidae: *Pardosa purbeckensis* O.F. Pickard-Cambridge, 1895, *Pardosa plumipes* (Thorell, 1875) (Tongiorgi, 1966). As the elongated metatarsal hairs occur exclusively in adult males, this morphological structure could be linked to sexual behaviour during the mating procedure.

Another trait, which is seen in all mentioned cave-dwelling *Heteropoda* species, is the presence of elongated appendages, especially pronounced in the male cymbium. This is known as troglobiomorphism and occurs also in other spider families e.g., Linyphiidae, Theridiidae (Ruzicka, 1998) and Agelenidae (Roth, 1968: *Tegenaria mexicana mexicana* Roth).

Relationships between the species described in the present paper can be best traced on the basis of the genitalia. In *H. fischeri* sp. n. the affiliation to the group which includes *H. robusta* and *H. afghana* is apparent from the striking similarities in the female copulatory duct system. All three species were found in cave habitats. All localities are located in a marginal zone of the distributional range of *Heteropoda* Latreille (Jäger, 2001b: fig. 63) and representatives of Heteropodinae are generally found in humid habitats as forests, leaf litter, rock crevices etc. Therefore the occurrence of *H. afghana* in caves only is probably due to less rainfall in this region. This seems to be true also for another species, *Heteropoda variegata* (Simon, 1871) from the eastern Mediterranen region, which exclusively inhabits caves and cave-like habitats (Levy, 1989). However, from the isolated distributional range of the latter species it remains unclear whether it has been introduced to this region or should be considered as a relict.

Some specimens show an unusually high variation of their genitalia and of other characters (body length, leg spination) and are here only tentatively placed close to *H. afghana*. A group of *Pseudopoda* species is known from the western Himalaya, i.e. *P. prompta* (O. Pickard Cambridge, 1882), *P. casaria* (Simon, 1897), *Pseudopoda* sp. cf. *casaria* (Simon, 1897), which also tends to have highly variable genitalia (Jäger, 2001b). In both genera this seems to be the initial phase of isolation of single marginal populations, as proposed by Sedlag (1995: 18), where geographical separation leads to higher variation.

Although all four forms listed above can be clearly grouped together, I avoid to establish new species groups, as relationships to other species with a similar course of the internal duct system and type of winding in female genitalia are not clear (axis of winding parallel to longitudinal axis of the body also occurs in: *H. umbrata* Karsch from Sri Lanka, *H. sexpunctata* Simon from the Himalayas, *H. cyperusiria* Barrion & Litsinger from the Philippines, *Heteropoda* spp. from India, Sri Lanka, Sumatra).

The general type of winding of the female internal genital duct system of *H. beroni* sp. n. is similar to those of several other species, among them *H. maxima* from Laos, *H. strasseni* Strand from Java, *H. kuekenthali* from Halmahera and the above mentioned species from Sulawesi (Jäger, 2002). Since no additional characters are available, no final conclusions on the phylogenetic relationships of these species can be drawn.

H. schwendingeri sp. n. seems to be close to *H. tetrica* from Myanmar and northern Thailand. Female *Heteropoda* specimens of the same species group are also known from southern Thailand. Since there are no definite conspecific specimens of the latter forms available, they are not included in this study.

I can conclude that inspite of superficial similarities (large size, elongated appendages, distinctly elongated hairs on male fore-legs) the cave-dwelling species treated here do not seem to be closely related to each other, but to regional species

groups. Thus I assume that species entered the caves independently and that similar characters were acquired secondarily due to similar conditions in the caves.

ACKNOWLEDGEMENTS

Part of these results arose from visits to important museum collections. These visits were sponsored by the European Community (Access to Research Infrastructure action of the Improving Human Potential Programme: Paris - PARSYST program, London - SYS-RESOURCE program, Copenhagen – COBICE program). Thanks are due to all curators of museum collections for loans. Special thanks go to the collectors of the here described specimens for not refusing to collect these large and hardly stowable animals and for providing me with information on them. These collectors are: Petar Beron and Teodora Ivanova (Sofia), Christian Fischer (Ehingen an der Donau), Dan Harris (Edinburgh), Peter Schwendinger (Genève), Yayuk R. Suhardjono (Jakarta) and the research team of the Maros Karst and Cave Biodiversity, the latter of which was supported by the ARCBC (ASEAN Regional Conservation Biodiversity Center) from the Philippines. Christa Deeleman (Ossendrecht) provided loans of material from her private collection. I gratefully acknowledge the helpful comments of Peter Schwendinger on the manuscript.

REFERENCES

BARTH, F. G. 2001. Sinne und Verhalten aus dem Leben einer Spinne. *Springer, Berlin, Heidelberg, New York*, i-ix + 424 pp.

DAVIES, V. T. 1994. The huntsman spiders *Heteropoda* Latreille and *Yiinthi* gen. nov. (Araneae: Heteropodidae) in Australia. *Memoirs of the Queensland Museum* 35 (1): 75-122.

FAGE, L. 1924. Araneids from Siju cave, Garo Hills, Assam. *Records of the Indian Museum* 26: 63-67.

JÄGER, P. 1998. First results of a taxonomic revision of the SE Asian Sparassidae (Araneae) (pp. 53-59). *In*: SELDEN, P. A. (ed.). Proceedings of the 17th European Colloquium of Arachnology, Edinburgh, 1997. *Burnham Beeches, Bucks*, 350 pp.

JÄGER, P. 2000a. Two new heteropodine genera from southern continental Asia (Araneae: Sparassidae). *Acta Arachnologica* 49 (1): 61-71.

JÄGER, P. 2000b. *Heteropoda parva* n. sp. and *H. martusa* n. sp. - primitive or derived *Heteropoda* species? (Araneae: Sparassidae: Heteropodinae). *Mitteilungen des Internationalen Entomologischen Vereins Frankfurt* 25 (3/4): 195-205.

JÄGER, P. 2001a. A new species of *Heteropoda* (Araneae: Sparassidae: Heteropodinae) from Laos - the largest huntsman spider? *Zoosystema* 23 (3): 461-465.

JÄGER, P. 2001b. Diversität der Riesenkrabbenspinnen im Himalaya. Über eine Radiation zweier Gattungen in den Schneetropen. (Araneae: Sparassidae: Heteropodinae). *Courier Forschungsinstitut Senckenberg* 232: 1-136.

JÄGER, P. 2002. Heteropodinae: transfers and synonymies (Arachnida: Araneae: Sparassidae). *Acta Arachnologica* 51 (1): 33-61.

JÄGER, P. 2004. A study of the character 'palpal claw' in the spider subfamily Heteropodinae (Araneae: Sparassidae). *In*: LOGUNOV, D.V. & PENNEY, D. (eds). Proceedings of the 21st Colloquium of Arachnology, St. Petersburg, 4-9 August 2003, pp. 107-125.

JÄGER, P. & ONO, H. 2000. Sparassidae of Japan. I. New species of *Olios*, *Heteropoda* and *Sinopoda* with remarks on known species (Arachnida: Araneae). *Acta Arachnologica* 49 (1): 41-60.

JÄGER, P. & BARRION, A. 2001. First description of the male of *Heteropoda cyperusiria* Barrion & Litsinger 1995 from the Philippines (Araneae: Sparassidae: Heteropodinae). *Philippine Entomologist* 15 (1): 37-43.

LEVY, G. 1989. The family of huntsman spiders in Israel with annotations on spiders of the Middle East (Araneae: Sparassidae). *Journal of Zoology, London* 217 (1): 127-176.

PLATNICK, N. I. 2004. The world spider catalog. Version 4.5. American Museum of Natural History. Online at: http://research.amnh.org/entomology/spiders/catalog/

POCOCK, R. I. 1897. Spinnen (Araneae). *In*: KÜKENTHAL, W. (ed.). Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. *Abhandlungen der Senckenbergischen naturforschenden Gesellschaft* 33 (4): 591-629.

ROEWER, C. F. 1962. Araneae Dionycha aus Afghanistan. II. *Acta Universitatis lundensis* (N. F.) (2) 58 (4): 3-34.

ROTH, V. D. 1968. The spider genus *Tegenaria* in the western hemisphere (Agelenidae). *American Museum Novitates* 2323: 1-33.

RUZICKA, V. 1998. The subterranean forms of *Lepthyphantes improbulus*, *Theonoe minutissima* and *Theridion bellicosum* (Araneae: Linyphiidae, Theridiidae) (pp. 101-105). *In*: SELDEN, P.A. (ed.). Proceedings of the 17th European Colloquium of Arachnology, Edinburgh, 1997. *Burnham Beeches, Bucks*, 350 pp.

SEDLAG, U. 1995. Tiergeographie. *Urania-Verlag, Leipzig*, 447 pp.

SETHI, V. D. & TIKADER, B. K. 1988. Studies on some giant crab spiders of the family Heteropodidae from India. *Records of the Zoological Survey of India, Miscellaneous Publications, Occasional Paper* 93: 1-94.

THORELL, T. 1870. Araneae nonnullae Novae Hollandiae. *Öfversigt af Konglige Vetenskaps-Akademien Förhandlingar* 27 (4): 367-389.

TONGIORGI, P. 1966. Wolf spiders of the *Pardosa monticola* group (Araneae: Lycosidae). *Bulletin of the Museum of Comparative Zoology* 134 (8): 335-359.

REVUE SUISSE DE ZOOLOGIE 112 (1): 115-119; mars 2005

A new *Hypomma* species from Stara Planina Mountains, Bulgaria (Araneae, Linyphiidae)

Christo DELTSHEV
Institute of Zoology, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel blvd, 1000-Sofia.

A new *Hypomma* species from Stara Planina Mountains, Bulgaria (Araneae, Linyphiidae). - *Hypomma aemonicum* sp. n. (male/female) is described and illustrated (male/female) from Stara Planina Mountains in Bulgaria. This interesting new species has somatic characters which correspond to *Hypomma* but genital organs differ from all known species of the genus.

Keywords: Description - spider - Balkan Peninsula.

INTRODUCTION

The genus *Hypomma* is represented in Balkan Peninsula by three species. *Hypomma cornutum* (Blackwall, 1833) is known from Bulgaria and Croatia, *H. bituberculatum* (Wider, 1834) was reported from Serbia and Croatia, and *H. brevitibiale* (Wunderlich, 1980) was found only in Macedonia (Blagoev, 2002; Deltshev & Blagoev, 2001; Deltshev *et al.*, 2003; Wunderlich, 1980). The new species was collected in Stara Planina Mountains from high altitude rocky habitats on the Vezhen Peak (2170 m) and was reported under *Pelecopsis* sp. n. (Popov *et al.*, 2000; Deltshev & Blagoev, 2001). All measurements in the description are in mm.

DESCRIPTION

Hypomma aemonicum sp. n. Figs 1-9

Pelecopsis sp. n.: Popov et al., 2000 : 352, 355, 360, 382, 383, 392, 406, 409, 414; Deltshev & Blagoev, 2001: 119.

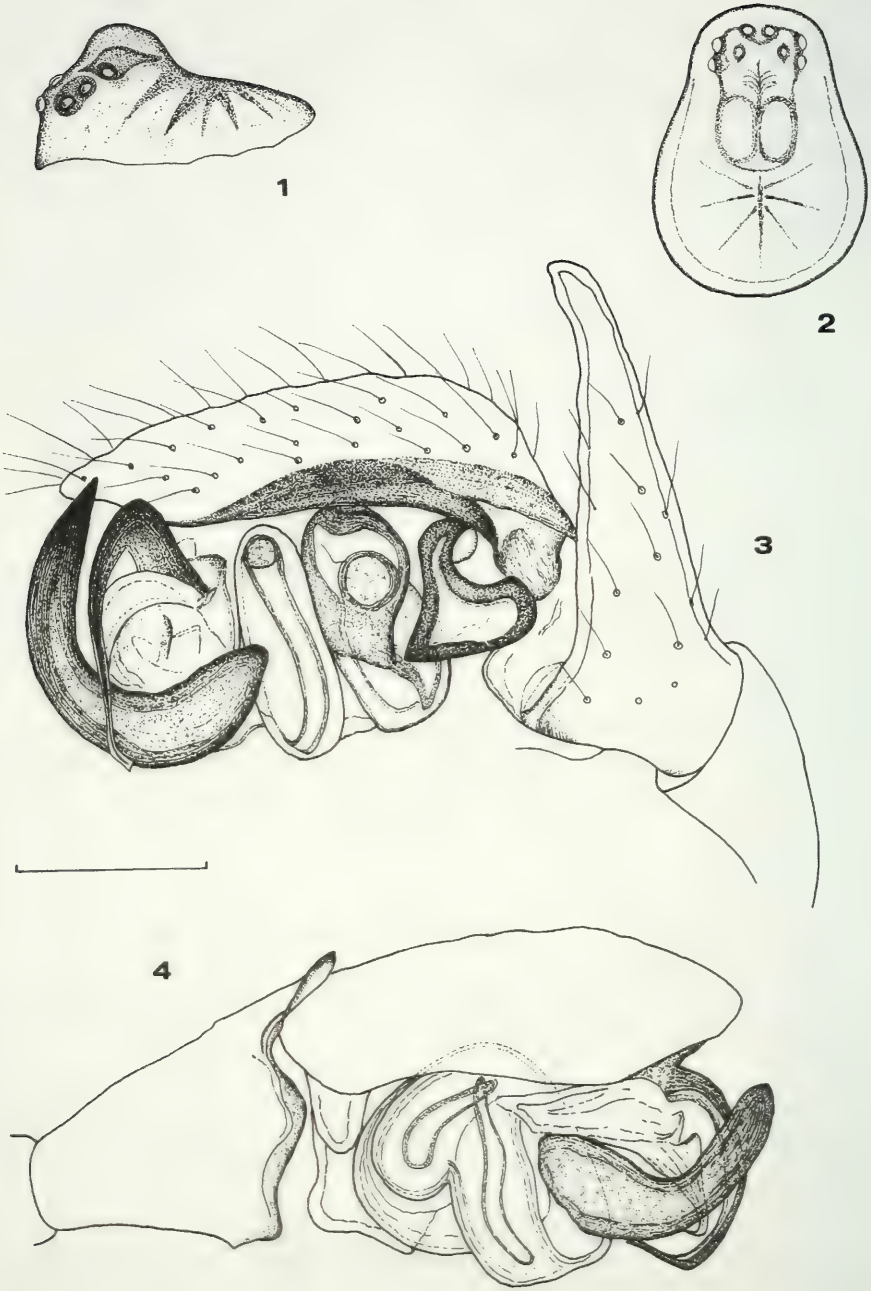
Material examined. Bulgaria, Stara Planina Mountains, Vezhen Peak (2170 m), under stones, male holotype, 11 male and 28 female paratypes, 2.08.1995 (leg. C. Deltshev); Stara Planina Mountains, Kamenitsa Peak (2000 m), 1 male and 2 female paratypes, 21.07.1997 (leg. C. Deltshev).

Depository: The holotype, 1 male and 2 female paratypes (Vezhen Peak) are deposited in the Muséum d'histoire naturelle, Genève; 1 male and 1 female paratypes (p. Vezhen) in Naturhistorisches Museum, Wien; 1 male and 1 female paratypes (Vezhen Peak) in the collection of K. Thaler (Innsbruck). The rest, 8 males and 25 females paratypes in the collections of the Institute of Zoology, Sofia.

Etymology. Derived from Aemon - the Tracian name of the mountain.

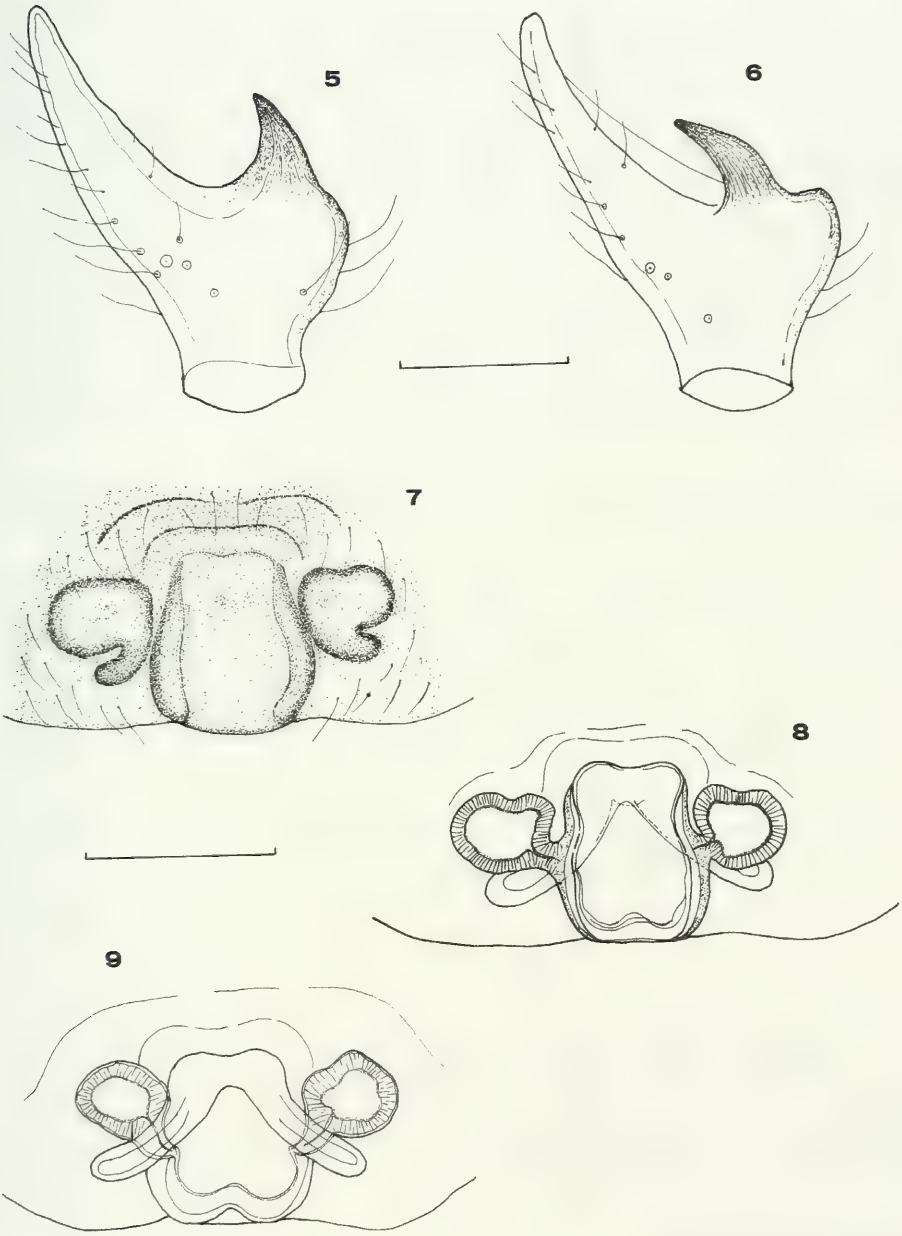
Diagnosis. Somatic characters corresponding to those of the genus: TmI 0.65-0.75; TmIV present: tibial spines 1-1-1-1 (very short in males). Male palps as in Figs 2-5, and female genitalia as in Figs 6-7. The genital organs are different from those of all known species of the genus.

Manuscript accepted 06.04.2004



FIGS 1-4

Hypomma aemonicum sp. n., male: 1, carapace, lateral view; 2, carapace, dorsal view; 3, palp, retrolateral view; 4, palp, retroventral view. Scale line (Figs 3, 4) 0.2 mm (Figs 1, 2 not to scale).



FIGS 5-9

Hypomma aemonicum sp. n.: 5, male palpal tibia, dorsal view; 6, male palpal tibia, retrolateral view; 7, epigyne; 8, vulva, ventral view; 9, vulva, dorsal view. Scale lines 0.2 mm.

Description. MALE: Total length 2.45; cephalothorax, length 1.22, width 0.9; sternum length 0.72, width 0.54; abdomen, length 1.44. Head raised into a longitudinally, bifid lobe, a well-defined pit present behind posterior eyes (Figs 1, 2). Posterior eye row procurved, with eyes of equal size and nearly equidistant (Fig 2). Chelicerae yellow-brown, armed with 4 teeth on outer margin of cheliceral furrow and 3- 4 denticles on inner margin. Carapace, yellow to yellow-brown. Sternum, yellow to yellow-grey. Abdomen, grey to dark grey. Legs uniformly yellow; tibial spines 1-1-1-1, very short and absent in some specimens. TmI 0.65-0.75. TmIV present. Leg measurements:

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	0.86	0.32	0.72	0.61	0.61	3,12
II	0.79	0.32	0.68	0.57	0.44	2.80
III	0.68	0.29	0.61	0.54	0.44	2.59
IV	0.90	0.36	0.90	0.83	0.61	3.56

Male palp: Figs 3, 4; palpal tibia: figs 5, 6, with stout retrolateral and straight prolateral apophysis. Suprategulum stout and elongated. Embolus long with truncated tip (Fig. 3).

FEMALE: Total length 2.88; cephalothorax, length 1.26, width 1.08; sternum length 0.79, width 0.64; abdomen, length 1.80. Anterior median eyes situated close to each other and ca. 75 % of their diameter apart from the laterals; posterior row with eyes of equal size and nearly equidistant. Chelicerae yellow-brown, armed with 4 teeth on outer margin of furrow and 3- 4 denticles on inner margin. Coloration of carapace, sternum, abdomen and legs as in male. Tibial spines of legs1-1-1-1. TmI 0.65-0.75. TmIV present. Leg measurements:

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	0.90	0.36	0.90	0.72	0.54	3,42
II	0.79	0.32	0.79	0.57	0.54	3.12
III	0.79	0.32	0.72	0.64	0.47	2.94
IV	1.08	0.36	1.08	0.97	0.61	4.10

Epigyne and vulva: Figs 7 – 9.

Affinities. Although *Hypomma aemonicum* sp. n. corresponds well with the genus *Hypomma* in somatic characters, it is difficult to find distinct resemblance to most of *Hypomma* species with respect to its genitalia. There are some similarities in tibial apophysis and elongated embolus with *Hypomma brevitibiale* (Wunderlich, 1980), known only from Macedonia.

ACKNOWLEDGEMENTS

The present investigation was supported by the Bulgarian-Swiss Biodiversity Conservation Program, to which I am especially indebted. I thank also Dr K. Thaler (Innsbruck), Dr P.I. van Helsdingen (Leiden) and Dr R. Bosmans (Gent) for their comments on the material and figures.

REFERENCES

BLAGOEV, G. 2002. Check List of Macedonian Spiders (Araneae). *Acta zoologica bulgarica* 54 (3): 9-34.

DELTSHEV, C. & BLAGOEV, G. 2001. A critical check list of Bulgarian spiders (Araneae). *Bulletin of the British arachnological Society* 12 (3): 110-138.

DELTSHEV, C., CURČIC, B., BLAGOEV, G. 2003. The Spiders of Serbia. - B. P. M. CURČIC (ed.). *Committee for Karst and Speleology - Serbian Academy of Sciences and Arts; Institute of Zoology -Bulgarian Academy of Sciences; Institute of Zoology - Faculty of Biology - University of Belgrade; Institute for Biological Research "Sini_a Stankovi_" (co-publishers). Belgrade and Sofia*, 833 pp.

POPOV, A., DELTSHEV, C., HUBENOV, Z., BESCHOVSKI, V., DOBREV, D. & GUEORGUIEV, B. 2000. Invertebrate fauna (pp. 339-416). *In*: POPOV, A. & MESHINEV, T. (eds). High mountain treeless zone of the Central Balkan National Park. Biological diversity and problems of its conservation. *BSBCP, Sofia*.

WUNDERLICH, J. 1980. Linyphiidae aus Süd-Europa und Nord-Afrika (Arach.: Araneae). *Verhandlungen des naturwissenschaflichten Vereins Hamburg* 23: 319-337.

Revue suisse de Zoologie 112 (1): 121-144; mars 2005

World revision of the genus *Nealsomyia* Mesnil (Diptera, Tachinidae)

Pierfilippo CERRETTI
Dipartimento di Biologia Animale e dell'Uomo, Università di Roma "La Sapienza", Viale dell'Università 32, I-00185 Roma, Italy.
E-mail: pierfilippocerretti@yahoo.it

World revision of the genus *Nealsomyia* Mesnil (Diptera, Exoristinae, Tachinidae). - A world taxonomic revision of the genus *Nealsomyia* is presented and the identity of the genus is defined and discussed. *Nealsomyia lindneri* Mesnil, *N. rufella* (Bezzi), *N. rufipes* (Villeneuve) and *N. triseriella* (Villeneuve) are redescribed and illustrated; *Nealsomyia merzi* sp. n. from Namibia is described, illustrated and compared with similar species. A key to the five known species of *Nealsomyia* is presented.

Keywords: Tachinidae - *Nealsomyia* - world revision - taxonomy - new species - identification key.

INTRODUCTION

Nealsomyia is a small genus of Goniini (sensu Herting, 1960, 1984; Wood, 1987), a vast and varied tribe, characterized by a particular reproductive strategy. Adult females lay a large number of "microtype" eggs on the food plants of their hosts; these eggs hatch only after being ingested. They are not damaged while passing through the host's mouth parts, and hatch in the mesenteron under the stimulus of proteolytic enzimes (Wood, 1987). The young larvae then reach the haemocele by breaking through the wall of the intestine. Once fully developed, the mature larva kills its host and pupates within the host's remains or in the ground. It was this complex suite of morphological and behavioural features that led Herting (1960, 1984), Wood (1987) and later many other specialists to consider the Goniini as a monophyletic group.

The genus *Nealsomyia* was described by Mesnil in 1939 to include *Exorista* (*Alsomyia*) *triseriella* Villeneuve, 1929, known at that time from a single male; this species remained the only one assigned to the genus until Mesnil wrote the first revision of the genus in 1954, also including *Exorista quadrimaculata* Baranov, 1934 and *Alsomyia rufipes* Villeneuve, 1937. Later, Mesnil (1959) decribed a further African species (*Nealsomyia lindneri*), considered by Crosskey (1980) as a taxon of uncertain generic placement. Mesnil (1954: 356) first included *Nealsomyia* in the tribe Salmaciini (= Goniini + Eryciini + Ethillini + Winthemiini of Herting, 1984) subtribe Masicerina (cf. Mesnil, 1944: 20, 22), and then in the tribe Eryciini (= Eryciini + Ethillini + Winthemiini of Herting, 1984) subtribe Nileina (Mesnil, 1975: 1386). Later,

Manuscript accepted 24.05.2004

Crosskey (1976: 250) considered it as an Eryciine (= Goniini + Eryciini [partim] of Herting, 1984). Finally, Herting (1984), following his above mentioned "concept", included it in the tribe Goniini.

Four species of the genus *Nealsomyia* were known before this study: *N. rufella*, an Oriental species with a distribution reaching the Palaearctic Region; *N. rufipes*, known from a few localities in Pakistan, India and Sri Lanka; *N. triseriella*, known only from a few specimens from two localities in Egypt; and *N. lindneri*, known from a single male from Tanzania. Herein, a new species of *Nealsomyia* from Namibia is described.

Hosts of this genus are known only for *N. rufella* and for the similar species *N. rufipes*. Both parasites of pests belonging to the families Psychidae and Limacodidae (Lepidoptera).

METHODS

The dissection of male and female terminalia was carried out following the method described in detail by O'Hara (2002) for the male terminalia. The dissected male terminalia are preserved in glycerine inside a small plastic tube, which is pinned together with the specimen. The female terminalia and the rest of the abdomen are preserved, separately from the rest of the specimen, in a test tube containing glycerine and alcohol. Drawings were done using a Leica DMLS optic microscope (terminalia) and a Leica MZ 7.5 stereoscopic microscope (head, legs, wings and abdomen).

The following information is given for each species: synonyms when existing, the countries of origin of the material examined (listed in alphabetical order), the known hosts and distribution. Label data are cited as printed, using the following symbols:

/ end of a line and beginning of the next line;

// end of a label and beginning of the next label (from top to bottom on the same pin);

[...] explanations, such as the number and sex of the examined specimens, or phrases written in an unintelligible fashion or perpendicularly to the rest.

Terminology

External morphology (except for antenna): Merz & Haenni (2000). Antenna: Stuckenberg (1999). Male terminalia: Sinclair (2000). Female terminalia: Kotrba (2000). Measurements and ratios of head: Tschorsnig & Richter (1998).

Acronyms

BLKU Biosystematics Laboratory, Kyushu University, Fukuoka, Japan (H. Shima).
BMNH The Natural History Museum, London, UK (N. Wyatt).
CNC Canadian National Collection of Insects, Ottawa, Canada (J. E. O'Hara).
MHNG Muséum d'histoire naturelle, Genève, Switzerland (B. Merz).
MSNM Museo di Storia Naturale, Milano, Italy (F. Rigato).
SMNS Staatliches Museum für Naturkunde, Stuttgart, Germany (H.-P. Tschorsnig).
TAU Department of Zoology, Tel Aviv University, Tel Aviv, Israel (A. Freidberg).

TAXONOMIC TREATMENT

Nealsomyia Mesnil, 1939

Nealsomyia Mesnil, 1939: 31, note 1 [original description]; Mesnil, 1954: 356 [redescription]; Crosskey, 1976: 145, 148 [taxonomy], 250 [catalogue]; Crosskey, 1981: 692 [catalogue]; Herting, 1984: 64 [catalogue]; Chao, 1996: 1888 [keys]; Herting & Dely-Drascovits, 1993: 227 [catalogue]; Tschorsnig & Richter, 1998: 810 [keys].

Type species: *Exorista* (*Alsomyia*) *triseriella* Villeneuve, 1929 (by original designation).

Recognition. *Colour*. General setulae of head (except for occiput), thorax, legs and abdomen black. Eye with pale yellow hairs; occiput with white setulae only. Thorax black in ground colour, with grey microtrichosity; scutum, before suture, with four longitudinal dark vittae.

Head (Figs 1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 5.1, 5.2). Eye densely haired (each hair longer than combined diameter of 3-5 facets). Postpedicel 1.5-2.2 times as long as antennal pedicel. Arista with short hairs that are shorter than its maximum diameter. Arista thickened on basal 2/5-1/2. First and second aristomeres short, not longer than wide. Antenna longer than the height of the gena and shorter than facial ridge. Lateral vertical setae: male – hair-like, generally not differentiated from the postocular setae; female – well-developed (*N. rufella* and *N. rufipes*). Ocellar setae proclinate, well-developed. Frons with only scattered black setulae outside frontal row. Frons at its narrowest point 0.5-0.9 times as wide as an eye in dorsal view. Six to 10 frontal setae descending to the level of the base of the postpedicel or to the base of the arista. Usually one pair of strong upper reclinate orbital setae – if two, (some specimens of *N. rufella*) then the posterior one short and weak. Proclinate orbital setae: absent in the male; two in the female. Parafacial entirely bare below lowest frontal seta. Facial ridge straight in lateral view or slightly concave, with short decumbent setae at most on lower 2/5. Vibrissa arising at level of lower facial margin. Face and lower facial margin not visible in lateral view. Genal dilation below eye well-developed. Occiput flat, without black setulae behind the postocular row.

Thorax. Scutum before suture with four narrow, longitudinal dark stripes. Prosternum generally with some setulae along its lateral margins, rarely bare (one specimen of *N. triseriella*). Proepisternum bare. Postpronotum with 4 setae, the 3 basal setae arranged in a (more or less) straight line, the anterior one placed between middle basal and medial basal (the medial basal seta is very short in *N. lindneri*). Scutum with 2-3+3 acrostichal setae, 2-3+3-4 dorsocentral, 1+3 intraalar, 2 posthumeral, 1 presutural, 2 notopleural, 3 supraalar setae; postalar callus with 3 setae. First postsutural supraalar seta longer than notopleural setae. Katepisternum with 2-3 setae. Katepimeron with 0-3 setulae on anterior fourth. Anepimeron with setulae on posterior half. Anatergite bare. Anterior and posterior lappets of posterior spiracle unequal in size. Scutellum: apical marginal setae crossed and horizontal (not inclined upwards) (Figs 1.3, 2.3, 5.3).

Wing (Figs 1.5, 3.5, 5.4). Membrane hyaline, upper and lower calypter white. Costal seta well differentiated from the other costal setae. Base of R_{4+5} with few setulae, sometimes with only one setula. Cell r_{4+5} open (see *N. lindneri*, redescription), closed just at wing margin or with a short petiole. Lower calypter: medial margin more or less contiguous to lateral margin of the scutellum.

Legs (Figs 2.4, 3.4). Preapical anterodorsal seta of fore tibia shorter than preapical dorsal one. Mid-tibia with one strong anterodorsal seta, if two (*N. triseriella*, *N. merzi*), then the upper one very short and weak, less than 1/3 of the strong one.

Abdomen (Figs 1.4, 2.5, 3.3). Middorsal depression on abdominal syntergite 1+2 extending posterior to hind margin of that segment. Tergites 3 and 4 of male each ventrally with one pair of patches of appressed setulae [possibly autapomorphy of the genus, see *Remarks*].

Male terminalia (Figs 1.6, 1.7, 1.8, 2.6, 2.7, 2.8, 2.9, 2.10, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.2, 4.3, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6). Sternite 5 with hind margin deeply cleft; lateral lobe large; medioapical margin of lateral lobe with dense microscopic setulae; transversal membraneous stripe present. Tergite 6 (Fig. 3.9) divided into two hemitergites, joining segment 7+8 by membrane; spiracle 6 situated on membrane. Sternite 6 well developed and asymmetrical, articulated to segment 7+8 on its left side, and attached to it by a membrane on its right side. Sternite 6 bare; segment 7+8 with few, weak setae. Epandrium short and convex. Cerci divided apically, slightly bent posteriorly, in lateral view. Bacilliform sclerites long. Medial plate of hypandrium subrectangular in dorsal view; hypandrial arms joining postero-medially, forming a bridge-like structure. Aedeagus: basiphallus with basal extension; epiphallus not differentiated; distiphallus joining basiphallus by a dorsal sclerite and by a ventrolateral membrane; distiphallus largely membraneus lateroventral surface of distiphallus covered with scale-like spinules.

Bionomy (*N. rufella*). Female micro-oviparous, laying eggs on leaves of hostplants (Shima & Tachi, 1996).

Known hosts. Larvae of Psychidae and Limacodidae (Lepidoptera).

Remarks. The presence of a pair of large patches of appressed setulae on the ventral side of abdominal tergites 3 and 4 in males of the Goniini is known so far only from *Nealsomyia* and *Pseudalsomyia* Mesnil, 1968. However very similar patches of more or less fine setulae on the ventral or latero-ventral sides of abdominal tergites are known in some other genera of Exoristinae (cf. Crosskey, 1973, 1976, 1984; Wood, 1987, Tschorsnig & Richter, 1998). These patches are usually present on abdominal tergites 4 and/or 5 with the exception of the Eryciine genus *Anacamptomyia* Bischof, 1904 and some *Lydella* Robineau-Desvoidy, 1830, which have a pair of patches on the ventral side of tergites 3 and 4 (cf. Crosskey, 1980: 274) very similar to those of *Nealsomyia* (Cerretti, unpublished). Analogous structures are found at the sides of tergite 5 in the males of genus *Sarromyia* Pokorny, 1893 (Tachininae), even if superficial analyses show very different morphological characters to those of the Exoristinae. All other features listed above in the "Recognition" paragraph are shared with other genera among the Goniini or Tachinidae in general, but only in *Nealsomyia* they occur all together in the described combination, univocally identyfing the genus. For these reasons *Nealsomyia* could be considered a monophyletic genus.

Distribution. *Nealsomyia* includes five species distributed from the tropical and subtropical (including desert and savana) areas of the Afrotropical and South-West Palaearctic Regions, to the tropical and humid subtropical of the South-East Palearctic Region and most of the Oriental Region (Map 1).

MAP 1. Known distribution of *Nealsomyia* spp.

KEY TO THE SPECIES OF *NEALSOMYIA* MESNIL

1 Four postsutural dorsocentral setae. Mid-tibia with only one antero-dorsal seta (Fig. 3.4); vein M present beyond bend (Figs 3.5, 5.4); abdominal tergites 3 and 4 without median discal setae (Fig. 3.3) 2

\- Three postsutural dorsocentral setae. Other combination of characters 3

2 Legs black or dark brown, sometimes coxae and throcanters reddish. Posterior 1/3 of the scutellum red or, rarely, completely black; sides of abdominal tergites 3, and anterior half of 4, more or less reddish . . . . . *N. rufella* (Bezzi)

\- Legs yellow or red. Posterior half of the scutellum yellowish or red, sometimes scutellum completely yellowish; sides of abdominal tergites 3 and 4 usually largely yellow or red, sometimes abdomen almost

entirely yellow except for a dark median longitudinal vitta on tergites 3, 4 and 5. . . . . *N. rufipes* (Villeneuve)

3 Abdominal tergites 3 and 4 without median discal setae (Fig. 1.4). Mid-tibia with only one anterodorsal seta (Fig. 2.4). M vein not reaching wing margin, ending about where bend should be (Fig. 1.5). Head profile as in Fig. 1.1. Abdomen and scutellum entirely black in ground colour (Fig. 1.3) . . . . . *N. lindneri* Mesnil

- Abdominal tergites 3 and 4 with a pair of median discal setae (Fig. 2.5). Mid-tibia with 2 anterodorsal setae, the uppermost anterodorsal seta very short and weak, less than 1/3 as long as the middle anterodorsal one (Fig. 2.4). M vein reaching wing margin (Fig. 5.4). Head profile as in Figs 2.1, 5.1. Scutellum at least apically yellowish or red and sides of abdominal tergites 3 and 4 red or yellowish 4

4 Male frons at its narrowest point 0.5 times as wide as an eye in dorsal view (Fig. 2.2). Medial vertical setae crossed (Fig. 2.2). Scutellum without lateral marginal setae (Fig. 2.3). Abdominal tergites 3-5 entirely microtrichose . . . . . *N. merzi* sp.n.

- Male frons at its narrowest point 0.80-0.85 times as wide as an eye in dorsal view (Fig. 5.2). Medial vertical setae sub-parallel (not crossed) (Fig. 5.2). Scutellum with a pair of lateral marginal setae (Fig. 5.3). Abdominal tergites 3-5 with at least posterior margin lacking microtrichosity . . . . . *N. triseriella* (Villeneuve)

Nealsomyia lindneri Mesnil, 1959 Pl. 1

Nealsomyia lindneri Mesnil, 1959: 12 [original description] (type locality – Tanzania, Mara, Mugango); Crosskey, 1980: 881 [catalogue, uncertain generic placement]; Crosskey, 1984: 286, 297 [keys].

Material examined. TANZANIA [Holotype ♂]: Mugango / a. Victoria See / 19.- 25.III. 1952 / D.O. Afrika Exp. [blue paper] // Mugango / 19.III.52 [handwritten] // *Nealsomyia lindneri* Mesn. / L. Mesnil det. 1958 // TYPE [red paper] // HOLOTYPE / of *Nealsomyia lindneri* Mesn. / examined 1983 / R.W. Crosskey. [SMNS].

Redescription. MALE. *Length*. (Holotype): 5.39 mm.

Colour. Head black - except frontal vitta and gena - with light grey microtrichosity; frontal vitta dark brown; gena reddish. Antenna black. Palpus yellow. Thorax black in ground colour, with grey microtrichosity; scutum, before suture, with four longitudinal dark vittae; scutellum and abdomen entirely black in ground colour. Tergite 3 dorsally covered with microtrichosity on anterior 4/5, tergites 4 and 5 microtrichose on anterior 2/3. Tegula black, basicosta reddish-brown, veins yellow. Base and stem of the halter yellowish, knob more or less brown. Legs black. Fore femur microtrichose on its posterior surface.

Head (Figs 1.1, 1.2). Arista thickened on its basal 1/2 or slightly more (left arista of holotype very short, abnormally developed, see Fig. 1.2). Second aristomere slightly longer than wide. Postpedicel 1.5 times as long as pedicel. Eye densely covered with long hairs that are longer than the combined diameters of four facets. Frons at its narrowest point 0.9 times as wide as an eye in dorsal view. Medial vertical setae

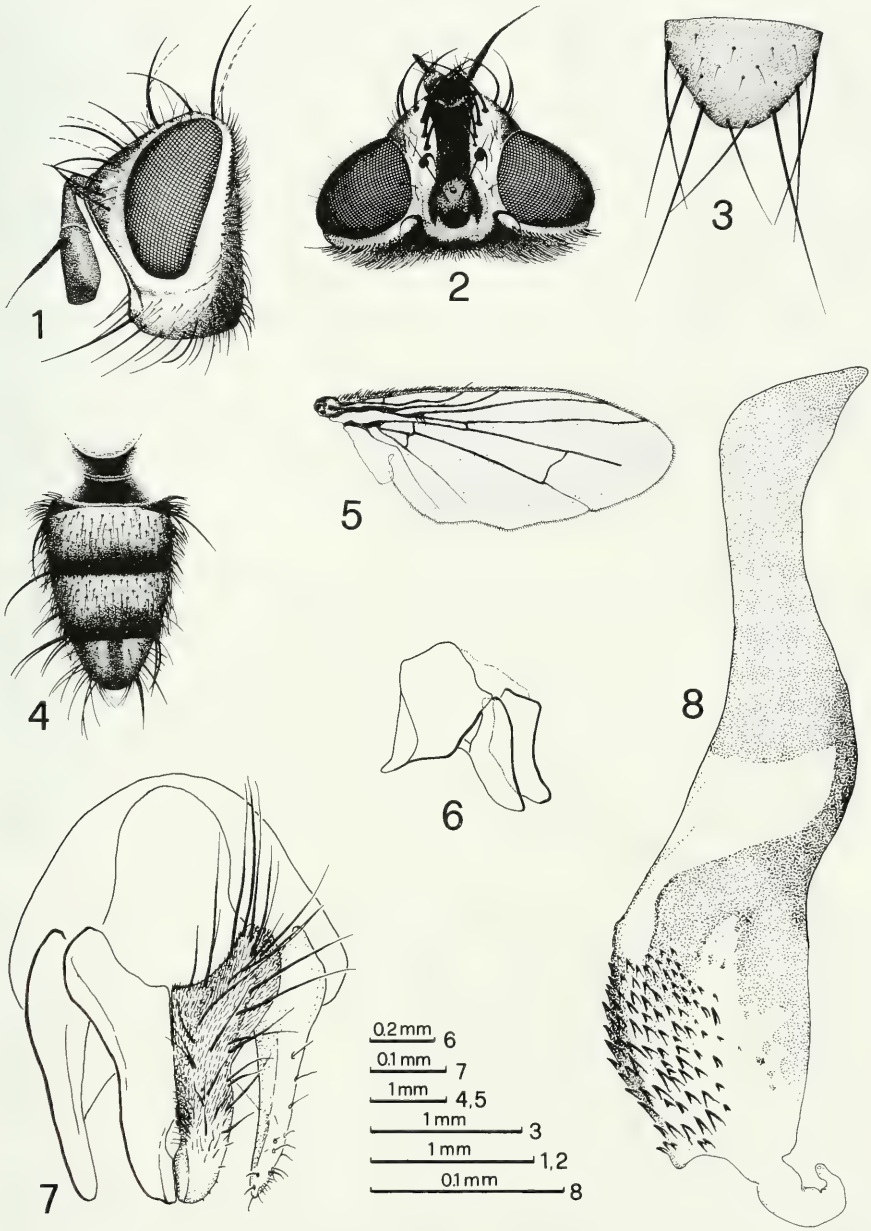


PLATE 1

Figs 1-8. *Nealsomyia lindneri*: Tanzania, Mugango (male – holotype) – 1. Head in lateral view. 2. Head in dorsal view. 3. Scutellum in dorsal view. 4. Abdomen in dorsal view. 5. Right wing. 6. Epandrial complex in right lateral view. 7. Epandrial complex in posterior view. 8. Aedeagus in left lateral view.

strong, retroclinate and sub-parallel, about 3/4 as long as vertical eye diameter. Right lateral vertical seta (asymmetric) absent or not differentiated from the postocular setae; left lateral vertical seta about 1.5 times as long as the postocular setae. One reclinate orbital seta about 3/4 as long as medial vertical seta. Six frontal setae descending to the level of the base of the postpedicel. Fronto-orbital plate with one row of sparse black setulae, lateral to the row of frontal setae. Parafacial (in lateral view) at its narrowest point 0.4 times as wide as the width of postpedicel. Gena in profile about 1/3 of vertical height of eye (height measured in the same vertical plane as height of head). Postocular setae short, bent forwards. Prementum about 3 times as long as wide. Palpus cylindrical with some setulae both ventrally and apically.

Thorax. Prosternum with few setulae (1-3) on its lateral margin. Scutum with 2+3 acrostichal setae, 2-3+3 dorsocentral, 1+3 intraalar, 2 posthumeral, 1 presutural, 2 notopleural, 3 supraalar setae; postalar callus with 3 setae. Proepimeron with 2-3 setae and 4-5 long and robust setulae. Katepisternum with 3 setae. One short anepimeral seta on left side, absent on the other side (asimmetrical). Anepisternum with 5-6 setae. Katepimeron bare. Scutellum (Fig. 1.3) with 1 pair of hair-like discal setae, 1 pair of crossed, horizontal apical setae, 1 sub-apical, 1 lateral and 1 basal setae; the lateral setae are slightly longer than the apical ones.

Legs. **Fore leg** – Tibia with 5 anterodorsal setae, 1 posterodorsal, 2 posterior setae; anterodorsal preapical seta shorter than dorsal. Claws longer than tarsomere 5. **Mid leg** (left lacking) – Femur with rows of very irregular, in number, length and thickness, anteroventral and posteroventral setae; 3 anterior setae and 2 posterior setae. Tibia (as in Fig. 3.4) with 1 anterodorsal seta; 1 weak posterodorsal, 2 posterior, 1 ventral setae. Claws about as long as tarsomere 5 or slightly shorter. **Hind leg** – Tibia with an irregular row of anterodorsal and posterodorsal setae, each row with a seta almost at midlength about 1.3-1.5 as long as the others; 2 anteroventral setae, 2 dorsal preapical setae. Posteroventral preapical seta shorter than anteroventral preapical one. Claws about 0.90 times as long as tarsomere 5.

Wing (Fig. 1.5). Costal spine longer than crossvein R-M. Second costal portion (between subcostal break and R_1) bare ventrally. Base of R_{4+5} with 3-5 setulae. M vein not reaching wing margin, ending approximately where bend should be.

Abdomen (Fig. 1.4). Syntergite 1+2 with 1 pair of short median marginal setae, 1 pair of lateral marginal setae at least twice as long as the median marginals; general setulae short (longer on the sides of the syntergite). Tergite 3 with 1 pair of median marginal setae (lacking in the holotype); 1 or 2 pairs of lateral marginal setae. Tergite 4 with a row of 11 marginal setae. General setulae of tergites 3 and 4 decumbent. Tergite 5 with rows of marginal and discal setae.

Terminalia. Cerci (Figs 1.6, 1.7) broad, with a dorso-medial suture, apically separated from each other and slightly bent medially. Cerci in profile broader than in the other known species of *Nealsomyia*. Surstylus (Figs 1.6, 1.7) broad, well developed, sub-triangular in lateral view, with several setulae latero-apically. Pregonite rounded apically and bent anteriorly, with a row of short and stout setae on its dorsal margin. Postgonite slender, rounded apically and bare.

FEMALE. Unknown.

Hosts. Unknown.

Distribution (Map 1). Afrotropical: Tanzania (Mara).

Remarks. The general shape of the head, the peculiar wing venation and the short, decumbent abdominal setulae give this species a characteristic general appearance which separates it from its co-generics. These characteristics, together with the asymmetric teratology of the arista and the anepimeral seta, induced Crosskey (1980) to list this species with the generically unassigned taxa, at least until the acquisition of new material. However, the examination of the male terminalia (which had not been extracted so far) and of the chetotaxy, do not provide strong enough arguments against considering *N. lindneri* as "*appartenant clairement au genre* Nealsomyia", to quote Mesnil (1959: 12).

The peculiarity of vein M which ends in the position usually occupied by the bend of M, was interpreted by Crosskey (1984: 297) as a probable teratology. This feature is however present in many other species of tachinids, sometimes within a single species, like the goniine *Ocytata pallipes* (Fallén, 1820) (cf. Tschorsnig & Herting, 1994; Cerretti, unpublished), for which specimens both with a complete or incomplete vein, like in the case of *N. lindneri* (Fig. 1.5), can be found.

Nealsomyia merzi sp. n. Pl. 2

Material examined. Holotype ♂: Namibia / Mont Erongo / 24.I.2000 / leg. J. Sudre [MHNG]. The holotype has been labelled as follows, handwritten with black ink on red card: HOLOTYPUS ♂ / *Nealsomyia* / *merzi* / Cerretti 2002.

Etymology. I dedicate this species to my colleague Bernhard Merz, Diptera curator at the Museum of Geneva.

Diagnosis. Frons at its narrowest point 0.5 times as wide as an eye in dorsal view. Medial vertical setae strong, reclinate and crossed. Scutellum without lateral marginal setae. Abdominal tergites 3-5 dorsally covered with dense grey microtrichosity.

Description. MALE. *Length*. 5.46 mm.

Colour. Head black - except frontal vitta and gena - with light grey microtrichosity; frontal vitta reddish-brown; gena reddish. Scape black; pedicel black, apically and distally dark-brown; postpedicel and arista black. Palpi basally brown, shading into yellowish distally. Thorax black, with grey microtrichosity; scutum, before transverse suture, with four longitudinal dark vittae; posterior 1/3 of the scutellum reddish. Abdomen black, sides of tergites 2 and 3 reddish; abdominal tergites 3-5 dorsally covered with dense grey microtrichosity. Tegula and basicosta black, costa basally yellowish, shading into brown distally; remaining veins brown. Halter yellowish. Legs black.

Head (Figs 2.1, 2.2). Arista thickened on its basal 2/5. Second aristomere not longer than wide. Postpedicel 1.5 times as long as pedicel. Eye densely covered with long hairs that are longer than combined diameter of 4-5 facets. Frons at its narrowest point 0.5 times as wide as an eye in dorsal view. Medial vertical setae strong, reclinate and crossed, about 3/4 as long as vertical eye diameter. Lateral vertical seta hair-like, about 0.5 times as long as medial vertical. One reclinate orbital seta about as long as medial vertical. Nine to 10 frontal setae descending to the level of the base of the post-

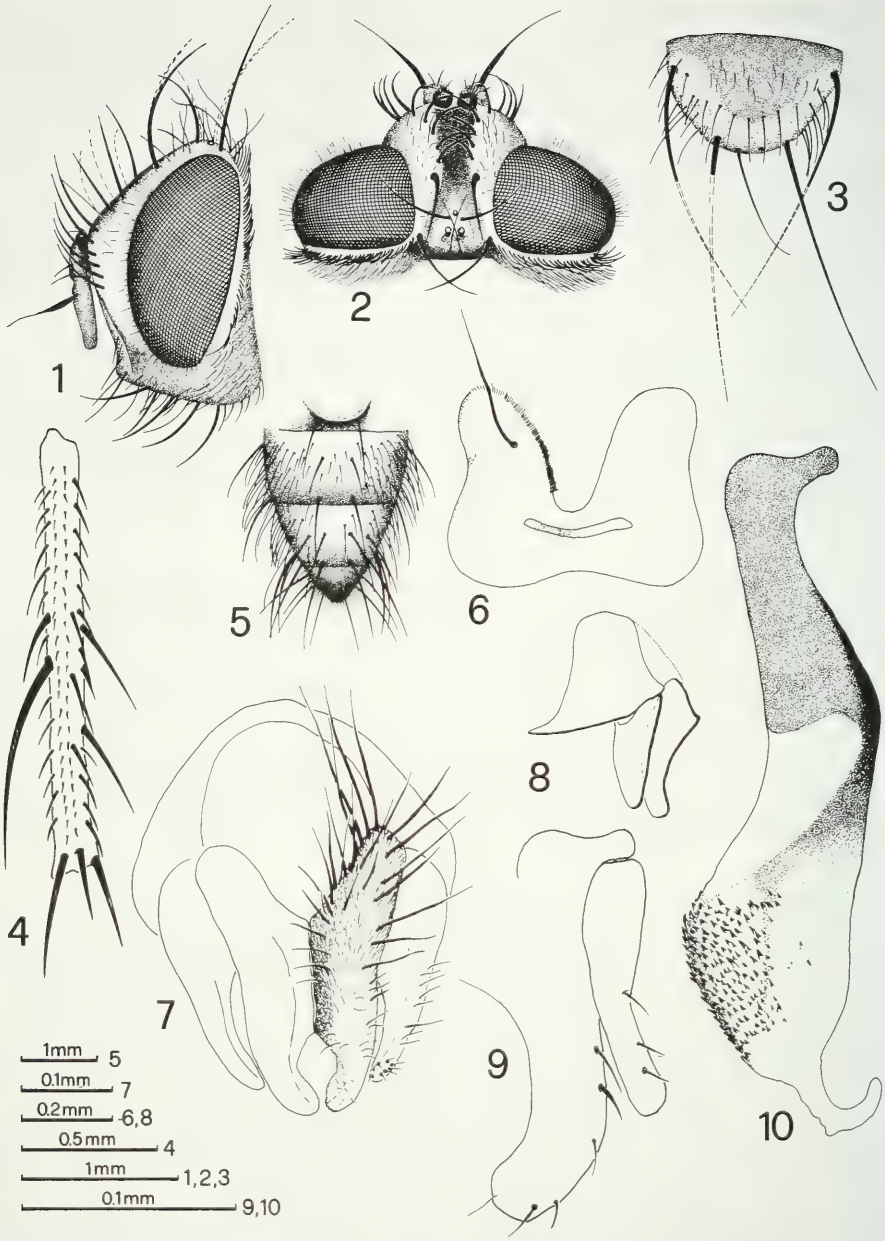


PLATE 2

Figs 1-10. *Nealsomyia merzi* sp. n.: Namibia, Mont Erongo (male – holotype) – 1. Head in lateral view. 2. Head in dorsal view. 3. Scutellum in dorsal view. 4. Left mid tibia. 5. Abdomen in dorsal view. 6. Sternite 5 in ventral view. 7. Epandrial complex in posterior view. 8. Epandrial complex in left lateral view. 9. Pregonite and postgonite in left lateral view. 10. Aedeagus in left lateral view.

pedicel. Fronto-orbital plate with one or two rows of sparse black setulae lateral to the row of frontal setae. Parafacial (in lateral view) at its narrowest point 0.9 times as wide as the width of postpedicel. Gena in profile 1/5 of vertical eye height. Postocular setae long, bent forwards. Prementum about 4 times as long as wide. Palpus slightly clavate with some setulae ventrally and apically.

Thorax. Prosternum with some setulae on its lateral margin (3-4). Scutum with 3+3 acrostichal setae, 3+3 dorsocentral, 1+3 intraalar, 2 posthumeral, 1 presutural, 2 notopleural, 3 supraalar; postalar callus with 3 setae. Proepimeron with 3 strong setae and 8-10 long setulae. Katepisternum with 3 setae. One anepimeral seta. Anepisternum with 6-7 setae. Katepimeron with few (2-3) setulae on anterior 1/5. Scutellum (Fig. 2.3) with 1 pair of discal setae, 1 pair of crossed apical setae (horizontal or inclined at most 30° to horizontal), 1 subapical, 1 basal – no lateral setae.

Legs. **Fore leg** – Tibia with an irregular row of short anterodorsal and posterodorsal setae, and 2 posterior setae; preapical anterodorsal seta shorter than preapical dorsal. Claws longer than tarsomere 5. **Mid leg** – Femur with rows of very irregular, in number, length and thickness, anteroventral and posteroventral setae, 2 anterior setae and no posterior setae. Tibia (Fig. 2.4) with 2 anterodorsal setae, the upper anterodorsal seta very short and weak, less than 1/3 of the length of the middle anterodorsal one. 1 weak posterodorsal seta, 2 posterior, 1 ventral. Claws about as long as tarsomere 5. **Hind leg** – Tibia with an irregular row of anterodorsal and posterodorsal setae, each row with a seta, almost at midlength, about 1.5 as long as the others; 2 anteroventral setae, 2 dorsal preapical setae. Posteroventral preapical seta shorter than anteroventral preapical one. Claws about 0.90 times as long as tarsomere 5.

Wing. Costal spine about as long as crossvein R-M or slightly longer. Second costal portion bare ventrally. Base of R_{4+5} with 3-4 setulae. Bend of M nearly at a right angle or slightly obtuse. Wing cell r_{4+5} with a short petiole, about as long as the diameter of M vein.

Abdomen (Fig. 2.5). Syntergite 1+2 with 1 pair of long median marginal setae, 2 pairs of lateral marginal setae; general setulae long and robust (longer on the sides of the syntergite). Tergite 3 with 1 pair of median marginal setae about as long as the dorsal length of tergite 3; 1 pair of median discal setae about 0.60 times as long as median marginal pair and sub-equal to the median marginals of the syntergite 1+2; 1 or 2 pairs of lateral marginal setae. Tergite 4 with a row of 9 marginal setae, 2 pairs of median discal setae and some long and robust setulae medially. Tergite 5 with rows of marginal and discal setae.

Terminalia. Cerci (Figs 2.7, 2.8) broad, with a dorso-medial suture, apically separated from each other and slightly bent medially. Surstylus (Figs 2.7, 2.8) well developed, sub-triangular in lateral view, with several setulae latero-apically. Pregonite (Fig. 2.9) rounded apically and bent anteriorly, with a row of short and stout setulae on its dorsal margin. Postgonite (Fig. 2.9) slender, apically rounded and bare.

FEMALE. Unknown.

Hosts. Unknown.

Distribution (Map 1). Afrotropical: Namibia.

Remarks. Species morphologically similar to *N. triseriella*, from which it is immediately distinguished because of the noticeably narrower vertex, the crossed outer

vertical setae, the absence of the lateral marginal setae of the scutellum and abdominal tergites 3-5 entirely covered with microtrichosity.

N. merzi and *N. triseriella* share the following characteristics : a) mid tibia with one short additional anterodorsal seta, dorsally to the strong anterodorsal one; b) abdominal tergites 3 and 4 with one pair of median discal setae. These features clearly separate these two taxa from the other *Nealsomyia*.

Nealsomyia rufella (Bezzi, 1925) Pl. 3; Pl. 4, Figs 4, 5

Parexorista corvinoides var. *rufella* Bezzi, 1925: 119 [original description] [type locality – Malaysia, Kuala Lumpur]; Crosskey, 1967: 104 [lectotype designation].

Exorista quadrimaculata Baranov, 1934: 43 [original description] (type locality – Malaysia: Malaya, Selangor, Klang); Mesnil, 1954: 356 [redescription]; Crosskey, 1967: 102 [new synonymy]; Crosskey, 1967: 104 [lectotype designation]; Sabrosky & Crosskey, 1969: 44 [taxonomy].

Alsomyia indica Villeneuve, 1937: 407 [original description] [type locality – Vietnam [North], Tonkin, Cho gành) [syntypes ♂ ♀, not located]; Mesnil, 1954: 356 [as (new?) synonym of *N. quadrimaculata*].

Nealsomyia rufella (Bezzi, 1925): Crosskey, 1967: 102 [new assignment (as new combination), new rank (as new status)], 104 [lectotype designation]; Crosskey, 1976: 250 [catalogue], 288 [host catalogue]; Crosskey, 1981: 692 [catalogue]; Arnaud, 1982: 13 [taxonomy]; Holloway *et al.*, 1989: 21 [bionomy]; Harris, 1989: 189, 192 [taxonomy, biology, distribution]; Chao, 1996: 1919 [taxonomy]; Shima & Tachi, 1996 [faunistics and bionomics]; Shima, 1999: 50 [host catalogue].

Material examined. CHINA. [1 ♀]: China / Canton / W.E.Hoffman / 49-1082/ (1) [vertical] // COM INST. ENT. / COLL. No 11555 // Pres. by / Imp. Inst. Ent. / B. M. 1952-299. // *Alsomyia indica* Vill. / L. Mesnil det., 1947 [BMNH]. [1 ♂]: China / Canton / W.E.Hoffman // 49-1082 / (1) [vertical] // COM INST. ENT. / COLL. No 11555 // Pres. by / Imp. Inst. Ent. / B. M. 1952-299. // *Alsomyia indica* Vill. / L. Mesnil det., 1951 [BMNH].

INDONESIA. [1 ♂]: Paralectotype // Pematang Siantar / Sumatra, E. C. / 13. 1. 32 / Coll. R. I. Nel. // ex larva of / bagworm / No. 59 // Simpang Raja Fst. 2,200 feet // *Exorista* / *4-maculata* / n.sp. / N. Baranoff [BMNH]. [3 ♀♀]: PEMATANG SIANTAR. / Sumatra E.C. / 21.II.31 / Coll. R.I. NEL. // Simpang Raja Est / 2,200 feet // ex larva of / bagworm / No 59 // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. // *Exorista* / *4-maculata* / Baranoff. [BMNH]. [2 ♂♂]: PEMATANG SIANTAR. / 22.3.32 / Coll. R.I. NEL. // *Exorista* / *4-maculata* / Bar // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. // Simbolon Estate / 1, 750 feet [BMNH].

IRAN. [2 ♂♂]: Teheran / Rafsandjan, 22.6.74 / M. Safavi leg. / ex *Amicta 4-angulata* [SMNS].

JAPAN. [5 ♂♂, 5 ♀♀]: KYUSHU / Fukuoka / Baikouen Mall / 15.IX.1995 / T. Tachi leg. [BLKU].

LAOS. [1 ♂]: Laos / 3-75 / G. Dean / C.I.E. A. 7961 // ex Psychid / on *Cassia* // *Nealsomyia* sp. / det. K. M. Harris, 1975 // Pres by / Com Inst Ent / B.M. 1975-1 [BMNH]. [1 ♀] [teratological]: Laos / 2-75 / G. Dean / C.I.E. A. 7961 // ex Psychid / on *Cassia* // *Nealsomyia* sp. / det. K. M. Harris, 1975 [BMNH].

MALAYSIA. [Lectotype ♀]: Lectotype // FED. MALAY STATES. / Kuala Lumpur. / V.1922 / Parasite from 119a / G.H.Corbett. / 119b [vertical] // Parasite on 119.A. (*Chalcoscelis fumifera*, Swinh). // Pres. by / Imp. Bur. Ent. / Brit. Mus. / 1925-540. // *Exorista* / *corvinoides* v.d.W. / var / *rufella* n.v. [BMNH]. [Lectotype ♂]: Lectotype // Malaya / Klang / 9.2.1931 / Entom. Div. / Agric. Dept. / 7451. [left, vertical] / Psychid on / *Areca* (7416) [right, vertical] // *Exorista* / *4-maculata* / n.sp. / N. Baranoff. // Pres. by / Imp. Bur. Ent. / Brit. Mus. /1933-43 [BMNH]. [1 ♂]: FED. MALAY STATES Kuala Lumpur -V.1922 Parasite from 119ª G. H. Corbett / Parasite on 119ª *Chalcoscelis fumifera* Swimh.) [MSNM]. [1 ♀]: Paralectotype // Malaya / Klang / 9.2.1931 / Entom. Div. / Agric. Dept. / 7451. [left, vertical] / Psychid on / *Areca* (7416) [right, vertical] // *Exorista* / *4-maculata* / n.sp. / N. Baranoff. // Pres. by / Imp. Bur. Ent. / Brit. Mus. / 1933-43 [BMNH]. [1 ♂]: Malaya Peninsula / 8. 4. 32. / Kuala Lumpur / 8451 [left,

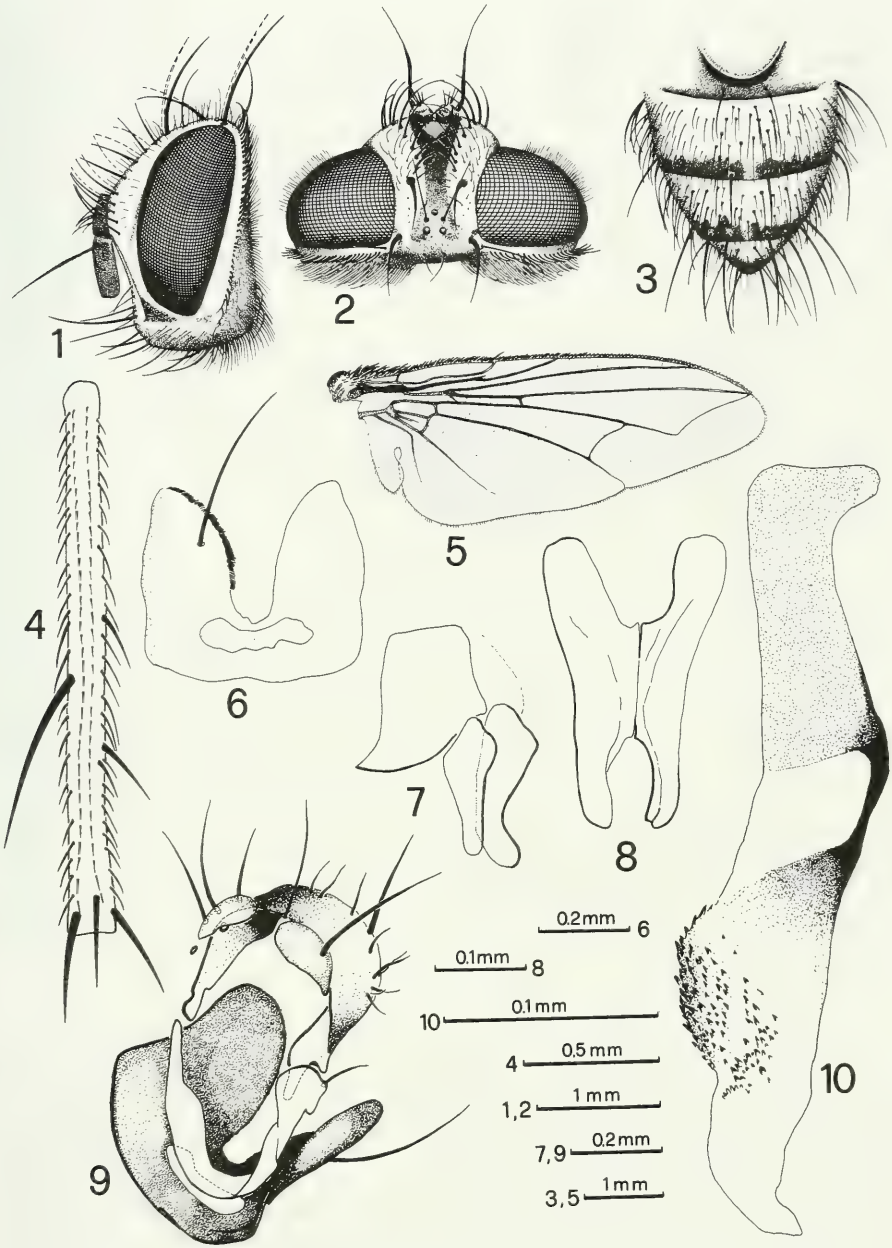


PLATE 3

Figs 1-10. *Nealsomyia rufella* (male) – 1. Head in lateral view (Japan). 2. Head in dorsal view (Japan). 3. Abdomen in dorsal view (Japan). 4. Left mid tibia (Japan). 5. Right wing (Japan). 6. Sternite 5 in ventral view (Thailand, Bangkok). 7. Epandrial complex in left lateral view (Japan). 8. Syncercus in posterior view (Thailand, Bangkok). 9. Segments 6-8 and sternite 5 in antero-lateral left view (Japan). 10. Aedeagus in left lateral view (Japan).

vertical] // *Exorista* / *4-maculata* / Baranoff. // Det. Baranoff // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. [BMNH]. [1 ♂]: 3172 // FED. MALAY STATES. / Kuala Lumpur. / 3.IV.1926 / ex Psychidae / on *Poinciana regia*. / G.H. Corbett. // Pres. by / Imp. Inst. Ent. / B. M. 1952-299. // *Alsomyia indica* Vill. / L. Mesnil det., 1951 [BMNH]. [1 ♂]: Malaya / Kuala Lumpur / bread from larvae / march 1939 / H.M. Pendlebury / F. M. S. / Museum [underside] // Ex F.M.S. / Museum / B.M.1955-354 [BMNH]. [1 ♀]: Kuala Lumpur 119 / ex *Chalcoscelis fumifera* Swimh [MSNM]. [2 ♀]: Malaya / Kuala Lipis / 1.5. 1931 / G.H. Corbett. / 7635 [left, vertical] // Host 7634 / Psychidae / ? *Clania* / *variegata* // Pres. by / Imp.Bur.Ent. / Brit. Mus./1933-43 // *Exorista* / *4-maculata* / Baranoff. [BMNH]. [1 ♀]: Malay Peninsula / 29.3.32 / Pahang. / G.H.Corbett. / 8414 [left, vertical] // Host 8410. Psychidae / on *Palaquium gutta* // *Exorista* / *4-maculata* / Baranoff. // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. [BMNH]. [1 ♂]: Malay Peninsula / 9.3.32 / Pahang. / G.H.Corbett. // 8386 [left, vertical] // *Exorista* / *4-maculata* / Bar. // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. // Host 9346 / Lepidoptera // on *Palaquium gutta* [BMNH]. [1 ♂]: Malay Peninsula / 9.3.32 / Pahang. / G.H.Corbett. / 8386 [left, vertical] // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. // on *Palaquium gutta* // Host 8346 / Psychidae // *Exorista* / *4-maculata* / Baranoff. [BMNH]. [1 ♀]: Malay Peninsula / 23. 4. 32 / Pahang / G.H.Corbett. / 8521 [left, vertical] // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. // Host 9514 lept. on / *Albiryria stipulata* // *Exorista* / *4-maculata* / Baranoff. [BMNH]. [1 ♂]: Malay Peninsula / 26.2.32 / Pahang. / G.H.Corbett. // 8337 [left, vertical] // Host 8194 Lepidoptera / on *Palaquium gutta* // *Exorista* / *4-maculata* / Bar // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. [BMNH]. [1 ♂]: Malaya / 8215 Pahang / Host - Moth 8159 / 11. 12. 1931 // *Exorista* / *4-maculata* / Bar // Pres. by / Imp. Inst. Ent. / B. M. 1933-328. [BMNH].

SRI LANKA. [1 ♂]: Paralectotype // Ceylon / Ratnapura / 27.VI.1922 / ex Psychid / per J.C.Hutson. // *Exorista* / *4-maculata* / n.sp. / N. Baranoff [BMNH].

THAILAND. [1 ♀]: Siam / Bangkok Noi / Fruit farm n. R.S. Ladau / ex bagworm on / *Pithecolobium* / *dulce*, Benth // *Exorista* / *4-maculata* / Bar // No-10 / 23-10-27 // Pres. by / Imp. Inst. Ent. / B. M. 1933-340 [BMNH]. [1 ♂]: Siam / Bangkok Noi / Fruit farm n. R.S. Ladau / ex bagworm on / *Pithecolobium* / *dulce*, Benth // *Exorista* / *4-maculata* / Bar // No-10 / 19-10-27 // Pres. by / Imp. Inst. Ent. / B. M. 1933-340. [BMNH]. [1 ♂]: Siam. / Bangkok. / 18. X. 1929. / W.R.S. Ladell. // *Exorista* / *4-maculata* / Bar // Pres. by / Imp. Inst. Ent. / B. M. 1933-340. [BMNH]. [1 ♂]: REARED / NO. BC675 / [handwritten, not translated –?in Thailandese] / SIAM [left, vertical] // REFERENCE / B.l. 675 / No. 208 / SIAM [left, vertical] // IMP. INST. ENT. / COLL. No. 10660 // *Alsomyia indica* Vill. / L. Mesnil det., 1950 [BMNH]. [1 ♀]: REARED / NO. BC385 / [not translated – ?in Thailandese] // SIAM [left, vertical] // REFERENCE / B.l. 385 / No. 199 / SIAM [left, vertical] // IMP. INST. ENT. / COLL. No. 10660 // *Alsomyia indica* Vill. / L. Mesnil det., 1950 [BMNH]. [1 ♀]: REARED / NO. BC675 / [handwritten not translated – ?in Thailandese] / SIAM [left, vertical] // REFERENCE / B.l. 675 / No. 268 // SIAM [left, vertical] // IMP. INST. ENT. / COLL. No. 10660 // *Alsomyia indica* Vill. / L. Mesnil det., 1950 [BMNH].

Redescription. MALE. *Length*. 3.7-6.7 mm

Colour. Head black – except frontal vitta and gena - with light grey microtrichosity; frontal vitta reddish-brown or dark brown; gena black, reddish or yellowish. Antennal scape and pedicel brown, reddish or yellowish; postpedicel basally yellow or reddish shading into black or brown distally, rarely entirely black. Palpus yellow. Thorax (except scutellum) black in ground colour, with grey microtrichosity; scutum, before transverse suture, with four longitudinal dark vittae; posterior 1/3-1/2 of the scutellum reddish or yellowish or scutellum entirely black. Abdomen black in ground colour, sides of tergites 2, 3 and anterior half of 4 reddish or yellowish (rarely only on sides of tergite 2); abdominal tergites 3 and 4 dorsally microtrichose on anterior 4/5-1/1, tergite 5 with microtrichosity on its anterior 2/3-4/5. Tegula black or brown, basicosta yellow or brown, rarely black, costa basally yellowish shading into brown distally, remaining veins brown. Halters yellow. Legs: coxa and trochanter black or

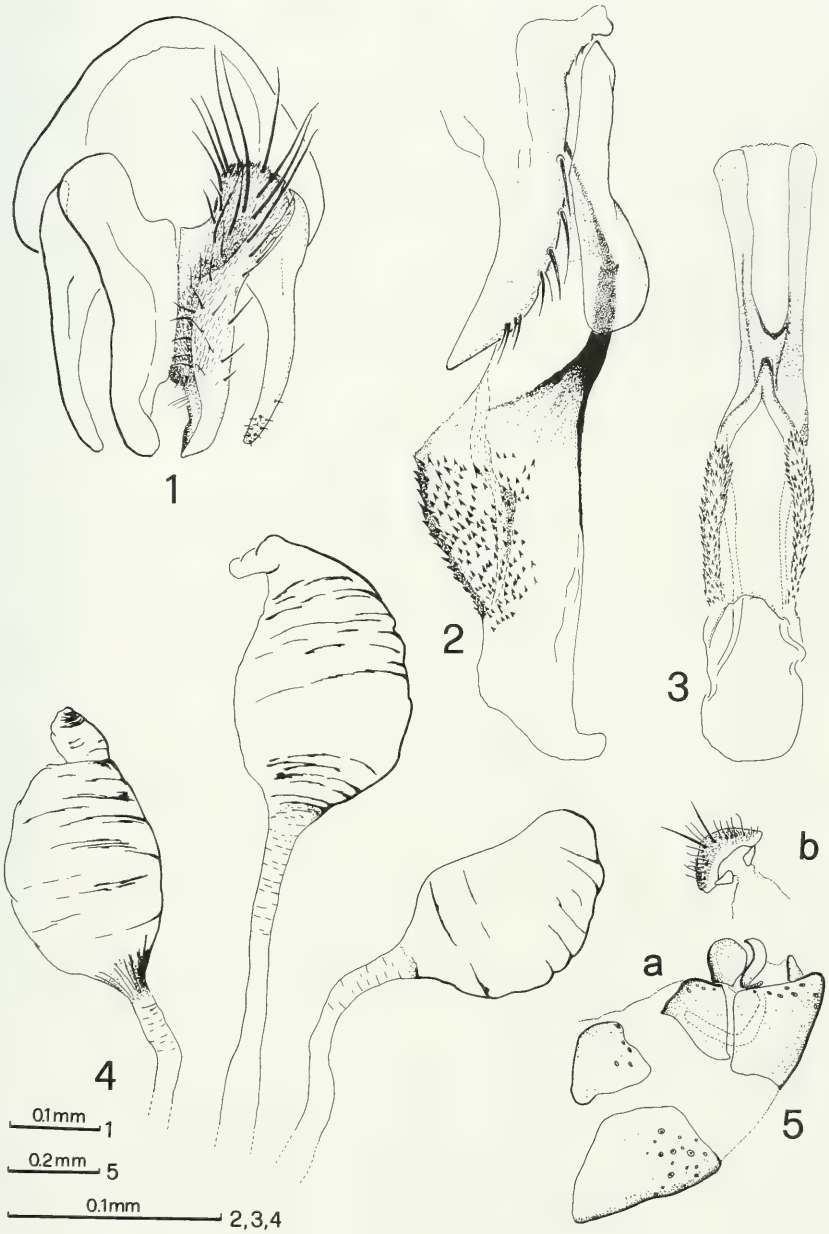


PLATE 4

Figs 1-3. *Nealsomyia rufipes*: S India (male) – 1. Epandrial complex in posterior view. 2. Aedeagus, pregonite and postgonite in left lateral view. 3. Aedeagus in ventral view. Figs 4-5a,b. *Nealsomyia rufella*: Japan (female) – 4. Spermathecae. 5a. Postabdomen in left lateral view. 5b. Postgenital plate in ventral view.

reddish-brown, femora black or brown, tibia black or brown, tarsi black. Fore femur microtrichose on its posterior surface.

Head (Figs 3.1, 3.2). Arista thickened on its basal 2/5-1/2. Second aristomere not longer than wide. Postpedicel 1.7-2 times as long as pedicel. Eye densely covered with long hairs that are longer than combined diameter of four facets. Frons at its narrowest point 0.6-0.8 times as wide as an eye in dorsal view. Medial vertical seta strong, reclinate and sub-parallel, about 1/2 as long as vertical eye diameter. Lateral vertical seta very weak, slightly differentiated from the postocular setae. One upper reclinate orbital setae about as long as medial verticals (if two, the posterior one short and weak). Nine to 10 frontal setae descending to the level of the base of the arista. Fronto-orbital plate with one or two rows of sparse, proclinate black setulae lateral to the row of frontal setae. Parafacial (in lateral view) at its narrowest point 0.3-0.7 (0.2 in one specimen from Laos) times as wide as the width of postpedicel. Gena in profile about 1/6-1/5 of vertical eye height. Postocular setae long, bent forwards. Prementum about 3 times as long as wide. Palpus cylindrical or slightly clavate, with some setulae ventrally and apically.

Thorax. Prosternum with some setulae on its lateral margin. Scutum with 3+3 acrostichal setae, 3+4 dorsocentral, 1+3 intraalar, 2 posthumeral, 1 presutural, 2 notopleural, 3 supraalar; postalar callus with 3 setae. Proepimeron with 1-4 strong setae and several long setulae. Katepisternum with 3 setae. One anepimeral seta. Anepisternum with 5-7 setae. Katepimeron bare. Scutellum with 1 pair of discal setae, 1 pair of crossed (horizontal or inclined at most 30° to horizontal) apical setae, 1 subapical, 1 lateral, 1 basal; (lateral setae about 4/5 as long as basal setae).

Legs. **Fore leg** – Tibia with 4-7 anterodorsal setae, 1-2 posterodorsal, 2 posterior setae; anterodorsal preapical seta shorter than dorsal. Claws longer than tarsomere 5. **Mid leg** – Femur with rows of very irregular, in number, length and thickness, anteroventral and posteroventral setae, 0-2 anterior setae and 2-4 posterior setae. Tibia (Fig. 1.4) with 1 anterodorsal seta; 1-2 weak posterodorsal, 2 posterior, 1 ventral. Claws about as long as tarsomere 5. **Hind leg** – Tibia with an irregular row of anterodorsal and posterodorsal setae, each row with 1-2 setae about 1.5 times as long as the others; 2-3 anteroventral setae, 2 dorsal preapical setae. Posteroventral preapical seta shorter than anteroventral preapical. Claws about 0.9 times as long as tarsomere 5.

Wing (Fig. 1.5). Costal spine about as long as crossvein R-M or slightly longer. Second costal portion ventrally bare. Base of R_{4+5} with 3-6 setulae. Cell r_{4+5} closed just at wing margin.

Abdomen (Fig. 1.3). Syntergite 1+2 with 1 pair of median marginal setae, 1-3 pairs of lateral marginal setae longer that median marginals; general setulae long and robust (longer on the sides of the syntergite). Tergite 3 with 1 pair of median marginal setae about 0.7-1.0 times as long as the dorsal length of tergite 3; 1 or 2 pairs of lateral marginal setae. Tergite 4 with a row of 11 marginal setae. Tergite 5 with rows of marginal and discal setae.

Terminalia. Cerci narrow, with a dorso-medial suture, apically separated from each other and slightly bent medially. Surstylus (Figs 3.7, 4.1) narrow, well developed, sub-triangular in lateral view, with several setulae latero-apically. Pregonite (as in Fig. 4.2) bent anteriorly, with a row of short and stout setae on its dorsal margin. Postgonite (as in Fig. 4.2) slender, rounded apically and bare.

