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

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REVUE SUISSE DE ZOOLOGIE 113 (4): 711-716; décembre 2006

Zelotes balcanicus sp. n., a new and widespread species from the Balkan Peninsula (Araneae, Gnaphosidae)
A new *Zelotes* species

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***Zelotes balcanicus* sp. n., a new and widespread species from the Balkan Peninsula (Araneae, Gnaphosidae).** - *Zelotes balcanicus* sp. n. (male/-female) from Bulgaria, Romania, Greece and Macedonia is described and illustrated. This new species has somatic and genital characters that correspond well with those of the genus *Zelotes*.

Keywords: Description, spider, Bulgaria, Romania, Greece, Macedonia.

INTRODUCTION

Up to now 45 *Zelotes* species have been observed in the Balkan Peninsula (Blagoev, 2000; Deltshev & Blagoev, 2001; Deltshev *et al.,* 2003; Bosmans & Chatzaki, 2005). These data indicate a high diversity of the genus in the region and recent descriptions of some new species (Chatzaki *et al.,* 2003) show that the genus is not yet completely investigated.

Each of the four authors of this paper independently founded a *Zelotes* species which we could not identify. The specimens came from the following four countries: Bulgaria, Romania, Greece and Macedonia (Fig. 1). This species turned out to be new to science and is described in the following.

MATERIAL AND METHODS

The spider material was collected by hand and by pitfall traps. Colour is described from formalin and alcohol preserved specimens. The measurements of the legs are taken from the dorsal side. Total length of the body includes chelicerae. The map of Balkan Peninsula is according Abadjiev (2001). All measurements are in mm.

DESCRIPTION

Zelotes balcanicus Deltshev sp. n. Figs 2-11

MATERIAL: BULGARIA: North Black Sea, Shabla town (dunes), 1 male holotype, 1 male and 2 female paratypes 4.06.1999 (V. Popov leg.); Zemenska Planina Mountain, Zemen Gorge, 1 female paratype, 4.07.1984; 1 female paratype, 4.06.1985; 1 female paratype, 27.05.1986; 1

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male paratype, 28.04.1986; 1 male paratype, 27.05.1986 (G. Blagoev leg.); North Black Sea, Albena Resort, 2 male paratypes, 18.06.1996; Rusalka Resort, 2 male paratypes, 31.07.1997; Kavarna Town, 2 male paratypes, 28.05.1994, 1 male paratype, 12.06.1996; South Black Sea, Ropotamo River, 1 female paratype, 27.05.1994; 1 female paratype 8.06.1995; 1 female paratype, 12.06.1996; Arkutino, 1 female paratype, 12.06.1996 (V. Popov & I. Krusteva leg.); Struma River Valley: Kresna Gorge, 1 female paratype, 4.08.1996; 2 female paratypes, 28.09.1998; 1 male, 1 female paratypes, 26.10.1996; Simitli Town, 1 male paratype, 27.10.1996; Delchevo Village, 1 male, 2 female paratypes, 8.06.1997 (M. Serafimova & G. Blagoev leg.); Maleshevska Planina Mountain (550 m), 1 female paratype, 31.07.2002 (S. Lazarov leg.); Kamenitsa Village, 3 male, 1 female paratypes, 30.04.2002; 1 male paratype, 31.05.2005; 2 female paratypes, 30.07.2002; 3 male paratypes, 28.09.2002; South Pirin: Kalimantsi village (450-500 m), 1 female paratype, 29.04.2002; 2 male, 1 female paratype, 30.05.2002; 1 male paratype, 30.09.2002 (S. Lazarov & M. Langourov leg.); East Rhodopy: Byala Reka River, 1 male paratype, 5.08.1996 (G. Tsonev leg.).– MACEDONIA: Scopije, Vodno Mountain (600-900 m), 1 female paratype, 3.06.2000; Katlanovo, Katlanovsko Burdo, 1 male paratype, 6.06.2000 (C. Deltshev & G. Blagoev leg.).– GREECE: Evvoia-Voroies Sporades: Evvoia: road Istiea-Kanadika, 2 females, 12.V.2001 (R. Bosmans leg.); Skopelos: between Elios and Platanakia, 1 female, under stones in pine forest, 8.VII.2000 (R. Bosmans leg.); Makedonia: Chalkidiki: just outside Marathousa, 200m, pitfalls in grassland in open *Quercus* forest, 1 ♂ 1 ♀, 12.VI.2004 (L. Provoost leg.); Sithonia, around Vourvourou, 50 m, 2 males, stones at road side, 21.V.2004 (L. Provoost leg.); Peloponnisos: Achaia, Tsivlos, 900 m, 1 male 1 female, *Platanus* forest along river Krathis, 13.IV.2000 (R. Bosmans leg.); Oros Panachaiko, Mirali, 1 female, stones in montane grassland, 31.V.1998 (R. Bosmans leg.); Messinia: Oros Taigetos, 1 male 2 females, stones and litter in mixed *Platanus* and *Abies* forest, 28.V.1998 (R. Bosmans leg.).– ROMANIA: Dobrogea: Jud. Constantsa: Agigea, centrul-universitar, pitfalls in dune grassland, 7 males, 2 females, 23.III-13.IV.2004 (De Spiegelaere leg.).

DEPOSITORY: The holotype and 1 female paratype (Bulgaria, Shabla) are deposited in the Museum d'histoire naturelle, Genève; 1 male and 1 female paratypes (Bulgaria, Delchevo village) are deposited in the Museum für Naturkunde, Humboldt-Universität zu Berlin; the remaining 20 males and 19 females paratypes collected in Bulgaria and Macedonia are kept in the collections of the Institute of Zoology, Sofia. The material collected in Romania and Greece is deposited in the collections of the collectors.

ETYMOLOGY: Derived from the name "Balkan".

DIAGNOSIS: Somatic characters corresponding to those of the genus, belonging to the *subterraneus* species group. Male palps as in Figs 2-7, and female genitalia as in Figs 8-11. Males cannot be mistaken for any other species, the palp clearly differs from all known species of the genus. Only the female is closely related to *Zelotes denisi*, described from Algeria by Marinaro (1967), and redescribed by Di Franco (1987). In *Z. denisi* the central V-mark in the epigyne is basally less pointed, and the copulation ducts are longer (Figs 12, 13).

DESCRIPTION: MALE: Total length 4.6-5.9; cephalothorax length 2.07- 2.75; cephalothorax width 1.72-2.2 mm. Leg and palp lengths:

	I	II	III	IV	Palp
Femur	1.47-1.89	1.28-1.65	1.10-1.46	1.65-2.07	0.79-1.04
Patella	0.92-1.22	0.79-1.04	0.67-0.79	0.92-1.10	0.37-0.43
Tibia	1.22-1.53	0.98-1.28	0.73-1.10	1.22-1.83	0.31-0.31
Tarsus	0.85-1.10	0.73-0.98	0.92-1.15	1.53-2.01	-
Metatarsus	0.67-0.86	0.61-0.85	0.55-0.73	0.73-0.85	0.91-1.09
Total	5.13-6.6	4.39-5.8	3.97-5.23	6.05-7.86	2.38-2.87

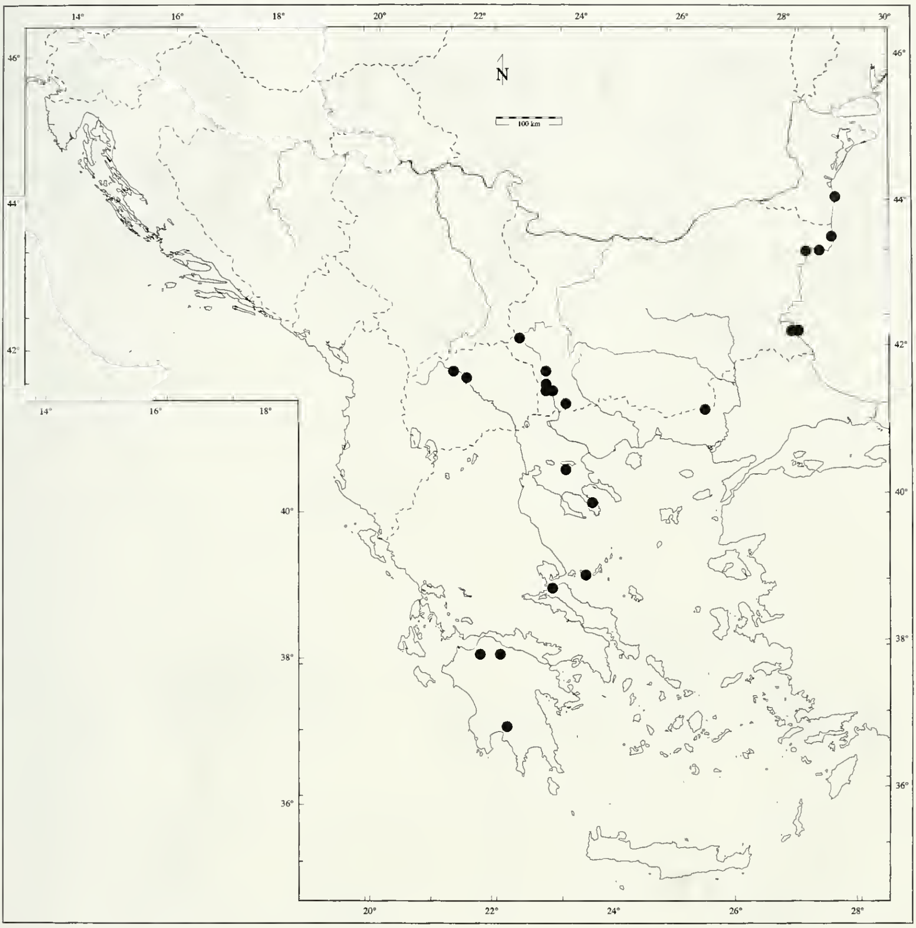
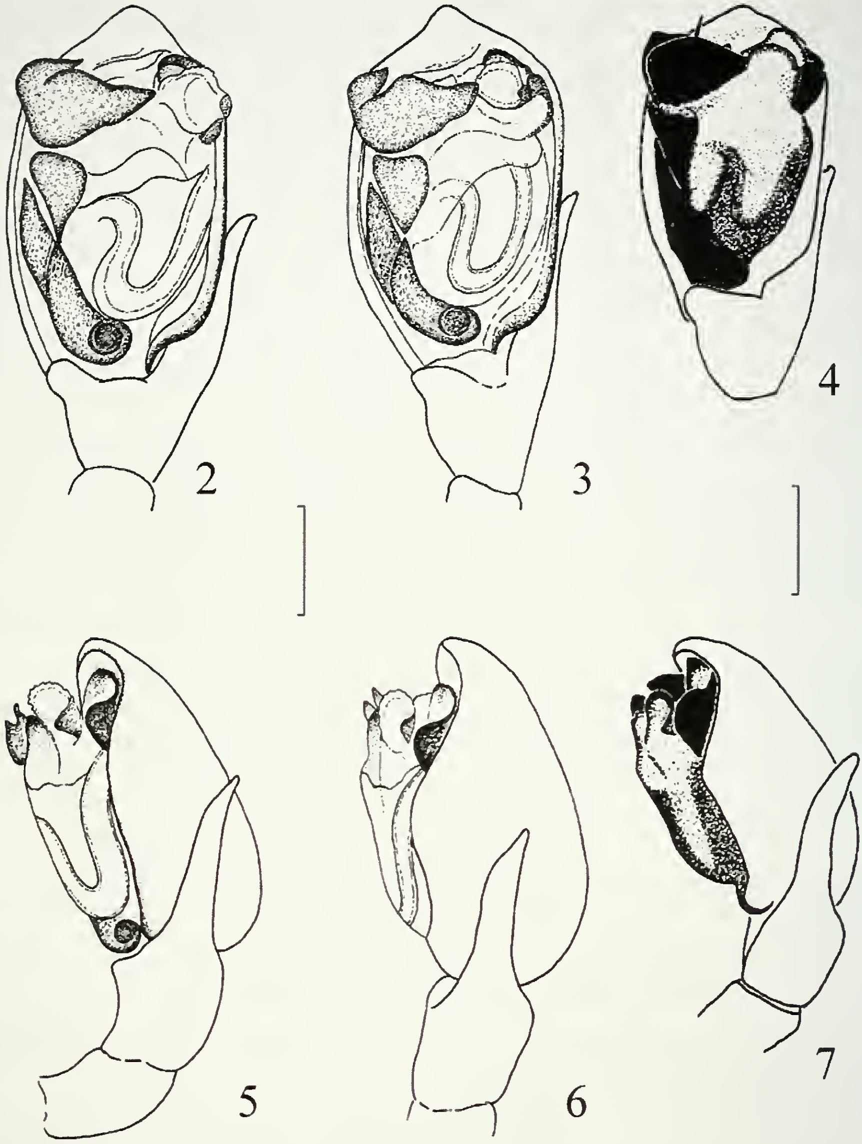


FIG. 1
Localities of *Zelotes balcanicus* sp. n. on the Balkan Peninsula.