FEMALE. Differs from male as follows: *Head*. Two proclinate orbital setae. Frons at its narrowest point 0.8-1.0 times as wide as an eye in dorsal view. *Abdomen*. Tergites 3 and 4 without patches of appressed setulae. *Postabdomen and genitalia* (Figs 4.4, 4.5a,b). Segments 6 and 7 retracted into the segment 5. Tergite 6 and 7 interrupted medio-dorsally forming two sub-trapezoidal sclerites bearing setae. Sternites 6 and 7 wider than corresponding tergites. Tergite 8 divided into two curved sclerites. Sternite 8 short and robust, sub-triangular in ventral view. Postgenital plate slightly bent upwards in lateral view, bearing setulae and microtrichia ventrally. Cerci sub-circular in lateral view. Three sub-globular well sclerotized spermathecae.

PUPARIUM. Sub-elliptical. Surface smooth except for transverse band of spinules on each segment. Posterior spiracle borne on short and heavily sclerotized tubercle; each spiracle with 3 openings. Spiracles divided by a broad sub-triangular or T-shaped carina.

Hosts and biological notes. *Nealsomyia rufella* has been reared from the larvae of the following species: *Amicta quadrangularis* Christoph, 1873 (Lepidoptera, Psychidae) – a species known from Armenia, Iran, Iraq and near East to Egypt. The status and distribution are, however, not yet clear. The species is also reported from Algeria, but this may be another species or a misidentification (Hättenschwiler, 2004 pers. comm.). – *Chalcocelis albiguttatus* (Snellen, 1879) (Lepidoptera, Limacodidae) – a polyphagous, widespread Oriental species, recorded on *Aleurites triloba* Forster (Euphorbiaceae), *Camellia* (Ternstroemiaceae), *Durio* (Malvaceae), *Elaeis* (Arecaceae), *Eugenia malaccensis* Linnaeus (Myrtaceae), *Nephelium* (Sapindaceae), and recorded as an important pest of *Cocos nucifera* Linnaeus (Arecaceae) in Malaysia and Indonesia (cf. Ooi *et al*. 2002). – *Eumeta variegata* (Snellen, 1879) (Lepidoptera, Psychidae) – a widespread species in India and Nepal, reaching the Solomon Islands; it is recorded from nearly all areas of Southeast Asia (Hättenschwiler, 2003 pers. comm.). – *N. rufella* has also been recorded from other unidentified psychids collected from tree species, some of which are of economic interest, such as: 1) *Albizia chinensis* Merrill (= *A. stipulata* Boivin) (Fabaceae), species widespread from the Tropical Hymalayas in Kumaon and Sikkim, to Sri Lanka, Birma and the Malaya Isles (Baker, 1878), 2) *Areca* spp. (Arecaceae), 3) *Cinnamomum cassia* Blume (Lauraceae), an Oriental species widespread in Southern China, Burma, Laos and Vietnam (commercial cultivation is restricted to China and Vietnam) – in Chinese cookery, cassia is an essential ingredient–, 4) *Delonix regia* (Bojer ex Hook.) Raf. (= *Poinciana regia*) (Cesalpinaceae), species originally from Madagascar, which is now widespread as an ornament in many subtropical and tropical areas of Asia and America, 5) *Palaquium gutta* Burk (Sapotaceae), an Oriental species from which gutta-percha is obtained, 6) *Pithecolobium dulce* Benth. in Hook (Fabaceae), a species cultivated throughout India, but of South American origin (Baker, 1878). *Nealsomyia rufella* in Japan, where it was probably accidentally introduced (Shima, 1999), is a parasite of *Eumeta japonica* (Heylaerts, 1884) (most likely a synonym of *E. variegata*), a species known only from Japan (Hättenschwiler, 2004 pers. comm.). It is a common pest of many artificially - grown tree species, like those of roadsides and cities, but has never been found in natural forests (Shima & Tachi, 1996); the same authors recorded high percentages of parasitization (approximately 90%) in Fukuoka, indicating *N. rufella* as a gregarious parasite.

Distribution (Map 1). Palaearctic: Iran, Japan (S Honshu, Kyushu); Oriental: China (Canton; Shandong Province), Indonesia (Sumatra), Laos, Malaysia (Malaya), Sri Lanka, Thailand, Vietnam.

Nealsomyia rufipes (Villeneuve, 1937)

Alsomyia rufipes Villeneuve, 1937: 407 [original description] (type locality – India, Coimbatore); Crosskey, 1976: 264 [lectotype designation].

Nealsomyia rufipes (Villeneuve, 1937): Mesnil, 1954: 356, 358 [redescription]; Crosskey, 1976: 251 [catalogue]; Crosskey, 1981: 692 [catalogue]; Harris, 1989: 192 [biology].

Material examined. INDIA. [Punjab] - [1 ♂, 1 ♀]: *Exorista* / *4-maculata* / Baran. // *Pinus* / *longifolia* // Pres. by / Imp. Inst. Ent. / B. M. 1935-233. // Chakmoh / Hoshiarpur, Punjab / B. M. Bhatia. / 7. IV. 1931 [BMNH]. [Bihar] - [2 ♀♀]: INDIA / [Ranchi] Namkum / 7.9.1965 / B. N. sah Coll. [BMNH]. [Gujarat] - [1 ♂]: V. C. PATEL / INST OF AGRI. / [Ahmadabad] ANAND (G.S.) // 23. Ex: Larvae Host: *P. granatum* / var. *nana* / June. ' 65 // C. I. E. COLL. / A. 1940 // *Nealsomyia* / *rufipes* Vill. / R. W. Crosskey det. 1966 [BMNH]. [Karnataka] - [1 ♂]: Ex Psychid / on terminalia // Pugalur, Sept. 1973 // CIBC – 1.5 / Bangalore // 1 // *Nealsomyia rufipes* Villeneuve / L.P. Mesnil det., 1985 // EX / L.-P. MESNIL / COLLECTION 1985 [CNC]. [1 ♀]: Bangalore. Ind. / 16-9-' 57 // ex bagworm on leaves of Ciuava // 3 // CIBC -BSC.I.E. COLL / No. 17639 // *Nealsomyia rufipes* Vill. [BMNH]. [1 ♂]: Bangalore. Ind./ 16-9-' 57 // ex bagworm on leaves of Ciuava // 1 // CIBC- BS. // C.I.E. COLL / No. 17639 [BMNH]. [Tamil Nadu] - [1 ♂, 1 ♀]: *Exorista* / *4-maculata* / Baran. // Pres. by / Imp. Inst. Ent. / B. M. 1936-522. // S. INDIA / COIMBATORE / par on Psychid / KPA COLL 27 I 32 [BMNH]. [1 ♂]: 14. VIII. 15 / SOUTH INDIA / COIMBATORE / Par on *Clania* / *crameri* / M.O.P. Coll. [BMNH].

PAKISTAN. [1 ♂]: Rawalpindi Pak. / 25. 9. 56 // Ex. Case bearing / larvae // C.I.B.C. 197 / 56-1 // Pres by / Com Inst Ent / B.M. 1959-378 // C.I.E. COLL / No. 15603 [BMNH]. [1 ♀]: Rawalpindi, Pak. / 27. 9. 56 // Ex. Case bearing / larvae // C.I.B.C. 197 / 56-1 // Pres by / Com Inst Ent / B.M. 1959-378 // C.I.E. COLL / No. 15603 [BMNH].

SRI LANKA. [1 ♀]: 157 // Ceylon / Trincomali / 18. XI. 90 / lt. Coll. Yerbury. / 1892-192. [BMNH].

Redescription. Male and female differ from those of *N. rufella*, only in the colour of the integument, as follows:

Legs yellow or red. Posterior half of the scutellum yellowish or red, sometimes completely yellowish; sides of tergites 3 and 4 usually largely yellow or red, sometimes abdomen almost entirely yellow except for a dark median longitudinal vitta on tergites 3, 4 and 5.

For other features, such as morphometric ratios, chetotaxy and the anatomy and morphology of the male and female terminalia, the specimens of *N. rufipes* are close to the range of variability of *N. rufella*. Nevertheless, I have chosen to retain *N. rufipes* as a valid species for the moment due to the stability of colour and the absence, among the examined material, of specimens with intermediate colour patterns.

Nealsomyia rufipes and *N. rufella* are easily distinguishable from the other known species of *Nealsomyia* in possessing 4 postsutural dorsocentral setae, one anterodorsal seta on the mid tibia, and lacking median discal setae on abdominal tergites 3 and 4.

Hosts. *Nealsomyia rufipes* is a parasite of *Eumeta crameri* (Westwood, 1854) (Lepidoptera, Psychidae), recorded from Pakistan, India, Nepal and Sri Lanka (Hättenschwiler, 2003 pers. comm.), and of other non-identified species of psychids (cf. Crosskey, 1976).

Distribution (Map 1). Oriental: Pakistan, India (Bihar, Gujarat, Karnataka, Madras, Mysore, Punjab, Tamil Nadu), Sri Lanka.

Nealsomyia triseriella (Villeneuve, 1929) Pls 5, 6

Exorista (*Alsomyia*) *triseriella* Villeneuve, 1929: 185 [original description] (type locality – Egypt, Sahara esh-Sharqiya, nr. Helwan (= Heluan, = Helouan), Wadi-Hof).

Nealsomyia triseriella: Mesnil, 1939: 31 [description]; Mesnil, 1954: 359 [redescription]; Kugler, 1979 [faunistic data]; Herting, 1984:64 [catalogue]; Herting & Dely-Drascovits, 1993: 227 [catalogue].

Material examined. [EGYPT]. [Holotype ♂]: WADI-HOFF [= Wadi-Hof, = Wadi Hawf] / 21.3.22 // *Alsomyia* / *triseriella* / n. sp. [handwritten] // *Nealsomyia* / *triseriella* Vill. L. P. Mesnil det., 1969 [name of the species handwritten] // TYPE [red paper] // ex / L.-P. MESNIL / COLLECTION 1970 [CNC]. [2 ♂♂]: Sinai mts. / Wadi Tlach / 1500 m 15.VII.74 / F. Kaplan [TAU].

Redescription. MALE. *Lenght*: 6.7-7.0 mm.

Colour. Head black - except frontal vitta and gena - with light grey microtrichosity; frontal vitta reddish-brown or dark brown; gena reddish. Antenna black. Palpus yellow. Thorax (except scutellum) black in ground colour, with grey microtrichosity; scutum, before transverse suture, with four longitudinal dark vittae; posterior 1/3 of the scutellum reddish. Abdomen black in ground colour, sides of tergites 2, 3 and (holotype) anterior half of 4, reddish; abdominal tergites 3 and 4 dorsally microtrichose on anterior 4/5-5/6, tergite 5 with microtrichosity on its anterior 2/3-4/5. Tegula and basicosta black or dark brown, costa basally yellowish, shading into brown distally, remaining veins brown. Halter yellow. Legs: femora black, tibia black or brown, tarsi black. Fore femur microtrichose on its posterior surface.

Head (Figs 5.1, 5.2). Arista thickened on its basal 2/5. Second aristomere not longer than wide. Postpedicel 1.7-2.2 times as long as pedicel. Eye densely covered with long hairs that are longer than combined diameter of four facets. Frons at its narrowest point 0.8-0.9 times as wide as an eye in dorsal view. Medial vertical setae strong, reclinate and sub-parallel, about 2/3 as long as vertical eye diameter. Lateral vertical seta very weak, not differentiated from the postocular setae. One reclinate orbital seta about as long as medial vertical one. Nine to 10 frontal setae descending to the level of the base of the postpedicel. Fronto-orbital plate with one or two rows of sparse black setulae lateral to the row of frontal setae. Parafacial (in lateral view) at its narrowest point 0.7-0.9 times as wide as the width of postpedicel. Gena in profile about 1/3 of vertical eye height. Postocular setae long, bent forward. Prementum about 4 times as long as wide. Palpus cylindrical with some setulae ventrally and apically.

Thorax. Prosternum with a few setulae (1-2) on its lateral margin or bare. Scutum with 3+3 acrostichal setae, 3+3 dorsocentral, 1+3 intraalar, 2 posthumeral, 1 presutural, 2 notopleural, 3 supraalar; postalar callus with 3 setae. Proepimeron with 3 strong setae and 8-10 long setulae. Katepisternum with 2 or 3 setae. One anepimeral seta. Anepisternum with 6-7 setae. Katepimeron with few setulae on anterior 1/5. Scutellum (Fig. 5.3) with 1 pair of discal setae, 1 pair of crossed (horizontal or inclined at most 30° to horizontal) apical setae, 1 subapical, 1 lateral (holotype with two lateral on one side and one on the other side), 1 basal; lateral setae about 4/5 as long as basal setae.

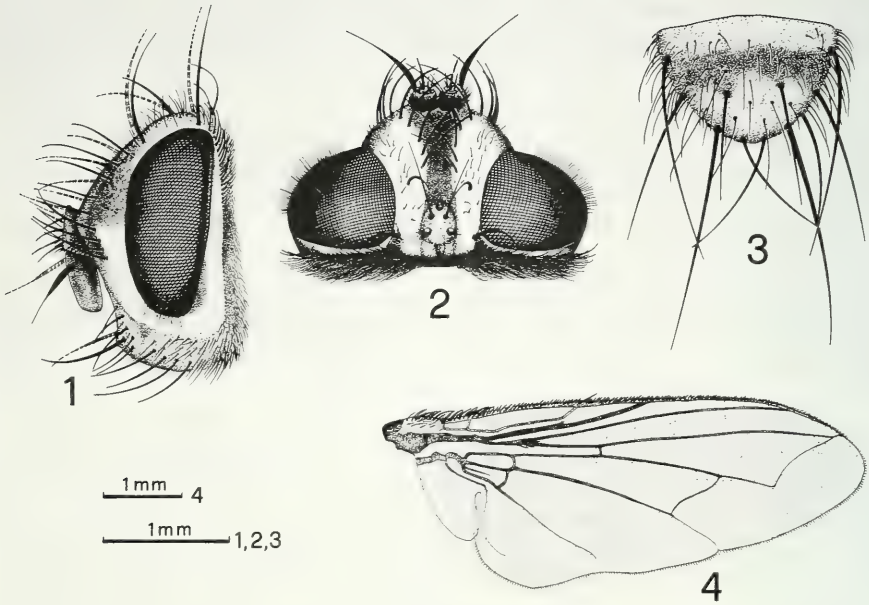


PLATE 5

Figs 1-4. *Nealsomyia triseriella*: Egypt (male) – 1. Head in lateral view (Wadi-Hof – holotype). 2. Head in dorsal view (Wadi-Hof – holotype). 3. Scutellum in dorsal view (Wadi-Hof – holotype). 4. Right wing (Sinai).

Legs. **Fore leg** – Tibia with 4 (rarely 5) anterodorsal setae, 2 posterodorsal, 2 posterior setae, anterodorsal preapical seta shorter than dorsal seta. Claws longer than tarsomere 5. **Mid leg** – Femur with rows of very irregular, in number, length and thickness, anteroventral and posteroventral setae, 0 (holotype)-2 anterior setae and 2 posterior setae. Tibia (as in Fig. 2.4) with 2 anterodorsal setae, the upper anterodorsal seta very short and weak, less than 1/3 as long as the middle anterodorsal one - rarely one very weak seta below middle and/or between middle and upper one; 1-2 weak posterodorsal, 2 posterior, 1 ventral. Claws about as long as tarsomere 5. **Hind leg** – Tibia with an irregular row of anterodorsal and posterodorsal setae, each row with a seta almost at midlength, about 1.5 as long as the others; 2 anteroventral setae, 2 dorsal preapical setae. Posteroventral preapical seta shorter than anteroventral preapical. Claws about 0.90 times as long as tarsomere 5.

Wing (Fig. 5.4). Costal spine about as long as crossvein R-M or slightly longer. Second costal portion bare ventrally. Base of R_{4+5} with 3-5 setulae. Bend of M with a short stub only in the holotype; stub lacking in the other specimens. Bend of M nearly at a right angle or slightly obtuse. Wing cell r_{4+5} with a short petiole, at least as long as the diameter of veins M, at most as long as 1/10 of the section of M beyond bend.

Abdomen. Syntergite 1+2 with 1 pair of long median marginal setae, 2-3 pairs of lateral marginal setae; general setulae long and robust (longer on the sides of the syntergite). Tergite 3 with 1 pair of median marginal setae about 1.25 times as long as the dorsal length of the tergite 3; 1 pair of median discal setae (sometimes 1-4 addi-

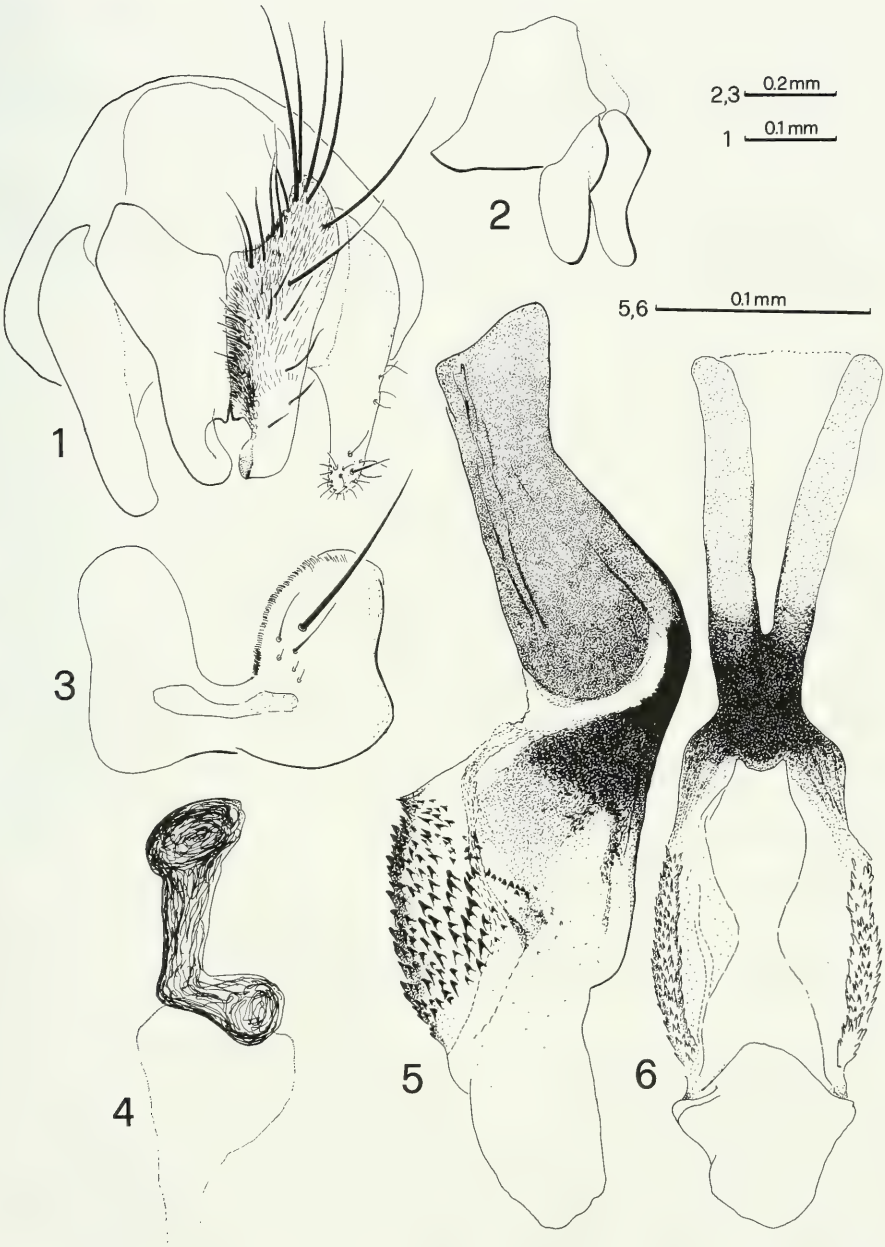


PLATE 6

Figs 1-6. *Nealsomyia triseriella*: Egypt, Sinai (male) – 1. Epandrial complex in posterior view. 2. Epandrial complex in left lateral view. 3. Sternite 5 in ventral view. 4. Ejaculatory apodem in left lateral view. 5. Aedeagus in left lateral view. 6. Aedeagus in ventral view.

tional irregular setae are present) about 0.60-0.70 times as long as median marginal and sub-equal to the median marginals of syntergite 1+2; 1 or 2 pairs of lateral marginal setae. Tergite 4 with a row of 17-20 marginal setae, 1-2 pairs of median discal setae and some long and robust setulae medially. Tergite 5 with rows of marginal and discal setae.

Terminalia. Cerci (Figs 6.1, 6.2) broad, with a dorso-medial suture, apically separated from each other and slightly bent medially. Surstylus (Figs 6.1, 6.2) well developed, sub-elliptical in lateral view, with several setulae latero-apically. Pregonite apically rounded and bent anteriorly, with a row of short and stout setae on its dorsal margin. Postgonite slender, rounded apically and bare.

FEMALE. Unknown.

Hosts. Unknown.

Distribution (Map 1). Palearctic: Egypt (Sahara esh-Sharqiya; Sinai).

ACKNOWLEDGEMENTS

Sincere thanks are due to the following colleagues, who enabled me to study the valuable material preserved in their institution: Dr Amon Freidberg (Tel Aviv); Dr Bernhard Merz (Geneva), Dr James E. O'Hara (Ottawa), Dr Fabrizio Rigato (Milano), Prof. Hiroshi Shima (Fukuoka), Dr Hans-Peter Tschorsnig (Stuttgart), Mr Nigel Wyatt (London). I am also indebted to Dr Nicolò Falchi (Rome) for the illustrations (head, wing, scutellum and abdomen), to Prof. Paolo Audisio (Rome), Dr Alessio De Biase (Rome), Dr Bernhard Merz, Dr Gianluca Nardi (Mantova) and Dr Mara Tisato (Verona) for critically revising the manuscript, to Dr Daniel Whitmore (Mantova) for improving the English, to Dr Peter Hättenschwiler (Uster) for useful information on Lepidoptera. A special thanks goes to Prof. Augusto Vigna Taglianti (Roma) for his constant support.

REFERENCES

ARNAUD, P. H., Jr 1982. The Mario Bezzi Diptera Collection, with remarks on the types of Tachinidae. *Memoirs of the Entomological Society of Washington* 10: 8-14.

BARANOV, N. 1934. Mitteilungen über gezüchtete orientalisches Larvevoriden (Insecta, Diptera). *Entomologisches Nachrichtenblatt*, Troppau 8: 41-49.

BAKER, J. G. 1878. 50 Leguminosae (pp.: 57-306). *In*: HOOKER, J.D. (ed.). The Flora of British India, 2 Sabiaceae to Cornaceae. *L. Reeve & co., 5 Henrietta street, Covent Garden, London*, 792 pp.

BEZZI, M. 1925. Some Tachinidae (Dipt.) of economic importance from the Federated Malay States. *Bulletin of Entomological Research* 41: 113-123.

CHAO, C. 1996. Tachinidae (pp.: 1661-2206). *In*: XUE, W. & CHAO, C. (eds). The Flies of China, vol. 2. *Liaoning Science and Technology Press, Shenyang*, 2425 pp. + xxxii pls.

CROSSKEY, R. W. 1967. New generic and specific synonymy in Oriental Tachinidae (Diptera). *Proceedings of the Royal entomological Society of London* (B) 36 (7-8): 95-108.

CROSSKEY, R. W. 1973. A conspectus of the Tachinidae (Diptera) of Australia, including keys to the supraspecific taxa and taxonomic and host catalogues. *Bulletin of the British Museum (Natural History), Entomology, Supplement* 21: 1-221.

CROSSKEY, R. W. 1976. A taxonomic conspectus of the Tachinidae (Diptera) of the Oriental Region. *Bulletin of the British Museum (Natural History), Entomology, Supplement* 26: 1-357.

CROSSKEY, R. W. 1980. Family Tachinidae (pp.: 822-882). *In*: CROSSKEY, R.W. (ed.). Catalogue of the Diptera of the Afrotropical Region. *British Museum (Natural History), London*, 1437 pp.

CROSSKEY, R. W. 1981. Family Tachinidae (pp.: 586-697). *In*: DELFINADO, M.D. & HARDY, D.E. (eds). A Catalog of the Diptera of the Oriental Region, 3. Suborder Cyclorrhapha (excluding Division Aschiza). *The University Press of Hawaii, Honolulu*, 854 pp.

CROSSKEY, R. W. 1984. Annotated keys to the genera of Tachinidae (Diptera) found in tropical and southern Africa. *Annals of the Natal Museum* 26 (1): 189-237.

HARRIS, K. M. 1989. 10. Tachinidae and Sarcophagidae. A summary of the recorded tachinid and sarcophagid parasitoids of South-east Asian Limacodidae (pp.: 187-193). *In*: COCK, M. J. W., GODFRAY, H. C. J. & HOLLOWAY, J. D. (eds). Slug and Nettle Caterpillars. The Biology, Taxonomy and Control of the Limacodidae of Economic Importance on Palms in South-east Asia. *C.A.B. International/120, Wallingford*, 270 pp.

HERTING, B. 1960. Biologie der westpläarktischen Raupenfliegen (Dipt., Tachinidae). *Monographien zur Angewandten Entomologie* 16: 1-188.

HERTING, B. 1984. Catalogue of Paleartic Tachinidae (Diptera). *Stuttgarter Beiträge zur Naturkunde (A)* 369: 1-228.

HERTING, B. & DELY-DRASKOVITS, Á. 1993. Tachinidae (pp.: 118-458). *In*: SOÓS, Á. & PAPP, L. (eds). Catalogue of Palaearctic Diptera, vol 13, Anthomyiidae-Tachinidae. *Hungarian Natural History Museum, Budapest*, 624 pp.

HOLLOWAY, J. D., COCK, M. J. W. & DESMIER DE CHENON, R. 1989. 3. Systematic account of South-east Asian pest Limacodidae (pp.: 15-117). *In*: COCK, M.J.W., GODFRAY, H.C.J. & HOLLOWAY, J.D. (eds). Slug and Nettle Caterpillars. The Biology, Taxonomy and Control of the Limacodidae of Economic Importance on Palms in South-east Asia. *C.A.B. International/120, Wallingford*, 270 pp.

KOTRBA, M. 2000. 1.3. Morphology and terminology of female postabdomen (pp.: 73-84). *In*: PAPP, L. & DARVAS, B. (eds). Contribution to a Manual of Palaearctic Diptera (with special reference to flies of economic importance). Vol. 1. General and Applied Dipterology. *Science Herald, Budapest*, 979 pp.

KUGLER, J. 1979. New taxa of Tachinidae (Diptera) with a list of the species from Israel and adjacent territories. *Israel Journal of Entomology* 13: 27-70.

MESNIL, L.-P. 1939. Essai sur les Tachinaires (Larvevoridae). *Monographies publiées par les Staions et Laboratoires de Recherches Agronomiques* 7: 1-67, 2 pls.

MESNIL, L.-P. 1944. 64g. Larvaevorinae (Tachininae). Teil 1: Salmaciini. *In*: LINDNER, E. (ed.) Die Fliegen der palaearktischen Region, 8: 1-48. *E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart*.

MESNIL, L.-P. 1954. 64g. Larvaevorinae (Tachininae). Teil 1: Salmaciini. *In*: LINDNER, E. (ed.). Die Fliegen der palaearktischen Region, 8: 305-368. *E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart*.

MESNIL, L.-P. 1959. Tachinidae d'Afrique orientale (Dipt.) (Récoltés par l'expédition zoologique allemande en Afrique orientale de 1951/52 Groupe Lindner – Stuttgart, Nr. 33). *Stuttgarter Beiträge zur Naturkunde* 23: 1-31.

MESNIL, L.-P. 1975. 64g. Larvaevorinae (Tachininae). Teil 3: Larvaevorini. *In*: LINDNER, E. (ed.). Die Fliegen der palaearktischen Region, 8: 1385-1435. *E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart*.

MERZ, B. & HAENNI, J.-P. 2000. 1.1. Morphology and terminology of adult Diptera (other than terminalia) (pp.: 21-51). *In*: PAPP, L. & DARVAS, B. (eds). Contribution to a Manual of Palaearctic Diptera (with special reference to flies of economic importance). Vol. 1. General and Applied Dipterology. *Science Herald, Budapest*, 979 pp.

O'HARA, J. E. 2002. Revision of the Polideini (Tachinidae) of America North of Mexico. *Studia dipterologica, Supplement* 10: 1-170.

OOI, P. A. C., WINOTAI, A. & PEÑA, J. E. 2002. Pests of Minor Tropical Fruits (pp.: 315-330). *In*: PEÑA, E., SHARP, J.L. & WYSOKI, M. (eds). Tropical Fruit Pests and Pollinators. *CAB International publishing*, 430 pp.

SABROSKY, C. W. & CROSSKEY, R. W. 1969. The type-material of Tachinidae (Diptera) described by N. Baranov. *Bulletin of the British Museum (Natural History), Entomology* 24 (2): 27-63.

SHIMA, H. 1999. Host-Parasite Catalog of Japanese Tachinidae (Diptera). *Makunagi / Acta Dipterologica, Supplement* 1: 1-188.

SHIMA, H. & TACHI, T. 1996. Outbreak (?) of a tachinid parasitoid of the bagworm *Eumeta japonica* in Japan. *The Tachinid Times* 9: 1-2.

SINCLAIR, B. J. 2000. 1.2. Morphology and terminology of Diptera male terminalia (pp.: 53-74). *In*: PAPP, L. & DARVAS, B. (eds). Contribution to a Manual of Palaearctic Diptera (with special reference to flies of economic importance). Vol. 1. General and Applied Dipterology. *Science Herald, Budapest*, 979 pp.

STUCKENBERG, B. R. 1999. Antennal evolution in the Brachycera (Diptera) with a reassessment of terminology relating to the flagellum. *Studia dipterologica* 6 (1): 33-48.

TSCHORSNIG, H.-P. 1985. Taxonomie forstlich wichtiger Parasiten: Untersuchungen zur Struktur des männlichen Postabdomens der Raupenfliegen (Diptera, Tachinidae). *Stuttgarter Beiträge zur Naturkunde (A)* 383: 1-137.

TSCHORSNIG, H.-P. & HERTING, B. 1994. Die Raupenfliegen (Diptera: Tachinidae) Mitteleuropas: Bestimmungstabellen und Angaben zur Verbreitung und Ökologie der einzelnen Arten. *Stuttgarter Beiträge zur Naturkunde (A)* 506: 1-170.

TSCHORSNIG, H.-P. & RICHTER, V.A. 1998. 3.54. Family Tachinidae (pp.: 691-827). *In*: PAPP, L. & DARVAS, B. (eds). Contribution to a Manual of Palaearctic Diptera (with special reference to flies of economic importance). Vol. 3. Higher Brachycera. *Science Herald, Budapest*, 880 pp.

VILLENEUVE, J. 1929. Propos diptérologiques (suite). *Bulletin et Annales de la Société Entomologiques de Belgique* 69: 181-187.

VILLENEUVE, J. 1937. Notes diptérologiques. *Bulletin et Annales de la Société Entomologiques de Belgique* 77: 404-408.

WOOD, D. M. 1987. 110. Tachinidae (pp.: 1193-1269). *In*: MCALPINE, J. F., PETERSON, B. V., SHEWELL, G. E., TESKEY, H. J., VOCKEROTH, J. R. & WOOD, D. M. (eds). Manual of Nearctic Diptera, Vol. 2. *Research Branch, Agriculture Canada, Monograph* 28: 675-1332.

REVUE SUISSE DE ZOOLOGIE 112 (1): 145-171; mars 2005

Nouvelles considérations taxonomiques sur les espèces du genre *Androctonus* Ehrenberg, 1828 et description de deux nouvelles espèces (Scorpiones, Buthidae)[1]

Wilson R. LOURENÇO
Département de Systématique et Evolution, USM 0602, Section Arthropodes (Arachnologie), Muséum national d'Histoire naturelle, 61 rue de Buffon, F-75005 Paris, France. E-mail: arachne@mnhn.fr

New taxonomic considerations on the species of the genus *Androctonus* Ehrenberg, 1828 and description of two new species (Scorpiones, Buthidae).- Results of the study of an interesting collection of scorpions of the genus *Androctonus* Ehrenberg, 1828 from North African and the Middle East, now deposited in the Geneva Museum, are presented. The collection contains specimens of 13 species, two of which are new and described here: *Androctonus maelfaiti* sp. n. and *Androctonus dekeyseri* sp. n. A key to all these species is provided. The following taxonomic changes are proposed: *Androctonus australis garzonii* Goyffon & Lamy and *Androctonus australis africanus* Lamy, Le Pape & Weill are placed in the synonymy of *Androctonus australis* (Linnaeus). *Androctonus crassicauda gonneti* Vachon and *Androctonus australis baluchicus* Pocock are raised to the status of species as *Androctonus gonneti* and *Androctonus baluchicus*. *Androctonus aeneas* C.L. Koch is placed in the synonymy of *Androctonus bicolor* Ehrenberg, whereas *Androctonus bicolor liouvillei* (Pallary) is reconsidered as a valid species. Finally, *Androctonus mauritanicus bourdoni* Vachon is placed in the synonymy of *Androctonus mauritanicus* (Pocock). Comments are given on the distributional patterns presented by the species of this genus.

Keywords: Scorpions - *Androctonus* - new species - North Africa - Middle East.

INTRODUCTION

Le genre *Androctonus* a été défini par Ehrenberg (In Hemprich & Ehrenberg, 1828), avec deux sous-genres *Prionurus* Ehrenberg et *Leiurus* Ehrenberg. L'espèce type, définie par désignation subséquente, est *Scorpio australis* Linnaeus, 1758 [= *Androctonus australis* (Linnaeus, 1758)]. Par la suite, le genre *Androctonus* n'a pas été retenu, et seul le sous-genre *Prionurus* fut conservé, et le plus souvent utilisé comme un sous-genre de *Buthus* Leach, 1815. Dans la mesure où le nom *Prionurus*

[1] Etude subventionnée par le Département municipal des affaires culturelles de la Ville de Genève.

Manuscrit accepté le 05.04.2004

était déjà préoccupé par *Prionurus* Lacépède, 1804 (Osteichthyes: Acanthuridae) et *Prionurus* Rafinesque, 1815 (Reptilia), Vachon (1948, 1952) décide de reprendre le nom *Androctonus* pour désigner le genre groupant toutes les espèces du sous-genre *Prionurus*.

Dans le catalogue mondial des scorpions, Fet & Lowe (2000) comptabilisent un total de 8 espèces et 14 sous-espèces pour le genre *Androctonus*. Selon ces deux auteurs, malgré la publication de plusieurs révisions régionales, plus ou moins récentes, Vachon (1952) pour l'Afrique du Nord, Vachon (1953) pour la Mauritanie, Vachon (1958) pour l'Afghanistan, Levy et Amitai (1980) pour Israël et le Sinaï et Tikader et Bastawade (1983) pour l'Inde, le statut taxonomique de plusieurs espèces demeure hautement problématique.

Le présent travail est le résultat de l'étude d'une collection de scorpions appartenant au genre *Androctonus*, provenant de diverses régions d'Afrique du Nord ainsi que du Moyen Orient. Cette collection, réunie en grande partie par notre collègue P.M. Brignoli, est déposée désormais au Muséum d'histoire naturelle de Genève. Comme mentionné dans une note récente (Lourenço, 2003), le matériel collecté par P.M. Brignoli, m'a été confié peu de temps avant sa disparition. Selon sa volonté, la collection devrait être déposée au Muséum d'histoire naturelle de Genève après étude.

Deux espèces nouvelles appartenant au genre *Androctonus* sont décrites. Des considérations sur la position taxonomique des espèces de ce genre sont également proposées. Par ailleurs, une liste des espèces présentes dans le matériel étudié est établie.

MATÉRIEL ET MÉTHODES

Encore une fois, dans la mesure où le présent travail concerne dans sa grande majorité des espèces déjà traitées par Vachon (1952, 1953, 1958), j'ai décidé de re-utiliser l'iconographie employée dans ses travaux, avec quelques modifications.

L'identification des sexes, même chez les spécimens juvéniles, est relativement facile chez les espèces du genre *Androctonus*. Cette distinction peut être faite grâce à la morphologie, la taille et le nombre des dents des peignes (Figs 1-2, d'après Farzanpay & Vachon, 1979). Cependant, le nombre de dents des peignes se montre assez homogène au sein des espèces d'*Androctonus*, ce qui rend l'utilisation de ce caractère peu utile pour la diagnose des espèces. A présent je propose des courtes descriptions simplifiées pour le genre et les espèces.

PARTIE SYSTÉMATIQUE

BUTHIDAE C.L. Koch, 1837

Androctonus Ehrenberg, 1828

Espèces de taille moyenne ou grande, pouvant atteindre de 60 à 110 mm. Coloration générale allant du jaunâtre pâle au noirâtre foncé. Metasoma: avec les anneaux fortement élargies vers l'arrière dans la majorité des espèces; sillon dorsal profond, voire très profond. Carènes dorsales généralement fortement marquées, munies de granules spiniformes. Cadre anal du Ve anneau à trois ou quatre lobes

arrondis ou aigus. Telson: vésicule lisse ou munie de granules sur la face ventrale; aiguillon de faiblement à fortement courbé, pouvant être plus court, aussi long, ou plus long que la vésicule. Pinces le plus souvent trapues avec les doigts moyennement longs, parfois fines avec les doigts très longs; tranchant des doigts fixe et mobile respectivement avec 11 à 15 et 13 à 16 séries semi-obliques de granules. Peignes avec de 26 à 36 dents chez le mâle et de 20 à 29 chez la femelle.

Distribution. Afrique: Algérie, Burkina Faso, Chad, Egypte, Eritrea, Ethiopie, Libye, Mauritanie, Maroc, Niger, Sénégal, Somalie, Soudan, Tunisie. Asie: Afghanistan, Arabie Saoudite, Arménie, Azerbaïdjan, Bahrayn, Emirats Arabes Unis, Inde, Iran, Irak, Israël, Jordanie, Kuwait, Liban, Oman, Pakistan, Syrie, Turkey, Yémen.

LISTE DES ESPÈCES DU GENRE *ANDROCTONUS*

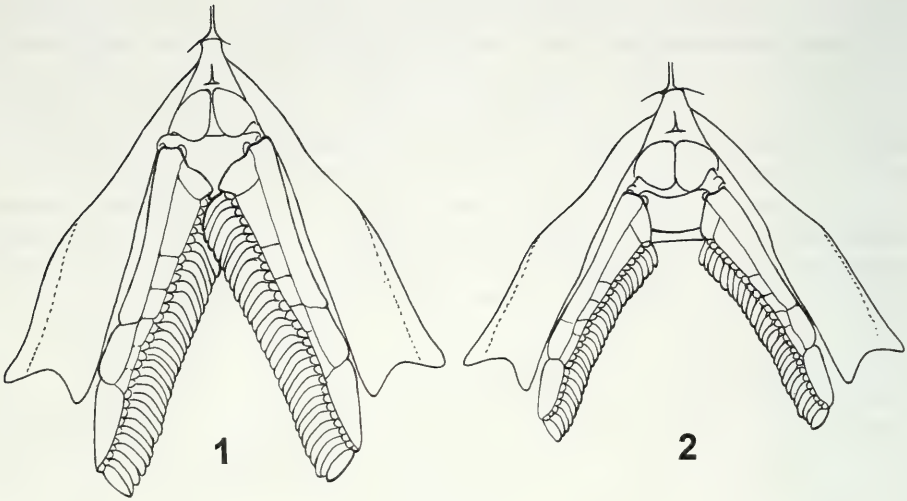
Androctonus australis (Linnaeus, 1758)
= *Androctonus australis garzonii* Goyffon & Lamy, 1973 **syn. n.**
= *Androctonus australis africanus* Lamy, Le Pape & Weill, 1974 **syn. n.**
Androctonus crassicauda (Olivier, 1807)
Androctonus gonneti Vachon, 1948 **stat. nov.**
Androctonus finitimus (Pocock, 1897)
Androctonus baluchicus (Pocock, 1900) **stat. nov.**
Androctonus maelfaiti sp. n.
Androctonus amoreuxi (Audouin, 1826)
Androctonus dekeyseri sp. n.
Androctonus bicolor Ehrenberg, 1828
= *Androctonus aeneas* C.L. Koch, 1839 **syn. n.**
Androctonus liouvillei (Pallary, 1924)
Androctonus mauritanicus (Pocock, 1902)
= *Androctonus mauritanicus bourdoni* Vachon, 1948 **syn. n.**
Androctonus hoggarensis (Pallary, 1929)
Androctonus sergenti Vachon, 1948

Androctonus australis (Linnaeus, 1758) Figs 1-4

Androctonus australis garzonii Goyffon & Lamy, 1973: 137. Syn. n.
Androctonus australis africanus Lamy, Le Pape & Weill, 1974: 3223. Syn. n.

Matériel. Egypte, Solloum, 16/I/1960 (JACL), 1 mâle, 2 femelles; Lybie, Oued Larzat, 44 km de Dchibat, 16/X/1979 (P.M. Brignoli), 1 mâle, 2 femelles; Sirte, distorni di Tripoli, III/1973 (S. Bizzi & P.M. Brignoli), 2 mâles; Tunisie, Gabés-Toujane, 29/IX/1972 (P.M. Brignoli), 1 mâle, 8 juvéniles; Iles Kerkennatt, 28/V/1980 (P.M. Brignoli), 2 mâles, 2 femelles; Matuati, 28/V/1980 (P.M. Brignoli), 1 juvénile; Medenine sud, VI/1977 (P.M. Brignoli), 1 mâle; Région Sud, X/1960 (C. Faure), 1 mâle; VI/2001 (A. Stephan) 1 mâle; Tozeur, 20/V/1980 (P.M. Brignoli), 1 femelle; III/1979 (P.M. Brignoli), 10 femelles.

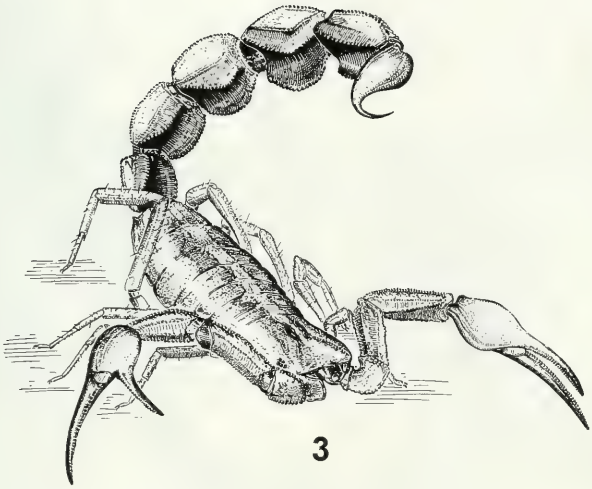
Espèce de grande taille pouvant atteindre 100 mm. Coloration générale jaune paille à jaune ocre, parfois avec des zones assombries sur le corps. Sternites jaune pâle. Anneaux métasomaux I à IV jaunâtres, avec les carènes ventrales brunâtres; V^{e} anneau et vésicule de coloration plus sombre; Telson: aiguillon rougeâtre à la base et brunâtre à l'extrémité. Pédipalpes jaune ocre, avec les doigts sombres. Pattes jaune pâle. Plaque

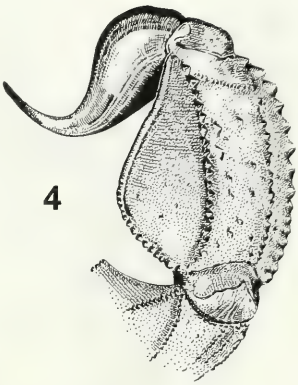


FIGS 1-2
Région ventrale d'*Androctonus australis*, avec le sternum, opercule génital et les peignes. 1. Mâle. 2. Femelle. Un très important dimorphisme sexuel peut être observé au niveau des peignes (d'après Farzanpay & Vachon, 1979).

prosomienne avec les carènes et les granules bien marqués. Tergites avec les carènes et les granules moins marqués que ceux de la plaque prosomienne. Metasoma avec les anneaux fortement élargies vers l'arrière; sillon sur la face dorsale très profond (Fig 3); carènes dorsales aux anneaux I-IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à trois lobes moyennement aigus; vésicule avec quelques granules sur la face ventrale; aiguillon moyennement courbé et aussi long que la vésicule (Fig 4). Pinces trapues avec les doigts moyennement longs; tranchant des doigts fixe et mobile avec 12-14 séries semi-obliques de granules de couleur sombre. Peignes avec 30-36 dents chez le mâle et 22-26 chez la femelle.

Androctonus australis a été décrite très probablement d'Afrique du Nord, sans indications d'un station précise. Par ailleurs, les types sont certainement perdus. Plusieurs sous-espèces et/ou variétés ont été associées à cette espèce. Ainsi, Vachon (1952) distingue trois sous-espèces fondé sur des variations de coloration: *A. australis australis*, *A. australis hector* C.L. Koch, 1939 et *A. australis libycus* Ehrenberg, 1828. Par la suite deux autres sous-espèces ont été décrites, *Androctonus australis garzonii* Goyffon & Lamy et *Androctonus australis africanus* Lamy, Le Pape & Weill, fondées sur l'analyse chromatographique de protéines de l'hémolymphe. Dans le catalogue mondial des scorpions, Fet & Lowe (2000), citent ces deux dernières sous-espèces, mais considèrent *A. a. hector* comme un synonyme d'*A. australis*. A présent, l'étude du matériel d'*A. australis*, en particulier de Tozeur en Tunisie, station type d'*A. a. garzonii* et d'*A. a. africanus*, montre que *A. australis* est une espèce unique qui présente un certain degré de polymorphisme. Par ailleurs, diverses espèces préalablement associées à *A. australis*, notamment au Moyen Orient doivent être considérées comme des espèces distinctes.





FIGS 3-4

Androctonus australis, femelle. 3. Habitus. A remarquer le profond sillon sur la face dorsale des anneaux caudaux. 4. V^e^ anneau et telson, vue latérale (d'après Vachon, 1963b).

Jusqu'à preuve du contraire, la distribution de cette espèce doit se limiter à l'Afrique du Nord, notamment en Algérie, Egypte, Libye, Soudan et Tunisie. Levy et Amitai (1980), mentionnent cette espèce pour le Sinaï, mais affirment ne pas l'avoir trouvée en Israël.

Androctonus crassicauda (Olivier, 1807) Figs 5-6

Matériel. Irak, Mossoul, 12/XI/1981 (B. Moutis), 1 femelle (16); Iran, Kashan, 250 km sud de Teheran, X/1964 (T. Fatami), 1 femelle (13); IX/1972 (R. Farzanpay), 1 femelle (14); 22/VII/1973 (T. Habibi), 4 mâles, 7 femelles (59); Syrie, Alawa, X/1980 (M. Orthmann), 2 mâles, 2 femelles, 2 juvéniles (15); 4 km SE Dibsi (Faraj), 150 m, 11/V/1994 (W. Bischoff), 1 mâle (60).

Espèce de grande taille pouvant atteindre 90 mm de longueur totale. Coloration générale de brun-rougeâtre à brun. Sternites brun-jaunâtre. Anneaux métasomaux et vésicule brun-rougeâtre uniforme, avec les carènes noirâtres; aiguillon brun-rougeâtre à la base et noirâtre à l'extrémité. Pédipalpes brun-rougeâtre; pattes jaune-rougeâtre. Plaque prosomienne avec les carènes et les granules bien marqués. Tergites avec les carènes et les granules moins marqués que ceux de la plaque prosomienne. Metasoma avec les anneaux moyennement élargies vers l'arrière; sillon sur la face dorsale profond; carènes dorsales fortement marquées aux anneaux I-IV, avec des granules spiniformes dans leur région postérieure. V^e^ anneau avec le cadre anal à trois lobes arrondis; vésicule avec trois séries de granules sur la face ventrale; aiguillon moyennement courbé et plus long que la vésicule. Pinces plutôt fines avec les doigts longs; tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules, assombris. Peignes avec 27-32 dents chez le mâle et 23-27 chez la femelle.

Espèce très commune dans certaines régions du Moyen Orient, notamment en Iran et en Irak. La localité type étant Kashan en Iran. Levy et Amitai (1980) la men-

FIGS 5-6
Androctonus crassicauda, mâle. Vues dorsale et ventrale.

tionnent pour le Sinaï, mais elle est absente des régions effectivement africaines. Levy et Amitai (1980) estiment que *A. crassicauda* serait associé à *A. australis*. La présente étude m'amène à la considérer plutôt proche des autres espèces du Moyen Orient, en particulier d'*Androctonus baluchicus* (Pocock).

Androctonus gonneti Vachon, 1948 stat. nov. Figs 7-9
Androctonus crassicauda gonneti Vachon, 1948: 305.

Matériel. Maroc, Basse vallée du Dra, Tafnidit, 20/V/1961 (Panouse), 1 mâle; Mauritanie, Fort Trinquet, VII/1967 (Rungs), 1 mâle, 1 femelle.

Espèce de grande taille, pouvant atteindre 90 mm de longueur totale. Coloration générale de brun-pâle à brun-rougeâtre. Sternites jaune-rougeâtre. Anneaux métasomaux rougeâtre uniforme, avec les carènes assombries; vésicule jaune-rougeâtre; aiguillon jaunâtre à la base et brun-foncé à l'extrémité. Pédipalpes jaune ocre; pattes jaune pâle. Plaque prosomienne avec les carènes et les granules fortement marqués. Tergites avec les carènes et les granules bien marqués. Metasoma avec les anneaux moyennement élargies vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à trois lobes peu aigus; vésicule avec une granulation fine mais intense sur la face ventrale; aiguillon bien courbé et plus long que la vésicule. Pinces trapues avec les doigts moyennement longs (Fig 8); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules de couleur rougeâtre. Peignes avec 28-33 dents chez le mâle et 23-25 chez la femelle.

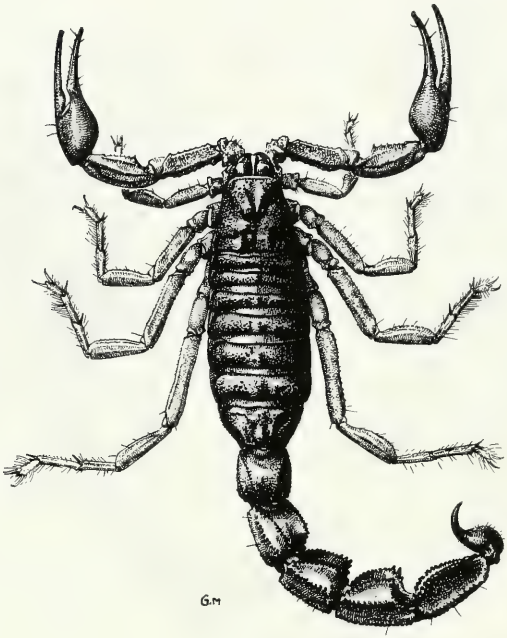


FIG. 7
Androctonus gonneti, mâle de Mauritanie. Habitus (d'après Vachon, 1953).

Forme décrite du Maroc et de la Mauritanie comme sous-espèce d'*A. crassicauda*. Levy et Amitai (1980) affirment que cette forme n'appartient pas à l'espèce *A. crassicauda*. Les différences morphologiques (cf. descriptions simplifiées) plaident dans ce sens. Leurs distributions géographiques totalement distinctes confortent cette position et semblent exclure toute hypothèse de sous-spéciation.

Androctonus finitimus (Pocock, 1897) Figs 10-11

Matériel. Pakistan, Lasbela near Bela City, IX/1962 (J.A. Anderson), 1 mâle; Mirpur-Sakro, sud de Karachi, X/1962 (J.A. Anderson), 1 femelle; Ziarat, IX/1962 (J.A. Anderson), 1 femelle.

Espèce de taille moyenne pouvant atteindre 70 mm de longueur totale. Coloration générale jaunâtre. Sternites jaune pâle. Anneaux métasomaux jaunâtres, avec parfois les IV et V un peu plus foncés; vésicule jaunâtre; aiguillon jaunâtre à la base et rougeâtre à l'extrémité. Pédipalpes et pattes jaune pâle. Plaque prosomienne avec les carènes et les granules bien marqués. Tergites avec les carènes et les granules moyennement marqués. Metasoma avec les anneaux peu élargies vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à quatre lobes plutôt arrondis (Fig 11); vésicule avec quelques granules sur la face ventrale; aiguillon moyennement courbé et aussi long que la vésicule. Pinces faiblement

FIGS 8-9
Androctonus gonneti, mâle type. 8. Pince, vue externe-dorsale. 9. Fémur et tibia, vue dorsale, avec trichobothries.

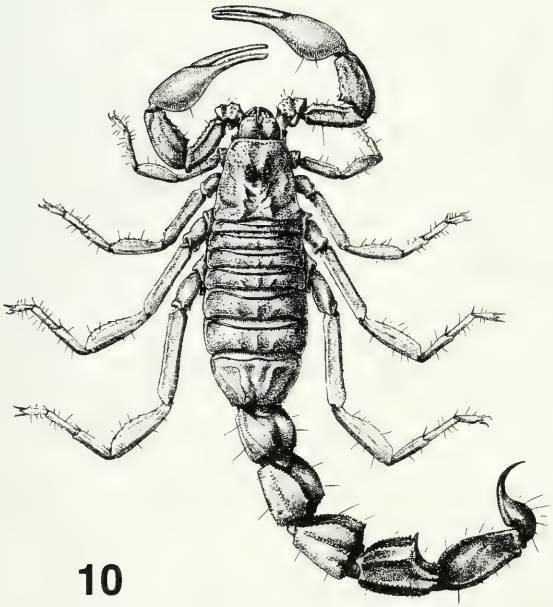
trapues avec les doigts moyennement longs; tranchant des doigts fixe et mobile avec 11-13 séries semi-obliques de granules. Peignes avec 29-30 dents chez le mâle et 23-24 chez la femelle.

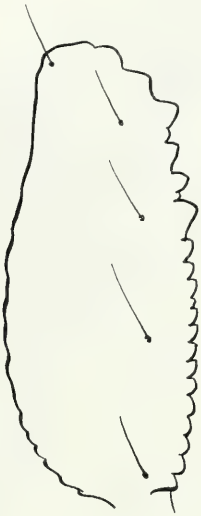
En vue des différences morphologiques importantes, j'accepte à présent l'opinion de Levy et Amitai (1980), et je considère cette espèce comme distincte et valable. Ce même type de réflexion m'amène à considérer *Androctonus baluchicus* Pocock également comme une espèce différente et valable, et à décrire une nouvelle espèce pour l'Inde, *Androctonus maelfaiti* sp. n. Ces trois espèces sont sans doute associées, mais bien distinctes d'*A. australis* et d'*A. amoreuxi*. La présence d'*A. finitimus* est confirmée pour le Pakistan, mais à revoir pour l'Inde (Pocock, 1900)

Androctonus baluchicus (Pocock, 1900) stat. nov. Figs 12-15

Androctonus australis baluchicus Pocock, 1900: 16.

Matériel. Afghanistan, Lashkari-Baszar, N. de Gala-Bist, X/1971 (C. Nauman), 3 mâles, 1 femelle.



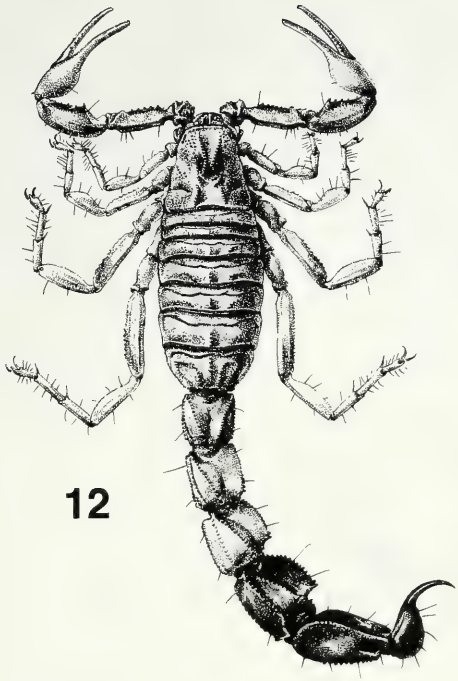


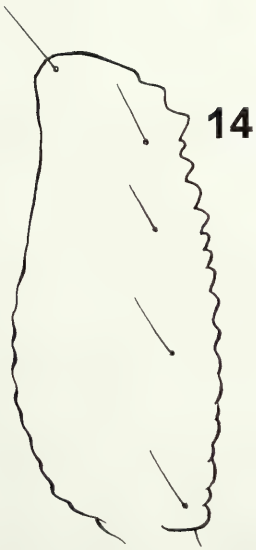
FIGS 10-11

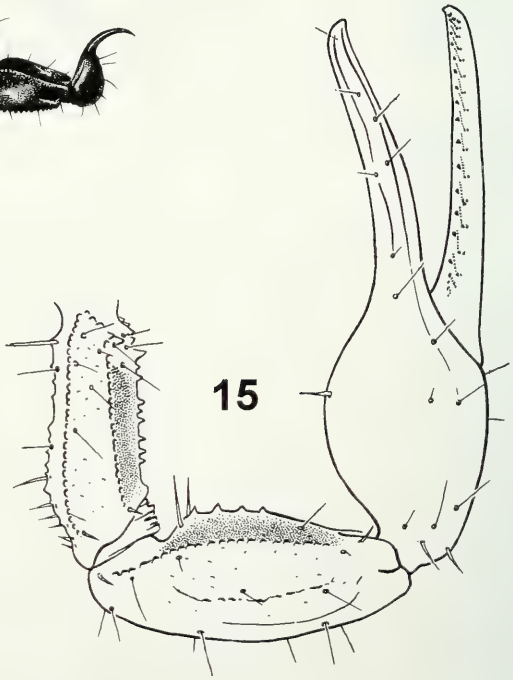
Androctonus finitimus. 10. Habitus mâle. 11. V^e^ anneau du metasoma avec les lobes de l'arc anal, vue latérale (femelle).

Espèce de taille moyenne, pouvant atteindre 65 mm de longueur totale. Coloration générale de jaune-rougeâtre à jaune-brunâtre. Sternites jaune pâle. Anneaux métasomaux I à III jaunâtres; anneau IV jaunâtre avec des zones assombries; V^e^ anneau et vésicule de coloration sombre; aiguillon rougeâtre à la base et noirâtre à l'extrémité. Pédipalpes jaune ocre, avec la face interne du fémur et du tibia assombries. Pattes jaune-rougeâtre. Plaque prosomienne avec les carènes et les granules faiblement marqués. Tergites avec les carènes et les granules moyennement marqués. Metasoma avec les anneaux faiblement élargies vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^e^ anneau avec le cadre anal à trois lobes plutôt arrondis (Fig 14); vésicule avec quelques granules sur la face ventrale; aiguillon peu courbé et aussi long que la vésicule. Pinces faiblement trapues avec les doigts moyennement longs (Fig 15); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules de couleur rougêatre. Peignes avec 27-30 dents chez le mâle et 22-26 chez la femelle.

La distribution de cette espèce est confirmée uniquement pour le Pakistan et Afghanistan. Comme pour le cas d'*Androctonus crassicauda* et d'*Androctonus gonneti*, plusieurs différences morphologiques (cf. descriptions simplifiées) plaident dans ce sens que *Androctonus australis* et *Androctonus baluchicus* n'ont rien en commun. Une fois de plus, leurs distributions géographiques totalement distinctes confortent cette position et semblent exclure toute hypothèse de sous-spéciation.







FIGS 12-15

Androctonus baluchicus, femelle. 12. Habitus. 13. Tarse de la patte IV, vue latérale. 14. V^e^ anneau du metasoma avec les lobes de l'arc anal, vue latérale. 15. Pédipalpe droit, avec trichobothries.

Androctonus maelfaiti sp. n. Figs 16-21

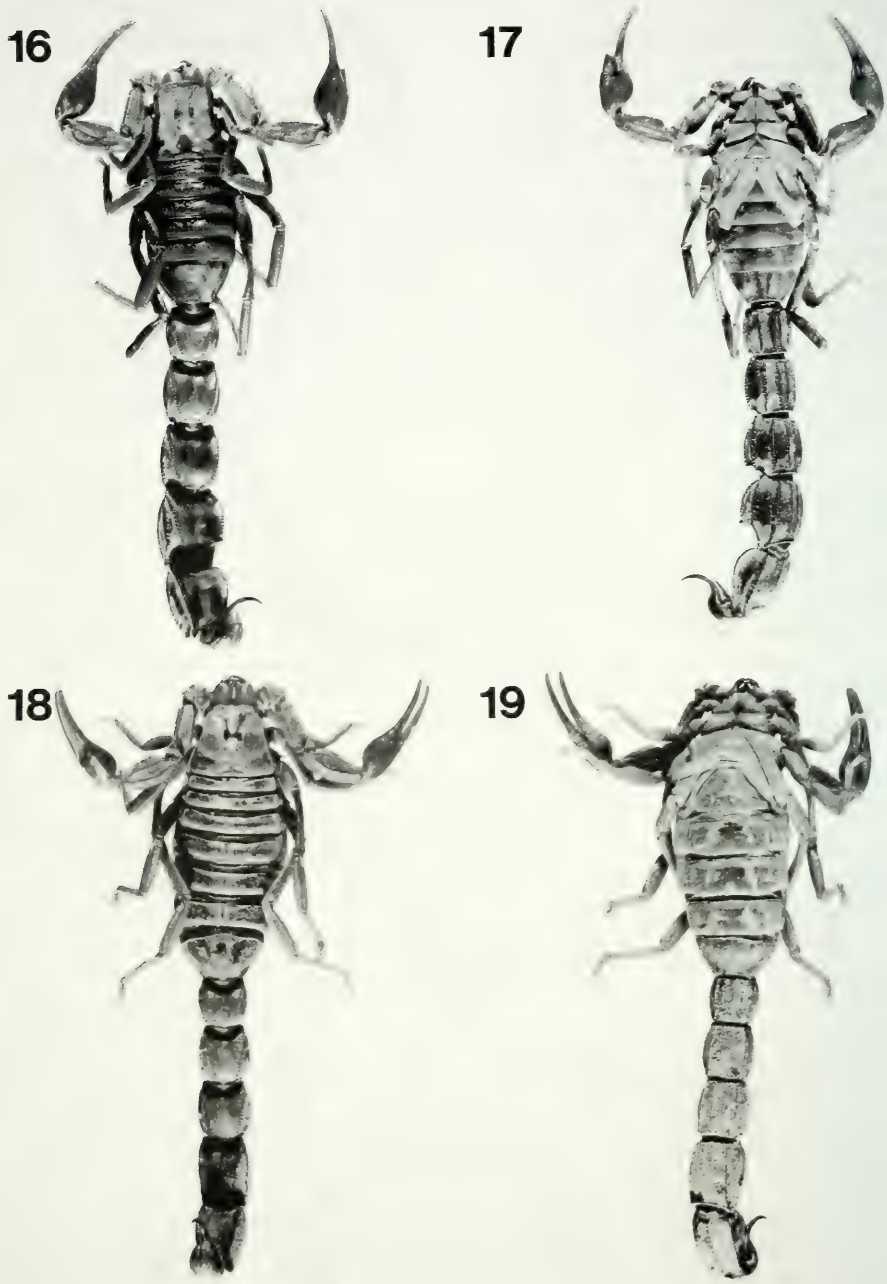
Matériel. Inde, NW Muktsar, S Jalalabad, IX/1961 (J.A. Anderson leg). 1 mâle holotype, 3 femelles paratypes.

Etymologie. Le nom spécifique est créé en hommage à mon collègue Jean-Pierre Maelfait de l'Université de Gent, Belgique.

Diagnose. Espèce de taille moyenne pouvant atteindre 65 mm de longueur totale. Coloration générale brun-rougeâtre. Sternites jaune-rougeâtre. Pattes et pédipalpes brun-rougeâtre. Plaque prosomienne avec les carènes et les granules fortement marqués. Tergites avec les carènes et les granules moyennement marqués. Metasoma avec les anneaux fortement élargies vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I à IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à trois lobes moyennement aigus. Pinces trapues avec les doigts moyennement longs; tranchant des doigts fixe et mobile avec 13-14 séries semi-obliques de granules. Peignes avec 30 dents chez le mâle et 21-22 chez les femelles.

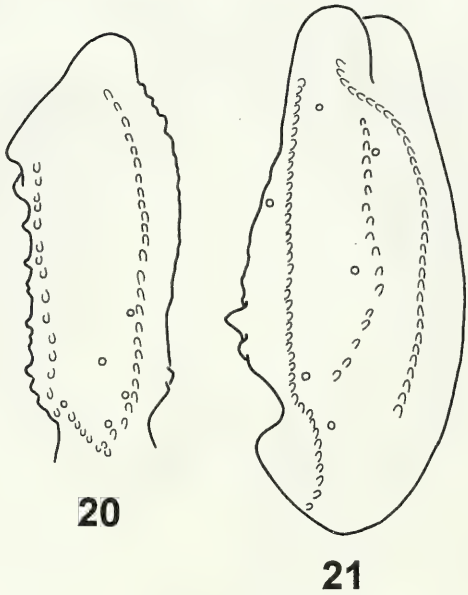
Description (basée sur le mâle holotype et une femelle paratype). Coloration générale brun-rougeâtre. Plaque prosomienne rougeâtre foncé avec quelques zones plus sombres autour des carènes. Tubercule oculaire et yeux latéraux noirâtres. Mesosoma de même couleur que la plaque prosomienne. Anneaux metasomaux et vésicule brun-rougeâtre; aiguillon rougeâtre à la base et noirâtre à l'extrémité. Peignes jaune pâle; opercule génital, sternum, hanches et processus maxillaire jaune ocre. Pattes jaune-rougeâtre, sans taches. Pédipalpes: fémur, tibia et pinces rougeâtres. Chélicères jaunâtres dépourvues de toute tâche ou trame; doigts rouge-noirâtre.

Morphologie. Prosoma: front de la plaque prosomienne sans aucune concavité, droit; tubercule oculaire situé à peu près au centre de la plaque prosomienne; yeux médians de taille moyenne, séparés par trois diamètres oculaires environ; quatre paires d'yeux latéraux; trois de taille normale et le quatrième très réduit. Toutes les carènes bien marquées; tégument avec une granulation épaisse et bien marquée dans la partie antérieure de la plaque; moyennement marquée sur les autres régions. Mesosoma: tergites avec une granulation moyenne et trois carènes bien marquées, mais moins développées sur les deux premiers tergites. Metasoma avec les anneaux plutôt carrés et fortement élargies vers l'arrière; sillon sur la face dorsale des anneaux moyennement profond; tégument presque lisse; présence de 10-10-10-8-5 carènes fortement marquées, en particulier les dorsales des anneaux I-IV, qui présentent des granules spiniformes dans leur région postérieure; carène intermédiaire des anneaux II-III représentée par trois granules; V^{e} anneau avec le cadre anal à trois lobes moyennement aigus, et la carène latéro-ventrale avec des lobes aigus. Vésicule fortement granulée sur la face ventrale; aiguillon moyennement incurvé et aussi long que la vésicule, dépourvu d'épine sous-aiguillonnaire. Peignes avec 30-30 dents chez le mâle et 21-22 chez la femelle. Pédipalpes: fémur et tibia avec 5 et 8 carènes bien marquées (Figs 20-21); présence de quelques granules spiniformes sur sa face interne du tibia. Pince lisse; tranchant des doigts fixe et mobile avec 13 séries semi-obliques de granules. Chélicères avec la dentition caractéristique des Buthidae (Vachon, 1963a); doigt mobile à deux dents basales bien marquées. Trichobothriotaxie du type A-Beta, orthobothriotaxique (Vachon, 1974, 1975). Eperons tarsaux présents sur toutes les pattes; les tibiaux présents sur les pattes III-IV, bien développés.



FIGS 16-19

Androctonus maelfaiti sp. n. 16-17. Mâle holotype. 18-19. Femelle paratype. Vues dorsale et ventrale.



FIGS 20-21
Androctonus maelfaiti sp. n., mâle holotype. Trichobothriotaxie des pédipalpes. 20. Fémur. 21. Tibia. Vue dorsale.

Mensurations (en mm) du mâle holotype et d'une femelle paratype: longueur totale 63,8/65,1; plaque prosomienne: longueur 8,8/8,2, largeur antérieure 5,6/5,4, largeur postérieure 9,4/9,5; anneau caudal I: longueur 5,9/5,6, largeur 6,2/5,4; anneau caudal V: longueur 9,1/8,9, largeur 6,2/5,2, hauteur 4,7/4,4; vésicule: largeur 3,8/3,6, hauteur 3,2/3,0; pédipalpe: fémur longueur 6,8/6,1, largeur 2,3/2,3; tibia longueur 8,2/7,9, largeur 3,5/3,3; pince longueur 13,9/13,2, largeur 3,9/3,3, hauteur 4,3/3,7; doigt mobile longueur 9,4/9,0.

Androctonus amoreuxi (Audouin, 1826)

Matériel. Algérie; Aouinet-Torkoz 24/VII/1973 (P.M. Brignoli), 1 mâle; Beni-Abbés, IV/1973 (P.M. Brignoli), 1 femelle; V/1976 (J. Garzoni), 1 femelle; Mettili-des-Chaamba, IV/1973 (P.M. Brignoli), 2 mâles, 1 femelle; Tata, VIII/1961 (C. Sauvage), 1 mâle, 3 femelles; Egypte, Assioud, X/1980 (P.M. Brignoli), 1 femelle, 3 juvéniles; Mauritanie, Fort Trinquet, III/1962 (Raulet), 2 femelles.

Espèce de grande taille pouvant atteindre 110 mm de longueur totale. Coloration générale jaunâtre, avec la plaque prosomienne et les tergites légèrement plus foncés. Sternites jaune pâle. Anneaux métasomaux jaunâtres, avec les carènes légèrement rougeâtres clair; vésicule jaune ocre; aiguillon jaunâtre à la base et rougeâtre à l'extrémité. Pattes et pédipalpes jaune pâle. Plaque prosomienne avec les carènes et les granules moyennement marqués. Tergites peu granulés et avec les carènes moyennement marqués. Metasoma avec les anneaux à largeur constante vers l'arrière; sillon sur

la face dorsale très peu marqué; carènes dorsales aux anneaux I-IV peu marquées, avec des granules arrondis. V^{e} anneau avec le cadre anal à trois lobes arrondis et discrets; vésicule sans granules, pratiquement lisse; aiguillon peu courbé et un peu plus long que la vésicule. Pinces faiblement trapues avec les doigts moyennement longs; tranchant des doigts fixe et mobile avec 12-13 séries semi-obliques de granules. Peignes avec 31-35 dents chez le mâle et 21-25 chez la femelle.

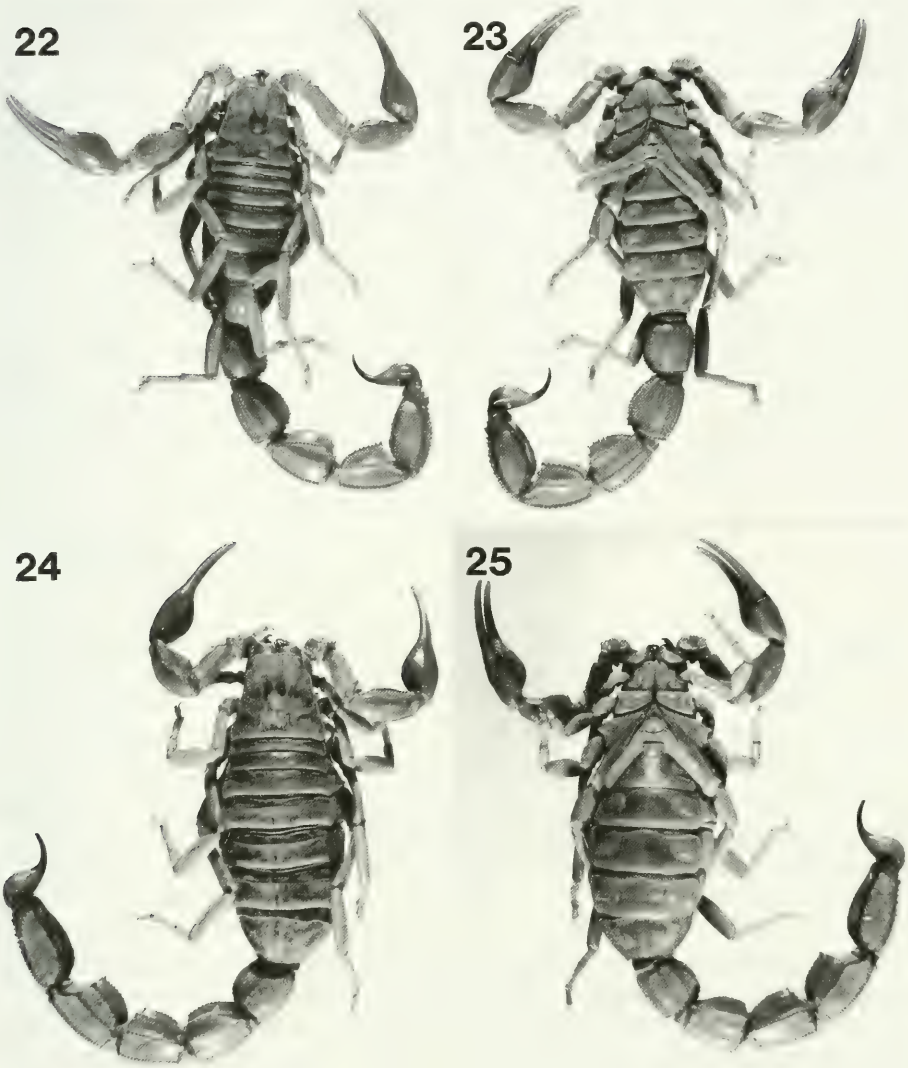
Cette espèce décrite de l'Egypte a été par la suite citée pour une très vaste région de distribution allant depuis le Sénégal et la Mauritanie jusqu'en Inde. A présent, l'étude des formes du Moyen Orient démontre que ces dernières n'ont aucune affinité avec *A. amoreuxi* (voire comparativement les descriptions simplifiées). Seules les citations de Levy et Amitai (1980) semblent confirmer la présence de cette espèce dans le Sinaï et en Israël. Aucun matériel de ces régions n'a été consulté à présent. Pour ce qui est des populations africaines, une étude précise des formes présentes au Sénégal et dans l'extrême sud de la Mauritanie montre l'existence de très importantes différences morphologiques entre ces populations et *A. amoreuxi*. En réalité la forme typique d'*A. amoreuxi*, clairement décrite par Vachon (1952), semble avoir une distribution limitée au nord de l'Afrique: Egypte, Lybie, Tunisie, Algérie et nord de la Mauritanie. Sa présence au Maroc serait discrète. Vachon (1952) définit cette espèce comme nettement saharienne; un scorpion des sables en quelque sorte. En revanche, la zone de répartition de la nouvelle espèce du Sénégal et du sud de la Mauritanie se trouve dans un domaine distinct, celui des 'Steppes boisées avec abondance d'Acacias (Sahel)' (Dekeyser & Derivot, 1966). Par ailleurs, l'identité de la population du Pays Ajjer au sud de l'Algérie (Vachon, 1955), correspondant à l'espèce *Androctonus eburneus* Pallary, 1928, pourrait être différente de celle d'*A. amoreuxi*, les caractéristiques morphologiques données par Vachon (1955) étant très distinctes. Dans ce cas, l'espèce *Androctonus eburneus* serait valable. Une décision dépendra de l'étude d'un matériel frais. Pour les illustrations d'*A. amoreuxi* voir Lourenço (2003).

Androctonus dekeyseri sp. n. Figs 22-31

Matériel. Sénégal, Linguére, région sud, IV/1964 (P.L. Dekeyser), 1 mâle holotype, 1 femelle paratype; Linguére, IX/1967 (A. Villiers), 2 mâles, 1 femelle, 10 juvéniles, paratypes; Fété-Olé, Ferlo, 24/VII/1971 (Gillon), 3 mâles, 4 femelles, 3 juvéniles, paratypes; M'Bao, près de Dakar, VI/1967 (A. Villiers), 1 femelle paratype. Mauritanie occidentale, Rosso, VIII/1966 (Rungs), 1 mâle, 1 femelle, paratypes.

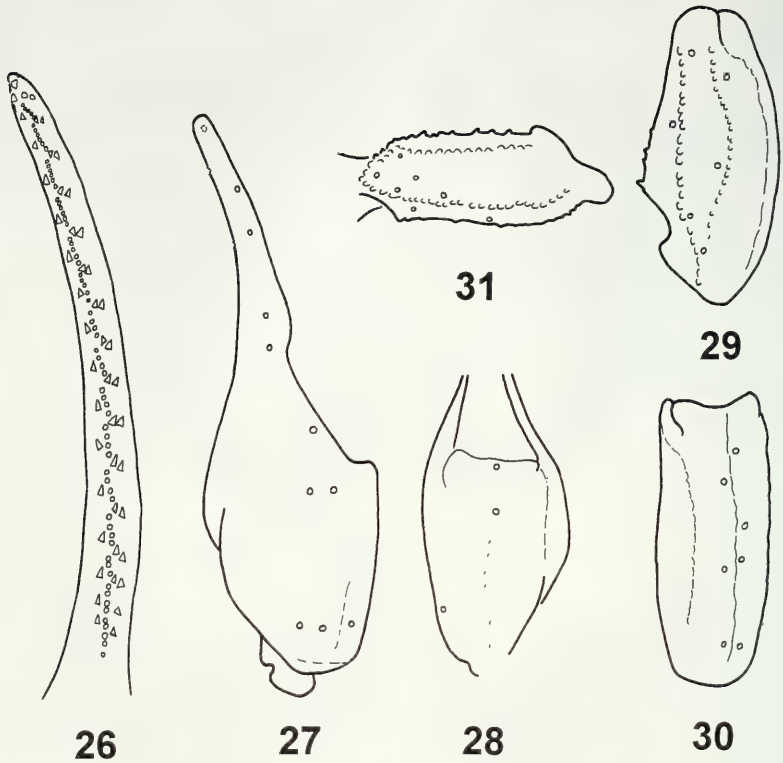
Etymologie. Le nom spécifique est créé en hommage au Professeur Pierre Louis Dekeyser, qui a su m'initier dans le domaine de la zoologie; collecteur également de l'espèce nouvelle.

Diagnose. Espèce de grande taille pouvant atteindre 88 mm de longueur totale. Coloration générale jaunâtre, avec parfois les tergites plus foncés chez la femelle. Sternites de jaune pâle à jaune ocre. Pattes et pédipalpes jaunâtres. Plaque prosomienne et tergites avec les carènes et les granules bien marqués. Metasoma avec les anneaux fortement élargis vers l'arrière; sillon sur la face dorsale profond; carènes dorsales, latéro-dorsales et latéro-ventrales fortement marquées, avec des granules spiniformes. V^{e} anneau avec le cadre anal à trois lobes aigus. Pinces trapues avec les doigts moyennement longs; tranchant des doigts fixe et mobile avec 12-13 séries semi-obliques de granules. Peignes avec 32 à 35 dents chez le mâle et 20 à 26 chez la femelle.



FIGS 22-25
Androctonus dekeyseri sp. n. 22-23. Mâle holotype. 24-25. Femelle paratype. Vues dorsale et ventrale.

Description (basée sur le mâle holotype et une femelle paratype). Coloration générale jaunâtre. Plaque prosomienne jaunâtre; tubercule oculaire et yeux latéraux noirâtres. Mesosoma jaune clair comme la plaque prosomienne chez le mâle, plus foncé chez la femelle. Anneaux metasomaux I à V jaunâtres; vésicule jaunâtre foncé; aiguillon jaunâtre à la base et noirâtre à l'extrémité. Peignes jaune pâle; opercule génital, sternum, hanches et processus maxillaire jaune ocre. Pattes jaune très clair;



FIGS 26-31

Androctonus dekeyseri sp. n. Mâle holotype. 26. Tranchant du doigt mobile. 27-31. Trichobothriotaxie des pédipalpes. 27-28. Pince, vues externe-dorsale et ventrale. 29-30. Tibia, vues dorsale et externe. 31. Fémur, vue dorsale.

aucune esquisse de taches même pas estompées. Pédipalpes: fémur, tibia et pince jaunâtres. Chélicères jaunâtres dépourvues de toute tâche ou trame; rouge-noirâtre.

Morphologie. Prosoma: front de la plaque prosomienne sans aucune concavité, droit; tubercule oculaire situé à peu près au centre de la plaque prosomienne; yeux médians séparés par trois diamètres oculaires environ; quatre paires d'yeux latéraux, trois de taille normale et le quatrième très réduit. Toutes les carènes bien marquées; tégument avec une granulation épaisse et bien marquée chez le mâle, plus faible chez la femelle. Mesosoma: tergites avec une granulation épaisse et bien marquée; trois carènes bien marquées, moins développées sur les tergites I et II; le VIIe tergite avec les carènes latérales à granules spiniformes. Metasoma avec les anneaux plutôt carrés et fortement élargis vers l'arrière; sillon sur la face dorsale des anneaux profond; tégument presque lisse et la présence de 10-10-8-8-5 carènes; toutes les carènes fortement marquées, en particulier les dorsales, latéro-dorsales et latéro-ventrales qui sont armées de granulés spiniformes sur tous les anneaux; carènes intermédiaires de l'anneau II représentée par 3-4 granules; V^{e} anneau du mâle avec le cadre anal à trois lobes aigus.

Vésicule avec quelques granules sur la face ventrale; aiguillon plus court que la vésicule, moyennement incurvé et dépourvu d'épine sous-aiguillonnaire. Peignes avec 34-32 dents chez le mâle et 24-24 dents chez la femelle (variation dans la diagnose). Pédipalpes: fémur et tibia avec 5 et 8 carènes bien marquées (Figs 29-31); présence de quelques granules spiniformes sur sa face interne du tibia. Pince lisse; tranchant des doigts fixe et mobile avec 12-13 séries semi-obliques de granules (Fig 26). Chélicères avec la dentition caractéristique des Buthidae (Vachon, 1963a); doigt mobile à deux dents basales réduites. Trichobothriotaxie du type A-Beta, orthobothriotaxique (Vachon, 1974, 1975) (Figs 27-31). Eperons tarsaux présents sur toutes les pattes; les tibiaux présents sur les pattes III-IV, bien développés.

Mensurations (en mm) du mâle holotype et d'une femelle paratype: longueur totale 76,6/86,1; plaque prosomienne: longueur 9,8/10,9, largeur antérieure 6,3/7,2, largeur postérieure 11,1/12,8; anneau caudal I: longueur 6,9/6,8, largeur 6,7/7,8; anneau caudal V: longueur 11,2/12,2, largeur 6,8/6,9, hauteur 5,5/5,8; vésicule: largeur 4,0/4,7, hauteur 3,5/3,9; pédipalpe: fémur longueur 8,4/8,1, largeur 2,9/2,3; tibia longueur 9,9/10,2, largeur 4,3/4,8; pince longueur 17,6/17,5, largeur 4,4/4,9, hauteur 4,5/5,2; doigt mobile longueur 10,8/11,3.

Androctonus bicolor Ehrenberg, 1828 Figs 32-35

= *Androctonus aeneas* C.L. Koch, 1839: 3. Syn. n.

Matériel. Egypte, Suez, X/1973 (P.M. Brignoli), 1 mâle, 2 femelles; Lybie, Cirene, Cirenaïca, 12/IV/1975 (V. Bianci & P.M. Brignoli), 2 femelles; Tripolitaine, Gargaresc, sous des pierres, 25/IV/1975 (V. Bianci & P.M. Brignoli), 5 mâles, 3 femelles; Syrie, III/1963 (Thibaud), 4 mâles, 4 femelles; Tunisie, Sidi-bou-Zid, VI/1976 (J. Garzoni), 1 mâle, 10 femelles.

Espèce de taille moyenne ou grande pouvant atteindre 70-80 mm de longueur totale. Coloration générale sombre, de brun-rougeâtre à noirâtre. Sternites brun-rougeâtre. Anneaux métasomaux et vésicule brunâtre foncé avec les carènes noirâtres; aiguillon brunâtre foncé. Pattes et pédipalpes brun-noirâtre. Plaque prosomienne avec les carènes et les granules moyennement marqués. Tergites peu granulés avec les carènes bien marqués. Metasoma avec les anneaux moyennement élargies vers l'arrière; sillon sur la face dorsale moyennement profond; carènes dorsales aux anneaux I-IV moyennement marquées, avec un granule spiniforme dans leur région postérieure (carènes plus fortement marquées chez des spécimens d'Afrique du Nord). V^{e} anneau avec le cadre anal à trois lobes arrondis; vésicule presque lisse; aiguillon moyennement courbé et aussi long que la vésicule (plus long que la vésicule chez des spécimens d'Afrique du Nord). Pinces fines avec les doigts longs (Fig 33); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules de couleur sombre. Peignes avec 26-28 dents chez le mâle et 20-24 chez la femelle.

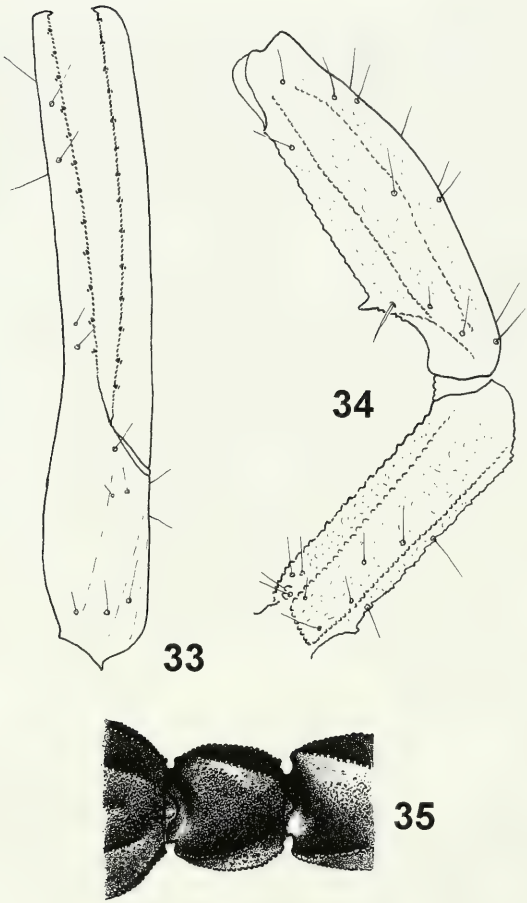
Comme l'affirme Vachon (1952): « *A. aeneas*, par la granulation intense de la face dorsale du 1er anneau de la queue se rapproche de *A. bicolor* H. et E. dont il diffère en particulier par le peu de développement de la carène intermédiaire du 3e anneau caudal..... *A. aeneas* est une espèce morphologiquement plastique dont les variétés sont nombreuses et difficiles à classer ». L'examen des spécimens collectés aussi bien en Syrie, Israel, Egypte, Libye et Tunisie, confirment une certaine variabilité surtout morphométrique. J'estime à présent que seul *A. bicolor* doit être retenue comme espèce valable, correspondant très probablement à une espèce polymorphe.

FIG. 32
Androctonus bicolor, femelle d'Israël. Habitus.

Par ailleurs, l'étude de plusieurs exemplaires de la sous-espèce *A. bicolor liouvillei* (Pallary), confirment l'existence de différences morphologiques importantes par rapport à *A. bicolor*: pinces plutôt trapues et présence d'une granulation et des carènes fortement marquées sur le corps les pattes et les pédipalpes. Pour cette raison je retiens *A. liouvillei* comme une espèce distincte et valable.

Androctonus liouvillei (Pallary, 1924) Figs 36-37

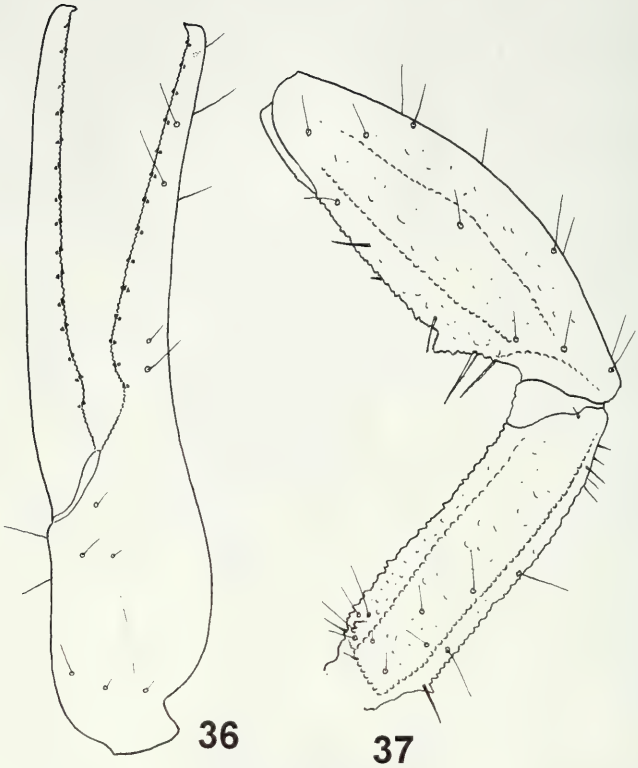
Matériel. Algérie, Foum El Hassane, VIII/1971 (P.M. Brignoli), 3 mâles, 1 femelle; Maroc, El Faty, N de Taghit, IV/1975 (P.M. Brignoli) 2 mâles, 1 femelle; 50 km Guercif, X/1980 (P.M. Brignoli), 3 mâles, 1 femelle; Hassi Mahjez, Basse Dioura, 15/IV/1979 (P.M. Brignoli), 1 femelle; Missour, 24/II/1972 (P.M. Brignoli), 2 mâles, 5 femelles, 3 juvéniles; Tafilalet, S Merzouga Erg Chebbi, 25/IV/1963 (Raymond), 1 femelle; 14/IV/1964 (Russoles), 1 femelle; Tafnidit, 25/III/1979 (P.M. Brignoli), 1 femelle; Mauritanie, Fort Trinquet, III/1962 (Ramlet), 1 femelle.



FIGS 33-35

Androctonus bicolor, mâle. 33-34. Trichobothriotaxie des pédipalpes. 33. Pince, vue externe-dorsale. 34. Tibia et fémur, vue dorsale. 35. Face dorsale du tergite VII et des anneaux caudaux I et II.

Espèce de taille moyenne ou grande pouvant atteindre environ 70 à 75 mm de longueur totale. Coloration générale brun-rougeâtre. Sternites jaune-rougeâtre. Anneaux métasomaux et vésicule brun-rougeâtre avec les carènes noirâtres; aiguillon rougeâtre à la base et brun-noirâtre à l'extrémité. Pattes et pédipalpes jaune-rougeâtre. Plaque prosomienne avec les carènes et les granules fortement marqués. Tergites avec les carènes et les granules bien marqués. Metasoma avec les anneaux élargis vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV bien marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à trois lobes faiblement aigus; vésicule avec des granules aigus sur la face ventrale; aiguillon bien courbé et plus long que la vésicule. Pinces moyennement trapues avec les doigts longs (Fig 36); tranchant des doigts fixe et mobile avec 15-16



FIGS 36-37
Androctonus liouvillei, mâle. Trichobothriotaxie des pédipalpes. 36. Pince, vue externe-dorsale. 37. Tibia et fémur, vue dorsale.

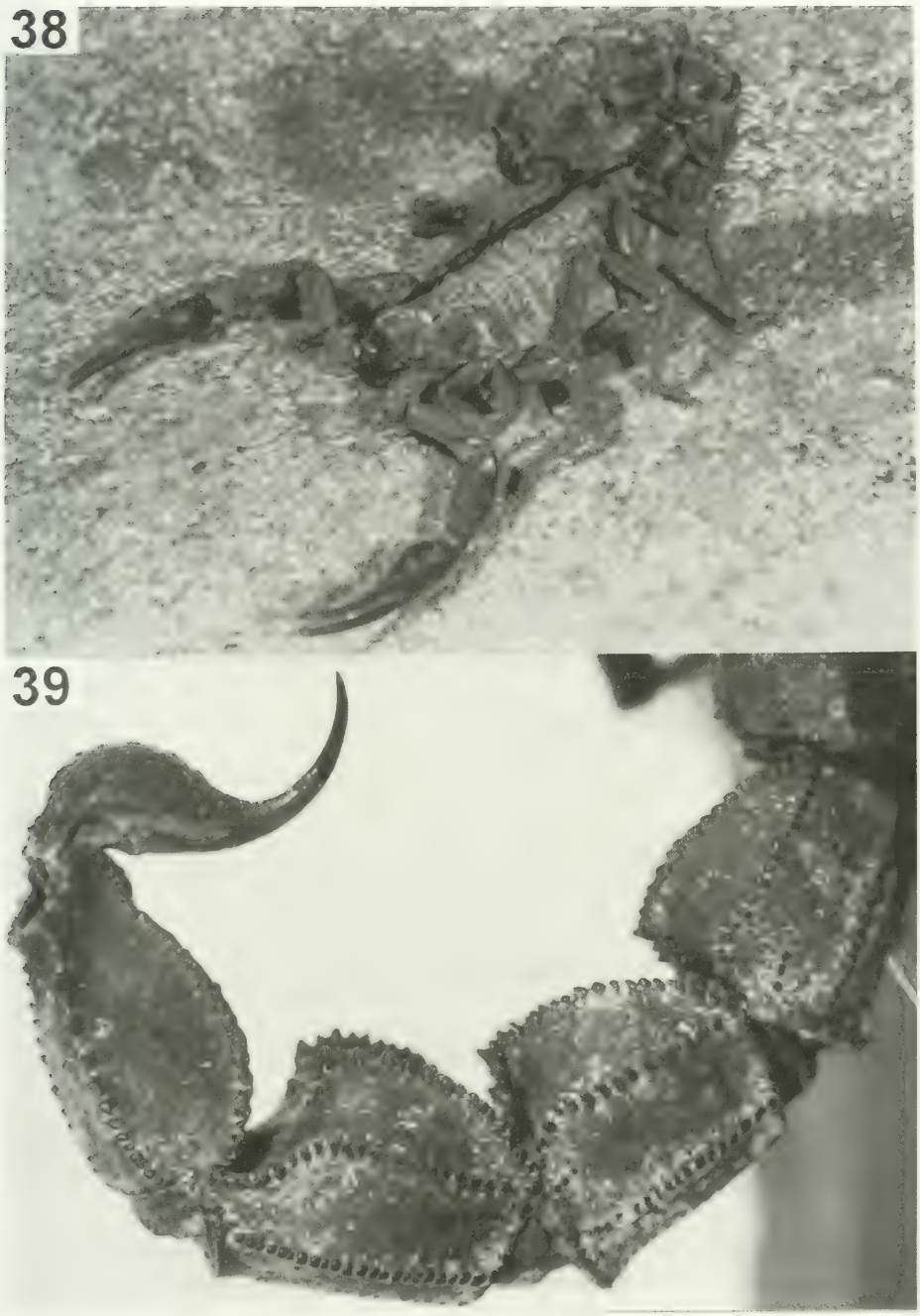
séries semi-obliques de granules de couleur rougeâtre. Peignes avec 28-32 dents chez le mâle et 22-26 chez la femelle.

Distribution. Algérie et Maroc.

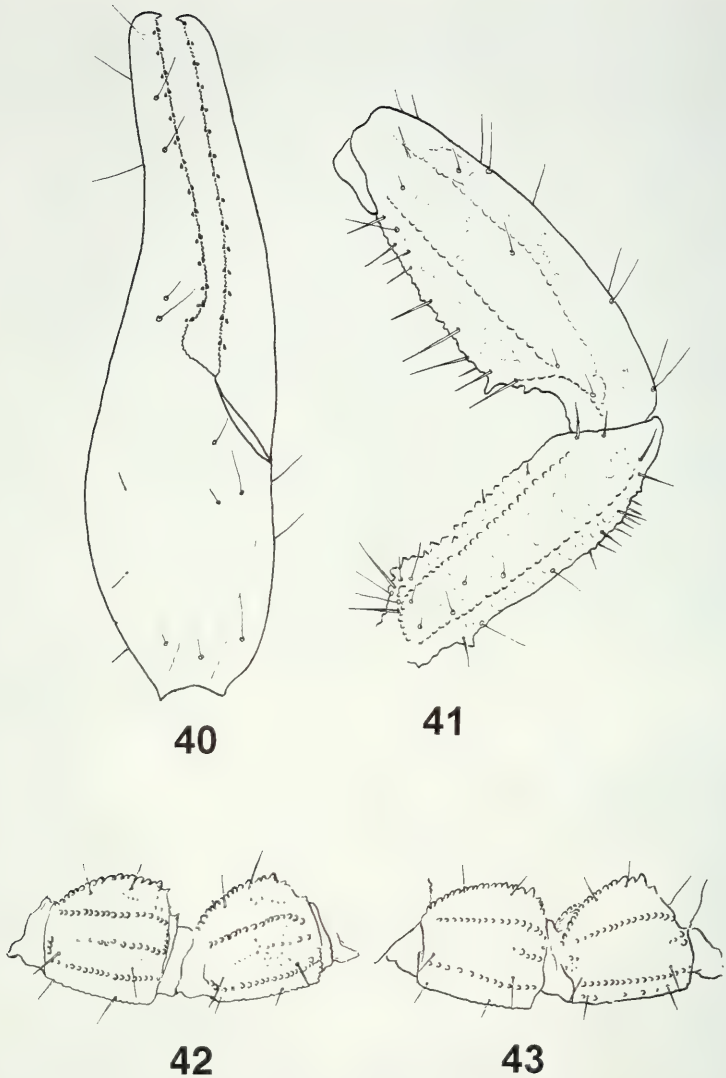
Androctonus mauritanicus (Pocock, 1902) Figs 38-43
= *Androctonus mauritanicus bourdoni* Vachon, 1948: 313. Syn. n.

Matériel. Maroc, Aït Mekrul, IV/1964, (Rungs), 1 femelle; Cheirat, 9/VII/1962 (Drissleg), 1 mâle; Environs de Mogador, 5/IV/1979 (P.M. Brignoli), 1 femelle; Jardins des A.I. Inezgane, 24/I/1966 (Smirnoff), 2 mâles, 1 femelle; Sidi Moussa d'Aglou, dans sable, X/1977 (P.M. Brignoli), 1 femelle; sud de Rabat, 7/V/1964 (Mulski), 1 femelle.

Espèce de grande taille pouvant atteindre 80 mm de longueur totale. Coloration générale de brun foncé à noirâtre. Sternites brun-foncé avec des zones plus claires. Anneaux métasomaux et vésicule brun-foncé avec les carènes noirâtres; aiguillon brunâtre, plus foncé à l'extrémité. Pattes et pédipalpes brun-foncé. Plaque prosomienne avec les carènes et les granules fortement marqués. Tergites très granulés avec les carènes bien marqués. Metasoma avec les anneaux élargis vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV bien marquées, avec des



FIGS 38-39
Androctonus mauritanicus, femelle. 38. Habitus. 39. Metasoma et telson, vue latérale.



FIGS 40-43

Androctonus mauritanicus, mâle. 40-41. Trichobothriotaxie des pédipalpes. 40. Pince, vue externe-dorsale. 41. Tibia et fémur, vue dorsale. 42-43. Anneaux II et III du metasoma, vue latérale, avec la variabilité en taille de la carène intermédiaire.

granules spiniformes dans leur région postérieure (Fig 39). V^{e} anneau avec le cadre anal à trois lobes moyennement aigus; vésicule avec quelques granules sur la face ventrale; aiguillon bien courbé et aussi long que la vésicule. Pinces moyennement trapues avec les doigts pas très longs (Fig 40); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules de couleur sombre. Peignes avec 26-30 dents chez le mâle et 20-25 chez la femelle.

Vachon (1952) caractérise deux sous-espèces pour *A. mauritanicus*: *A. m. mauritanicus* et *A. m. bourdoni*, fondée en particulier sur le développement des carènes intermédiaires des anneaux II et III du metasoma. L'examen de spécimens de deux formes ne permet pas de confirmer une différence constante pour ce caractère, mais plutôt une variabilité aléatoire. Ceci semble indiquer uniquement une variabilité intraspécifique. Pour cette raison je considère à présent *Androctonus mauritanicus* comme la seule espèce valable.

Distribution. Maroc et Mauritanie.

Androctonus hoggarensis (Pallary, 1929) Figs 44-45

Matériel. Algérie, Tamanrasset, sous pierre, X/1965 (M. Doury), 2 femelles.

Espèce de grande taille pouvant atteindre 100 mm de longueur totale. Coloration générale de vert sombre à brun chocolat. Sternites brun-jaunâtre. Anneaux métasomaux et vésicule brun chocolat avec les carènes noirâtres; aiguillon brunâtre. Pédipalpes brun-rougeâtre, avec les doigts plus foncés; pattes jaune-rougeâtre. Plaque prosomienne avec les carènes et les granules bien marqués. Tergites avec les carènes et les granules moyennement marqués. Metasoma avec les anneaux élargis vers l'arrière; sillon sur la face dorsale profond; carènes dorsales aux anneaux I-IV fortement marquées, avec des granules spiniformes dans leur région postérieure. V^{e} anneau avec le cadre anal à quatre lobes arrondies; vésicule peu granulée, mais ponctuée sur les faces ventrale et latérales; aiguillon moyennement courbé et aussi long que la vésicule. Pinces trapues avec les doigts moyennement longs (Fig 44); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules de couleur sombre. Peignes avec 31-33 dents chez le mâle et 24-29 chez la femelle.

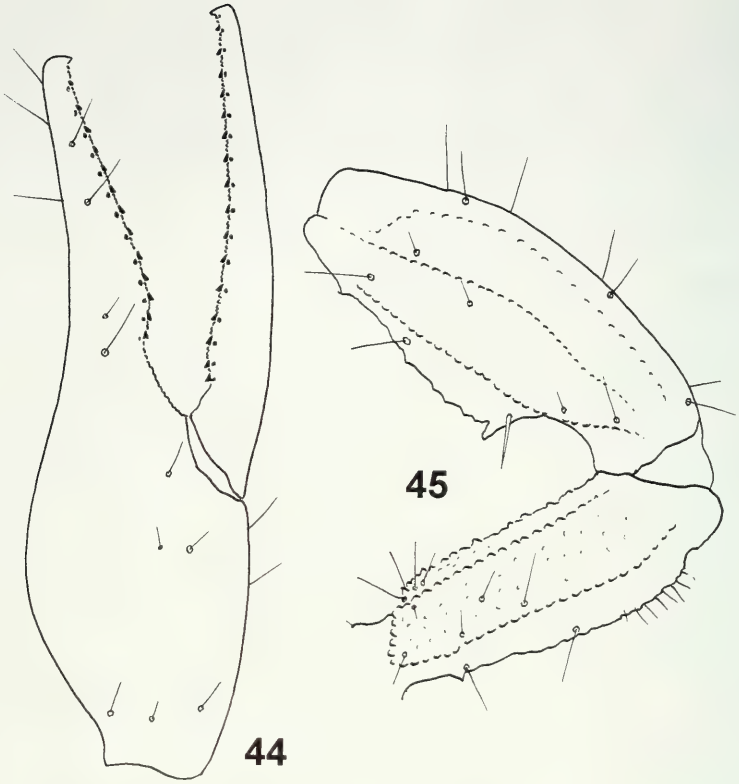
Distribution. Montagnes du sud de l'Algérie et du nord du Niger. C'est une espèce d'altitude.

Androctonus sergenti Vachon, 1948 Figs 46-47

Matériel. Maroc, Bou-Izatra N, 2 km de la ville, 16/VII/1970 (F.G. Celo), 4 mâles, 1 femelle.

Espèce de taille moyenne pouvant atteindre 65 mm de longueur totale. Coloration générale sombre, de brun-chocolat à brun-noir. Sternites brunâtres avec des zones plus claires. Anneaux métasomaux et vésicule brun-foncé; aiguillon brunâtre plus foncé à l'extrémité. Pattes et pédipalpes brun-chocolat. Plaque prosomienne avec les carènes et les granules fortement marqués. Tergites avec les carènes et les granules bien marqués. Metasoma avec les anneaux élargis vers l'arrière; sillon sur la face dorsale moyennement profond; carènes dorsales aux anneaux I-IV peu marquées, avec un granule spiniforme dans leur région postérieure. V^{e} anneau avec le cadre anal à trois ou quatre lobes peu distincts; vésicule avec quelques granules sur la face ventrale; aiguillon bien courbé et aussi long que la vésicule. Tégument des anneaux avec des zones ponctuées (Fig 48). Pinces fines avec les doigts longs (Fig 46); tranchant des doigts fixe et mobile avec 13-15 séries semi-obliques de granules. Peignes avec 25-27 dents chez le mâle et 21-25 chez la femelle.

Selon Vachon (1952), c'est une espèce montagnarde que semble localisée aux pentes donnant sur la vallée du Souss au Maroc.

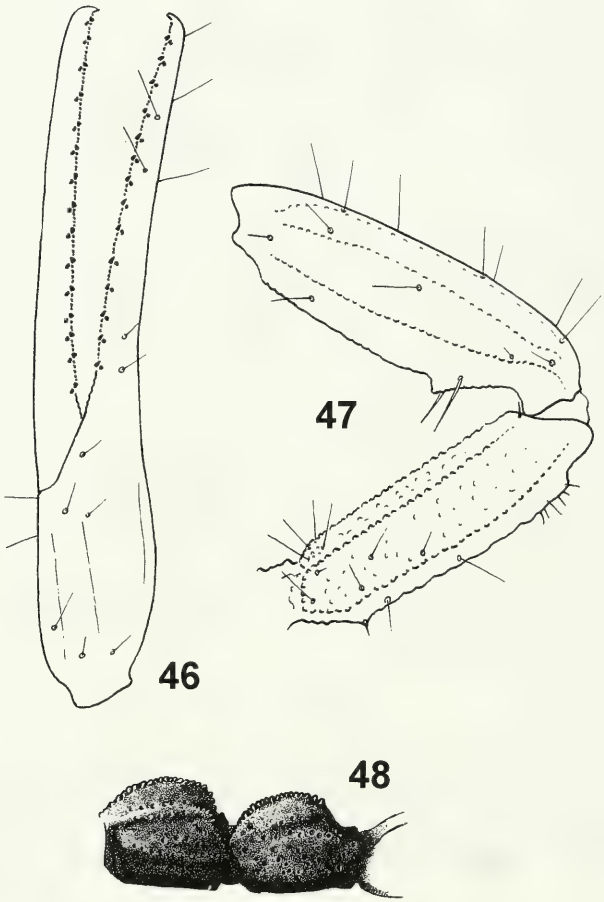


FIGS 44-45

Androctonus hoggarensis, mâle. Trichobothriotaxie des pédipalpes. 44. Pince, vue externe-dorsale. 45. Tibia et fémur, vue dorsale.

CLÉ D'IDENTIFICATION POUR LES ESPÈCES DE *ANDROCTONUS* TRAITÉES DANS LE PRÉSENT TRAVAIL

1 Teinte générale jaune-pâle, jaune-ocre, jaune-rougeâtre ou brun-rougeâtre avec parfois des zones assombries 2
- Teinte générale sombre; vert-sombre, brun-chocolat ou noirâtre 7
2 Metasoma avec les anneaux peu ou fortement élargies vers l'arrière; sillon sur la face dorsale des anneaux peu ou très profond; carènes avec des granules spiniformes 3
- Metasoma avec les anneaux à largeur constante; sillon sur la face dorsale des anneaux peu marqué; carènes avec des granules arrondis . *A. amoreuxi*
3 Teinte prédominante, jaune-pâle ou jaunâtre 4
- Teinte prédominante jaune-rougeâtre ou brun-rougeâtre 6
4 Anneaux peu élargies vers l'arrière; sillon dorsal peu profond; pinces faiblement trapues . . . . . *A. finitimus*
- Anneaux fortement élargies vers l'arrière; sillon dorsal profond; pinces trapues 5



FIGS 46-48
Androctonus sergenti, femelle. 46-47. Trichobothriotaxie des pédipalpes. 46. Pince, vue externe-dorsale. 47. Tibia et fémur, vue dorsale. 48. Anneaux caudaux III et IV, vue latérale avec les zones ponctuées.

5 Teinte jaune-paille, avec des zones assombries sur la pince des pédipalpes et parfois les anneaux distaux du metasoma et le telson; sillon dorsal très profond; carènes latérales et intermédiaires chez le mâle sans granules spinoides . . . . . *A. australis*

- Teinte jaunâtre foncé, sans zones assombries; sillon dorsal profond; carènes latérales et intermédiaires chez le mâle avec des granules spinoides . . . . . *A. dekeyseri* sp. n.

6 Teinte jaune-rougeâtre, avec les anneaux IV-V, le telson et la face interne du fémur et tibia des pédipalpes assombries . . . . . *A. baluchicus*

- Teinte brun-rougeâtre uniforme sur le corps, pattes et pédipalpes . . . . . *A. maelfaiti* sp. n.

7 Teinte de vert-sombre à brun, brun-rougeâtre 8
- Teinte brun-chocolat, très foncé ou noirâtre 11
8 Teinte vert sombre, parfois brunâtre; cadre anal avec 4 lobes; vésicule ponctuée . . . . . *A. hoggarensis*
- Teinte de brun-pâle à brun-rougeâtre; cadre anal avec 3 lobes; vésicule granulée 9
9 Granules de la vésicule spiniforme; tranchant des doigts mobile et fixe des pédipalpes avec 15-16 séries de granules . . . . . *A. liouvillei*
- Granules de la vésicule arrondie; tranchant des doigts mobile et fixe des pédipalpes avec 13-15 séries de granules 10
10 Vésicule avec 3 séries de gros granules sur la face ventrale; pinces faiblement trapues . . . . . *A. crassicauda*
- Vésicule avec une granulation fine mais intense sur la face ventrale; pinces trapues . . . . . *A. gonneti*
11 Tégument des anneaux du metasoma avec des zones ponctuées . . . *A. sergenti*
- Tégument des anneaux du metasoma sans ponctuations 12
12 Pinces fines avec les doigts longs; vésicule presque lisse; plaque prosomienne et tergites moyennement granulés . . . . . *A. bicolor*
- Pinces moyennement trapues avec les doigts pas très longs; vésicule avec quelques granules sur la face ventrale; plaque prosomienne et tergites fortement granulés . . . . . *A. mauritanicus*

REMERCIEMENTS

Je suis très reconnaissant aux Drs Charles Lienhard et Peter Schwendinger, Muséum d'histoire naturelle, Genève pour la révision des versions préliminaires du texte. Je remercie également Maurice Gaillard, Paris et Claude Ratton, Muséum d'histoire naturelle, Genève, pour la réalisation de dessins et des photos.

RÉFÉRENCES BIBLIOGRAPHIQUES

DEKEYSER, P. L. & DERIVOT, J. H. 1966. Les Oiseaux de l'Ouest Africain. Initiations et Etudes Africaines n° 19. *Université de Dakar, Institut Fondamental d'Afrique Noire* 1: 507 pp.

FARZANPAY, R. & VACHON, M. 1979. Contribution à l'étude des caractères sexuels secondaires chez les scorpions Buthidae (Arachnida). *Revue Arachnologique* 2 (4): 137-142.

FET, V. & LOWE, G. 2000. Family Buthidae C. L. Koch, 1837 (pp. 54-286). *In*: FET, V., SISSOM, W.D., LOWE, G. & BRAUNWALDER, M.E. (eds). Catalog of the Scorpions of the world (1758-1998). *New York, NY: The New York Entomological Society*, 690 pp.

GOYFFON, M. & LAMY, J. 1973. Une nouvelle sous-espèce d'*Androctonus australis* L. (Scorpion, Buthidae): *Androctonus australis garzonii* n. ssp. Caractéristiques morphologiques, écologiques et biochimiques. *Bulletin de la Société zoologique de France* 98 (1): 137-144.

HEMPRICH, F. W. & EHRENBERG, C. G. 1828. Zoologica II. Arachnoidea. Plate I: *Buthus*; plate II: *Androctonus*. *In*: Symbolae Physicae seu Icones et Descriptiones Animalium evertebratorum sepositis Insectis quae ex itinere per Africam borealem et Asiam occidentalem. Friderici Guilelmi Hemprich et Christiani Godofredi Ehrenberg, medicinae et chirurgiae doctorum, studio novae aut illustratae redierunt. Percensuit et regis iussu et impensis edidit Dr. C. G. Ehrenberg. Decas prima. *Berolini ex officina Academica, Venditur a Mittlero*.

KOCH, C. L. 1839. Die Arachniden. *C. H. Zeh'sche Buchhandlung, Nürnberg*. 6 (1-6): 1-156.

LAMY, J., LE PAPE, G. & WEILL, J. 1974. Hétérogénéité de l'espèce *Androctonus australis* L. (Scorpiones, Buthidae). Création d'une nouvelle sous-espèce *A. australis africanus* n. ssp. sur la base de critères biochimiques et génétiques. *Comptes rendus hebdomadaires des séances de l'Académie des sciences, Paris* (D) 278: 3223-3226.

LEVY, G. & AMITAI, P. 1980. Fauna Palaestina, Arachnida I: Scorpiones. *Israel Academy of Sciences and Humanities, Jerusalem*, 130 pp.

LOURENÇO, W. R. 2003. Compléments à la faune de scorpions (Arachnida) de l'Afrique du Nord, avec des considérations sur le genre *Buthus* Leach, 1815. *Revue suisse de Zoologie* 110 (4): 875-912.

POCOCK, R. I. 1900. Arachnida. The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. *Edited by W. T. Blandford, Taylor & Francis, London*, xii + 279 pp.

TIKADER, B. K. & BASTAWADE, D. B. 1983. The Fauna of India. Vol. 3. Scorpions (Scorpionida: Arachnida). *Zoological Survey of India, Calcutta*, 671 pp.

VACHON, M. 1948. Etudes sur les Scorpions. III (suite). Description des Scorpions du Nord de l'Afrique. *Archives de l'Institut Pasteur d'Algérie* 26 (3): 288-316.

VACHON, M. 1952. Etudes sur les scorpions. *Publications de l'Institut Pasteur d'Algérie, Alger*, 482 pp.

VACHON, M. 1953. Contribution à l'étude du peuplement de la Mauritanie. Scorpions. *Bulletin de l'Institut Français d'Afrique Noire* 15 (3): 1012-1028.

VACHON, M. 1955. Le Scorpion jaune des pays Ajjer: *Androctonus amoreuxi* (Aud. et Sav., 1812 et 1826) (=*Prionurus eburneus* Pallary, 1928). *Archives de l'Institut Pasteur d'Algérie* 33: 54-58.

VACHON, M. 1958. Scorpionidea (Chelicerata) de l'Afghanistan. The 3rd Danish expedition to Central Asia. (Zoological results 23). *Videnskabelige meddelelser fra Dansk naturhistorisk forening i København* 120: 121-187.

VACHON, M. 1963a. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle, Paris*, 2e sér., 35 (2): 161-166.

VACHON, M. 1963b. Quelques remarques sur les scorpions hôtes indésirables des lieux habités. *Travaux du Centre de Biologie Industrielle et Agricole du Conservatoire National des Arts et Métiers,* fasc. 1: 3-7.

VACHON, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle, Paris*, 3e sér., n° 140, *Zool.* 104: 857-958.

VACHON, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus des Séances de l'Académie de Sciences, Paris*, sér. D, 281: 1597-1599.

REVUE SUISSE DE ZOOLOGIE 112 (1): 173-182; mars 2005

Glyphomerus aylax sp. n. (Hymenoptera: Torymidae) from Bulgaria

Anelia STOJANOVA
Department of Zoology, University of Plovdiv, 24 Tsar Assen Str., Plovdiv 4000, Bulgaria.
E-mail: stanelia@pu.acad.bg

***Glyphomerus aylax* sp. n. (Hymenoptera: Torymidae) from Bulgaria. -** The new species *Glyphomerus aylax* is described and illustrated on the basis of specimens that emerged from galls of *Aylax hypecoi* Trotter (Cynipidae) on *Hypecoum imberbe* (Hypecoaceae). A key to all species of *Glyphomerus* is presented. Biological notes of the new species are given.

Keywords: Hymenoptera - Torymidae - *Glyphomerus* - taxonomy - key to species.

INTRODUCTION

Glyphomerus Förster, 1856 is a genus with 8 species (incl. the new species), mostly distributed in Palaearctics. Only *Glyphomerus stigma* (Fabricius) is recorded in Nearctics, where it probably was introduced from Europe. Bouček (1970) published a key and comments on the known species up to that time. Grissell (1995) gave a catalogue of species and diagnostic characters of the genus, and stressed on its basal position in the subfamily Toryminae. Zerova & Seryogina (1999a, b; 2000) reviewed *Glyphomerus* with descriptions of 3 new species, a redescription and keys.

Species of *Glyphomerus* have been reared from galls of Cynipidae (Hymenoptera) associated with Rosaceae, Asteraceae and Lamiaceae, and from Eurytomidae (Hymenoptera) galls on Poaceae.

MATERIAL AND METHODS

Glyphomerus aylax sp. n. was reared from galls of *Aylax hypecoi* Trotter (Hymenoptera: Cynipidae) on *Hypecoum imberbe* Sibthorp et Smith (Hypecoaceae). Galls (Fig. 10) that developed in fruit tissues between seeds were stored under laboratory conditions and some of them were opened to study the trophic relationships.

Along with the new species, some chalcidoids, braconids and ichneumonids emerged from those galls. The specimens were air-dried and card-mounted.

Specimens used for scanning electron microscopy were dissected and glued with conductive paste LEIT-C. They were coated with a 150-200 Å gold layer and photographed using a Philips-515 SEM (25 kV; secondary electrons-mode).

The key of *Glyphomerus* species is based on previous keys in the literature, and also after studying of the specimens of *Gl. stigma*, *Gl. tibialis*, *Gl. europaeus*, *Gl.*

Manuscript accepted 13.10.2004

carinatus, *Gl. isosomatis* and *Gl. aylax* sp. n. *Gl. parvulus* and *Gl. montanus* are given in the key according their original descriptions.

Terminology and abbreviations follow Grissell (1995) and Graham & Gijswijt (1998).

DESCRIPTION AND DISCUSSION OF THE NEW SPECIES

Glyphomerus aylax sp. n. Figs 1-9

MATERIAL EXAMINED

Holotype: ♀, Bulgaria: Plovdiv, Dzhendem tepe locality – 165 m a. s. l., emerged 20-29.VI.2002 from gall collected 2.VI.2002, A. Stojanova. *Paratypes*: 99 ♀♀ and 68 ♂♂, same locality as holotype, A. Stojanova; collecting and emerging dates, number and sex of specimens are presented in Table 1.

Holotype and 10 paratypes are deposited in the collection of the Muséum d'histoire naturelle, Geneva. Ten paratypes are deposited in the collection of the Institute of Zoology, Ukrainian Academy of Sciences (Kiev) and 148 paratypes are deposited in the collection of the Department of Zoology, University of Plovdiv.

DIAGNOSIS

The following combination of features separates *Glyphomerus aylax* sp. n. from other species of the genus: 1) Malar space 0.38 to 0.4 times the length of the eye. 2) Antenna: female – F1 slightly elongate, F2-F5 quadrate, F6 and F7 slightly transverse; male – F1 and F2 slightly elongate, F3-F7 quadrate. 3) Marginal vein 1.2 times as long as postmarginal vein and 2.4 times as long as stigmal vein. 4) Ovipositor index 1.75 to 2.18. 5) Fore wing infumate with a macula below stigma and with dark stripes on cubital fold, and above the middle part of posterior margin.

DESCRIPTION

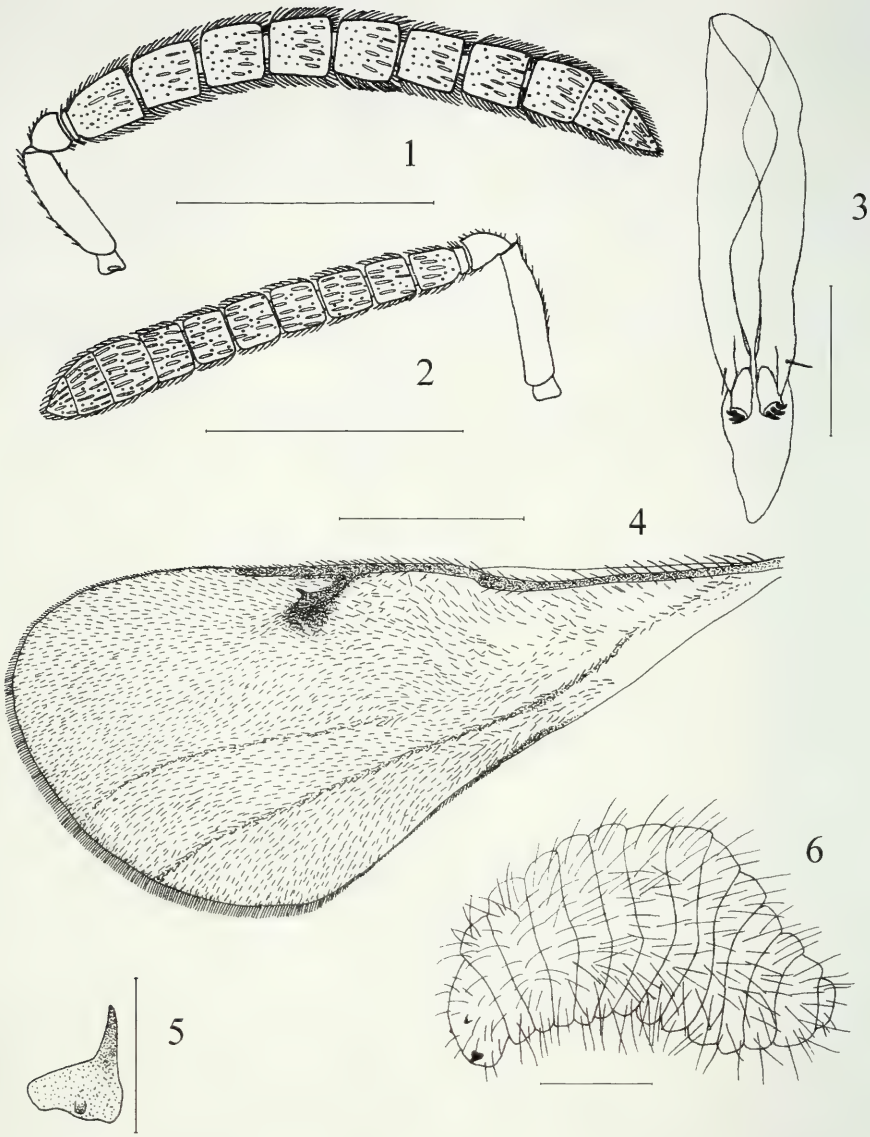
FEMALE: *Morphology*. Head with finely reticulate surface and moderately dense pubescence. Head in dorsal view 2.3-2.4 times as broad as long, temples 0.22-0.25 times length of eye. POL 2.1-2.3 times OOL, OOL 1.1-1.2 times OD. Head in frontal view (Fig. 7) subtrapezoid, with vertex slightly arched and straight genae. Anterior margin of clypeus straight, face protruding medially. Mouth 1.9-2 times length of malar space, the latter 0.38-0.45 times the length of eye. Eyes with sparse hairs. Scrobal depression shallow, not reaching anterior ocellus. Toruli (Fig. 7) well above lower ocular line, slightly nearer to clypeus than to lower edge of anterior ocellus. Antenna (Fig. 2) with scape 4.3 times as long as broad, not reaching anterior ocellus; pedicel 1.5 times as long as broad; anellus strongly transverse; F1 slightly elongate, F2 – F5 quadrate, F6 and F7 slightly transverse; clava twice as long as broad; sensilla numerous, arranged in 2 rows. Flagellum clothed with short, adpressed hairs.

Mesosoma (Fig. 8) with dorsal surface reticulate and shining; pubescence consisting of dense, rather short and slightly raised hairs on pronotum and mesoscutum, and longer hairs on posterior third of scutellum and on callus. Mesosoma short, about 1.25 times as long as the maximum height in lateral view; pronotum transverse, 2.7 times as broad as long on median line including neck. Mesoscutum 1.5 times as broad as long with notauli complete, superficial. Scutellum barely longer than wide, with subtruncate base and posterior margin with a carina. Propodeum (Fig. 9) finely

TABLE 1. Data of paratypes of *Glyphomerus aylax* sp. n.

Date of galls collecting	Emerging date	♀	♂
19.V.2001	10-15.V.2002	2	-
14.II.2002	31.V.2002	1	1
17.III.2002	19.IV.2002	-	1
28.III.2002	5.IV.2002	2	3
28.III.2002	23-29.IV.2002	2	5
28.III.2002	1-4.V.2002	11	-
28.III.2002	10-15.V.2002	-	1
28.III.2002	6.VI.2002	1	1
14.IV.2002	7.V.2002	1	1
19.IV.2002	12.V.2002	1	-
12.V.2002	7-10.VI.2002	2	3
12.V.2002	20-29.VI.2002	1	-
19.V.2002	30.V. -10.VI.2002	-	1
19.V.2002	10-14.VI.2002	-	3
19.V.2002	14-18.VI.2002	1	1
25.V.2002	14-18.VI.2002	1	-
29.V.2002	14-18.VI.2002	1	2
29.V.2002	19.VI.2002	-	2
29.V.2002	20-29.VI.2002	13	4
29.V.2002	7-10.V.2002	2	-
29.V.2002	14.V.2002	1	-
29.V.2002	21.V.2003	1	-
29.V.2002	27.V.2003	1	-
2.VI.2002	14-18.VI.2002	3	1
2.VI.2002	19.VI.2002	3	-
2.VI.2002	20-29.VI.2002	21	10
2.VI.2002	15.VIII.2002	-	1
2.VI.2002	21.IV.2003	-	1
2.VI.2002	7.V.2003	2	1
2.VI.2002	14.V.2003	1	-
9.VI.2002	14-18.VI.2002	-	2
9.VI.2002	20-29.VI.2002	4	4
9.VI.2002	5.III.2003	1	1
9.VI.2002	23.IV.2003	1	-
9.VI.2002	10.V.2003	1	1
9.VI.2002	14.V.2003	1	-
9.V.2003	28.V. -3.VI.2003	-	7
17.V.2003	4-11.VI.2003	2	3
17.V.2003	12-16.VI.2003	4	1
25.V.2003	4-11.VI.2003	1	-
25.V.2003	12-16.VI.2003	1	1
25.V.2003	17-20.VI.2003	2	-
2.VI.2003	12-16.VI.2003	1	-
2.VI.2003	17-20.VI.2003		3
2.VI.2003	22.VI. -5.VII.2003	7	2

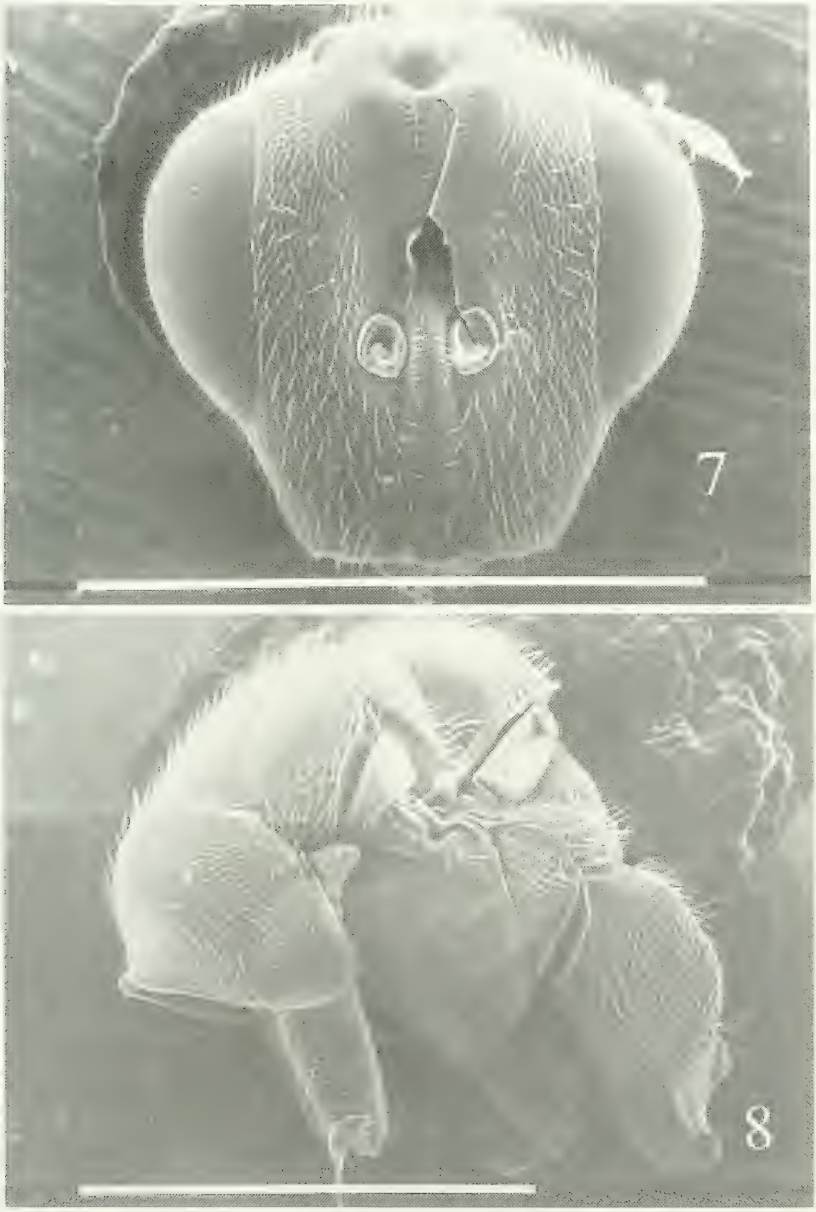
reticulate; in median part 0.3 as long as distance between spiracles; median carina indistinct and submedian carinae incomplete. Mesepimeron 2.7 times as high as broad, smooth and shining (except for reticulate lower posterior half). Hind femora moderately strongly enlarged, 3.4 times as long as broad, slightly crenulate in apical part. Fore wing (Fig. 4) 2.4 times as long as broad; basal cell hairy except for a bare



FIGS 1-6
Glyphomerus aylax sp. n. 1, 3 male: 1 – antenna; 3 – genitalia; 2, 4 female: 2 – antenna; 4 – fore wing; 5, 6 larva: 5 – mandible; 6 – last instar larva. Scale bars = 0.1 mm for mandible; 0.2 mm for genitalia; 0.5 mm for the others.

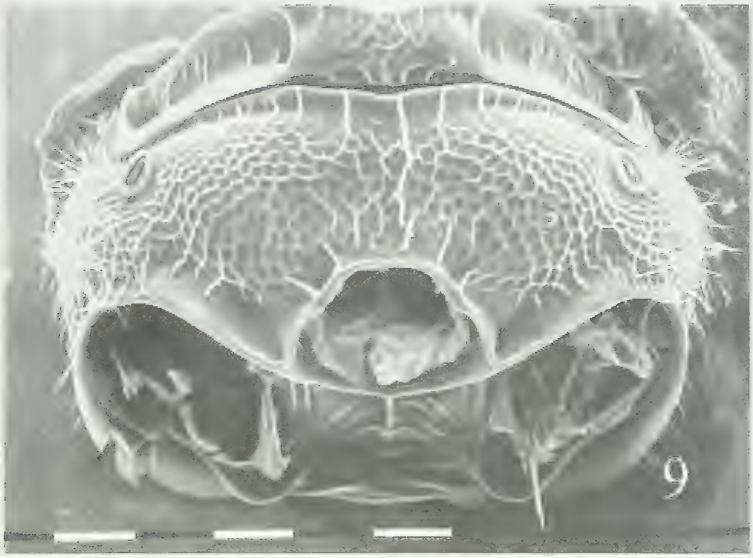
stripe along cubital hairline, speculum partly present; cubital fold with hairline. Fore wing venation: M: PM: ST as 36: 29: 15.

Gaster with puncture surface; pubescence consisting of dense hairs. Gaster 1.2-1.5 times the length of mesosoma. Tip of hypopygium extending 2/3 along gaster.



FIGS 7-8
Glyphomerus aylax sp. n.: 7 – head, frontal view; 8 – mesosoma, lateral view. Scale bars = 1 mm.

Ovipositor index (ratio length of ovipositor: length of hind tibia) 1.75-2.18 (except for one female with ovipositor index of 1.31). Ovipositor tilted upwards at an angle of about 40°-70° relative to imaginary line crossing petiolus and ovipositor base, but 3 females have almost vertical ovipositors.



FIGS 9-10

9 – *Glyphomerus aylax* sp. n., propodeum. Units of scale bar = 0.1 mm. 10 – Galls of *Aylax hypecoi* on *Hypecoum imberbe*. Scale bar = 10 mm.

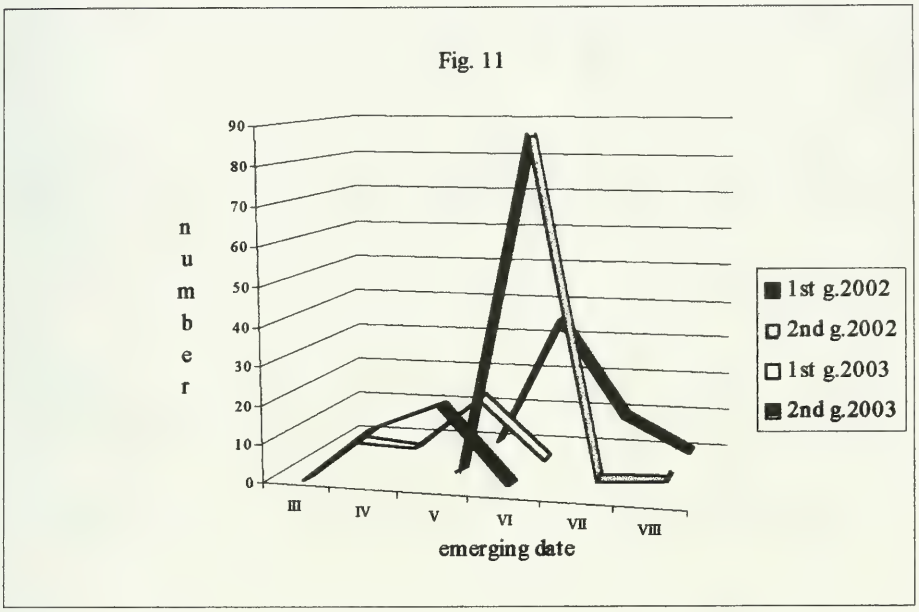


FIG. 11
Dynamic of number of first and second generations of *Glyphomerus aylax* sp. n.

Length 2.2-3.3 mm.

Colour. Dark bluish-green with bronze shine to brownish-black with weak violaceous metallic shine. Following structures brown: antenna (except for yellowish-brown base of scape), clypeus, lower face only lateral to clypeus; lateral part of gastral terga (first and second testaceous); hypopygium; ovipositor sheaths; inner surface of fore coxa, mid and hind coxae; femora (except for yellowish knees); hind tibia (except for yellowish apex); pretarsi. Fore and mid tibiae yellowish brown, tarsal segments yellow. Wings infumate, fore wings with a macula below the stigma (sometimes paler) and with dark stripes on cubital fold and above the middle part of posterior margin; veins and pubescence on wing disc dark brown.

MALE: *Morphology*. Differs from female as follows: antenna (Fig. 1) – scape cylindrical, without enlargement, 3.6 times as long as broad; pedicel about one third the length of scape; anellus strongly transverse; F1 slightly elongate, 1.3 times as long as broad, F2 subquadrate, F3-F7 quadrate (sometimes F2-F7 slightly transverse); clava 2.8 times as long as broad. Flagellum thickly clothed with short brown setae. Malar space 0.35-0.45 length of eye. Legs with hind femur 3.2 times as long as broad. Gaster oval, about as broad as mesosoma and 0.65-1.4 times the length of the latter. Genitalia (Fig. 3).

Length 1.4-2.85 mm.

Colour. Bronze-green with metallic shine to brownish-black with green metallic shine. Antennae dark brown; coxae and femora (except for testaceous knees)

concolorous with body, fore and mid tibiae yellowish, hind - brown. Fore wings with relatively weaker infumation and paler macula below stigma (smaller paratypes with almost hyaline wings and maculae hardly traceable).

BIOLOGY

Glyphomerus aylax sp. n. is a primary, solitary, ectophagous parasitoid of *Aylax hypecoi*, but secondary parasitism via chalcidoid (Eurytomidae: *Eurytoma aemula* Szelenyi, *Eurytoma jaceae* Mayr, *Eurytoma* sp.; Eupelmidae: *Eupelmus microzonus* Förster, *Eupelmus vesicularis* (Retzius), *Eupelmus* sp.; Pteromalidae: *Cyrtoptyx* sp.; Torymidae: *Exopristoides* sp.), braconid or ichneumonid species emerging from the same galls cannot be excluded.

The new species appears to be at least bivoltinous. Adults of first generation emerge between March and June (Fig. 11) from galls formed in the previous year (February, March and April); second generation emerge between May and August from galls collected in May and June of the same year. For five larvae of galls collected on 9.VI.2002 a prolonged diapause of about 2 years was established.

The fully-grown larva (Fig. 6) is ivory white and densely clothed with long hairs. The mandible (Fig. 5) is unidentate.

ETYMOLOGY

Named after the host.

DISCUSSION

The females of *Glyphomerus aylax* sp. n. are closely related to those of *Glyphomerus tibialis* (Förster) regarding the shape of first funicular segment slightly elongate; annelus transverse; malar space 0.38 to 0.45 times the length of eye; mesosoma short, about 1.25 times as long as the maximum height in lateral view and scutelium barely longer than wide; gastral terga densely punctured. The new species can be distinguished from *Gl. tibialis* in having marginal vein 1.2 times as long as the postmarginal vein and 2.4 times as long as the stigmal vein (*tibialis* has marginal vein 1.8 times as long as the postmarginal vein and 3 times as long as the stigmal vein). There are some more differences between both species: the second funicular segment in *Gl. tibialis* is elongate; the new species has F2 quadrate; the fore wing of *Gl. tibialis* has two maculae, whereas that of *Gl. aylax* sp. n. has one macula below the stigma and dark stripes on the cubital fold and above the middle part of posterior margin. *Gl. tibialis* has usually pale tibiae, whereas those of *Gl. aylax* sp. n. are yellowish brown.

The following characters: ovipositor index and coloration of the body vary greatly in both species and they are not reliable for distinguishing of them (ovipositor index varies in *Gl. tibialis* from 0.95 to 2.14 and in *Gl. aylax* sp. n. - from 1.75 to 2.18; the coloration of the mesosoma in *Gl. tibialis* varies from bluish green to green, and of the gaster - from black to brown with reddish base; the coloration of the mesosoma in *Gl. aylax* sp. n. varies from green with blue or bronze shine to brownish-black and of the gaster – from green to brown).

On the other hand *Glyphomerus aylax* sp. n. is related to *Glyphomerus isososmatis* Zerova et Seryogina in having similar shape of funicular segments two to seven, shape of anterior margin of clypaeus, malar spase: length of eye 0.38 to 0.45, and

ovipositor index. The new species differs from *Gl. isososmatis* in having: F1 slightly elongate (first funicular segment of *Gl. isososmatis* is distinctly transverse), the marginal vein 1.2 times as long as the postmarginal vein and 2.4 times as long as the stigmal vein (in *Gl. isososmatis* the stigmal vein is 0.45 times as long as the marginal veil, which is subequal in length with the postmarginal vein), and in having fore wing with one macula below the stigma and with dark stripes on cubital fold and above the middle part of posterior margin (*Gl. isososmatis* has two connected maculae below the stigmal vein and the parastigma).

KEY TO THE SPECIES OF *GLYPHOMERUS* FÖRSTER

Females

1 Malar space short, 0.25 to 0.33 length of eye 2
- Malar space 0.38 to 0.55 length of eye 4

2 Pronotum in dorsal view with sides diverging anteriorly; anterior corners prominent, below the corners with deep holes laterally; propodeum with distinct median carina and incompleted submedian carinae. Ovipositor index 1.8. Body black with dark green gloss, scape dirty yellow, at least below . . . . . *Glyphomerus carinatus* Nikolskaya
- Pronotum in dorsal view with sides subparallel, no prominent corners and holes laterally 3

3 Propodeum coarsly reticulate and with some curved wrinkles. Postmarginal vein 2 times as long as stigmal vein. Ovipositor index 2.25. Body black with bluish-green gloss. [Fore wing infumate with 2 maculae] . . . . . *Glyphomerus stigma* (Fabricius)
- Propodeum finely reticulate. Postmargimal vein 1.7 times as long as stigmal vein. Ovipositor index 2.35. Body dark bronze-green. [Fore wing with 2 maculae] . . . . . *Glyphomerus montanus* Zerova & Seryogina

4 Body testaceous; anellus elongate, flagellum very slender, F1 narrower and shorter than pedicel. Ovipositor index 0.45. Fore wing almost hyaline, not maculate . . . . . *Glyphomerus europaeus* (Erdös)
- Body bronze-green to black with bluish-green gloss; anellus transverse, flagellum stoat, F1 at least as broad as pedicel. Ovipositor indexes much more than 0.5. Fore wing usually maculate 5

5 F1 distinctly transverse 6
- F1 subquadrate to slightly elongate 7

6 F2-F7 subquadrate; clava as broad as funicle. Marginal and postmarginal veins subequal in length. Ovipositor index 1.85. Fore wing infumate with 2 connected maculae. [Stigmal vein about half as long as marginal vein] . . . . . *Glyphomerus isosomatis* Zerova & Seryogina
- F2-F7 distinctly transverse; clava broader than funicle. Marginal vein 1.3 times as long as postmarginal vein. Ovipositor index 4.07. Fore wing with one dark macula below stigma. [Stigmal vein about half as long as marginal vein] . . . . . *Glyphomerus parvulus* Zerova & Seryogina

7 Marginal vein 1.8 times as long as postmarginal vein and 3 times as long as stigmal vein. F2 slightly elongate. Fore wing not strongly infumate, with 2 maculae. Tibiae pale. [Ovipositor index 0.95 to 2.14] . . . . . *Glyphomerus tibialis* (Förster)

- Marginal vein 1.2 times as long as postmarginal vein and 2.4 times as long as stigmal vein. F2 quadrate. Fore wing infumate, with macula below the stigma and with dark stripes on cubital fold and above the middle part of posterior margin. Tibiae yellowish brown. [Ovipositor index 1.75 to 2.18] . . . . . *Glyphomerus aylax* sp. n.

ACKNOWLEDGEMENTS

I am very thankful to Dr M. Zerova (Ukrainian Institute of Zoology, Kiev) for her help with my study on the new species, to Dr G. Melika (Systematic Parasitoid Laboratory, Kõszeg, Hungary) for determination the Cynipid host of the new species and to Dr M. Draganov (University of Plovdiv, Bulgaria) for his encouragement during the preparation this manuscript.

REFERENCES

Bouček, Z. 1970. On some new or otherwise interesting Torymidae, Ormyridae, Eurytomidae and Pteromalidae (Hymenoptera), mainly from the Mediterranean subregion. *Bolletino del Laboratorio di Entomologia Agraria "Filippo Silvestri" di Portici* 27: 27-54.

Graham, M. & Gijswijt, M. 1998. Revision of the European species of *Torymus* Dalman (Hymenoptera: Torymidae). *Zoologische Verhandelingen* 317: 202 pp.

Grissell, E. 1995. Toryminae (Hymenoptera: Chalcidoidea: Torymidae): a redefinition, generic classification, and annotated world catalog of species. *Memoirs on Entomology, International* 57: 470 pp.

Zerova, M. & Seryogina, L. 1999a. Review of Palaearctic *Glyphomerus* (Hymenoptera, Torymidae) species and description of two new species. *Zoologicheskyi Zhurnal* 78: 960-964. (In Russian).

Zerova, M. & Seryogina, L. 1999b. Torymid chalcidoid wasps (Hymenoptera, Chalcidoidea, Torymidae) of tribes Podagrionini and Monodontomerini of the Ukrainian fauna. *Vestnik Zoologii, Supplement* 13: 130 pp. (In Russian).

Zerova, M. & Seryogina, L. 2000. New data on systematic and distribution of the *Glyphomerus* species (Hymenoptera, Torymidae). *Vestnik Zoologii* 34 (3): 95-98. (In Russian).

Revue suisse de Zoologie 112 (1): 183-188; mars 2005

New records of Psychodidae (Diptera) for Switzerland

Phil WITHERS
Montée du Cimetière, F-01600 Sainte Euphémie, France.

New records of Psychodidae (Diptera) for Switzerland. - New records are given for 35 species of moth flies. 11 of these are new to Switzerland. *Psychoda mycophila* Vaillant is synonymized with *Psychomora vanharai* Jezek (syn. nov.). The current Swiss list is considered to be well under half of the probable number of species present in the country.

Keywords: Diptera - Psychodidae - faunistics - new records - new synonymy - Switzerland.

INTRODUCTION

The psychodid fauna of Switzerland is extremely poorly known, and the current checklist (Wagner, 1998) together with its first supplement (Merz *et al.*, 2001) lists only 68 species. In all probability the number is nearer 200 (see also Wagner, 1998). This family of small nondescript flies has become better understood in Europe in the last 30 years thanks to a number of useful monographs, but Switzerland has had no resident specialist, and European workers such as Wagner and Vaillant have seemingly had access to only scanty material from the country.

The present author has had the opportunity to study material collected in Vezia and Rochefort, using principally luminous Malaise traps (see also Dufour, 1986), and from the Sihlwald near Zürich, using various eclectors (Schiegg, 2001). This latter material should have been reported in Schiegg *et al.* (1999), but the data were not requested from the author, who remained unaware of their (incomplete) publication until now. A detailed list, including several species new to Switzerland, is now provided. Almost all of the material cited has been deposited in the Muséeum d'histoire naturelle, Genève, to establish a basic slide collection with a view to improving the national coverage of this neglected family. A few specimens remain in the collection of the author. All specimens were determined by the author except where indicated.

The nomenclature follows that of the Catalogue of Palaearctic Diptera (Wagner, 1990) incorporating recent corrections as detailed by Chandler (1998). In the absence of a universally agreed classification, genera and species are arranged alphabetically within subfamilies and tribes.

Abbreviations for localities:

R Rochefort (Canton Neuchâtel) 780 m, château, 551.350/201.750
V Vezia (Canton Ticino) 410 m, San Martino
S Sihlwald (Canton Zurich) (see Schiegg *et al.*, 1999)

Manuscript accepted 12.05.2004

RESULTS

Psychodinae

Pericomini

Berdeniella magniseta (Sarà, 1953) **New to Switzerland**

The genus *Berdeniella* is specifically adapted to cold alpine streams and the Swiss fauna is likely to be considerably greater than currently recorded. Because of the specialised habitat and the strategy needed to collect specimens, this genus is under-recorded in many countries.

S: 1♂ 12-23.v.96; 1♂ 6-15.vi.96 (det. R. Wagner)

Boreoclytocerus dalii (Eaton, 1893) **New to Switzerland**

Closely related to *B. ocellaris*, and only distinguishable by details of the male terminalia. Records of this species are few for most of Europe and it is only known to occur with certainty in Great Britain, Slovenia and the Czech Republic.

S: 1♂, 23.iv-23.v.96

Boreoclytocerus ocellaris (Meigen, 1804)

[As indicated by Chandler (1998) successive authors have erroneously quoted Meigen, 1818 for the five species described in *Trichoptera* in 1804.]

S: 1♂, 25.iv-11.v.96; 5♂♂, 12-23.v.96; 2♂♂, 24.v-5.vi.96; 1♂, 19.vii-14.viii.96

Recorded as *Clytocerus ocellaris* by Wagner (1998), on the basis of literature records only. This is the first record based on an authenticated specimen, for a species which should be widespread in Switzerland, as it has high larval tolerance of insanitary conditions.

Pericoma (Pericoma) pseudoexquisita Tonnoir, 1940

A reasonably common species of *Pericoma* which, like the previous species, was included in the Swiss Checklist on the basis of literature records.

S: 15 ♂♂ 25.iv-23.v.96

Pericoma (Pneumia) nubila (Meigen, 1818)

S: 1♂ 12-23.v.96

Pericoma (Pneumia) palustris (Meigen, 1804) **New to Switzerland**

Despite being widely distributed throughout most of Europe, this species has surprisingly yet to be recorded from Switzerland.

S: 2♂♂ 12-23.v.96

Pericoma (Ulomyia) cognata Eaton, 1893

S: 3♂♂ 25.iv-23.v.96

Pericoma (Ulomyia) fuliginosa (Meigen, 1804)

S: 1♂ 6-19.vi.96

Psychodini

Psychoda albipennis Zetterstedt, 1850

S: 1♂, 1♀, 12-23.v.96; 3♂♂, 4♀♀, 24.v-19.vi.96; 2♂♂, 20.vi-18.vii.96; 1♀, 19.vii-14.viii.96

V: 1♂, 14-20.v.79
R: 2♀♀, 10-12.v.82; 1♀, 20-24.v.82; 2♂♂, 28.vi-3.vii.82; 1♂, 26-31.x.82

Psychoda brevicornis Tonnoir, 1940
S: 1♂ 25.iv-11.v.96

Psychoda buxtoni Withers, 1988 **New to Switzerland**
Since its description in 1988 based on material from Great Britain, this species has only since been recorded from the Czech Republic. The species is associated with higher fungi, original specimens having been reared from an unnamed *Boletus*.
S: 1♂ 1♀ 24.v-19.vi.96

Psychoda cinerea Banks, 1894
S: 1♂, 2♀♀, 25.iv-23.v.96; 1♂, 20.vi-18.vii.96

Psychoda crassipenis Tonnoir, 1940
S: 1♀, 25.iv-11.v.96; 2♀♀, 24.v-19.vi.96; 1♀, 20.vi-18.vii.96

Psychoda erminea Eaton, 1898
S: 1♀, 24.v-19.vi.96; 1♂, 5♀♀ 20.vi-18.vii.96; 8♀♀, 19.vii-14.viii.96
R: 1♀, 4-6.x.82

Psychoda gemina (Eaton, 1904)
S: 3♂♂, 12-23.v.96; 5♂♂, 1♀, 24.v-19.vi.96; 7♂♂, 20.vi-18.vii.96; 15♂♂, 19.vii-14.viii.96
R: 1♂, 28.vi-3.vii.82; 1♀, 19-22.viii.82
V: 1♂, 14-20.v.79

Psychoda grisescens Tonnoir, 1922
The first record for Switzerland based on studied specimens. Wagner (1998) cites literature records only.
S: 1♀, 25.iv-23.v.96; 1♂, 3♀♀, 24.v-19.vi.96; 2♀♀, 20.vi-18.vii.96
R: 1♂, 16-18.viii.82; 1♂, 26-31.x.82

Psychoda lobata Tonnoir, 1940
S: 2♂♂, 24.v-19.vi.96
R: 1♀, 6-8.ix.82; 1♀, 16-19.ix.82; 1♂, 23-26.ix.82; 1♂, 27-29.ix.82; 1♂, 12-20.x.82

Psychoda minuta Banks, 1894
S: 1♀, 25.iv-11.v.96; 3♀♀, 24.v-19.vi.96; 3♂♂, 14♀♀, 20.vi-18.vii.96; 51♂♂, 6♀♀, 19.vii-14.viii.96
V: 1♀, 16-22.vii.79

Psychoda mycophila Vaillant, 1988 **New to Switzerland**
Another species associated with fungi, usually in decomposition. Originally described from French material reared from *Hypholoma capnoides, Lactarius vellereus* and *Craterellus cornucopioides*. It is clear from comparison of the descriptions and figures that this is the same species as *Psychomora vanharai* Jezek, 1995, recorded from the Czech Republic. I therefore formally declare this synonymy (**syn. nov**.).
S: 1♂ 6-19.vi.96

Psychoda phalaenoides (Linnaeus, 1758)
S: 4♀♀, 25.iv-11.v.96; 2♂♂, 12-23.v.96; 2♂♂, 3♀♀, 24.v-19.vi.96
R: 1♀, 7-9.v.82; 1♂, 1♀, 26-31.x.82; 1♀, 3-8.xi.82

Psychoda setigera Tonnoir, 1922 **New to Switzerland**
S: 1♂ 19.vii-14.viii.96

Psychoda trinodulosa Tonnoir, 1922
S: 1♂, 12-23.v.96; 3♂♂, 1♀, 24.v-19.vi.96
R: 1♂ 4-11.vii.82

TELMATOSCOPINI

Clogmia albipunctata (Williston, 1893) **New to Switzerland**
This species has a circumtropical distribution, having been carried by man to many countries. It is a species where larvae develop in small "container habitats", often using surprisingly small temporary containers, and is tolerant of quite insanitary conditions. It is assumed to be present in most European countries, although there are many countries for which no formal record exists.
V: 1♂ 23-29.vii.79 (det. J. Jezek)

Feuerborniella obscura (Tonnoir, 1919)
S: 7♀♀, 25.iv-23.v.96; 12♂♂, 3♀♀, 24.v-19.vi.96; 2♂♂, 7♀♀, 20.vi-18.vii.96; 1♂, 1♀, 19.vii-14.viii.96

Mormia eatoni (Tonnoir, 1940)
S: 5♂♂, 24.v-19.vi.96; 4♂♂, 20.vi-18.vii.96, 1♂, 19.vii-14.viii.96
V: 1♂, 11-17.vi.79

Mormia nigripennis Krek, 1971
Jezek (1984a) has stated that this species is a synonym of *andrenipes* (Strobl). However, in a paper published the same year (Jezek, 1984b) which subdivides the genus Mormia into a number of smaller genera, this synonymy is not mentioned. It is furthermore apparent that the type of *nigripennis* has not been examined in establishing this supposed synonymy. The differences in morphology between the two species, as detailed by Vaillant (1971), are clear. Until this matter is resolved by evaluation of the type material, it seems prudent to consider *M. nigripennis* as a good species.
S: 1♂ 6-19.vi.96

Philosepedon humeralis (Meigen, 1818)
Species of the genus *Philosepedon* are often difficult to determine and it is known that other European species remain to be described. For this reason the Swiss Checklist has this species with "?" (Wagner, 1998). This is therefore the first definite determination of a species which should be common in localities with dead snails, on which the larvae feed.
S: 1♂ 25.iv-11.v.96; 1♂ 12-23.v.96; 1♂ 24.v-5.vi.96

Telmatoscopus vaillanti Withers, 1986 **New to Switzerland**
V: 1♂ 11-17.vi.79

Threticus balkaneoalpinus Krek, 1971 **New to Switzerland**
S: 1♂ 24.v-19.vi.96; 1♂ 19.vii-14.viii.96

Trichopsychoda hirtella (Tonnoir, 1919)
The first record for Switzerland based on studied specimens. Wagner (1998) cites literature records only.
V: 1♂, 18-24.vi.79; 2♂♂, 25.vi-1.vii.79; 1♂, 16-22.vii.79

SYCORACINAE
Sycorax feuerborni Jung, 1954
S: 1♂ 24.v-5.vi.96

Sycorax silacea Haliday in Curtis, 1839
S: 18♂♂ 24.v-19.vi.96

Sycorax similis (Müller, 1927)
S: 2♂♂, 25.iv-23.v.96; 7♂♂,12-23.v.96; 54♂♂ ,24.v-19.vi.96; 6♂♂, 20.vi-18.vii.96; 1♂, 19.vii-14.viii.96

Sycorax tonnoiri Jung, 1954 **New to Switzerland**
The small size of members of the genus *Sycorax* and their un-psychodid like appearance often leads to under-recording. There also seems to be an imbalance in sex ratios of trapped material, with many more females than males being captured. (The 75 females collected from Sihlwald cannot be attributed to species).
This species is thus far known from Slovenia, Czech Republic, Germany, former Yugoslavia and Denmark.
S: 2♂♂ 20.vi-18.vii.96

TRICHOMYIINAE
Trichomyia urbica Haliday in Curtis, 1839 **New to Switzerland**
Although widespread in Europe, this species is rarely encountered in any numbers. This is certainly because of its close association with tree rot-holes, a resource frequently overlooked by collectors, but with a very specialised fauna found in no other habitat. Further work with this type of habitat may reveal other species in Switzerland of this elusive genus.
S: 1♂ 20.vi-18.vii.96

DISCUSSION

The systems of trapping employed at Sihlwald were designed to give information principally about the xylophagous fauna (Schiegg, 2001). In the case of the psychodids, only one specimen of one species known to be an associate of tree rot-holes was captured (*Trichomyia urbica*). Four species of *Sycorax* are represented, which is exceptional for one locality. This is a genus often associated with fen vegetation in calcareous areas, in particular where tufa deposits occur around *Carex* tussocks. *Psychoda* is probably the most "terrestrial" of psychodid genera, with several species associated with higher fungi or herbivore dung. *Berdeniella* is the genus most typically found in fast-flowing alpine streams – its presence in the Sihlwald is unusual.

The use of luminous Malaise traps, as employed at Vezia and Rochefort has enabled a number of species to be recorded which are rarely taken by more classical methods. Further work of this kind could assist in assessing which species are more active at night, something which is currently only poorly understood.

ACKNOWLEDGEMENTS

I am grateful to Willy Geiger and Christophe Dufour of the Museum in Neuchâtel who passed the Vezia and Rochefort material to me for identification. Similar thanks are due to Karin Schiegg for kindly inviting me to participate in the insect survey at Sihlwald.

REFERENCES

CHANDLER, P. J. (ed.) 1998. Checklists of Insects of the British Isles (New Series). Part 1: Diptera. *Handbooks for the Identification of British Insects* 12: 1-234.

DUFOUR, Ch. 1986. Les Tipulidae de Suisse (Diptera, Nematocera). *Documenta Faunistica Helvetiae* 2: 1-187 & 149 plates.

JEZEK, J. 1984a. Taxonomic notes on Mormiini (Diptera, Psychodidae) from the High Tatra National Park. *Acta entomologica Bohemoslovaca* 81: 223-231.

JEZEK, J. 1984b. Nomenclatorial changes of some higher taxa of Palaearctic Psychodinae (Diptera, Psychodidae). *Acta fauna Entomologica Museum Naturae Pragae* 17: 155-170.

MERZ, B., BÄCHLI, G. & HAENNI, J.-P. 2001. Erster Nachtrag zur Checkliste der Diptera der Schweiz. *Mitteilungen der Entomologischen Gesellschaft Basel* 51 (3/4): 110-140.

SCHIEGG, K. 2001. Saproxylic insect diversity of beech: limbs are richer than trunks. *Forest Ecology and Management* 149: 295-304.

SCHIEGG, K., OBRIST, M., DUELLI, P., MERZ, B. & EWALD, K. C. 1999. Diptera and Coleoptera collected in the forest reserve Sihlwald ZH. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 72: 289-302.

VAILLANT, F. 1971-1983. 9d. Psychodidae. *In*: LINDNER, E. (ed.). Die Fliegen der Palaearktischen Region Vol. III (1). 358 pp. *Schweizerbarth, Stuttgart*.

WAGNER, R. 1990. Family Psychodidae (pp. 11-65). *In*: SOOS, A. & PAPP, L. (eds). Catalogue of Palaearctic Diptera. Vol. 2. 499 pp. *Akademiai Kiado, Budapest*.

WAGNER, R. 1998. 8. Psychodidae (pp. 84-86). *In*: MERZ, B., BÄCHLI, G., HAENNI, J.-P. & GONSETH, Y. (eds). Diptera – Checklist. *Fauna Helvetica* 1: 1-369.

REVUE SUISSE DE ZOOLOGIE 112 (1): 189-193; mars 2005

A new spider species from Bulgaria, *Brachythele langourovi* sp. n. (Araneae, Nemesiidae)

Stoyan LAZAROV
Institute of Zoology, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd, 1000-Sofia, Bulgaria. E-mail slazarov@zoology.bas.bg

A new spider species from Bulgaria, *Brachythele langourovi* sp. n. (Araneae, Nemesiidae). - The new species is described from male and female specimens (male and female illustrated) collected in Bulgaria (Central Stara Planina Mts, South Pirin Mts, Mt Maleshevska, Mt Osogovo, Mt Vitosha, East Rhodopi Mts and Strouma Valley). The male palps of this species are different from those of all previously known species of the genus.

Keywords: Description - new species - Enina Gorge - Kalimantsi - Osogovo - Vitosha.

INTRODUCTION

The genus *Brachythele* Ausserer, 1871 was previously known from Bulgaria by a single species: *Brachytele denieri* (Simon, 1916) (Drensky, 1937; Lazarov *et al.*, 2001). The species was described by Simon (1916) as *Nemesia denieri*, but Drensky (1937) was looking on its two tibial spurs and placed it to *Nemesiothele*, which is now considered as a junior synonym of *Brachythele* (Raven, 1985). Material of a new species has been collected by intensive research in recent years (2000-2003) in Southern Bulgaria and is here described after critical consideration of all available unpublished records.