FEMALE: Total length 6.0-6.7; cephalothorax length 2.53-2.81; cephalothorax width 1.65-2.2 mm. Leg and palp lengths:

	I	II	III	IV	Palp
Femur	1.52-1.89	1.28-1.40	1.04-1.55	1.59-2.13	0.67-0.98
Patella	0.98-1.22	0.79-1.09	0.67-0.85	1.16-1.22	0.37-0.43
Tibia	1.10-1.40	0.98-1.34	0.79-1.04	1.16-1.65	0.31-0.49
Tarsus	0.85-1.10	0,73-1,04	0,85-1,22	1,53-2,01	-
Metatarsus	0.67-0.85	0.61-0.79	0.55-0.67	0.79-0.85	0.61-0.49
Total	5.12-6.76	4.39-5.66	3.9-5.33	6.23-7.86	1.96-2.39

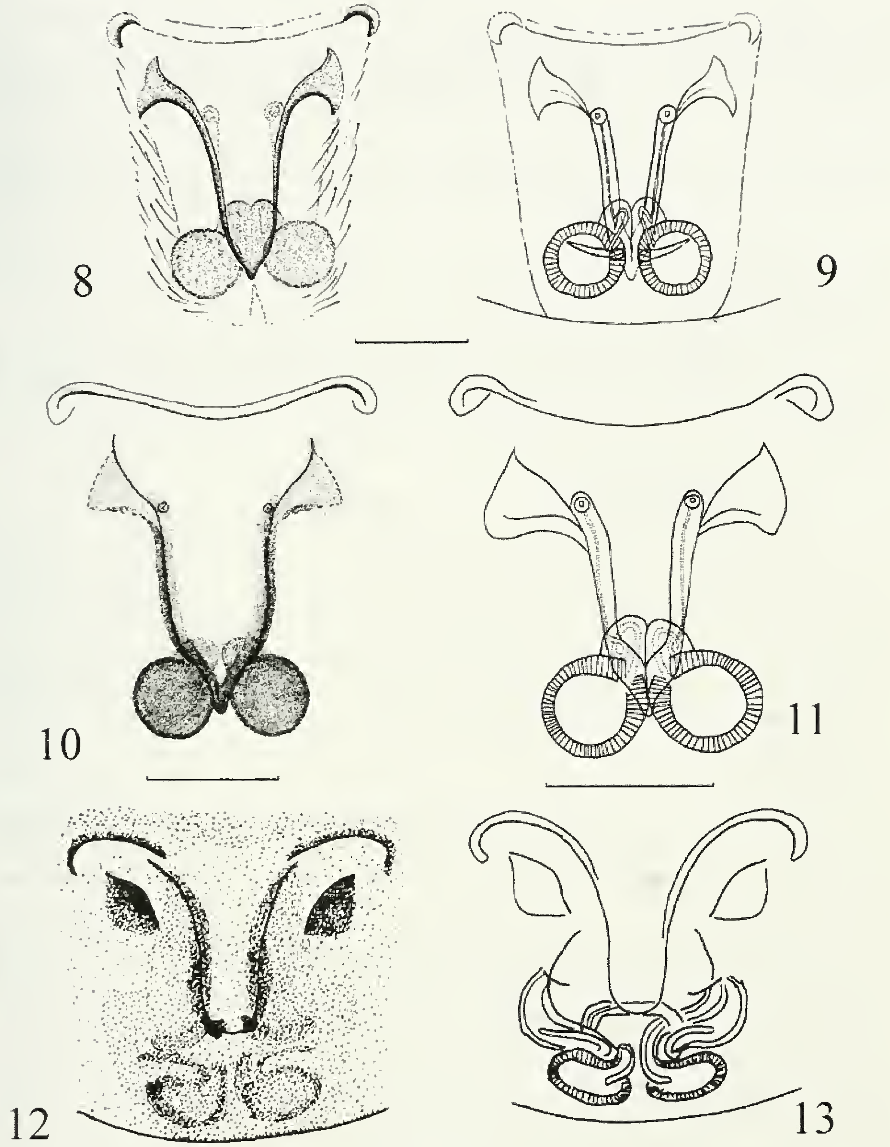
Posterior eye row with eyes of equal size and nearly equidistant. Chelicerae yellow-brown, armed with 4 teeth on outer margin of cheliceral furrow and 3-4



FIGS 2-7

Zelotes balcanicus sp. n., male: 2, palp, ventral view (Bulgaria, Shabla); 3, palp, ventral view (Bulgaria, Zemen); 4, palp, ventral view (Romania, Agigea); 5, palp, retrolateral viev (Bulgaria, Shabla); 6, palp, retrolateral view (Bulgaria, Zemen); 7, palp, retrolateral view (Romania, Agigea). Scale lines: 0.3 mm.

denticles on inner margin. Carapace, sternum and abdomen, brown. Metatarsi I an II spineless. Opistosoma with large dark-brown scutum, occupying ca 40% from the opistosoma.



FIGS 8-13

Zelotes balcanicus sp. n., female: 8, epigyne; 9, vulva, dorsal view (Bulgaria, Shabla); 10, epigyne, ventral view; 11, vulva, dorsal view (Greece, Marathousa); *Zelotes denisi* Marinaro, 1967, female: 12, epigyne, ventral view; 13, vulva, dorsal view (Algeria). Scale lines for Figs 8, 9: 0.3 mm, Figs 10 -13: 0.1 mm.

Male palp (Figs 2-7): Tibial apophysis long and slender. Embolic complex with S-shapeed base and a small sclerotized embolus visible only from the dorsal site of the bulbus. Terminal apophysis stout. Retinaculum with microdenticles on the edge, transverse, situated at apical end of tegulum.

Epigyne (Figs 8, 10): Long and relatively narrow. Anterior furrow with two caps. Lateral margins long and forming V.

Vulva (Figs 9, 11): Copulatory ducts long, leading to globular spermathecae in the centre of the vulva.

AFFINITIES: Although *Z. balcanicus* sp. n. corresponds well with the *subterraneus* species group, its genital organs are very different from those of all known species of this species group.

ECOLOGY: The new species reaches altitudes of up to 1000 m, but prefers the lowlands. Mature males were captured from April to September, females from April to November.

DISTRIBUTION: *Z. balcanicus* sp. n. seems to be widespread over the eastern part of the Balkan Peninsula. Until now, it was captured in Bulgaria, Greece, Macedonia and Romania.

ACKNOWLEDGEMENTS

We are especially grateful to the colleagues Dr G. Blagoev, Dr M. Langourov, Dr S. Lazarov, Dr V. Popov, Mag. I. Krusteva, Mag. M. Serafimova and Mag. G. Tsonev for the collected material, to Dr J. Dunlop for access to the collections of the Natural History Museum Berlin, and to Dr S. Abadjiev for computerizing the map. Research in the collections of Natural History Museum Berlin was supported by grant from the «European Commission's Research Infrastructure Action via the SYNTHESYS Project» – DE-TAF (Museum für Naturkunde).

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REVUE SUISSE DE ZOOLOGIE 113 (4): 717-726; décembre 2006

Thivolleo, a new genus with two new species from Africa (Lepidoptera: Pyraloidea, Crambidae, Pyraustinae)

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Thivolleo, a new genus with two new species from Africa (Lepidoptera: Pyraloidea, Crambidae, Pyraustinae).- *Thivolleo* gen. n. is erected for three species, one known: *T. xanthographa* Hampson, 1913 comb. n., and two new species: *T. albicervix* sp. n. and *T. meruensis* sp. n. The three species occur in Africa. The genitalia and adults of all species are illustrated. The genus is tentatively placed near *Pronomis* Munroe & Mutuura, 1968.

Keywords: *Thivolleo* new genus - new species - Pyraustinae - Africa.

INTRODUCTION

The Pyraloidea of the African continent are poorly studied. The number of species when compared to other continents is quite low (number of valid species of Crambidae: African region: 1431; Oriental region: 2408; Palaearctic region: 1695; and Neotropical region: 2888 [personal database]). History shows that the African continent was explored late when compared to the exploration of other continents. It happened also when the peak of natural history explorations started to decline. This may explain the low number of known species.

The same is applicable for the subfamily Pyraustinae of Africa; at the moment I counted only 147 known species compared to 432 in the Palaearctic region, 384 in the Oriental regions, and 306 in the Neotropical region. It is possible that in the Palaearctic and Oriental regions the numbers are too high because of the inclusion of a number of Spilomelinae, but the fauna of the Neotropical region is better studied (Munroe, 1995) and the figure is more reliable. The African region has a number of typical Old World genera such as *Crypsiptya* Meyrick, 1894, *Euclasta* Lederer, 1855, *Hyalobathra* Meyrick, 1885, *Placosaris* Meyrick, 1897, to name only a few, but also a number of endemics such as *Ethiobotys* Maes, 1997, *Paschiodes* Hampson, 1913, *Pseudognathobotys* Maes, 2001, *Herpetobotys* Maes, 2001, and *Cybalobotys* Maes, 2001. This new genus is also restricted to Africa and it contains three species. Based on the morphology of the male genitalia *Thivolleo albicervix* sp. n. and *T. xanthographa* (Hampson, 1913) are most closely related. They also both occur in the forested areas of Africa. The third species, *T. meruensis* sp. n. is more distant from the former two because of the rectangular uncus and the more elongated valva, but the general pattern of the male genitalia is identical. This third species is restricted to the drier areas of East Africa.

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Several museums were so kind to put material at my disposal and numerous collecting trips added to a better knowledge of the distribution patterns of this group.

This paper is the result of research on the Crambidae of Africa that has been ongoing for several years (Maes, 1996 a, b; 1997, a, b; 1998, 2000, 2001a, b, c; 2002a, b; 2003).

ABBREVIATIONS USED:

ABSRC	AgroBioSys Reference Collection, Wetteren, Belgium.
BMNH	The Natural History Museum, London, UK.
MHNG	Muséum d'histoire naturelle, Genève, Switzerland.
NMK	National Museums of Kenya, Nairobi, Kenya.
RMCA	Royal Museum for Central Africa, Tervuren, Belgium.

SYSTEMATIC PART

Thivolleo gen. n.

TYPE SPECIES: *Thivolleo albicervix* sp. n. Gender: feminine.

ETYMOLOGY: The genus is named after Mr. J-P. Thivolle, with whom I had the pleasure to share several expeditions in Africa.

DISTRIBUTION: Nigeria, Cameroon, Central African Republic, Democratic Republic of Congo, Uganda, Kenya, and Tanzania.

DIAGNOSIS: Characteristic white collar, tibia of fore legs and femur of middle legs; male genitalia with a strongly developed and elongate sella and editum near the central part of the valva; female genitalia with a cup-shaped ostium bursae.

DESCRIPTION:

Head: frons flat, slightly protruding, forming small transversal ridge; labial palps porrect, about as long as diameter of compound eye; maxillary palps above proboscis, clearly visible, densely scaled.

Wings: fore wing triangular, with R1 free, R2 and R3+4 very close and parallel for most of length, both arising before the upper angle of cell; R3 short, before termen; R4 ending in termen; R5 from upper angle of cell, parallel with M; M2 and M3 separated for some distance at base, both forming lower angle of cell; Cu1 before lower angle of cell; Cu2 parallel with Cu1; A1 present. Both sexes with retinaculum consisting of series of bristles near M-stem of cell, males with additional subcostal retinaculum; frenulum hook simple in males, triple in females; wingspan: 18-31mm.

Legs: males with enlarged femur, spurs: 0, 2, 4.

Tympanal organs deeply invaginated with well-developed saccus tympani; venula prima continuing in strongly sclerotized venula secunda, latter extending beyond edge of saccus tympani.

Male genitalia: uncus broad or narrow triangular with simple setae dorsally; dorsal part of tegumen with setae on both sides; vinculum V-shaped, saccus small, laterally with membranous extension of various size forming base for bunch of simple setae; valva distally dilated and rounded or terminally narrowing; editum directed towards juxta, consisting of series of modified, flattened, apically forked setae; sella in central part of valva, inner part forming base of editum, outer part strongly sclerotized and forming specific structure; both valvae connected by membranous transtilla; juxta V- or U-shaped, rather small; aedeagus tubular tube with larger part of vesica covered with minute, short spines; anellus with few setae.