MATERIAL AND METHODS

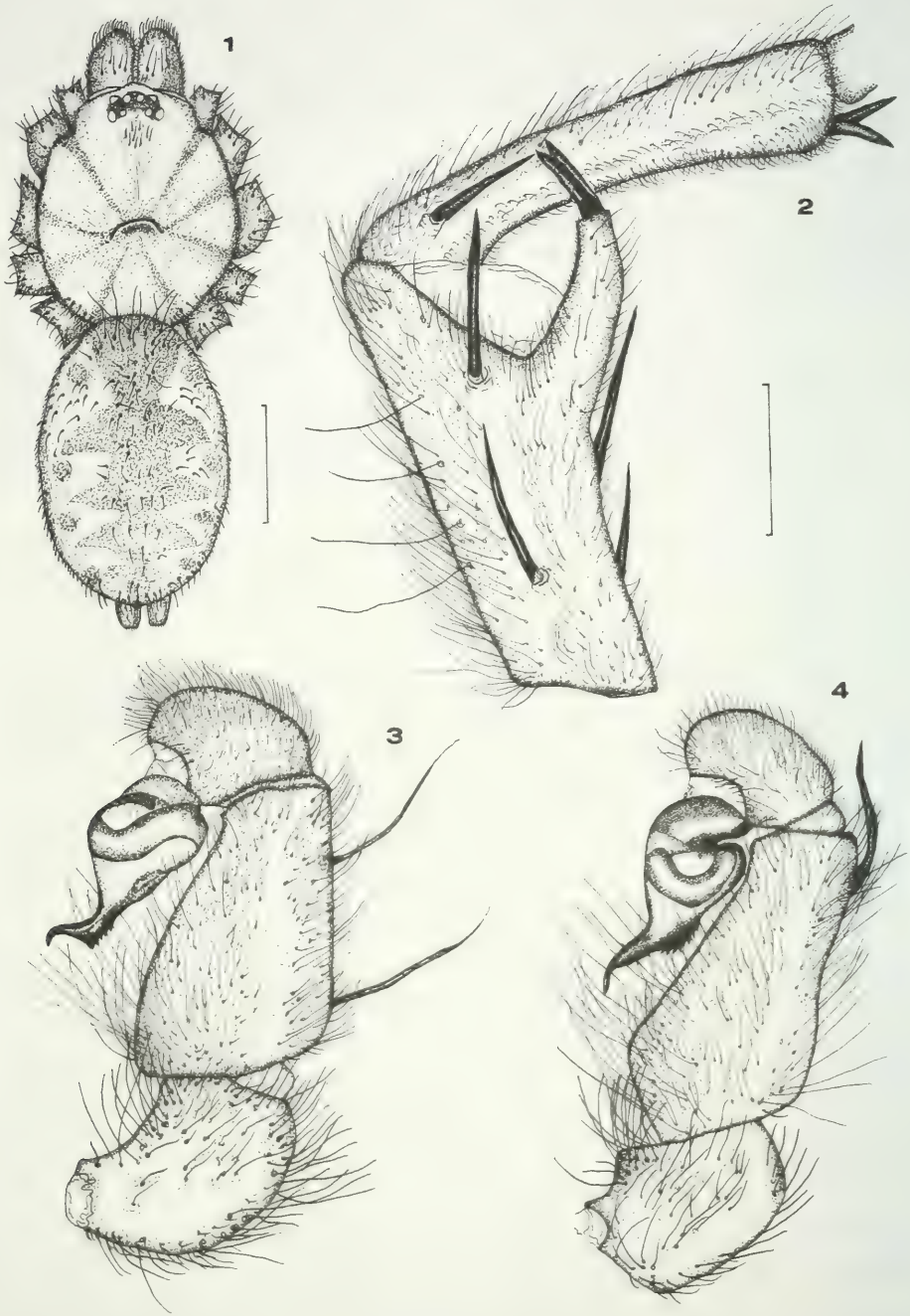
The spider material was collected by pitfall traps with 4% formalin, which were emptied once a month. Colour is described from formalin and alcohol preserved specimens. All measurements used in the description are given in mm. The measurements of the legs are taken from the dorsal side. Total length of the body includes chelicerae. Spermathecae were dissected off and mounted dorsal side on an excavated slide in 15% potassium hydroxide (KOH).

TAXONOMY

Brachythele langourovi sp. n. Figs 1-5

Material examined: Bulgaria: Central Stara Planina Mts, Enina Gorge, 600 m alt., 15 March – 10 April 2000, 1 male holotype, 6 male paratypes (leg. M. Langourov); 1 April – 1 May 2000, 5 male paratypes (leg. M. Langourov); South Pirin Mts, Sveti Iliya Hill near Kalimantsi

Manuscript accepted 27.04.2004



FIGS 1-4

1. *Brachythele langourovi* sp. n., cephalothorax and abdomen of male, dorsal view. Scale line 0.3 mm. 2. Tibia and metatarsus of leg I, prolateral view. 3. Palpal patella, tibia, cymbium and bulb, prolateral view. 4. Same, retrolateral view. Scale line 0.1 mm.

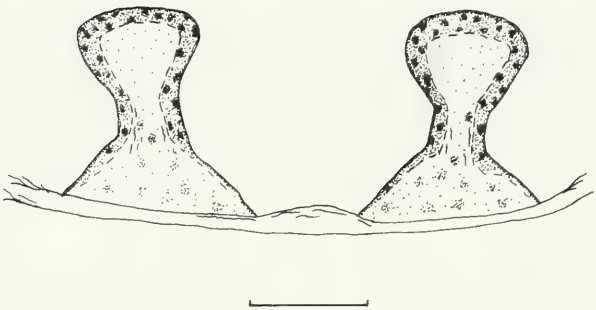


FIG. 5
Brachythele langourovi sp. n. Spermathecae, dorsal view. Scale line 0.6 mm.

Village, 450-510 m alt., maquis (*Quercus coccifera* association), 6 April – 10 May 2002, 19 male paratypes, 10 May – 1 June 2002, 12 male paratypes, 1-22 June 2002, 4 female paratypes, 28 September – 3 November 2002, 12 male paratypes, 3 November – 3 December 2002, 6 male paratypes (leg. M. Langourov & S. Lazarov); Strouma Valley, near Kamenitsa Village, maquis (*Quercus coccifera* association), 170-240 m alt., 5 April – 9 May 2002, 19 male and 1 female paratypes, 9-31 May 2002, 1 male paratype, 28 September – 2 November 2002, 3 male paratypes, 2 November – 3 December 2002, 1 male paratype, (leg. M. Langourov & S. Lazarov); Mt. Maleshevska, near Gorna Breznitsa Village, 790 m alt., ecotone between oak forest and meadow, 14 June – 9 July 2002, 2 female paratypes (leg. S. Lazarov); Mt. Maleshevska, Dobri Laki Village, 650 m alt., 25 September 2002, 1 male paratype (leg. T. Lyubomirov); Mt Osogovo, Bogoslov Village, May 1994, 2 male paratypes (leg. B. Georgiev & G. Tsonev); Mt Vitosha, Bosnek Village, 1200 m alt., 20 November 1994, 9 male paratypes (leg. G. Tsonev); East Rhodopi Mts, near Meden Buk Village, 7 October 1996, 4 male paratypes (leg. G. Tsonev); Strouma Valley, Kozhuh Hill, 20 April – 18 May 1996, 10 male paratypes (leg. B. Georgiev). Depository: The holotype, 12 male and 1 female paratypes are deposited in the Muséum d'histoire naturelle, Genève. The rest, 98 male and 6 female paratypes, are in the collection of the Institute of Zoology, Sofia.

Etymology: Named in honour of the colleague Dr Mario Langourov (Sofia), who collected the main part of the material.

Diagnosis: The male genitalia are different from those of all known species of the genus. The new species differs from the other species of the genus by the curved embolus, which is widened at the base and armed with a row of teeth (Figs 3-4). Females are very similar to those of other *Brachythele* species, but there are differences in detailes of the spermathecae (Fig 5).

Description: MALE. Total length 15.1; chelicera, length 1.8, width 1.2; cephalothorax, length 6.5, width 5.4; abdomen, length 6.9. Cephalothorax yellow-brown, fovea thoracica distinctly recurved (Fig. 1). Eye group well presented, wider than longer (Fig. 1). Eyes on black background. Anterior eyes very different in size, arranged in slightly procurved row. Diameter of median anterior eyes almost half of diameter of lateral anterior eyes. Posterior eyes similar to each other, arranged in a straight line, close to the line of anterior eyes. Chelicerae yellow-brown, armed with 10 teeth, frontal and dorsal surface covered by short and thatch setae (Fig. 1). Labium wider than long. Prolateral sides of maxillae with several claviform spicules. Sternum normal. Legs very massive. Femur I-IV dorsally with several thin and long spines. Tibiae and metatarsi III-IV more strongly sclerotized and rough (especially ventrally),

with many rows of spines. Tibiae I - II with 3 rows of spines. Tibia I with bent spur with 2 thick and hard spines (Fig. 2). Tibiae and metatarsi III-IV and palps with 4 rows of spines: Tibial rows with 3 spines and palpal rows with 2 spines. Some specimens with additional spines mainly at the base or at the end of the segment. Chetotaxy of the metatarsi of legs analogous. Tarsal claws with 2 rows of teeth. Bulbus pyriform, embolus long and curved, widened at the base, with one row of teeth (Figs 3-4), variable in different specimens. Opisthosoma pale yellow anteriorly with 4 or 5 brown triangular spots, these often united into a single band (Fig. 1).

	femur	patella	tibia	metatarsus	tarsus	total
leg I	4.74	2.62	3.40	3.27	2.39	16.42
leg II	4.51	2.55	2.85	3.27	2.32	15.50
leg III	3.91	1.89	2.81	3.50	2.02	14.13
leg IV	5.15	2.79	4.19	5.06	2.71	19.90
palp	2.58	1.10	1.89	-	1.20	6.77

FEMALE. Total length 22.3; chelicerae, length 2.8, width 2.0; cephalothorax, length 7.5, width 6.7; abdomen, length 12.0. Cephalic part of abdomen elevated. Chelicerae rougher than in the male. Legs I-II and palps with femora curved forward. Tibia I without modified spines. Ventral spines of legs not so rough as in the male. Spermathecae claviform, small but well expressed (Fig. 5).

	femur	patella	tibia	metatarsus	tarsus	total
leg I	5.26	3.12	3.81	2.98	2.28	17.45
leg II	4.70	3.07	3.21	2.93	1.72	15.63
leg III	4.18	2.19	2.58	2.47	2.09	13.51
leg IV	5.58	2.79	4.88	4.18	2.55	19.98
palp	3.91	2.28	2.51	-	2.14	10.84

Discussion: The genus *Brachythele* comprises 8 species (Platnick, 2004). Two species are distributed in Northern America and 6 are distributed in Europe, mainly on the Balkan Peninsula. *Brachythele speculatrix* Kulczyn'ski, 1897 was described from a juvenile specimens, *B. incerta* Ausserer, 1871 and *B. anomala* Schenkel, 1950 both from female specimens. The majority of species were described without any figures. The most important characters are the bulb and the mating spur with modified spines on tibia I. The male palp of *Brachythele langourovi* sp. n. is different from those of all known species of the genus. In the other species known from males the embolus is thin and spiniform. This is also the case in the type species, *Brachythele icterica* (C. L. Koch, 1838), described from the eastern part of the Balkan Peninsula. The male holotype of that species is lost (Raven, 1985).

Distribution and habitats: The new species has been found in Southern Bulgaria, inhabiting screes and dry stony areas covered with bushes (from 170-1200 m a.s.l.).

ACKNOWLEDGEMENTS

I thank Dr C. Deltshev (Sofia) and Dr K. Thaler (Innsbruck) for their comments on the illustrations and also Dr P. Schwendinger (Genève) for the improvement of the manuscript. I want to express my thanks to my colleagues Dr M. Langourov, Dr B. Georgiev, Dr T. Lyubomirov and G. Tsonev for the opportunity to examine this material. I also thank Dr S. Abadjiev for valuable advice.

REFERENCES

Drensky, P. 1937. Die Spinnenfauna Bulgariens. I. Unterordnung Mygalomorphae, Familie Ctenizidae und Atypidae. *Izvestiya na Tsarskite Prirodonauchni Instituti* 10: 259-280. (In Bulgarian, with German summary).

Platnick, N. 2004. The world spider catalog, version 4.5. *American Museum of Natural History*, online at http://research.amnh.org/entomology/spiders/catalog/index.html.

Raven, R. 1985. The spider infraorder Mygalomorphae (Araneae): cladistics and systematics. *Bulletin of the American Museum of Natural History* 182: 1-180.

Lazarov, S., Deltshev, C. & Blagoev, G. 2001. Spiders (Araneae) of Sushtinska Sredna Gora Mountain, Bulgaria. *Acta zoologica bulgarica* 53: 3-28.

Simon, E., 1916. Liste des Arachnides recueillis à Salonique pendant l'occupation française (1916) par le sergent Pierre Denier, membre de la Société. *Annales de la Société entomologique de France* 85: 273-276.

REVUE SUISSE DE ZOOLOGIE 112 (1): 195-213; mars 2005

Two new cave-dwelling *Larca* species from the South-East of Spain (Arachnida, Pseudoscorpiones, Larcidae)

Juan A. ZARAGOZA
Departamento de Ecología, Facultad de Ciencias, Universidad de Alicante,
E-03080 Alicante, Spain. E-mail: juanzeta@teleline.es

Two new cave-dwelling *Larca* species from the South-East of Spain (Arachnida, Pseudoscorpiones, Larcidae). - *Larca lucentina* sp. n. and *Larca fortunata* sp. n. are described from the south-eastern Spanish provinces of Alicante and Murcia. These cave-dwelling species are compared with the other species of the genus, particularly the European taxa. The hypothetical descent of cavernicolous European species from populations of a common ancestor similar to the epigean *Larca lata* (H. J. Hansen) is considered.

Keywords: Pseudoscorpiones - Larcidae - *Larca lucentina* sp. n. - *Larca fortunata* sp. n. - *Larca lata* (H. J. Hansen) - cavernicoles - Spain - Alicante - Murcia.

INTRODUCTION

The genera *Larca* Chamberlin and *Archeolarca* Hoff & Clawson were assigned by Harvey (1992) to the newly established family Larcidae, having previously been placed in the Garypidae. Harvey's decision was based on distinctive differences from the Garypidae, such as the anal plate surrounded by a desclerotised region and sternite XI bearing numerous and small lyrifissures. The genus *Larca* was erected by Chamberlin (1930) and only eight species have been described from Europe and North America (Harvey, 1991; Henderickx & Vets, 2002). Species of this genus are inconspicuous and their habits are little known, but they appear to be rare and vulnerable. The dependence of *Larca lata* (H. J. Hansen), the only widespread European species, on old tree hollows and the decline of suitable habitats due to management (Ranius, 2002) were the reasons to include this species in the Red List of endangered species for Sweden (Gärdenfors, 2000). Up to now, four species of the genus were known for Europe, three of which are cave-dwelling, while the fourth, *L. lata*, is epigean. Relationships among these species and the probable origin of taxon diversity is discussed herein.

Beier (1939) described two species from the Iberian peninsula: *Larca hispanica* and *Larca spelaea*, both known only from caves in Catalonia. Two *L. spelaea* specimens were later studied by Mahnert (1977a). Beier's (1939, 1963) criteria for separating these species were mainly based on the size and proportions of the palps, but Estany (1980) showed that there is an overlap when large numbers of specimens

Manuscript accepted 16.08.2004

are considered, and this led him to propose the synonymy of the two species under the name *L. hispanica*. This species has been considered a relict (Beier, 1969) due to its fragmentary distribution and its restriction to caves. Mahnert (1977b) did not mention it as cavernicolous and Zaragoza (1986) considered it to be troglophilic, whereas Bellés (1987, 1994) qualified it as troglobitic.

Specimens reported under *Larca* sp. by Zaragoza & Sendra (1988) and Zaragoza (1990) from Alicante Province in fact belong to a new taxon, herein described as *L. lucentina* sp. n. By mistake Ruiz-Portero *et al.* (2002) mentioned the synonymized *L. spelaea* from Cueva del Yeso, Sorbas, Almeria; its true identity remains uncertain. In recent years the author and some collaborators have been collecting *Larca* specimens (close to *L. hispanica*) from caves in the provinces of Murcia and Valencia; these will be analysed in a future article. The genus *Larca* is therefore widespread in the eastern and southeastern Mediterranean regions of Spain, from Barcelona to Almeria Provinces, where at least three different cave-dwelling species occur.

The two new taxa described in this article show the most highly evolved degree of cave-life adaptation for the genus and a hypothetical argument for their origin is offered.

MATERIAL AND METHODS

Specimens are preserved in 70% ethanol. Examination was carried out with specimens embedded in glycerol on temporary slide mounts. For better observation of the genital region, some specimens were cleared using 10% potassium hydroxide. Some appendages have been dissected for measurement; the measurements and the number of specimens examined are given in Tables 1 and 2. The average measurements (AM) and average ratios (AR) that appear in Tables 1 and 2 have been calculated by adding the holotype data to those of the specimens of the same sex. AR is calculated using the arithmetical mean of the ratios of the specimens of the same species and sex. Explanation about what measurements and what kind of ratios are used is given in Tables 1, 2 and 3. For the photographs, dried specimens were gold-coated and examined under a HITACHI -SN 3000 N- Scanning electron microscope.

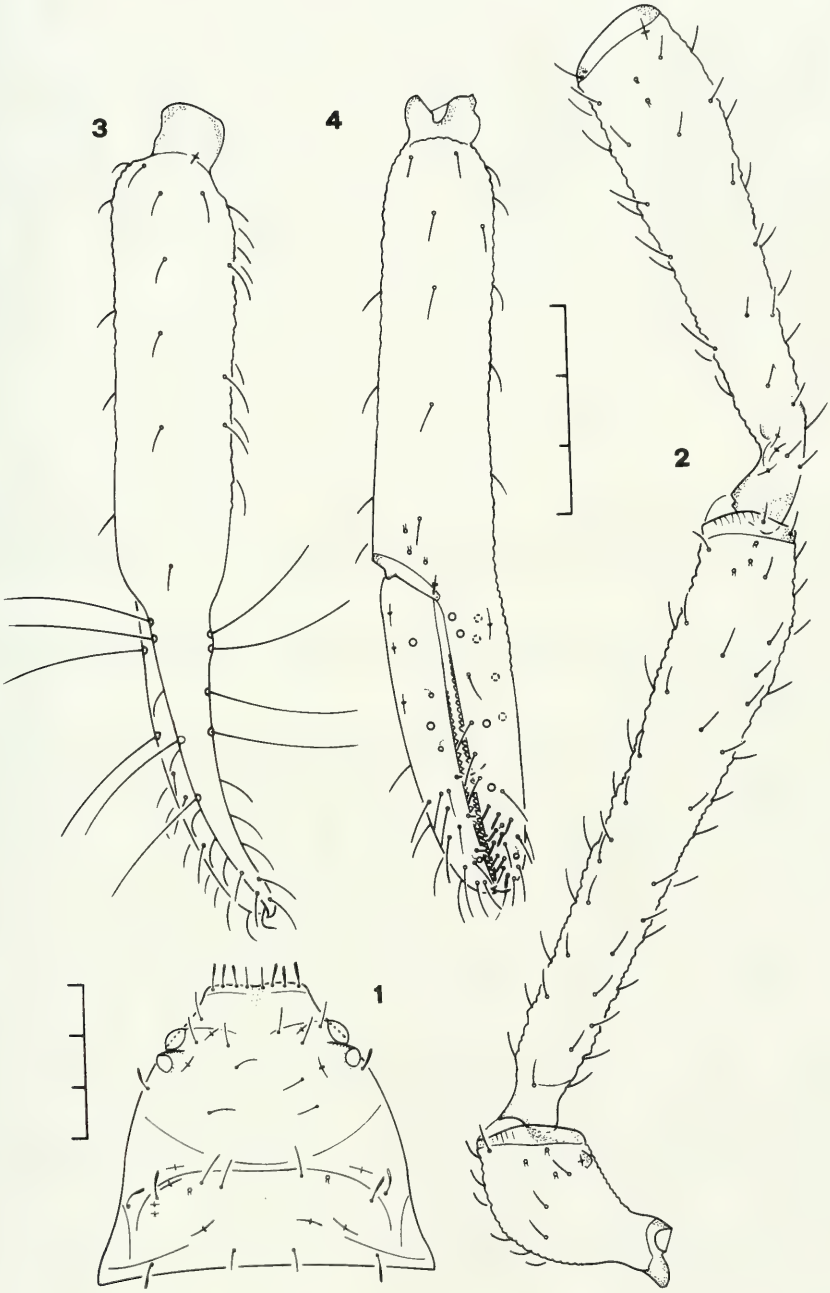
DESCRIPTIONS

Larca lucentina sp. n. Figs 1-6, 12, 13, 16, 18, 20-23

Type material: Male holotype and 24 paratypes (8 ♂♂, 9 ♀♀, 5 tritonymphs and 2 deutonymphs) from Spain, provincia de Alicante, Villena, Sima del Poste, 5 October 1986, leg. J. Pardo and J.A. Zaragoza. 1 ♂, 1 ♀ and 1 tritonymph deposited in Muséum d'Histoire naturelle de Genève; 1 ♂ and 1 ♀ deposited in Muséum National d'Histoire Naturelle, Paris; holotype and remaining paratypes in the pseudoscorpion collection of Departamento de Ecología de la Universidad de Alicante.

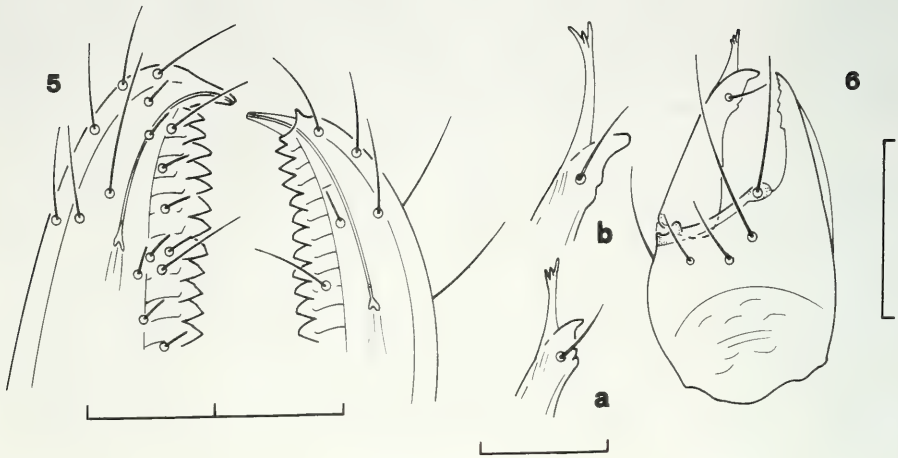
Description of adults

NOTE: Adult paratype data differing from holotype data are given in parentheses.



FIGS 1-4

Larca lucentina sp. n., male holotype. **1** Carapace; **2** Dorsal view of right palp, without chela; **3** Dorsal view of right chela; **4** Lateral view of right chela. Individual scale units = 0.1 mm.



FIGS 5-6

Larca lucentina sp. n., male holotype. **5** Apex of fingers of right chela, lateral view; **6** Left chelicera; **6a** Apex of movable finger with galea. *Larca lucentina* sp. n., female paratype. **6b** Apex of movable finger with galea. Individual scale units = 0.1 mm (Figs 5, 6), 0.05 mm (Figs 6a, b).

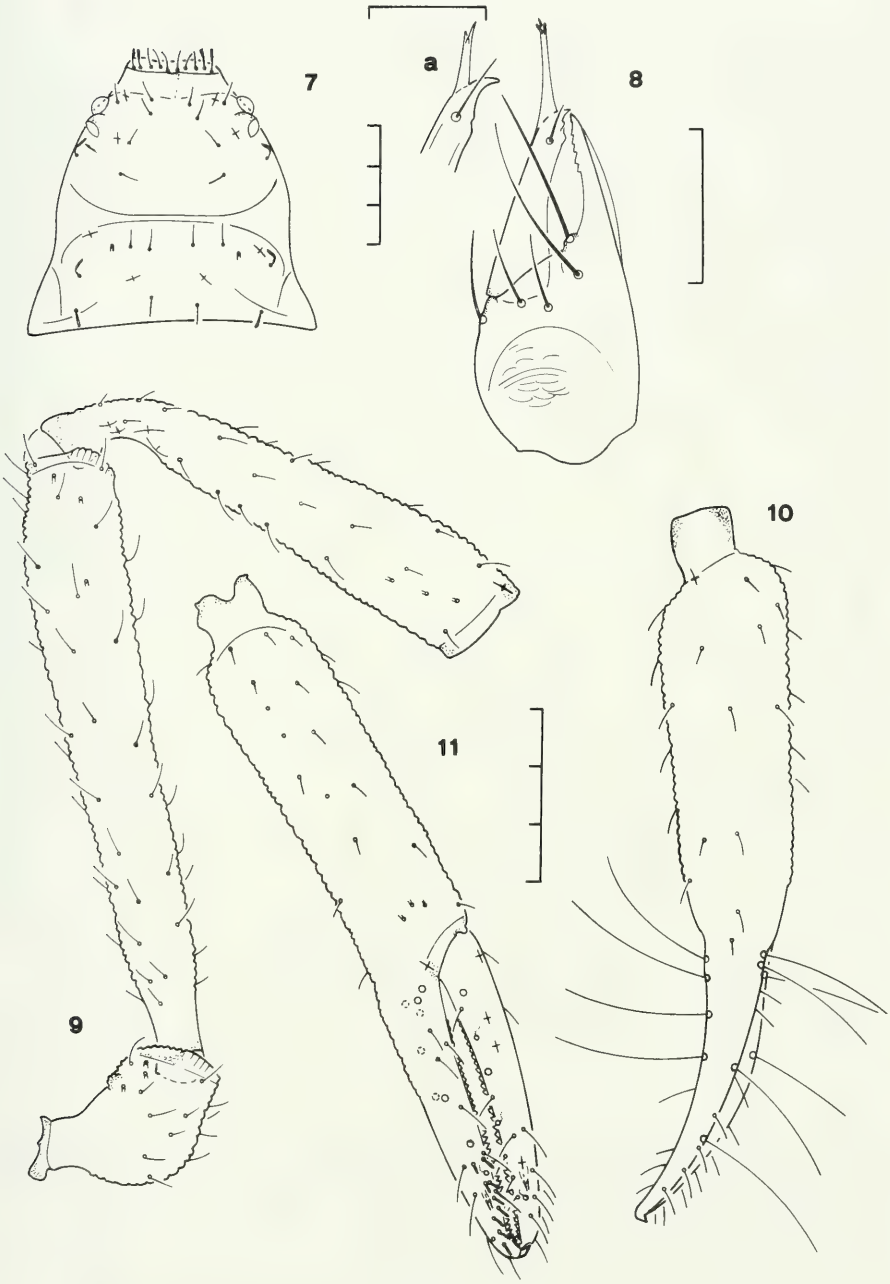
Opisthosomal pleura and legs yellowish, tergites slightly sclerotized. Carapace and pedipalps brownish. Opisthosoma oval, maximum breadth at tergite VI (females clearly broader than males).

Carapace (Fig. 1) granulated, without epistome, broader than long. Two pairs of eyes, anterior eyes situated 0.08 mm (0.10-0.11) from anterior margin, with lens 0.05 mm (0.06-0.07) long and 0.03 mm. (0.02-0.04) broad; posterior eyes raised on a low tubercle with flattened 0.03 mm (0.03-0.04) long lens. Chaetotaxy: 31 (27-36), with 8 (8-10) setae at anterior margin, 12 (10-14) in anterior region delimited by well-marked median furrow, 7 (6-10) in posterior region between median and posterior furrows, and 4 (1-4) at posterior margin. Anterior and lateral setae curved and apically enlarged, others simple. Some lyrifissures and glandular pores present, as shown in figure 1.

Tergal chaetotaxy I-X: 6 : 9 : 7 : 10 : 9 : 9 : 10 : 10 : 9 : T7T (4-6 : 6-7 : 6-10 : 8/10 : 8-10 : 8-11 : 10 : 8-11 : 9-11 : T6-7T), all tergites divided with exception of tergites I and X, these undivided, tergite IX only divided in distal 1/3. All tergites with granulation, tergites VIII-X showing denticulation. Some lyrifissures present, aligned between setae. Microlyrifissures (gland pores, according to Judson & Legg, 1996) horseshoe-shapes ("ferro di cavallo", Gardini, 1983), present on distolateral corners of tergites I-X: 2-3 : 2-3 : 2-3 : 3-4 : 4-5 : 5-6 : 4-4 : 4-5 : 4-5 : 3-3 (0-2 : 1-2 : 2-3 : 3-4 : 3-7 : 4-5 : 4-5 : 2-6 : 2-5 : 3-3).

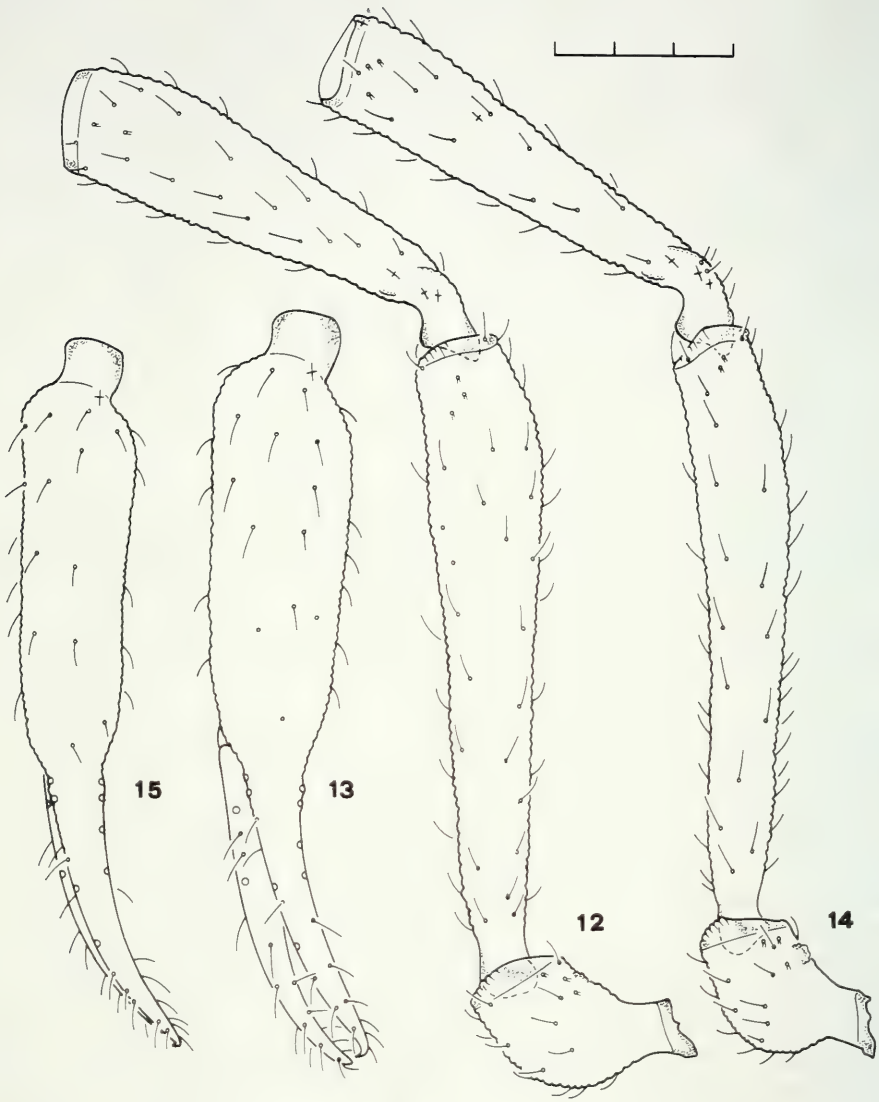
Manducatory process with 3 setae (3-4); palp coxa with 11-12 setae (7-14), pedal coxae with 7-8 setae on coxa I (5-10), II: 8-10 (6-12), III: 9 (7-12), IV: 14-15 (12-19).

Male genital opercula as shown in Fig. 18, with 22 (15-17 in male paratypes) setae on anterior sternite and 28 (23-26) on posterior sternite, median setae in two rows; genital opening with 2+2 (2+3) internal setae. Female genital opercula as shown



FIGS 7-11

Larca fortunata sp. n., female holotype. **7** Carapace; **8** Left chelicera; **9** Dorsal view of the left palp, minus chela; **10** Dorsal view of left chela; **11** Lateral view of left chela. *Larca fortunata* sp. n., male paratype. **8a** Apex of movable finger with galea. Individual scale units = 0.1 mm (Figs 7, 8, 9, 10, 11), 0.05 mm (Fig. 8a).

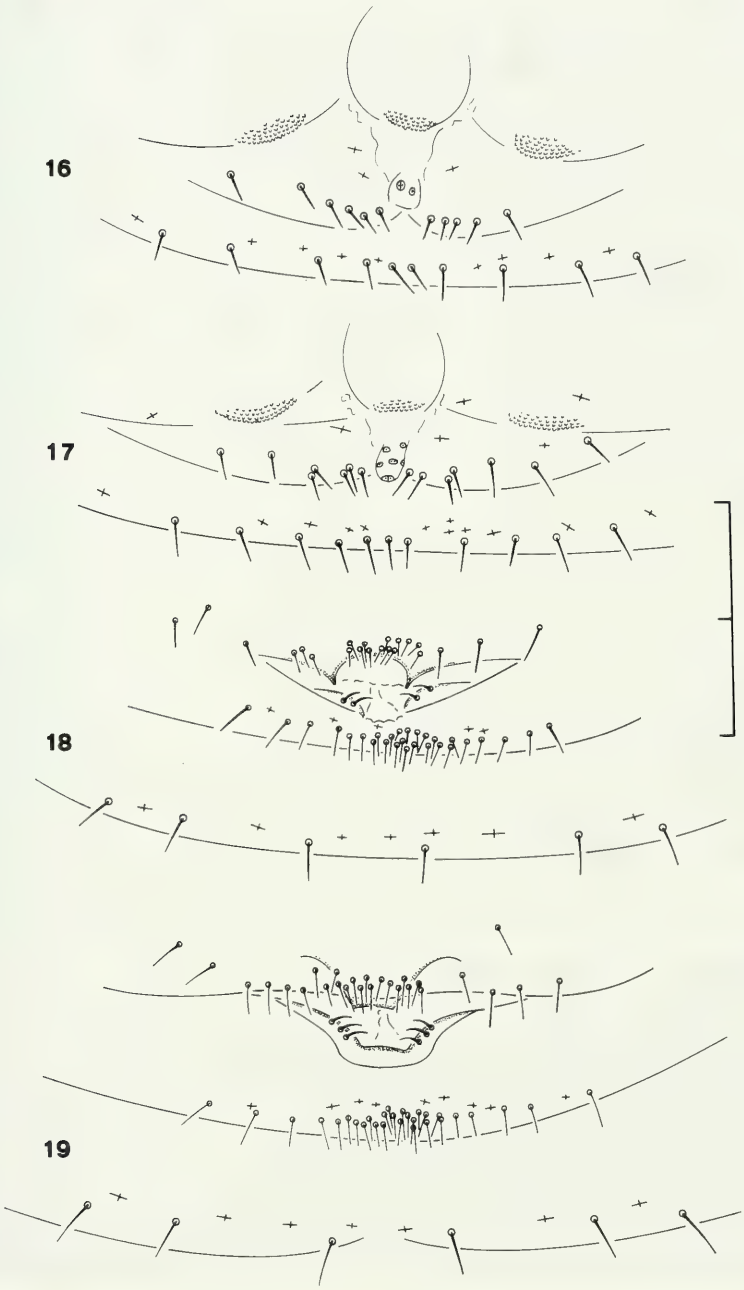


FIGS 12-15

Larca lucentina sp. n., female paratype. **12** Dorsal view of right palp, without chela; **13** Dorsal view of right chela. *Larca fortunata* sp. n., male paratype. **14** Dorsal view of right palp, without chela; **15** Dorsal view of right chela. Individual scale units = 0.1 mm.

in Fig. 16, with 11-15 setae on anterior sternite (some external setae and two median groups of 4-5 setae), posterior sternite with 10/15 setae; three slightly sclerotized cribriform plates in a transverse row, median plate smaller than the laterals.

Sternite IV partially divided, V-VIII divided, IX-X undivided. Chaetotaxy IV-X: 6 : 10 : 9 : 9 : 8 : 8 : 7 (5-7 : 8-11 : 8-12 : 7-10 : 8-11 : 8-10 : 8-9). Sternite XI with



FIGS 16-19

Larca lucentina sp. n. Genital opercula: **16** female paratype; **18** male holotype. *Larca fortunata* sp. n. Genital opercula: **17** female paratype; **19** male paratype. Individual scale units = 0.1 mm.

desclerotised region surrounding anus (Gardini, 1983; Harvey, 1992) and bearing 8 external and 8 internal setae (7-10 + 5-8). Anal plate with 2+2 setae. Some microlyrifissures (as defined for tergites) present on sternites V-XI: 0-1 : 3-4 : 3-3 : 3-3 : 3-4 : 3-3 : 17 (1-1 : 2-5 : 3-4 : 3-4 : 2-3 : 2-4 : 15-20). No setae associated with spiracles.

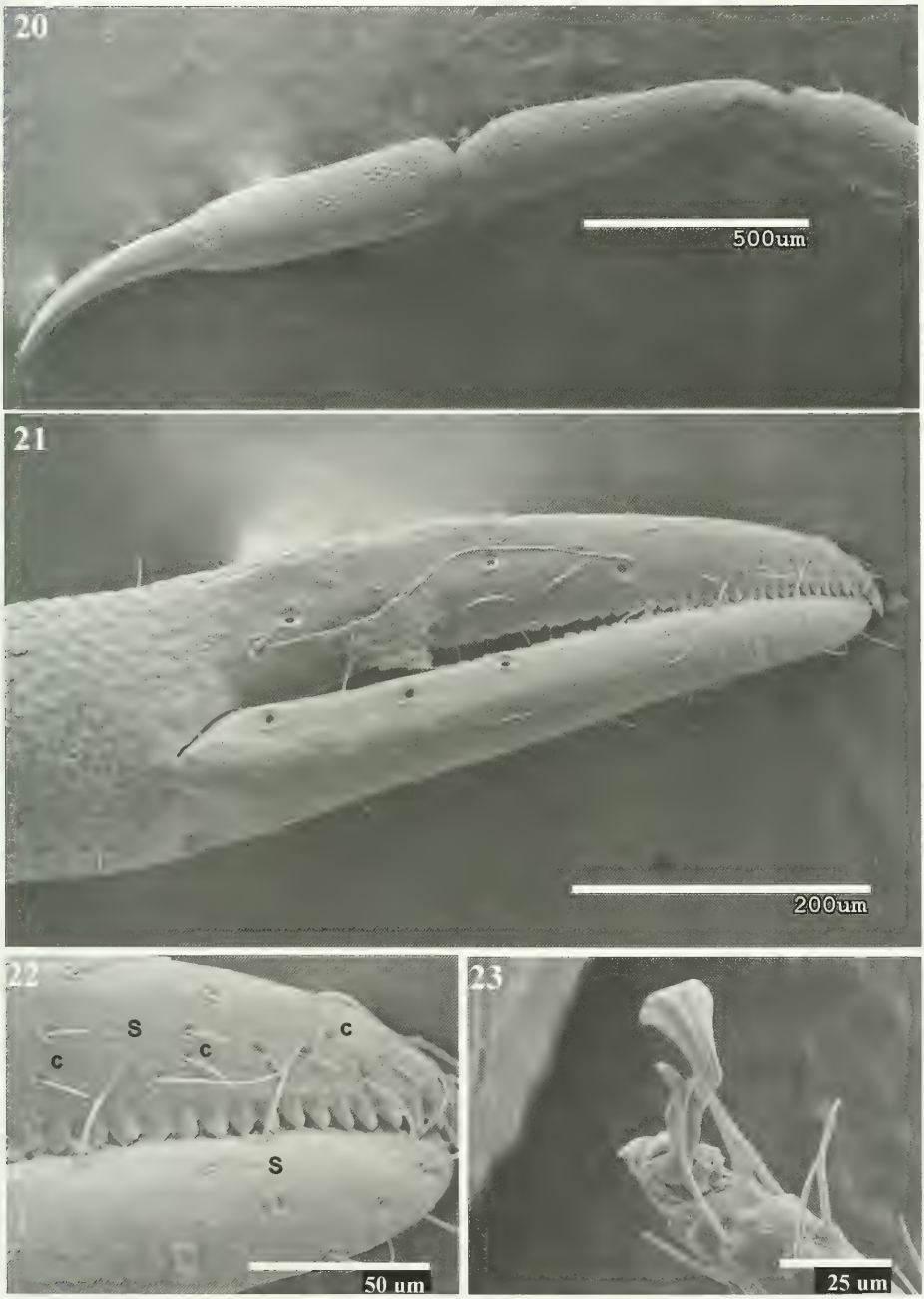
Chelicera (Fig. 6) with 5 setae on hand and 1 seta on movable finger, the latter 0.84 (0.83-0.86) from base. Galea long (Fig. 6a), with 3 (3-4) apical rami, in females longer (0.06-0.08 mm) (Fig. 6b) than in males (0.04 mm). Fixed finger with 2 (1-3) tiny subterminal denticles and 3 (2-4) small teeth; movable finger with 2 rounded subterminal denticles up to the level of seta *gs*. Lamina exterior thin. Flagellum with 4 (3-4) blades, anterior blade with 8 (5-9) spinules, others smooth. Serrula exterior with 16 (15-16) blades. Serrula interior with 10 (10-11) blades, the 3 anterior ones slightly denticulate.

Palp (Figs 2, 3, 4) strongly granulated, except for smooth distal 2/3 of fingers palps. With marked sexual dimorphism, less slender in females (Figs 12, 13). Measurements and ratios in Table 1. Trochanter internally with a small subdistal tubercle and 3 (2-3) micropores. Femur with 3 (2-3) distal micropores. Patella with 3 lyrifissures near pedicel close to a small internal tubercle and 2 distal micropores. Hand laterally with 3 micropores at base of finger. Fixed finger with 8 trichobothria, *est* slightly distal to *it*, distance *isb/ist* 1.13 (1.04-1.28; AR: 1.15) times longer than distance between *ist/it* [according to Harvey (1990) trichobothrium *isb* has altered its position in Larcidae, moving to an "abnormal" position between *ist* and *it*; however, here I prefer to use Chamberlin's (1924) traditional terminology, based on trichobothrial positions along the finger, leaving aside the question of post-embryonic changes]; *est* slightly distal *t*; 1 sensilla present in subapical position (Fig. 22); 9 (7-9) chemosensory setae present between trichobothrium *et* and tip finger (drawn and mentioned by Judson & Legg, 1996) (Figs 5, 22); dental line with 40 (35-43) teeth reaching just beyond *esb* or between *esb-eb*, distal half with pointed teeth, the rest progressively flattening towards base finger. Movable finger usually with 2 trichobothria (*b* and *t*), but one male with 2 trichobothria on one finger and 3 on the other (*st* added), another male and one female with 3 trichobothria on both fingers (Fig. 21); with 3 sensilla, 1 between trichobothria *b* and *t* (or close to *st*, when third trichobothrium present), 1 distal to *t* and 1 subapical (Fig. 22); with 34 (33/42) teeth reaching proximal trichobothrium *t*, distal half with pointed teeth, basalmost teeth very flattened. Nodus ramosus (Fig. 5) of fixed finger reaching 9th (9/11th) tooth from tip, longer in movable finger, reaching to 11th (11/12th) tooth.

Legs I and IV (length/breadth ratios and measurements in table 1) with arolia undivided and nearly twice as long as claws (Fig. 23). Claws and subterminal seta of telotarsus smooth.

Brief description of nymphs

Deutonymphs with 5 setae on each cheliceral palm. 6 setae on anterior margin of carapace and 2-4 on posterior border. Body length 1.68-1.76 mm. Measurements length/breadth in mm (ratios length/breadth in brackets): carapace 0.44-0.46/0.51-0.55 (0.83-0.85); palp: femur 0.58-0.63/0.13, (4.30-4.96), patella 0.48-0.51/0.14 (3.31-



FIGS 20-23

Larca lucentina sp. n., male paratype, SEM photographs. **20** Dorsal view of hand, patella and femur (partially) of palp. **21** Fingers of chela, lateral view, showing anomalous number of three trichobothria on movable finger. **22** Apex of fingers of chela, lateral view (S = sensilla; c = chemosensory setae, only three of them marked). **23** Apex of leg IV with arolia.

3.52), hand (with pedicel) 0.45-0.50/0.17 (2.59-2.91), finger 0.36-0.37, chela (with pedicel) 0.80-0.84/0.17 (4.60-4.88). Tritonymphs: 5 setae on each cheliceral palm. 7-8 setae on anterior margin of carapace and 2-4 setae on posterior margin. Body length 1.80-2.15 mm. Measurements length/breadth in mm (ratios length/breadth in brackets): carapace 0.48-0.55/0.62-0.65 (0.77-0.88); palp: femur 0.73-0.84/0.15-0.16 (4.97-5.35), patella 0.62-0.69/0.16-0.17 (4.00-4.24), hand (with pedicel): 0.56-0.61/0.17-0.18 (3.04-3.41), finger 0.42-0.46, chela (with pedicel) 0.97-1.02/0.17-0.18 (5.27-5.74).

Tritonymph and deutonymph without epistome (in contrast to *L. lata*, in which the protonymph and deutonymph, but not the later stages, have an epistome: Dumitresco & Orghidan, 1964; Judson & Legg, 1996).

Deutonymphs, with basi- and telotarsus of legs I and II fused, but still showing constriction at joint position (vestige of division, as found in *L. lata* protonymph: Judson & Legg, 1996); posterior legs with weak division between tarsi. Tritonymphs with tarsi partially fused on anterior legs and completely divided on posterior legs.

Etymology

Lucentina is a female inhabitant of *Lucentum*, the Roman name for the provincial capital Alicante.

Remarks

According to Gardini's (1983) key for the genus *Larca*, *L. lucentina* sp. n. can be placed in the group of species with 4 setae on the posterior margin of the carapace. This group includes *L. lata* and *L. hispanica* to which *Larca bosselaersi* Henderickx & Vets, 2002 (from Crete) was later added. It can be seen from the above description that some specimens of the new species have fewer setae on the posterior margin of the carapace: 2 specimens have 2 setae and one specimen has only 1 seta. I have also checked a collection of 48 specimens [15 ♂♂, 16 ♀♀, 16 tritonymphs (T) and 1 deutonymph (D)] from Cova de l'Escaleta, Camarasa, Lérida, Catalonia, Spain, determined by Estany (1980) as *L. hispanica*, of which 14 ♂♂, 11 ♀♀, 10 TT and 1 D possess 4 setae on the posterior margin of carapace, 1 ♂, 3 ♀♀ and 4 TT have 3 setae, and 2 ♀♀ and 2 TT only 2 setae. However, this variation does not change the fact that the four species may be distinguished from other *Larca* species in having a maximum of 4 setae on the posterior margin of carapace, whereas the others have 6 or 8 setae. *Larca italica* Gardini, 1983, the only European species with 7 setae on the posterior margin of the carapace, possesses increased numbers of setae on the rest of the carapace and on the tergites. Based on the arguments that are presented below, it seems plausible that *L. italica* may represent another case of "néochétotaxie majorante" in the sense of Heurtault (1980), Mahnert & Schuster (1981) and Zaragoza (1982), but this needs to be confirmed by the capture and study of nymphal stages.

The second character used by Gardini (1983) for distinguishing species is the number of setae on the cheliceral hand, there are 6 in *L. hispanica*, 5 in *L. lata* and only 4 in *L. bosselaersi* (Henderickx & Vets, 2002). Estany (1980) established that *L. hispanica* possesses 6 setae on the cheliceral hand after having studied a large collection from Cova de l'Escaleta, Camarasa. However, a re-examination of specimens from this cave reveals that 10 ♂♂, 6 ♀♀, 15 TT and 1 D have 5 setae on each chelicera; 4 ♂♂,

9 ♀♀ and 1 T have 5 setae on one chelicera and 6 setae on the other; and only 1 ♂ and 1 ♀ have 6 setae on both chelicerae. M. Judson (in litt.) has observed that one paratype of *L. bosselaersi* (deposited in Muséum National d'Histoire Naturelle, Paris) has 5 setae on one chelicera and 4 on the other. It is evident that the variability seen in the number of cheliceral setae renders this character unreliable for distinguishing species within *Larca*. Moreover, Judson & Legg (1996) noted considerable overlap between the size and proportions of the palps of *L. lata* and *L. hispanica*. It will therefore be necessary to compare other characters in more detail to determinate the validity of these taxa. In a separate article I will present a study of *L.* aff. *hispanica* specimens from new localities in Spain, which will hopefully provide some clarification of this matter.

L. lucentina sp. n. may be easily distinguished from the other *Larca* species by its larger size and more slender articles of the palp. In general, the same applies to the size and proportions of the legs (at least when these are known for other species), with the exception of *Larca fortunata* sp. n., described below. One of the most distinctive characters of *L. lucentina* sp. n. is the ratio between the hand and patella breadth, which in males is only 1.02 (AR) (Figs 2, 3, 20) (some specimens with both articles of the same breadth) and in females 1.13 (AR) (Figs 12, 13). In most other species this ratio is clearly larger, particularly in males. The only species that is similar in this respect is the cave-dwelling *Larca laceyi* Muchmore, 1981, from California, but the dorsal and lateral shape of the palp hand is quite different. As in other species of the genus, *L. lucentina* sp. n. presents marked sexual dimorphism in palp ratios and in the shape of the hand, which must be taken into account when identifying single specimens.

Larca fortunata sp. n. Figs 7-11, 14, 15, 17, 19

Type material: Female holotype and 6 paratypes (2 ♂♂ and 4 ♀♀) from Spain, Murcia Province, Fortuna, Cueva del Solin, collected during the period from 20 September 1984 to 12 January 1985, by Díaz, Lencina & Ortiz. 9 paratypes (5 ♂♂, 3 ♀♀ and 1 tritonymph) collected on 17 June 2003 by J. L. Lencina & V. M. Ortuño. 1 ♂ and 1 ♀ deposited in Muséum d'histoire naturelle de Genève; 1 ♂ and 1 ♀ deposited in Muséum National d'Histoire Naturelle, Paris; holotype and remaining paratypes deposited in the pseudoscorpion collection of Departamento de Ecología de la Universidad de Alicante.

Description of adults

NOTE: Adult paratype data differing from holotype data are given in parentheses.

Opisthosomal pleura and legs yellowish, tergites slightly sclerotized. Carapace and pedipalps brownish. Opisthosoma oval, maximum breadth at tergite VI (some female paratypes have an ovoid shape while others have a more "masculine" appearance, being only moderately ovale).

Carapace (Fig. 7) granulated, without epistome, broader than long. Two pairs of eyes, anterior eyes 0.11 mm (0.08-0.12) from anterior margin, with lens 0.06 mm (0.05-0.07) long and 0.02 mm (0.01-0.03) broad; posterior eyes raised on low tubercle with flattened 0.05 mm (0.04-0.06) long lens. Chaetotaxy: 32 (29-36), 10 (7-9) setae in anterior margin, 12 (12-17) in anterior region, 6 (6-9) in posterior region and 4 (2-4, only one male specimen with 5) on posterior margin. Anterior and lateral setae curved and apically enlarged, the rest simple. Some lyrifissures and glandular pores present as shown in Fig. 7.

Tergal chaetotaxy I-X: 4 : 5 : 7 : 10 : 10 : 10 : 10 : 9 : 10 : T6T (4-5 : 4-7 : 5-8 : 8-10 : 8-10 : 7- 12 : 8-10 : 8-12 : 8-11 : T7-9T), all tergites divided except for tergites I and X undivided, and tergite IX partially divided. Tergites granulated, VIII-X with denticulation. Some lyrifissures aligned with setae. Gland pores of tergites I-X: 0-0 : 2-2 : 2-3 : 4-4 : 4-4 : 4-4 : 4-5 : 3-4 : 4-4 : 3-3 (1-2 : 1-2 : 2-3 : 2-4 : 2-5 : 4-5 : 3-5 : 3-5 : 4-4 : 3-4).

Manducatory process with 3 setae (some specimens with 2 setae on each process, others with 3 on each process); palp coxa with 9-11 setae (9-14), pedal coxae with 6-7 setae on coxa I (6-10), II: 9-10 (6-11), III: 8-10 (6-11), IV: 13-14 (13-19).

Genital opercula of female as shown in Fig. 17, with 14 (10-15) setae on anterior operculum, including two median groups of 4-5 setae, posterior operculum with 11 (10-13) setae; three weakly sclerotized cribriform plates in a transverse row, median plate smaller than lateral ones. Male genital opercula as shown in Fig. 19, with 18-27 setae on anterior and 23-30 on posterior operculum, median setae disposed in two rows; genital opening internally with 1-3+2-3 setae.

Sternite IV partially divided, V-VIII completely divided, IX-X undivided. Chaetotaxy: IV-X: 6 : 7 : 8 : 10 : 10 : 8 : 9 (4-7 : 7-9 : 6-10 : 7-10 : 7-10 : 7-10 : 6-9). Sternite XI bearing 10 (9-13) external and 7 (6-8) internal setae in the desclerotized region surrounding anus. Anal plates with 2+2 setae. Gland pores on sternites V-XI: 2-2 : 3-3 : 3-4 : 3-4 : 3-3 : 2-3 : 21 (1/2 : 2-4 : 3-4 : 3-4 : 3-4 : 2-3 : 16-22). No setae associated with spiracles.

Chelicera (Fig. 8) with 5 setae on the hand and 1 seta on movable finger, the latter 0.83 (0.82-0.87) from base. Galea long, with 4 (3-4) apical rami of unequal length, longer (0.08 mm) in females than in males (0.05 mm) (Fig. 8a). Fixed finger with 2 (2-3) tiny subterminal denticles and 4 (2-5) small teeth; movable finger with 2 rounded subterminal denticles at the level of seta *gs*. Lamina exterior thin. Flagellum with 4 blades, anterior blade with 8 (5-9) spinules, others smooth. Serrula exterior with 15 (15-16) blades. Serrula interior with 10 (9-10) blades, the 3 anterior ones slightly denticulate.

Palp (Figs 9, 10, 11) strongly granulated, except for smooth distal 2/3 of fingers palps. With marked sexual dimorphism, more slender in males (Figs. 14, 15). Ratios and measurements as in Table 2. Trochanter internally with a small subdistal tubercle and 3 micropores. Femur with 3 (2-3) distal micropores. Patella with 3 lyrifissures near pedicel close to a small internal tubercle and 3 (1-4) distal micropores. Hand laterally with 3 micropores at base of finger. Fixed finger with 8 trichobothria, but some adult specimens (5) lacking *ib*, *isb* or *ist*; *est* only slightly distal to *it* (or at the same level or slightly basal), distance *isb*/*ist* 0.91 (0.71-1.04, bigger than 1.00 only found in one specimen; AR: 0.90) times shorter than distance between *ist*/*it*; *est* slightly distal to *t*; one sensilla present in subapical position; 9 (7-9) chemosensory setae present between trichobothrium *et* and tip of finger; dental margin with 37 (36-41) teeth reaching almost to *esb*, teeth pointed along distal third (or half) of finger, the rest rounded and becoming flattened basally to the point of being almost unrecognizable in some specimens. Movable finger with 2 trichobothria, but one male with 3 trichobothria on both fingers; with 3 sensilla, 1 between trichobothria *b* and *t*, 1 distal to *t* and 1 subapical; 36 (35-40) teeth up to trichobothrium *t*, those of distal third (or half) pointed, other teeth

rounded, progressively flattened basally. Nodus ramosus of fixed finger level with 10th (10-12th) distal tooth, that of movable finger longer, reaching 11th (11-14th) distal tooth.

Legs I and IV (length/breadth ratios and measurements in Table 2) with arolia nearly twice as long as claws. Claws and subterminal seta smooth.

Brief description of nymphs

Single tritonymph with 5 setae on each cheliceral palm. 8 setae on anterior margin of carapace and 4 on posterior margin. Body length 2.04 mm. Measurements length/breadth in mm (ratios lenght/breadth in brackets): carapace 0.54/0.62 (0.87); palp: femur 0.76/0.14 (5.43), patella 0.67/0.15 (4.35), hand (with pedicel) 0.57/0.17 (3.29), finger 0.44, chela (with pedicel) 0.99/0.17 (5.66). No epistome on carapace. Tarsi partially fused on the anterior legs and completely divided on posterior legs.

Etymology

The name refers to the town where the species has been collected: Fortuna (fortune).

Remarks

L. fortunata sp. n. is very close to *L. lucentina* sp. n., but differs in the more slender femur and patella of the palp. The length/breadth ratios of these segments do not overlap in males of the two species, whereas this character is less distinctive in females, but in general the palps and legs are more slender in *L. fortunata* sp. n. than in *L. lucentina* sp. n. In *L. fortunata* sp. n. the patella is longer, relative to the other segments, than in *L. lucentina* sp. n., as reflected in the femur/patella and patella/hand ratios. The form of the patella is also different in these species: in *L. lucentina* sp. n. it is markedly convex subapically on the external side, whereas in *L. fortunata* sp. n. it is quite straight. The same is true to a certain extent for the palp femur. Another distinctive character is provided by the chelal hand/patellar breadth ratio: 1.14 in males of *L. fortunata* sp. n. (vs. 1.02 in *L. lucentina* sp. n.) and 1.18 in females (vs. 1.13). Finally, trichobothrium *ist* is closer to *isb* than to *it* in *L. fortunata* sp. n., which is not the case in *L. lucentina* sp. n. where *ist* is closer to *it* than to *isb*.

DISCUSSION

A useful summary of the natural history and habitats of *Larca* species, particularly *L. lata*, is provided by Judson & Legg (1996). Species of this genus are xerophilic, restricted to dry, dusty habitats. *L. lata* is often found in old tree hollows, other species occur in caves. Phoresy on mosquitoes has been observed. *L. lucentina* sp. n. was found in the dry zone of the cave, on the strongly sloping walls of the first hall after the entrance. The walls were covered in dust and the specimens were only recognized by their palps; the rest of the body was hidden under the dust, as if they were waiting for prey to slip on the slope (pers. obs.). The first *L. fortunata* sp. n. specimens were captured using traps baited with cheese or vinegar, the second collection was made by hand in a dry dusty area at the end of the cave. Most of these specimens were found on mustelid droppings, in company with abundant Acari and Collembola which probably form the main prey of this species.

TABLE 1. *Larca lucentina* sp. n.: ratios and measurements. Ratios express how many times an article is longer than broad (unless otherwise noted). Measurements of length/breadth expressed in mm (unless otherwise noted). Abbreviations: L length; B breadth; AR average of ratios; AM average of measurements.

Larca lucentina	**Male holotype**		**Male paratypes** (6 specimens)				**Female paratypes** (6 specimens)			
	Ratio	Measures	Ratio	AR	Measures	AM	Ratio	AR	Measures	AM
Body (L)		2.36			1.99-2.56				2.17-2.50	**2.37**
Carapace	0.84	0.56/0.67	0.79-0.85	**0.82**	0.58-0.61/0.71-0.76	**0.59/0.72**	0.71-0.91	**0.82**	0.54-0.70/0.75-0.83	**0.64/0.77**
Chelicera										
Hand (L)		0.21			0.21				0.21-0.24	**0.23**
Finger (L)		0.13			0.13				0.12-0.14	**0.13**
Pedipalps										
Trochanter	1.97	0.35/0.18	1.96-1.97	**1.97**	0.34-0.36/0.17-0.18	**0.35/0.18**	1.69-1.91	**1.83**	0.34-0.37/0.18-0.19	**0.35/0.19**
Femur	5.77	0.94/0.16	5.40-5.76	**5.65**	0.91-1.01/0.17-0.18	**0.96/0.17**	5.34-5.78	**5.57**	0.99-1.10/0.18-0.20	**1.04/0.19**
Patella	4.49	0.80/0.18	4.19-4.44	**4.33**	0.76-0.81/0.18-0.19	**0.79/0.18**	4.08-4.48	**4.31**	0.78-0.92/0.18-0.21	**0.85/0.20**
Pedicel (L)		0.15			0.14-0.16	**0.15**			0.15-0.19	**0.17**
Hand (with pedicel)	3.98	0.73/0.18	3.49-3.97	**3.77**	0.67-0.73/0.18-0.19	**0.71/0.19**	3.06-3.78	**3.31**	0.72-0.76/0.20-0.24	**0.74/0.22**
Pedicel (L)		0.10			0.07-0.10	**0.09**			0.08-0.10	**0.09**
Finger (L)		0.47			0.45-0.51	**0.48**			0.50-0.53	**0.51**
Chela (with pedicel)	6.38	1.18-0.18	6.10-6.27	**6.23**	1.16-1.19/0.18-0.19	**1.17/0.19**	5.39-5.95	**5.65**	1.19-1.24/0.20-0.23	**1.22/0.22**
Chela/carapace (L/L)	2.11		1.95-2.00	**2.01**			1.89-1.99	**1.93**		
Femur/carapace (L/L)	1.68		1.58-1.66	**1.63**			1.58-1.85	**1.64**		
Femur/finger (L/L)	1.98		1.85-2.04	**1.99**			1.98-2.06	**2.02**		
Femur/patella (L/L)	1.17		1.17-1.26	**1.21**			1.18-1.28	**1.22**		
Patella/hand (L/L)	1.10		1.10-1.18	**1.13**			1.08-1.23	**1.15**		
Hand/patella (B/B)	1.04		1.00-1.05	**1.02**			1.10-1.17	**1.13**		
Hand/finger (L/L)	1.54		1.32-1.58	**1.47**			1.40-1.47	**1.43**		
Leg I										
Femur	3.72	0.34/0.09	3.30-3.57	**3.53**	0.32-0.33/0.09-0.10		3.65-3.89	**3.74**	0.32-0.39/0.09-0.10	**0.36/0.10**
Patella	2.51	0.24/0.10	2.30-2.45	**2.42**	0.24/0.10	**0.24/0.10**	2.31-2.56	**2.45**	0.23-0.28/0.10-0.11	**0.26/0.11**
Tibia	4.14	0.29/0.07	3.67-4.03	**3.92**	0.27-0.28/0.07-0.08	**0.28/0.07**	4.00-4.22	**4.10**	0.27-0.33/0.07-0.08	**0.31/0.08**
Basitarsus	4.15	0.23/0.06	3.91-3.95	**3.98**	0.22/0.06	**0.22/0.06**	3.73-4.21	**4.04**	0.21-0.24/0.06	**0.23/0.06**
Telotarsus	4.01	0.19/0.05	3.89-4.30	**4.07**	0.19-0.20/0.05	**0.19/0.05**	3.35-4.20	**3.93**	0.18-0.21/0.05	**0.20/0.05**
Femur/patella (L/L)	1.37		1.36-1.40	**1.38**			1.33-1.48	**1.39**		
Basitarsus/telotarsus (L/L)	1.19		1.08-1.18	**1.14**			1.11-1.25	**1.19**		
Leg IV										
Femur+patella	5.85	0.72/0.12	5.19-5.52	**5.44**	0.69-0.70/0.13	**0.70/0.13**	5.14-5.48	**5.33**	0.68-0.79/0.12-0.15	**0.74/0.14**
Tibia	6.23	0.51/0.08	5.65-6.05	**5.97**	0.47-0.49/0.08	**0.49/0.08**	5.73-6.24	**5.97**	0.48-0.55/0.08-0.09	**0.52/0.09**
Basitarsus	4.62	0.28/0.06	4.25-4.59	**4.49**	0.26-0.28/0.06	**0.27/0.06**	4.12-4.55	**4.42**	0.28-0.30/0.06-0.07	**0.29/0.07**
Telotarsus	4.78	0.24/0.05	4.56-5.20	**4.82**	0.24-0.26/0.05	**0.25/0.05**	4.19-4.91	**4.64**	0.22-0.27/0.05-0.06	**0.25/0.06**
Basitarsus/telotarsus (L/L)	1.13		1.04-1.14	**1.10**			1.07-1.25	**1.12**		

TABLE 2. *Larca fortunata* sp. n.: ratios and measurements. Ratios express how many times an article is longer than broad (unless otherwise noted). Measurements of length/breadth expressed in mm (unless otherwise noted). Abbreviations: L length; B breadth; AR average of ratios; AM average of measurements.

Larca fortunata	**Female holotype**		**Female paratypes** (5 specimens)				**Male paratypes** (6 specimens)			
	Ratio	Measures	Ratio	AR	Measures	AM	Ratio	AR	Measures	AM
Body (L)		2.66			2.22-2.86	**2.61**			1.86-2.73	**2.38**
Carapace	0.90	0.64/0.71	0.83-1.00	**0.89**	0.58-0.71/0.69-0.83	**0.66/0.74**	0.83-0.95	**0.88**	0.55-0.60/0.60-0.71	**0.58/0.66**
Chelicera									0.21-0.22	
Hand (L)		0.22			0.21-0.25	**0.23**				**0.21**
Finger (L)		0.13			0.12-0.15	**0.13**			0.12-0.13	**0.13**
Pedipalps										
Trochanter	1.83	0.35/0.19	1.81-1.91	**1.86**	0.34-0.39/0.18-0.20	**0.37/0.20**	1.84-2.08	**1.99**	0.33-0.36/0.16-0.19	**0.35/0.18**
Femur	5.97	1.03/0.17	5.59-5.78	**5.74**	1.01-1.13/0.17-0.20	**1.06/0.19**	6.06-6.52	**6.27**	0.96-1.01/0.15-0.16	**0.98/0.16**
Patella	4.62	0.86/0.19	4.36-4.59	**4.51**	0.85-0.95/0.19-0.21	**0.90/0.20**	4.78-5.11	**4.98**	0.80-0.88/0.17-0.18	**0.85/0.17**
Pedicel (L)		0.17			0.16-0.18	**0.17**			0.14-0.16	**0.15**
Hand (with pedicel)	3.28	0.73/0.22	3.08-3.29	**3.18**	0.70-0.78/0.22-0.25	**0.75/0.24**	3.58-3.74	**3.63**	0.69-0.72/0.19-0.20	**0.71/0.19**
Pedicel (L)		0.11			0.11	**0.11**			0.09-0.10	**0.09**
Finger (L)		0.51			0.49-0.54	**0.52**			0.46-0.50	**0.48**
Chela (with pedicel)	5.39	1.20/0.22	5.06-5.37	**5.24**	1.17-1.24/0.22.0.25	**1.22/0.24**	5.85-6.21	**6.00**	1.17-1.18/0.19-0.20	**1.17/0.19**
Chela/carapace (L/L)	1.88		1.80-2.02	**1.93**			1.95-2.11	**2.04**		
Femur/carapace (L/L)	1.61		1.56-1.75	**1.63**			1.65-1.79	**1.70**		
Femur/finger (L/L)	2.03		1.94-2.16	**2.05**			1.94-2.14	**2.03**		
Femur/patella (L/L)	1.20		1.16-1.20	**1.18**			1.12-1.20	**1.15**		
Patella/hand (L/L)	1.18		1.19-1.22	**1.20**			1.16-1.24	**1.21**		
Hand/patella (B/B)	1.19		1.14-1.22	**1.18**			1.12/1.16	**1.14**		
Hand/finger (L/L)	1.43		1.40-1.51	**1.44**			1.43-1.51	**1.46**		
Leg I										
Femur	3.75	0.36/0.10	3.57-3.84	**3.68**	0.33-0.38/0.09-0.11	**0.37/0.10**	3.39-3.94	**3.73**	0.32-0.36/0.08-0.10	**0.34/0.09**
Patella	2.39	0.26/0.11	2.43-2.55	**2.49**	0.25-0.28/0.10-0.11	**0.27/0.11**	2.42-2.65	**2.50**	0.24-0.27/0.10	**0.25/0.10**
Tibia	4.19	0.31/0.07	4.22-4.31	**4.24**	0.30-0.33/0.07-0.08	**0.32/0.08**	3.96-4.50	**4.25**	0.29-0.32/0.07	**0.30/0.07**
Basitarsus	4.21	0.24/0.06	3.91-4.41	**4.18**	0.23-0.25/0.06	**0.24/0.06**	4.11-4.76	**4.40**	0.22-0.25/0.05-0.06	**0.23/0.05**
Telotarsus	4.30	0.22/0.05	4.05-4.33	**4.22**	0.19-0.22/0.05	**0.21/0.05**	3.95-4.49	**4.22**	0.19-0.21/0.05	**0.20/0.05**
Femur/patella (L/L)	1.41		1.34-1.41	**1.37**			1.31-1.41	**1.36**		
Basitarsus/telotarsus (L/L)	1.11		1.07-1.28	**1.16**			1.08-1.23	**1.15**		
Leg IV										
Femur+patella	5.33	0.73/0.14	5.18-5.54	**5.28**	0.71-0.78/0.14-0.15	**0.75/0.14**	5.17-5.92	**5.65**	0.68-0.74/0.12-0.13	**0.70/0.13**
Tibia	6.38	0.54/0.09	5.91-6.43	**6.26**	0.51-0.58/0.09	**0.55/0.09**	5.65-6.84	**6.27**	0.48-0.54/0.08	**0.51/0.08**
Basitarsus	4.59	0.29/0.06	4.29-4.69	**4.52**	0.27-0.31/0.06-0.07	**0.29/0.06**	4.17-5.04	**4.67**	0.26-0.29/0.06	**0.28/0.06**
Telotarsus	5.05	0.28/0.06	4.41-5.00	**4.75**	0.25-0.28/0.05-0.06	**0.27/0.06**	4.90-5.10	**4.99**	0.25-0.27/0.05	**0.25/0.05**
Basitarsus/telotarsus (L/L)	1.03		1.04-1.22	**1.10**			1.05-1.16	**1.09**		

TABLE 3: Femur/carapace length ratio and biology of the known species of *Larca*. Average ratio given for females-males when sex data are known [data from the present study and from: Benedict & Malcolm (1977); Gardini (1983); Henderickx & Vets (2002); Hoff (1961); Judson & Legg (1996); Muchmore (1981); Tooren (2001)].

***Larca* species**	**Femur/carapace length**	**Biology**
L. notha	1.20-1.25	Epigean
L. chamberlini	1.39-1.26	Epigean
L. granulata	1.30	Epigean
L. lata	1.50-1.42	Epigean
L. boesselarsi	1.34-1.41	Cave-dwelling
L. italica	1.48	Cave-dwelling
L. hispanica	1.50-1.53	Cave-dwelling
L. laceyi	1.56	Cave-dwelling
L. lucentina	1.64-1.63	Cave-dwelling
L. fortunata	1.63-1.70	Cave-dwelling

In recent years Ranius and his collaborators (Ranius, 2000, 2002; Ranius & Douwes, 2002; Ranius & Wilander, 2000) have been intensively studying the specialized fauna of tree hollows in Sweden. Although their study mainly focuses on the beetle *Osmoderma eremita* Scopoli, other beetles, flies, mites and pseudoscorpions are also considered. Seven pseudoscorpion species have been found in wood mould samples from hollow oaks (Ranius & Wilander, 2000), two of which deserve special attention: *L. lata* and *Allochernes wideri* (C. L. Koch) (Ranius, 2002; Ranius & Douwes, 2002). *A. wideri* occurs on solitary trees with small hollows, while *L. lata* is confined to larger assemblages of very old trees with hollows containing large amounts of wood mould. A genetic studies of both species, at sites situated 400-900 km apart, revealed that in *A. wideri* the genetic differentiation between populations was low but significant, whereas in *L. lata* it did not deviate significantly from zero for mainland populations and only became significant when an island population was taken into account. The authors concluded that migration rates are high for *L. lata*, probably due to phoresy, although this has only occasionally been observed.

Considering the fact that five of the six *Larca* species known from Europe (including the two new species described here) bear four setae or less on the posterior margin of their carapace, it seems reasonable to suppose that they are derived from a common ancestor similar to *L. lata*, since this is the only epigean species in Europe and the least evolved taxon of this group.

L. lata has been reported from Austria, the Czech Republic, Denmark, England, Germany, Poland, Rumania, Sweden (Judson & Legg, 1996), Latvia (Tumss, 1934) and the Netherlands (Tooren, 2001), but it seems to be absent from the Mediterranean region. The dependence on old tree hollows observed for *L. lata* suggests that in colder ages, during the Quaternary period, the genus was probably more widespread in Europe, accompanying the expansion of forests. During the last warmer interglacial period, the forest mass declined in the Mediterranean regions due to climatic changes and to management. This is very marked in the south-eastern region of Spain that is considered arid or semiarid zone and where the new taxa are present. Populations of *Larca* would consequently have disappeared from these areas or else subsisted in cave

refugia, which provided the most similar habitat to the tree hollows in terms of constant temperature and humidity, with dusty floor and dry guano from bats or other vertebrates. It is possible that the fauna inhabiting this niche, including potential prey such as Acari, Collembola and Psocoptera, may be similar to that found in tree hollows populated by *L. lata*, but this remains to be confirmed. The greater distance between the caves inhabited by the surviving populations, compared to that between the trees in a forest, would have reduced or eliminated genetic exchange via phoresy on mosquitoes: these insects can be found at the entrances of caves, but rarely inside. The resulting isolation and adaptation to the new habitat would have given rise to new taxa with troglomorphic adaptations.

Cave adaptation is seen in some characters of *Larca* but not in others. Both pairs of eyes seem to be functional in all known species, but in the cave species the lenses are more flattened. Some general desclerotization is visible in the cave taxa, but the best indicators of adaptation to cave life are the elongated palps. The ratio femur/carapace length [used by Gardini (1983) to separate the North America species in his key] indicates quite well the degree of troglomorphic adaptation (Table 3), according to which *L. lucentina* sp. n. and *L. fortunata* sp. n. are the species with most pronounced adaptation for a cavernicolous way of life.

The presence of two trichobothria on the movable finger of the chela is typical for the genus *Larca*, except that the epigean species *Larca notha* Hoff, 1961, has three trichobothria and no variation has been reported for this species (Muchmore, 1981). Gardini (1983), citing Vachon (1947), writes about "neotenia localizzata" where the number of trichobothria in deutonymphs persist in tritonymphs and adults, but in this genus this phenomenon is limited to the movable finger only. The variation observed in both new species, which includes some specimens with three trichobothria, may be the result of neoteny too, which is quite frequent in other Arthropoda with adaptation to cave life (Galan & Herrera, 1998). Therefore the neotenia retention of three trichobothria on the movable finger of the chelae is possibly another morphological adaptation to a cave-dwelling life.

ACKNOWLEDGEMENTS

I am indebted to Prof. Volker Mahnert (MHNG) who first confirmed the validity of the new taxa. I am very grateful to Dr Mark Judson (MNHNP) for his critical reading of the first draft of the manuscript, providing helpful advice and revising the English. My thanks are due to José Luis Lencina (Dep. Biología Animal, Fac. Veterinaria, Univ. Murcia, Spain) and Vicente Ortuño (Dpto. Zoología y Antropología Física, Fac. Biología, Univ. Alcalá, Spain) who on purpose collected the *L. fortunata* sp. n. material in June 2003 at my request; without their collaboration I would not have been able to complete this study. This paper is dedicated to the memory of José Pardo, from Villena, who guided me to the Cueva del Poste and of whose death, some years ago, I learnt only recently.

REFERENCES

BEIER, M. 1939. Die Pseudoscorpioniden-Fauna der iberischen Halbinsel. *Zoologische Jahrbücher (Systematik)* 72: 157-202.

BEIER, M. 1963. Ordnung Pseudoscorpionidea (Afterskorpione). Bestimmungsbücher zur Bodenfauna Europas, Vol. 1. *Akademie-Verlag, Berlin*, 313 pp.

BEIER, M. 1969. Reliktformen in der Pseudoscorpioniden-Fauna Europas. *Memoire della Società Entomologica Italiana* 48: 317-323.

BELLÉS, X. 1987. Fauna Cavernícola i Intersticial de la Península Ibèrica i les Illes Balears. *C.S.I.C. Mallorca*.

BELLÉS, X. 1994. Espagne (pp. 649-662). *In:* Encyclopaedia Biospeologica, Vol. 1. *Société Internationale de Biospéologie, Moulis-Bucarest*.

BENEDICT, E. M. & MALCOLM, D. R. 1977. Some garypoid false scorpions from western North America (Pseudoscorpionida: Garypidae and Olpiidae). *Journal of Arachnology* 5: 113-132.

CHAMBERLIN, J. C. 1924. The Cheiridiinae of North America (Arachnida-Pseudoscorpionida). *Pan-Pacific Entomologist* 1: 32-40.

CHAMBERLIN, J. C. 1930. A synoptic classification of the false scorpions or chela-spinners, with a report on a cosmopolitan collection of the same. Part II. The Diplosphyronida (Arachnida-Chelonethida). *Annals and Magazine of Natural History* (10) 5: 1-48, 565-620.

DUMITRESCO, M. & ORGHIDAN, T. 1964. Contribution à la connaissance des Pseudoscorpions de la Dobroudja, 1re note. *Annales de Spéléologie* 19(3): 599-630.

ESTANY, J. 1980. Quelques remarques à propos de *Larca hispanica* Beier et *Larca spelaea* Beier (Pseudoscorpionida, Garypidae) (pp. 65-70). *In*: Comptes-Rendus du Vème Colloque d'Arachnologie d'Expression Française, Barcelona. *Eunibar, Barcelona*.

GALAN, C. & HERRERA, F. F. 1998. Fauna cavernicola: ambiente y evolución. *Boletín de la Sociedad Venezolana de Espeleología* 32: 13-43.

GÄRDENFORS, U. 2000. The 2000 Red List of Swedish species. *Artdatabanken, Uppsala*, 397 pp.

GARDINI, G. 1983. *Larca italica* n. sp. cavernicola dell'Apennino Abruzzese (Pseudoscorpionida Garypidae) (Pseudoscorpioni d'Italia XV). *Bollettino della Società Entomologica Italiana* 115(4-7): 63-69.

HARVEY, M. S. 1990. Trichobothrial "migration" in diplosphyronid pseudoscorpions. *Acta Zoologica Fennica* 190: 157-160.

HARVEY, M. S. 1991. Catalogue of the Pseudoscorpionida. *ManchesterUniversity Press, Manchester*, 727 pp.

HARVEY, M. 1992. The phylogeny and classification of the Pseudoscorpionida (Chelicerata: Arachnida). *Invertebrate Taxononomy* 6: 1373-1435.

HENDERICKX, H. & VETS, V. 2002. A new *Larca* (Arachnida, Pseudoscorpiones: Larcidae) from Crete. *Bulletin of the British Arachnological Society* 12: 280-283.

HEURTAULT, J. 1980. La néochétotaxie majorante prosomatique chez les Pseudoscorpions Neobisiidae: *Neobisium pyrenaicum* et *N. mahnerti* sp. n. (pp. 87-97). *In*: Comptes-Rendus du Vème Colloque d'Arachnologie d'Expression Française, Barcelona. *Eunibar, Barcelona*.

HOFF, C. C. 1961. Pseudoscorpions from Colorado. *Bulletin of the American Museum of Natural History* 122(5): 409-464.

JUDSON, M. L. I. & LEGG, G. 1996: Discovery of the pseudoscorpion *Larca lata* (Garypoidea, Larcidae) in Britain. *Bulletin of the British Arachnological Society* 10(6): 205-210.

MAHNERT, V. 1977a. Spanische Höhlenpseudoskorpione. *Miscelanea Zoologica* 4(1): 61-104.

MAHNERT, V. 1977b. Zur Verbreitung höhlenbewohnender Pseudoskorpione der iberischen Halbinsel (pp. 21-23). Comunicacions del 6è. Simposium d'Espeleología, Terrassa.

MAHNERT, V. & SCHUSTER, R. 1981. *Pachyolpium atlanticum* n. sp., ein Pseudoskorpion aus der Gezeitenzone der Bermudas: Morphologie und Ökologie (Pseudoscorpiones: Olpiidae). *Revue suisse de Zoologie* 88(1): 265-273.

MUCHMORE, W. B. 1981. Cavernicolous species of *Larca*, *Archeolarca* and *Pseudogarypus* with notes on the genera (Pseudoscorpionida, Garypidae and Pseudogarypidae). *Journal of Arachnology* 9: 47-60.

RANIUS, T. 2000. Minimum viable metapopulation size of a beetle, *Osmoderma eremita*, living in tree hollows. *Animal Conservation* 3: 37-43.

RANIUS, T. 2002. Population ecology and conservation of beetles and pseudoscorpions living in hollow oaks in Sweden. *Animal Biodiversity and Conservation* 25 (1): 53-68.

RANIUS, T. & DOUWES, P. 2002. Genetic structure of two pseudoscorpion species living in tree hollows in Sweden. *Animal Biodiversity and Conservation* 25 (2):67-74.

RANIUS, T. & WILANDER, P. 2000. Occurrence of *Larca lata* H. J. Hansen (Pseudoscorpionida: Garypidae) and *Allochernes wideri* C.L. Koch (Pseudoscorpionida: Chernetidae) in tree hollows in relation to habitat quality and density. *Journal of Insect Conservation* 4: 23-31.

RUIZ-PORTERO, C., BARRANCO, P., FERNÁNDEZ-CORTÉS, A., TINAUT, A. & CALAFORRA, J. M. 2002. Aproximación al conocimiento de la entomofauna de la Cueva del Yeso (Sorbas, Almeria). *Sedeck* 3: 16-25.

TOOREN, D. van den. 2001. First record of the pseudoscorpion *Larca lata* in the Netherlands (Pseudoscorpiones: Garypoidea: Larcidae). *Nederladse Faunistiche Mededelingen* 15: 33-39.

TUMSS, V. 1934. Beitrag zur Kenntnis der Pseudoscorpionidenfauna Lettlands. *Folia Zoologia Hydrobiologia* 7(1): 12-19.

VACHON, M. 1947. Comment reconnaître l'âge chez les Pseudoscorpions (Arachnides). *Bulletin du Muséum National d'Histoire Naturelle, Paris* (2) 19(3): 271-274.

ZARAGOZA, J. A. 1982. *Roncus (Parablothrus) setosus* n. sp., otro caso de "néochétotaxie majorante prosomatique" (Heurtault) en los pseudoscorpiones Neobisiidae. *Mediterránea (Biol.)* 6: 101-108.

ZARAGOZA, J. A. 1986. Distribución de los Pseudoscorpiones cavernícolas de la península Ibérica e islas Baleares (Arachnida) (pp. 405-411). *In*: BARRIENTOS, J. A. (ed.). Actas X Congreso Internacional de Aracnología, Jaca, Vol. 1, 428 pp.

ZARAGOZA, J. A. 1990. Escorpiones, pseudoescorpiones y solífugos de la provincia de Alicante (pp. 45-70). *In*: Ayudas a la investigación 1986-1987. *Instituto de Cultura Juan Gil-Albert. Diputación Provincial Alicante (ed.)*, Vol. 1, 280 pp.

ZARAGOZA, J. A. & SENDRA, A. 1988. Fauna cavernícola de la provincia de Alicante (pp. 11-35). *In*: Ayudas a la investigación 1984-1985. *Instituto de Cultura Juan Gil-Albert. Diputación Provincial Alicante (ed.)*, Vol. 3, 285 pp.

Revue suisse de Zoologie 112 (1): 215-224; mars 2005

Zoogeographical aspects of some scutacarid mites and their phoresy hosts (Acari, Heterostigmata; Hymenoptera, Aculeata)

Manfred HALL & Ernst EBERMANN
Institut für Zoologie, Biodiversität & Evolution, Karl-Franzens-Universität, Universitätsplatz 2, A-8010 Graz, Austria.
E-mail: ernst.ebermann@uni-graz.at, manfred.hall@gmx.at

Zoogeographical aspects of some scutacarid mites and their phoresy hosts (Acari, Heterostigmata; Hymenoptera, Aculeata). - The known distribution of the scutacarid species *Imparipes (Imparipes) apicola* (Banks), *I. (I.) haeseleri* Ebermann & Hall and *I. (I.) breganti* Ebermann & Hall is presented. *Imparipes apicola* shows a Holarctic distribution with records from Canada, USA, Mexico and Central Europe. The area of distribution of *I. haeseleri* reaches from Central and South-eastern Europe to India. *Imparipes breganti* is known only from a number of localities in Central Europe. Females of these three mite species were found to be phoretic on solitary bees, sphecids and one eumenine wasp species, respectively; moreover, they all possess a so-called sporotheca. The distribution of these scutacarid-species with respect to the distribution of their hymenopterous hosts is discussed. A tabular list of all species of the genus *Imparipes* which were found to be phoretic on various hymenopterans (data of their distribution included) is presented.

Keywords: Acari - Scutacaridae - *Imparipes* - zoogeography - phoresy - wild bees - Sphecidae - sporothecae.

INTRODUCTION

Associations of species of the scutacarid genus *Imparipes* with other arthropods have been recorded frequently (e.g. Delfinado & Baker, 1976; Eickwort, 1979, 1990, 1994; Ebermann, 1988; Ebermann & Hall, 2003). Association with hymenopterans is especially prevalent as more than 3/4 of all phoretic species of *Imparipes* can be found on Formicoidea and Apoidea. Our research is thus devoted to the relationship between the mite family Scutacaridae – especially the genus *Imparipes* – and Hymenoptera-Aculeata, mainly wild bees and sphecids, but also eumenine wasps and mutillids. Our inspection of museum and private collections for these insects with respect to phoretic scutacarid species and the investigation of microscopic slides with phoretic scutacarids from Europe, Asia and North America revealed a total of six *Imparipes* species (all phoretic females). Three of these six species, namely *Imparipes (I.) apicola* (Banks, 1914), *I. (I.) haeseleri* Ebermann & Hall, 2003 and *I. (I.) breganti* Ebermann & Hall

Manuscript accepted 17.05.2004

(2004) were found to be phoretic on wild bees, sphecids and one eumenine wasp. These mite species all possess a sporotheca that is used for the transport of fungal spores (Ebermann & Hall, 2003, 2004, 2005). A table showing the distribution of *Imparipes* species associated with bees (Apidae), digger wasps (Sphecidae) and eumenine wasps (Vespidae) with respect to the distribution of their hymenopterous hosts, is presented from our collections and already published findings.

MATERIAL

Hymenopterous hosts and microscopic slides were studied from the following collections: CMK = Collection Michael Kuhlmann, Ahlen, Germany; ISNB = Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium; SLJG = Steiermärkisches Landesmuseum Joanneum, Graz, Austria; OÖLM = Oberösterreichisches Landesmuseum, Linz, Austria; ZMUH = Zoologisches Institut and Zoologisches Museum der Universität Hamburg, Germany.

The following abbreviations are used in this paper. *Localities:* AUT = Austria, BEL = Belgium, CAN = Canada, GER = Germany, IDA = Idaho, ITA = Italy, MAS = Massachusetts, MEX = Mexico, NEV = Nevada, NY = New York, POL = Poland, UKR = Ukraine, UT = Utah, WY = Wyoming; *Austrian provinces:* BL = Burgenland, NÖ = Lower Austria, OÖ = Upper Austria, SB = Salzburg, ST = Styria.

Collections: CEE = Collection Ernst Ebermann, Karl-Franzens-University Graz, Austria; CGA = Collection Gerd Alberti, Ernst-Moritz-Arndt-University Greifswald, Germany; HNHM = Hungarian Natural History Museum, Budapest, Hungary; MHNG = Muséum d'histoire naturelle, Geneva, Switzerland.

Localities and Hymenopterous Hosts: The complete list of localities of *Imparipes apicola* and *I. breganti* was published in Ebermann & Hall (2004, 2005) and is not repeated here. Due to the considerable quantity of material of *I. haeseleri* that we have at our disposal, only a part of the collecting sites and dates were already published in Ebermann & Hall (2003); the list is completed in the following. The labelling of samples refers to original labels of microscopic slides or preserved insects. With the exception of *Hylaeus angustatus* (Apidae) from POL-1 all host species mentioned in the list belong to the Sphecidae.

AUSTRIA: **AUT-BL-1**: Neustift bei Güssing, S-Burgenland; *Ectemnius dives* (Lepeletier & Brullé, 1834): ♀, 13.06.1997, Bregant leg., Gusenleitner det.; (SLJG), 12 mites. **AUT-NÖ-2**: Purgstall, garden Ressl; *Ectemnius continuus* (Fabricius, 1804): ♀, 24.06.1994, Gusenleitner leg. & det.; (OÖLM), 3 mites. **AUT-OÖ-1a**: Linz Urfahr, park; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♂, 12.07.1999, Schwarz-Waubke leg., Schwarz det.; (OÖLM), 1 mite. **AUT-OÖ-1b**: same as AUT-OÖ-1a; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♂, 29.07.1999, Schwarz-Waubke leg., Schwarz det.; (OÖLM), 1 mite. **AUT-OÖ-2a**: Plesching near Linz; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 09.09.1999, Schwarz leg. & det.; (OÖLM), 1 mite. **AUT-OÖ-2b**: same as AUT-OÖ-2a; *Ectemnius dives* (Lepeletier & Brullé, 1834): ♀, 25.05.1999, Schwarz leg. & det.; (OÖLM), 1 mite. **AUT-OÖ-2c**: same as AUT-OÖ-2a; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 29.08.2000, Schwarz leg., Gusenleitner det.; (OÖLM), 1 mite. **AUT-OÖ-3**: Klamleiten W Alberndorf; *Lestica clypeata* (Schreber, 1759): ♀, 29.06.1999, Gusenleitner leg. & det.; (OÖLM), 1 mite. **AUT-OÖ-4**: Linz, Pöstlingberg, dehiscent fruit meadow; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 08.09.1999, Schwarz leg. & det.; (OÖLM), 1 mite. **AUT-SB-1a**: Salzburg,

Parsch; *Crossocerus annulipes* (Lepeletier & Brullé, 1834) ["Crossocerus ambiguus"]: ♂, 08.06.1963, Leclercq; (ISNB), 1 mite. **AUT-SB-1b**: same as AUT-SB-1a; *Ectemnius continuus* (Fabricius, 1804): ♀, 18.09.1963, Leclercq; (ISNB), 2 mites. **AUT-SB-1c**: same as AUT-SB-1a; *Ectemnius dives* (Lepeletier & Brullé, 1834): 1 ex., 21.07.1963, Leclercq; (ISNB), 3 mites. **AUT-ST-1a**: Graz-Messendorf, "Heimgartenanlage"; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 16.07.1994, Bregant & Klingberg leg., Gusenleitner det.; (SLJG), 1 mite. **AUT-ST-1b**: same as AUT-ST-1a; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 31.07.1994, Bregant & Klingberg leg., Gusenleitner det.; (SLJG), 1 mite. **AUT-ST-1c**: same as AUT-ST-1a; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 31.07.1994, Bregant & Klingberg leg., Gusenleitner det.; (SLJG), 3 mites. **AUT-ST-2**: Pirkwiesen W St. Marein bei Graz, E-Styria; *Crossocerus annulipes* (Lepeletier & Brullé, 1834): ♀, 31.07.1995, Bregant leg. & det.; Gusenleitner det.; (SLJG), 1 mite. **AUT-ST-3a**: Eichberg-Trautenburg S Kreuzberg, Windische Bühel, NNW Leutschach; *Crossocerus elongatulus* (v. d. Linden, 1829): ♀, 28.07.1996, Bregant leg. & det.; (SLJG), 1 mite. **AUT-ST-5**: Fladnitz im Raabtal; *Ectemnius continuus* (Fabricius, 1804): ♀, 26.08.1997, Bregant leg. & det.; (SLJG), 1 mite. **AUT-ST-6**: Grieberg NE Paldau; *Ectemnius dives* (Lepeletier & Brullé, 1834): ♀, 03.08.2000, Gusenleitner leg. & det.; (OÖLM), 3 mites.

BELGIUM: **BEL-1a**: Riviere; *Ectemnius continuus* (Fabricius, 1804) ["Crabro vagus"]: 1 ex., 09.08.1933, Crevecoeur; (ISNB), 3 mites. **BEL-2**: Welkenraedt; *Ectemnius lapidarius* (Panzer, 1804): ♂, 09.06.1964, Leclercq; (ISNB), 5 mites. **BEL-3**: Wegimont; *Lestica clypeata* (Schreber, 1759) ["Crabro clypeatus"]: ♀, 11.08.1935, Crevecoeur; (ISNB), 2 mites.

GERMANY: **GER-1a**: National park Bayerischer Wald, "Urwald Mittelsteighütte"; *Pemphredon lugubris* (Fabricius, 1793): ♀, 20.06.-05.07.2000, Malaise, Kuhlmann leg. & det.; (CMK), 1 mite. **GER-1b**: same as GER-1a; *Ectemnius ruficornis* (Zetterstedt, 1838): ♀, 30.05.-20.06.2000, Malaise, Kuhlmann leg. & det.; (CMK), 2 mites. **GER-1c**: same as GER-1a; *Ectemnius ruficornis* (Zetterstedt, 1838): ♀, 30.05.-20.06.2000, Malaise, Kuhlmann leg. & det.; (CMK), 1 mite. **GER-1d**: same as GER-1a; *Crossocerus barbipes* (Dahlbom, 1845): ♀, 01.08.-31.08.2000, Malaise, Kuhlmann leg. & det.; (CMK), 1 mite. **GER-1e**: same as GER-1a, PF "Feistenhang"; *Mimumesa dahlbomi* (Wesmael, 1852): ♀, 07.08.-09.09.1998, Kuhlmann leg. & det.; (CMK), 3 mites. **GER-2b**: Bremen; *Crossocerus megacephalus* (Rossi, 1790): ♀, 14.07.1904, Haeseler det.; (ZMUH), 21 mites. **GER-2c**: same as GER-2b; *Crossocerus megacephalus* (Rossi, 1790): ♀, 04.08.1955, Haeseler det.; (ZMUH), 1 mite. **GER-2d**: same as GER-2b; *Ectemnius sexcinctus* (Fabricius, 1775): ♀, 06.07.1946, Haeseler det.; (ZMUH), 30 mites. **GER-2e**: same as GER-2b; *Ectemnius sexcinctus* (Fabricius, 1775): ♀, 08.07.1935, Haeseler det.; (ZMUH), 5 mites. **GER-3**: Sage near Cloppenburg; *Crossocerus cetratus* (Shuckard, 1837): ♀, 24.06.1983, Haeseler det.; (ZMUH), 2 mites. **GER-4**: Brockel, Kreis Rotenburg Wümme; *Crossocerus vagabundus* (Panzer, 1798): ♀, 06.08.1954, Haeseler det.; (ZMUH), 105 mites. **GER-5**: Sottrum bei Hildesheim; *Ectemnius continuus* (Fabricius, 1804): ♀, 23.08.1973, Haeseler det.; (ZMUH), 102 mites. **GER-6**: Krahnberg; *Ectemnius dives* (Lepeletier & Brullé, 1834): ♀, 02.08.1915, Haeseler det.; (ZMUH), 2 mites. **GER-7**: Deckbergen bei Rinteln; *Ectemnius sexcinctus* (Fabricius, 1775): ♀, 03.08.1894 Haeseler det.; (ZMUH), 1 mite. **GER-17a**: Wedel (Ki); *Pemphredon inornata* Say, 1824 ["Pemphredon inornatus"]: ♀, 16.07.1987, Haack det.; (ZMUH), 1 mite. **GER-17b**: same as GER-17a; *Stigmus solskyi* Morawitz, 1864: ♀, 16.07.1987, Haack det.; (ZMUH), 1 mite. **GER-18**: BW-Karlsruhe, Eggenstein MV53; *Ectemnius lapidarius* (Panzer, 1804): ♀, 07.08.1991, Schmid-Egger leg., Gauss det.; (CMK), 2 mites. **GER-22**: *Crossocerus vagabundus* (Panzer, 1798): 1 ex., 06.06.2002, Greifswald St. Georgsfeld, Kornmilch leg. & det.; (CGA), 19 mites.

ITALY: **ITA-1**: Sardinia; *Cerceris flavilabris* (Fabricius, 1793) ["Cerceris ferreri"]: ♀, 10.07.1939, Haeseler det.; (ZMUH), 1 mite.

POLAND: **POL-1**: Poland; *Hylaeus angustatus* (Schenck, 1861) ["Prosopis curviscapus"]: 1 ex., 1927(?), Chmielewski det.; (ZMUH), 1 mite.

UKRAINE: **UKR-1b**: Simpheropol, Crimea; *Lestica clypeata* (Schreber, 1759): ♀, 08.07.1998, Gurko leg., Gusenleitner det.; (OÖLM), 1 mite. **UKR-1c**: same as UKR-1b; *Lestica clypeata* (Schreber, 1759): ♀, 25.08.1999, Gurko leg., Gusenleitner det.; (OÖLM), 4 mites.

RESULTS AND DISCUSSION

General information on the Palaearctic and Nearctic distribution of sphecids and wild bees in the following section is taken from Blösch (2000) and Westrich (1990).

Imparipes (Imparipes) apicola (Banks)

Material and deposition: see Ebermann & Hall (2005).

Distribution: We found phoretic females of *Imparipes apicola* on 13 soil-dwelling bee species but also on three soil-dwelling sphecids. The area of distribution of *I. apicola* includes the Nearctic region of Mexico (Delfinado & Baker, 1976), wide areas of North America (Canada: Banks, 1914; USA: Cross & Bohart, 1969, 1992; Delfinado & Baker, 1976; Ebermann & Hall, 2005) and parts of Central Europe (Germany: Kuhlmann, 1998; Ebermann & Hall, 2005; Austria, Belgium, Poland: Ebermann & Hall, 2005) (Tab. 1, 2).

The geographic origin of this species is not known. Most probably the colonization of North America and/or Europe occurred in close connection with their hosts. Today all bee hosts, at least on the generic level, are inhabitants of nearctic and palaearctic regions: hosts include *Apis*, *Andrena*, *Lasioglossum* (*Dialictus*, *Evylaeus*, *Lasioglossum* s. str.), *Nomia* and *Sphecodes* (Tab. 1). Especially the latter three genera, all of them belonging to the family Halictidae, represent the preferred hosts of *I. apicola*. Halictids, in general, are also known to serve as hosts for other phoretic mite species (e.g. Fain *et al.*, 1999). A total of 24 bee host species for *I. apicola* are hitherto known, 12 of them from North America and Mexico and 12 from Europe. Apart from the honey bee (*Apis mellifera*), none of these hosts occurs on both continents (Michener *et al.*, 1994; Michener, 2000; Westrich, 1990). Only *Ectemnius continuus*, one of the three sphecids found exclusively in Europe as a host of *I. apicola* (Tab. 1), is distributed throughout the Holarctic Region. Thus, with regard to the colonization history of *I. apicola*, only the distribution of *Apis mellifera* and *Ectemnius continuus* may represent a possible link between the Old and the New World. However, *I. apicola* was found only once phoretic on a honey bee (Banks, 1914: Canada) and once on *E. continuus* (Ebermann & Hall, 2005: Europe), respectively. Especially the former record is questionable as it is very uncertain whether *A. mellifera* serves as a phoresy host for *I. apicola* at all. Since the honey bee is the best-investigated insect and no other records of this mite species have been documented within the last 90 years, we assume that in 1914 Banks has investigated a wild bee species. This could have been a species of *Andrena*, a genus which is very similar to honey bees (Westrich, 1990). Actually, *I. apicola* is quite frequently found to be phoretic on *Andrena* bees. On the other hand, with the honey bee as a phoresy host *I. apicola* could have reached the New World recently in the course of the domestication of honey bees in America.

The mechanisms resulting in the Holarctic distribution of *I. apicola* are subject to speculation. Apart from the possibility of a trans-Atlantic faunal exchange, e.g. due to a dispersal by air as it is documented for various other arthropods (e.g. Lindroth, 1957), a colonization via the Northern Bering land-bridge could have been possible. Such a faunal exchange could have taken place during the late Tertiary with its

moderate climatic conditions. Subsequent climatic changes to Subarctic conditions during the Pleistocene would have resulted in a less passable land-bridge ("filter-bridge": see Simpson, 1940, in Lindroth, 1957) for aculeate insects in general. However, mainly due to the poorly investigated aculeate and mite fauna of the Palaearctic parts of East Asia and the north-west of Alaska, empirical evidence for such an intercontinental passage are hitherto lacking.

The different ranges of hosts for *I. apicola* in America and Europe suggest a successive acceptance of local soil-dwelling hosts during colonization. Such a successive adoption of suitable new hosts is also indicated by the close relationship of these hosts and their uniform modes of nesting. Additionally, the development of sporotheca by these mites, well suited for the transport of spores of the fungi the species very probably feeds on (Ebermann & Hall, 2003), represents an increased independence from food resources in the nest of its hosts. Thus, the independence of food resources could have represented the driving evolutionary force for the search and acceptance of new hymenopterous hosts.

Imparipes (Imparipes) haeseleri Ebermann & Hall

Material and deposition: 481 ♀♀ from 53 localities in Austria, Italy, Belgium, Germany, Poland, Ukraine and India (Ebermann & Hall, 2003; present study). 33 of the 481 specimens were used for molecular-biological analysis: AUT-NÖ-2, AUT-OÖ-1a, AUT-OÖ-1b, AUT-OÖ-2a, AUT-OÖ-2b, AUT-OÖ-2c, AUT-OÖ-3, AUT-OÖ-4, AUT-ST-6, GER-22 (16 specimens out of 19 still exist), UKR-1a (one specimen out of 13 still exists), UKR-1b, UKR-1c. The remaining 448 slides are deposited in CEE, HNHM, ISNB, MHNG and ZMUH.

Distribution: Our findings originate from 18 wood-nesting sphecid species, two wild bee species and one eumenine wasp species (Tab. 1). The phoresy hosts and the phoretic mites were collected in Central and Southern Europe, respectively, and in the Ukraine, with one additional record from the Indian Peninsula (Ebermann & Hall, 2003; present study) (Tab. 1, 2). The fragmented distribution of *I. haeseleri* is obviously a result of the poor degree of sampling in these regions. By contrast, while the Nearctic and Palaearctic distribution of sphecids is relatively well documented (Blösch, 2000), the Hymenoptera-associated mites from Northern America and Asia have remained largely unknown. This lack of data becomes obvious when regarding the distribution of the 18 sphecid phoresy hosts: their distribution far exceeds the hitherto known spatial distribution of *I. haeseleri*. Seven phoresy hosts of *I. haeseleri* are also documented for North America (*Crossocerus annulipes*, *C. elongatulus*, *Ectemnius continuus*, *E. dives*, *E. lapidarius*, *E. ruficornis*, *Pemphredon inornata*) and thus show a holarctic distribution. Moreover *Ectemnius ruficornis* is also known from the Neotropical Region. Four other sphecid species are distributed as far south as Northern Africa (*Crossocerus continuus*, *C. elongatulus*, *C. megacephalus*, *Lestica clypeata*). The distribution of 16 additional species reaches the eastern Palaearctics (e.g. Mongolia, Korea, Siberia), with seven of them even recorded for Japan (*Crossocerus barbipes*, *C. cetratus*, *C. vagabundus*, *Ectemnius lapidarius*, *E. ruficornis*, *Pemphredon inornata*, *P. lugubris*). One species, *Mimumesa dahlbomi*, has extended its eastern distribution area to Sakhalin and Kamchatka. Thus, the wide distribution of the phoresy hosts of *I. haeseleri* indicates that also *I. haeseleri*, together with its hosts, may occur in Northern Africa, Central and East Asia, North America and

TAB. 1

Imparipes species associated with bees (Apidae), digger wasps (Sphecidae) and eumenine wasps (Vespidae); Nearctic host species of *I. apicola* underlined.

Mite species	Hymenopterous Hosts	Regions	References
Imparipes (Imparipes) americanus **(Banks, 1905)**	**Apidae**: *Halictus venablesii*	Canada	Banks, 1904 & 1906 Delfinado & Baker, 1976
I. (I.) apicola **(Banks, 1914)**	**Apidae:** *Apis mellifera* *Andrena erythrogaster, "extricata", flavipes, florea, hippotes, nana, nigrifrons, semilaevis* *Dialictus cressoni, laevissimus, lineatulus, nymphaearum, zephyrus* *Evylaeus quebecensis* *Halictus simplex* *Lasioglossum (Dialictus)* sp. *Lasioglossum leucopus, lucidulum, semilucens, villosulum* *Nomia melanderi* *Sphecodes crassus, monilicornis* **Sphecidae**: *Diodontus luperus* *Ectemnius continuus* *Gorytes* sp.	Austria, Belgium, Canada, Germany, Mexico, Poland, USA	Banks, 1914 Cross & Bohart, 1969, 1992 Delfinado & Baker, 1976 Kuhlmann, 1998 Ebermann & Hall, 2005
I. (I.) breganti **Ebermann & Hall, 2004**	**Apidae**: *Andrena flavipes* *Hylaeus variegatus* *Osmia papaveris* *Sphecodes monilicornis* **Sphecidae:** *Cerceris rybyensis, sabulosa* *Crossocerus elongatulus, ovalis, varus* *Diodontus luperus, tristis* *Gorytes* sp. *Lestica subterranea* *Lindenius albilabris, panzeri*	Austria, Belgium, Germany	Ebermann & Hall, 2004
I. (I.) eickworti **Mahunka, 1969**	**Apidae**: *Dialictus umbripennis*	Costa Rica	Mahunka, 1969

I. (I.) floridensis **Delfinado & Baker, 1976**	**Apidae**: *Halictus ligatus* *(Augochlorella striata)*	USA	Delfinado & Baker, 1976
I. (I.) haeseleri **Ebermann & Hall, 2003**	**Apidae**: *Hylaeus angustatus* *Megachile lapponica* **Sphecidae**: *Cerceris flavilabris* *Crossocerus annulipes, asward, barbipes, cetratus, elongatulus, megacephalus, vagabundus* *Ectemnius continuus, dives, lapidarius, ruficornis, sexcinctus* *Lestica clypeata* *Mimumesa dahlbomi* *Pemphredon inornata, lugubris* *Stigmus solkyi* **Vespidae**: *Symmorphus bifasciatus*	Austria, Belgium, Germany, India, Italy, Poland, Ukraine	Ebermann & Hall, 2003 present study
I. (I.) ithacensis **Delfinado & Baker, 1976**	**Apidae**: *Dialictus rohweri*	USA	Delfinado & Baker, 1976
I. (I.) mexicanus **Delfinado & Baker, 1976**	**Apidae**: *Lasioglossum (Evylaeus)* sp.	Mexico	Delfinado & Baker, 1976
I. (I.) neotropicus **Delfinado & Baker, 1976**	**Apidae**: *Lasioglossum (Dialictus)* sp.	Chile	Delfinado & Baker, 1976
I. (I.) rafalskii **Dastych, 1978**	**Apidae:** *Dasypoda plumipes*	Poland	Dastych, 1978
I. (I.) texanus **(Cockerell, 1910)**	**Apidae**: *Nomia nortoni* var. *plebeia*	USA	Cockerell, 1910
I. (I.) vulgaris **Delfinado & Baker, 1976**	**Apidae**: *Dialictus zephyrus* *Lasioglossum titusi*	USA	Delfinado & Baker, 1976
I. (Apidacarus) apidophilus **Mahunka, 1974**	**Apidae:** *Halictus geminatus*	Hungary	Mahunka, 1974
I. (A.) paulyi **Ebermann & Fain, 2002**	**Apidae**: *Halictus (Vestitohalictus) pollinosus thevestensis* *Halictus (Seladonia) foanus, jucundus*	Algeria, Namibia, Uganda	Ebermann & Fain, 2002

possibly also in the Neotropics. Thus, carefully directed efforts might contribute to close existing gaps in the distribution of *I. haeseleri*. Consistent with this idea, a single record of *I. haeseleri* on a sphecid-species (*Crossocerus asward*) from the Oriental Region additionally supports a wider – but not yet determinable – distribution of *I. haeseleri* in the south-east of Asia.

Imparipes (Imparipes) breganti Ebermann & Hall

Material and deposition: see Ebermann & Hall, 2004.

Distribution: In contrast to *Imparipes haeseleri* and *I. apicola*, *I. breganti* shows a distribution restricted to Central Europe. Mainly found on Sphecidae, *I. breganti* is only known from for Austria, Belgium and Germany (Ebermann & Hall, 2004) (Tab. 1, 2). However, the known area of distribution very likely reflects the poor status of investigation of phoretic scutacarids on sphecids. Seven of the known 10 sphecid hosts are distributed from Central Europe to West or Central Asia *(Crossocerus elongatulus, C. ovalis, C. varus, Diodontus luperus, D. tristis, Lindenius albilabris, L. panzeri)*. *Crossocerus varus* has also been recorded from Japan; *Cerceris rybyensis* is known to be widely distributed in the Palaearctics, and the distribution area of *Lestica subterranea* even reaches the Ural. Furthermore, *Crossocerus elongatulus* is known from North America. Due to the distribution of already mentioned species throughout the Palaearctics or even the Holarctics, it can be assumed that *I. breganti* is more widely distributed than hitherto known, possibly also occuring outside Central Europe and possibly matching the distribution areas of its hosts.

TAB. 2

The records of *Imparipes apicola, I. haeseleri* and *I. breganti*. The numbers in the brackets show (1) the total number of localities and (2) the total number of collected mites in this country. **?** = records of *I. apicola* in the USA published by Cross & Bohart (1969, 1992), who mentioned only federal states, but not the exact localities and numbers of mites in the hymenopteran nests.

Europe	Asia	North America
Imparipes apicola		
AUT (8/91)		CAN (1/8)
BEL (1/1)		MEX (1/10)
GER (8/19)		USA: IDA (?),MAS (1/8), NEV (?),
POL (1/1)		NY (11/140), WYO (?), UT (?)
Imparipes haeseleri		
AUT (23/65)	IND (1/1)	
BEL (4/11)		
GER (20/384)		
ITA (1/1)		
POL (1/1)		
UKR (3/18)		
Imparipes breganti		
AUT (16/33)		
BEL (2/3)		
GER (5/59)		

ACKNOWLEDGEMENTS

We express our sincere thanks to Dr K. Adlbauer (Landesmuseum Joanneum Graz, Austria), Prof. Dr G. Alberti (Ernst-Moritz-Arndt-Universität, Greifswald, Germany), E. Bregant † (Graz, Austria), Dr H. Dastych (Zoologisches Institut und Zoologisches Museum der Universität Hamburg, Germany), Prof. Dr G. C. Eickwort † (Cornell University, Ithaca N.Y., USA), Prof. Dr A. Fain (Institut Royal de Zoologie, Brussels, Belgium), Mag. F. Gusenleitner (Biologiezentrum OÖ Landesmuseum Linz, Austria), Dr J. Gusenleitner (Linz, Austria), Prof. Dr V. Haeseler (Universität Oldenburg, Germany), Dr U. Hausl-Hofstätter (Landesmuseum Joanneum Graz, Austria), Dr M. Kuhlmann (Universität Münster, Germany), Dr G. Raspotnig, Prof. Dr R. Schuster and Dr S. Weiss (Karl-Franzens-Universität, Graz, Austria).

REFERENCES

BANKS, N. 1904. A treatise on the Acarina, or mites. *Proceedings of the United States National Museum* 28: 1-114.

BANKS, N. 1906. Description of some new mites. *Proceedings of the Entomological Society of Washington* 7 (1905): 133-142.

BANKS, N. 1914. New Acarina. *Journal of Entomology and Zoology* 6: 55-66.

BLÖSCH, M. 2000: Die Grabwespen Deutschlands. Lebensweise, Verhalten, Verbreitung. *Die Tierwelt Deutschlands* 71: 1-480.

COCKERELL, T. D. A. 1910. Descriptions and records of bees. XXXII. *The Annals and Magazine of Natural History* 6 (8): 272-284.

CROSS, E. A. & BOHART, G. E. 1969. Phoretic behavior of four species of alkali bee mites as influenced by season and host sex. *Journal of the Kansas Entomological Society* 42: 195-219.

CROSS, E. A. & BOHART, G. E. 1992. The biology of *Imparipes apicola* (Acari: Scutacaridae) and its relationships to the alkali bee, *Nomia melanderi* (Hymenoptera: Halictidae), and to certain fungi in the bee cell ecosystem. *Journal of the Kansas Entomological Society* 65 (2): 157-173.

DASTYCH, H. 1978. *Imparipes (Imparipes) rafalskii* sp. nov. (Acari, Tarsonemina) a new species of scutacarid mite from Poland. *Bulletin de l'Académie Polonaise des Sciences. (série des sciences biologiques Cl. II.)* 26 (4): 251-255.

DELFINADO, M. D. & BAKER, E. W. 1976. New species of Scutacaridae (Acarina) associated with insects. *Acarologia* 28 (2): 264-301.

EBERMANN, E. 1988. *Imparipes (Imparipes) pselaphidorum* n. sp., a new scutacarid species phoretic upon african beetles (Acari, Scutacaridae; Coleoptera, Pselaphidae). *Acarologia* 29 (1): 35-42.

EBERMANN, E. & FAIN, A. 2002. A new subgenus of phoretic mite (Acari: Scutacaridae) associated with African halictid bees (Hymenoptera: Halictidae). *International Journal of Acarology* 28 (4): 367-371.

EBERMANN, E. & HALL, M. 2003. First record of Sporothecae within the mite family Scutacaridae (Acari, Tarsonemina). *Zoologischer Anzeiger* 242: 367-375.

EBERMANN, E. & HALL, M. 2004. A new species of scutacarid mites transferring fungal spores (Acari, Tarsonemina). *Revue suisse de Zoologie* 111 (4): 941-950.

EBERMANN, E. & HALL, M. 2005: Examination on the distribution and morphology of the mite species *Imparipes (I.) apicola* (BANKS, 1914) (Acari, Scutacaridae). *Mitteilungen des Naturwissenschaftlichen Vereines für Steiermark* 134: 189-197.

EICKWORT, G. C. 1979. Mites associated with Sweat Bees (Halictidae) (pp. 575-581). *In*: RODRIGUEZ, J. G. (ed.). Recent Advances in Acarology, vol. 1, *Academic Press, New York*.

EICKWORT, G. C. 1990. Associations of mites with social insects. *Annual Review of Entomology* 35: 469-488.

EICKWORT, G. C. 1994. Evolution and life-history patterns of mites associated with bees. *In*: HOUCK, M. A. (ed.). Mites. Ecological and evolutionary analyses of life-history pattern: 218 - 251. *Chapman & Hall, New York, London*.

FAIN, A., ENGEL, M. S., FLECHTMANN, C. H. W. & OCONNOR, B. M. 1999. A new genus of Acaridae (Acari) phoretic on *Thectochlora alaris* (Hymenoptera: Halictidae: Augochlorini) from South America. *International Journal of Acarology* 25 (3): 163-172.

KUHLMANN, M. 1998. Nachweise mit Bienen und Wespen (Hymenoptera Aculeata) assoziierter Milben (Acari) und Fächerflügler (Strepsiptera). *Linzer biologische Beiträge* 30 (1): 69-80.

LINDROTH, C. H. 1957. The faunal connections between Europe and North America. *Almqvist & Wiksells, Uppsala*, 344 pp.

MAHUNKA, S. 1969. *Imparipes (I.) eickworti* sp. n., a new Scutacarid mite (Acari, Tarsonemina) from *Dialictus umbripennis* Ellis (Hym.). *Parasitologica Hungarica* 2: 153-158.

MAHUNKA, S. 1974. Beiträge zur Kenntnis der an Hymenopteren lebenden Milben (Acari), I. *Annales Historico-Naturales Musei Nationalis Hungarici* 66: 389-394.

MICHENER, C. D. 2000. The bees of the world. *The Johns Hopkins University Press, Baltimore*, 913 pp.

MICHENER, C. D., MCGINLEY, R. J. & DANFORTH, B. N. 1994. The bee genera of North and Central America. *Smithsonian Institution Press, Washington*, 209 pp.

WESTRICH, P. 1990. Die Wildbienen Baden-Württembergs. 2 Vol., 2. edition. *Ulmer, Stuttgart*, 972 pp.

Revue suisse de Zoologie 112 (1): 225-252; mars 2005

Two new *Cyclocosmia* (Araneae: Ctenizidae) from Thailand

Peter J. SCHWENDINGER
Muséum d'histoire naturelle de Genève, Case postale 6434, CH-1211 Genève 6, Switzerland. E-mail: peter.schwendinger@mhn.ville-ge.ch

Two new *Cyclocosmia* (Araneae: Ctenizidae) from Thailand. - Two new species of the peculiar trapdoor spider genus *Cyclocosmia, C. siamensis* sp. n. and *C. lannaensis* sp. n., are described from male and female specimens collected in Thailand and are compared with *C. ricketti* (Pocock) from China. Notes are given on taxonomic characters, variation, relationships, biology and the distribution of all three species.

Keywords: *Cyclocosmia* - *C. ricketti* - *C. siamensis* - *C. lannaensis* - new species - taxonomy - Thailand - trans-Pacific disjunction - biology.

INTRODUCTION

The species of *Cyclocosmia* are spectacular trapdoor spiders which possess a truncate opisthosoma that ends in a heavily sclerotized round plate or disc similar to a manhole cover. This disc serves as a false bottom with which the spider seals a constriction in the lower portion of its burrow when molested (Gertsch & Platnick, 1975: 1, figs 6-8; Preston-Mafham & Preston-Mafham, 1984: 143, fig. 7.5). Similar though less pronounced modifications of the opisthosoma for burrow plugging are also found in the idiopid genera *Galeosoma* (Africa) and *Idiosoma* (Australia) (Gertsch & Platnick, 1975: 1-2). Phragmotic opisthosomata or abdomina are quite rare (in contrast to phragmotic heads in many ant and termite species) and elsewhere found only in larvae of psilopsocid Psocoptera (Smithers, 1995), in adults of elipsocid Psocoptera (Smithers, 1997) and in adults of wood-boring bostrychid beetles.

The four species of *Cyclocosmia* hitherto known are: *C. truncata* (Hentz, 1841) and *C. torreya* Gertsch & Platnick, 1975 from the USA, *C. loricata* (C. L. Koch, 1842) from Mexico and Guatemala, and *C. ricketti* (Pocock, 1901) from China and allegedly also from Thailand. The latter species was originally described from Fujian Province in eastern China, and later also reported from another unspecified locality in China (Song *et al.* 1999: pl. 1, figs A, B), from northeastern (Gertsch & Platnick, 1975: 19) and from northern Thailand (Huber, 1995a, b; Schwendinger, 1996). The records from Thailand are here attributed to a new species. Although *C. ricketti* was described more than a hundred years ago and the genus appears to be widely distributed in East and Southeast Asia, little is known on the biology of these conspicuous spiders, and males from this region remained unknown.

Manuscript accepted 09.07.2004

FIG. 1
Records of *Cyclocosmia* in Thailand. *Cyclocosmia lannaensis* sp. n.: 1. Doi Tung. *Cyclocosmia siamensis* sp. n.: 2. Doi Chiang Dao (unconfirmed record), 3. Doi Suthep, 4. Ban Khok, 5. Phu Phan, 6. Khao Yai.

During extensive fieldwork in Thailand I collected *Cyclocosmia* at several localities in northern and northeastern Thailand (Fig. 1), raised juvenile males to maturity and obtained some data on the biology of these spiders. Siegfried Huber made additional specimens from northern Thailand available for study. Examination of this material revealed that two species are present, both of which are new to science and are described below. This adds two most attractive new species to the rapidly increasing number of spider records from Thailand.

MATERIAL AND METHODS

External morphology was studied and drawn with a Zeiss SV11 stereomicroscope, the vulvae with a Nikon Optiphot compound microscope (both with a drawing tube). Vulvae were cleared in KOH or made transparent with warm lactic acid. Opisthosomal discs of exuviae and of specimens were photographed with a ZEISS DSM-940A scanning electron microscope and with the AutoMontage® system using a video camera mounted on a Leica MZ APO stereomicroscope, respectively.

Body measurements were taken with a stereomicroscope and are given in mm. Total body length includes the chelicerae. Lengths of leg and palp articles were measured on their dorsal side, from midpoint of anterior margin to midpoint of posterior margin. The number of corresponding structures on the left and right side of the body, if different from each other, are separated by a stroke. Rib numbers on the opisthosomal discs were counted according to Gertsch & Platnick (1975: 2-3). These refer only to the ribs that end below the disc angles, and only to those of one side in between the pair of paramedian upper ribs that border on the dorsoventral midline (not included in the count) and the last lower rib (included) running transversally across the disc between both lower muscle impressions. The opisthosomal disc diameter refers to the maximal distance between the peripheral margins of ribs on the disc and does not include the rib angles. Measurements of eye diameters and interdistances are based on the dimensions of the whole eye lenses, not just their light-coloured central portions. The curvature of the eye rows refers to an imaginary line running through the centre of each eye in the same row.

Abbreviations. IZCAS - Institute of Zoology, Chinese Academy of Sciences, Beijing, PR Cina; MHNG - Muséum d'histoire naturelle, Geneva, Switzerland; NHML - Natural History Museum of London (formerly British Museum of Natural History), England. AME, ALE, PME, PLE - anterior (posterior) median (lateral) eyes; d - dorsal, pd - prodorsal, pl - prolateral, pv - proventral, rd - retrodorsal, rl - retrolateral, rv - retroventral, v - ventral.

RESULTS

Cyclocosmia ricketti (Pocock, 1901) Figs 2-8, Pl. 1D

Halonoproctus ricketti Pocock, 1901: 209-210, pl. 21, figs 1-1d (description of ♀ holotype).
Cyclocosmia ricketti. - Simon (1903: 885-887, figs 1044-1047). - Berland (1932: 117, fig. 239). - Gerhardt & Kästner (1938: 587, fig. 715). - Gertsch & Platnick (1975: 18-19, figs 28-29, 32, 36; partim). - Song *et al.* (1999: cover, 36, fig. 16h, k-l, pl. 1a-b). - Murphy & Murphy (2000: 62, 485). - Platnick (2004; partim).

Material examined

♀ *holotype*: CHINA, N.W. Fokien (= Fujian) Prov., Kuatun, autumn 1896, leg. C. B. Rickett & J. de la Touche (NHML 1898.9.5.1).

CHINA, Sichuan Province, Lushan County, Longmen Town, near Longmen Cave (30.00°N, 102.44°E), 1050 m, 2 ♀, 6.VII.2004, leg. S. Li (IZCAS, n° Xu 033; MHNG).

Extended diagnosis

Females of *Cyclocosmia ricketti* are distinguished by the following combination of characters: Anterior margin of eye tubercle steeply rising; 4 long bristles in longituninal row running through eye field; lenses of PME as long as or longer than those

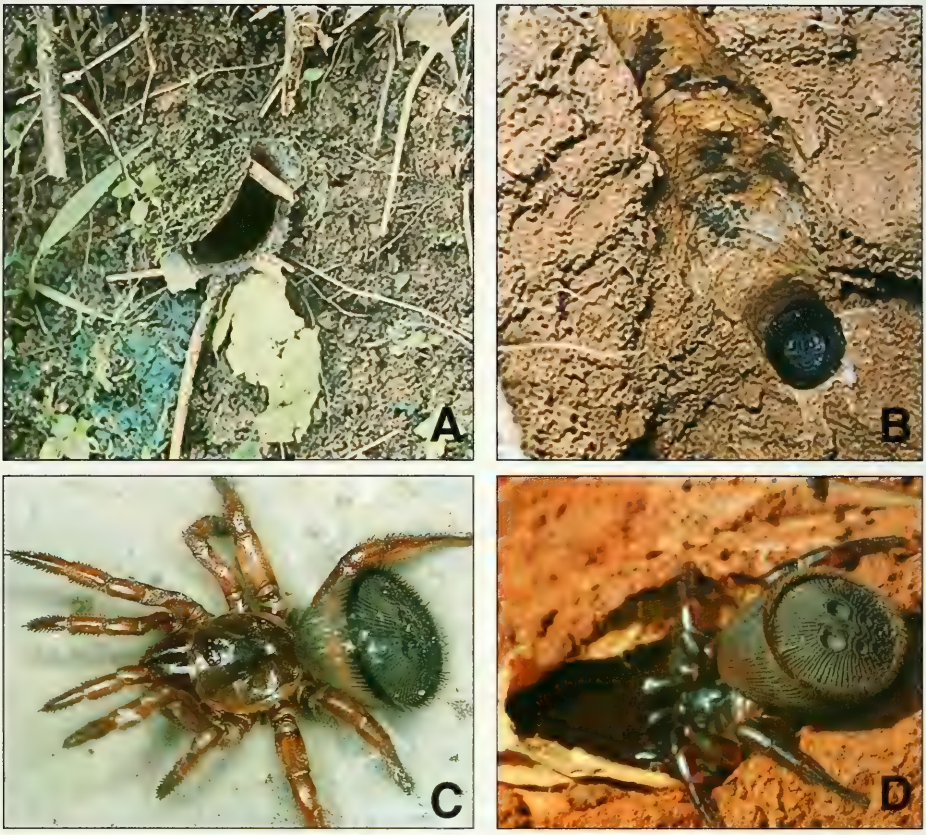
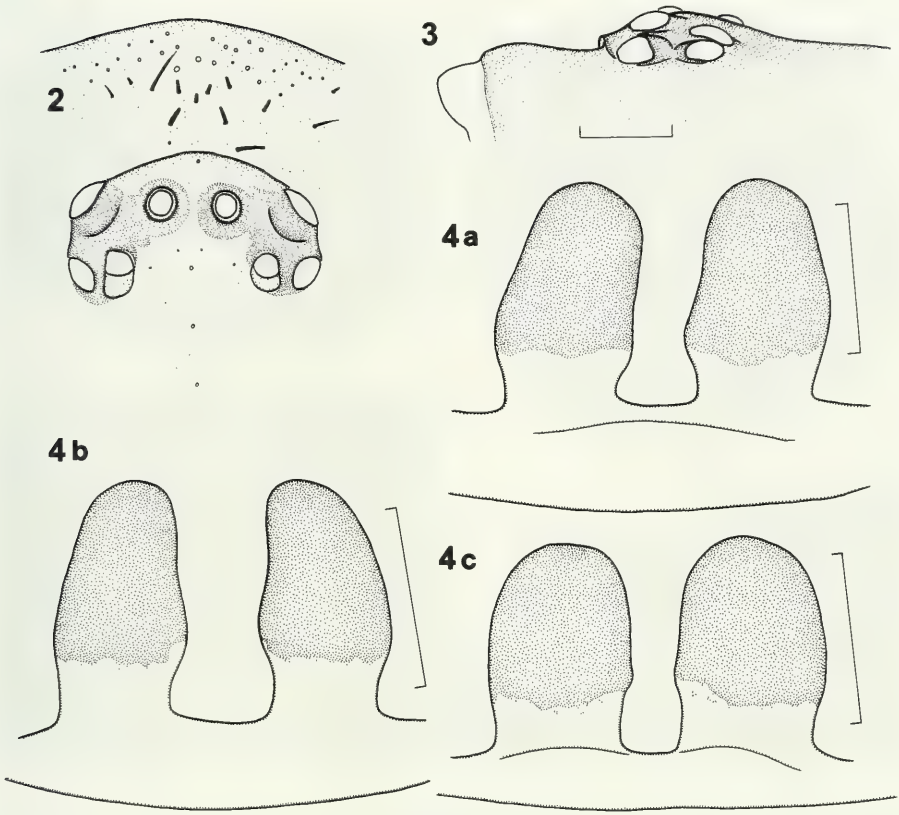


PLATE 1

A. *Cyclocosmia lannaensis* sp. n., burrow entrance with slightly opened trapdoor; note fresh leaf attached to entrance rim. B. Same burrow, upper portion removed, opisthosomal disc of spider in plugging position. C. *Cyclocosmia siamensis* sp. n., ♀. D. *Cyclocosmia ricketti* (Pocock), ♀ from Sichuan (photo by P. Jäger).

of PLE; anterior part of opisthosoma strongly sclerotized (Fig. 6, Pl. 1D); opisthosomal disc with oval upper pair of muscle impressions separated from median pair by only 1 transversal rib, second (lower) transversal rib running into upper portion of ring around median muscle impression (Fig. 5, Pl. 1D); these rings and intermediate transversal ribs thick; ribs of opisthosomal disc covered with small granules, no fine hairs or elevated tubercles present (Fig. 8); setae on rib angles copper-coloured, all strongly bent away from centre of disc (none directed toward centre) and of different sizes, with median setae of each rib angle clearly longer than lateral ones (most distinctly so on lower rib angles) (Fig. 7); crescent-shaped sclerite behind spinnerets separated by distinct suture from unpaired rib angles posterior to it (Fig. 6); spermathecae fairly short and wide, not constricted in median portion (Fig. 4), very similar to those of *C. siamensis* sp. n. (see Figs 17-21).



FIGS 2-4

Cyclocosmia ricketti (Pocock). 2. Eye group and clypeus of ♀ holotype, dorsal view. 3. Same, lateral view. 4a. Vulva of holotype, dorsal view. 4b-c. Vulvae of 2 ♀ from Sichuan. Scale lines 1.0 mm.

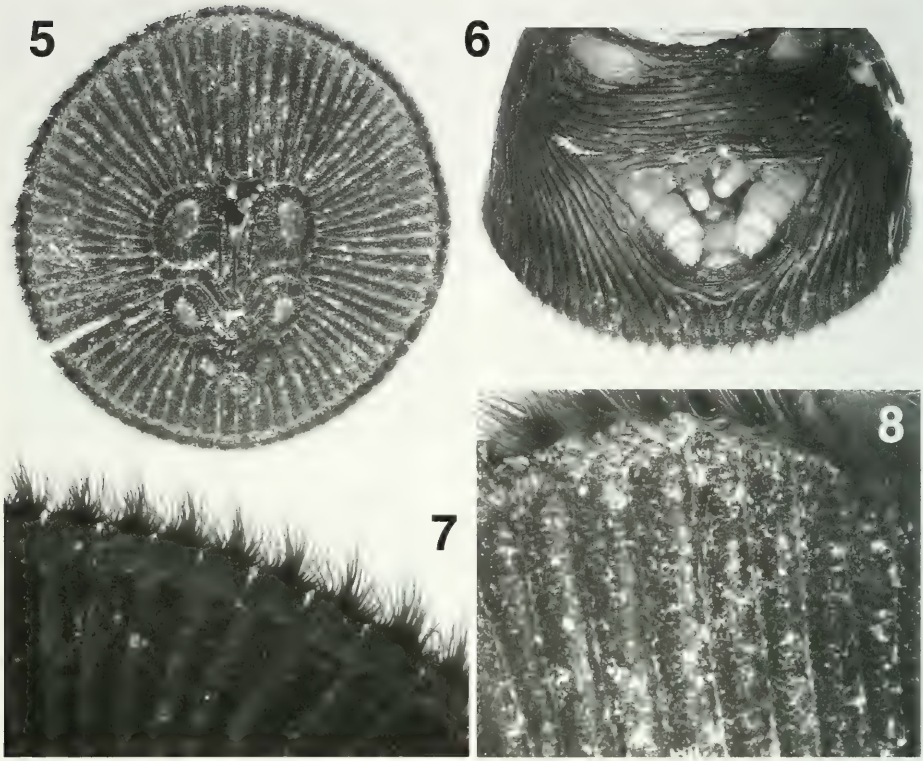
VARIATION

Measurements and rib counts of 3 ♀ (first value refers to holotype). Body length ca. 30, 27.0, 27.3; carapace length 11.7, 10.5, 10.8, width 10.5, 9.4, 9.5; opisthosoma length ca. 15, 13.7, 14.8, width 16.5, 15.3, 15.8; disc diameter 15.8, 13.8, 14.4; rib counts 30/32, 23/24, 24.

Eye tubercle of holotype anteriorly with a distinct ledge (Figs 2, 3); not so in other females examined. Labium with 5 (in holotype), 4, 2, and maxillae with 14-22 cuspules. Palpal patellae with 2/3 proventral spines in holotype, only 1 such spine in both other specimens. Disc ribs of both specimens from Sichuan with less distinctly granular surface than in holotype. Variation of spermathecae, see Fig. 4 and Song *et al.* (1999: fig. 16H).

REMARKS

Most legs and one palp of the holotype are partly or completely detached and were therefore not measured again. The opisthosoma is detached from the prosoma and



FIGS 5-8
Cyclocosmia ricketti (Pocock), ♀ holotype. 5. Opisthosomal disc, caudal view. 6. Posterior portion of opisthosoma, ventral view. 7. Setae on disc angles. 8. Detail of opisthosomal disc.

has been pinned through its axis, probably for taking the drawings in the original description.

The female illustrated in Song *et al.* (1999; no locality given; not examined) partly corresponds with the holotype of *C. ricketti* in the shape of its genitalia (Song *et al.* 1999: fig. 16H) and of its opisthosomal disc (Song *et al.* 1999: pl. 1B). However, the drawing of the disc (Song *et al.* 1999: fig. 16L; taken from the same specimen?) shows two transversal ribs separating the upper two pairs of muscle impressions, which is characteristic for both new species described below. This presumably is a mistake by the artist who made this drawing.

Males of this species are still unkown.

RELATIONSHIPS

Cyclocosmia ricketti is most colesly related to *C. siamensis* sp. n. Morphological differences (see paragraph Variation) between the specimens from Fujian and from Sichuan are here regarded as intraspecific variation, but may turn out to be of specific relevance when more material of both sexes becomes available.

BIOLOGY

Both females from Sichuan Province were collected in early July. Their burrows were situated the base of soil banks between fields. As shown on photos taken by S. Li at least one of them had a fairly long thin twig attached to the entrance. Each of these spiders had an egg sac suspended in the lower portion (at about 2/3) of its burrow (P. Jäger, pers. commun.).

DISTRIBUTION

This species appears to have a fairly wide distribution in central and eastern China. The type locality "Kuatun" cannot be identified, but the northwestern part of Fujian Province is about 1500 km away from Longmen Cave in Sichuan Province.

Cyclocosmia siamensis sp. n. Figs 9-30, Pl. 1C

Cyclocosmia ricketti. - Gertsch & Platnick, 1975: 18-19, figs 28-29, 32, 36; description of ♀ under *C. ricketti*). - Huber (1995a: 6-7, photo) - Huber (1995b: 1-6, photo). - Schwendinger (1996: 579).

MATERIAL EXAMINED

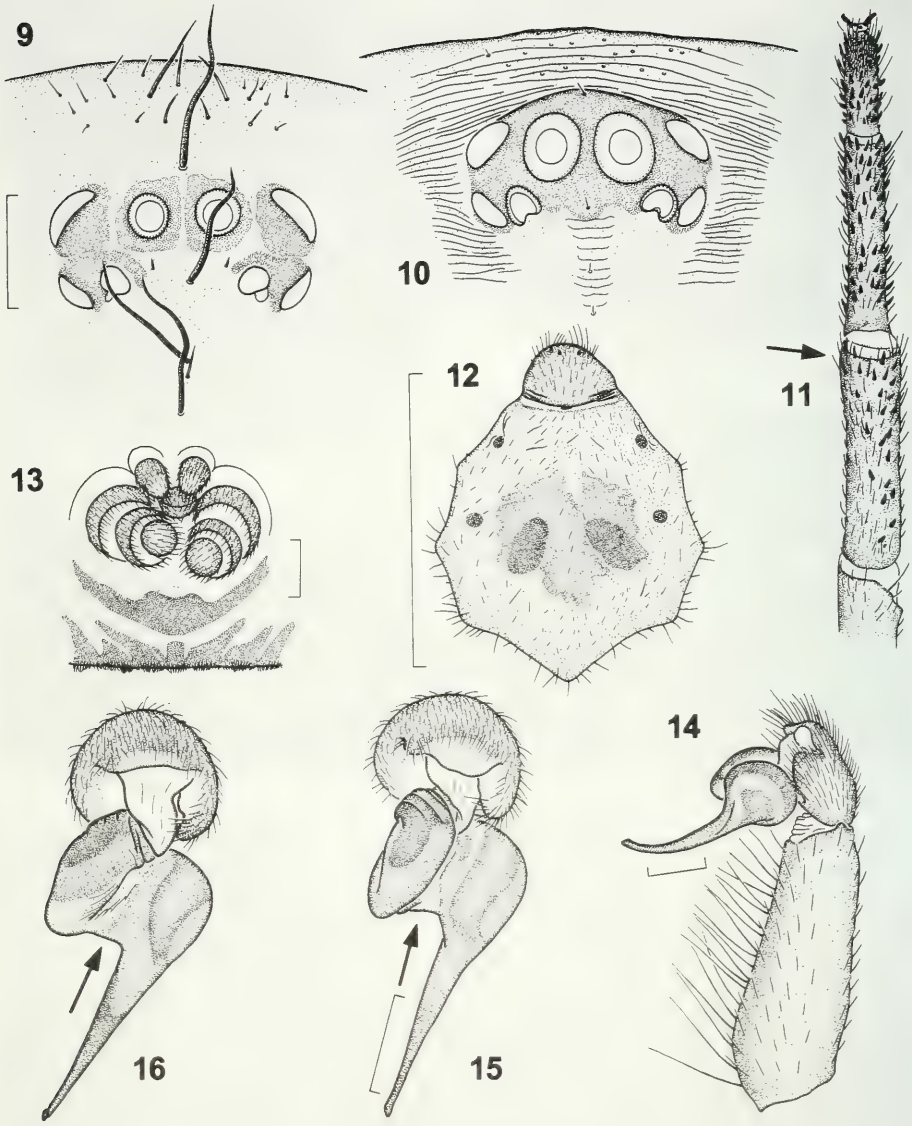
♀ *holotype**: THAILAND, Nakhon Ratchasima Province, Pak Chong District, Khao Yai National Park, near Kong Kaeo Waterfall, 680 m, 20.XII.1993, leg. P.J. Schwendinger (MHNG).

Paratypes: From the type locality: 2 ♀ and 1 ♂ (moulted 25.IV., 10.IX.1995, 13.VII. 1996, matured 12.XII.1997), 20.XII.1993; 1 ♂ (moulted 1.V.1995, matured 2.I.1997), 30.IX. 1994. Kalasin Province, Somdet District, Phu Phan National Park, 480 m, 1 ♀, 1 penultimate ♂, 7.XII.1995. All leg. P.J. Schwendinger (MHNG). Chiang Mai Province and District, Doi Suthep-Pui National Park, Doi (= Mount) Suthep, near What (= Temple) Phra That Doi Suthep, ca. 1000 m, 1 ♂ (without palps; date of maturation unknown; coll. S. Huber), 30.XI.1997, 1 ♀, 2.XII.1993 (coll. S. Huber), 1 ♀, 16.XII.2003 (MHNG). All leg. S. Huber. Doi Suthep, Suan Son, 1050 m, 1 penultimate ♂, 18.XI.1997; leg. P.J. Schwendinger (MHNG).

DIAGNOSIS

Similar to *C. ricketti*, females distinguished by the following characters: Anterior portion of opisthosoma less strongly sclerotized (Pl. 1C); upper and median pair of muscle impressions on opisthosomal disc separated by two transversal ribs (Fig. 22); all ribs carrying hairs with dark, short, cylindrical, upright proximal portion and light, long, flat (hollow?), reclining distal portion (Figs 23, 24); 25 or more dark, fairly smooth, slightly curved setae of similar length on each upper rib angle; a few setae with brush-like surface microstructure rising from inner face of rib angles and bent towards disc centre (Figs 25-27); palpal patella usually with only 1 proventral spine; lenses of PME shorter than those of PLE (Fig. 10). Males characterized by: Sclerotization outside opisthosomal disc confined to small plates on disc angles (Figs 29, 30); prolateral side of tibia I with only few distal spines (Fig. 11, see arrow); patellae of anterior legs without retroventral distal spine; legs and palps relatively long, palpal tibia 53-55% of carapace length, 129-131% of bulb length (Fig. 14); left and right part of bulb in ventral view separated by wide straight gap (Figs 15, 16, see arrows). Both sexes with crescent-shaped sclerite posterior to spinnerets and anus not connected to ventral median rib angle (Fig. 13); rib counts ranging from 28 to 34.

* As distinctive characters are more easily recognizable in females and as all primary types of previously described *Cyclocosmia* species belong to this sex, female holotypes are also chosen for both new species.



FIGS 9-16

Cyclocosmia siamensis sp. n. 9. Eye group of ♀ holotype, dorsal view. 10. Eye group of ♂, dorsal view. 11. Leg I of ♂, patella to tarsus, ventral view (arrows pointing to prolateral distal spines of tibia). 12. Sternum and labium of ♂, ventral view. 13. Posterior portion of opisthosoma of ♂, ventral view. 14. Distal part of right ♂ palp, prolateral view. 15, 16. Bulbs of 2 ♂, frontal view; arrows pointing to angular distal invagination between left and right part of bulb. Scale lines 1.0 mm (9, 10, 14-16), 5.0 mm (12, 13), 6.0 mm (11, same scale line as in 12).

DESCRIPTION OF ♀ HOLOTYPE

Coloration in alcohol. Carapace and chelicerae mostly reddish brown, pars cephalica of carapace darker, with three longitudinal bands between eyes and fovea, lateral ones widening anteriorly; ventral side of prosoma lighter, except for chelicerae, maxillae, leg trochanters, labium and sternal sigilla. Opisthosoma light brown, mottled with grey dorsally; spiracles with orange margins; sclerite behind spinnerets reddish brown; opisthosomal disc and rib angles dark brown. All membranes cream.

Length 26.9. Photo of whole animal, see Pl. 1C.

Carapace 8.3 long, 7.4 wide, smooth, without dark reticulation or transverse fissures; few blunt hairs in periphery and on margin, small group of tapering bristles in front of eyes, four long bent bristles in longitudinal row running through eye field, pair of small, short bristles between AME and PME. Eyes on low mound, eye group rectangular, 1.01 long, 2.22 wide anteriorly, 2.12 posteriorly. Anterior eye row straight, posterior row slightly recurved (Fig. 9). Eye diameters and interdistances: AME 0.40, ALE 0.54, PME 0.28, PLE 0.38; AME-AME 0.22, AME-ALE 0.30, PME-PME 0.91, PME-PLE 0.15, ALE-PLE 0.20. MOQ 0.86 long, front width 0.95, back width 1.43. Fovea very deep and strongly procurved, occupying about one forth of carapace width at that point. Tiny pleurits present between carapace and leg coxae.

Chelicerae quite long and robust. Promargin of cheliceral groove with 19/18, retromargin with 13/14 denticles of different sizes and arranged in quite irregular rows. Rastellum carrying 1 retrolateral-proximal and about 12 distal spines.

Maxillae 3.6 long, 2.0 wide, carrying 9/12 distinct black cuspules in prolateral-proximal corner and many weaker reddish spicules distributed all over ventral surface.

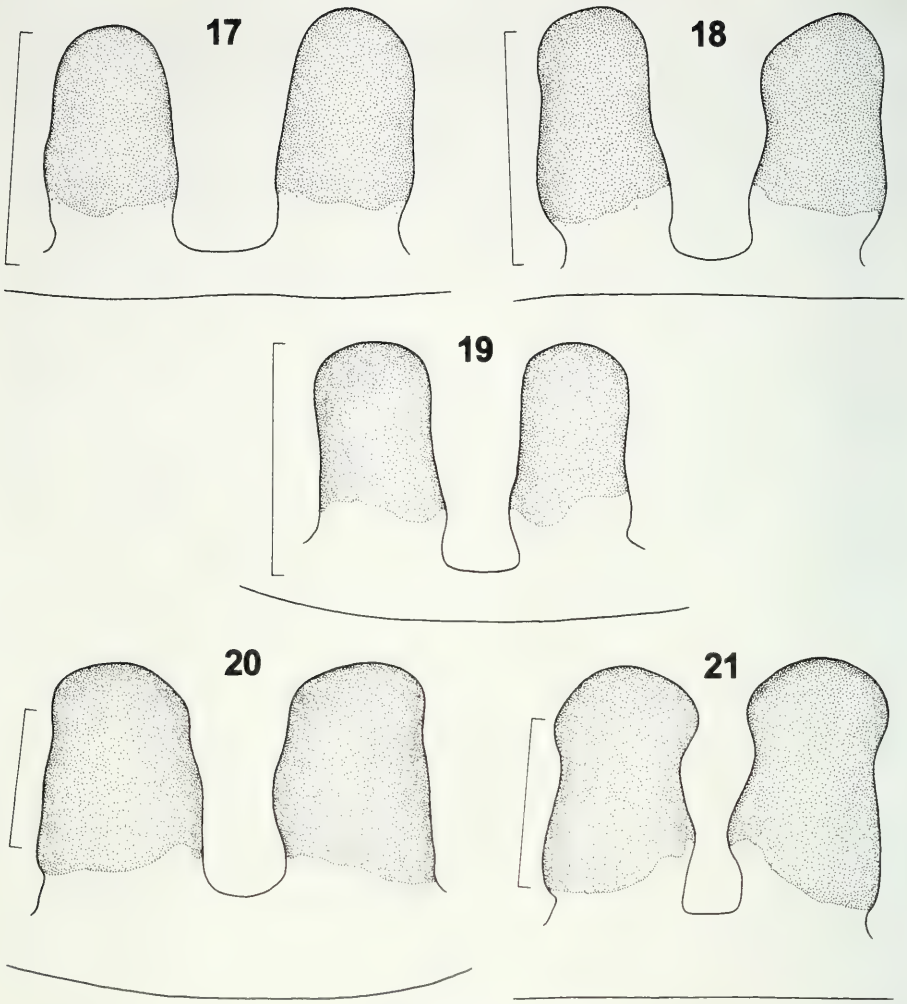
Labium 1.4 long, 1.8 wide, carrying 2 distinct black cuspules.

Sternum 5.4 long, 5.0 wide, separated from labium by shallow furrow. Three pairs of sigilla present. Two anterior pairs small, oval and submarginal, median one more remote from margin than anterior one; posterior pair of sigilla very large, medially confluent, forming shallow orchid-flower-shaped depression enclosing pair of deeper, oval paramedian depressions.

Palp with smooth surface; tarsus and metatarsus depressed. 1 pv distal spine on patella and femur, both femora additionally with 1 stiff pv subdistal bristle, right femur additionally with 1 stiff pd subdistal bristle; many pl to pv and rv to rl spines with slightly bent apices on tibia and tarsus (as also present on legs). Trichobothria: 4 pd and 3 rd in proximal half of tibia, 6/7 d in more (on right side) or less (on left side) regular row on tarsus. Palpal claw with 4/2 proximal teeth on common base.

Legs 3214, fairly short and stout, clothed with black bristles and spines; surface of articles smooth. No scopula on tarsi; no pv terminal spine on patella of anterior legs. Tarsi and metatarsi of anterior legs moderately depressed, those of posterior legs moderately compressed.

Leg spination: I, II: Many pl and rl spines with slightly bent apices on tibiae to tarsi (none on femora and patellae). III, IV: Many pd and distodorsal spines on patellae and tibiae III, IV (no distodorsal ones on retrolateral side of patella IV), d and pd spines on metatarsus III and pd spines on metatarsus IV; 1 rd, 2/3 pd, 1 pv, 1 rv distal spines on metatarsus III; 3/4 v to pv distal spines on metatarsus IV; ca. 20 rv to pd distal spines



FIGS 17-21

Cyclocosmia siamensis sp. n. Vulvae of 5 ♀, dorsal view: Holotype (17), ♀ from Khao Yai (18), ♀ from Phu Phan (19), 2 ♀ from Doi Suthep (20, 21). Scale lines 1.0 mm.

on tarsus IIII, 2/3 pv distal spines (difficult to distinguish from nearby stiff bristles) on tarsus IV.

Trichobothria: I: Tibia - 4/5 pd, 4 rd in proximal half; metatarsus - 6/9 d in distal half, irregularly arranged; tarsus - 13/17 pd to rd, irregularly arranged. II: Tibia - 4 pd, 4/5 rd in proximal half; metatarsus - 7/8 d in distal half, irregularly arranged; tarsus - 15/16 pd to rd, irregularly arranged. III: Tibia - 5 pd, 5 rd in proximal half; metatarsus - 5 d in distal half, irregularly arranged; tarsus - 16/18 pd to rd, irregularly arranged. IV: Tibia - 6/7 pd, 6/7 rd in proximal half; metatarsus - 6 d in distal half, irregularly arranged; tarsus - 9/10 d, irregularly arranged.

Paired tarsal claws with 1-2 proximal teeth; unpaired claws bare.

Opisthosoma 12.8 long, 11.9 wide. Disc strongly sclerotized, with 3 pairs of muscle impressions; 2 transversal ribs separating upper and median pair of muscle impressions (Fig. 22); 2 pairs of setae rising from rims of muscle impressions; ribs clothed with fine hairs divided into short, cylindrical, dark upright portion and long, flat, light portion (possibly hollow) bent towards (or lying on) disc surface (Figs 23-25); rib angles distinctly elevated, distally carrying more than 25 long and smooth bristles of more or less similar length and slightly bent away from disc (Figs 25, 26); a few bottlebrush-like bristles rising from posterior surface of rib angles and bent towards disc centre (Figs 25-27). Opisthosoma outside disc sparsely covered with dark needle-like bristles. Two ribs in posterior part of dorsal side of opisthosoma interrupted by indistinct small, longitudinally elliptical, bold spot with leathery surface (remnant of opisthosomal tergite as present in ♂♂ of Atypidae?).

Crescent-shaped sclerite posterior to spinnerets and anus not connected to ventral median rib angle.

Posterior median spinnerets digitiform, 1.3 long; posterior lateral spinnerets 3-segmented, 2.7 long (proximal segment 1.2, median 0.8, distal 0.7).

Vulva (Fig. 17). Spermathecae fairly wide, with almost parallel sides and broadly rounded apices.

DESCRIPTION OF ♂ (MATURED 2.I.1997)

Coloration in alcohol. Prosoma and limbs chestnut-brown, dorsal side and especially carapace darker than ventral side; palpal tibia and tarsus lighter (red-brown when alive) than other articles. Area between anterior carapace margin and fovea uniformly dark brown; in bleached specimen 3 longitudinal dark stripes discernible between eyes and fovea. Opisthosoma mostly light brown, ribs on disc darker along their slightly elevated midline, narrow lines in between ribs and muscle impressions brown, the latter with dark brown margins (Fig. 28); dorsal side of opisthosoma anteriorly with wide grey-brown area reaching middle of rudimentary tergite (Fig. 29); ventral side with orange-brown quadrangular or slightly trapezoidal area (not present in ♀♀) anterior to genital orifice, spiracles with orange-brown margins; crescent-shaped sclerite behind spinnerets brown. All membranes cream.

Length 22.8.

Carapace 7.4 long, 7.1 wide, with dark reticulation over most of its surface and with thin transverse fissures running across area between carapace front margin and fovea (Fig. 10); few short, blunt bristles in front of eyes and in longitudinal row on and behind eye mound, otherwise carapace glabrous; no pair of bristles between AME and PME discernible.

Eyes on low mound, eye group rectangular, 0.96 long, 2.17 wide anteriorly, 2.05 posteriorly. Anterior eye row slightly procurved, posterior row slightly recurved (Fig. 10). Eye diameters and interdistances: AME 0.59, ALE 0.49, PME 0.33, PLE 0.41; AME-AME 0.10, AME-ALE 0.12, PME-PME 0.89, PME-PLE 0.02. MOQ 0.94 long, front width 1.11, back width 1.47. Fovea very deep and strongly procurved, occupying one fifth of carapace width at that point. Tiny pleurites between carapace and leg coxae.

Chelicerae relatively long and slender. Promargin of cheliceral groove with 15, retromargin with 11 denticles of different sizes, arranged in more or less regular rows.

Rastellum slender, composed of 1 retrolateral-proximal spine and 11 distal spines on strongly elevated mound.

Maxillae 3.3 long, 1.8 wide, carrying 1/2 small and several tiny cuspules in prolateral-proximal corner; black needle-like hairs (reddish spicules in ♀♀) distributed over entire surface.

Labium (Fig. 12) 1.1 long, 1.5 wide, carrying 1 small and 3 larger cuspules.

Sternum (Fig. 12) 4.6 long, 4.5 wide, separated from labium by shallow, not clearly outlined groove. Sigilla as in ♀♀.

Palp finely ornamented with small transversal fissures, sparsely clothed with short hairs, most dense hair cover on dorsal side of tarsus, longest hairs on ventral side of tibia. Tarsus short, with invagination separating apical emargination from rounded prolateral-distal lobe. No spines present. Trichobothria: 3 pd and 3 rd in proximal half of tibia, 6 d in oblique row on tarsus. Bulb divided by deep furrow on ventral surface, both halves distally separated by wide, angular invagination (Figs 15, 16, see arrows). Embolus slender and tapering, with compressed and slightly widened apex.

Legs 3214, distinctly longer than in ♀♀, finely ornamented with small transversal fissures (these most pronounced on femora), clothed with short black (blunt or pointed) bristles and black spines. Distal leg segments cylindrical. All tarsi with thin ventral scopula covering slightly less than distal half on leg I and about distal two thirds on other legs, extending over entire width of ventral side of tarsi on all legs except leg IV; longitudinal row of 7/8 spines running through tarsal scopula on leg IV, 9/11 on leg III, 4 on leg II and only 1 spine present inside scopula on leg I.

Leg spination: I: Tibia - 26/29 pv to rv, 4 of them pv, few rv; metatarsus - 57/58 pv to rv; tarsus 22 pl to pv, 2 v, 26 rv. II: Tibia - 31 pv to rv; metatarsus - about 70 pv to rv; tarsus - 28 pl to pv, 8 v, 28 rv to rl. III, IV: Many spines pl to rl on tibiae to tarsi, but none on rl side of metatarsus IV; about 5 (difficult to delimit) dorsodistal spines on metatarsus III.

Trichobothria: I: Tibia - 4 pd, 3/4 rd in proximal half; metatarsus - 4/5 d in distal half; tarsus - 13 d to rd, irregularly arranged. II: Tibia - 4 pd, 4 rd in proximal half; metatarsus - 5/6 d in distal half; tarsus - 13 d to rd, irregularly arranged. III: Tibia - 3/4 pd, 4 rd in proximal half; metatarsus - 4/5 d in distal half; tarsus - 16 d to rd, irregularly arranged. IV: Tibia - 6/7 pd, 6/7 rd in proximal half; metatarsus - 6/7 d in distal half; tarsus - 8 d to rd, irregularly arranged.

Paired tarsal claws with 2 proximal teeth, 1 large principal tooth more distally and 1 small or tiny secondary one more proximally. Unpaired claws bare.

Opisthosoma 10.2 long, 11.0 wide; disc 9.0 in diameter, distinctly less sclerotized than in ♀♀, ribs much narrower, slightly keeled, without hairs (Fig. 28). Rib count 34. Margins of opisthosomal seam indistinct, rib angles little elevated, carrying only about 20 short blunt bristles each. Ribs outside opisthosomal disc weakly developed, lightly pigmented and sclerotized only at rib angles, carrying short black hairs (Figs 29, 30). Rudimentary tergite (?) with leathery surface extending over two ribs in posterior part of dorsal side of opisthosoma (Fig. 29).

Crescent-shaped sclerite between spinnerets (plus anus) and ventral rim of opisthosomal disc moderately sclerotized, not connected to median ventral rib angle (Fig. 13).

Posterior median spinnerets digitiform, 1.0 long; posterior lateral spinnerets 2.9 long (proximal segment 1.3, median 1.0, distal 0.6).

PALP AND LEG MEASUREMENTS OF ♀ AND ♂ (IN PARENTHESES) DESCRIBED ABOVE

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	5.0 (6.2)	3.0 (3.2)	2.9 (4.3)	- -	3.6 (2.1)	14.5 (15.8)
Leg I	5.6 (7.5)	3.4 (3.6)	3.1 (5.2)	2.9 (5.7)	1.6 (2.1)	16.6 (24.1)
Leg II	4.5 (6.5)	3.0 (3.2)	2.3 (4.1)	2.3 (5.0)	1.5 (2.0)	13.6 (20.8)
Leg III	4.2 (5.8)	3.1 (3.3)	2.1 (3.7)	2.4 (5.0)	1.6 (2.4)	13.4 (20.2)
Leg IV	4.9 (7.3)	3.7 (3.8)	2.8 (4.9)	3.6 (7.1)	1.9 (3.0)	16.9 (26.1)

DESCRIPTION OF JUVENILES

Third (or later) instar juveniles (body length 4.8, carapace length 1.5, width 1.4; collected from burrow of their mother) possessing fully developed opisthosomal discs with 28-32 ribs but only 1 seta on each rib angle. Penultimate ♂♂ easily recognizable by proximally swollen palpal tarsi.

VARIATION

Measurements and rib counts: ♀♀ (n=6), ♂♂ (n=3) in parentheses. Body length < 42.2 (22.3-24.8), carapace length < 13.0 (7.7-8.6), width < 11.7 (7.0-7.7); rib counts 29-33 (28-34; in the 2 penultimate ♂ 28 and 34).

Spination of patellae: One ♀ from Khao Yai possesses 2 pv subterminal spines on its right palpal patella, 1 additional v spine on the other palpal patella (in other ♀♀ only 1 pv spine present) and 1 pv terminal spine on its right leg patella I (none in other ♀♀). Another ♀ from Khao Yai has 1 v spine on its right leg patella I (none in other ♀♀).

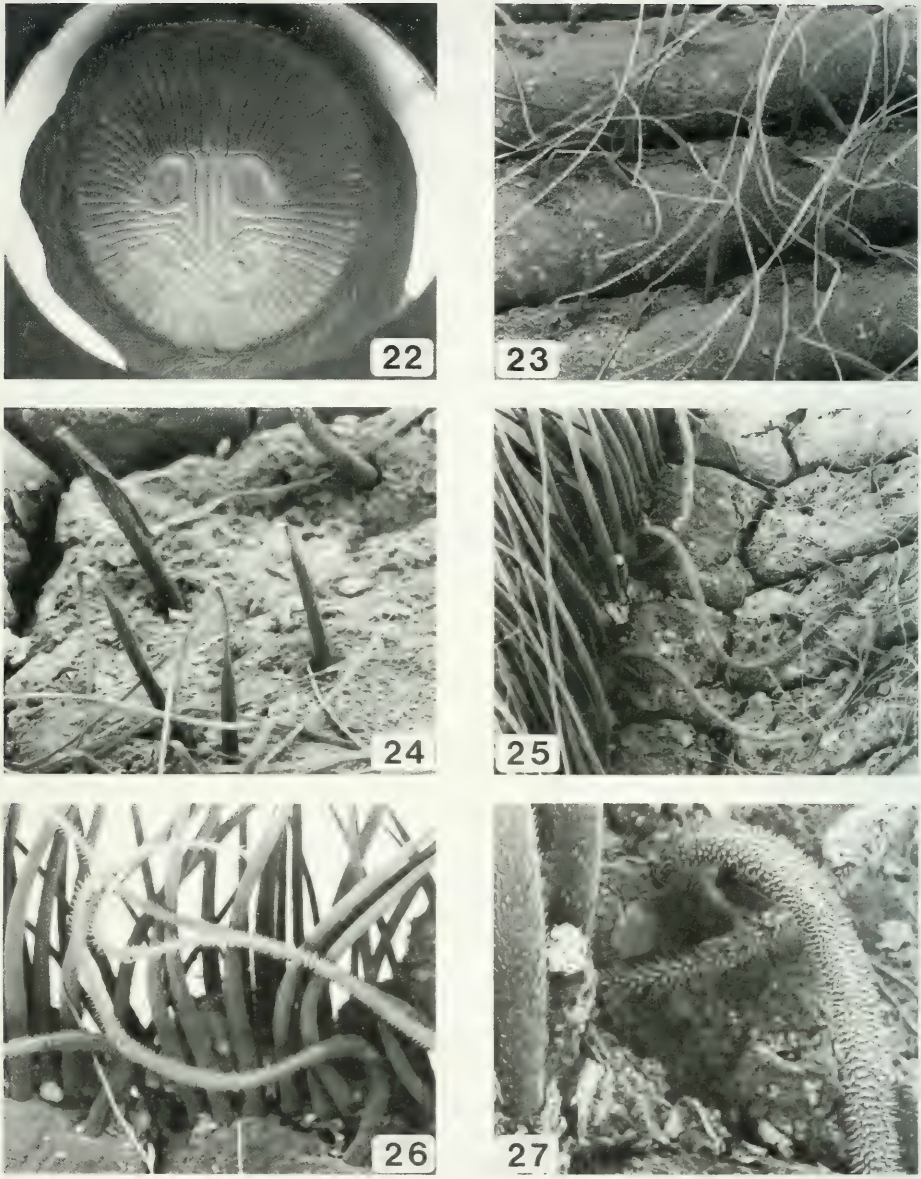
Labium with 2-5 cuspules of different sizes. In the ♀ from Phu Phan the upper pair of muscle impressions on the disc is rather quadrangular. Spermathecae are almost parallel-sided (Figs 17, 19, 20) or slightly constricted after the proximal two-thirds (Figs 18, 21), with evenly rounded (Figs 19, 21) or slightly oblique apices (Figs 17, 18, 20). Variation in ♂ genitalia, see Figs 15, 16.

REMARK

The female specimen from Ban Khok (NE-Thailand) (not examined), described under *C. ricketti* by Gertsch & Platnick (1975: 18-19; figs 28, 29, 32, 36), most likely belongs to *C. siamensis* sp. n. The illustration of its opisthosomal disc shows that two transversal ribs separate the upper and median pairs of muscle impressions and that the ribs carry short setae (Gertsch & Platnick, 1975: fig. 29), which probably correspond to the upright proximal part of the fine hairs present in all females and juveniles of this species examined. These basal parts are easily mistaken for stiff setae when regarded under a stereomicroscope with low magnification. Moreover, Ban Khok [Fig. 1 (4)] lies within the area delimited by other finds of *C. siamensis* sp. n.

RELATIONSHIPS

Cyclocosmia siamensis sp. n. is very similar and obviously closely related to *C. ricketti*.