Female genitalia: papillae anales membranous with short and long setae; length apophyses posteriores about half or about two thirds of apophyses anteriores; sinus vaginalis membranous without sclerotization; ostium bursae wide, cup-shaped, depth of cup specific; antrum V-shaped, rather small; ductus bursae turned just beneath the antrum, of moderate length; corpus bursae with small, rounded signum and well-developed appendix bursae.

LIFE CYCLE: unknown.

SYSTEMATIC POSITION: The genus is placed in the Pyraustinae because of the typical sella and editum in the male genitalia and the presence of an appendix bursae in the female genitalia. In male genitalia the genus shows some resemblance with the *Pronomis* Munroe & Mutuura, 1968, *Nomis* Motschulsky, [1861]1860 and *Paranomis* Munroe & Mutuura, 1968 group. The structure of the sella in *Thivolleo* is different; it is clearly separate from the editum. The female genitalia of *Pronomis-Nomis-Paranomis* group have the ductus bursae coiled near the corpus bursae close to the appendix bursae. The female genitalia of *Thivolleo* have no coil in the ductus bursae.

Thivolleo xanthographa (Hampson, 1913) comb.n. Figs 1 C, 3 B, 4 A.

Pionea xanthographa Hampson, 1913: 16

TYPE MATERIAL: Holotype ♀: Nigeria, Lagos, Pyr.Br.Mus.slide n° ♀17157 (BMNH).

ADDITIONAL MATERIAL EXAMINED: Democratic Republic of Congo: 1♂, 1♀ [D.R.C.] Kitobola 1911 Rovere, K.Maes Gen.Prep.nr.♂14292 & ♀14293 (RMCA).

DISTRIBUTION: Nigeria, Democratic Republic of Congo.

DIAGNOSIS: Overall colour straw-yellow; male genitalia with distinctive sella.

DESCRIPTION:

Head: frons slightly protruding; labial palps porrect, length about 1.5 times diameter of compound eye, base of first segment white, other segments concolourous with ground colour of fore wings; maxillary palps well developed, last segment covering base of proboscis.

Thorax and abdomen: white collar on ventral part of thorax; rest yellow as ground colour of fore wings; abdomen slightly paler yellow; colouration of fore legs as described for genus.

Wings (Fig. 1 C): ground colour straw-yellow with light brown antemedial and postmedial fascia; also with faint, slightly curved subterminal fascia in fore and hind wings; wingspan: 28 mm.

Male genitalia (Fig. 3 B): uncus short triangular, dorsally with simple setae; valva with editum consisting of flattened, terminally forked setae on large protrusion near base of valva, protrusion larger here than in the other two species; sella placed more outwards on valva, near the middle, consisting of numerous small spines and series of stronger ones on the inner part, the whole sclerotization is much smaller as in *T. albicervix* sp. n.; apical part valva rectangular; aedeagus short and thick, larger as in the other two species.

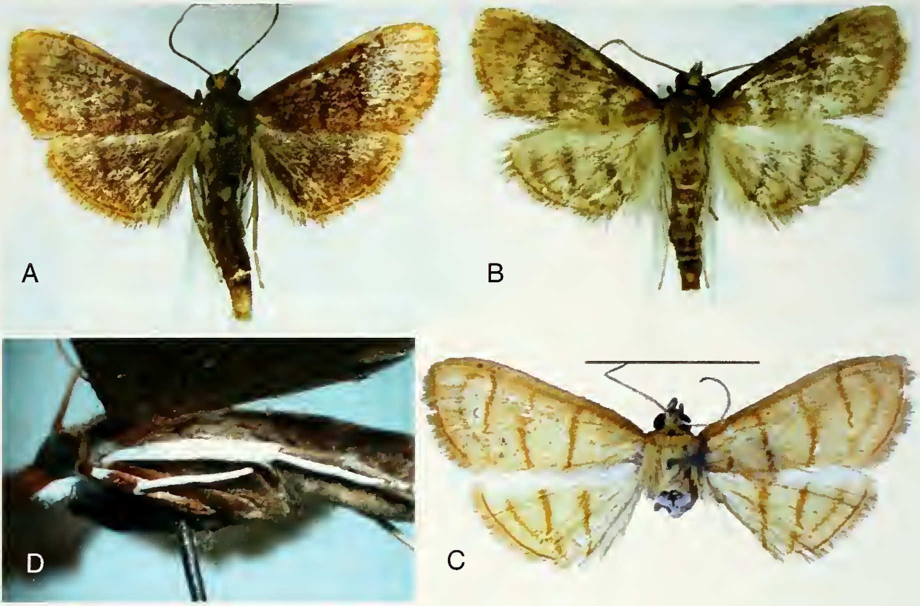

Fig. 1

Adults. (A) *Thivolleo albicervix* sp. n. Holotype. (B) *Thivolleo meruensis* sp. n. Paratype. (C) *Thivolleo xanthographa* (Hampson, 1913). (D) Lateral view adult moth *Thivolleo albicervix* sp. n. Scale: black bar equals 1 cm.

Female genitalia (Fig. 4 A): length apophyses posteriores about two thirds length of apophyses anteriores; ostium bursae wide, bulbous, antrum narrow, well sclerotized; ductus bursae starting narrow to widen immediately, almost as wide as corpus bursae.

Thivolleo albicervix sp.n. Figs 1 A, 2 A-D, 4B

TYPE MATERIAL: Holotype ♂: Cameroon, Centre, Yaoundé, Mt. Phébé 1070m, 6.vi.1993 (ABSRC); 28 Paratypes: 1♂: Cameroon, Centre, Yaoundé, Mt. Phébé 1070m, vi.1993 (ABSRC); 1♂: Cameroon, Center Prov., Batchenga, 19.vi.1993, K.Maes, (ABSRC); 1♂: Cameroon, Centre, Nkolbisson 16.xi.1992 K.Maes, K.Maes Gen.Prep.nr.♂591 (ABSRC); 1♂: Cameroon, Dschang, 1800m, 8.x.90 K.Maes (ABSRC); 3♂: Cameroon, Dschang, 18.viii.92, K.Maes (ABSRC); 3♂: Republic of Central Africa, Bangui, Chasseurs Africains, Collection Jacques Plante (MHNG); 1♂: Democratic Republic of Congo, Elisabethville, 25.xi.1949, Ch.Seydel (RMCA); 1♀: Uganda, Bw[a]mba, May 1956, R.Carcasson, K.Maes Gen.Prep. nr.♀20428 (NMK); 1♂: Uganda, Bwamba, Sept.1961, N.Mitton (NMK); 1♂: Uganda, Kibale Forest, Toro, May 1966, R.H.Carcasson (NMK); 1♂: Kenya: Kakamega Forest, W.Kenya 5000ft., June 1961, J.G.Williams (NMK); 5♂: Kenya, Kakamega, Rainforest Edge "Quarry" 0.17N34.47E, 1800m, Mercury Vapor Light, 7.v.1997, K.Maes (ABSRC); 1♂: ibidem, K.Maes Gen.Prep.nr.♂904 (ABSRC); 3♂: Kenya, Kakamega Forest, Rondo Retreat, ca 1700m, 5-8.v.1997, Réc. U.Dall.Asta (RMCA); 1♂:Kenya Kakamega Forest, 1575m, 00°19N 034°52'E, 31.iii.2003, Leg. J.& W. De Prins (RMCA); 1♂: Kenya, Western, Kakamega Forest, Rondo Retreat 00°13.38"N34°53'07"E, 1588m, Mercury Vapor Light, 26.viii.1999, K.Maes, K.Maes Gen.Prep.nr.♂909 (ABSRC); 1♀: ibidem, K.Maes Gen.Prep.nr.♀910 (ABSRC); 1♂: Tanzania, Kigoma, Kasekera, nov.1972, J.Kielland, K.Maes Gen.Prep.nr.♂903 (ABSRC).

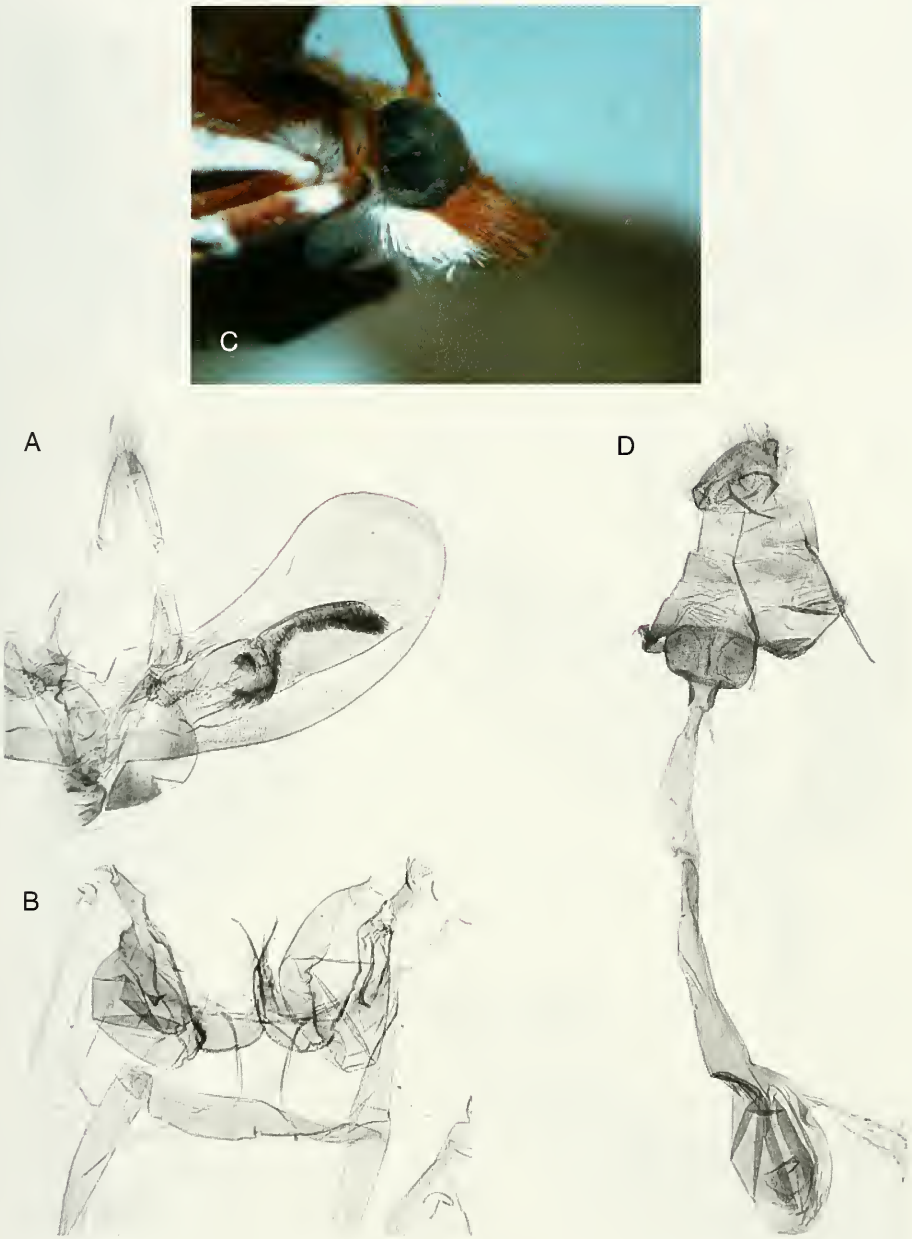

FIG. 2

Generic type: *Thivolleo albicervix* sp. n. (A) male genitalia with aedeagus illustrated underneath, K.Maes Gen.prep.nr.♂591. (B) tympanal organs, K.Maes Gen.Prep.nr.♂904. (C) lateral view head. (D) female genitalia, K.Maes Gen.Prep.nr.♀910.