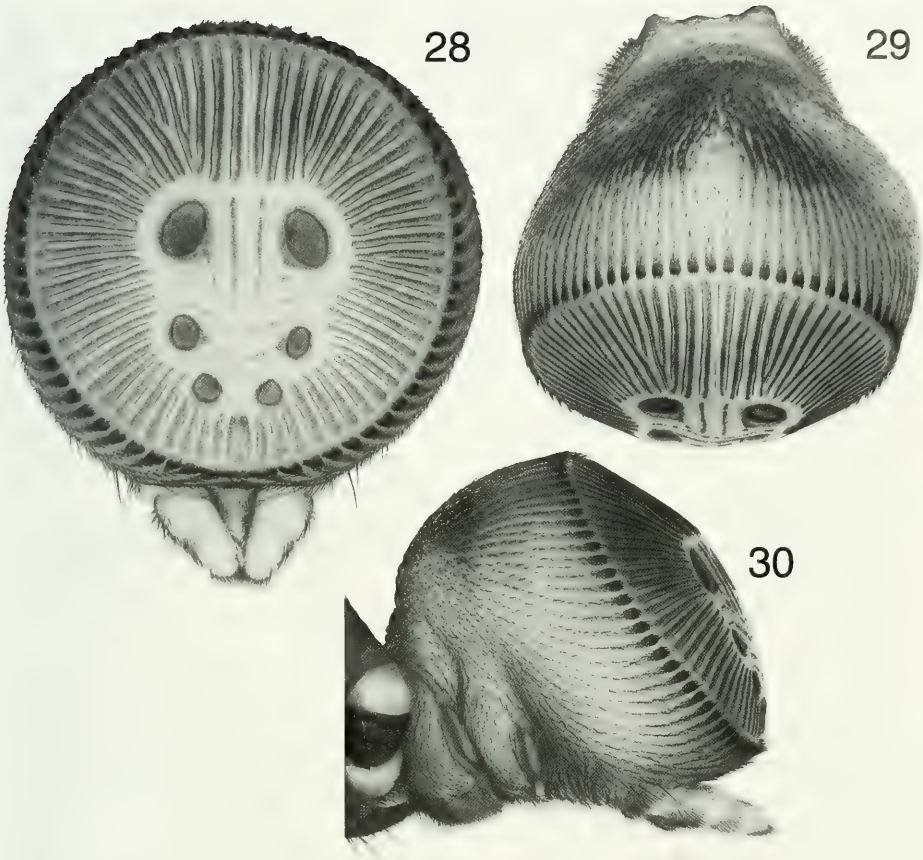


FIGS 22-27

Cyclocosmia siamensis sp. n., ♀ (SEM micrographs). 22. Opisthosomal disc, caudal view. 23, 24. Detail of ribs showing setae. 25. Detail of ribs and rib angles showing three kinds of setae. 26, 27. Detail of inner side of rib angles showing two kinds of setae.

BIOLOGY

Habitat and burrow. The specimens examined were collected from a semi-evergreen rain forest (terminology according to Whitmore, 1991) (in Khao Yai N.P.), from an evergreen hill forest (on Doi Suthep) and from an evergreen gallery forest



FIGS 28-30
Cyclocosmia siamensis sp. n., ♂. 28. Opisthosoma, caudal view. 29. Same, dorsal view. 30. Same, lateral view.

surrounded by seasonally dry deciduous forest (in Phu Phan N.P.). Most specimens were found at vertical road or path cuts, but the two specimens from Phù Phan had settled in a moderately sloping stream bank, and two specimens collected by S. Huber on Doi Suthep were taken in the middle of a level dirt road. It appears that, at least on Doi Suthep, larger specimens prefer to build their burrows into the lower portion of road cuts, whereas smaller specimens were mostly found in the higher portion (pers. commun. by S. Huber and own observations). None of the burrows was found hidden under a cover of leaf litter as described for *C. truncata* (Hunt, 1976).

Cyclocosmia siamensis sp. n. was always found together with other orthognathous spiders, like *Liphistius* spp. and *Atypus* spp., which also require humid conditions.

Borrows are typical for *Cyclocosmia*: Up to 18 cm long; entrance closed with a trapdoor (up to 1.8 cm long and 2.4 cm wide in the case of females, 1.5 cm and 2.1 cm in the case of males) and usually with some dead leaves or twigs attached to the rim

(thus enlarging the prey sensing area); burrow walls lined with a dense and tough layer of silk (especially below the entrance, less so at the narrow passages); upper and median portion of burrow wide (allowing the spider to turn round), constricted after about two thirds (where the opisthosomal disc plug is placed) and more or less distinctly widened again near the bottom. A large female with juveniles had a second constriction in the upper portion of the burrow. No prey or exuviae remnants were found inside these burrows. Prior to moulting the female from Phu Phan was weaving the trapdoor to the burrow entrance from inside.

Phenology. In captivity males (from Khao Yai) became mature in early December and at the beginning of January. The date of maturation of the male from Doi Suthep is unknown. It was not yet adult when collected at the end of November (S. Huber, in litt.). A mature female (from Phu Pan) moulted in captivity in early October; two other females (from Doi Suthep) in January and in March (S. Huber, in litt. and Huber, 1995b: 5). Soon after moulting the spiders converted the exuviae into tiny fragments, which were ejected from the burrow in pellets (fragments occasionally stored at the bottom of the burrow in captive specimens).

At Khao Yai more than a hundred juveniles (at least 3rd instar) were found below the shelter of their mother's opisthosomal disc plug at the bottom of her burrow in late December. This indicates that egg development and brooding takes a full year and that females do not reproduce annually.

DISTRIBUTION

Cyclocosmia siamensis sp. n. appears to be widely distributed in northern and northeastern Thailand [Fig. 1 (2-6)]. It presumably also occurs in Laos (maybe also in Myanmar and Cambodia), but due to insufficient sampling in this region and due to the usually rare occurrence of these spiders it is not surprising that they have not yet been found there.

In the course of a biodiversity survey by members of Chiang Mai University in 1995/96 a large *Cyclocosmia* female was collected on Doi Chiang Dao [Fig. 1 (2)]. This specimen probably also belongs to *C. siamensis* sp. n. but unfortunately it could not be traced again later to confirm species identity.

On Doi Suthep this species is locally abundant. In December 2003 S. Huber collected nine specimens from a road side of about 100 m length, and together we subsequently observed two additional occupied burrows at the same site.

Cyclocosmia lannaensis sp. n. Figs 31-55, Pl. 1A, B

MATERIAL EXAMINED

♀ *holotype*: THAILAND, Chiang Rai Province, Mae Sai District, Doi Tung, 1250 m (20°19'28.1"N, 99°49'53.1"E), 16.X.1995, leg. P. J. Schwendinger (MHNG).

Paratypes: From the type locality, 1250-1300 m: 1 ♀, 1.X.1992; 1 ♂ (moulted 8.VII.1993, 22.V.1994, 2.VI.1995, matured XII.1995), 18.XI:1992; 1 ♂ (matured 16.III.1997), 13.X.1994; 3 ♀ and 2 ♂ (one matured 29.X.1995, the other 18.I.2001), 16.X.1995. All leg. P.J. Schwendinger (MHNG).

DIAGNOSIS

Similar to *C. siamensis* sp. n., females distinguished by: All ribs of disc carrying knob-like tubercles but no hairs (Fig. 51); more than 30 dark, slightly bent bristles

present on each upper rib angle, most of them standing away from surface (Fig. 50); few setae (all with smooth surface) rising from inner side of rib angles and bending towards disc centre (Fig. 52); spermathecae fairly long and narrow, distinctly constricted medially or after proximal two thirds, their apices rounded (Figs 45-48). Males distinguished from those of *C. siamensis* sp. n. by: Rib sclerotizations outside opisthosomal disc well-developed (Figs 54, 55); patellae of anterior legs with retroventral terminal spine; prolateral side of tibia I with many distal spines (Fig. 36, see arrow); legs and palps relatively shorter, palpal tibia 47-49% of carapace length and 117-126% of bulb length (Figs 36, 38-40); left and right part of each bulb in ventral view separated by rather narrow, rounded invagination (Figs 41-44, see arrow). Both sexes with T- or Y-shaped arrangement of bristles behind AME; crescent-shaped sclerite posterior to spinnerets and anus broadly connected to ventral median rib angle (Fig. 35); upper pair of muscle impressions on disc more parallel-sided (Figs 49, 53); rib counts of opisthosomal discs ranging from 20 to 26.

DESCRIPTION OF ♀ HOLOTYPE

Coloration in alcohol. Sclerotized parts of body mostly brown, opisthosomal disc dark brown, remaining parts of opisthosoma light greyish brown; all membranes cream. Area between eyes and fovea with thin median stripe and with pair of darker, longitudinally elliptical patches posterolaterally on pars cephalica.

Length 32.8.

Carapace 10.5 long, 9.5 wide, smooth, without dark reticulation or transverse fissures; blunt hairs thinly scattered over carapace surface and aligned along carapace margin (there longest), 2 long, tapering sigmoid bristles in front of AME, 5 more (in T-shaped arrangement) behind AME. Eyes on low mound, eye group rectangular, 1.19 long, 2.47 wide anteriorly, 2.30 posteriorly. Anterior eye row slightly procurved; posterior eye row straight (Fig. 32). Eye diameters and interdistances: AME 0.49, ALE 0.74, PME 0.30, PLE 0.37; AME-AME 0.27, AME-ALE 0.35, PME-PME 1.01, PME-PLE 0.15, ALE-PLE 0.27. MOQ 1.07 long, front width 1.04, back width 1.53. Fovea very deep and strongly procurved, occupying about one forth of carapace width at that point. Tiny pleurits present between carapace and leg coxae.

Chelicerae quite long and robust. Promargin of cheliceral groove with 26/27, retromargin with 12/13 denticles of different sizes and arranged in quite irregular rows. Rastellum composed of 1 retrolateral-proximal spine and about 22 distal spines on strongly elevated mound.

Maxillae 4.3 long, 2.5 wide, carrying 18/23 distinct black cuspules in prolateral-proximal corner and many weaker reddish spicules distributed all over ventral surface.

Labium 1.7 long, 2.3 wide, carrying 4 distinct cuspules.

Sternum 6.5 long, 6.1 wide, separated from labium by shallow furrow. Three pairs of sigilla present. Two anterior pairs small, oval and submarginal, median one more remote from margin than anterior one; posterior pair of sigilla very large, medially confluent, forming shallow orchid-flower-shaped depression enclosing pair of deeper, oval paramedian depressions.

Palp with smooth surface; tarsus and metatarsus depressed. 1 pv distal spine on femur and patella, many pl to pv and rv to rl spines with slightly bent apices on tibia

and tarsus (as also present on legs). Trichobothria: 4/5 pd and 3 rd in proximal half of tibia, 7/8 d in more or less regular row on tarsus. Palpal claw with 3/2 proximal teeth on common base and 1 small denticle situated more distally.

Legs 3214, fairly short and stout, clothed with black bristles and spines; surface of articles smooth. No scopula on tarsi; no pv terminal spine on patella of anterior legs (as present in ♂♂). Tarsi and metatarsi of anterior legs moderately depressed, those of posterior legs moderately compressed.

Leg spination: I, II: Many pl and rl spines with slightly bent apices on tibiae to tarsi (none on femora and patellae) (Fig. 37). III, IV: Many pd and distodorsal spines on patellae and tibiae III, IV (no distodorsal ones on retrolateral side of patella IV), d and pd spines on metatarsus III and pd ones on metatarsus IV; 1 rd, 3/4 pd, 1 pv, 1 rv distal spine on metatarsus III; 1 pv, 1 v, 1 rv distal spine on metatarsus IV; 8-10 v to pd distal spines on tarsus IIII, 2-4 pv distal spines (difficult to distinguish from nearby stiff bristles) on tarsus IV.

Trichobothria: I: Tibia - 4 pd, 3 rd in proximal half; metatarsus - 7/8 rd to d in distal half, irregularly arranged; tarsus - 13/15 d to rd, irregularly arranged. II: Tibia - 4 pd, 4/5 rd in proximal half; metatarsus - 7/8 rd to d in distal half, irregularly arranged; tarsus - 14/15 d to rd, irregularly arranged. III: Tibia - 4 pd, 5 rd in proximal half; metatarsus - 5/6 rd to d in distal half, irregularly arranged; tarsus - 16/17 d to rd, irregularly arranged. IV: Tibia - 5/6 pd, 5 rd in proximal half; metatarsus - 5/6 rd to d in distal half, irregularly arranged; tarsus - 9 d, irregularly arranged.

Paired tarsal claws with 1-2 proximal teeth on legs I-III, 1-3 teeth on leg IV. Unpaired claws bare.

Opisthosoma 15.2 long, 14.5 wide. Disc strongly sclerotized, with 3 pairs of muscle impressions; ribs carrying knob-like tubercles (Fig. 51); no setae present on disc surface apart from 6 pairs of long bristles (upper pair staggered); 2 transversal ribs (divided into segments) separating upper and median pair of muscle impressions (Fig. 49); rib angles carrying more than 30 long and tapering bristles of similar length (Fig. 50); inner sides of rib angles with few smooth setae bent towards disc centre (Fig. 52). Opisthosoma outside disc sparsely covered with dark, needle-like bristles. Two ribs in posterior part of dorsal side of opisthosoma interrupted by indistinct rudimentary tergite (?) with leathery surface.

Crescent-shaped sclerite posterior to spinnerets (plus anus) connected to ventral median rib angle by a fairly wide stalk.

Posterior median spinnerets digitiform, 1.5 long; posterior lateral spinnerets 3.9 long (proximal segment 1.8, median 1.3, distal 0.8).

Vulva (Fig. 45). Spermathecae fairly long and narrow, distinctly constricted after proximal two thirds, its apices broadly rounded.

Description of ♂ (matured 16.III.1997)

Coloration in alcohol. Three dark longitudinal bands (becoming narrower posteriorly) between eye group and fovea; no pair of dark posterolateral patches on pars cephalica. Prosoma and limbs chestnut-brown, dorsal side and especially carapace darker than ventral side; palpal tibia and tarsus lighter (red-brown when alive) than other articles. Opisthosoma mostly light brown, with chestnut-brown ribs and muscle impressions on disc; trapezoidal area anterior to genital orifice orange-brown.

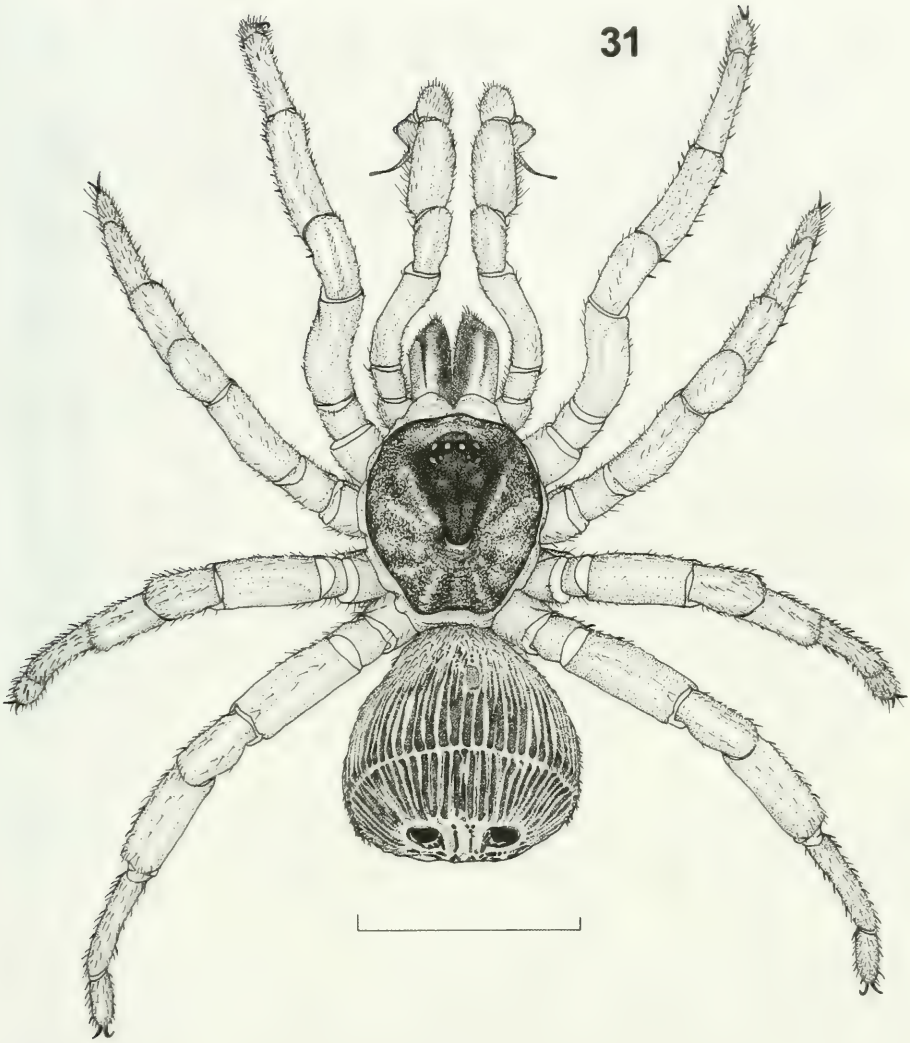
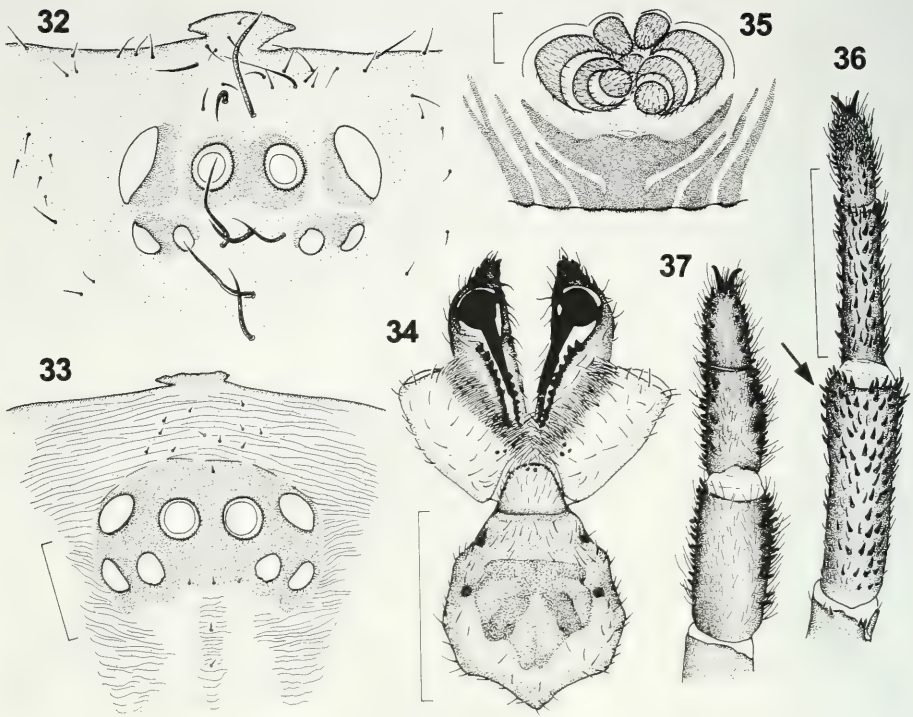


FIG. 31
Cyclocosmia lannanensis sp. n., habitus of ♂. Scale line 10.0 mm.

Length 24.8. Illustration of whole animal, see Fig. 31.

Carapace 7.6 long, 6.8 wide, with dark reticulation on most of its surface and with thin transverse fissures running across area between carapace front margin and fovea; few very short, blunt bristles in front of and behind eye mound (posterior ones in T-shaped arrangement), otherwise carapace glabrous (Fig. 33). Eye group 0.94 long, 2.05 wide anteriorly and posteriorly. Anterior eye row slightly procurved, posterior row slightly recurved (Fig. 33). Eye diameters and interdistances: AME 0.42, ALE 0.44, PME 0.35, PLE 0.36; AME-AME 0.21, AME-ALE 0.15, PME-PME 0.86, PME-PLE



FIGS 32-37

Cyclocosmia lannaensis sp. n. 32. Eye group of ♀ holotype, dorsal view. 33. Eye group of ♂, dorsal view. 34. Chelicerae, maxillae, labium and sternum of ♂, ventral view. 35. Posterior portion of opisthosoma of ♂, ventral view. 36. Leg I of ♂, patella to tarsus, ventral view. 37. Same of ♀. Scale lines 1.0 mm (32, 33, 35), 5.0 mm (34, 36, 37).

0.12. MOQ 0.84 long, front width 1.09, back width 1.38. Fovea occupying one fifth of carapace width at that point. Tiny pleurites between carapace and leg coxae.

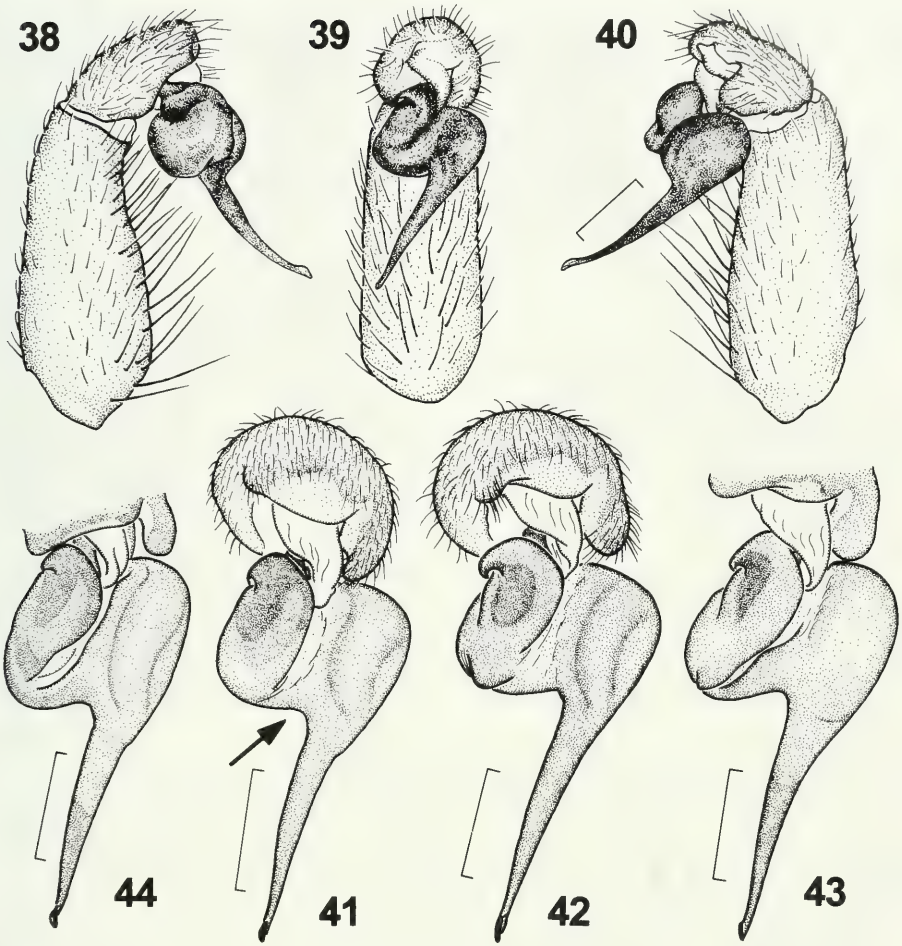
Chelicerae (Fig. 34) slightly weaker than in ♀♀. Promargin of cheliceral groove with 13/15, retromargin with 13/10 denticles of different sizes and arranged in more or less regular rows. Rastellum composed of 1 retrolateral-proximal spine and 5 distal spines.

Maxillae (Fig. 34) 3.2 long, 1.8 wide, carrying 1/0 distinct, 2/3 small and several tiny cuspules in prolateral-proximal corner; black needle-like hairs (reddish spicules in ♀♀) distributed over entire surface.

Labium (Fig. 34) 1.2 long, 1.5 wide, carrying 1 small and 1 tiny cuspule.

Sternum (Fig. 34) 4.5 long, 4.4 wide. Sigilla as in ♀.

Palp (Figs 38-41) finely ornamented with small transversal fissures, sparsely clothed with short hairs, most dense hair cover on dorsal side of tarsus, longest hairs on ventral side of tibia. No spines present. Trichobothria: 4 pd and 3 rd in proximal half of tibia, 6 d in more or less regular row on tarsus. Tarsus short, with invagination

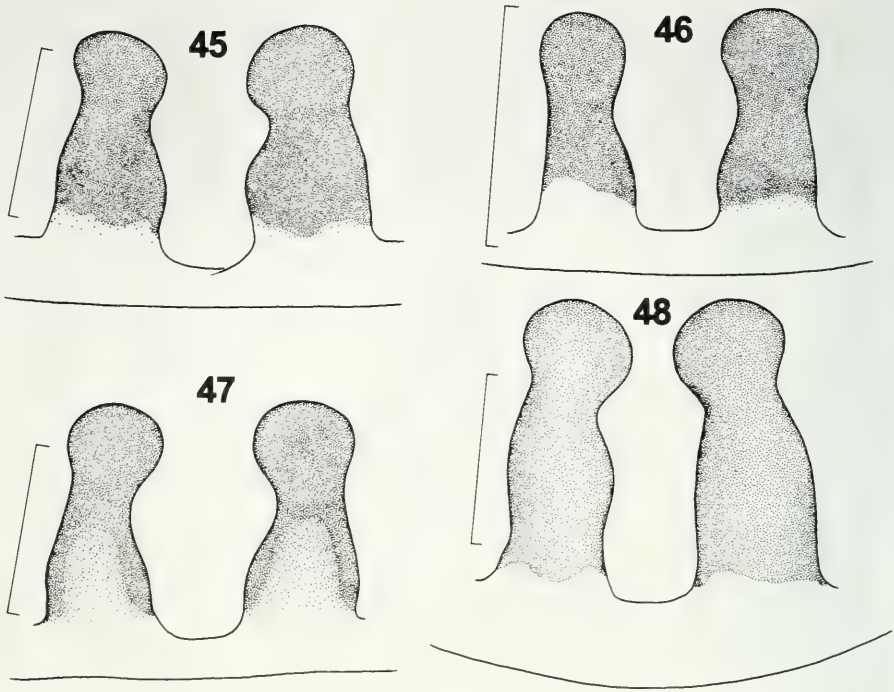


FIGS 38-44

Cyclocosmia lannaensis sp. n., ♂. 38. Distal part of right palp, retrolateral view. 39. Same, ventral view. 40. Same, prolateral view. 41-44. Bulbs of 4 ♂, frontal view; arrow pointing to rounded invagination between left and right part of bulb. Scale lines 1.0 mm.

separating apical emargination from rounded prolateral-distal lobe. Bulb divided by deep furrow on ventral surface, both halves distally separated by shallow, rounded invagination (Fig. 41, see arrow). Embolus slender and tapering, with compressed and slightly widened apex.

Legs 3214, much longer than in ♀♀, with distinctly fewer and shorter (blunt or pointed) bristles and different arrangement of spines; surface of articles finely ornamented with small transversal fissures (most pronounced on femora). Distal leg segments cylindrical. All tarsi with thin ventral scopula covering distal half of tarsus I and distal two thirds of other tarsi; scopula confined to narrow (less than tarsal width) longitudinal band on tarsus IV; longitudinal row of 6-8 spines running through tarsal



FIGS 45-48
Cyclocosmia lannaensis sp. n., vulvae of 4 ♀: Holotype (45). Scale lines 1.0 mm.

scopula on posterior legs, only 1-2 spines present inside scopula on anterior legs (Fig. 36).

Leg spination: I: Patella - 1 rv; tibia - about 55 pv to rv (14 pv, few rv); metatarsus - about 35 pv to rv; tarsus 14 p to pv, 2 v, 16 rv. II: Patella - 1 rv; tibia - about 30 pv to rv; metatarsus - about 30 pv to rv; tarsus - 14 pl to pv, 2 v, 22 rl to rv. III, IV: Many pl to rl spines on tibiae to tarsi, no rl spines on metatarsus IV; 3-4 dorsal spines on metatarsus III.

Trichobothria: I: Tibia - 4 pd, 3 rd in proximal half; metatarsus - 2 rd followed by 4 d (last rd and first d on same level) in distal half; tarsus - 13/14 d to rd, irregularly arranged. II: Tibia - 3/4 pd, 4 rd in proximal half; metatarsus - 3/4 rd followed by 3/4 d (last rd and first d on same level) in distal half; tarsus - 15 d to rd, irregularly arranged. III: Tibia - 4 pd, 4 rd in proximal half; metatarsus - 3/4 rd followed by 2 d (none on same level) in distal half; tarsus - 16/17 d to rd, irregularly arranged. IV: Tibia - 5/6 pd, 5 rd in proximal half; metatarsus - 3 rd followed by 1/2 d (none on same level) in distal half; tarsus - 11/12 d to rd, irregularly arranged.

Paired tarsal claws with 1-2 proximal teeth on leg I, 2 teeth on other legs, 1 large principal tooth with 1 tiny (on legs I-III) or 1 small (on leg IV) secondary tooth. Unpaired claws bare.

Opisthosoma 13.1 long, 9.4 wide; disc 7.9 in diameter, distinctly less sclerotized than in ♀♀, ribs narrower and with peglike tubercles reduced to indistinct dark dots (Fig. 53). Rib angles indistinctly elevated, carrying only about 13 short blunt bristles each. Ribs outside opisthosomal disc well-developed, distinctly sclerotized for about one third of opisthosomal length posterodorsally (less so posterolaterally and posteroventrally) (Figs 54, 55). Rudimentary tergite (?) more distinct than in ♀♀.

Crescent-shaped sclerite between spinnerets (plus anus) and ventral rim of opisthosomal disc broadly connected to median ventral rib angle (Fig. 35).

Posterior median spinnerets 1.1 long; posterior lateral spinnerets 2.7 long (proximal segment 1.2, median 0.9, distal 0.6).

PALP AND LEG MEASUREMENTS OF ♀ AND ♂ (IN PARENTHESES) DESCRIBED ABOVE

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	4.7 (5.3)	3.6 (3.0)	3.4 (3.7)	- -	4.0 (2.0)	15.7 (14.0)
Leg I	6.5 (7.0)	4.1 (3.4)	3.8 (4.8)	3.5 (4.7)	2.0 (2.0)	19.9 (21.9)
Leg II	5.3 (6.1)	3.8 (3.2)	2.7 (3.9)	2.9 (4.3)	1.8 (1.8)	16.5 (19.3)
Leg III	5.0 (5.4)	3.8 (3.0)	2.5 (3.4)	2.9 (4.3)	1.8 (2.1)	16.0 (18.2)
Leg IV	5.6 (6.3)	4.6 (3.6)	3.3 (4.5)	4.2 (5.9)	2.3 (2.5)	20.0 (22.8)

DESCRIPTION OF JUVENILES

Spiderlings (3rd instar?; body length 3.9, carapace length 1.4, width 1.3), collected from the burrow of their mother, posses fully developed opisthosomal discs with 19-22 ribs and only a single seta per rib angle.

VARIATION

Measurements and rib counts: ♀♀ (n=5), ♂♂ (n=4) in parentheses. Body length < 36.9 (21.3-24.3), carapace length < 12.7 (7.5-8.7), width < 11.2 (6.6-7.7); rib counts 20-23 (23-26).

Bristles behind AME in T-shaped (anterior 3 bristles on the same transversal level; 2 ♂, 3 ♀) or in Y-shaped arrangement (anterolateral bristles in front of anteromedian one; 2 ♂, 2 ♀); in one ♀ the left lateral seta in this arrangement is missing.

In larger (and older) ♀♀ the sclerites are darker and the opisthosomal ribs outside the disc more strongly sclerotized than in smaller specimens.

One ♂ possesses 2 rv distal spines on its left patella I (Fig. 36); some ♂♂ have 1-2 of the v distal bristles on patella I developed as spines. One large ♀ has 1 rv distal spine on both patellae of leg I.

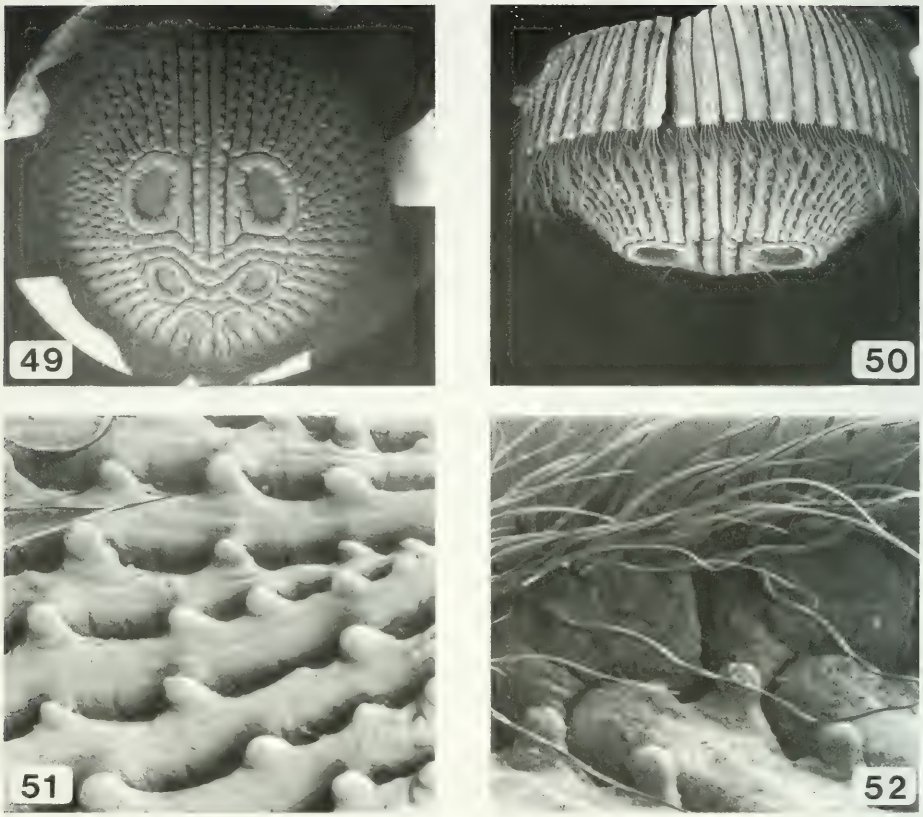
Variation in ♂ and ♀ genitalia, see Figs 41-44 and Figs 45-48, respectively.

RELATIONSHIPS

Geographic proximity suggests that *C. lannaensis* sp. n. is the sister taxon of *C. siamensis* sp. n. and *C. ricketti*, but a possible close relationship with *C. loricata* should also be taken into consideration (see discussion).

BIOLOGY

Habitat and burrow. The spiders were all collected from shady (north facing) vertical road cuts in a remnant patch of evergreen hill forest. No preference for a

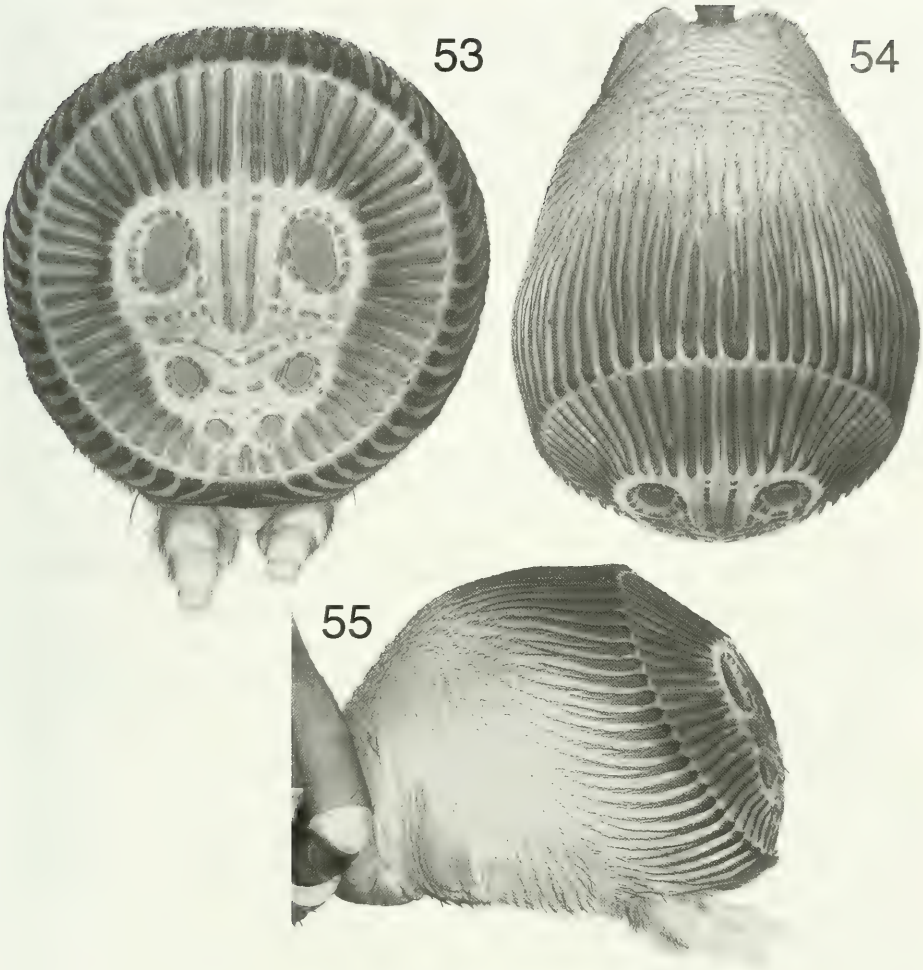


FIGS 49-52

Cyclocosmia lannaensis sp. n., ♀ (SEM micrographs). 49. Opisthosomal disc, caudal view. 50. Same, dorsal view. 51. Detail of ribs showing tubercles. 52. Detail of ribs and rib angles showing setae and tubercles.

certain zone on these road cuts by specimens of different sizes and age (as seen in *C. siamensis* sp. n.) was observed.

Borrows (up to 19 cm long in the case of females, 10.5 cm in the case of males) were closed with trapdoors (up to 2.6 cm long and 3.6 cm wide in the case of females, 2.0 cm and 2.5 cm in the case of males) and, as in *C. siamensis* sp. n., had dead leaves attached to their entrances and often also to the trapdoors (Pl. 1A). The inside of the burrows was lined with a strong layer of tough silk and constricted to about half its diameter in the lower portion (after about two thirds of the length) where the opisthosomal plug is placed (Pl. 1B). Each burrow ended in a slightly widened terminal part, which was only a little longer than the spider itself. Two large females (one with juveniles) had a second constriction in the upper portion of their burrows (also observed in *C. siamensis* sp. n.), which left a wide median chamber where the spider could turn round. No prey remnants or exuviae were found inside these burrows in the field, but in captivity some spiders deposited heavily fragmented exuviae at the bottom of their burrows.



FIGS 53-55
Cyclocosmia lannaensis sp. n., ♂. 53. Opisthosoma, caudal view. 54. Same, dorsal view. 55. Same, lateral view.

Phenology. In captivity males became mature between late October and mid-March. The maturation date in late October, less than two weeks after the male was captured, presumably accords with the mating period in nature. Another male was raised from an early juvenile instar (3rd instar?; collected from the maternal burrow) and reached maturity after five years in late January (not very long after maturations in the field). Mature males did not feed in captivity. One male courted with jerking movements in front of the burrow of a female, but was turned away by her (perhaps due to disturbance during observation) and no mating occurred. A mature female moulted (and died in the process) in mid-July.

In mid-October a large female was found with 345 juveniles (at least 3rd instar) sheltering below her opisthosomal disc plug at the bottom of the burrow. As in *C. siamensis* sp. n., this indicates that egg development and brooding extend over a full year and that females do not reproduce annually. Considering that it takes fives years (at least for males) to become mature and that females reproduce only each second year, it is likely that these spiders live for ten years and more. *Cyclocosmia* specimens from America have survived more than twelve years in captivity (Gertsch & Platnick, 1975: 2).

Distribution

Cyclocosmia lannaensis sp. n. is known only from a mountain at the northernmost tip of Thailand, a few kilometres away from the border to Myanmar (= Burma). This species is probably more widely distributed in mountainous regions of Myanmar and possibly also of Laos.

DISCUSSION

Relationships. According to the character polarization given by Gertsch & Platnick (1975: 3-4), *C. ricketti* and *C. siamensis* sp. n. appear to be the most primitive species in the genus *Cyclocosmia*. The large numbers of bristles on rib angles and the wide eye group of both species are considered as plesiomorphic. The same apparently also holds true for the presence of elevated rib angles [not present in *C. truncata* (Hentz)], for the absence of a dorsally emarginated tibia III [present in *C. loricata* (C. L. Koch)] and for parallel-sided spermathecae (medially constricted or apically widened spermathecae present in all other congeners). Accordingly *C. lannaensis* sp. n. is more derived than the other two Asian species, mostly due to its medially constricted spermathecae with knob-shaped apices, which are quite similar to those of *G. loricata* from Mexico and Guatemala (Figs 45-48, cf. Gertsch & Platnick, 1975: fig. 27). Additional congruences between these two species are found in the Y-shaped arrangement of long bristles behind the AME and in similar low rib counts (Figs 32, cf. Gertsch & Platnick, 1975: 15-18, figs 31, 35). The reduction in numbers of ribs on the opisthosomal disc of *C. lannaensis* sp. n. follows the same trend as seen in American *Cyclocosmia* spp., whereas the numbers of bristles on its rib angles appear to have increased. Therefore *C. lannaensis* sp. n. is either the sister taxon of *C. siamensis* sp. n. plus *C. ricketti*, or that of *C. loricata*. A taxonomic revision of all *Cyclocosmia* species is necessary properly to analyse phylogenetic relationships within this genus.

Zoogeography. Like most other trapdoor spiders, *Cyclocosmia* species are of a sedentary disposition and possess very poor powers of dispersal. There is no indication that their spiderlings disperse by gossamer. Therefore it is very unlikely that the disjunct trans-Pacific distribution of *Cyclocosmia* results from migration through the high latitude Bering Bridge (Beringia) in the Tertiary, as is the classical explanation for such a distribution. Apart from the short time frame, suitable habitats or a direct land connection may not have existed there in the Tertiary (Shields, 1979: 183, 184).

Vicariance due to the opening of the Pacific Ocean and the subsequent separation of East and Southeast Asia from North America in the Jurassic would better

explain the distribution of *Cyclocosmia*. This scenario is part of the "Rapid Earth Expansion" hypothesis, which postulates that in the Jurassic the earth was much smaller than today, and which is based on geological data, fossil data and numerous examples of trans-Pacific disjunctions in extant plants and animals (McCarthy, 2003; Shields, 1979, 1988). *Cyclocosmia lannaensis* sp. n. (northern Thailand) and *C. loricata* (Mexico, Guatemala) may represent another example of trans-Pacific sister taxa that occur at about the same latitude, a phenomenon interpreted as evidence for this hypothesis. Additional examples of trans-Pacific disjunctions in the northern hemisphere, which refer to ground-dwelling or burrowing spiders with requirements for humid conditions and which probably also result from vicariance, are: *Antrodiaetus* (Antrodiaetidae) (Japan - USA; Coyle, 1971), Pachylomerinae (Ctenizidae) (South and Southeast Asia, Australia, western Pacific islands - North and Central America; Raven, 1985), Hypochilidae (China - USA; Forster *et al.*, 1987) and the *Callilepis schuszteri* group (Gnaphosidae) (France to Japan - southwestern N-America; Platnick, 1976). Although the "Rapid Earth Expansion" hypothesis appears somewhat radical, the body of evidence represented by such disjunctions requires its further consideration.

ACKNOWLEDGEMENTS

Siegfried Huber (Oberuhldingen) let me study his specimens from Doi Suthep, kindly donated one of them to the MHNG, led me to the collecting site and shared his observations. Peter Jäger (Senckenberg, Frankfurt) informed me about the new *C. ricketti* material from Sichuan Province and sent photographs. Shuqiang Li (IZCAS) provided two females of this species (with photographs of their capture) and kindly donated one of them to the MHNG. Thérèse Cuche and Lionel Monod (both MHNG) helped raising captive spiders in Geneva, Barbara Thaler-Knoflach did so in Innsbruck. Christine Lehmann-Graber (Geneva) skilfully produced several of the illustrations in this paper, including the habitus drawing. Bernhard Merz helped with the Automontage photographs, Jean Wüest produced the SEM photographs, Lionel Monod helped processing the digital images, Charles Lienhard informed me about phragmotic abdomina in psocids, and John Hollier (all MHNG) checked the English text. Janet Beccaloni (NHML) sent me the type of *C. ricketti* for examination. Norman Platnick (American Museum of Natural History, New York) commented on an earlier version of this manuscript. The Royal Forest Department of Thailand provided collecting permits and the National Research Council of Thailand research permits to carry out fieldwork.

REFERENCES

BERLAND, L. 1932. Les Arachnides (Scorpions, Araignées, etc.). Encyclopédie entomologique, série A, part 16. *Paul Lechevalier & fils, Paris,* 485 pp.

COYLE, F. A. 1971. Systematics and natural history of the mygalomorph spider genus *Antrodiaetus* and related genera (Araneae: Antrodiaetidae). *Bulletin of the Museum of Comparative Zoology* 141: 269-402.

FORSTER, R. R., PLATNICK, N. I. & GRAY, M. R. 1987. A review of the spider superfamilies Hypochiloidea and Austrochiloidea (Araneae, Araneomorphae). *Bulletin of the American Museum of Natural History* 185: 1-116.

GERHARDT, U. & KÄSTNER, A. 1938. 8. Ordnung der Arachnida: Araneae = echte Spinnen = Webspinnen (p. 394-656). *In*: KRUMBACH, T. (ed.). Handbuch der Zoologie, vol. 3, 2nd half, part 1. *Walter de Gruyter & Co., Berlin*, 656 pp.

GERTSCH, W. J. & PLATNICK, N. I. 1975. A revision of the trapdoor spider genus *Cyclocosmia* (Araneae, Ctenizidae). *American Museum Novitates* 2580: 1-20.

HUBER, S. 1995a. A record of the ctenizid spider *Cyclocosmia ricketti* (Pocock, 1901) from northern Thailand. *Newsletter of the British arachnological Society* 73: 6-7.

HUBER, S. 1995b. *Cyclocosmia ricketti* (Pocock, 1901) aus Nord-Thailand im Terrarium (Araneida: Ctenizidae). *Arachnologisches Magazin* 3 (6): 1-6.

HUNT, R. H. 1976. Notes on the ecology of *Cyclocosmia truncata* (Araneae, Ctenizidae) in Georgia. *Journal of Arachnology* 3: 83-86.

MCCARTHY, D. 2003. The trans-Pacific zipper effect: disjunct sister taxa and matching geological outlines that link the Pacific margins. *Journal of Biogeography* 30: 1545-1561.

MURPHY, F. & MURPHY, J. 2000. An introduction to the spiders of South East Asia with notes on all the genera. *Malaysian Nature Society, Kuala Lumpur,* 625 pp. +32 colour plates.

PLATNICK, N. I. 1976. Drifting spiders or continents?: vicariance biogeography of the spider subfamily Laroniinae (Araneae: Gnaphosidae). *Systematic Zoology* 25: 101-109.

PLATNICK, N. I. 2005. The world spider catalog, version 5.5. *American Museum of Natural History, online at http://research.amnh.org/entomology/spiders/catalog/index.html*

POCOCK, R. I. 1901. On some new trap-door spiders from China. *Proceedings of the zoological Society of London* 1901 (1): 207-215.

PRESTON-MAFHAM, R. & PRESTON-MAFHAM, K. 1984. Spiders of the world. *Blandford Press, Poole,* 191 pp.

RAVEN, R. J. 1985. The spider infraorder Mygalomorphae (Araneae): cladistics and systematics. *Bulletin of the American Museum of Natural History* 182: 1-180.

SCHWENDINGER, P. J. 1996. The fauna of orthognathous spiders (Araneae: Mesothelae, Mygalomorphae) in Thailand (pp. 577-584). *In*: MAHNERT, V. (ed.). Proceedings of the XIIIth International Congress of Arachnology, Geneva, 3-8 September 1995. *Revue suisse de Zoologie,* special edition I+II, 720 pp.

SHIELDS, O. 1979. Evidence for initial opening of the Pacific Ocean in the Jurassic. *Palaeogeography, Palaeoclimatology, Palaeoecology* 26: 181-220.

SHIELDS, O. 1998. Upper Triassic Pacific vicariance as a test of geological theories. *Journal of Biogeography* 25: 203-211.

SIMON, E. 1903. Histoire naturelle des Araignées, vol. 2 (part 4). *Encyclopédie Roret, Paris*, 1080 pp.

SMITHERS, C. N. 1995. *Psilopsocus mimulus* Smithers (Psocoptera: Psilopsocidae), the first known wood-boring psocopteran. *Journal of the Australian entomological Society* 34: 117-120.

SMITHERS, C. N. 1997. An apterous, possibly phragmotic new species representing a new genus and subfamily of Elipsocidae (Psocoptera) from South Australia. *Entomologica scandinavica* 28: 97-101.

SONG, D., ZHU, M. & CHEN, J. 1999. The spiders of China. *Hebei Science and Technology Publishing House, Shijiazhuang*, 640 pp.

WHITMORE, T. C., 1991. An introduction to tropical rain forests. *Clarendon Press, Oxford,* 226 pp.

REVUE SUISSE DE ZOOLOGIE 112 (1): 253-269; mars 2005

Salvelinus evasus sp. n., a charr from deep waters of Lake Ammersee, southern Germany (Teleostei: Salmonidae), with comments on two extinct species

Jörg FREYHOF [1] & Maurice KOTTELAT [2]

[1] Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 310, D-12587 Berlin, Germany. E-mail: freyhof@igb-berlin.de

[2] Case postale 57, CH-2952 Cornol, Switzerland (permanent address) and Raffles Museum of Biodiversity Research, National University of Singapore, Kent Ridge, Singapore 119260.

Salvelinus evasus sp. n., a charr from deep waters of Lake Ammersee, southern Germany (Teleostei: Salmonidae), with comments on two extinct species. - *Salvelinus evasus* sp. n., from Lake Ammersee (southern Germany), is a deepwater charr distinguished from other prealpine charrs by the following combination of characters: mouth subinferior; snout blunt; 19-25 gill rakers; flank yellowish to silvery, sometimes with faint pale spots; eye diameter 0.8-1.4 times in interorbital; head depth at eye 9.4-11.4% SL; body depth at anal-fin origin 10.6-14.7% SL. The extinct *S. profundus* Schillinger is rediagnosed on the basis of the only 4 known museum specimens and a replacement name (*S. neocomensis* nom. n.) is proposed for the extinct *Salvelinus salvelinus* var. *profundus* Fuhrmann, 1903 from Lake Neuchâtel (Switzerland); lectotypes are designated for both species.

Keywords: Prealpine endemics - taxonomy - Lake Konstanz - Lake Neuchâtel - Switzerland.

INTRODUCTION

The systematics of European charrs (genus *Salvelinus*) is still superficially understood. This is partly due to the existence of stocks with different appearance in different lakes (Behnke, 1980, 1984) as well as within individual lakes (Jonsson & Hinar, 1982; Hartley *et al.*, 1992; Vollestad & L'Abee-Lund, 1994). This also reflects the concepts used in the systematics of European fishes in the 1960s and the lack of attention for critical systematics since.

In the prealpine lakes of central Europe, Behnke (1980) and Kottelat (1997) recognised two species: the 'common' charr *S. umbla* (Linnaeus, 1758), a large mid-water fish found in most lakes north of the Alps, and the deepwater charr *S. profundus* Schillinger, 1901, a small fish which inhabits the deepest layers of a few lakes.

Manuscript accepted 23.08.2004

Salvelinus umbla and *S. profundus* co-occurred in Lake Konstanz and our knowledge of the biology of *S. profundus* is derived from that population. The two species differ in life history, habitat preference, colouration and morphology (Dörfel, 1974).

Deepwater charrs were also recorded from prealpine lakes Ammersee, Achensee, Attersee, Königsee, Plansee, Tegernsee, Traunsee and Walchensee in the Danube basin (Burersch, 1925; Haempel, 1930; Neresheimer, 1937; Schindler, 1951; Behnke, 1972; Brenner, 1980) and Neuchâtel (Fuhrmann, 1903; Quartier, 1953) in the Rhine basin. There is, however, some confusion between deepwater charrs and small growing stocks of 'normal' charrs, called schwarzreuter by several local authors. It remains uncertain whether real deepwater charrs exist or existed in all the above-mentioned lakes. The populations of Lakes Neuchâtel (Fuhrmann, 1903; Quartier, 1951), Konstanz (Dörfel, 1974; Cavender, 1980) and Attersee (Haempel, 1930; Brenner, 1980) are the only ones which were studied in more detail, but they have never been compared to each other. Fuhrmann (1903) described *S. salvelinus* var. *profundus* from Lake Neuchâtel as a distinct species but, probably because he used the same name as Schillinger had created 2 years earlier for the Lake Konstanz deepwater charr, this second species went almost unnoticed.

Kottelat (1997:154) commented that *S. profundus* was definitively reported from Lake Konstanz only and pointed out, that there is an urgent need to re-examine deepwater charrs from all lakes, to establish whether there was a single species shared by the different lakes, or different species in the different lakes. This is especially important since deepwater charrs seem to be very sensitive to environmental changes as eutrophication. The populations from Lakes Neuchâtel and Konstanz seem to be already extinct (Rubin & Buttiker, 1987; Kottelat, 1997).

In contrast to all other lakes, Lake Ammersee is inhabited only by deepwater charrs, no 'normal' charr occurs or is reported to have occured there.

Here, we describe the Ammersee deepwater charr as a new species and briefly diagnose the two previously named prealpine European deepwater charr species (Lakes Konstanz and Neuchâtel), discuss their nomenclature and propose a replacement name for the preoccupied *S. profundus* of Fuhrmann.

MATERIAL AND METHODS

Material of *S. evasus* were caught by commercial fishermen and preserved in 5% formaldehyde and transferred to 70% ethanol for storage. Method for measurements follow Schulz & Freyhof (2004); they are taken point-to-point with dial callipers and recorded to the nearest of 0.1 mm. Gill rakers were counted on the right anterior gill arch. Scales in lateral line were counted until the end of the hypural complex. Scales on caudal fin were counted separately. In dorsal, caudal and anal fins only branched rays were counted, last two rays in dorsal and anal fins articulating on a single pterygophore are noted 1 1/2 ray. Holotype is included in the calculation of means and SD. Sex was determined by examination of the gonads. All characters given are obtained from male and female specimens. Abbreviations used: HL, dorsal head length; SL, standard length; TL, total length; CAS, California Academy of Sciences, San Francisco; CMK, Collection Maurice Kottelat; EAWAG, Limnological Research

Center, Swiss Federal Institute for Environmental Science and Technology, Kastanienbaum; FSJF, Fischsammlung Jörg Freyhof, Berlin; MHNG, Muséum d'histoire naturelle, Genève; ZSM, Zoologische Staatssammlung München. The species concept used here is the phylogenetic species concept (see Kottelat, 1997; Kullander, 1999).

TAXONOMIC TREATMENT

Salvelinus profundus Schillinger Fig. 1

Salvelinus salvelinus var. *profundus* Schillinger, 1901:149, fig. (in part; material from Lake Konstanz, Germany, one specimen here designated as lectotype, no longer extant, see remarks below).

Material examined. CAS 209135, 4, 178-237 mm SL; Germany: Bodensee (Lake Konstanz); N. Peters, received 17 September 1963.

Diagnosis. Salvelinus profundus is distinguished from the other *Salvelinus* species in prealpine lakes by the combination of: mouth subinferior; lower jaw enclosed in upper jaw; snout blunt; 19-27 gill rakers (n=64; Dörfel, 1974); eye diameter 1.3-1.5 (mean 1.5) times in interorbital distance, flank yellowish to silvery, sometimes with faint pale spots; fins without white margins. See Figure 1 for general appearance of lectotype and Table 1 for morphometric data of four specimens.

Distribution. Salvelinus profundus was found in Lake Konstanz, upper Rhine basin.

Biology. Schillinger (1901) recorded specimens up to 150-160 mm total length (?) and mentioned that *S. profundus* already spawns with 100 mm (total length ?). Dörfel (1978) reported most deepwater charrs between 180-260 mm up to 280 mm total length. Lived and fed on bottom. When brought to surface in nets, usually appears with a greatly expanded belly because of expansion of gas bladder resulting from reduction of water pressure. Possibly spawns on an extended period between July-February (or maybe even at all seasons), at depths around 60-80 m, on pebble substrate. Feeds mainly on small bivalves (*Pisidium* spp.), chironomids, cocoons of turbellaria, and copepods.

Conservation status. Extinct. Behnke (1980: 464) still wrote, that "it would be tragic if such a unique and interesting charr became extinct ...". Lake Konstanz was strongly eutrophicated (peak between 1974-1987). Although still abundant in 1972 (Dörfel, 1974), *S. profundus* vanished a few years later. It is a sad irony that it might already have been extinct when Behnke's comment was published.

Remarks. In 1892, *Salvelinus profundus* was discovered by Schillinger who studied the spawning time of the kilch *Coregonus gutturosus* in Lake Konstanz (Schillinger, 1901). All the data presented by Schillinger (1901) refer to the deepwater charr from lake Konstanz. In the penultimate paragraph, Schillinger indicated that "later" he had also seen deepwater charrs from Lake Ammersee; he only mentioned that these grow slightly larger than those from Lake Konstanz. In the last paragraph, Schillinger noted that colourful charrs with slightly subinferior mouth were known from Lake Walchensee which differ from those known to him from Lakes Konstanz and Ammersee. From Schillinger's text, it is obvious that his drawing (p. 149) is based on the deepwater charr from Lake Konstanz [*Bei einer Tiefe von ca. 100 m wurde gele-*

gentlich mit den Kilchen ein Fischchen mitgefangen, welches wie der Kilch einen aufgetriebenen Leib besaß und auch in der Farbe dieselben Grundtöne erkennen ließ, wie sie für die Kilche charakteristisch sind. Wie die Abbildung auf den ersten Blick zeigt, haben wir es hier mit einem Saibling (Salmo salvelinus) *zu tun*, ...]. [*A small fish was caught together with the kilch in a depth around 100 m, which, as the kilch, has a blown up body and the same ground coloration characteristic for the kilch. As is obvious from the figure, this fish is a charr* (Salmo salvelinus), ...].

Schillinger is not known to have deposited any material in a museum. As the material on which his account is based includes specimens from three lakes and representing at least two species, a type specimen is needed to definitively link the name to a single species. Kottelat (1997: 154) had restricted the type locality to Lake Konstanz, but there is no provision for such an action in the International Code of Zoological Nomenclature and this 'restriction' has no nomenclatural validity. We designate here the specimen on which Schillinger's (1901:149) figure is based as lectotype of *S. profundus*; thus, the type locality is now restricted to Lake Konstanz. All other specimens mentioned by Schillinger (1901) automatically become paralectotypes. We could have designated a neotype, but neotype designations should be restricted to exceptional cases where only a neotype designation can define a nominal taxon objectively or to clarify its type locality (ICZN arts. 75.1, 75.3.1). These goals can be achieved by the designation of a lectotype, even if that specimen is no longer extant.

Vogt & Hofer (1909) mentioned deepwater charr from Lakes Konstanz and Walchensee and used Schillinger's figure on their plate XIII, Fig. 4. See the discussion below for characters distinguishing *S. profundus* from other prealpine charrs.

Salvelinus neocomensis nom. n. (new replacement name) Fig. 2

Salvelinus salvelinus var. *profundus* Fuhrmann, 1903: 332 (Lake Neuchâtel) [Not *Salvelinus salvelinus* var. *profundus* Schillinger, 1901, see *S. profundus*, above].

Lectotype (by present designation, see remarks below). MHNG 809.61, 151 mm SL; Switzerland: Lake Neuchâtel, depth 70-80m ?; O. Fuhrmann, catalogued 3 Sept. 1902.

Additional material. MHNG 642.61, 2, 139, 146 mm SL; Switzerland: Lake Neuchâtel; E. Galopin, 1896.

Diagnosis. *Salvelinus neocomensis* is distinguished from the other *Salvelinus* species in prealpine lakes by the combination of: eye diameter 1.0-1.1 (mean 1.0) times in interorbital distance, 34.6-36.0% HL; head depth at eye 10.3-11.5% SL; lateral head length 24.4-27.5% SL; body depth at anal-fin origin 13.1-16.4% SL; body width at anal-fin origin 6.1-7.2% SL; 21-23 gill rakers; pelvic fin reaching to anus in males; subinferior mouth, lower jaw enclosed in upper jaw; snout blunt; mandible reaching backwards beyond vertical of posterior eye margin; flank yellowish, fins without white margins. See Figure 2 for general appearance and Table 1 for morphometric data of lectotype and two additional specimens.

Distribution. *Salvelinus neocomensis* was found in Lake Neuchâtel, upper Rhine basin.

Etymology. Named for Neocomus, the latin name of Neuchâtel. An adjective.

Notes on biology. Based on data presented by Quartier (1951). Lived on lake bottom. When brought to surface in nets, usually appears with a greatly expanded bel-

ly because of expansion of gas bladder resulting from reduction of water pressure. Possibly spawned on an extended period between July-February (or maybe even at all seasons), at depths around 100-150 m on muddy sediments. Feeds mainly on insect larvae, *Pisidium* bivalves, crustaceans and fish eggs.

Conservation status. Extinct. The species is definitively known only from the 3 specimens listed above. Although the species was still reported as abundant before 1951 (Quartier, 1951) some uncertainties remain as to whether Quartier (1951) had the same species in hands as Fuhrmann.

We have seen other *Salvelinus* specimens collected in Lake Neuchâtel before 1951 and although some had been identified as *S. profundus*, they represent *S. umbla*. This especially applies to EAWAG 187 received by Steinmann from Fuhrmann in the 1940's. Unfortunately, it is not known whether these individuals were identified by Fuhrmann or by Steinmann. Additional material of *S. umbla* has been collected in 1907 (MHNG 715.83) and in the 19th century. This indicates that both species were present in Lake Neuchâtel at the turn of the 20th century.

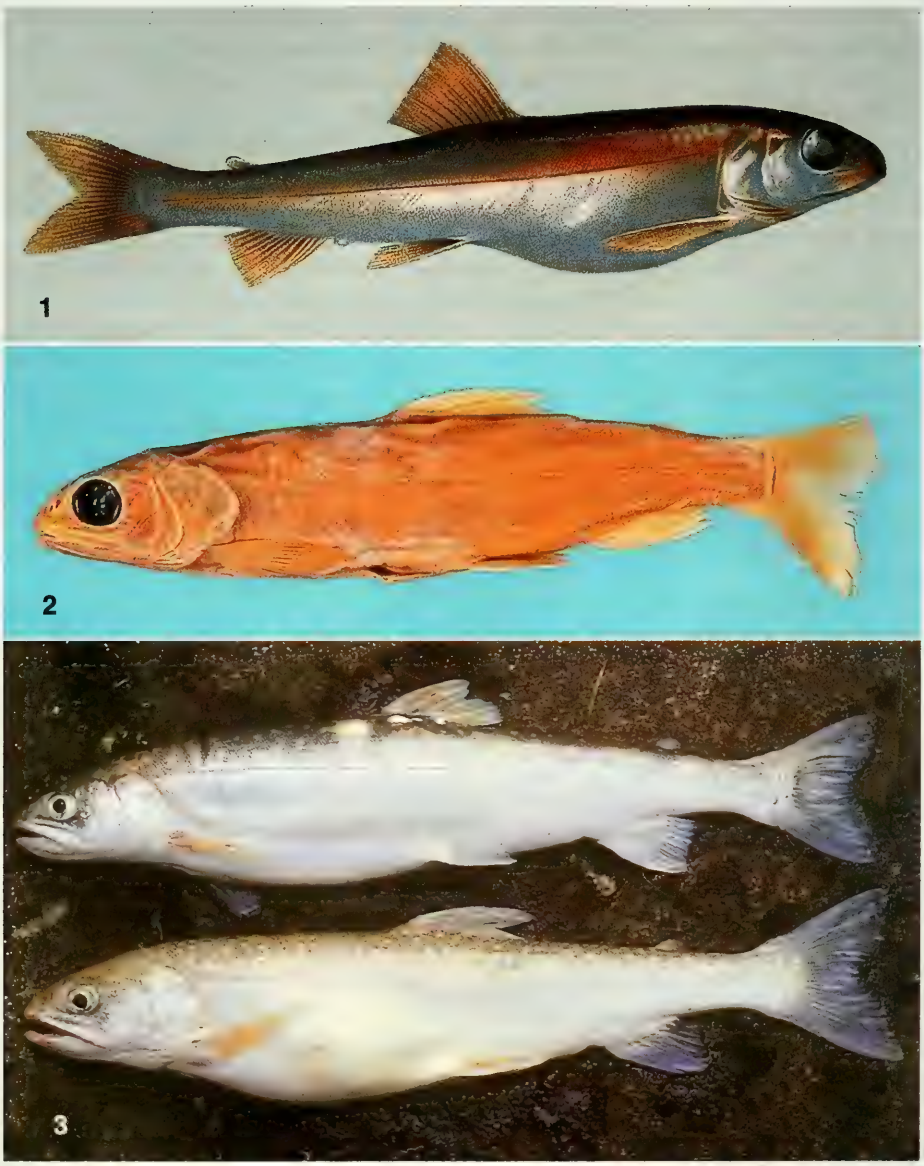
Quartier (1951) records the maximum size of his material as 273 mm TL, which is significantly larger than the 160 mm (TL ?) reported by Fuhrmann and the 139-151 mm SL material we examined. Quartier also report that the 'normal' charr was up to 5 kg in 1811.

Unfortunately, the morphometric and morphological information in Quartier (1951) are impossible to use for comparison with our data as Quartier's procedures and method for measurements are not explained. Especially the values in his Table 1 seem to be raw data in mm and not values expressed in ratios or percentages. The average body depth (i. a.) of the specimens in a given sample is of very limited use in about any context.

Rubin & Buttiker (1987) commented that around 1950 the 'normal' charr had disappeared and that only the small one was still present, what would suggest, that native population of *S. umbla* got extinct in this period. The population of the deep-water charr was said to have decreased since 1917 and had virtually disappeared around 1963. Since 1979, *S. umbla* from Lake Geneva is stocked in Lake Neuchâtel and is now locally produced for stocking.

In 2003, MK tried to obtain information about the possible survival of *S. neocomensis*. Information from M. Samuel Arm, fisherman at St Aubin, is that beside the 'normal' (large, 70-80 cm TL, the introduced stock) *S. umbla*, a few smaller, yellowish individuals (around 25 cm, locally called biblet or jaunet) are occasionally caught, usually at the beginning of the spawning period and on the spawning grounds of 'normal' charr. The observation on size and timing may be biased by the legal mesh size and fishing periods. It has not been possible to obtain any specimen of this small charr in the winter 2003-2004; the spawning season started and ended much earlier than previous years.

Without being able to see material of this 'biblet' it is difficult to conclude that it is *S. neocomensis*. The small size of the original *S. neocomensis* (140-160 mm; Fatio, 1890, Fuhrmann, 1903), the mention of a larger size by all subsequent authors, the confusion of a smaller stock of 'normal' charr with *S. neocomensis* in the 1940s by Fuhrmann and/or Steinmann and the extirpation of the 'normal' charr suggest that alternative hypotheses should also be considered.



FIGS 1-3

1. *Salvelinus profundus* Schillinger, lectotype; Lake Konstanz, from Vogt & Hofer (1909). 2. *Salvelinus neocomensis* nom. n., lectotype, MHNG 809.61, 151 mm SL; Lake Neuchâtel. 3. *Salvelinus evasus* sp. n., FSJF 1550, paratypes, female (upper) 256 mm SL and male (lower) 253 mm SL, fully mature, caught during spawning season; Germany: Lake Ammersee.

The first hypothesis is that the present 'biblet' is not *S. neocomensis* but the original stock of *S. umbla* of Lake Neuchâtel which has been able to survive, either as a pure lineage or introgressed with the introduced stock from Lake Geneva. If this

hypothesis is correct, it also means that the two stocks are genetically isolated and indeed are two species. It would then also be necessary to explain the reduction in size of the 'normal' charr.

The second hypothesis is that at some time around the beginning of the 20th century the two original species may have hybridized and formed an hybrid population. This would account for the increased size of *S. neocomensis*, the decreased size of 'normal' charr, the disappearance of 'normal' charr, and may be, more recently, the extinction of the hybrid population because of some 'hybrid weakness'. The formation of the hybrid stock could be due to some environmental stress, especially one which would disturb the spawning sites. There has not been a large size environmental changes in Lake Neuchâtel in the beginning of the 20th century, but the area has been greatly impacted by the so-called 'Jura water corrections' in 1868-78 and 1962-70 which resulted in a 2.4 meters lowering of the level of Lakes Neuchâtel, Bienne (Biel) and Morat (Murten) and a 30 km^2 decrease of their area. These hydrographic alterations could have induced the hybridisation between the two chars, as they are possibly responsible for the extinction of two coregonid species described from these lakes by Fatio (1885). Extinction by hybridisation is a process which would require numerous generations. Ruhlé (1986) reported a case of likely large scale hybridisation between two *Coregonus* species in Lake Walenstadt after the 'correction of the Linth' waterworks.

Remarks. This species was described by Fuhrmann (1903: 332) as *S. salvelinus* var. *profundus*. This name is a junior homonym of *S. s.* var. *profundus* Schillinger, 1901. The name *S. neocomensis* is proposed here as a new replacement name (ICZN art. 60.3) for *S. s. profundus* Fuhrmann, 1903. The extant syntype MHNG 809.61 is designated as lectotype. See discussion below for characters distinguishing *S. neocomensis* from other prealpine charrs.

Salvelinus evasus sp. n. Figs 3-4

Salvelinus salvelinus var. *profundus* Schillinger, 1901:149 (in part; from Lake Ammersee, Germany).

Holotype. ZSM 30460, 242 mm SL; Germany: Bavaria: Lake Ammersee between Utting and Schondorf, approx. 50 m depth; Mar 2003, W. Ernst.

Paratypes. All from Germany: Bavaria. ZSM 30458, 1, 243 mm SL, ZSM 30459, 1, 210 mm SL, 30461, 2, 108, 132 mm SL; same data as holotype. - ZSM 29525, 29526, 28, 134-213 mm SL; Lake Ammersee, approx. 50 m depth; S. Rauch, Oct-Nov 1996. - ZSM 4481-4485, 4488-4502, 21, 136-170 mm SL; Lake Ammersee at Diessen; A. Rauch, Oct 1951. - ZSM 5943-5946, 4, 102-132 mm SL; Lake Ammersee at Diessen; A. Rauch, 17-19 Oct 1951. - CMK 18465, 15, 136-209 mm SL, Lake Ammersee at Utting; 8 July 2004, J. Freyhof. – FSJF 1550, 30, 108-256 mm SL, Lake Ammersee at Utting; 8 July 2004, J. Freyhof.

Diagnosis. *Salvelinus evasus* is distinguished from the other *Salvelinus* species in prealpine lakes by the combination of: mouth subinferior; lower jaw enclosed in upper jaw; upward curved hook at tip of lower jaw of sexually mature males very small and enclosed in upper jaw; snout blunt; 19-25 gill rakers; eye diameter 0.8-1.4 times in interorbital width (vs. 1.3-1.5), 19.2-26.1% HL (26.0-28.6); head depth at eye 9.4-11.4% SL (7.6-9.4); body depth at anal-fin origin 10.6-14.7% SL (15.0-16.3); body width at anal-fin origin 5.2-8.2% SL (7.6-9.0); flank yellowish to silvery, sometimes with faint pale spots; fins with white margins in large males only.

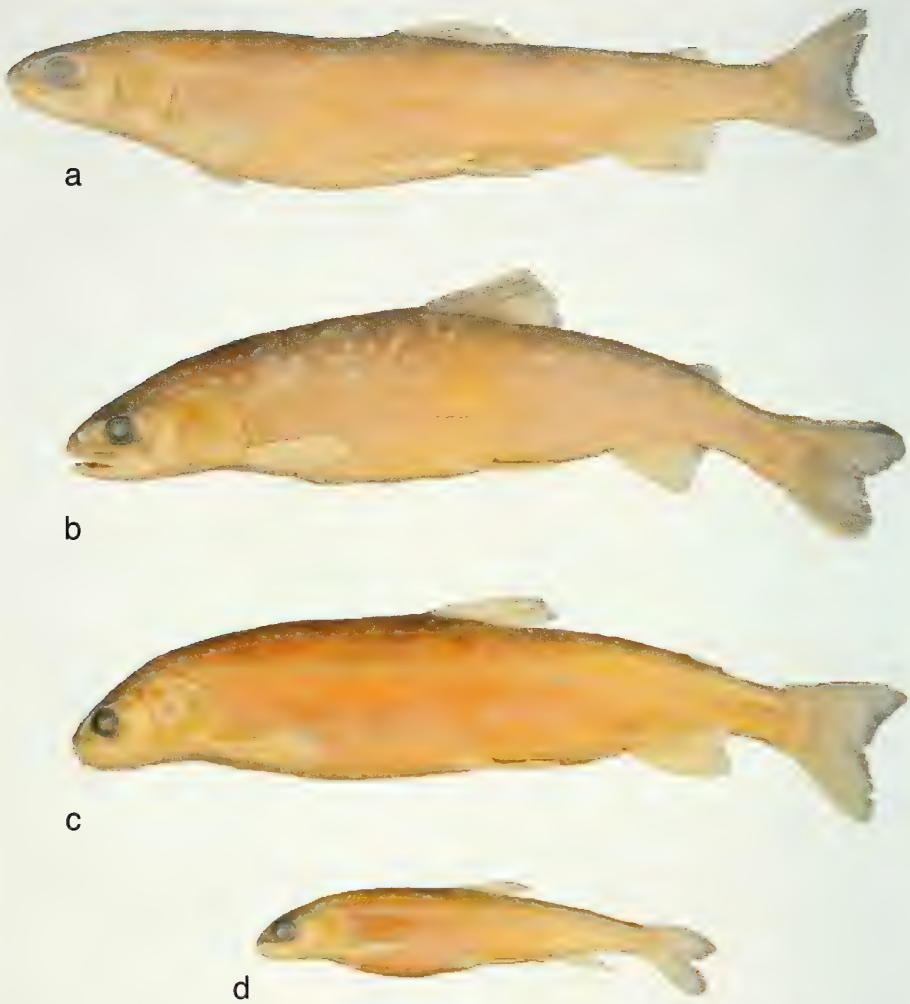


FIG. 4

Salvelinus evasus sp. n., Lake Ammersee. a, ZSM 30460, holotype, 242 mm SL, b, ZSM 30459, paratype, 243 mm SL, c, ZSM 30458, paratype, 210 mm SL, d, ZSM 30461, paratype, 107 mm SL.

Description. See Figures 3-4 for general appearance and Table 2 for morphometric data of holotype (ZSM 30458) and 25 paratypes (ZSM 30458-30459, 30461, 29525-29526, 5943-5946). Small, elongate and moderately compressed (Table 1). Mouth subinferior, lower jaw enclosed within teeth of upper jaw (Fig. 5). Maxilla reaching beyond posterior eye margin in specimens larger than 150 mm SL or slightly in front in smaller ones. Mandible reaching beyond posterior eye margin. Upward curved hook at tip of lower jaw of sexually mature males very small and enclosed in upper jaw. Eye large, 1.1-1.5 (mean 1.3) times in interorbital width. Caudal peduncle

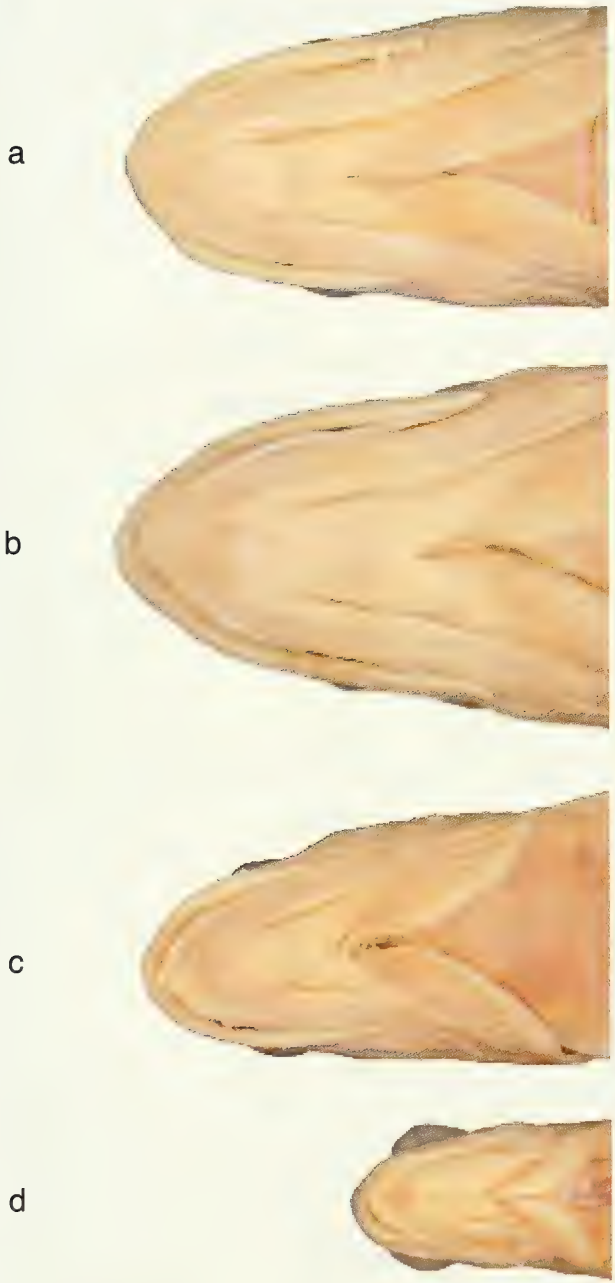


FIG. 5

Salvelinus evasus sp. n., ventral view of head, a, ZSM 30460, holotype, 242 mm SL, b, ZSM 30459, paratype, 243 mm SL, c, ZSM 30458, paratype, 210 mm SL, d, ZSM 30461, paratype, 107 mm SL.

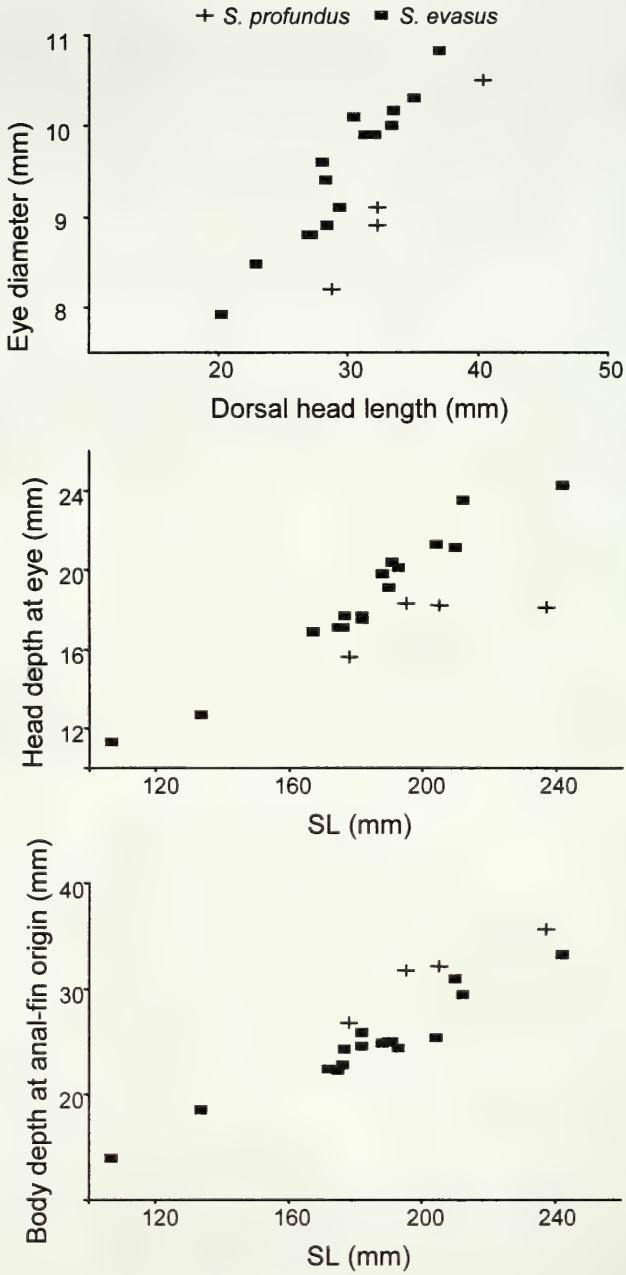


FIG. 6

Scatter plot of body depth at anal-fin origin, head depth at eye against SL and eye diameter against dorsal head length in 16 female *Salvelinus evasus* sp. n. and 4 female *S. profundus* Schillinger.

TABLE 1. Morphometric data of *Salvelinus profundus* Schillinger (CAS 209135, n=4) and *S. neocomensis* nom. n. (lectotype, MHNG 809.61; MHNG 642.61, n=2).

	S. profundus				*S. neocomensis*		
	CAS 209135				MHNG 809.61	MHNG 642.61	MHNG 642.61
SL (mm)	178	205	195	237	151	146	139
in percents of SL							
Dorsal head length	16.1	15.8	16.6	17.0	18.4	16.8	17.6
Lateral head length	22.5	22.0	23.4	23.4	27.5	24.4	24.6
Predorsal length	48.2	45.2	49.7	50.4	51.3	46.7	48.3
Pre-pelvic length	54.4	53.7	61.0	54.5	56.4	53.6	53.9
Pre-anus length	72.5	72.2	79.5	55.2	73.0	71.1	70.3
Pre-anal length	74.2	74.1	82.1	72.8	75.6	74.0	73.2
Head depth at eye	8.8	8.9	9.4	7.6	11.5	10.3	10.8
Head depth at nape	14.9	12.5	13.5	13.2	15.6	13.7	13.2
Body depth at dorsal fin origin	22.2	20.0	23.2	20.2	21.1	19.2	18.7
Body depth at anal fin origin	15.1	15.7	16.3	15.0	16.4	14.9	13.1
body depth at adipose fin	10.6	11.6	11.8	11.2	12.1	10.7	9.6
Depth of caudal peduncle	8.3	7.7	8.5	7.8	9.1	8.6	6.7
Adipose base end to centre of caudal origin	15.1	14.4	17.0	14.6	15.7	15.9	15.3
Length of caudal peduncle	16.3	15.8	17.7	17.0	15.7	18.5	17.6
Head width at gill openings	9.0	9.3	9.3	8.7	8.9	8.9	9.4
Body width at dorsal-fin origin	10.4	13.4	11.6	11.7	8.9	10.7	9.5
Body width at anal origin	7.6	9.0	8.2	8.5	6.2	7.2	6.1
Length of dorsal fin base	15.0	10.7	11.3	11.7	12.1	10.8	9.9
Length of upper caudal-fin lobe		17.3	18.5	17.0	20.6	20.4	19.3
Length of middle caudal-fin ray	10.3	8.7	11.0	11.0	12.6	10.7	11.3
Length of lower caudal-fin lobe	17.8	16.9	18.6	17.5		20.2	19.9
Anal fin depth	15.7	13.4	16.1	15.3	16.5	14.6	14.2
Length of anal-fin base	11.9	9.8	10.3	10.6	9.9	10.3	9.5
Length of pelvic fin	12.2	11.6	14.5	12.4	16.3	13.6	14.4
Length of pectoral fin	15.3	14.7	17.4	16.1	18.9	16.0	17.9
in percents of dorsal HL							
Eye diameter	28.6	27.6	28.2	26.0	36.0	34.6	34.8
Interorbital width	38.0	42.4	41.5	39.6	39.2	34.6	34.0
Distance between nasal openings	22.6	23.5	22.3	23.5	20.9	19.9	21.6
Snout length	37.6	36.8	37.8	39.6	38.1	33.3	35.2
Maxillary length	55.1	55.1	56.3	58.9	57.9	54.9	54.4
Mandible length	66.2	62.8	61.9	63.9	65.8	63.4	64.4
Maxillar width	13.2	12.1	11.5	11.9	11.5	8.9	10.4
in percents of lateral HL							
Eye diameter	20.5	19.8	19.9	18.9	24.0	23.9	24.9
Interorbital width	27.3	30.4	29.3	28.8	26.2	23.9	24.3
Distance between nasal openings	16.3	16.9	15.8	17.1	13.9	13.8	15.4
Snout length	27.0	26.4	26.7	28.8	25.5	23.0	25.1
Maxillary length	39.5	39.6	39.8	42.8	38.7	37.9	38.9
Mandible length	47.5	45.1	43.8	46.4	44.0	43.8	46.0
Maxillary width	9.5	8.7	8.1	8.6	7.7	6.2	7.4

1.9-2.3 (mean 2.1) times longer than deep. Dorsal-fin margin straight or slightly convex, pelvic-fin origin below branched dorsal-fin ray 3-4. Adipose-fin origin above 6-8th anal-fin ray. 8-11 (mode 9) gill rakers in upper branch of first gill arch, 12-15 (mode 14) in lower branch, total 19-25 (mode 22). Largest recorded specimen 256 mm

TABLE 2. Morphometric data of *Salvelinus evasus* sp. n. (holotype, ZSM 30460; paratypes, ZSM 30458-30459, 30461, 29525-29526, 5943-5946, n=26).

	S. evasus holotype	paratypes mean	SD	min	max
SL (mm)	242	177		107	243
in percents of SL					
Dorsal head length	15.3	16.7	0.8	15.3	18.9
Lateral head length	21.5	23.9	1.6	18.9	26.3
Predorsal length	48.8	49.1	4.7	26.1	52.1
Pre-pelvic length	55.8	54.2	1.5	51.8	57.8
Pre-anus length	75.2	73.2	1.7	70.2	77.5
Pre-anal length	76.4	76.5	1.9	73.1	83.3
Head depth at eye	10.0	10.3	0.6	9.4	11.4
Head depth at nape	13.0	13.8	0.6	12.8	14.8
Body depth at dorsal fin origin	18.3	19.4	1.6	16.3	23.6
Body depth at anal fin origin	13.7	13.2	0.8	10.6	14.7
body depth at adipose fin	10.4	10.7	1.2	7.9	15.1
Depth of caudal peduncle	7.1	7.5	0.5	6.0	8.4
Adipose base end to centre of caudal origin	14.0	14.7	1.2	11.0	16.4
Length of caudal peduncle	14.4	15.5	0.9	12.9	17.3
Head width at gill openings	7.9	8.8	0.6	7.9	10.6
Body width at dorsal-fin origin	10.4	10.3	1.2	8.3	12.8
Body width at anal origin	6.6	6.5	0.7	5.0	8.0
Length of dorsal fin base	10.7	10.7	0.8	9.0	12.1
Length of upper caudal-fin lobe	14.2	17.7	2.2	14.2	19.9
Length of middle caudal-fin ray	9.1	10.6	0.6	9.1	11.6
Length of lower caudal-fin lobe	14.0	17.8	1.2	14.0	20.0
Anal fin depth	12.0	14.3	0.9	12.0	15.9
Length of anal-fin base	10.3	9.6	0.8	8.1	11.4
Length of pelvic fin	9.9	12.6	0.9	9.9	14.2
Length of pectoral fin	12.8	15.6	1.0	12.8	17.2
in percents of dorsal HL					
Eye diameter	29.3	22.0	1.7	19.2	26.1
Interorbital width	41.1	27.8	1.9	23.5	33.0
Distance between nasal openings	23.5	16.4	1.7	13.5	22.6
Snout length	38.7	26.3	2.0	22.4	33.9
Maxillary length	58.0	39.7	3.3	34.1	48.1
Mandible length	75.3	48.5	5.3	41.9	64.3
Maxillar width	9.0	7.0	0.7	5.7	8.4
in percents of lateral HL		16.7	0.8	15.3	18.9
Eye diameter	20.8	23.9	1.6	18.9	26.3
Interorbital width	29.1	49.1	4.7	26.1	52.1
Distance between nasal openings	16.7	54.2	1.5	51.8	57.8
Snout length	27.4	73.2	1.7	70.2	77.5
Maxillary length	41.1	76.5	1.9	73.1	83.3
Mandible length	53.4	10.3	0.6	9.4	11.4
Maxillary width	6.4	13.8	0.6	12.8	14.8

SL (FSJF 1550, paratype). A specimen of about 350 mm SL was seen in commercial catches.

Dorsal fin with 8-9 1/2 branched rays. Caudal fin forked, with 9+8 branched rays. Anal fin with 8 1/2 branched rays. Pectoral fin with 13-14 rays, reaching 34.6-56.1 (mean 47.4) % of distance to pelvic-fin origin. Pelvic fin with 9 rays. Axillary

pelvic lobe present. Lateral line complete, reaching caudal-fin base, perforating 117-123 scales on body and 3-4 on caudal-fin base. Compared to other *Salvelinus* from lakes in upper Danube basin and Lake Konstanz studied for this character, *S. evasus* has four unique mtDNA haplotypes (see Englbrecht *et al.*, 2002, for details).

Coloration. In preservative. Body pale to dark reddish brown with few whitish spots on dorsum. Mature males with white anterior margin along pectoral, pelvic and anal fins. White margin on lower lobe of caudal fin and dark grey submarginal bands on caudal lobes. No parr marks in specimens examined.

In life. Body silvery to yellowish brown with few whitish spots on dorsum. Mature males pale yellowish ventrally and white anterior margin along pectoral, pelvic and anal fins. White margin on lower lobe of caudal fin and dark grey submarginal bands on caudal lobes.

Distribution. *Salvelinus evasus* is restricted to Lake Ammersee, upper Danube basin, Germany.

Etymology. Named with reference to its survival in spite of all threats. Past participle of the latin verb *evadere* (escape, get away), used as an adjective.

Notes on biology. Seem to spawns at all seasons with a peak in September-October.

Conservation status. Vulnerable. Although already recorded by Schillinger (1901) this species has been overlooked since. It might be the only surviving real deep-water charr in prealpine lakes. Using molecular markers, Englbrecht (2000) demonstrated a strong 'bottleneck' in *S. evasus*. It is only a matter of chance that *S. evasus* still exists despite the heavy water pollution in the middle of the 20th century.

Discussion. *Salvelinus profundus*, *S. neocomensis* and *S. evasus* are distinguished from prealpine charrs collectively called here *S. umbla* (data on *S. umbla* based on Buresch, 1925 and Behnke, 1980) by: mouth subinferior, lower jaw enclosed in upper jaw (vs. terminal to subterminal); upward curved hook at tip of lower jaw of sexually mature males very small and enclosed in upper jaw in *S. evasus* (vs. projecting upper jaw); snout blunt (vs. conical); 19-25 gill rakers (vs. 25-31); flank yellowish to silvery, sometimes with faint pale spots (vs. flank greenish brown with reddish spots); fins with white anterior margin in large males only in *S. evasus* (vs. fins with white margin in all adults).

Salvelinus neocomensis is distinguished from *S. evasus* and *S. profundus* by eye diameter 34.6.0-36.0% HL (19.2-28.6) and pelvic fin reaching to anus in males (vs. not). *Salvelinus evasus* is distinguished from *S. profundus* by eye diameter 0.8-1.4 times in interorbital width (vs. 1.3-1.5), 19.2-26.1% dorsal HL (26.0-28.6); head depth at eye 9.4-11.4% SL (vs. 7.6-9.4); body depth at anal-fin origin 10.6-14.7% SL (vs. 15.0-16.3); body width at anal-fin origin 5.2-8.2% SL (vs. 7.6-9.0).

The differential diagnoses of *S. evasus* vs. *S. profundus* and *S. neocomensis* are limited because the last two species are apparently extinct and known only from the lacunary description of Schillinger (1901), Dörfel (1974), Fuhrmann (1903) and Rubin & Buttiker (1987) and the four (*S. profundus*) and three (*S. neocomensis*) museum specimens examined. All four *S. profundus* are large mature females. Figure 6 shows three diagnostic morphometric characters of these four specimens and 16 females of *S. evasus*, demonstrating that *S. profundus* is outside the range of *S. evasus*. We do not

exclude that, if more material of *S. profundus* had been available, there could have been an overlap in morphometric characters. Conversely, well preserved material would allow a more detailed comparison of head and body shape and morphology; this is not possible without destructing the few remnant specimens. Behnke (1980) described the colouration of *S. profundus* as uniform yellowish brown, and no spots or anything was recorded in the specimens examined for this study. However, colouration might have faded due to conservation and cannot be used as character to distinguish this species from *S. evasus*, which has whitish spots on dorsum. Dörfel (1974) reported spots to be rarely present in the material of *S. profundus* he examined.

Behnke (1980) speculated, that *S. profundus* might be the last living representative of an ancient *Salvelinus* lineage. Brunner *et al.* (1998) surveyed several charr populations of prealpine lakes of the Rhine, Rhone and Danube drainages, including *S. evasus,* using microsatellites and analysis of mitochondrial DNA data. This study supports the hypothesis of a single postglacial origin for the prealpine charr populations and there was no evidence that deepwater charrs from lake Ammersee may represent a second species which invaded only this prealpine lake. Brunner *et al.* (1998) data support the view that relationship of charr populations within prealpine lakes parallels the hydrographic system and that Lake Ammersee charr belongs to the Danubian lineage. Molecular data of Englbrecht *et al.* (2002) demonstrate that *S. evasus* has unique mitochondrial DNA haplotypes but is most similar to the geographically close charrs from lakes Plansee and Heiterwanger See and has therefore evolved in that area. The extinct *S. profundus* and *S. neocomensis* could not be included in any molecular study. It seems difficult, however, to hypothesize that *S. profundus, S. neocomensis* and *S. evasus* could form a monophyletic lineage as this would mean that Lake Ammersee charrs would have invaded Lake Konstanz and Lake Neuchâtel, which seems quite unlikely. A scenario of the invasion of Lake Konstanz and Lake Neuchâtel from Lake Ammersee would require that a riverine *Salvelinus* coming from the Rhine (that is from the north) has invaded Lake Ammersee, quickly adapting to the deep water environment and then, as an adapted deepwater charr, migrated via the open Danube-Rhine connection to Lake Konstanz. Under this scenario, all this should have happened before this connection was closed in the early Holocene (Hantke, 1993). We hypothesize that *S. profundus, S. neocomensis* and *S. evasus* evolved independently within their lakes and similarities in head shape are due to convergent adaptation to benthic life in deep lakes. A similar situation has been demonstrated for lacustrine coregonids by Douglas *et al.* (1999).

Burersch (1925) reported an average of 26-27 gill rakers in charr populations from 12 Austrian lakes and Behnke (1980) distinguished *S. profundus* from all other prealpine charrs known to him by 20-25 gill rakers (vs. 27-31). We observed a remarkable interpopulation variation among the prealpine charrs here collectively called *S. umbla*. Colourful, strictly winter spawning, large growing (more than 550 mm SL) 'normal' charrs with terminal mouth and 18-26 (mode 22, n=31) gill rakers (FSJF 1380) are known from Lake Konstanz (2004, pers. obs.). The same applies to Lake Neuchâtel (see above). Brenner (1980) reported deepwater charrs with 19-26 gill rakers from lake Attersee. This population is distinguished from *S. profundus* and *S. evasus* in having fins with white margins (vs. absent except in very large males), parr marks present in adults (vs. absent in specimens larger than 100 mm SL), mandible

reaching backwards to vertical through posterior eye margin (vs. reaching backwards beyond vertical through posterior eye margin in *S. profundus* and *S. evasus* over 140 mm SL).

A critical review of prealpine charrs is likely to show that several species are lumped under the name *S. umbla*. As is exemplified by the cases of Lakes Konstanz and Neuchâtel, it might be too late to critically review most of them. Further, transplantation between the different lakes may have blurred the pattern in such a way that most stocks or populations are merely hybrid swarms. Urgent attention is needed to identify the native stocks which have not been impacted by introduction if we want to save them. Studies on taxonomy and phylogeny of populations of hybrid origin do not present any interest and can only lead to flawed conclusions. Conservation of hybrid stocks is an unjustifiable waste of resources.

COMPARISON MATERIAL

Salvelinus cf. *umbla* FSJF 1380, 31, 204-412 mm SL; Lake Konstanz: between Marienschlucht Teufelstisch. A. Revermann, 16 Dec 2003. – *Salvelinus* sp. FSJF 728, 5 125-170 mm SL; Austria: Lake Attersee. A. Jagsch, Mar 2002. - EAWAG 187, 6; Switzerland: Lake Neuchâtel; O. Fuhrmann, ca. 1940. - MHNG 715.83, 1; same locality; Lugrin, 1907.

ACKNOWLEDGEMENTS

It is a pleasure to thank Dirk Neumann and Uli Schliewen (ZSM), David Catania (CAS), Sonia Fisch-Muller, Claude Weber (MHNG), Rudolf Müller (EAWAG) for access to material under their care and Samuel Arm for information on the 'biblet' of Lake Neuchâtel.

REFERENCES

BEHNKE, R. J. 1972. The systematics of salmonid fishes of recently glaciated lakes. *Journal of Fischeries Research* 29: 639-671.

BEHNKE, R. J. 1980. A systematic review of the genus *Salvelinus* (pp. 441-481). *In*: BALON, E. K. (ed.). Charrs - salmonid fishes of the genus *Salvelinus*. *Junk, Den Haag,* 893 pp.

BEHNKE, R. J. 1984. Organizing the diversity of the arctic charr complex (pp. 3-21). *In*: JOHNSON, L. & BRUNS, B. L. (eds). Biology of the Arctic Charr. *Proceedings of the International Symposium on Arctic Charr May 1981, Winnipeg, Manitoba. University Manitoba Press, Winnipeg*, 579 pp.

BRENNER, T. 1980. The arctic charr, *Salvelinus alpinus salvelinus*, in the prealpine Attersee, Austria (pp. 765-772). *In*: BALON, E. K. (ed.). Charrs - salmonid fishes of the genus *Salvelinus*. *Junk, Den Haag,* 893 pp.

BRUNNER, P. C., DOUGLAS, M. R. & BERNATCHEZ, L. 1998. Microsatellite and mitochondrial DNA assessment of population structure and stocking effects in Arctic charr *Salvelinus* alpinus (Teleostei: Salmonidae) from central Alpine lakes. *Molecular Ecology* 7: 209-223.

BURERSCH, R. 1925. Studien an Seesaiblingen mehrerer Alpenseen. Ein Beitrag zur Kenntnis der Seesaiblingsfauna Österreichs. *Zeitschrift für Fischerei und deren Hilfswiss*enschaften 23: 99-119.

CAVENDER, T. M. 1980. Systematics of *Salvelinus* from the North Pacific basin (pp. 295-322). *In*: BALON, E. K. (ed.). Charrs - salmonid fishes of the genus *Salvelinus*. *Junk, Den Haag*, 893 pp.

DÖRFEL, H.-J. 1974. Untersuchungen zur Problematik der Saiblingspopulationen (*Salvelinus alpinus* L.) im Überlinger See (Bodensee). *Archiv für Hydrobiologie*, Suppl. 47: 80-105.

DOUGLAS, M. R., BRUNNER, P. C. & BERNATCHEZ, L. 1999. Do assemblages of *Coregonus* (Teleostei: Salmoniformes) in the central alpine region of Europe represent species flocks? *Molecular Ecology* 8: 589-603.

ENGLBRECHT, C. 2000. Untersuchungen zur Phylogeographie und Populationsstruktur zweier paläarktischer Fischarten, der Mühlkoppe (*Cottus gobio* L.) und des alpinen Seesaiblings (*Salvelinus alpinus* L.). *PhD Dissertation, University of München*, 123 pp.

ENGLBRECHT, C. C., SCHLIEWEN, U. & TAUTZ, D. 2002. The impact of stocking on the genetic integrity of Arctic charr (*Salvelinus*) populations from the Alpine region. *Molecular Ecology* 11: 1017-1027.

FATIO, V. 1890. Faune des vertébrés de la Suisse. V. Histoire naturelle des poissons. II. Physostomes (suite et fin), anacanthiens, chondrostéens, cyclostomes. *Georg, Genève & Bâle*, lxxx+576+13 pp., 4 pls.

FATIO, V. 1885. Les coregones de la Suisse (feras diverses) classification et condition de frai. *Recueil Zoologie Suisse, Ser.* 1, 2: 649-665, pls 22-23.

FUHRMANN, O. 1903. L'Omble chevalier des zones profondes, *Salvelinus salvelinus* var. *profundus*. *Archives des Sciences Physiques et Naturelles* (4) 16: 331-332 [also in: *Bulletin de la Société Neuchâteloise des Sciences Naturelles* 31: 382-384].

HAEMPEL, O. 1930. Fischereibiologie der Alpenseen (Vol. 10). *In*: THIENEMANN, A. (ed.). Die Binnengewässer – Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten. *Schweizerbart, Stuttgart*, 259 pp.

HANTKE, R. 1993. Flußgeschichte Mitteleuropas. *Enke Verlag, Stuttgart*, 480 pp.

HARTLEY, S. E., BARTLETT, S. E. & Davidson, W. S. 1992. Mitochondrial DNA analysis of Scottish populations of Arctic charr, *Salvelinus alpinus* (L.). *Journal of Fish Biology* 40: 219-224.

HARTMANN, J. 1994. Hilft der Saiblingsbesatz den Saiblingsarten des Bodensee? *Österreichs Fischerei* 47: 46-50.

ICZN (International Commission of Zoological Nomenclature) 1999. International Code of Zoological Nomenclature. *International Trust for Zoological Nomeclature, London*, 4th edition, 306 pp.

JONSSON, B. & HINAR, K. 1982. Reproductive strategy of dwarf and normal arctic charr (*Salvelinus alpinus*) from Vangsvatnet Lake, western Norway. *Canadian Journal of Fisheries and Aquatic Sciences* 39: 1404-1413.

KOTTELAT, M. 1997. European freshwater fishes. An heuristic checklist of the freshwater fishes of Europe (exclusive of former USSR), with an introduction for non-systematists and comments on nomenclature and conservation. *Biologia, Bratislava*, Section Zoology 52 (Suppl. 5): 1-271.

KULLANDER, S. O. 1999. Fish species - how and why. *Reviews in Fish Biology and Fisheries* 9: 325-352.

NERESHEIMER, E. 1937. Die Lachsartigen (Salmonidae). 1. Teil (pp. 219-365). *In*: DEMOLL, R. & MAIER, H. N. (eds). Handbuch der Binnenfischerei Mitteleuropas. Band IIIA. *Schweizerbart, Stuttgart*.

QUARTIER, A. 1951. Morphologie et biologie de *Salvelinus alpinus* dans le lac de Neuchâtel. *Revue suisse de Zoologie* 58: 613-637.

RUBIN, J.-F. & BUTTIKER, B. 1987. Croissance et reproduction de l'Omble-chevalier, *Salvelinus alpinus* (L.), dans le lac de Neuchâtel (Suisse). *Schweizerische Zeitschrift für Hydrologie* 49: 51-61.

RUHLÉ, C. 1986. Ergebnisse bisheriger Abklärungen über die systematische Beziehungen zwischen Sommeralbeli und Winteralbeli [*Coregonus lavaretus* (L.)] im Walensee. *Schweizerische Zeitschrift für Hydrologie* 48: 145-152.

RUHLÉ, C. 1991. Comparison of the growth pattern of autochtonous and stocked arctic charr [*Salvelinus alpinus* (L.)] in the oligotrophic source lake (lake Lucerne) and the mesotrophic stocked lake (lake Constance). *International Society of Arctic Char Fanatics*, Informal Series: 147-150.

SCHILLINGER, A. 1901. Der Tiefseesaibling. *Allgemeine Fischerei-Zeitung*, N. F., 16: 149-151.

SCHINDLER, O. 1953. Unsere Süßwasserfische. *Kosmos, Franckh'sche Verlagshandlung, Stuttgart*, 222 pp.

SCHULZ, M. & FREYHOF, J. 2003. *Coregonus fontanae*, a new spring-spawning cisco from Lake Stechlin, northern Germany (Salmoniformes: Coregonidae). *Ichthyological Exploration of Freshwaters*, 14: 209-214.

VOGT, C. & HOFER, B. 1909. Die Süßwasserfische von Mitteleuropa. *Commissions Verlag Wilhelm Engelmann, Leipzig*, 558 pp.

VOLLESTAD, L. A. & L'ABEE-LUND, J. H. 1994. Evolution of the life history of Arctic charr *Salvelinus alpinus*. *Evolutionary Ecology* 8: 315-327.

REVUE SUISSE DE ZOOLOGIE 112 (1): 271-310; mars 2005

Les *Hyperolius* camerounais du groupe d' *H. nasutus* (Amphibia, Anura, Hyperoliidae)

J.-L. AMIET
48, rue des Souchères, F-26110 Nyons, France.

Cameroonian *Hyperolius* of the *H. nasutus* group (Amphibia, Anura, Hyperoliidae). - At the present time, the «*Hyperolius nasutus* group» includes fifteen species names, but several of them are certainly synonyms. First, a tentative synthesis of the characteristic features of the group is proposed. Some of them were formerly ignored or misinterpreted. For example, it is pointed out that specimens which do not exhibit the snout shape illustrated in Günther's description of *H. nasutus* were erroneously attributed to this species. In the Cameroonian batrachofauna, two species were confounded with *H. nasutus*: *H. igbettensis* Schiøtz (formerly a subspecies of *nasutus*) and *H. adspersus* Peters (a species fallen in oblivion). As these species have easily recognizable nuptial calls, it was possible to find distinguishing morphological characters. *H. igbettensis* is very slender and relatively larger, with a narrow head; its snout is long, but not «shark-like» as in Günther's description of *nasutus*; nuptial calls are of type A sensu Channing, Moyer & Burger; in Cameroon, this species inhabits guineo-sudanian and medio-sudanian savannas. *H. adspersus* is somewhat smaller, broader, and has a broad head and short, subtruncate snout; brown chromatophores are more numerous than in *igbettensis* and may give a speckled pattern; calls are of type C; *H. adspersus* is a farmbush species (= «parasylvicole» sensu Amiet) spread in the Cameroonian forest zone and reproducing in more open sites. Phonocenoses to which both species participate are described. Their distribution out of Cameroon is traced and their affinities are discussed. Finally, a diagnosis of each species is proposed and taxonomic problems concerning other species of the group are evoked.

Keywords: Africa - Cameroon - batrachology - systematics - ecology.

INTRODUCTION

Depuis la description d'*Hyperolius nasutus* par Günther, en 1864, quatorze taxons plus ou moins proches de cette espèce ont été reconnus. A l'heure actuelle, ce «groupe d'*H. nasutus*» constitue un ensemble dont plusieurs auteurs ont souligné la complexité, voire la confusion (Poynton & Broadley, 1987; Schiøtz, 1999). Une récente tentative de mise en ordre basée sur les vocalisations (Channing *et al.*, 2002) n'a pas entièrement résolu le problème.

Manuscrit accepté le 20.04.2004

Au Cameroun, l'existence de deux espèces différentes appartenant à ce groupe a été signalée depuis une trentaine d'années (Amiet, 1975, note infrapaginale p. 94). Sur du matériel de collection, ces espèces pourraient être confondues. Dans la nature, leurs appels permettent une séparation aisée, à partir de laquelle il devient possible de mettre en évidence des critères distinctifs morphologiques. De plus, elles sont localement syntopiques, ce qui apporte la garantie d'une séparation de niveau spécifique. L'objectif de ce travail est d'en donner une description détaillée, qui mettra l'accent sur leurs caractères différentiels, en espérant que cela fournira des points de repère pour une clarification de la systématique de l'ensemble du groupe.

Une analyse attentive des descriptions originales montre qu'aucune des deux espèces ne peut être rapportée à *H. nasutus*, tel que Günther l'a décrit et figuré, mais qu'elles correspondent cependant à des taxons déjà nommés: *H. adspersus* Peters, 1877, seconde espèce décrite dans le groupe, et *H. igbettensis* Schiøtz, 1963, initialement considéré comme sous-espèce d'*H. nasutus*. Les raisons qui ont conduit à retenir ces dénominations seront discutées après les redescriptions des deux espèces.

MATÉRIEL ET MÉTHODES

Pour les deux espèces représentées au Cameroun, les spécimens et les données de terrain ont été recueillis par l'auteur. La méthode de recherche a été le repérage acoustique au cours de prospections nocturnes. Cette méthode présente le double avantage de donner une orientation taxonomique, grâce aux différences des appels, et d'apporter la certitude que les mâles capturés sont adultes, puisque vocalement actifs. L'inconvénient est que les prélèvements ne comportent pas de juvéniles et peu de femelles, mais on est sûr que celles-ci, venues pour pondre, sont elles aussi adultes.

Grâce à l'obligeance de A. Schiøtz, j'ai reçu en prêt du Musée de Copenhague 2 ex. d'*H. viridis* Schiøtz (de Sumbawanga, Tanzanie), 8 ex. d'*H. benguellensis* Bocage (de Hillwood, Zambie) et 6 ex. d'un *Hyperolius* désigné ici comme «*H.* cf. *nasutus*» (Hillwood, Zambie). Ce matériel a été étudié suivant la méthode exposée ci-après et sera souvent mentionné dans ce travail, car il offre de précieux éléments de comparaison qui permettent de mieux cerner les caractéristiques des deux espèces camerounaises.

Pour les mensurations, délicates sur de si petits animaux (de l'ordre de 20 mm), deux méthodes ont été utilisées.

1°) Les distances «extrémité du museau – entrejambe» (L), «largeur de la tête en arrière des yeux» (T) et «longueur de la jambe du genou au talon» (J) ont été mesurées au pied à coulisse (Fig. 1).

2°) Même sous la loupe binoculaire, les mensurations céphaliques sont difficiles à faire au pied à coulisse. Comme ce sont les rapports morphométriques qui sont intéressants, plutôt que les valeurs absolues, j'ai procédé de la façon suivante. (1) L'animal est disposé bien à plat sur le fond d'une petite cuvette à dissection, immergé pour éviter tout risque de dessiccation. (2) La cuvette étant placée sur la platine d'une loupe binoculaire, sa tête est dessinée à la chambre claire (grossissement x 12). (3) Sur le dessin obtenu, de l'ordre de 7 à 9 cm dans sa plus grande dimension, les mensurations sont faites en employant un calque portant deux axes perpendiculaires gradués, qu'il suffit de déplacer pour obtenir les mesures suivantes: T, largeur de la tête, LT, longueur de la

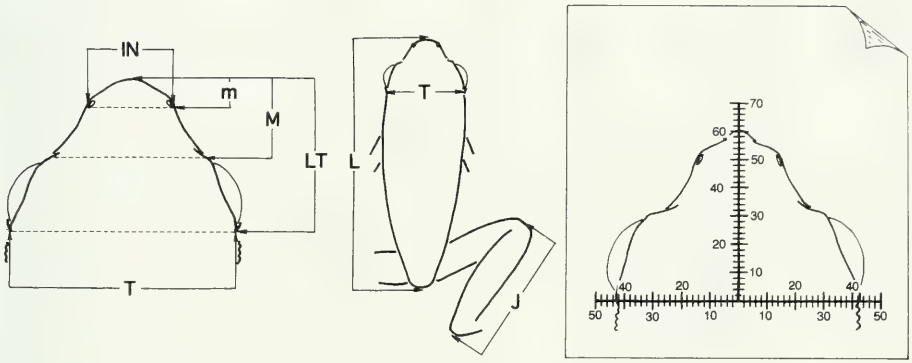


FIG. 1
Mensurations utilisées dans le présent travail. A droite, méthode d'obtention des données de morphométrie céphalique à l'aide d'un calque portant deux axes perpendiculaires gradués.

tête, M, longueur du museau, IN, espace entre les narines, m, extrémité du museau (Fig. 1). (4) Ces mesures sont utilisées pour calculer les rapports morphométriques suivants: LT/T, M/T, M/IN, m/IN (Tab. V).

Pour chacune des deux espèces camerounaises, une dizaine de spécimens, pris au hasard, ont été ainsi dessinés. Pour les espèces extra-camerounaises, tous les spécimens utilisables l'ont été aussi. Il n'y a donc pas une trop grande disparité entre les échantillons des premières et des secondes.

Les dessins de profil de la tête ont été faits suivant la même méthode, mais ils ne peuvent pas être utilisés pour des mensurations (projection sur un plan, introduisant un biais des valeurs réelles). Une mesure souvent utilisée, celle du diamètre oculaire, a été écartée: il suffit d'examiner un spécimen sous l'objectif de la loupe binoculaire pour constater qu'il n'y a pas de «commissures palpébrales» définies, ce qui empêche de faire des mesures correctes. Il en est de même pour la largeur de la paupière supérieure et l'espace interoculaire: la saillie du globe oculaire se raccordant à la face supérieure de la tête par une courbe, il est impossible d'y trouver un repère permettant de mesurer les dimensions précitées.

La méthode précédente consomme beaucoup de temps, mais elle a l'avantage de fournir, par la même occasion, des dessins qui permettent d'illustrer des caractères difficiles à quantifier ou à décrire de façon objective. C'est ainsi qu'ont été faites les Fig. 2, 7, 10 et 11, montrant les variations de forme du museau chez les espèces étudiées. Dans le même but, elle a été utilisée aussi pour montrer la variation intra- et interspécifique de la palmure (Fig. 4 et 8).

La méthode de cartographie, sur trame quadrillée à 10 minutes sexagésimales, a été exposée dans un travail antérieur (Amiet, 1983). Il faut souligner ici que: (1) les relevés acoustiques n'ont pas été nécessairement accompagnés de prélèvements; (2) comme les carrés mesurent une vingtaine de km de côté, plusieurs localités ont pu faire l'objet de relevés distincts dans un même carré; (3) surtout dans la région de Yaoundé, le même site a pu faire l'objet de plusieurs visites, et l'activité vocale être notée dans

plusieurs relevés différents: dans ce cas, pour la description des phonocénoses, les relevés ont été regroupés. Il résulte de ce qui précède qu'il y a des différences entre le nombre de localités mentionnées sous «Matériel étudié», le nombre des pointages sur la carte et le nombre de relevés utilisés dans le tableau VI.

La plupart des repérages des deux *Hyperolius* ont été faits à l'occasion de prospections portant sur l'ensemble de la batrachofaune vocalement active sur le même site. Le tableau VI fait la synthèse des listes d'espèces-compagnes d'*H. igbettensis* et d'*H. adspersus*. Ces espèces constituent les «phonocénoses» (*cf.* Amiet, 2001) auxquelles participent ces *Hyperolius*. Dans le cas présent, il s'agit plutôt d'esquisses, car les relevés utilisables sont peu nombreux: 14 se rapportent à la phonocénose d'*H. igbettensis*, 16 à celle d'*H. adspersus*, et 2 sont relatifs à des sites où s'intriquent savanes et lisières de forêt plus ou moins dégradée et où les deux espèces peuvent coexister. Dans le tableau VI, les espèces-compagnes ont été réparties en *groupes*, correspondant à autant de cortèges écologiques: groupe 1: savanicoles médio-soudaniennes; groupe 2: savanicoles *s. lato;* groupe 3: endémique savanicole ouest-camerounaise; groupe 4: savanicoles pénétrant plus ou moins profondément dans la zone forestière; groupe 5: espèces euryéciques (milieux ouverts); groupe 6: espèces parasylvicoles à large extension vers le nord; groupe 7: espèces parasylvicoles propres à la zone forestière.

Les enregistrements sonores ont été effectués sur magnétophone UHER 4000 Report, puis recopiés sur un magnétophone numérique Tascam DA-P1. Les sonagrammes ont été réalisés par A. Schiøtz au Laboratoire de Zoologie de l'Université de Copenhague. Dans ce qui suit, une analyse fine des vocalisations des deux espèces camerounaises ne sera pas tentée. En revanche, pour chacune, plusieurs sonagrammes d'appels provenant d'individus d'origines différentes seront présentés, de façon à illustrer les différences interspécifiques et la variation intraspécifique des vocalisations.

Dans les rubriques «Matériel étudié», les noms des localités sont placés par ordre alphabétique. Les coordonnées des carrés d'où proviennent les échantillons sont indiquées, entre crochets, en degrés et minutes de longitude est puis, après le signe «x», de latitude nord. Les numéros de collection des spécimens sont mentionnés entre parenthèses.

RÉSULTATS ET DISCUSSION

Le groupe d'*Hyperolius nasutus*

Dans ce qui suit, on appellera «groupe d'*H. nasutus*» l'ensemble des 15 taxons répertoriés dans le tableau I. *H. pusillus* (Cope, 1862), *H. quinquevittatus* Bocage, 1866, et *H. parkeri* Loveridge, 1933, rapprochés par certains auteurs d'*H. nasutus*, en diffèrent par trop de caractères pour y être inclus.

Il est certain que plusieurs noms du tableau I correspondent à des synonymes. Une analyse comparative de toutes les descriptions, faite dans une perspective historique, permettrait de mettre au moins certains d'entre eux en évidence. Toutefois, ce travail ne prendrait tout son intérêt que dans une révision générale de l'ensemble, entreprise qui dépasse mes possibilités. Heureusement, cette remise en ordre n'est pas nécessaire pour répondre à l'objectif défini dans l'Introduction.

TAB. I. Synopsis des taxons décrits dans le groupe d'*Hyperolius nasutus*, par ordre chronologique des descriptions. Pour les planches, les nombres entre parenthèses correspondent aux numéros des figures. *R*: *Rappia*.

Taxon	Auteur	Date	Pages, figures	Terra typica
H. nasutus	Günther, A.	1864	P. 482, pl. XXXIII (3)	Angola: "province Duque de Bragance".
H. adspersus	Peters, W.C.H.	1877	P. 616, pl. (6)	Angola (Cabinda): "Chinchoxo (Westafrika)".
R. benguellensis	Barboza du Bocage, J. V.	1893	P. 119	Angola: "Cahata, ... Benguella".
R. punctulata	Barboza du Bocage, J. V.	1895	P. 168	Angola: "bords du Quanza".
R. granulata	Boulenger, G. A.	1901	P. 4-5, pl. II (3)	R. D. Congo: "Pweto".
R. oxyrhynchus	Boulenger, G. A.	1901	P. 5, pl. II (4)	R. D. Congo: "Pweto et Lofoi".
R. papyri	Werner, F.	1907	P. 1903 [81], pl. IV (15)	Soudan: "Khor Attar und Mongalla... Gondokoro".
H. acuticeps	Ahl, E.	1931	P. 29-31	Tanzanie ("Deutsch-Ost-Afrika"): "Konde-Nika".
H. poweri	Loveridge, A.	1938	P. 213-214	Afrique du Sud: "Umvoti, ..., Natal".
H. dartevellei	Laurent, R.	1943	P. 71, fig. 3	R. D. Congo: "Zambi (Bas Congo)".
H. nasicus	Laurent, R.	1943	P. 71-72, fig. 4	R. D. Congo: "Kasiki (Marungu...)".
H. sagitta	Laurent, R.	1943	P. 72-73, fig. 5 et 6	R. D. Congo: "Kambo (Haut Luapula)".
H. lamottei	Laurent, R.	1958	P. 292-294, pl. III (16)	Guinée: "entre Zouguépo et Sérengbara".
H. nas. igbettensis	Schiøtz, A.	1963	P. 64-66, fig. 22, pl. I (12 et 13)	Nigeria: "north of Igbetti, Oyo Province".
H. viridis	Schiøtz, A.	1975	P. 110-112, fig. 109 et 110	Tanzanie: "30 miles southwest of Mbeya".

TAB. II. Forme du museau selon les descriptions originales de divers taxons du groupe d'*Hyperolius nasutus*. Faute d'indications explicites sur ce point, les descriptions d'*H. poweri* et *H. viridis* n'ont pas été mentionnées. *R*: *Rappia*.

Auteur	Date	Taxon	Descriptions originales
Museau long et pointu			
Günther	1864	*H. nasutus*	P. 482: "Snout much produced, acutely pointed..." (pl. 33, fig. 3, profil et dessus).
B. du Bocage	1893	*R. benguellensis*	P. 119: "Ressemble à *R. nasuta*, Günth., par son museau saillant et acuminé".
Boulenger	1901	*R. oxyrhynchus*	P. 5: "Le museau est très pointu et dépasse fortement la bouche" (pl. 2, fig. 4, vue de dessus).
Werner	1907	*R. papyri*	P. 1903 [81]: "Schnauze ähnlich wie bei *R. oxyrhynchus* zugespitzt, vorspringend ...".
Ahl	1931	*H. acuticeps*	P. 29: "Schnauze sehr spitz, im Profil zugespitzt oder schräg nach hinten abgestutzt, über das Maul hinausragend".
Laurent	1943	*H. nasicus*	P. 71: "Museau pointu, parfois un peu relevé à l'extrémité, dépassant fortement la mâchoire inférieure, tronqué en profil" (fig. 4, vue de dessus, peu significative).
Laurent	1943	*H. sagitta*	P. 72: "Museau obtusément pointu, obliquement tronqué en profil, dépassant de beaucoup la mâchoire inférieure" (fig. 5 et 6, vues de dessus, peu significatives).
Museau court			
Peters	1877	*H. adspersus*	P. 619: "Schnauze abgeplatel, zugespizt..." (description peu explicite, mais la fig. 6, vue de trois-quarts, montre clairement un museau court).
B. du Bocage	1895	*R. punctulata*	P. 168: "museau court et tronqué à l'extrémité".
Boulenger	1901	*R. granulata*	P. 4: "le museau est court et arrondi, un peu pincé, tronqué et proéminent" (pl. II, fig. 3, face dorsale).
Laurent	1943	*H. dartevellei*	P. 71: "Museau obtusément tronqué, ne dépassant pas de beaucoup la mâchoire inférieure... (museau court et obtus)" (fig. 71, vue de dessus).
Laurent	1958	*H. lamottei*	P. 292: "Museau arrondi, dépassant légèrement la mâchoire inférieure".
Schiøtz	1963	*H. nas. igbettensis*	P. 64: "Snout rounded" (fig. 22, profil).

Dans cette partie seront examinés des caractères qui permettent de séparer le groupe d'*H. nasutus* de l'ensemble des autres *Hyperolius*, ainsi que des caractères, parfois méconnus, susceptibles d'être discriminants *à l'intérieur* du groupe, et donc d'éclairer le statut de certains taxons qui y sont inclus.

TAILLE

La comparaison des tailles indiquées dans les différentes descriptions originales conduit, pour l'ensemble du groupe, à des valeurs extrêmes de 18 mm (chez *H. oxyrhynchus*: Boulenger, 1901) et 27,6 mm (chez *H. lamottei*: Laurent, 1958); il semble préférable de ne pas tenir compte de la taille extrêmement faible indiquée par Werner (1907) pour son type d'*H. papyri*: 14 mm! Les diverses redescriptions n'ont pas conduit à rectifier ces valeurs. Les *Hyperolius* du groupe de *nasutus* ont donc pour première caractéristique leur petite taille, ce qu'ont relevé de nombreux auteurs. Toutefois, ce ne sont pas les plus petits des *Hyperolius:* dans le travail d'ensemble de Schiøtz (1999) sont mentionnées une dizaine d'espèces, aussi bien forestières que savanicoles, dont la taille peut s'abaisser en dessous de 20 mm (avec un record pour *H. minutissimus* Schiøtz, 1975, dont les mâles mesurent de 12 à 17 mm!).

Plus remarquable est l'absence de différence de taille notable entre les mâles et les femelles d'une même espèce. Cette particularité a été notée par tous les auteurs qui ont pu disposer d'un matériel suffisant. Elle est illustrée par les valeurs rapportées dans les tableaux de mensurations des deux espèces camerounaises (tab. IV): pour l'une, la taille moyenne des mâles représente 97,4% de celle des femelles, et pour l'autre 93,4%, mais dans les deux cas les plus grands mâles dépassent ou égalent les plus grandes femelles. Par rapport au reste du genre, où les mâles sont en général plus petits, voire beaucoup plus petits, que les femelles, ce faible écart est un bon caractère distinctif du groupe.

HABITUS

Les descriptions soulignent en général l'aspect étroit et élancé, comme étiré, d'*H. nasutus* et des espèces affines. Cet habitus, partagé par les mâles et les femelles, se traduit aussi par de faibles valeurs du rapport T/L (largeur de la tête / longueur du corps), de l'ordre de 23 à 29% seulement.

Toutefois, cet aspect élancé n'est pas général: les descriptions et/ou les figures qui les accompagnent montrent que *H. adspersus*, *H. granulatus*, *H. dartevellei* et *H. viridis* ont des proportions plus ramassées.

Les deux espèces camerounaises illustrent bien ces deux possibilités: chez l'une, très longiligne, tous les individus (32) ont un rapport T/L compris entre 23,18 et 26,52%, alors que chez l'autre, plus trapue, il est compris (pour 47 individus) entre 28,29 et 32,63%.

PIGMENTATION

Dans un genre au chromatisme très diversifié et parfois spectaculaire, les *Hyperolius* du groupe de *nasutus* se distinguent par leur aspect peu coloré et relativement uniforme.

Chez la plupart des espèces, la face supérieure du corps et des membres est d'un vert diaphane, plus ou moins densément piqueté de chromatophores bruns; au moins

chez certaines «formes», la teinte de fond peut cependant être brune (*cf.* photo *in* Wager, 1965, p. 210). La seule ornementation consiste en deux lignes latéro-dorsales blanches ou jaune pâle, partant des canthus ou des paupières et s'étendant jusqu'à la région inguinale. Une concentration de chromatophores bruns, plus apparents en livrée nocturne, peut souligner plus ou moins largement les bords supérieur et inférieur des bandes claires. Il y a aussi, assez souvent, un alignement médio-dorsal de chromatophores foncés.

Associé à l'habitus allongé, le patron dorsal linéaire paraît bien adapté aux supports habituels de ces rainettes, les feuilles de Graminées. Il s'enrichit même de bandes claires supplémentaires chez *H. lamottei* et, au moins chez certains individus, chez *H. benguellensis*.

Ventralement, le tégument est transparent et la pigmentation vert pâle, sauf sous les régions pectorale et abdominale, où une tunique opaque, d'un blanc pur, masque les viscères.

L'existence de phases ou de morphes est insuffisamment documentée. En tout cas, elle est beaucoup moins apparente que chez un grand nombre d'autres espèces d'*Hyperolius*. Quelques auteurs ont signalé que les juvéniles sont tous semblables (Schiøtz, 1963, p. 65; Wager, 1965, p. 208). Leur livrée se retrouve chez les mâles reproducteurs, alors que les femelles diffèrent par l'absence de bandes claires latéro-dorsales, sauf dans certaines populations (ou espèces?) où, suivant les cas, les femelles, ou au moins une partie d'entre elles, sont semblables aux mâles (Stevens, 1974, p. 10, pour *H. nasutus* au Malawi; Schiøtz, 1975, p. 98, pour *H. nasutus* en Afrique orientale). Chez *H. benguellensis*, il y a plusieurs types de coloration possibles («morphs»: Schiøtz & Van Daele, 2003): – à quatre bandes blanches (deux latéro-dorsales et deux paravertébrales), – à deux bandes latéro-dorsales, – ou sans bandes mais tachetée. Au moins chez les deux espèces camerounaises et chez les *H. nasutus* d'Ethiopie (*cf.* Largen, 1998, fig. 1), les femelles peuvent montrer une forte ponctuation dorsale, bien contrastée: il est possible que cette livrée succède à la livrée sans bandes et représente une phase de coloration ultime, réalisée seulement chez les femelles.

Forme du museau

De nombreuses descriptions ou redescriptions soulignent que le museau a une forme caractéristique: allongé et pointu, il s'avance bien au-delà de la bouche et, de profil, rappelle celui d'un squale («shark-like»: Poynton & Broadley, 1987). Le tableau II donne un synopsis des descriptions originales mentionnant cette particularité, qui apparaît dans l'étymologie de plusieurs noms spécifiques (*nasutus*, *oxyrhynchus*, *acuticeps*, *nasicus*).

Chez certains représentants du groupe, l'extrémité du museau peut être légèrement retroussée. Ce caractère, sans équivalent chez les autres rainettes africaines, a été relevé par Monard (1937: redescriptions d'*H. benguellensis* et *H. nasutus*) et par Laurent (1943: description d'*H. nasicus*).

Le profil squaliforme et le retroussement du museau sont illustrés par les dessins de têtes d'*H. benguellensis* de la Fig. 10. Ces dessins montrent une autre particularité qui, curieusement, a été passée sous silence par tous les auteurs (sauf Wilson, dans un travail non publié): les narines sont, chez cette espèce, portées par des

saillies latérales du museau, ce qui, en vue dorsale, accentue l'impression de rétrécissement de son extrémité. Ce caractère est bien visible aussi sur les dessins qui accompagnent la description d'*H. nasutus* par Günther (1864: pl. XXXIII, fig. 3); de même, il est perceptible sur le dessin de *Rappia oxyrhynchus* (Boulenger, 1901: pl. II, fig. 4). Le fait que ces auteurs n'y fassent pourtant pas allusion dans leurs descriptions conduit à s'interroger sur la réalité de son absence chez d'autres espèces, car il peut simplement avoir été omis.

A l'opposé des précédents, d'autres taxons rapportés au groupe d'*H. nasutus* se distinguent par la brièveté de leur museau, qui peut, de profil et/ou de dessus, avoir un aspect arrondi ou même tronqué. Le tab. II répertorie les espèces où ce caractère a été explicitement signalé dans les descriptions originales.

Malgré ce que pourrait laisser espérer l'aperçu précédent, le critère «forme du museau» est d'une utilisation délicate pour la définition des taxons à l'intérieur du groupe: 1°) plusieurs espèces (ou sous-espèces), nommées ou non, ont un museau d'aspect plus ou moins intermédiaire; 2°) dans une même espèce, comme le montrent les Fig. 2, 7, 10 et 11, il y a une variabilité individuelle importante, difficile à exprimer objectivement dans les descriptions; 3°) les auteurs ne sont pas toujours suffisamment explicites (dans quelques cas, l'auteur ne précise pas si le caractère est vu dorsalement ou latéralement!).

La forme du museau permet cependant de séparer au moins des cas extrêmes, comme ceux d'*H. adspersus* et d'*H. benguellensis*, illustrés par les Fig. 7 et 10. Elle permet aussi, éventuellement, d'apprécier la pertinence de certaines attributions spécifiques par rapport aux descriptions originales: par exemple, des *Hyperolius* à museau pointu ont souvent été rapportés à *H. granulatus*, et ce dernier mis en synonymie d'*H. nasutus* ou *H. benguellensis*, alors que la description de *Rappia granulata*, et le dessin qui l'accompagne, montrent clairement qu'il s'agit d'une espèce *à museau court*!

Remarque: d'après Laurent (1957) «Il semble bien que la forme du museau puisse varier chez un même individu [d'*H. granulatus*], selon la position des prémaxillaires», la forme pointue ou arrondie du museau étant due à la position des processus ascendants. Il en conclut que *H. oxyrhynchus*, à museau pointu, et *H. granulatus*, à museau arrondi, sont synonymes, comme l'avait soutenu Loveridge (1953). Si cette explication était valable, tous les *Hyperolius* devraient montrer des individus à museau pointu et d'autres à museau arrondi, car on ne voit pas pourquoi cette capacité de déformation du museau serait limitée à une seule espèce. Cette hypothèse ne sera donc pas retenue ici.

Relief tégumentaire dorsal

Dans la plupart des descriptions ou redescriptions où ce caractère est évoqué, le tégument est qualifié de lisse.

Deux descriptions font exception, celles de *Rappia benguellensis* par Barboza du Bocage (1893) et de *Rappia granulata* par Boulenger (1901). En ce qui concerne la première de ces espèces, Monard (1937), qui en a récolté des spécimens en Angola, et Perret (1976), qui en a révisé des syntypes, confirment que le tégument dorsal est granuleux (même si Monard estime que «la granulation ... est moins accusée que ne le laisse penser la description originale»). Ce caractère ne paraît pas, en général, avoir

retenu l'attention des auteurs ultérieurs. Quant à la seconde espèce, elle a été assez rapidement mise en synonymie de la première (sûrement à tort: *cf.* ci-dessus), ce qui fait que l'on ne dispose pas de données relatives à son relief tégumentaire autres que celles fournies par Boulenger.

Les photos publiées par Schiøtz (1999) et Schiøtz & Van Daele (2003) montrent l'existence d'une très fine granulation chez *H. benguellensis* et *H. viridis*. Sur les exemplaires de ces espèces qui m'ont été communiqués, des traces de granulation sont perceptibles chez certains, bien qu'ils paraissent lisses à l'œil nu.

La texture du tégument dorsal peut varier beaucoup suivant les conditions de préservation des spécimens. Elle varie aussi, comme le faisait déjà remarquer Monard dans l'article cité, en fonction de l'état physiologique de l'animal: on sait que chez tous les *Hyperolius* le relief tégumentaire, lorsqu'il existe, est accentué en atmosphère sèche. Ceci diminue l'intérêt du caractère dans la pratique systématique. Il reste que, dans le groupe d'*H. nasutus*, certaines espèces sont toujours lisses, alors que d'autres *peuvent* présenter un aspect finement granuleux, différence qui ne doit pas être négligée.

Parmi la trentaine de descriptions et redescriptions de taxons du groupe de *nasutus*, une seule, celle de Inger (1968), mentionne que chez les mâles d'*H. nasutus* du Parc de la Garamba «The dorsal surfaces of body and legs are covered with minute whitish asperities». Ces aspérités existent aussi chez les mâles des deux espèces représentées au Cameroun. Il s'agit de minuscules excroissances coniques à sommet émoussé, incolores, présentes sur toutes les parties supérieures du corps et des membres, mais aussi sur les côtés de la tête, les flancs, la tranche interne et externe des jambes, et même sous les tarses. Leur observation nécessite un grossissement d'environ x 25 et un éclairage rasant. Elles peuvent être difficiles à voir sur les spécimens mal fixés, dont l'épiderme a tendance à s'exfolier.

Chez les trois espèces dont des spécimens, récoltés par Schiøtz, m'ont été communiqués, trois degrés de développement sont observables. (1) Les *H.* cf. *nasutus* du NW de la Zambie ne montrent pas de différence notable par rapport aux deux espèces camerounaises. (2) Chez les deux spécimens d'*H. viridis*, les aspérités sont encore plus petites et très dispersées, et de ce fait difficilement décelables. (3) Chez les spécimens d'*H. benguellensis*, elles sont très nombreuses, bien visibles, et présentes *à la fois* chez les 6 mâles et les 2 femelles examinés, bien qu'elles paraissent un peu plus développées chez les premiers.

Ce dernier cas est doublement intéressant. Il montre d'abord que ces aspérités, contrairement à ce qu'on aurait pu penser, ne représentent pas un caractère sexuel secondaire au sens strict du terme. Ensuite, il suggère un moyen supplémentaire, par l'examen des femelles, de séparer *H. benguellensis* d'autres taxons voisins.

D'autres *Hyperolius* que ceux du groupe de *nasutus* montrent une spinosité tégumentaire plus ou moins apparente et, semble-t-il, propre aux mâles. La répartition de ce caractère à travers le genre, ainsi que ses différentes modalités, restent toutefois à préciser.

Appareil tympanique

Comme chez la plupart des *Hyperolius*, le tympan n'est pas visible chez les espèces du groupe de *nasutus*. Dans un intéressant travail non publié (cité par Schiøtz

& Van Daele, 2003), Wilson a montré que, parmi plusieurs espèces du groupe qu'elle a étudiées, *H. benguellensis* se distingue par la régression de l'appareil tympanique, complètement recouvert par le muscle *depressor mandibulae*. Ce caractère, facile à mettre en évidence, mériterait d'être recherché dans un large échantillon de populations se rapportant au groupe. Chez les deux espèces camerounaises, comme chez *H. viridis* et *H. cf. nasutus* de Zambie, le tympan n'est qu'en partie recouvert par le muscle *depressor mandibulae*.

Caractères sexuels secondaires

Les faibles différences de taille et de chromatisme entre les mâles et les femelles ont été soulignées plus haut. Deux particularités des mâles doivent aussi être relevées.

Disque (ou glande) gulaire et sac vocal. Plus étendue que chez la plupart des *Hyperolius*, la glande gulaire occupe presque tout l'arc mandibulaire. Sa taille présente aussi beaucoup moins de variation individuelle que chez les autres représentants du genre. Epaisse, généralement de teinte jaune, sa surface est chagrinée-ridulée. A en juger par les deux individus examinés, *H. viridis* se distingue par son disque gulaire plus lisse, légèrement convexe et de contour plus arqué postérieurement.

Au moins chez les deux espèces camerounaises, la partie dilatable du sac vocal porte une macule d'un blanc pur située près du bord postérieur du disque gulaire. Quand le sac est enflé, cette tache blanche, de taille très variable suivant les individus, est bien visible (*cf.* photos p. 25 et p. 95 *in* Schiøtz, 1999, et fig. c, pl. I et pl. II). Au repos, quand la partie membraneuse est repliée sous le disque, une bande blanche longeant le bord postérieur de ce dernier peut en indiquer la présence (fig. b, pl. III), mais chez les spécimens fixés depuis longtemps elle devient difficile à voir. Comme l'iconographie disponible dans la littérature ne fournit pas d'autres images de ce caractère, il n'est pas possible de dire s'il existe chez toutes les espèces du groupe. Il se retrouve, sporadiquement, chez quelques autres espèces d'*Hyperolius* (*cf.* photo d'*H. marmoratus* Rapp, *in* Wager, 1965, p. 7).

Absence de glandes pectorales et brachiales. Seule Wilson, dans le travail non publié mentionné plus haut, a relevé que les mâles des espèces du groupe d'*H. nasutus* n'ont pas de pores pectoraux. Effectivement, l'examen des mâles des cinq espèces à ma disposition n'a pas permis de déceler la présence de glandes tégumentaires dans la région pectorale, pas plus que sur les avant-bras. Ces formations sont présentes chez de nombreuses espèces d'*Hyperolius* mais, faute d'une investigation portant sur l'ensemble du genre, il n'est pas possible, comme dans le cas précédent, de savoir si leur absence est un caractère propre au groupe.

Vocalisations

Channing *et al.* (2002) ont analysé 237 appels de 69 mâles provenant de 19 localités allant de l'Afrique occidentale à l'Afrique australe. Cette analyse les a amenés à distinguer trois types d'appels, qu'ils définissent de la façon suivante. (1) Type A: «The relatively long call consists of a series of pulses that usually slows down during the last half of the call, although in some cases showing a clear division between the initial fast phase and the slower second phase». (2) Type B: «The call is made up of a

TAB. III. Données morphométriques relatives au matériel camerounais d'*Hyperolius igbettensis* et *H. adspersus* et, pour comparaison, à quelques spécimens d'*H.* cf. *nasutus*, *H. benguellensis* et *H. viridis*. Abréviations: voir «Matériel et méthodes».

		H. igbettensis	*H. adspersus*	*H.* cf. *nastutus*	*H. benguellensis*	*H. viridis*
	N	32	47	6	8	2
	mini.	190	185	175	189	
L	maxi.	245	218	193	220	
	moy.	**223**	**201,7**	**185,8**	**181,5**	**217,5**
	mini.	23,18	28,29	28,94	26,26	
T/L	maxi.	26,52	32,63	32	28,49	
	moy.	**25,06**	**30,24**	**30,34**	**27,72**	**30,79**
	mini.	48,08	49,75	52,15	48,63	
J/L	maxi.	55,71	56,92	55,95	52,87	
	moy.	**50,58**	**52,35**	**54,25**	**50,92**	**51,25**

TAB. IV. Taille (L) des mâles et des femelles chez *Hyperolius igbettensis* et *H. adspersus* du Cameroun.

		H. igbettensis	*H. adspersus*
Mâles			
	N	26	42
	minima	190	185
	maxima	245	218
	moyennes	**220,1**	**201,1**
	écarts-types	11,89	8,33
Femelles			
	N	6	5
	minima	225	195
	maxima	245	215
	moyennes	**235,7**	**206,6**
	écarts-types	7,15	8,5

TAB. V. Quelques rapports morphométriques céphaliques chez cinq espèces du groupe d'*Hyperolius nasutus*. Abréviations: voir «Matériel et méthodes».

	H. benguellensis	*H. igbettensis*	*H. adspersus*	*H.* cf. *nasutus*	*H. viridis*
N	5	10	8	6	2
LT/T	68,19	69,84	61,88	68,32	65,62
M/T	34,62	33,15	27,33	31,75	29,56
M/IN	39,52	31,7	26,32	29,22	27,95
n/IN	93,4	89,13	74,77	88,32	79,86

very brief, rapidly pulsed initial phase, followed by a series of slower pulses. The two sections are clearly separated...». (3) Type C: «The call consists of a very brief, high-pitched buzz, sometimes followed by one or three slower pulses». La distinction entre ces trois types est étayée par des précisions sur les divers paramètres physiques caractérisant les appels analysés.

Le travail de Channing *et al.* (2002) présente un double intérêt: – il confirme, sur des bases biologiques, que *H. nasutus* est bien un complexe d'espèces, question plusieurs fois évoquée auparavant (voir par exemple Schiøtz, 1999), – il fournit un cadre pour la description des appels des espèces de ce complexe. On verra ainsi que les vocalisations de l'une des espèces représentées au Cameroun sont de type A, alors que celles de l'autre espèce sont de type C.

Malheureusement, Channing *et al.* (2002) n'ont pas utilisé les caractéristiques bio-acoustiques comme un guide leur permettant de mettre en évidence des différences morphologiques. De plus, ils ont ignoré les descriptions originales (pourtant toutes citées) et attribué de façon arbitraire des noms spécifiques aux entités distinguées à partir de leurs vocalisations. Enfin, ils ne discutent pas l'éventualité que des espèces différentes aient des appels semblables (c'est le cas, dans la faune camerounaise, pour *Afrixalus dorsalis* et *A. fulvovittatus*, *Hyperolius acutirostris*, *mosaicus* et *endjami*, *Leptopelis notatus* et *L. millsoni*), ou que, inversement, il puisse y avoir, surtout chez des espèces à vaste répartition, une variation géographique, de type clinal, des vocalisations (exemples dans Amiet, 2004). Cela les conduit à des résultats taxonomiquement discutables. Par exemple, ils réunissent, sous le nom de «*H. nasutus*», *H. dartevellei* et *H. lamottei*. Or, le premier a été défini (et nommé) par Günther sur la base de son museau long et pointu, le second a été isolé par Laurent en raison de la brièveté de son museau, et le troisième est, morphologiquement et vocalement (à en juger par le sonagramme publié par Schiøtz, 1975), très différent des deux autres!

Hyperolius igbettensis Schiøtz, 1963

MATÉRIEL ÉTUDIÉ

Il comprend 26 mâles et 6 femelles se répartissant comme suit. Djaye [10°30-40' x 6°00-10'], 23.VI.79, 3 M, 6 F (79.059-067); Elomzok [11°30-40' x 4°10-20'], 29.IX.76, 1 M (76.184); -id-, 28.IX.77, 1 M (77.090); -id-, 07.X.77, 1 M (77.092); Foumban [10°40-50' x 5°40-50'], 25.V.70, 2 M (70.866-867); Lac Paponoun [10°30-40' x 5°30-40'], 21.VI.79, 5 M (79.032-036); Mbé [13°30-40' x 7°40-50'], 13.VII.73, 1 M (73.423); Ngaoundéré [13°30-40' x 7°10-20'], 30.VI.71, 5 M (71.971-975); Ngaoundéré, lac Bini [13°30-40' x 7°20-30'], 18.VII.75, 3 M (75.404-406); Sadolkoulaye [13°50'-14° x 7°10-20'], 06.VI.69, 1 M (69.258); -id-, 29.VI.71, 1 M (71.996); Tignère [12°30-40' x 7°20-30'], 19.V.81, 2 M (81.073-074).

Dix spécimens de référence (8 mâles et 2 femelles) sont déposés au Musée d'Histoire naturelle de Genève sous les numéros M.H.N.G. – 2644.89 à 2644.98.

DESCRIPTION

Par sa taille, cette espèce se situe parmi les plus grandes du groupe, juste après *H. lamottei:* dans sa description, Schiøtz (1963) indique 22 à 22,5 mm pour les mâles et 22,5 à 23 mm pour les femelles. Les spécimens camerounais, comme le montre le tab. III, varient de 19 à 24,5 mm, avec une moyenne de 22,3 mm.

Les 6 femelles disponibles ont toutes été prises le même jour et dans la même localité, ce qui peut biaiser la comparaison entre les deux sexes car les mâles sont

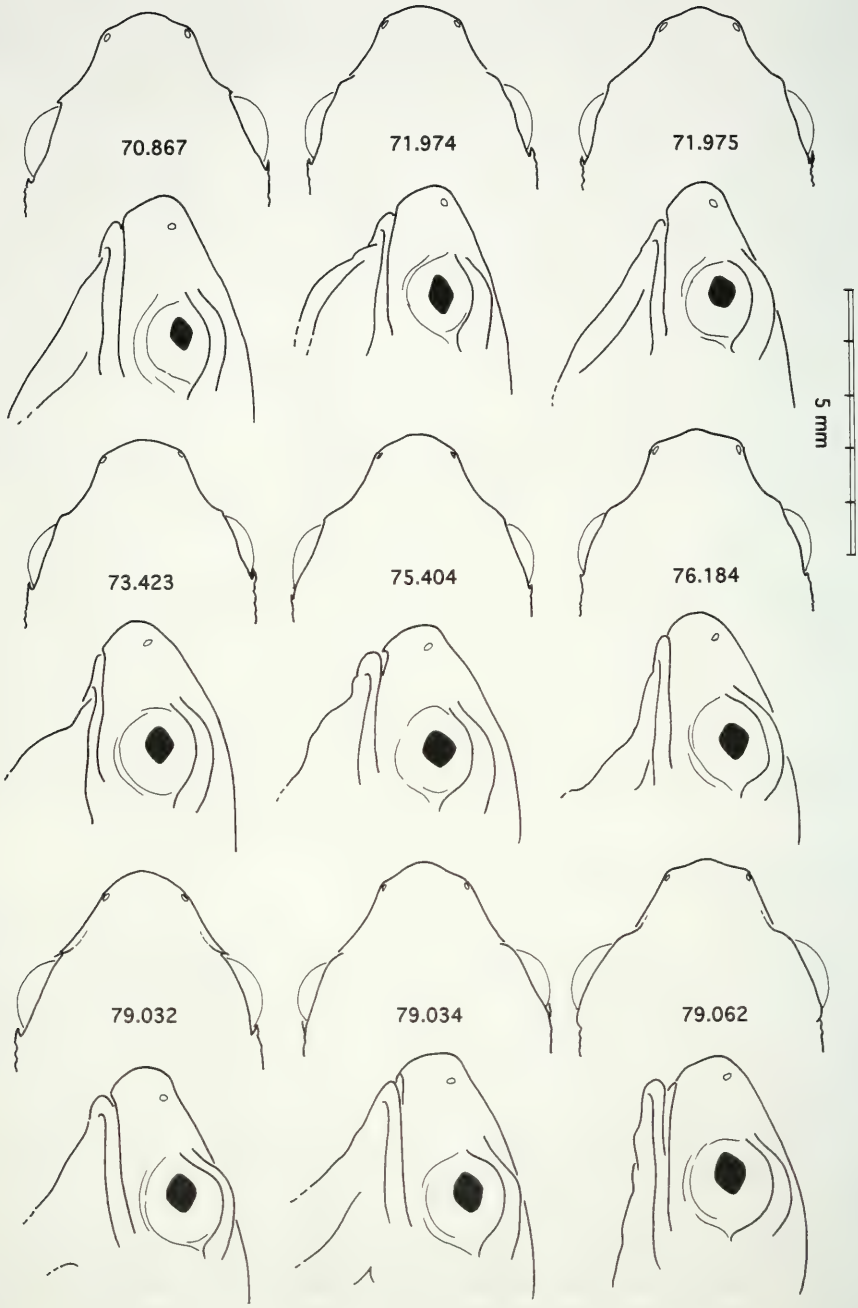
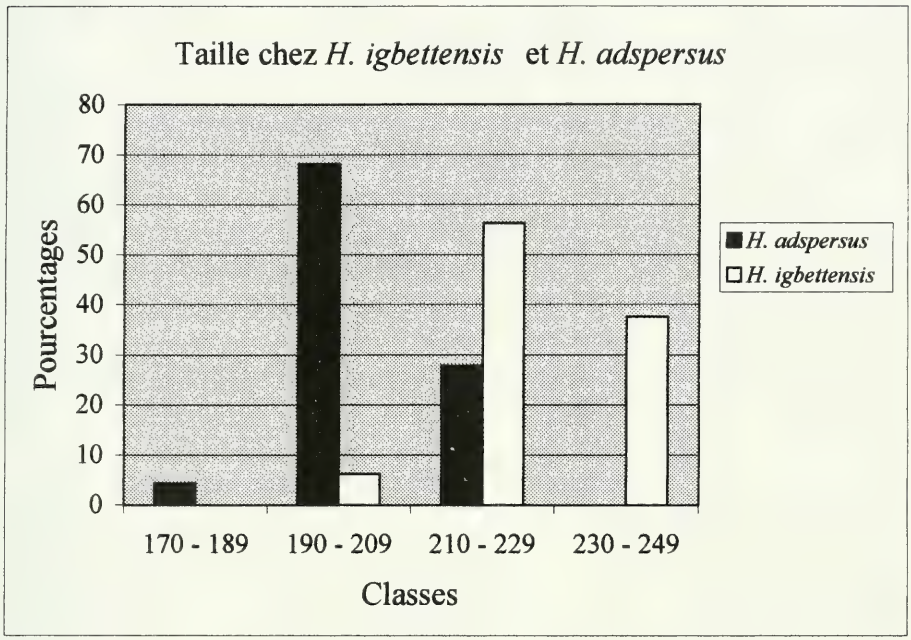


FIG. 2

Forme du museau chez neuf spécimens d'*Hyperolius igbettensis*. Les numéros sont les numéros de collection de l'auteur. Voir «Matériel étudié» pour l'origine des spécimens.



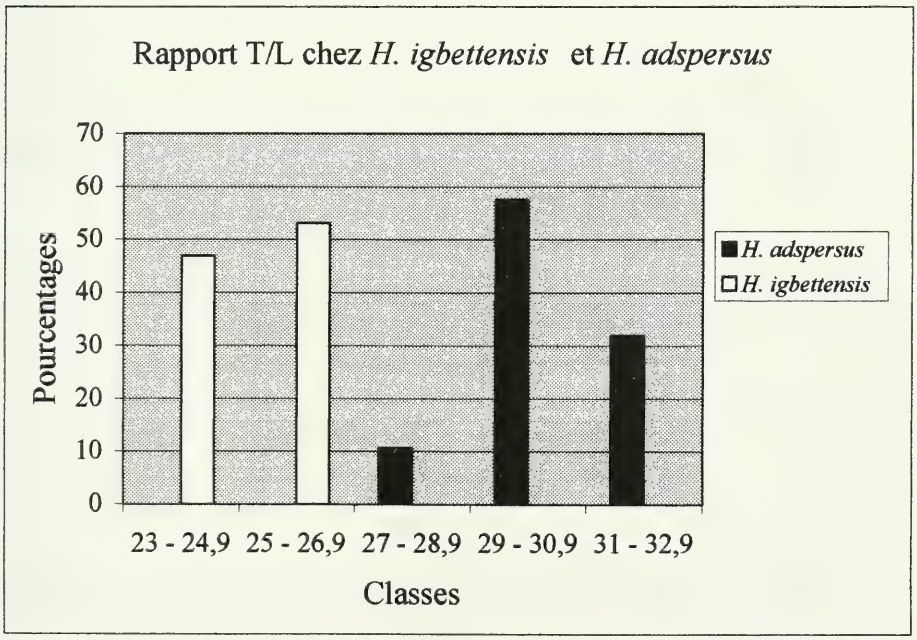


FIG. 3

Histogrammes montrant la variation de la taille et du rapport T/L chez *Hyperolius igbettensis* et *H. adspersus*.

d'origines diverses. Ces femelles ont, en moyenne, une taille un peu supérieure à celle des mâles (tab. IV), mais les maxima sont les mêmes pour les deux sexes.

H. igbettensis est aussi une des espèces les plus élancées du groupe, cet aspect étant accentué par l'étroitesse de la tête (le rapport T/L est de l'ordre de 25%: tab. III) et la petitesse des yeux.

Aussi bien chez les individus vivants que chez les spécimens préservés, le tégument dorsal et latéral est lisse, d'aspect satiné, la région rictale présentant seule quelques granulations. Le tégument ventral paraît lisse mais est en fait légèrement chagriné. Comme chez les autres espèces du groupe, le tégument est diaphane, sauf dans les régions pectorale et abdominale où une lame sous-épidermique d'un blanc argenté masque les viscères.

Chez les mâles, les minuscules aspérités tégumentaires dorsales et latérales sont nombreuses, mais pas autant que chez *H. benguellensis*. Contrairement à cette dernière espèce, elles sont absentes chez les femelles.

Vu en plan, le museau (Fig. 2) se rétrécit assez progressivement jusqu'aux narines, mais la courbure concave des canthus accentue l'impression de rétrécissement; en avant des narines, il dessine un arc plus ou moins largement ouvert ou, moins souvent, présente un contour légèrement bisinué. L'aspect en profil, comme le montrent les dessins de la Fig. 2, est très variable. Les spécimens figurés ont été pris au hasard, et il est possible qu'une étude plus exhaustive, portant sur un matériel plus abondant, montre une certaine variation géographique de sa forme. On notera la forte avancée du museau du n° 71.975, et le léger méplat au-dessus des narines chez les spécimens 75.404 et 79.034, ainsi que la variabilité de la distance œil-narine. Cependant, d'une manière générale, le museau, vu de profil, a un contour arrondi et s'avance modérément au-delà de la bouche. Sa forme est bien différente, en tout cas, de celle que montrent les spécimens d'*H. benguellensis* illustrés par la Fig. 10, ou le type d'*H. nasutus* figuré dans l'article de Günther (1864).

En moyenne, la jambe représente environ 50,6 % de la longueur museau-anus, valeur un peu plus faible que chez l'espèce suivante (tab. III); elle paraît pourtant relativement plus longue en raison de sa minceur. Le développement de la palmure est illustré par les dessins de la Fig. 4. Dans les trois cas figurés on constate que, sur le côté interne de l'orteil IV, le bord libre de la palmure se situe au niveau du tubercule sous-articulaire médian, ce qui équivaut à deux phalanges libres de palmure. Globalement, chez *H. igbettensis* la palmure est plus développée que chez *H. viridis*, à peu près semblable à celle d'*H. benguellensis,* et moins développée que chez *H. adspersus* et chez *H.* cf. *nasutus* de Zambie. La palmure se prolonge le long des orteils en une frange cutanée assez large atteignant le disque. Les tubercules sous-articulaires sont petits, le basal de l'orteil V parfois à peine différencié.

La main porte des doigts relativement plus longs que chez l'espèce suivante (Fig. 8). A leur base, ils sont reliés par une palmure rudimentaire qui, au doigt IV, ne dépasse pas le premier tubercule sous-articulaire. Elle se prolonge en un étroit repli cutané le long des doigts, surtout le troisième et le quatrième.

La pigmentation dorsale *in vivo*, à tonalité dominante vert pâle, peut être nuancée de jaunâtre ou de rosâtre. Sur ce fond, les bandes claires latéro-dorsales, variant du

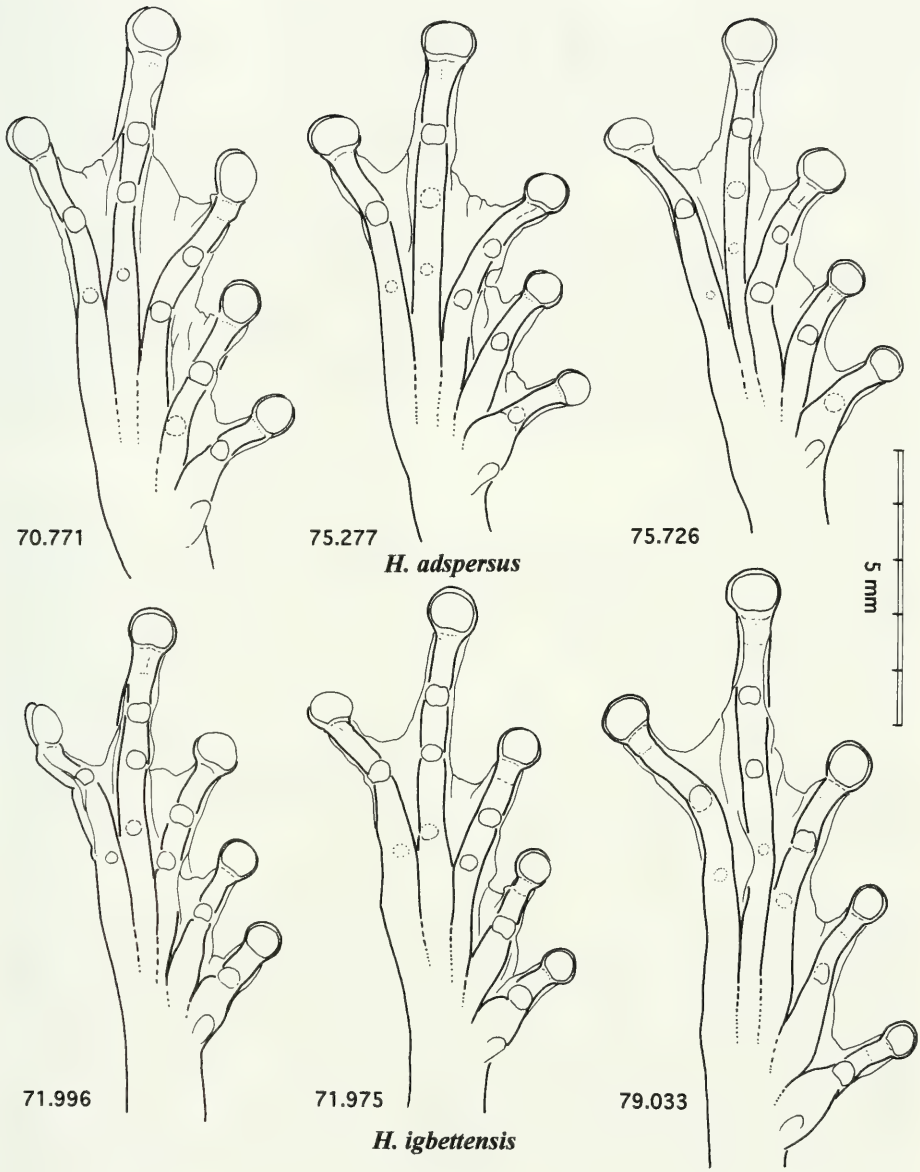


FIG. 4
Extension de la palmure pédieuse chez *Hyperolius adspersus* et *H. igbettensis*. Les numéros sont les numéros de collection de l'auteur. Voir «Matériel étudié» pour l'origine des spécimens.

jaune pâle (livrée nocturne) au blanc argenté (livrée diurne), ressortent assez peu; à peine marquées au niveau des canthus, elles deviennent plus apparentes en arrière de la paupière supérieure et s'étendent jusqu'à la région inguinale. Comparée à celle d'*H.*

adspersus ou *H. benguellensis*, cette pigmentation est remarquable par la faible densité des chromatophores bruns, très épars (fig. a, pl. I, à gauche). Chez certains individus, ils peuvent cependant être plus nombreux et souligner d'un liséré brunâtre plus ou moins continu les bords des bandes latéro-dorsales. Dans ce cas, il y a aussi un alignement sagittal de chromatophores. Contrairement à ce qui s'observe chez *H. benguellensis*, il n'y a pas de concentration particulière de chromatophores sur le dessus de la tête et du museau.

Les femelles n'ont pas de lignes claires latéro-dorsales et, dans l'ensemble, ont une pigmentation dorsale encore plus pauvre que celle des mâles, seulement piquetée de quelques chromatophores. Chez certaines, une fine ligne médio-dorsale est cependant perceptible. Une photographie d'une femelle de Ngoundéré, communiquée par J.-L. Perret, montre qu'il peut y avoir chez cette espèce des femelles à forte ponctuation dorsale d'un noir presque violacé, disséminée mais très contrastée et de ce fait bien apparente.

Distribution

La carte de la Fig. 5 donne une vision sûrement très incomplète de la distribution d'*H. igbettensis* au Cameroun, car de vastes secteurs de savanes n'ont pas été prospectés, ou l'ont été à une saison défavorable. A l'heure actuelle, on peut admettre que l'espèce peuple les régions suivantes, toutes à végétation graminéenne dominante.

1°) Le Plateau de l'Adamaoua: cette région, dont l'altitude moyenne est de 1100 m, avec des pointements de l'ordre de 2000 m, constitue le «massif central» du Cameroun. Sa végétation est constituée de savanes arborées et arbustives de type soudano-guinéen, souvent dégradées en prairies plus ou moins hautes. Sur les rives de lacs ou d'étangs, permanents ou temporaires, ou sur des zones cuirassées inondables, ces prairies peuvent présenter un caractère hygrophile. Sur la carte, les pointages situés entre 6° 30' et 7° 30' N correspondent à ce secteur.

2°) Le piedmont nord de l'Adamaoua: malgré une altitude beaucoup plus basse que la précédente, de l'ordre de 200 à 500 m, cette région de savanes boisées et de forêts sèches médio-soudaniennes, encore assez arrosée, possède une batrachofaune peu différente de celle du plateau. *H. igbettensis* y a été trouvé dans la région de Mbé.

3°) Plateaux de l'ouest camerounais: leur végétation, largement herbacée, prolonge celle de l'Adamaoua au contact des reliefs de la Dorsale camerounaise. La présence d'*H. igbettensis* y a été constatée en plusieurs points du Plateau bamoun, et l'indication «Bamenda District» donnée par Mertens (1940) se rapporte très probablement à cette espèce. Elle doit exister aussi sur le Plateau bamiléké.