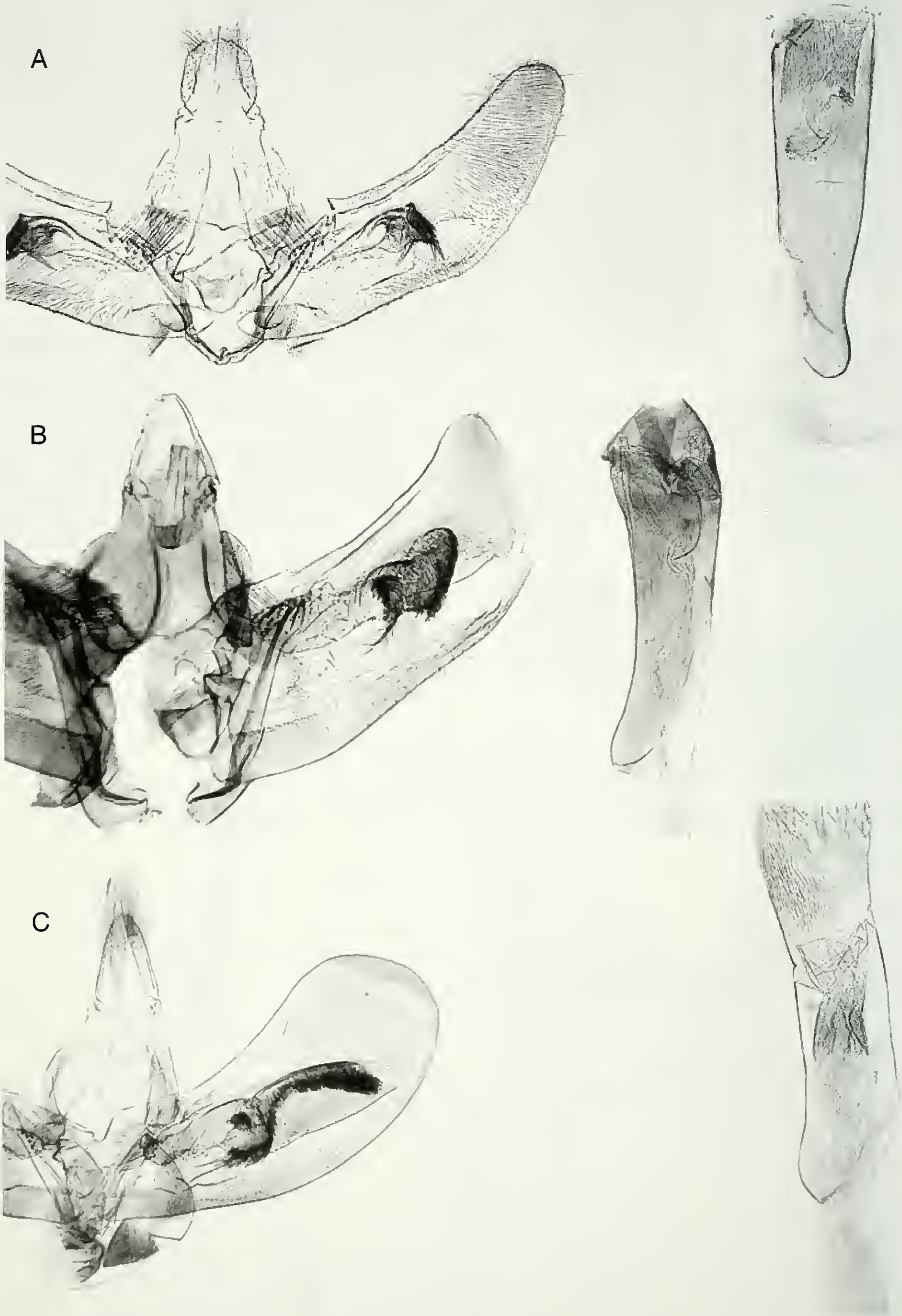

Fig. 3

Male genitalia. (A) *Thivolleo meruensis* Holotype. (B) *Thivolleo xanthographa* (Hampson, 1913). (C) *Thivolleo albicervix* Paratype K.Maes Gen.prep.nr.♂591

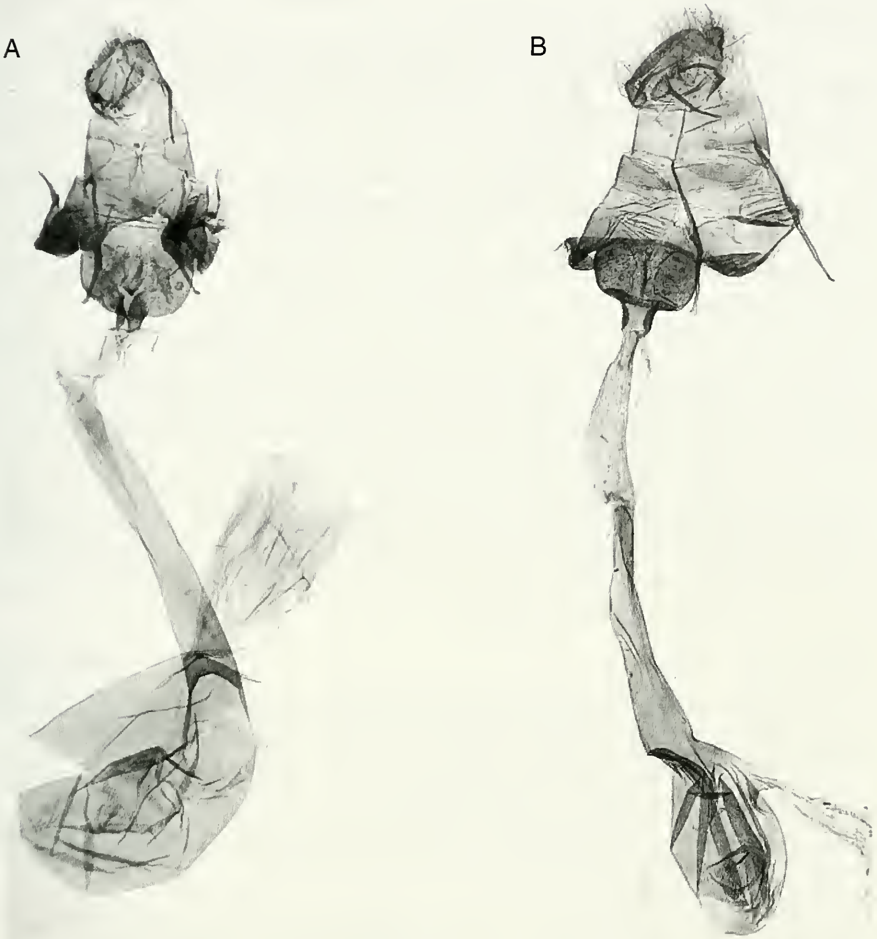

FIG. 4

Female genitalia. (A) *Thivolleo xanthographa* (Hampson, 1913) K.Maes Gen.prep.nr.♀14293. (B) *Thivolleo albicervix* Paratype K.Maes Gen.Prep.nr.♀910.

ETYMOLOGY: The name is derived from the latin "*album-i*" (white) and "*cervix*" (neck) and refers to the characteristic white part of the ventral part of the collar.

DISTRIBUTION: Cameroon, Central African Republic, Democratic Republic of Congo, Uganda, Kenya and Tanzania.

DIAGNOSIS: Labial palps porrect but rather short. Male genitalia with characteristic sella and editum (Fig. 2 A).

DESCRIPTION:

Head: frons brown, laterally delimited by some yellow scales; labial palps porrect but rather short, base of first segment of labial palps white, other segments brown.

Thorax and abdomen: brown as fore and hind wings; ventral part of collar and dorsal side of femur of middle legs white.

Wings (Fig.1 A): fore and hind wings brown to dark brown with faint ante- and postmedial fascia; usually with clearly visible dentate subterminal fascia; subterminal area usually light brown and suffused with yellow scales or even clearly yellow; fringe in most specimens yellow; wingspan: 23-31 mm.

Male genitalia (Fig 2 A): uncus more narrow triangular as in other two species; dorsally with some simple setae; vinculum broad V-shaped, saccus small, laterally with a membranous extension which serves as a base for a bunch of simple setae; valva distally dilated and rounded; editum directed towards the juxta, consisting of a series of modified, flattened, terminally forked setae; sella elongated and covering most of the central part of the valva, inner part forming the base of the editum, outer part extending towards the apex of the valva and a hook-shaped middle part; outer part carries on its ventral side numerous short spines; middle part carries bunch of short spines on its dorsal side and large series of more elongated longer spines on its ventral side; valva apically widened and rounded; juxta V-shaped, rather small.

Female genitala (Fig. 4 B): papillae anales membranous with short and long setae; length apophyses posteriores about half the length of apophyses anteriores; sinus vaginalis membranous without any sclerotizations; ostium bursae wide, cup-shaped, much shallower as in *T. xanthographa*; corpus bursae with a small, rounded signum and a well developed appendix bursae.

Thivolleo meruensis sp.n. Figs 1 B, 3 A.

TYPE MATERIAL: Holotype ♂: KENYA, Eastern Prov., Meru N.P., Bwatherongi Camp Site, 00°09'57.9"N. 38°12'27.4"E., 620m., Black/MV lights, 30 to 31-XII-2001. K.Maes & A.Powys, K.Maes Gen.prep.nr.♂953 (ABSRC).

4 Paratypes: 3♂: same data as holotype (1 NMK, 1 ABSRC, 1 RMCA); 1♂: same data as holotype except 30-XII-2001, K.Maes (ABSRC).

ETYMOLOGY: The name is derived of the type locality: Meru National Park in Eastern Kenya.

DISTRIBUTION: Kenya.

DIAGNOSIS: Male genitalia with sella bearing two large strongly sclerotized spines.

DESCRIPTION:

Head: labial palps porrect, length about two times diameter of compound eye; maxillary palps long, covering base of proboscis.

Thorax and abdomen: concolourous with fore wings; abdomen rather dark, each segment apically with pale band.

Wings (Fig. 1 B): fore wings triangular, somewhat rounded at apex; ground colour grey- brown, fore wing darker than hind wing, latter more yellow with clearly distinguishable ante- and postmedian lines; wingspan: 18-19mm.

Male genitalia (Fig. 3 A): uncus rectangular, dorsally with simple setae; valva long and slender; sella strongly sclerotized with two prominent inwards directed large spines and some smaller spines on ventral side of sclerotization; juxta U-shaped; aedeagus short with some minute spines on vesica.

Female genitalia: unknown.

KEY FOR THE SPECIES OF *THIVOLLEO*

The key is based on external characters and the male genitalia. Female genitalia are not included since they are not known for *T. meruensis* sp. n.

1 Ground colour straw-yellow, male genitalia with apical part valva rectangular . . . . *T. xanthographa* (Hampson, 1913)
\- Ground colour brown, apical part valva rounded 2
2 Wingspan 18-19 mm, apical part valva narrow, elongated and apically rounded . . . . *T. meruensis* sp.n.
\- Wingspan 23-31 mm, apical part valva widened, rounded . . . *T. albicervix* sp.n.

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I wish to thank the staff of the National Museums of Kenya, Dr B. Landry from the Muséum d'histoire naturelle in Geneva, Dr M. De Meyer and Dr U. Dall'Asta from The Royal Museum for Central Africa for putting material at my disposal. For years the staff of the Microlepidoptera section, The Natural History Museum, London, have assisted me with the loan of material and literature. Again, thanks. This paper results research finalized during a project funded by DWTC (Federale Diensten voor Wetenschappelijke, Technische en Culturele Aangelegenheden), Belgium.

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New species and records of *Phlegra* from Africa (Araneae, Salticidae)

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New species and records of *Phlegra* from Africa (Araneae, Salticidae). - Six poorly known species of *Phlegra* from Africa are diagnosed, figured and redescribed: *P. lugubris* Berland & Millot, 1941; *P. nuda* Próchniewicz & Hęciak, 1994; *P. pusilla* Wesołowska & van Harten, 1994; *P. soudanica* Berland & Millot, 1941; *P. trifoveolata* Lessert, 1927; and *P. tristis* Lessert, 1927. New records from the Mediterranean and Africa, and taxonomic comments on *Phlegra bresnieri* (Lucas, 1846) are provided. *Phlegra lugubris* var. *senegalensis* Berland & Millot, 1941 and *P. tuzetae* Berland & Millot, 1941 are synonymized with *Phlegra lugubris* Berland & Millot, 1941. The ♀ lectotype is designated for *Phlegra tristis* Lessert, 1927. Three new species are described: *Phlegra etosha* sp. n. (♂; Namibia); *P. gagnoa* sp. n. (♂; Ivory Coast); and *P. touba* sp. n. (♂ ♀; Ivory Coast).

Keywords: Jumping spiders - synonymy - lectotype designation - (re)descriptions.

INTRODUCTION

The genus *Phlegra* Simon, 1876 comprises 70 described species, mostly distributed in the Palaearctic and Afrotropical Regions (Platnick, 2006). Although the Palaearctic species of *Phlegra* have been studied reasonably well (see Logunov, 1996; Azarkina, 2003), except for the *bresnieri* species group and some species from the W. Mediterranean, those of Africa remain poorly known. Many of the African species are only known from old descriptions of single sexes. Taxonomic data on the Afrotropical *Phlegra* species can be found in Lessert (1927), Berland & Millot (1941), Próchniewicz & Hęciak (1994), Wesołowska & van Harten (1994), Wesołowska & Russell-Smith (2000), and a few other works.

The aims of the present work are (1) to re-examine type material of *Phlegra* from some museums and (2) to describe newly collected species from the private collection of Dr A. Russell-Smith. In total, ten species are treated in this paper.

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MATERIAL AND METHODS

Specimens for this study were borrowed from the following museums and personal collection: HECO = Hope Entomological Collection, Oxford, UK (Mr J. Hogan); MEUU = Museum of Evolution of the Uppsala University, Sweden (Dr M. Eriksson); MHNG = Museum d'histoire naturelle, Genève, Switzerland (Dr P. Schwendinger); MNHN = Muséum National d'Histoire Naturelle, Paris, France (Dr C. Rollard and Ms E.-A. Leguin); PCRS = Personal collection of Dr Anthony Russell-Smith (Kent, UK); SMF = Naturmuseum und Forschungsinstitut Senckenberg, Frankfurt am Main, Germany (Dr P. Jäger). Type specimens of the new species are deposited at the MHNG.

Abbreviation used in the text: AME = anterior median eye, ap = apical, D = description of, Fm = femur, Mt = metatarsus, nr. = near, PLE = posterior lateral eye, pr = prolateral, Pt = patella, rt = retrolateral, Tb = tibia, v = ventral. For the leg spination the system adopted is that used by Ono (1988). The term 'fossa(e)' is adopted from Davies & Żabka (1989) and means the single or paired epigynal indentation(s) within which the copulatory openings are situated. The sequence of leg segments in measurement data is as follows: femur + patella + tibia + metatarsus + tarsus. In all cases, the described colouration refers to the specimens preserved in alcohol. All measurements are in mm.

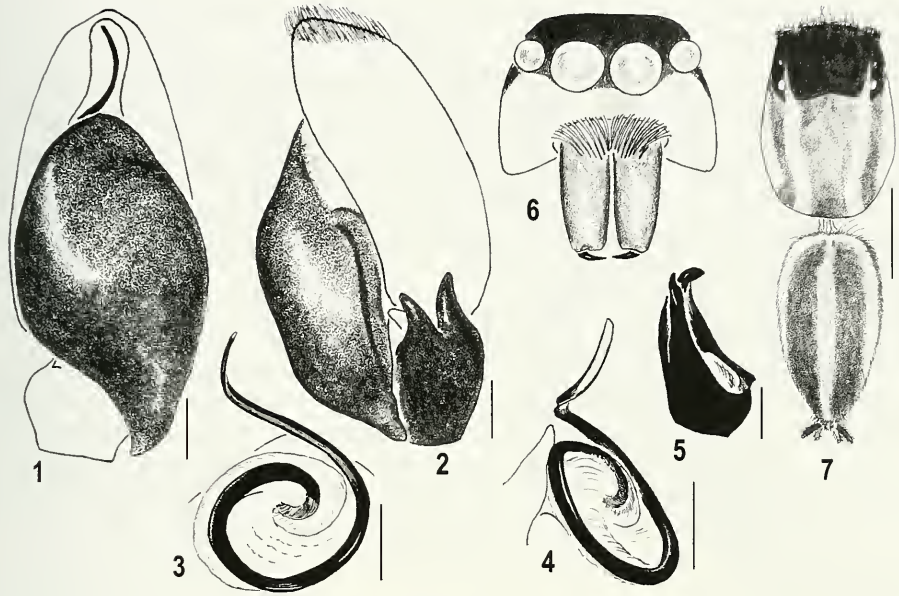
DESCRIPTIONS

Phlegra bresnieri (Lucas, 1846) Figs 1-7

A complete set of references is given in Platnick (2006).

Material examined: CROATIA. 1 ♂ (SMF), 'NE Istrien, 10 km n. Pazin, Nordufer Butoniga Jezebo, bei Vrh. Wegeböschung im Kulturland', 28.04.2003, J. Altmann & J. Meier. – ITALY. 1 ♀ (SMF), Sicily, Liparian Islands (Volcano Isld.), NW-slope of volcano, volcanic ashes and rocks, very dry, little grass and yellow Leguminosa (under stones), 5 m a.s.l., 20.04.1957, H. Kahmann; 2 ♂ (SMF), Sicily, c. 2.5 km E of Castelbuono, stony E-slope, slightly damp thin grass, *Matricaria* and *Biscutella* (under stones), 31.03.1957, H. Kahmann; 1 ♂ (SMF), Sardinia (W part), Camp of Riola Sardo, olive trees with grass, sheep pasture and slightly moist grass, 7.04.1956, H. Kahmann; 1 ♂ (SMF), Sardinia (SW part), S of Gonnosfanadiga, steep E-slope, cultivated land, alive and almond trees, with grass *Euphorbia* and *Cirsium* (under granite rocks), 6.04.1956, H. Kahmann; 1 ♂ (SMF), Sardinia (W part), c. 2 km N of Cuglieri (N-slope), 420 m a.s.l., stony pastures with stonewalls, *Rubus fruticosus*, *Juniperus communis* (under stones), 13.04.1956, H. Kahmann; 1 ♂ (SMF), Sardinia (SW part), NW of Riola Sardo, Sale Porcus, marshy grassland with *Cirisium* (under stones), 10.04.1956, H. Kahmann; 1 ♂ (SMF), Archipelago Toscano, Isola di Capraia, 25.09.1955, coll.?; 1 ♂ (SMF), 'Pianosa', 21.04.1955, coll.?. – SPAIN. 7 ♂ 10 ♀ (SMF), 200-250 km SW of Madrid, Extremadura (= Estremadura), 'El-Baldio', summer 1996, P. Jäger. – PORTUGAL. 3 ♀ (HECO, bottle 2166), Lisbon. – IVORY COAST. 1 ♂ (PCRS), 'West African Rice Development Association', Mbé, nr. Bouaké (07°52'N, 05°06'W), upland rice field (pitfall traps), 22 July 1994, A. Russell-Smith. – TUNISIA. 2 ♂ 1 ♀ (SMF), NE Tindja, olive grove, dense grass with *Lycnis viscaria*, *Cirisium* and *Asphodelus* (under stones and in litter), 9.04.1959, H. Kahmann; 1 ♂ (SMF), El Houaria, Macchie with *Cistus*, *Pistacia* and *Colycotome*, slightly moist sand (under stones), 29.03.1959, H. Kahmann; 1 ♀ (MHNG), nr. Kef, July 1972, E. & C. Supper.

Comments: The taxonomy and distribution of *P. bresnieri* remains poorly understood, as a great number of very similar, poorly diagnosed species, sometimes described after single females (e.g. *P. amitaii*), have been reported to date. Generally



FIGS 1-7

Phlegra bresnieri (Lucas, 1846) (Ivory Coast: Bouaké). (1) Male palp, ventral view. (2) Ditto, prolateral view. (3) Embolus, dorsal view. (4) Ditto, lateral view. (5) Tibial apophysis, dorsal view. (6) Colour pattern of male face, frontal view. (7) Male, general appearance, dorsal view. Scale lines: 0.1 mm (1-5), 1 mm (7).

speaking, the *bresnieri* species group contains species of two types: those with males having the clypeus densely covered with white hairs (*P. bresnieri*, *P. lineata*, *P. pisarskii*, etc.), and those with males having a 'naked' clypeus (*P. albostriata*, *P. particeps*, etc.). Unfortunately, the entire *bresnieri* species group needs a thorough critical revision before any of its species can be reliably identified.

According to Metzner (1999), *P. bresnieri* is closely related to *P. lineata* (C. L. Koch, 1848) and can be separated from it by the male coloration, viz. by the absence of two longitudinal stripes on the eye field, and by tiny differences in the arrangement of spermathecal loops in females. It remains uncertain though, how the latter author identified both species, as he did not re-examine any type material. However, most authors agree with Metzner's diagnosis, which is therefore followed in the present work.

The 'Material examined' given above includes only those records that certainly belong to *P. bresnieri* (*sensu* Metzner, 1999). Thus, the male from Ivory Coast, figured and described below, is certainly conspecific with specimens from the Mediterranean and seems to represent the most south-western locality for this species. *P. bresnieri* has once been recorded from N.E. Tanzania (Wesołowska & Russell-Smith, 2000), but the description of the male by these authors contains no reference to the white haired clypeus. Therefore, we suspect that Wesołowska & Russell-Smith (2000) actually dealt with *P. albostriata* Simon, 1901, known from E and S Africa (see Lessert, 1936). We have re-examined Lessert's specimens (1 ♂ 1 ♀; kept in the MHNG) and found that the ♂ has a brownish, 'naked' clypeus.

DESCRIPTION: MALE (from Ivory Coast, nr. Bouaké). *Measurements*. Carapace 2.3 long, 1.2 wide, 0.9 high at PLE. Ocular area 0.9 long, 1.2 wide anteriorly and 1.2 wide posteriorly. Diameter of AME 0.4. Abdomen 2.2 long, 1.2 wide. Chelicera length 0.9. Clypeus height 0.2. Length of leg segments: I 1.3+0.7+0.8+0.6+0.5; II 1.2+0.6+0.8+0.6+0.5; III 1.4+0.7+0.8+0.8+0.5; IV 1.6+0.7+1.2+1.3+0.6. *Leg spination*. Leg I: Fm d 1-1-3; Tb pr 1-1, v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-4; Tb pr 1-1, v 1-1-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-1-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr and rt 1-0-2, v 0-2-2ap. Leg IV: Fm d 1-1-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2ap. *Coloration*. Carapace dark brown, with black eye field and two wide, white longitudinal stripes (Fig. 7). Clypeus and 'cheeks' yellow, both densely covered with white hairs (Fig. 6). Chelicerae light brown. Sternum dark brown. Abdomen dark brown, its dorsum dark brown, without a scutum, but with a median yellow stripe and two white lateral stripes. Book-lung covers brownish, spinnerets dark brown. Palps dark brown, covered with black hairs. Palpal structure as in Figs 1-5.

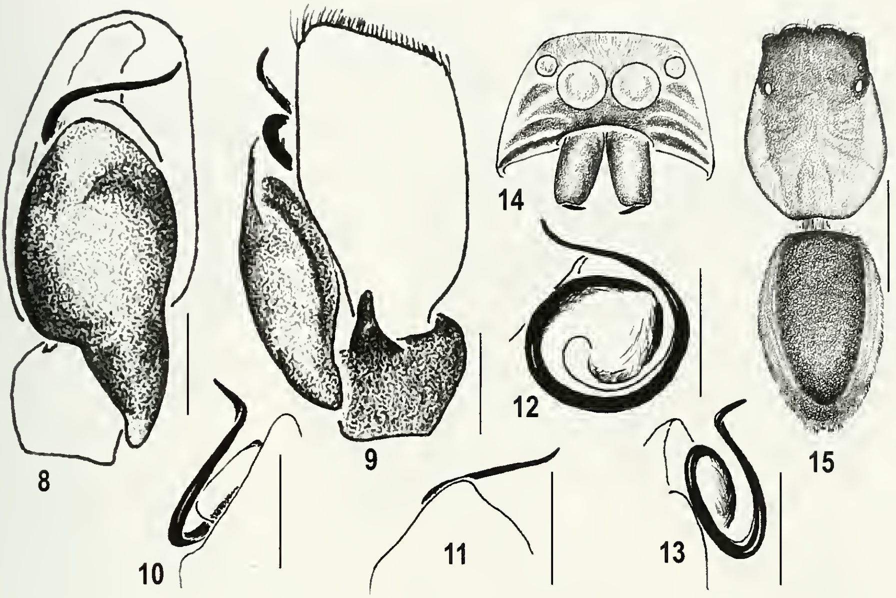
Phlegra etosha **sp. n.** Figs 8-15

TYPES: Holotype ♂ (MHNG) from Namibia, Etosha National Park, Natukanaoka (18°35'N, 15°39'E), shrubby *Mopane* savanna (pitfall traps), March 1997, A. Russell-Smith. – Paratypes: 2 ♂ (MHNG), collected together with the holotype.

ETYMOLOGY: The specific name is used as a noun in apposition referring to the type locality, viz. Etosha National Park in Namibia.