4°) Partie septentrionale du Plateau sud-camerounais: situé à 600-700 m d'altitude, ce plateau s'étend sur une large partie du sud du Cameroun. Dans ses deux tiers méridionaux, c'est le domaine de la forêt dense tropicale humide. Plus au nord, jusqu'au pied de l'Adamaoua, des massifs de forêt mésophile et des galeries forestières alternent avec des savanes «périforestières» de type guinéen. La présence d'*H. igbettensis* a été constatée dans l'ouest de ce secteur, où il atteint la limite de la forêt dense (voir ci-après, *H. adspersus*), et l'absence de relevés dans sa partie centrale (région de Nanga Eboko) et orientale (régions de Bertoua et Batouri) est sûrement due à une insuffisance des prospections.

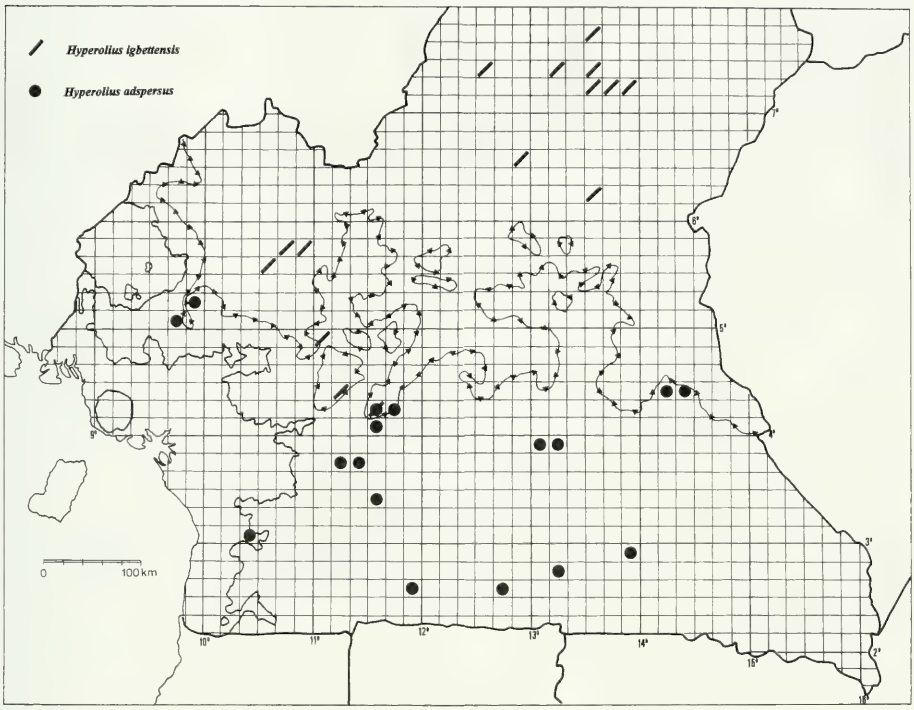


FIG. 5

Carte du Cameroun au sud du 8e parallèle, montrant les pointages d'*Hyperolius igbettensis* et *H. adspersus*. Pour la méthode de cartographie, voir «Matériel et méthodes». La courbe de niveau figurée est celle de 600 m. La ligne avec triangles représente la limite nord de la forêt dense.

En dehors du Cameroun, Schiøtz (1967) a montré que *H. igbettensis* atteint la moitié occidentale de la Côte d'Ivoire; il souligne que, plus à l'ouest, en particulier en Sierra Leone, l'espèce est «almost certainly absent» et qu'elle est remplacée par *H. lamottei*, au-delà d'une zone de sympatrie. A l'est du Cameroun, comme pour beaucoup d'autres espèces d'Anoures, il y a une énorme lacune de distribution ou d'information, jusqu'au Parc de la Garamba, à environ 1500 km, d'où *H. nasutus* est cité par Inger (1968). Dans le SW de l'Ethiopie, Largen (1998) signale la présence d'*H. nasutus* en plusieurs localités mais, d'après lui (comm. pers.), les populations éthiopiennes se rapprocheraient plus des espèces à museau allongé que d'*H. igbettensis*.

ECOLOGIE

H. igbettensis, strictement lié à des milieux herbacés graminéens, est une espèce savanicole typique, mais qui paraît éviter les formations les plus sèches. En effet, dans le nord du Cameroun, il atteint peut-être la région de Poli, mais aucun indice de sa présence n'a été relevé dans la plaine de la Bénoué ni dans la région de Maroua, à végétation soudano-sahélienne. Or ces régions reçoivent moins de 1200 mm de précipitations annuelles et ont une saison sèche de 7 mois ou plus (Suchel, 1972).

Ses sites de reproduction favoris correspondent à la frange de Graminées basses, en partie immergées, entourant des lacs ou des étangs, ou à des prairies temporairement inondées, situées dans des bas-fonds mal drainés ou sur des cuirasses imperméables. Dans de pareils biotopes, les rassemblements de mâles reproducteurs peuvent réunir des effectifs impressionnants, de l'ordre de plusieurs centaines d'individus. Des sites plus exigus, comme les rives de larges fossés, peuvent être aussi utilisés. Les supports des mâles chanteurs sont toujours des Graminées à feuilles étroites et les postes de chant se trouvent en général au-dessus de l'eau.

Période d'activité vocale, phonocénoses

Les relevés effectués sont trop peu nombreux (environ 25) et trop inégalement répartis dans le temps et l'espace pour donner une image précise du cycle d'activité vocale.

Dans la partie centrale et septentrionale de son aire, soumise à un régime de précipitations de type tropical, l'espèce n'a été entendue qu'en mai, juin et juillet (il n'y a pas eu de prospections en août). Cela correspond, suivant la latitude des localités étudiées, à une saison des pluies déjà bien engagée, avec mise en eau des mares temporaires, forte humidité atmosphérique et précipitations fréquentes. Les mâles peuvent alors être réunis en si grand nombre que le son qu'ils produisent est, à faible distance, insoutenable. L'espèce n'a jamais été relevée entre novembre et avril, bien que quelques voyages aient été effectués en saison sèche dans des régions où elle existe sûrement. Il serait intéressant de vérifier si cette interruption est effective pendant toute la saison sèche à proximité de grandes collections d'eau permanentes.

Vers le sud de son domaine, *H. igbettensis* est soumis à un régime de précipitations subéquatorial, avec deux saisons pluvieuses séparées par une grande et une petite saison sèche (cette dernière souvent peu marquée, voire absente certaines années). C'est de cette zone climatique que proviennent les relevés des mois de septembre et octobre, mais les données disponibles ne permettent pas de dire s'il y a deux périodes d'activité vocale correspondant aux deux saisons pluvieuses.

Comme le montre le tableau VI, la majorité des espèces participant à la même phonocénose qu'*H. igbettensis* sont des savanicoles (17 espèces dans les groupes 1, 2 et 4), auxquelles s'ajoutent des espèces euryéciques (groupe 5: trois espèces) et des espèces parasylvicoles tolérant des milieux fortement déboisés et susceptibles de s'étendre jusqu'à la bordure nord de l'Adamaoua (groupe 6: cinq espèces). Plusieurs espèces n'ont été notées que dans un petit nombre de relevés. Cela ne signifie pas forcément qu'elles soient rares ou utilisent d'autres milieux de reproduction: en fait, beaucoup ont une période d'activité reproductrice, et donc vocale, plus précoce, et seuls quelques mâles attardés se font entendre en même temps qu'*H. igbettensis*. C'est ce qui explique, par exemple, le «score» nul de *Pt. mascareniensis*, ou les scores très faibles de *Pt. oxyrhynchus* et des *Bufo maculatus* et *regularis*, toutes espèces dont l'activité vocale, brève, débute avec les premières pluies.

Vocalisations

Les appels d'*H. igbettensis* sont des trilles brefs, à tonalité grinçante, répétés de façon rapide et insistante (dziii – dziii – dziii ...); ils suggèrent quelque peu les appels

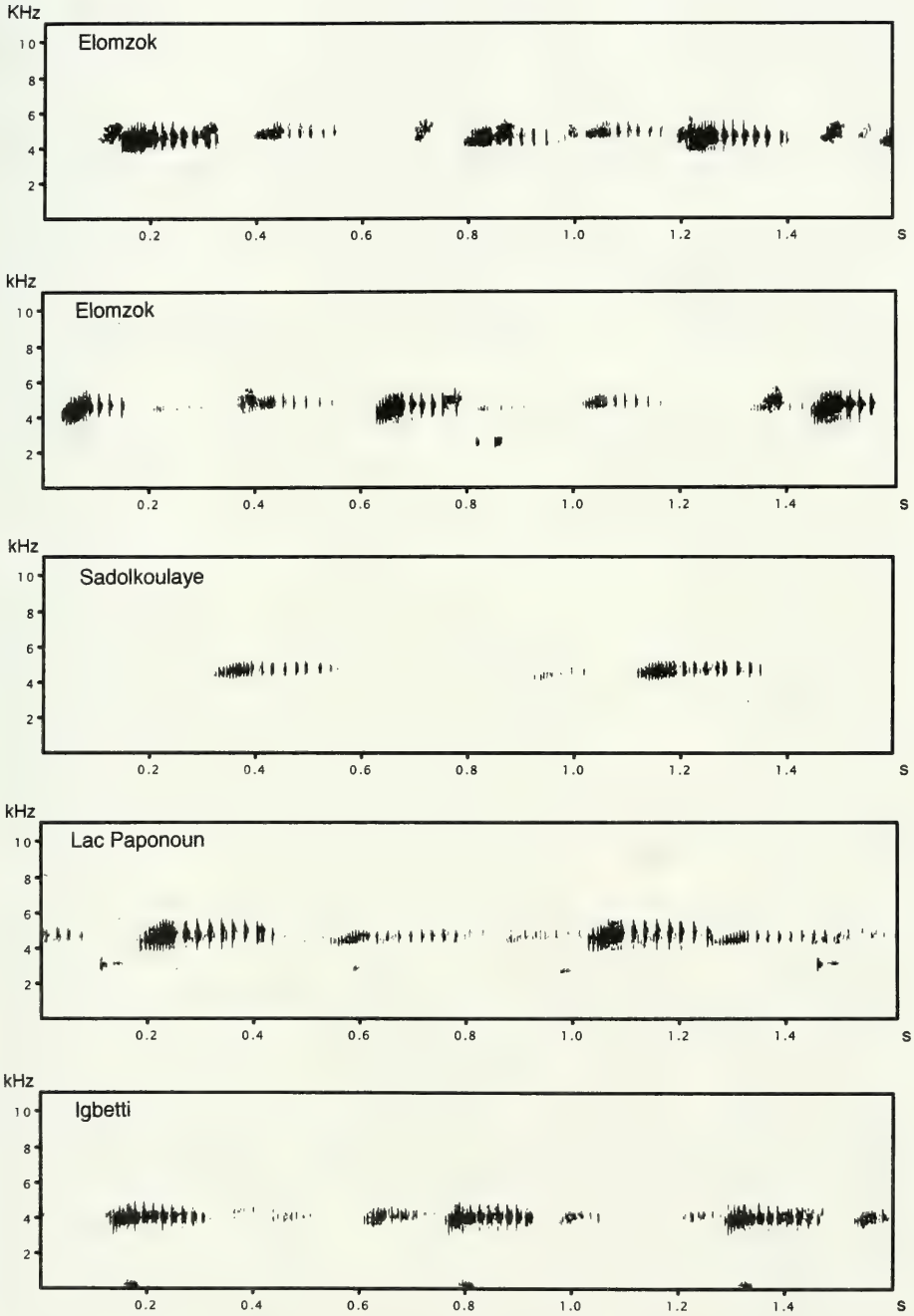


FIG. 6

Sonagrammes d'individus d'*Hyperolius igbettensis* du Cameroun (Elomzok, Sadolkoulaye et Lac Paponoun) et du Nigeria (Igbetti, enregistrement A. Schiøtz). Sonagrammes A. Schiøtz.

de certains *Afrixalus*. Dans la batrachofaune camerounaise, ils ne peuvent être confondus avec les appels d'aucun autre *Hyperolius*, sauf, à la rigueur, ceux d'*H. adametzi* Ahl, toutefois émis plus lentement.

La figure 6 reproduit les sonagrammes d'individus provenant de l'ouest (Lac Paponoun), du sud (Elomzok) et du nord (Sadolkoulaye) de l'aire camerounaise de l'espèce. Comme on peut le constater, les différences entre ces sonagrammes sont minimes, du niveau de la variation individuelle. La même constatation peut être étendue au sonagramme d'un individu de la localité typique d'Igbetti (Nigeria), enregistré par A. Schiøtz et reproduit ici pour comparaison.

Dans la classification de Channing *et al.* (2002), ces appels correspondent au type A, dans sa variante illustrée par la figure 1-2 (voir plus haut pour la définition de ce type).

Remarque: sous la rubrique *H. nasutus igbettensis*, les mêmes auteurs indiquent (p. 96) que «The published call (Schiøtz, 1967) is type C», alors que le sonagramme publié par Schiøtz est clairement de type A (c'est d'ailleurs celui d'un appel du même individu qui est reproduit dans le présent travail); de plus, sur leur carte de la Fig. 3, ils omettent d'indiquer la localité d'où provient l'enregistrement.

Affinités

Il est évident que, par tous ses caractères, l'espèce décrite ci-dessus appartient au groupe d'*H. nasutus*. Il est tout aussi clair que, par la forme de son museau, elle ne correspond pas à *H. nasutus*, tel qu'il a été décrit et figuré par Günther, pas plus qu'à *H. benguellensis*, *H. oxyrhynchus* ou *H. acuticeps* (peut-être tous synonymes d'*H. nasutus*?).

En revanche, il n'y a aucun point de divergence, morphologique, vocale ou étho-écologique, avec un taxon savanicole répandu à l'ouest du Cameroun, *H. nasutus igbettensis*, sous-espèce créée par Schiøtz (1963) précisément en raison de son «more rounded snout».

L'amélioration des connaissances sur l'ensemble du groupe montre que cet *Hyperolius* doit être placé au rang spécifique, car il est plus différent du *nasutus* de Günther que ne l'est *H. benguellensis*, pourtant considéré comme une espèce (Poynton & Broadley, 1987; Schiøtz & Van Daele, 2003). Pour le désigner, le nom *igbettensis* est disponible, et a donc été retenu dans le présent travail.

Cette solution est peut-être provisoire. On ne sait pas en effet quelles sont les relations de ce taxon avec les populations situées plus à l'est, rapportées à *H. nasutus* mais qui devraient être redéfinies en fonction du *nasutus* de Günther. Il pourrait se révéler conspécifique de certaines d'entre elles, portant un nom plus ancien, ce qui conduirait à une mise en synonymie d'*igbettensis*.

Hyperolius adspersus Peters, 1877

Matériel étudié

Il comprend 42 mâles et 5 femelles se répartissant comme suit. Batouri [14°20-30' x 4°20-30'], 27.III.76, 1 M (76.080); Bidjouka [10°20-30' x 3°00-10'], 28.IV.72, 1 M (72.358); Elomzok [11°30-40' x 4°10-20'], 29.IX.76, 5 M (76.181-183 et 185-186); -id-, 28.IX.77, 2 M (77.086-087); Mboassoum [9°50'-10° x 5°00-10'], 30.III.77, 5 M (77.055-059); Mintom [13°10-20' x 2°40-50'], 05.IV.75, 1 M (75.171); Olembé [11°40-50' x 4°10-20'], 17.IX.70, 2M,

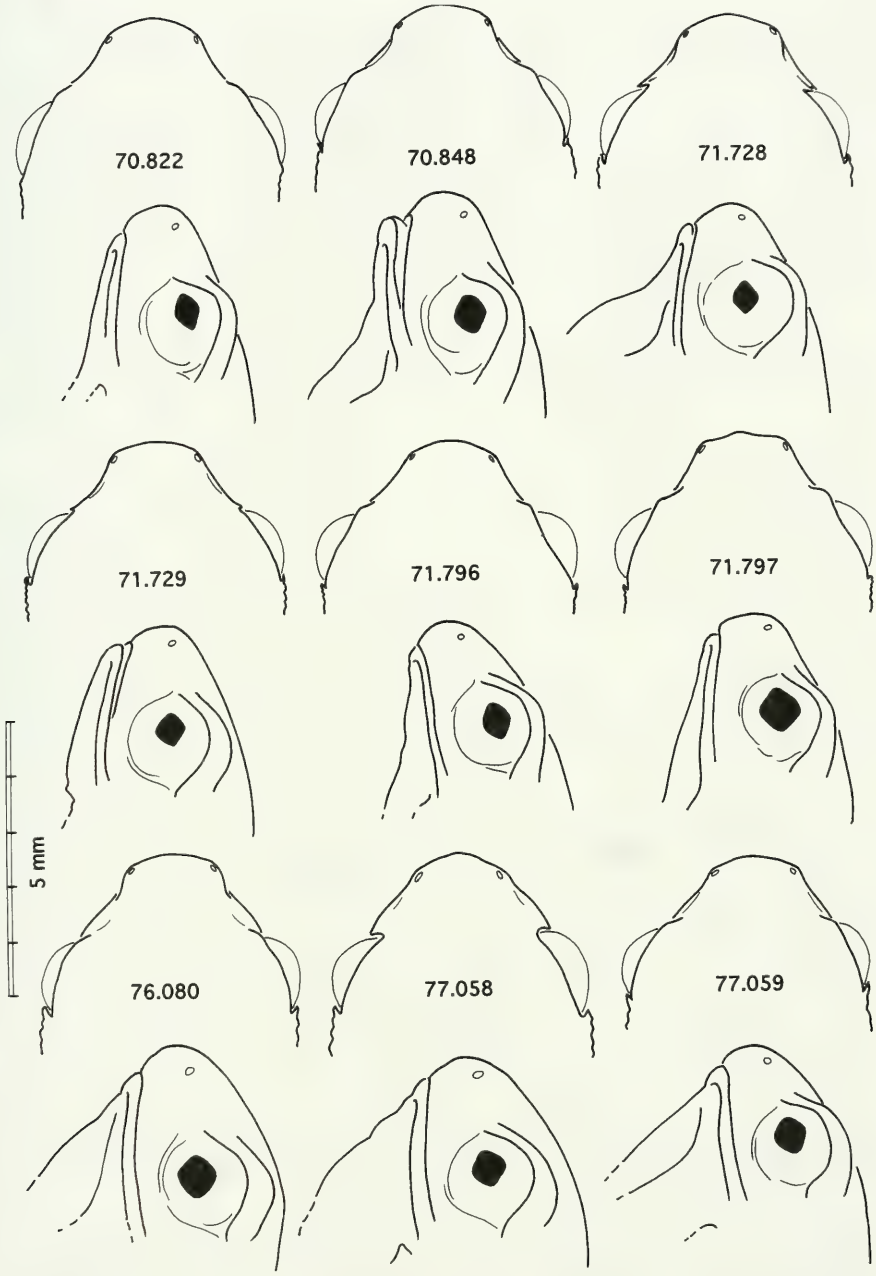


FIG. 7

Forme du museau chez neuf spécimens d'*Hyperolius adspersus*. Les numéros sont les numéros de collection de l'auteur. Voir «Matériel étudié» pour l'origine des spécimens. On comparera cette figure avec la Fig. 2.

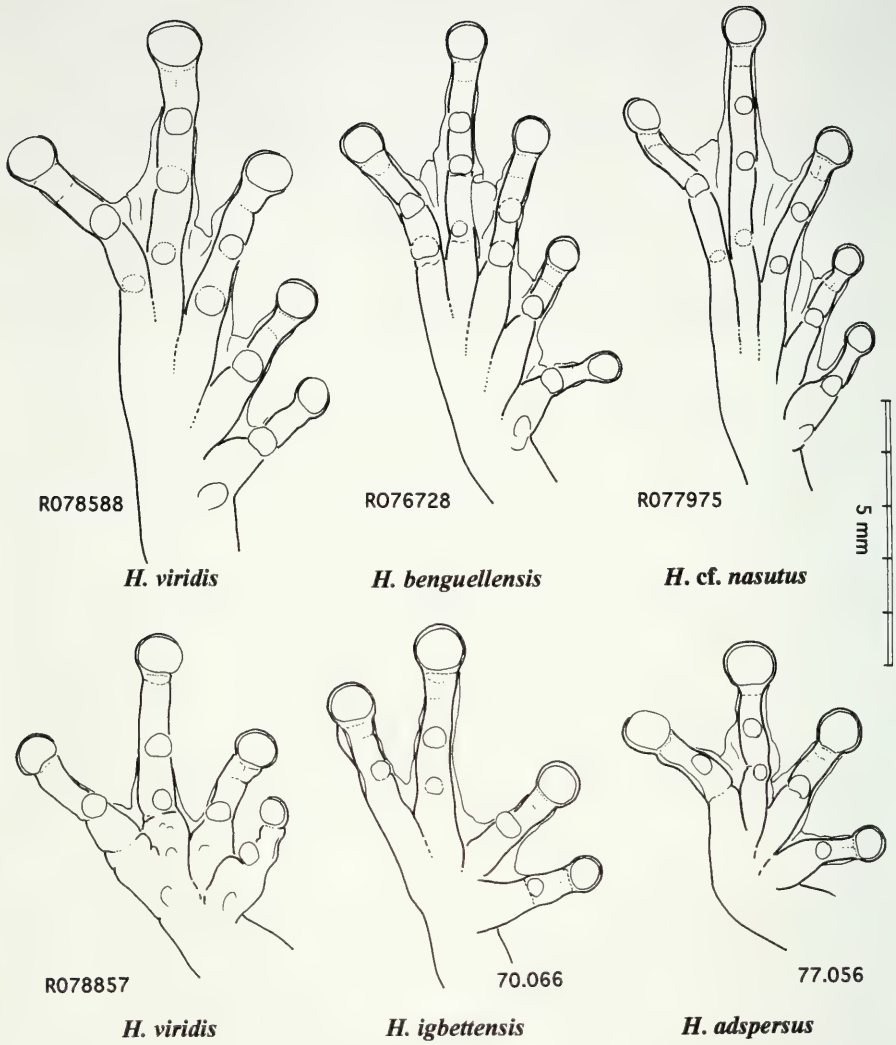


FIG. 8

Palmure du pied (en haut) et de la main (en bas) chez diverses espèces du groupe d'*Hyperolius nasutus*. Les numéros débutant par RO sont ceux du Musée de Copenhague, les autres les numéros de collection de l'auteur.

1F (70.749-751); -id-, 11.VI.70, 8 M, 1 F (70.847-848 et 850-856); Ototomo [11°10-20' x 3°40-50'], 07.II.70, 3 M (70.820-822); -id-, 21.II.70, 1 M (70.692); -id-, 30.IV.70, 2 M (70.810-811); -id-, 04.VI.70, 3 M (70.769-771); -id-, 09.VII.70, 1 M, 1 F (70.706-707); -id-, 15.VII.71, 1 M (71.1034); Santchou [9°50'-10° x 5°10-20'], 24.V.71, 2 M, 2 F (71.728-729 et 796-797); -id-, 25.V.75, 4 M (75.274-276).

Seize spécimens de référence (14 mâles et 2 femelles) sont déposés au Musée d'histoire naturelle de Genève sous les numéros M.H.N.G. – 2644.73 à 2644.88.

DESCRIPTION

Cette espèce se distingue de la précédente par sa taille plus faible, de l'ordre de 20 mm en moyenne, avec extrêmes à 18,5 et 21,8 mm (tab. III et histogramme Fig. 3), sans différence nette entre les sexes (tab. IV).

Elle en diffère surtout par son habitus nettement plus ramassé. Les valeurs du rapport T/L sont comprises entre 28,3 et 32,6%, avec une moyenne de 30,2% et, comme le montre l'histogramme de la Fig. 3, elles ne recoupent pas celles d'*H. igbettensis*. Chez divers *Hyperolius*, surtout chez les mâles, la tête est relativement large par rapport au corps, ce qui conduit aussi à des valeurs élevées de T/L. Dans le cas présent, c'est l'ensemble de la tête et du corps qui, proportionnellement, est plus large que chez *H. igbettensis*.

Le tégument ne montre aucune différence marquante par rapport à l'espèce précédente. Apparemment lisse, il porte aussi, chez les mâles seulement, de très petites aspérités en cône émoussé.

La forme du museau est bien différente de celle d'*H. igbettensis*, et a fortiori de celle d'*H. benguellensis*. Comme le montrent les dessins de la Fig. 7, vu en plan, il est court et large et se prolonge très peu en avant des narines, elles-mêmes très écartées; son extrémité dessine une courbe très largement ouverte, ou paraît même presque tronquée. En profil, son contour est très arrondi, et il s'avance peu au-delà de la bouche. Sa brièveté et la largeur de la tête font que chez *H. adspersus* les valeurs de divers rapports morphométriques céphaliques sont nettement inférieures à celles obtenues chez les autres espèces (tab. V). On relèvera en particulier les écarts importants entre *H. igbettensis* et *H. adspersus* pour les rapports «longueur / largeur de la tête» (LT / T) et «longueur de l'extrémité du museau / espace internasal» (m / IN), de l'ordre de 10% pour le premier et de 14% pour le second!

Les membres postérieurs sont moins minces que chez *H. igbettensis*, en particulier la jambe, qui est proportionnellement un peu plus longue que chez ce dernier. La palmure pédieuse est aussi plus étendue (Fig. 4). Sur les côtés internes des orteils III et IV, son bord libre se situe à peu près à hauteur du dernier tubercule sous-articulaire, ce qui équivaut à une phalange libre seulement, si on ne tient pas compte du repli assez large qui borde les orteils. Cette extension est supérieure à celle d'*H. benguellensis* et *H. viridis*, mais elle est du même ordre que chez l'*H. cf. nasutus* de Zambie.

A la main, la palmure interdigitale est elle aussi un peu plus étendue. Elle se prolonge assez largement le long des doigts, ce qui contribue à leur donner un aspect plus court que chez *H. igbettensis* (Fig. 8).

La pigmentation dorsale est du même type que chez ce dernier: tégument d'un vert plus ou moins jaunâtre, transparent, piqueté de chromatophores bruns. La différence entre les deux espèces est quantitative: chez *H. adspersus*, il y a beaucoup plus de chromatophores foncés que chez *H. igbettensis*. Ils constituent un semis plus ou moins dense suivant les individus, sans zone de concentration particulière, sauf au-dessus des yeux. En extension, c'est-à-dire en livrée nocturne, ils peuvent supplanter la pigmentation foncière, sans pour autant être coalescents (fig. b, pl. II).

Il y a une autre différence chromatique possible entre les deux espèces, mais elle porte sur un caractère inconstant: aucun des mâles d'*H. adspersus* photographiés

(une douzaine) ne montre la ligne médio-dorsale de chromatophores bruns présente chez certains individus d'*H. igbettensis*.

Chez les quelques femelles observées, la pigmentation obéit au même principe que chez les mâles, sauf que les bandes latéro-dorsales sont absentes et que le dos est parsemé de gros chromatophores, peu nombreux mais très apparents, coexistant avec des chromatophores semblables à ceux des mâles. Ces gros chromatophores présentent en leur centre un petit point bleu clair (couleur peu visible sur la photo de la fig. a, pl. II) leur donnant l'aspect de minuscules ocelles.

Dans le matériel étudié, il n'y a pas de femelles ne différant des mâles que par l'absence des bandes latéro-dorsales. En revanche, il y a au moins un mâle (fig. a, pl. III, individu au centre de la rangée inférieure) sans bandes blanches.

La coloration ventrale est la même que chez *H. igbettensis*: tégument transparent vert turquoise, éventuellement lavé de rose, sauf sur l'abdomen et la poitrine, où il est d'un blanc brillant et opaque. La glande gulaire des mâles est le plus souvent jaune, mais parfois vert pâle. Elle est bordée postérieurement par une bande blanche qui, lorsque le sac vocal est gonflé, forme une macule de taille très variable en avant de la glande gulaire (fig. b, pl. III).

Distribution

Par rapport aux autres espèces parasylvicoles, le nombre de localités où la présence d'*H. adspersus* a été constatée est faible: 17 carrés seulement (carte Fig. 5). La répartition des points montre cependant que l'espèce a une large répartition, englobant toute la zone forestière camerounaise, à l'exception du bassin de Mamfé et de la Plaine littorale. Ces deux secteurs ont fait l'objet de recherches suffisantes pour que l'espèce n'ait pu y passer inaperçue (ce n'est pas le cas pour l'extrême sud-est et pour les avancées de la forêt au-delà du 5e parallèle). Ce domaine s'étend donc sur une grande partie du Plateau sud-camerounais (voir ci-dessus, *H. igbettensis*) et sur le piedmont est de la Dorsale camerounaise (points les plus à l'ouest sur la carte). Sa végétation se rattache soit à la forêt mésophile (= semi-décidue), soit à la forêt sempervirente, de type congolais ou sub-atlantique.

L'amplitude de la distribution verticale d'*H. adspersus* est assez faible, les relevés se situant entre 500 et 800 m environ. L'altitude, ou plutôt les conditions climatiques qui en dépendent, ne doit pas être le facteur qui limite son extension dans la Plaine littorale car, dans le bassin inférieur du Kouilou, *H. adspersus* a été trouvé à très basse altitude (Largen & Dowsett-Lemaire, 1991).

On verra plus loin («Affinités») que la zone forestière camerounaise représente l'extrémité septentrionale d'une aire beaucoup plus étendue, incluant la basse vallée du fleuve Congo.

Ecologie

H. adspersus fait partie de l'important cortège d'espèces qui, de façon apparemment paradoxale, sont inféodées à la zone forestière (ou à ses extensions périphériques) tout en n'étant pas sylvicoles. Ces espèces «parasylvicoles» («farmbush species» *sensu* Schiøtz, 1967 et 1975) peuvent se reproduire dans des milieux très divers, mais partageant la caractéristique commune de ne pas être recouverts par une

canopée continue (Amiet, 1986, 1989). *H. adspersus* est de celles qui choisissent les sites les plus ouverts. Il s'agit le plus souvent de mares ou d'étangs situés dans des endroits largement déboisés et bordés d'une végétation mixte mêlant buissons, arbustes, grandes herbacées (Marantacées en particulier) et Graminées. Beaucoup de ces biotopes sont d'origine anthropique: étangs artificiels destinés à la pisciculture, retenues d'eau dues à des remblais routiers, etc. La dispersion des relevés de cette espèce reflète sûrement en grande partie celle des sites de reproduction. Le fait que certains soient entièrement enclavés dans la forêt (par exemple l'étang artificiel de l'ancienne réserve forestière d'Ototomo) témoigne de la capacité de cette espèce, et plus généralement des espèces parasylvicoles, à pénétrer le milieu forestier, même si elles sont incapables de s'y reproduire (Amiet, 1989).

Comparés à ceux d'*H. igbettensis*, les sites de reproduction d'*H. adspersus* sont, en général, moins riches en Graminées: l'habitus plus ramassé et les palmures plus étendues sont peut-être en relation avec une utilisation plus fréquente de plantes-supports à limbe large.

Le site d'Elomzok doit faire l'objet d'une mention spéciale puisque c'est le seul où *H. igbettensis* et *H. adspersus* ont été observés et entendus en étroite syntopie (celle-ci est probable dans un autre site, peu éloigné, placé pour cette raison dans la colonne centrale du tab. VI). Située à une quarantaine de km au nord de Yaoundé, cette localité se trouve dans la zone de contact entre la forêt mésophile, ici très largement dégradée, et la savane de type guinéen. Lisières, galeries, boqueteaux, savanes hautes à Andropogonées et prairies basses hygrophiles constituent un véritable puzzle, propice à la coexistence d'espèces savanicoles et parasylvicoles. On en trouvera une illustration dans le tab. VI, consacré aux phonocénoses auxquelles participent *H. adspersus* et *H. igbettensis*. D'autres points de syntopie des deux espèces doivent exister le long de la frontière forêt/savane.

Période d'activité vocale, phonocénoses

Le cycle d'activité vocale d'*H. adspersus* est bien différent de celui d'*H. igbettensis:* les différents relevés effectués à travers le territoire peuplé par l'espèce se répartissent sur *tous les mois* de l'année (sauf en août, mais n'y a pas eu de prospections pendant ce mois).

Cette continuité de l'activité vocale a été confirmée par le suivi pendant deux ans et quatre mois d'une localité proche de Yaoundé (entre les villages de Zamakoé et Nkolngock), au rythme d'une sortie de nuit chaque quinzaine, sauf en juillet et août: – pendant les mois de pleine saison des pluies, soit mai, juin, septembre et octobre, *H. adspersus* a été noté comme très actif dans tous les relevés, sauf en octobre (4 relevés sur 6); – pendant les mois de pleine saison sèche, il a été noté dans la moitié (février), les deux tiers (décembre) ou la totalité (janvier) des relevés, mais souvent avec une activité vocale faible.

Comme cela a déjà été indiqué (Amiet, 1989), le maintien d'un certain niveau d'activité vocale tout au long de l'année est un caractère fréquent chez les espèces parasylvicoles, en particulier celles des milieux les plus ouverts. C'est toutefois après la reprise des pluies que le maximum d'individus peuvent être entendus.

Le tableau VI donne un aperçu de la phonocénose à laquelle participe *H. adspersus* et permet de comparer celle-ci à celle d'*H. igbettensis* (voir ci-dessus). Parmi

TAB. VI. Phonocénoses d'*Hyperolius igbettensis* et *H. adspersus*. Les groupes sont définis dans «Matériel et méthodes». Pour chaque espèce est indiqué le nombre de relevés où elle a été notée; dans les colonnes de droite et de gauche, le second chiffre exprime la présence en pourcentage du nombre total de relevés effectués dans chaque phonocénose (chiffres soulignés: espèces présentes dans 33 à 66% des relevés; chiffres en gras: dans plus de 66%). *A. fulvovittatus* correspond au «type B» dans Schiøtz (1999).

Espèces	14 relevés en savane	2 relevés savane / lisière	16 relevés milieux secondaires en forêt
Hyperolius igbettensis Schiøtz, 1963	14 - **100**	1	
Hyperolius adspersus Peters, 1877		2	16 - **100**
Groupe 1			
Amnirana galamensis (Dum. & Bib., 1841)	1 - 7,1		
Kassina cassinoides (Boulenger, 1903)	1 - 7,1		
Groupe 2			
Ptychadena bibroni (Hallowell, 1845)	3 - 21,4	2	
Ptychadena stenocephala (Boulenger, 1901)	2 - 14,2	2	
Ptychadena straeleni (Inger, 1968)	2 - 14,2		
Phrynobatrachus natalensis (Smith, 1849)	2 - 14,2	2	
Phrynobatrachus sp. 3	3 - 21,4	1	
Hyperolius viridiflavus (Dum. & Bib., 1841)	8 - 57,1		
Afrixalus weidholzi (Mertens, 1938)	3 - 21,4		
Kassina senegalensis Dum. & Bib., 1841	5 - 35,7	2	
Leptopelis nordequatorialis Perret, 1966	6 - 42,8		
Leptopelis viridis (Günther, 1868)	4 - 28,5		
Groupe 3			
Hyperolius adametzi Ahl, 1931			2 - 12,5
Groupe 4			
Bufo regularis Reuss, 1833	3 - 21,4	2	2 - 12,5
Hoplobatrachus occipitalis (Günther, 1859)	5 - 35,7	2	2 - 12,5
Ptychadena pumilio (Boulenger, 1920)	5 - 35,7	2	1 - 6,2
Hyperolius balfouri (Werner, 1907)	10 - **71,4**	2	5 - 31,2
Kassina maculosa (Sternfeldt, 1917)	7 - 50,0	2	5 - 31,2
Groupe 5			
Bufo maculatus Hallowell, 1855	4 - 28,5	2	5 - 31,2
Ptych. mascareniensis (Dum. & Bib., 1841)		1	5 - 31,2
Ptychadena oxyrhynchus (Smith, 1849)	3 - 21,4		3 - 18,7
Afrixalus fulvovittatus (Cope, 1860)	11 - **78,5**	2	12 - **75,0**
Groupe 6			
Amnirana albolabris (Hallowell, 1856)	1 - 7,1		11 - **68,7**
Hyperolius tuberculatus Mocquard, 1897	5 - 35,7	2	13 - **81,2**
Hyper. cinnamomeoventris Bocage, 1866	3 - 21,4		9 - 56,2
Hyperolius kuligae Mertens, 1940	2 - 14,2	1	4 - 25,0
Leptopelis notatus (Buchholz & Peters, 1875)	2 - 14,2		4 - 25,0
Groupe 7			
Ptychadena perreti Guibé & Lamotte, 1958	1 - 7,1	1	6 - 37,5
Phrynobatrachus hylaios Perret, 1959			5 - 31,2
Phrynobatrachus auritus Boulenger, 1900			2 - 12,5
Hyperolius platyceps (Boulenger, 1900)			9 - 56,2
Hyperolius pardalis Laurent, 1947			6 - 37,5
Hyperolius bolifambae Mertens, 1938			1 - 6,2
Hyper. camerunensis Amiet, 2004			1 - 6,2
Afrixalus paradorsalis Perret, 1960			4 - 43,7
Afrixalus dorsalis (Peters, 1875)			1 - 6,2
Cryptothylax gresshoffi (Schilthuis, 1889)			1 - 6,2

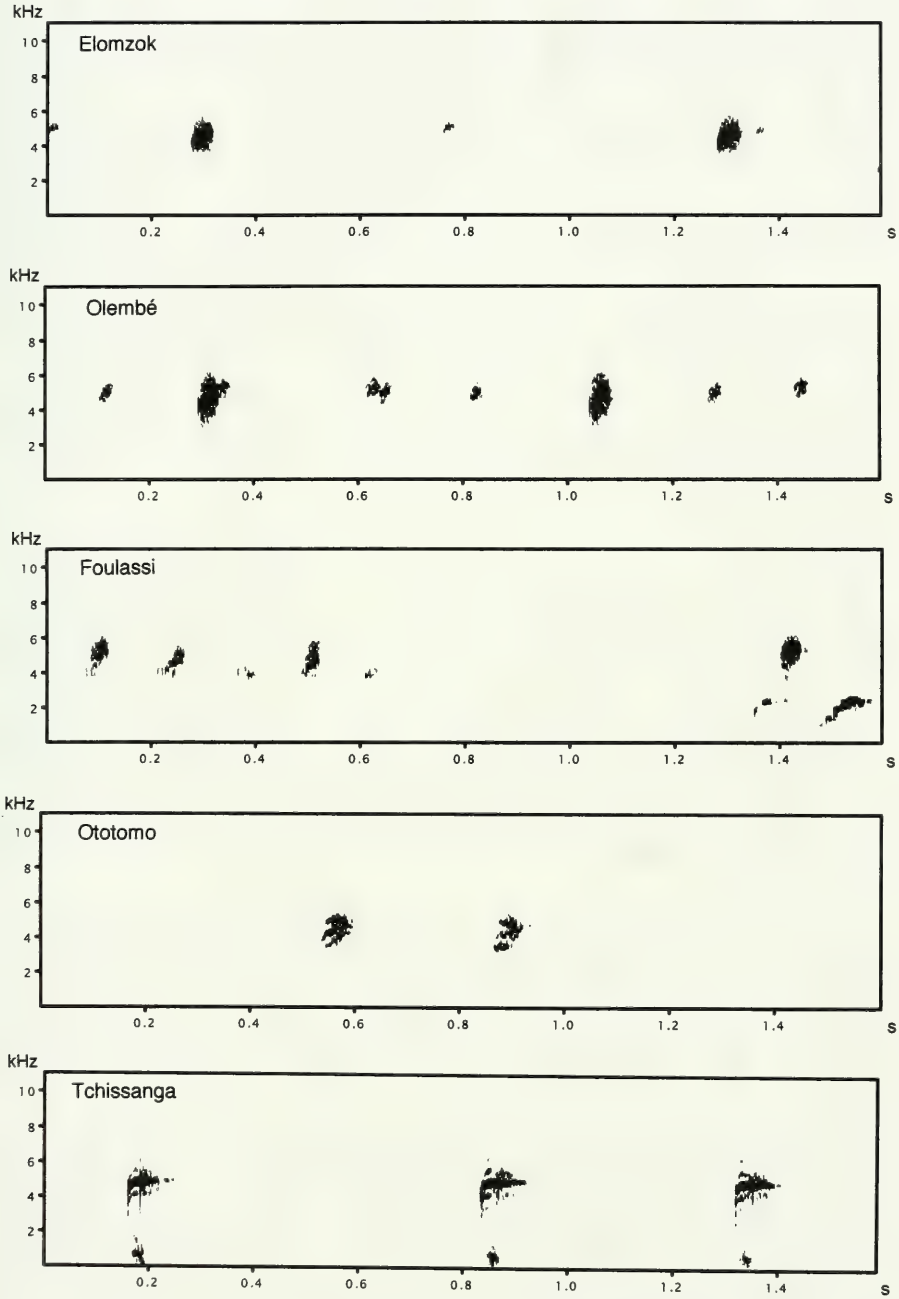


FIG. 9

Sonagrammes d'individus d'*Hyperolius adspersus* du Cameroun (Elomzok, Olembé, Foulassi, Ototomo) et du Congo (Tchissanga, enregistrement F. Dowsett-Lemaire). Sonagrammes A. Schiøtz.

les espèces-compagnes, on relève quelques savanicoles (groupe 4, avec cinq espèces), qui pénètrent dans les marges du massif forestier à la faveur des nombreuses ouvertures créées par l'activité humaine: la demi-douzaine de relevés où elles ont été notées correspondent aux pointages les plus septentrionaux d'*H. adspersus*. Le reste de la phonocénose est constitué d'euryéciques (groupe 5, quatre espèces) et de parasylvicoles. Parmi ces dernières, celles du groupe 6, au nombre de cinq, sont les plus tolérantes au déboisement et peuvent coloniser des formations constituées de buissons ou de broussailles plus ou moins denses sur un fond de végétation graminéenne; elles se retrouvent toutes, mais avec une fréquence moindre, dans la phonocénose d'*H. igbettensis*.

Dans l'ensemble, les pourcentages de fréquence atteints par les espèces-compagnes (autres que celles du groupe 4) sont plus élevés que dans la phonocénose d'*H. igbettensis*. Cela s'explique par le fait que l'activité vocale de la plupart des parasylvicoles s'étend sur une grande partie de l'année, ce qui accroît les chances de les entendre en même temps qu'*H. adspersus*. On relèvera le cas d'*Afrixalus fulvovittatus*, qui confirme son euryécie en étant presque aussi souvent associé à *H. adspersus* (75% des relevés) qu'à *H. igbettensis* (78,5%).

Vocalisations

Les appels se distinguent sans difficulté de ceux d'*H. igbettensis*: ce sont des «tchik» très brefs, presque explosifs, émis à une cadence moins rapide que les notes d'*igbettensis*. Ils sont illustrés par les sonagrammes de la figure 9 (Ototomo, Olembé et Elomzok) auxquels a été ajouté, pour comparaison, le sonagramme d'un individu de Tchissanga (basse vallée du Kouilou, Congo) enregistré par F. Dowsett-Lemaire. Les différences visibles sur ce dernier peuvent être dues aux techniques d'enregistrement; auditivement, la ressemblance avec les appels des individus camerounais est étroite.

Ces appels correspondent au type C de Channing *et al.* (2002) (voir plus haut pour la définition de ce type), qui classent d'ailleurs comme tel l'enregistrement de F. Dowsett-Lemaire.

Remarque: ces auteurs mentionnent trois enregistrements d'appels de ce type effectués par M. Burger dans la réserve de Moukalaba-Dougoua (Gabon), donc, géographiquement, entre ceux du Cameroun et celui du Congo. Cette indication est très intéressante sur le plan taxonomique et biogéographique (voir ci-après «Affinités»). En l'absence de précisions morphologiques sur les individus enregistrés, elle doit toutefois être accueillie avec quelque réserve.

Affinités

Superficiellement, *H. adspersus* ressemble beaucoup aux autres espèces du groupe. En l'absence de critères bio-acoustiques, un examen attentif des spécimens montre cependant que l'habitus, les proportions de la tête et, surtout, la forme du museau, le distinguent nettement d'*H. igbettensis* et des autres représentants du groupe, à l'exception d'un cas particulier qui sera discuté plus loin.

Ce sont ces mêmes critères qui avaient conduit Laurent (1943) à séparer une unique femelle de «Zambi, Bas-Congo» de plusieurs centaines de spécimens conservés dans les collections du Musée du Congo. Soulignant «les caractères très particuliers de la tête (museau court et obtus)», qu'il n'avait pas rencontrés «dans les variétés les plus

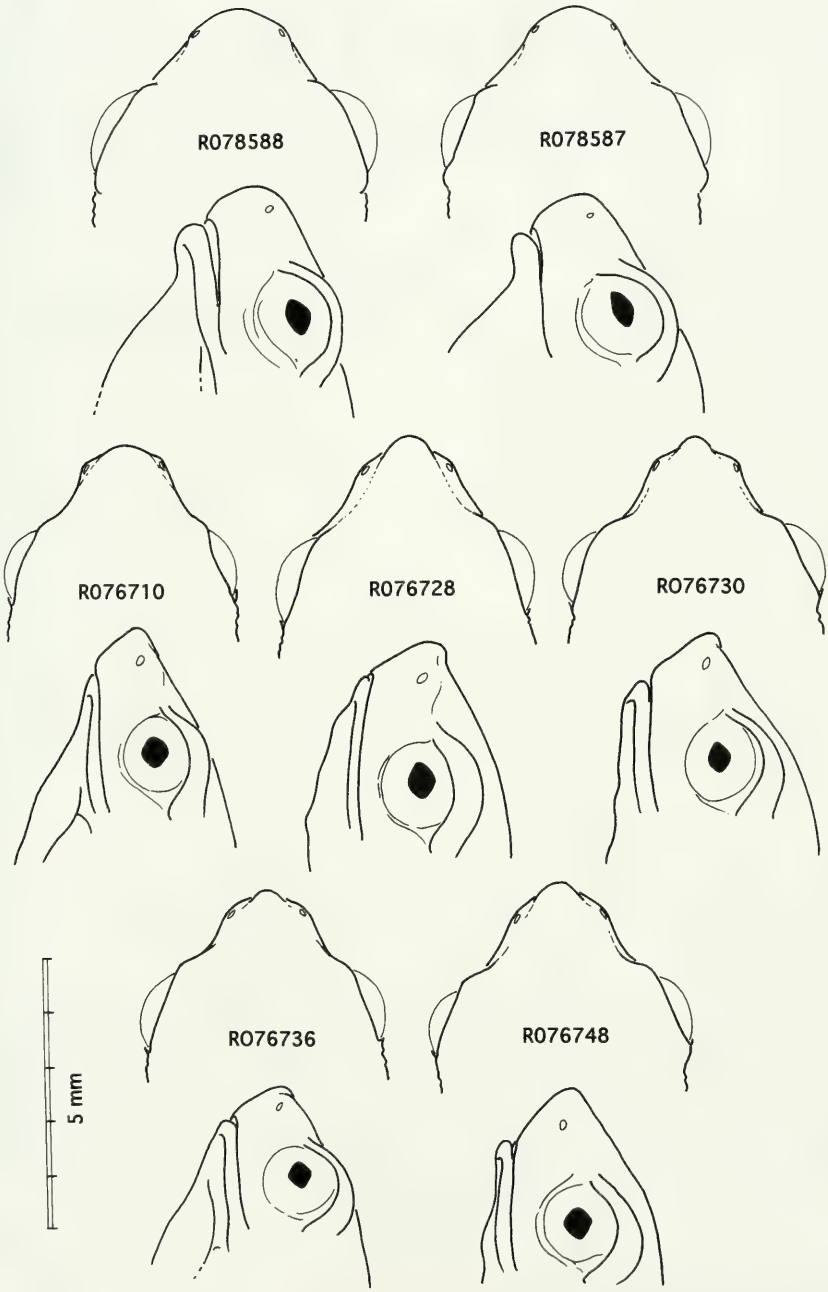


FIG. 10

Forme du museau chez deux individus d'*Hyperolius viridis* (rangée supérieure) et cinq individus d'*H. benguellensis* (rangées moyenne et inférieure). On remarquera, chez ce dernier, la disposition caractéristique des narines. Spécimens du Musée de Copenhague.

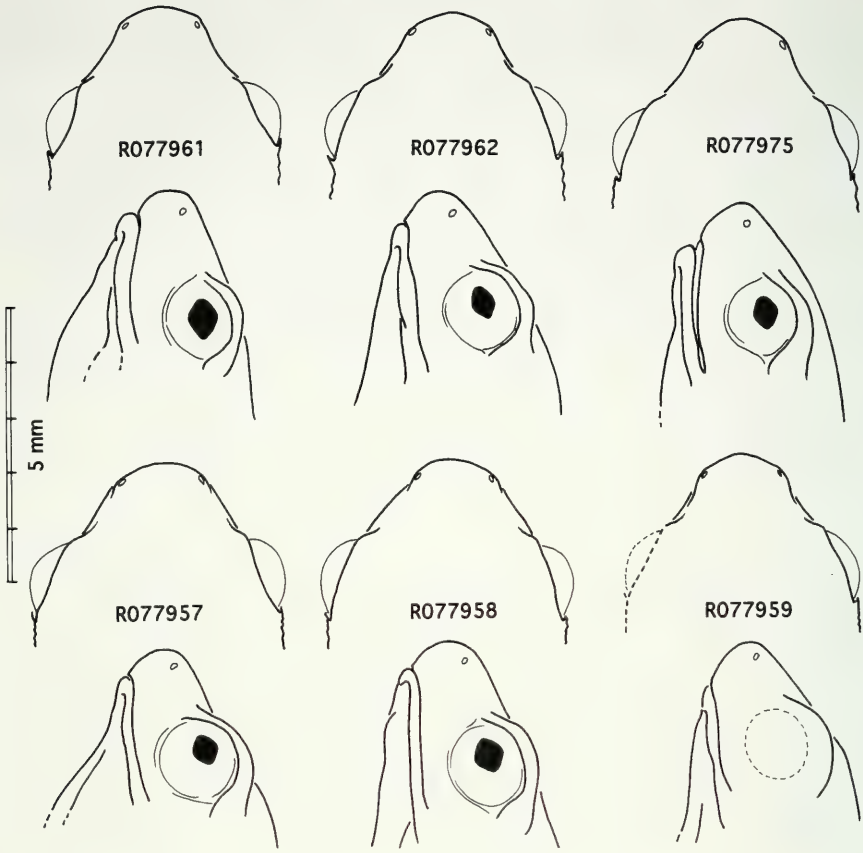


FIG. 11
Forme du museau chez six individus d'*Hyperolius* cf. *nasutus*. Spécimens du Musée de Copenhague.

extrêmes de *H. nasutus*», il en avait fait le type d'une espèce nouvelle, *Hyperolius dartevellei*. Sa description mentionne des bandes latéro-dorsales à peine visibles, une peau ventrale diaphane, une taille de 19 mm, et n'insiste pas sur les chromatophores dorsaux: ces caractères laissent supposer que cette femelle n'est pas tout à fait adulte. Par la suite, en examinant le type d'*H. adspersus* (là encore, une femelle unique), Laurent (1963) s'aperçut que son espèce était identique à celle de Peters, la mit en synonymie de celle-ci... et fit d'*adspersus* une sous-espèce d'*H. nasutus*!

La description de Peters (1877) est beaucoup moins explicite que celle de Laurent. Les seuls éléments qui peuvent en être retenus sont la taille (20 mm) et l'aspect de la pigmentation dorsale, heureusement précisé par une figure montrant une forte ponctuation éparse (à l'origine du nom spécifique); grâce à cette figure, on peut constater aussi que l'habitus est assez trapu, et le museau court. Le type de Peters provient de Chinchoxo, dans l'actuelle enclave angolaise de Cabinda, donc relativement près du Bas-Congo d'où provenait le type d'*H. dartevellei*.

A proximité, dans le bassin inférieur du Kouilou (Congo), Largen et Dowsett-Lemaire ont trouvé un petit *Hyperolius* dont ils m'ont communiqué un enregistrement sonore. J'y ai reconnu les appels de l'espèce de la zone forestière camerounaise, et c'est sur la base de cette identification acoustique qu'ils ont signalé cette espèce comme *Hyperolius* sp. aff. *nasutus* (Largen & Dowsett-Lemaire, 1991). Plus récemment, Largen a eu l'obligeance de comparer les spécimens qu'il avait capturés avec des photos d'individus camerounais et m'a confirmé leur parfaite ressemblance.

D'autre part, Perret (comm. pers.) a attiré mon attention sur un autre synonyme d'*H. adspersus*. Il s'agit de *Rappia punctulata*, espèce décrite par Barboza du Bocage en 1895, à partir d'un individu trouvé près de la rivière Quanza, dans le nord de l'Angola. Sa description ne suggère pas, a priori, un rapprochement avec *H. nasutus*, mais Perret a pu voir le type au Musée de Lisbonne avant sa destruction, ce qui lui a permis d'apporter des précisions intéressantes (Perret, 1976). Il relève en particulier que, contrairement à l'assertion de Barboza du Bocage, le type est une femelle. Il souligne son aspect beaucoup plus trapu que celui d'*H. nasutus* et *H. benguellensis*. Le nom spécifique choisi par Barboza du Bocage fait allusion (comme celui de Peters pour *adspersus*) à la présence de «petits points noirs» sur la face supérieure du corps et des membres. Monard (1937) rapporte à cette espèce «trois jeunes individus de Katumbela très conformes à la description de Bocage» (la rivière Catumbela se situe dans le Benguela, un peu au-delà de 12° sud).

La conspécifité des individus du Cameroun, du Congo, de la République Démocratique du Congo (ex-Zaïre), de l'enclave de Cabinda et d'Angola ne fait pas de doute. Il faut ajouter que trois enregistrements effectués au Gabon et attribués par Channing *et al.* (2002) à leur type C, se rapportent probablement à cette espèce, ce qui réduirait la lacune de 800 km séparant les populations camerounaises des autres (voir plus haut «Vocalisations»).

Un problème connexe reste posé. Dans un travail récent, Schiøtz & Van Daele (2003) ont cité sous le nom d'*H. nasutus* une espèce qu'ils avaient récoltée et enregistrée dans le NW de la Zambie. Schiøtz m'a communiqué 6 spécimens de cet *Hyperolius*. Pour autant qu'on puisse en juger par des échantillons numériquement très inégaux, il partage avec *adspersus* un caractère morphométrique important, la largeur relative de la tête: comme le montre le tab. III, le rapport T / L est en moyenne de 30,24% chez *adspersus* et de 30,34% chez les spécimens de Zambie. Un rapport identique se retrouve chez *H. viridis*, mais celui-ci est par ailleurs bien différent. D'autre part, la palmure pédieuse (Fig. 8) a un extension semblable à celle d'*H. adspersus*. Un point de rapprochement pourrait aussi être fourni par les appels, qui sont sinon identiques, du moins du même type (*cf.* sonagramme *in* Schiøtz & Van Daele, 2003). Enfin, Schiøtz (comm. pers.) m'a signalé que, dans son unique localité du NW de la Zambie, cette espèce a été trouvée dans un site (« overgrown fishpond ») impliquant une écologie parasylvicole plutôt que savanicole.

Malgré ces points de ressemblance avec *H. adspersus*, les individus de Zambie se séparent de ceux du Cameroun par leur taille nettement plus petite (environ 1,6 mm d'écart sur les moyennes) et, surtout, par leur museau beaucoup moins court. Cette différence apparaît bien sur les dessins de la Fig. 11, et dans les rapports morphométriques du tab. V (où la faible disparité numérique entre les échantillons permet une

PLANCHE I

Hyperolius igbettensis – a: deux mâles de Minkama, 28.IX.77; b: mâle d'Elomzok, 29.IX.76; c: mâle du Lac Paponoun, 21.VI.78, montrant la macule blanche caractéristique sur le sac vocal gonflé; d: mâle, même localité et même date.

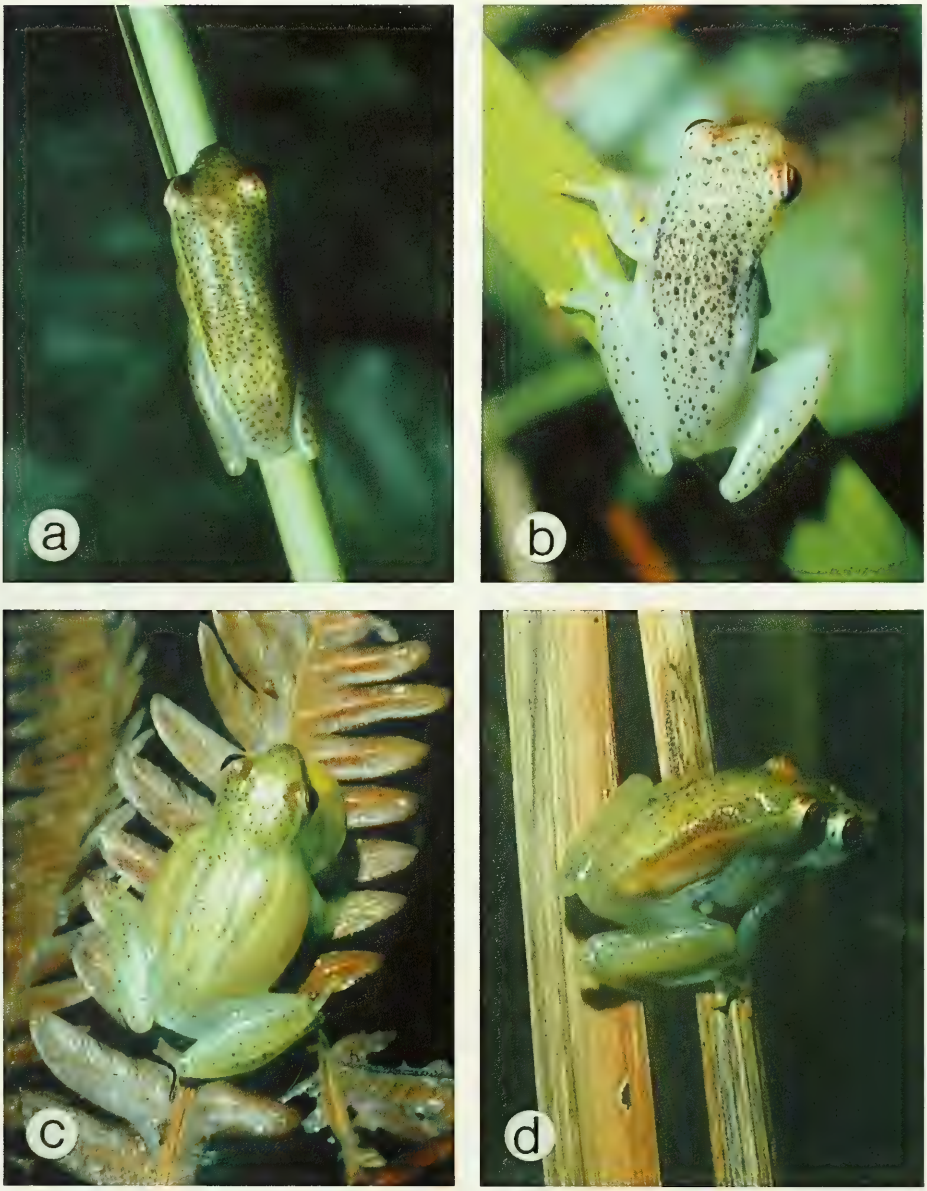


PLANCHE II

Hyperolius adspersus – a: mâle, Elomzok, 29.IX.76; b: femelle, Zamakoé, 10.IV.89; c: mâle en activité vocale, Ototomo, II.70; d: couple en amplexus, Olembé, 12.X.70. Remarquer les petites taches ocellées de la femelle, et la ponctuation dense du mâle d'Elomzok.

meilleure comparaison): les valeurs sont toutes nettement supérieures à celles d'*H. adspersus* et proches de celles d'*H. igbettensis* ou même, pour la longueur relative de la tête, d'*H. benguellensis*.

Comme la forme du museau est le caractère discriminant le plus apparent d'*H. adspersus*, il est justifié de distinguer spécifiquement les populations du NW de la Zambie. Celles-ci, par ailleurs, ne peuvent être rapportées ni à l'*H. nasutus* de Günther, ni à d'autres taxons du groupe, ce qui fait qu'elles restent pour le moment sans nom. Il ne faudrait cependant pas écarter totalement la possibilité qu'elles soient reliées par des populations intermédiaires aux populations d'*H. adspersus*, situées à environ 1500 km plus à l'ouest, et que les unes et les autres représentent les termes extrêmes d'un cline. La rareté des aréotypes similaires chez les Anoures africains rend réanmoins cette hypothèse peu probable.

CONCLUSION

Les problèmes posés par le groupe d'*H. nasutus* ont des causes bien différentes: – le groupe est intrinséquement difficile, surtout parce que la livrée, très uniforme, n'offre pas de caractères discriminants; – la sympatrie, voire la syntopie, d'espèces très ressemblantes doit être fréquente: c'est une source de difficultés (et d'erreurs) pour qui ne dispose que de matériel fixé où plusieurs espèces sont mélangées; – un certain manque de rigueur à l'égard des descriptions originales a entraîné des «glissements» dans la conception des taxons: des *Hyperolius* d'origines diverses rapportés à *nasutus* ne paraissent pas correspondre au type décrit et figuré par Günther et plusieurs synonymies erronées ont été proposées et admises.

Reconnues *in natura*, et assez souvent repérées au cours d'une vingtaine d'années de batrachologie de terrain, les deux espèces représentant le groupe au Cameroun sont cependant relativement faciles à définir. Il est possible, au terme du présent travail, d'en proposer les diagnoses actualisées suivantes.

***H. igbettensis*:** espèce relativement grande (19-22,3 mm), de forme très élancée, à tête étroite (moy. T/L ≈ 25%). Museau long (moy. M/T ≈ 33%) mais, vu de profil, à extrémité arrondie et modérément saillante en avant de la bouche (non «squaliforme»). Palmure pédieuse laissant, sur le côté interne de l'orteil 4, environ deux phalanges libres. Chromatophores bruns peu nombreux, n'affectant pas notablement la pigmentation foncière verte. Appels de type A *sensu* Channing *et al.* (2002). Habitat savanicole.

H. adspersus: espèce un peu plus petite que la précédente (18,5 à 21,8 mm), de forme trapue, à tête large (moy. T/L ≈ 30%). Museau court (moy. M/T ≈ 27,3%), à profil arrondi, son extrémité, vue de dessus, à la fois très courte et large (moy. m/IN ? 75%). Palmure pédieuse laissant environ une phalange libre sur le côté interne de l'orteil 4. Chromatophores bruns assez nombreux et uniformément répartis sur la face dorsale, pouvant donner, en livrée nocturne, un aspect densément ponctué. Appels de type C. Habitat parasylvicole, dans des milieux largement ouverts de la zone forestière.

Si la discrimination des deux espèces précédentes ne pose pas de problème dans les limites de la batrachofaune camerounaise, il est beaucoup plus difficile de les définir par rapport aux autres espèces du groupe (*H. lamottei* excepté) en raison de la

PLANCHE III

Hyperolius adspersus et *H. igbettensis* – a: pigmentation dorsale chez *H. igbettensis* (individu en bas à gauche) et chez *H. adspersus* (les neuf autres individus); b: -id-, pigmentation ventrale, montrant l'aspect de la tache blanche quand le sac vocal est rétracté. Spécimens mâles capturés ensemble à Elomzok, 29.IX.76.

confusion qui y règne encore. A en juger par les indications de la littérature et par l'examen de quelques spécimens préservés, et bien que je n'en aie aucune expérience sur le terrain, deux entités me paraissent émerger de l'ensemble; elles sont bien distinctes l'une de l'autre et des espèces précédentes.

1°) La première est caractérisée par: – la forme de son museau, très pointu aussi bien en profil («squaliforme») qu'en plan, à extrémité parfois retroussée, et à narines portées par des dilatations latérales, – son tympan entièrement masqué par le muscle dépresseur de la mandibule, – ses aspérités tégumentaires très denses, présentes chez la femelle. Deux caractères variables, qui ont pu être sources de confusion, doivent être relevés: – le tégument dorsal peut être granuleux, – la pigmentation dorsale peut montrer 2 ou 4 bandes longitudinales claires, ou aucune.

Cette définition correspond, pour l'essentiel, à *H. benguellensis* au sens de Wilson (travail inédit) et de Schiøtz & Van Daele (2003). Une analyse comparative des descriptions originales suggère comme synonymes *H. oxyrhynchus* (synonymie généralement admise), *H. papyri*, *H. acuticeps* et *H. nasicus* (synonymies non discutées par les auteurs). Il est aussi possible que cette espèce soit, en réalité, le «vrai» *H. nasutus*, tel que l'a décrit et figuré Günther. Toutefois, il ne faut pas écarter l'éventualité que la diagnose précédente s'applique à deux espèces ou plus. Il est en effet remarquable que, dans leurs descriptions d'*H. nasutus* et *H. benguellensis*, Monard (1937) aussi bien que Poynton & Broadley (1987) utilisent *les mêmes termes* pour décrire le museau de ces espèces, qu'ils considèrent comme distinctes.

2°) La seconde est caractérisée, entre autre, par: – sa forme assez massive, – sa tête large (comme chez *adspersus*) et son museau obtus, – sa palmure pédieuse relativement peu étendue, – ses aspérités cutanées éparses et difficilement perceptibles, – ses appels de type B, sensu Channing *et al.* (2002). Comme chez la précédente, le tégument peut avoir un aspect granuleux.

Ce signalement correspond à peu près à l'*H. viridis* de Schiøtz, qui paraît lui-même très proche, voire inséparable, de la *Rappia granulata* de Boulenger, espèce qui a été mise à tort en synonymie d'*H. oxyrhynchus* (actuellement *benguellensis*), d'abord par Loveridge (1953), ensuite par Laurent (1957).

A côté des entités précédentes, il en existe sûrement d'autres, encore plus difficiles à séparer et définir. L'*Hyperolius* cf. *nasutus* plusieurs fois mentionné ci-dessus en fait partie; il est probable que son extension dépasse largement celle des spécimens du NW de la Zambie récoltés par Schiøtz et Van Daele. De même, on peut se demander si *H. igbettensis* ne s'étend pas beaucoup plus à l'est que ne le laisse supposer sa distribution actuellement connue, ou s'il ne fait pas partie d'un ensemble de taxons vicariants.

REMERCIEMENTS

Quand j'ai commencé à étudier mes spécimens d'*Hyperolius* camerounais proches d'*H. nasutus*, je ne pressentais pas les nombreux problèmes auxquels je serais confronté. Beaucoup ont été résolus grâce à l'aide de plusieurs collègues: – A. Schiøtz a réalisé les sonagrammes au Laboratoire de Zoologie de l'Université de Copenhague, m'a fait parvenir des spécimens provenant de Zambie et, à l'occasion d'un échange

soutenu de correspondance, a activement participé à l'élaboration de cet article; – J.-L. Perret, avec son amabilité coutumière, m'a envoyé de nombreux documents accompagnés de ses commentaires et a attiré mon attention sur *Rappia punctulata*; – M. Largen a comparé des photos de mes spécimens d'*H. adspersus* avec ceux qu'il avait récoltés au Congo et m'a fait d'utiles suggestions sur le manuscrit; – F. Dowsett-Lemaire a mis à ma disposition ses enregistrements de Batraciens de la région du Kouilou; – T. Frétey m'a fait bénéficier de sa riche bibliothèque en me procurant des publications rares. Je les remercie vivement pour leur amicale collaboration. Ma reconnaissance va aussi à V. Mahnert et à C. Lienhard, qui ont beaucoup facilité la §publication de ce travail dans la Revue suisse de Zoologie. Enfin, je ne saurais oublier l'aide efficace qui m'a été apportée par le Studio Toton, pour les tirages photographiques, et par le Bureau Van Dam, pour la traduction des textes en allemand.

RÉFÉRENCES

Ahl, E. 1931. Amphibia: Anura III. Polypedatidae. *Das Tierreich* 55: XVI + 477 pp.

Amiet, J.-L. 1975. Ecologie et distribution des Amphibiens Anoures de la région de Nkongsamba (Cameroun). *Annales de la Faculté des Sciences de Yaoundé* 20: 33-107.

Amiet, J.-L. 1983. Un essai de cartographie des Anoures du Cameroun. *Alytes* 2 (4): 124-146.

Amiet, J.-L. 1986. La batrachofaune sylvicole d'un secteur forestier du Cameroun: la région de Yaoundé. *Mémoires du Muséum national d'Histoire naturelle, nouvelle série, série A, Zoologie* 132: 29-42.

Amiet, J.-L. 1989. Quelques aspects de la biologie des Amphibiens Anoures du Cameroun. *Année Biologique* 28 (2): 73-136.

Amiet, J.-L. 2001. Un nouveau *Leptopelis* de la zone forestière camerounaise (Amphibia, Anura, Hyperoliidae). *Alytes* 19 (1): 29-44.

Amiet, J.-L. 2004. A propos de deux *Leptopelis* nouveaux pour la faune du Cameroun. *Alytes* 21 (3-4): 111-170.

Barboza du Bocage, J. V. 1893. Diagnoses de quelques nouvelles espèces de Reptiles et de Batraciens d'Angola. *Jornal de Sciencias Mathematicas, Physicas e Naturales* 2 (3):115-121.

Barboza du Bocage, J. V. 1895. Herpétologie d'Angola et du Congo. *Lisbonne*, 203 pp.

Boulenger, G. A. 1901. Matériaux pour la faune du Congo. Batraciens et Reptiles. *Annales du Musée Royal de l'Afrique centrale. Zoologie série 1*, 2, 1: 1-14, pl. I-V.

Channing, A. 2001. Amphibians of Central and Southern Africa. *Cornell University Press*, Ithaca, 470 pp., 23 pl.

Channing, A., Moyer, D. & Burger, M. 2002. Cryptic species of sharp-nosed reed frogs in the *Hyperolius nasutus* complex: advertisement call differences. *African Zoology* 37 (1): 91-99.

Günther, A. 1864. Descriptions of new species of Batrachians from West Africa. *Proceedings of the Zoological Society of London* 1864: 479-482, pl. XXXIII.

Günther, A. 1894. Second Report on the Reptiles, Batrachians, and Fishes transmitted by Mr. H. H. Johnston, C. B., from British Central Africa. *Proceedings of the Zoological Society of London* 1894: 616-628.

Inger, R. F. 1968. Amphibia. *Exploration du Parc National de la Garamba* 52: 1-190.

Largen, M. J. 1998. The status of the genus *Hyperolius* Rapp, 1842 (Amphibia Anura Hyperoliidae) in Ethiopia. *Tropical Zoology* 11: 61-82.

Largen, M. J. & Dowsett-Lemaire, F. 1991. Amphibians (Anura) from the Kouilou River basin, République du Congo. *Tauraco Research Report* 4: 145-168.

Laurent, R. 1943. Les *Hyperolius* (Batraciens) du Musée du Congo. *Annales du Musée Royal du Congo Belge* 4: 61-140.

LAURENT, R. 1957. Genres *Afrixalus* et *Hyperolius* (Amphibia Salientia). *Exploration du Parc National de l'Upemba* 42: 1-47, pl. I-IV.

LAURENT, R. 1958. La réserve nationale du Mont Nimba. Les rainettes du genre *Hyperolius*. *Mémoires de l'Institut français d'Afrique noire* 53: 275-299.

LAURENT, R. 1963. Note sur les *Hyperolius* et quelques *Afrixalus* (Salientia) du Musée de Berlin. *Revue de Zoologie et Botanique Africaines* 64 (1-2): 65-96.

LOVERIDGE, A. 1938. A new frog (*Hyperolius poweri*) from Natal, South Africa. *Proceedings of the Biological Society of Washington* 51: 213-214.

LOVERIDGE, A. 1953. Zoological results of a fifth expedition to East Africa. IV. Amphibians from Nyasaland and Tete. *Bulletin of the Museum of Comparative Zoology* 110: 323-406, 4 pl.

MERTENS, R. 1940. Amphibien aus Kamerun gesammelt von M. Köhler und Dr. H. Graf. *Senckenbergiana* 22 (3-4): 103-135.

MONARD, A. 1937. Contribution à la Batrachologie d'Angola. *Bulletin de la Société neuchâteloise des Sciences naturelles* 62: 5-59.

PASSMORE, N. I. & CARRUTHERS, V. C. 1995. South African Frogs, Revised Edition. *Southern Book Publishers & Witwatersrand University Press, Johannesburg*, 322 pp.

PERRET, J.-L. 1976. Révision des Amphibiens africains et principalement des types, conservés au Musée Bocage de Lisbonne. *Publicaçao do Museu e Laboratorio Zoologico e Antropologico*, 2a Série 6 (2): 15-34.

PETERS, W. C. H. 1877. Übersicht der Amphibien aus Chinchoxo (Westafrika), welche von der Africanischen Gesellschaft dem Berliner Zoologischen Museum übergeben sind. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaft zu Berlin (October):* 611-620, 1 pl.

POYNTON, J. C. & BROADLEY, D. G. 1987. Amphibia Zambesiaca 3. Rhacophoridae and Hyperoliidae. *Annals of the Natal Museum* 28 (1): 161-229.

SCHIØTZ, A. 1963. The Amphibians of Nigeria. *Videnskabelige Meddelelser fra Dansk naturhistorik Forening* 125: 1-92, pl. I-IV.

SCHIØTZ, A. 1967. The treefrogs (Rhacophoridae) of West Africa. *Spolia Zoologica Musei Hauniensis* 25: 1-346.

SCHIØTZ, A. 1975. The Treefrogs of Eastern Africa. *Steenstrupia, Copenhagen*, 232 pp.

SCHIØTZ, A. 1999. Treefrogs of Africa. *Ed. Chimaira, Frankfurt am Main*, 350 pp.

SCHIØTZ, A. & VAN DAELE, P. 2003. Notes on the treefrogs (Hyperoliidae) of North-Western province, Zambia. *Alytes* 20 (3-4): 137-149.

STEVENS, R. A. 1974. An annotated check list of the Amphians and Reptiles known to occur in south-eastern Malawi. *Arnoldia* 30 (6): 1-22.

STEWART, M. M. 1967. Amphibians of Malawi. *State University of New York Press*, 163 pp.

SUCHEL, J.-B. 1972. La répartition des pluies et les régimes pluviométriques au Cameroun. Travaux et documents de géographie tropicale, 5. *Université fédérale du Cameroun et C.N.R.S.*, 287 pp.

WAGER, V. A. 1965. The Frogs of South Africa. *Purnell & Sons, Cape Town & Johannesburg*, 242 pp.

WERNER, F. 1907. Ergebnisse der mit Subvention aus der Erbschaft Treitl unternommenen zoologischen Forschungsreise Dr. Franz Werner's nach dem ägyptischen Sudan und Nord-Uganda. XII. Die Reptilien und Amphibien. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse* 116 (1): 1823-1926, pl. I-IV.

WILSON, L. G. (inédit). Discovery of a novel character involving the tympanic apparatus in five species of *Hyperolius* (Anura: Hyperoliidae). (*In*: SCHIØTZ, A. & VAN DAELE, P. 2003).

REVUE SUISSE DE ZOOLOGIE

Tome 112 — Fascicule 1

REVUE SUISSE DE ZOOLOGIE

Volume 112 — Number 1

Indexed in CURRENT CONTENTS, SCIENCE CITATION INDEX

Volume 112 - Number 1 - 2005

Revue suisse de Zoologie: Instructions to Authors

The *Revue suisse de Zoologie* publishes papers by members of the Swiss Zoological Society and scientific results based on the collections of the Muséum d'histoire naturelle, Geneva. Submission of a manuscript implies that it has been approved by all named authors, that it reports their unpublished work and that it is not being considered for publication elsewhere. A financial contribution may be asked from the authors for the impression of colour plates and large manuscripts. All papers are refereed by experts.

In order to facilitate publication and avoid delays authors should follow the *Instructions to Authors* and refer to a current number of R.S.Z. for acceptable style and format. Papers may be written in French, German, Italian and English. Authors not writing in their native language should pay particular attention to the linguistic quality of the text.

Manuscripts must be typed or printed (high quality printing, if possible by a laser-printer), on one side only and double-spaced, on A4 (210 x 297 mm) or equivalent paper and all pages should be numbered. All margins must be at least 25 mm wide. Authors must submit three paper copies (print-outs), including tables and figures, in final fully corrected form, and are expected to retain another copy. Original artwork should only be submitted with the revised version of the accepted manuscript.

We encourage authors to submit the revised final text on a disk (3,5"), or on a CD-R, using MS-WORD or a similar software. The text should be in roman (standard) type face throughout, except for genus and species names which should be formatted in *italics* (***bold italics*** in taxa headings) and authors' names in the list of references (not in other parts of the text!), which should be formatted in SMALL CAPITALS. LARGE CAPITALS may be used for main chapter headings and SMALL CAPITALS for subordinate headings. Footnotes and cross-references to specific pages should be avoided. Papers should conform to the following general layout:

Title page. A concise but informative full title plus a running title of not more than 40 letters and spaces, full name(s) and surname(s) of author(s), and full address(es) including e-mail address(es) if possible.

Abstract. The abstract is in English, composed of the title and a short text of up to 200 words. It should summarise the contents and conclusions of the paper and name all newly described taxa. The abstract is followed by up to 10 keywords, separated by hyphens, which are suitable for indexing. Some of the terms used in the title may be omitted from the list of keywords in favour of significant terms not mentioned in the title.

Introduction. A short introduction to the background and the reasons for the work.

Material and methods. Sufficient experimental details must be given to enable other workers to repeat the work. The full binominal name should be given for all organisms. The International Code of Zoological Nomenclature must be strictly followed. Cite the authors of species on their first mention.

Results. These should be concise and should not include methods or discussion. Text, tables and figures should not duplicate the same information. New taxa must be distinguished from related taxa. The abbreviations gen. n., sp. n., syn. n. and comb. n. should be used to distinguish all new taxa, synonymies or combinations. Primary types must be deposited in a museum or similar institution. In taxonomic papers the species heading should be followed by synonyms, material examined and distribution, description and comments. All material examined should be listed in similar, compact and easily intelligible format; the information should be in the same language as the text. Sex symbols should be used rather than "male" and "female" (text file: $ = ♂, £ = ♀).

Discussion. This should not be excessive and should not repeat results nor contain new information, but should emphasize the significance and relevance of the results reported.

References. The author-date system (name-year system) must be used for the citation of references in the text, e.g. White & Green (1995) or (White & Green, 1995). For references with three and more authors the form Brown *et al.* (1995) or (Brown *et al.*, 1995; White *et al.*, 1996) should be used. In the text authors' names have to be written in standard type face. However, in the list of references they should be formatted in SMALL CAPITALS (see below). The list of references must include all publications cited in the text and only these. References must be listed in alphabetical order of authors, in the case of several papers by the same author, the name has to be repeated for each reference. The title of the paper and the name of the journal must be given in full in the following style:

PENARD, E. 1888. Recherches sur le *Ceratium macroceros*. *Thèse, Genève*, 43 pp.

PENARD, E. 1889. Etudes sur quelques Héliozoaires d'eau douce. *Archives de Biologie* 9: 1-61.

MERTENS, R. & WERMUTH, H. 1960. Die Amphibien und Reptilien Europas. *Kramer, Frankfurt am Main*, XI + 264 pp.

HANDLEY, C. O. Jr 1966. Checklist of the mammals of Panama (pp. 753-795). *In:* WENZEL, R. L. & TIPTON, V. J. (eds). Ectoparasites of Panama. *Field Museum of Natural History, Chicago*, XII + 861 pp.

Tables. These should be self-explanatory, not integrated in the text-file, with the title at the top, organised to fit 122 x 180 mm, each table on a separate sheet and numbered consecutively.

Figures. These may be line drawings or half tones, not integrated in the text-file, and all should be numbered consecutively. Figures should be arranged in plates which can be reduced to 122 x 160 mm. Drawings and lettering should be prepared to withstand reduction. Magnification should be indicated with scale lines. Authors should refrain from mixing drawings and half tones. If possible, originals of figures (ink drawings, photographs, slides) should be submitted (together with the revised version of the accepted manuscript). Original drawings will not be returned automatically. The *Revue suisse de Zoologie* declines responsibility for lost or damaged slides or other documents. If electronically scanned figures are submitted on disk or CD-R (never in MS-Powerpoint format !), this should be clearly indicated on the print-out of these figures enclosed with the print-out of the text. The following minimum resolutions should be respected: scanned line drawings: 600 dpi; scanned photographs: 300 dpi; digital photographs: 5 millions of pixels.

Legends to figures. These should be typed in numerical order on a separate sheet.

Proofs. Only page proofs are supplied, and authors may be charged for alterations (other than printer's errors) if they are numerous.

Offprints. The authors receive a total of 25 offprints free of charge; more copies may be ordered at current prices when proofs are returned.

Correspondence. All correspondence should be addressed to

Revue suisse de Zoologie, Muséum d'histoire naturelle, CP 6434, CH-1211 Genève 6, Switzerland.
Phone: +41 22 418 63 33 - Fax: +41 22 418 63 01. E-mail: volker.mahnert @ mhn.ville-ge.ch
Home page RSZ: http://www.ville-ge.ch/musinfo/mhng/page/rsz.htm