DIAGNOSIS: This species is unique among the described *Phlegra* species known to us, as the male possesses a single tibial apophysis (Fig. 9) and the diagnostic face colour pattern consists of transverse lines of white scales (Fig. 14). The embolus is filiform and coiled (Figs 10, 12, 13) as in the other members of the *bresnieri* species group (*sensu* Logunov, 1996).

DESCRIPTION: MALE (the paratype). *Measurements*. Carapace 1.7 long, 1.2 wide, 0.6 high at PLE. Ocular area 0.6 long, 0.9 wide anteriorly and 0.9 wide posteriorly. Diameter of AME 0.2. Abdomen 1.8 long, 1.1 wide. Chelicera length 0.5. Clypeus height 0.1. Length of leg segments: I 0.8+0.4+0.5+0.4+0.4; II 0.7+0.4+0.4+0.3+0.3; III 0.9+0.3+0.6+0.6+0.4; IV 1.1+0.5+0.8+0.8+0.6. *Leg spination*. Leg I: Fm d 1-1-3; Tb pr 1-1, v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-3; Tb pr 1-1, v 1-1-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-2-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr 1-1-1, rt 0-1-1, v 1-0-2ap; Mt d 0-1-0, pr and rt 1-0-2, v 2-2ap. Leg IV: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2ap. *Coloration*. Carapace brown, with dark brown eye field and sides covered with white hairs, the thorax region with a wide longitudinal band of brownish scales. Clypeus, 'cheeks' and chelicerae brown, with three narrow, transverse lines of white hairs on each 'cheek' (Fig. 14). Sternum yellow-brown. Abdomen: dorsum grey-brown, with dark brown scutum covering 4/5 of its length (Fig. 15); venter yellow to grey-yellow. Book-lung covers yellow-brown, spinnerets dark brown. Legs I and II



FIGS 8-15

Phlegra etosha sp. n. (♂ paratype). (8) Male palp, ventral view. (9) Ditto, prolateral view. (10) Embolus, median view. (11) Ditto, ventral view. (12) Ditto, dorsal view. (13) Ditto, lateral view. (14) Colour pattern of male face, frontal view. (15) Male, general appearance, dorsal view. Scale lines: 0.1 mm (8-13), 1 mm (15).

brown, with dark brown femora, patellae, tibiae and metatarsi. Legs III and IV yellow-brown. Palps dark brown, covered with black hairs. Palpal structure as in Figs 8-13; the male bulbus is slightly expanded because the specimens studied were collected by pitfall traps. FEMALE unknown.

DISTRIBUTION: Known from the type locality only.

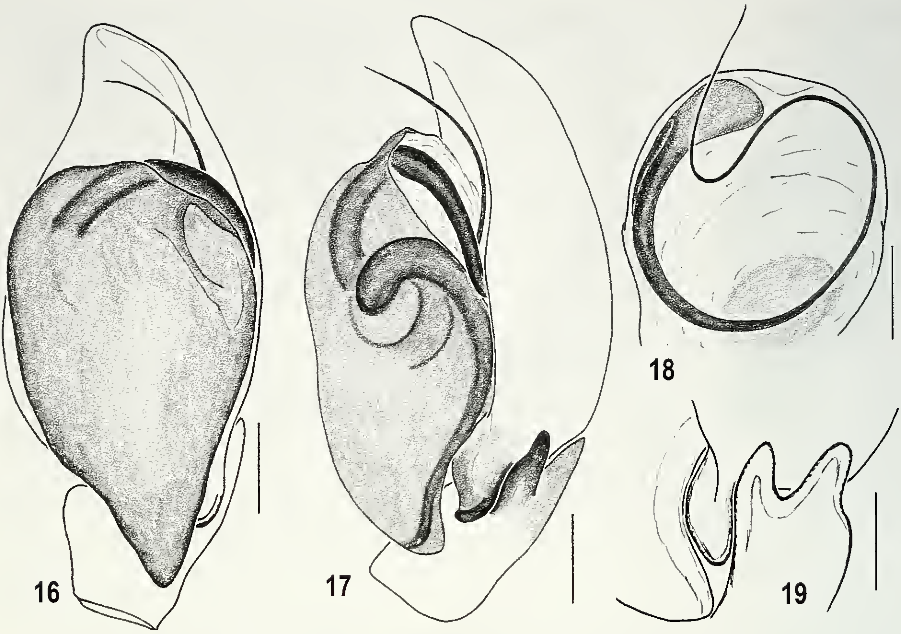
***Phlegra gagnoa* sp. n.** Figs 16-19

TYPES: Holotype ♂ (MHNG) from Ivory Coast, nr. Gagnoa (06°08'N, 05°56'W), upland rice field (pitfall traps), 26-30 March 1995, A. Russell-Smith.

ETYMOLOGY: The specific name is used as a noun in apposition referring to the type locality, Gagnoa in Ivory Coast.

DIAGNOSIS: This species is easily separable from all described *Phlegra* species known to us in having a long thin, S-shaped embolus (Fig. 18). This conformation has never been observed in other *Phlegra* species.

DESCRIPTION: MALE (the holotype). *Measurements*. Carapace 1.5 long, 1.1 wide, 0.7 high at PLE. Ocular area 0.7 long, 0.9 wide anteriorly and 0.9 wide posteriorly. Diameter of AME 0.3. Abdomen 1.4 long, 0.9 wide. Chelicera length 0.4. Clypeus height 0.1. Length of leg segments: I 0.8+0.4+0.4+0.3+0.3; II 0.7+0.4+0.3+0.3+0.3; III 0.9+0.4+0.5+0.6+0.3; IV 1.1+0.4+0.7+0.8+0.4. Leg



Figs 16-19

Phlegra gagnoa sp. n. (♂ holotype). (16) Male palp, ventral view. (17) Ditto, prolateral view. (18) Embolus, dorsal view. (19) Tibial apophysis, prolateral view. Scale lines: 0.1 mm.

spination. Leg I: Fm d 0-1-1-3; Tb pr 0-1, v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 0-1-1-4; Pt pr 0-1-0, Tb pr 1-1, v 1-1-2ap; Mt pr 1-1ap, rt 1ap, v 2-2ap. Leg III: Fm d 0-1-1-3; Pt pr and rt 0-1-0; Tb pr and rt 1-1-1, v 1-2ap; Mt pr 1-2ap, rt and v 1-1-2ap. Leg IV: Fm d 0-1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-0-2ap; Mt pr and rt 1-1-2ap, v 2-2ap. *Coloration*. Carapace yellow brownish, eye field black; the thorax region with two longitudinal yellow stripes and dark brown area in between them. Sternum, maxillae, labium and chelicerae yellow. Clypeus yellow, densely covered with pale white (almost transparent) hairs. Abdomen: dorsum grey-brown, with large scutum; sides grey, venter yellow. Book-lung covers yellow, spinnerets grey. All legs yellow. Palps: femora yellow, the remaining segments and parts of the bulbus brownish. Palpal structure as in Figs 16-19. FEMALE unknown.

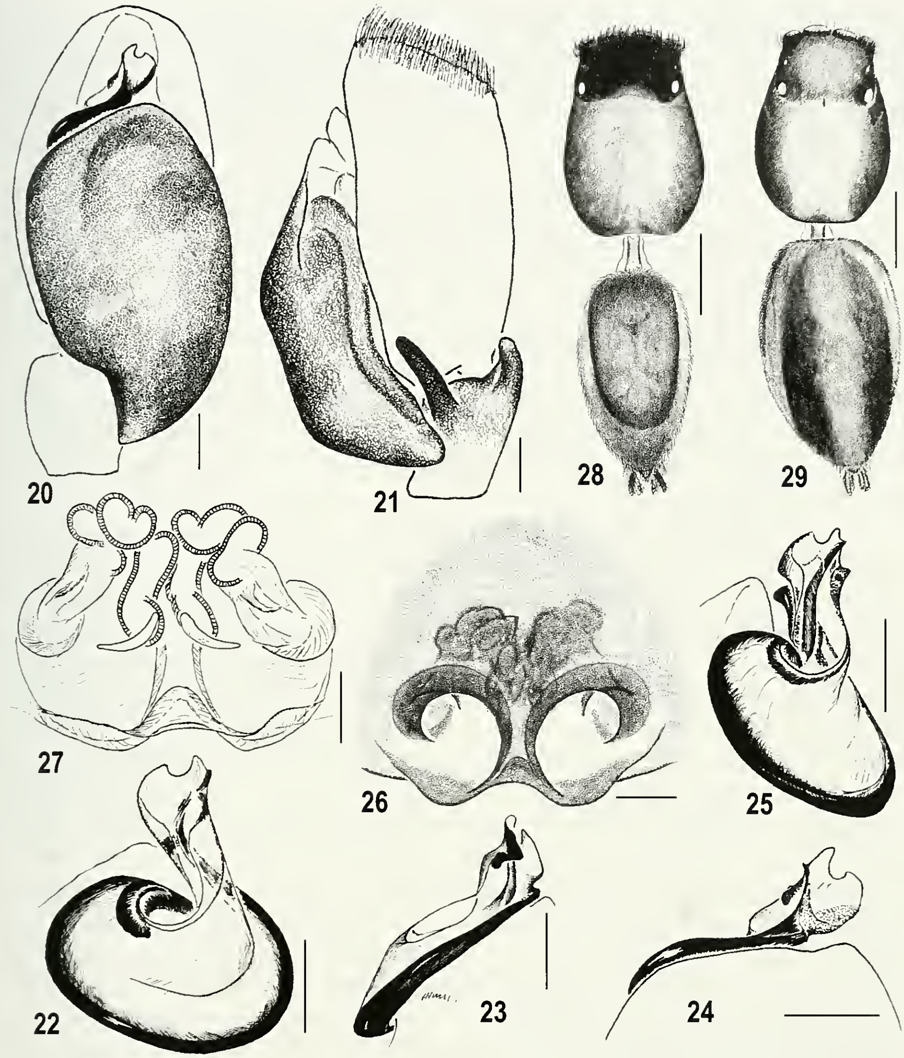
DISTRIBUTION: Known from the type locality only.

Phlegra lugubris Berland & Millot, 1941 Figs 20-29, 56, 57, 75

Phlegra lugubris Berland & Millot, 1941: 310, figs 12A-C (D♂; ♂ holotype not found in MNHN and not examined).

Phlegra lugubris var. senegalensis Berland & Millot, 1941: 310-311 (D♂; ♂ holotype in MNHN, examined). **New synonymy**.

Phlegra tuzetae Berland & Millot, 1941: 312, figs 13D,C (D♀; ♀ holotype in MNHN, examined). **New synonymy**.



Figs 20-29

Phlegra lugubris Berland & Millot, 1941 (♂ from Ivory Coast: Touba, ♀ from Senegal: Thyssé region). (20) Male palp, ventral view. (21) Ditto, prolateral view. (22) Embolus, dorsal view. (23) Ditto, median view. (24) Ditto, ventral view. (25) Ditto, lateral view. (26) Epigyne, ventral view. (27) Spermathecae, dorsal view. (28) Male, general appearance, dorsal view. (29) Female, general appearance, dorsal view. Scale lines: 0.1mm (20-27), 1 mm (28-29).

TYPES: Holotype ♂ of *lugubris var. senegalensis* Berland & Millot, 1941 (MNHN, 2381-2, without both palps) from Senegal, Dakar, July 1937, J. Millot [although Berland & Millot (1941: p. 311) reported that the ♂ holotype was collected in August, the original label contains the reference to July]. – Holotype ♀ of *P. tuzetae* Berland & Millot, 1941 (MNHN, 2381-2) from Guinea, Kouroussa, August 1937, J. Millot; see Figs 56, 57.

OTHER MATERIAL EXAMINED: IVORY COAST. 1 ♂ 2 ♀ (MHNG), nr. Touba (08°17'N, 05°56'W), upland rice field (pitfall traps), 15-18 October 1994, A. Russell-Smith; 2 ♂ 1 ♀ (PCRS), 'West African Rice Development Association', Mbé, nr. Bouaké (07°52'N, 05°06'W), upland rice field, 22-29 July 1994, A. Russell-Smith. – SENEGAL. 1 ♂ (PCRS), Kolda, Haute Casamance (12°49'N, 14°53'W), litter in 15 yr. old fallow, 19 August 1993, A. Russell-Smith; 1 ♀ (PCRS), Thyssé region, Ngayère classified forest (13°40'N, 15°35'W), degraded forest, 24 July 1996, A. Russell-Smith.

DIAGNOSIS: This species belongs to the *fasciata* group (*sensu* Logunov, 1996) and seems to be most similar to *P. yaelae* Prószyński, 1998 from Tunisia and Israel (Azarkina, 2003; Prószyński, 2003). The males of *P. lugubris* differ from those of the latter species in having comparatively narrower and longer lateral tibial apophyses (compare Fig. 21 with fig. 115 in Azarkina, 2003) and in the longer and slender embolus (compare Figs 22, 23 with fig. 117 in Azarkina, 2003). The females of *P. lugubris* have a narrower median septum of the epigyne and a clearly different conformation of the spermathecae (compare Figs 26, 27, 56, 57 with figs 30-33 in Prószyński, 1998, or figs 536-538 in Prószyński, 2003). See also 'Diagnoses' of *P. soudanica*, *P. touba* sp. n. and *P. tristis*.

COMMENTS: *P. lugubris* was described by Berland & Millot (1941) from a single male from Ivory Coast (no exact locality). Although we have been unable to re-examine the male holotype of this species, which was not found in the MNHN (E.-A. Leguin, pers. comm.), this species is characterized by a rather peculiar conformation of the male palp, viz. by the long lateral tibial apophysis and the massive membrabous embolus (Figs 20-25). Both characters are clearly shown by Berland & Millot (1941: figs 12A-C) and therefore we are sure that our identification is correct.

In the same work, Berland & Millot (1941) described *P. lugubris* var. *senegalensis* (1 ♂; Senegal) and *P. tuzetae* (1 ♀; Guinea; Figs 56, 57). The subspecies *P. l. senegalensis* showed no differences in the male palp from that of *P. lugubris*, as the authors admitted themselves (Berland & Millot, 1941: p. 311), but only minor dissimilarities in the distance between PLEs and in the poorly marked stripes of the abdomen. We doubt the taxonomic significance of either character in this case because all described *Phlegra* species are known to be quite variable regarding both coloration and structure of the copulatory organs (see Logunov, 1996; Azarkina, 2003). Furthermore, examination of newly collected samples, in which both sexes were present together, leaves no doubt that the female of *P. tuzetae* (Figs 56, 57) is clearly conspecific with the male of *P. lugubris* (Figs 26, 27). Thus, both. *P. lugubris* var. *senegalensis* and *P. tuzetae* should be treated as junior synonyms of *P. lugubris*.

DESCRIPTION: MALE (from Ivory Coast, Touba). *Measurements*. Carapace 2.6 long, 1.7 wide, 1.1 high at PLE. Ocular area 0.9 long, 1.3 wide anteriorly and 1.3 wide posteriorly. Diameter of AME 0.5. Abdomen 2.3 long, 1.4 wide. Chelicera length 0.9. Clypeus height 0.2. Length of leg segments: I 1.2+0.8+0.9+0.5+0.5; II 1.2+0.6+0.7+0.5+0.5; III 1.4+0.7+0.8+1.0+0.6; IV 1.8+0.8+1.4+1.4+0.7. *Leg spination*. Leg I: Fm d 1-1-4; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-4; Tb pr 1-1, v 1-1-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-2-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1-1, v 1-0-2ap; Mt d 1-1-0, pr and rt 1-0-2, v 2-2ap. Leg IV: Fm d 1-1-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v

1-1-2ap. *Coloration.* Carapace dark brown, with black eye field. Clypeus, 'cheeks' and chelicerae brown. Clypeus with a row of black bristles. Sternum light brown. Abdomen yellow-grey, with dark brown scutum (covering 4/5 of abdomen length) (Fig. 28). Book-lung covers yellow-grey, spinnerets dark brown. Palps brown, covered with black hairs. Palpal structures as in Figs 20-25, 71.

FEMALE (from Ivory Coast, Touba, but coloration also from the ♀ from Senegal, Thyssé region). *Measurements.* Carapace 2.7, long, 1.8 wide, 1.2 high at PLE. Ocular area 1.1 long, 1.3 wide anteriorly and 1.4 wide posteriorly. Diameter of AME 0.5. Abdomen 3.2 long, 1.8 wide. Chelicera length 0.9. Clypeus height 0.2. Length of leg segments: I 1.2+0.8+0.8+0.5+0.4; II 1.1+0.7+0.6+0.4+0.4; III 1.2+0.7+0.8+0.9+0.6; IV 1.8+0.9+1.3+1.4+0.8. *Leg spination.* Leg I: Fm d 1-1-3; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-3; Tb pr 0-1, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 1-2-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr 1-1-1, rt 0-1-1 or 1-1-1, v 1-0-2ap; Mt d 0-1-0 or 1-1-0, pr and rt 1-0-2, v 2-2. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr and 1-1-2, v 1-1-2ap. *Coloration.* Carapace dark brown, with black eye field, sometimes with two poorly visible white stripes running from AMEs to the rear end of carapace. Clypeus dark brown, 'cheeks' and chelicerae brown. Sternum brown. Abdomen grey, dorsum dark brown, with a median, longitudinal grey stripe and two grey-yellow stripes (Fig. 29). Book-lung covers grey brownish to brownish, spinnerets dark brown. Legs mostly brown, but patellae and tibiae I, as well as femora of all legs, dark brown. In some specimens legs I and II darker than III and IV. Palps yellow, covered with white hairs. Epigyne and spermathecae as in Figs 26, 27, 56, 57.

DISTRIBUTION: Ivory Coast (Touba and Bouaké), Senegal (Dakar, Kolda and Thyssé region), Guinea, (Kouroussa) (Berland & Millot, 1941: sub *P. lugubris* and *P. tuzetae*; present data) and Ghana (Bolgatanga) (Prószyński, 2005).

***Phlegra nuda* Próchniewicz & Hęciak, 1994** Figs 30-40

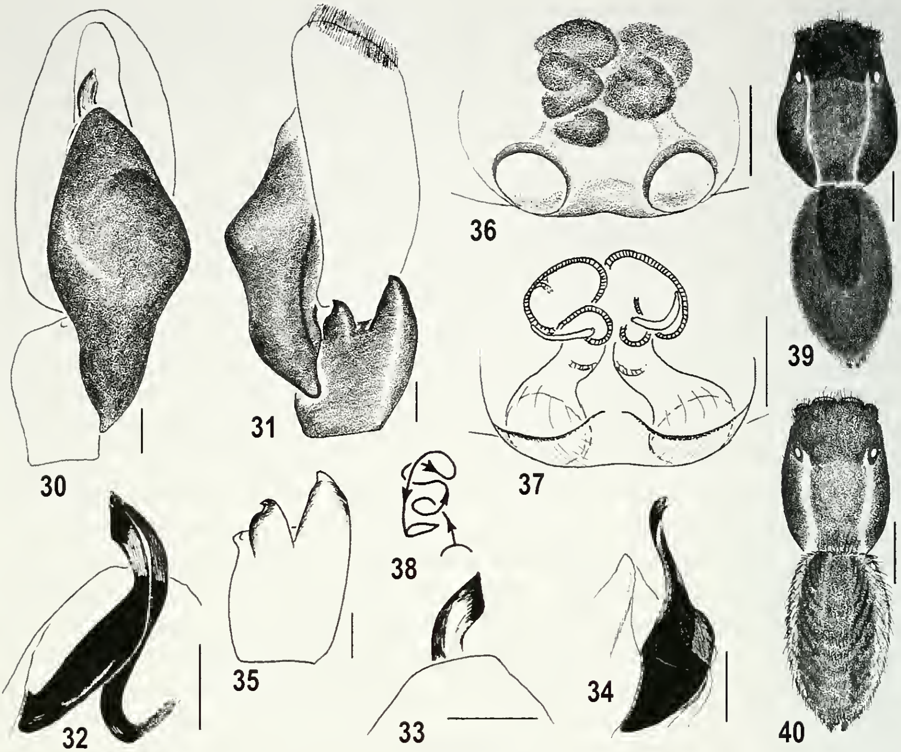
Phlegra nuda Próchniewicz & Hęciak, 1994: 37-39, figs 6a-f (D♂; ♂ holotype in MEUU; examined).

TYPES: Holotype ♂ of *Phlegra nuda* Próchniewicz & Hęciak, 1994 (MEUU) from Kenya, Cherangani, Kapolet Forest, 1960 m a.s.l., 24 January 1986, Å. Holm.

OTHER MATERIAL EXAMINED: UGANDA. 1 ♂ 1 ♀ (MHNG) from Uganda, Kampala, Fairview Hotel (00°19'N, 32°35'E), wall of building, 11 March 2001, A. Russell-Smith; 1 ♂ (PCRS), Iganga, Ikulwe Farm Center (00°26'N, 33°28'E), in long grass, 23 October 1998, A. Russell-Smith.

DIAGNOSIS: This species belongs to the *fasciata* species group (*sensu* Logunov, 1996), but differs from other congeners in having a wide embolic base, a flat, slightly bent, embolic tip (Figs 32, 34) and the lateral tibial apophysis notched at its tip (Fig. 35) in males. Females have rounded, widely separated fossae (Fig. 36) and a comparatively simple structure of spermathecae which resemble large sacs (Fig. 37).

DESCRIPTION: MALE (from Uganda, Iganga, Ikulwe Farm). *Measurements.* Carapace 3.5 long, 2.3 wide, 1.4 high at PLE. Ocular area 1.0 long, 1.5 wide anteriorly and 1.6 wide posteriorly. Diameter of AME 0.5. Abdomen 3.5 long, 2.0 wide. Chelicera length 1.30. Clypeus height 0.3. Length of leg segments: I 1.7+1.0+1.4+1.0+0.8; II



FIGS 30-40

Phlegra nuda Próchniewicz & Hęciak, 1994 (♂ paratype from Uganda: Iganga, ♀ paratype from Uganda: Kampala). (30) Male palp, ventral view. (31) Ditto, prolateral view. (32) Embolus, dorsal view. (33) Ditto, ventral view. (34) Ditto, lateral view. (35) Tibial apophysis, prolateral view. (36) Epigyne, ventral view. (37) Spermathecae, dorsal view. (38) Diagrammatic course of insemination duct. (39) Male, general appearance, dorsal view. (40) Female, general appearance, dorsal view. Scale lines: (0.1 mm 30-37), 1 mm (39-40).

1.6+1.0+1.0+0.9+0.6; III 1.8+0.9+1.1+1.3+0.6; IV 2.3+1.1+1.7+2.0+0.7. *Leg spination*. Leg I: Fm d 1-1-5; Tb v 3-3-3ap; Mt v 2-1-2ap. Leg II: Fm d 1-1-3; Tb pr 1-1, v 1-1-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-2-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0 or 1-1-1-0, pr and rt 1-0-2, v 2-2ap. Leg IV: Fm d 1-1-5; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2ap. *Coloration*. Carapace brown, with black eye field and a couple poorly visible white stripes. Clypeus, 'cheeks' and chelicerae dark brown, covered with black hairs and bristles. Sternum dark brown to black. Abdomen dark brown, scutum narrow, covering the anterior half of dorsum (Fig. 39). Legs mostly dark brown, but all tarsi brown in proximal halves and yellow in distal ones. Palps dark brown, covered with black hairs and bristles. Palpal structure as in Figs 30-35.

FEMALE (from Uganda, Kampala). *Measurements*. Carapace 2.6 long, 1.9 wide, 1.2 high at PLE. Ocular area 1.0 long, 1.3 wide anteriorly and 1.4 wide posteriorly. Diameter of AME 0.4. Abdomen 2.8 long, 1.6 wide. Chelicera length 0.8.

Clypeus height 0.2. Length of leg segments: I 1.2+0.8+0.9+0.6+0.5; II 1.1+0.8+0.7+0.5+0.5; III 1.4+0.7+0.8+1.0+0.6; IV 1.9+0.9+1.5+1.6+0.7. *Leg spination.* Leg I: Fm d 1-1-3; Tb v 2-2-2 ap; Mt v 2-2 ap. Leg II: Fm d 1-1-3; Tb pr 0-1, v 1-1-2 ap; Mt v 2-2 ap. Leg III: Fm d 1-1-4; Pt pr and rt 1; Tb d 1-0-0, pr 1-1-1, rt 0-1-1, v 1-0-2 ap; Mt d 0-1-0, pr and rt 1-0-2, v 2-2 ap. Leg IV: Fm d 1-1-4; Pt pr and rt 1; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2 ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2 ap. *Coloration.* Carapace dark brown, with black eye field and two longitudinal stripes of white scales and hairs. Clypeus and 'cheeks' brown, chelicerae yellow-brown. Sternum brown. Abdomen yellow-grey. Dorsum dark brown, with grey-brown median stripe and two yellow stripes on abdomen sides (Fig. 40). Book-lung covers yellow-grey, spinnerets dark brown. Legs brownish yellow, but all femora of all legs dark brown; patellae and tibiae I brown. Palps yellow, covered with white hairs. Epigyne and spermathecae as in Figs 36-38.

DISTRIBUTION: Uganda (Kampala and Iganga) and Kenya (Cherangani). The records of *P. nuda* from N.E. Tanzania by Wesołowska & Russell-Smith (2000) are likely to belong to *P. pusilla*. For further details see below under 'Comments' of *P. pusilla*.

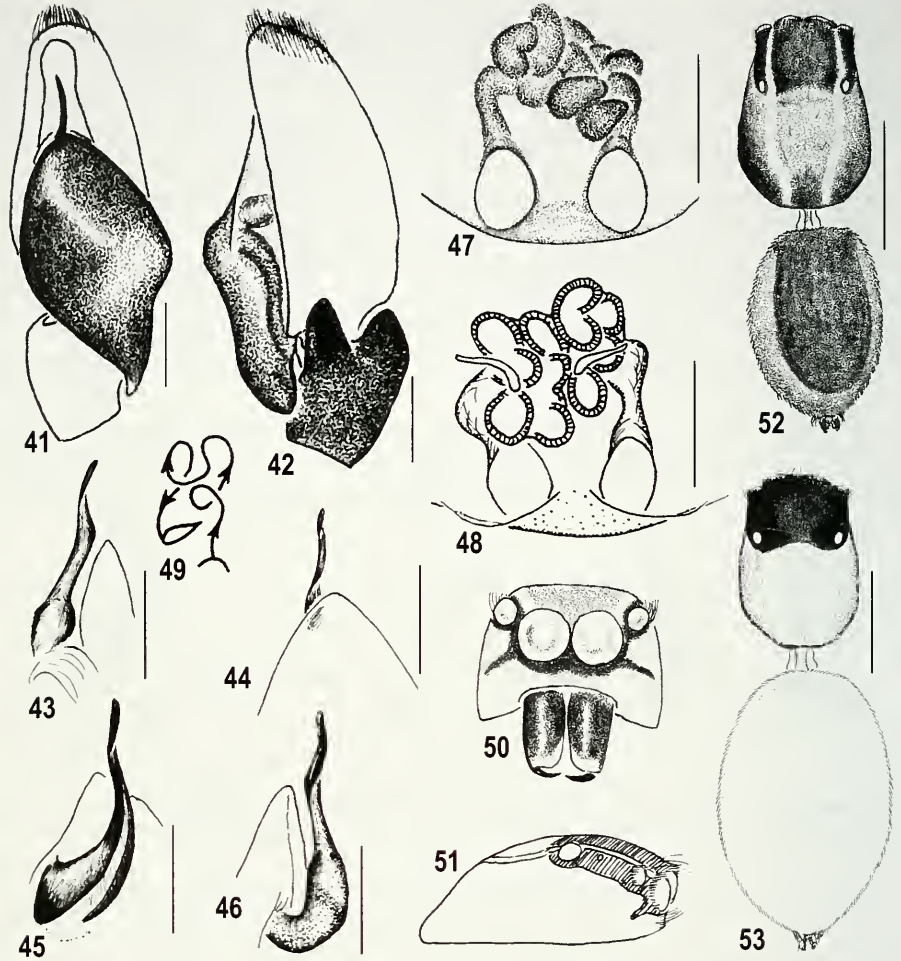
Phlegra pusilla Wesołowska & van Harten, 1994 Figs 41-53

Phlegra pusilla Wesołowska & van Harten 1994: 70, figs 140-143 (D♂; ♂ holotype not examined).

MATERIAL EXAMINED: TANZANIA. 2 ♂ (PCRS, hitherto identified as *Phlegra nuda*), Summit of Ibaya Hill, Mkomazi Game Reserve (03°59'N, 37°47'E), litter in montane *Spirostachys* forest, 17 September 1993, A. Russell-Smith. – KENYA. 1 ♀ (MHNG, 77/45), Taita, Tsavo Park East, W Sala Gate, 30 October 1977, V. Mahnert; 3 ♀ (MHNG), Melindi, Casuarina Point, sea drifts, 5-13 August 1965, V. Mahnert. – SENEGAL. 1 ♂ (PCRS), Sonkorong, Thyssé region (13°45'N, 15°40'E), 3 yr. old *Combretum* fallow, 5 October 1995, A. Russell-Smith; 3 ♂ 3 ♀ (MHNG), same locality, 20 yr. old *Combretum* fallow, 14 June 1994, A. Russell-Smith.

DIAGNOSIS: This is a very small species of *Phlegra*, which can be distinguished by the characteristic colour pattern of the carapace (with two narrow white lines, Fig. 52) and the dark brown, shiny scutum of the abdomen in males, as well as by the structure of the copulatory organs. The male has the embolus with a thin, slightly twisted tip and a wide base (Figs 43-46) and the female has rounded/ovoid and shallow fossae situated close to the epigastric furrow (Figs 47, 48). The clypeus of males also has a peculiar colour pattern of transverse brownish lines (Fig. 50), but this pattern is not always clearly marked.

COMMENTS: *P. pusilla* was described from a single male from Yemen (Wesołowska & van Harten, 1994) and has not been recorded elsewhere so far. It is very likely that some (or all) of the records of *P. nuda* from N.E. Tanzania (Mkomazi Game Reserve) by Wesołowska & Russell-Smith (2000) actually belong to *P. pusilla*. We have examined two males from this locality, which were earlier identified as *P. nuda*, and found that both should be assigned to *P. pusilla*. The males of the latter species have a wide, straight tibial apophysis (compare Fig. 42 with fig. 142 in Wesołowska & van Harten, 1994), whereas Wesołowska & Russell-Smith (2000: figs 226, 227) clearly illustrated the short tibial apophysis, without a notch at its tip, in



Figs 41-53

Phlegra pusilla Wesołowska & van Harten, 1994 (♂♀ from Senegal: Sonkorong). (41) Male palp, ventral view. (42) Ditto, prolateral view. (43) Embolus, median view. (44) Ditto, ventral view. (45) Ditto, dorsal view. (46) Ditto, lateral view. (47) Epigyne, ventral view. (48) Spermathecae, dorsal view. (49) Diagrammatic course of insemination duct. (50) Colour pattern of male face, frontal view. (51) Male carapace, lateral view. (52) Male, general appearance, dorsal view. (53) Female, general appearance, dorsal view. Scale lines: (0.1 mm 41-48), 1 mm (52-53).

Tanzanian males (compare with the tibial apophysis of true *P. nuda*, Fig. 31). They also mentioned that it is "the commonest member of this genus in Mkomazi..." (op.cit., p. 86). Thus, we suspect that either both species should occur in Mkomazi, or one of them (*P. pusilla*) was misidentified as *P. nuda*. The matter needs further attention in the future.

Finally, our record of *P. pusilla* from Kenya is based on four females only. All these females have the slightly smaller fossae and the slightly larger epigynal pocket as compared to the females from Senegal, so being closer to what was illustrated by Wesołowska & Russell-Smith (2000: figs 228-229) under the name *P. nuda*. Males are required to confirm or reject our identification of the Kenyan females.

DESCRIPTION: MALE (from Tanzania, Mkomazi Game Reserve). *Measurements*. Carapace 1.5 long, 1.0 wide, 0.8 high at PLE. Ocular area 0.6 long, 0.9 wide anteriorly and 0.9 wide posteriorly. Diameter of AME 0.3. Abdomen 1.4 long, 0.8 wide. Chelicera length 0.5. Clypeus height 0.2. Length of leg segments: I 0.7+0.4+0.4+0.3+0.3; II 0.7+0.4+0.4+0.3+0.3; III 0.9+0.4+0.4+0.5+0.4; IV 1.0+0.5+0.8+0.8+0.5. *Leg spination*. Leg I: Fm d 1-1-2; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-2; Tb pr 0-0-1, v 1-1-2ap; Mt pr 0-1, v 2-2ap. Leg III: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 0-1-1, v 1-0-2ap; Mt d 0-1-0, pr and rt 1-0-2, v 1-1-2ap. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2ap. *Coloration*. Carapace brown, covered with orange hairs, with dark brown eye field and two longitudinal white stripes running from AMEs to rear part of carapace (Figs 51-52). Clypeus and 'cheeks' yellow to brownish; clypeus with a colour pattern of brownish transverse stripes (Fig. 50). Scales around AMEs: orange-brown dorsally and black on sides and ventrally. Sternum yellow. Chelicerae brown. Abdomen brownish grey, with dark brown scutum (Fig. 52). Legs yellow brownish, but femora, patella, tibiae and metatarsi dark brown. All tarsi yellow. Palps dark brown, their femora ventrally and apically with white hairs. Palpal structure as in Figs 41-46.

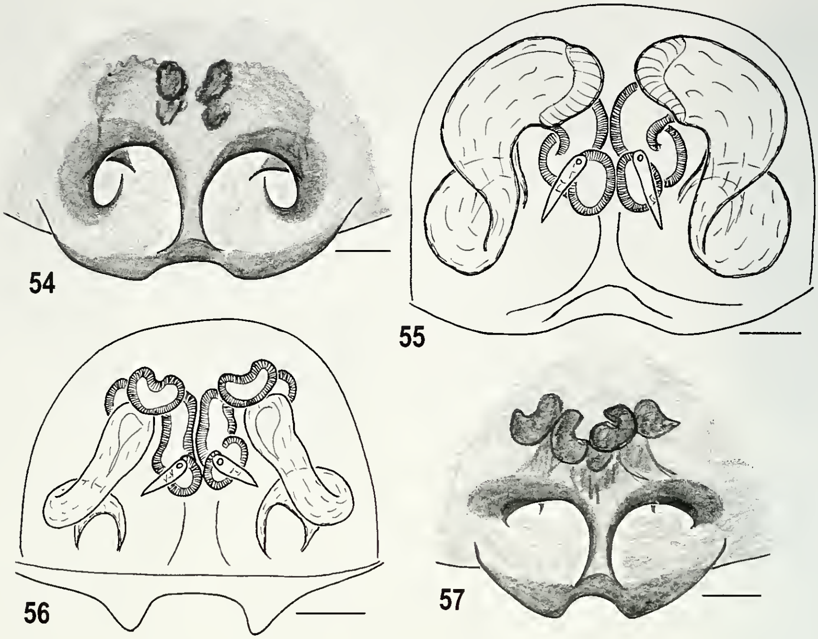
FEMALE (from Senegal, Sonkorong). *Measurements*. Carapace 1.7, long, 1.1 wide, 0.80 high at PLE. Ocular area 0.7 long, 1.0 wide anteriorly and 0.9 wide posteriorly. Diameter of AME 0.3. Abdomen 2.5 long, 1.7 wide. Chelicera length 0.6. Clypeus height 0.2. Length of leg segments: I 0.7+0.6+0.5+0.3+0.3; II 0.7+0.4+0.4+0.3+0.3; III 0.9+0.5+0.5+0.5+0.4; IV 1.2+0.6+0.8+0.8+0.5. *Leg spination*. Leg I: Fm d 1-1-2; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-2; Tb pr 0-1, v 1-1-2ap; Mt v 2-2 ap. Leg III: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 0-1-1, v 1-0-2ap; Mt d 0-1-0, pr and rt 1-0-2, v 2-2ap. Leg IV: Fm d 1-1-1; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr and 1-1-2, v 1-1-2ap. *Coloration*. Carapace brown, with dark brown eye field and two longitudinal light yellow stripes on thorax region. Clypeus brown. 'Cheeks' and chelicerae yellow. Sternum yellow. Dorsum yellow, with a poorly marked colour pattern of brown patches and stripes (Fig. 53). Palps yellow. Epigyne and spermathecae as in Figs 47-49.

DISTRIBUTION: Yemen, Tanzania, Kenya and Senegal, but likely to occur in most African countries north of the equator.

Phlegra soudanica **Berland & Millot, 1941** Figs 54, 55

Phlegra soudanica Berland & Millot, 1941: 311-312, figs 13A,B (D♀; ♀ holotype in MNHN, examined).

TYPES: Holotype ♀ of *P. soudanica* Berland & Millot, 1941 (MNHN, 2381-2) from SW Mali, Bamako, August 1937, J. Millot. – Paratype ♀ of *P. soudanica* Berland & Millot, 1941 (MNHN, 2381-2) from SW Mali, Sangha, September 1937, J. Millot.



FIGS 54-57

Phlegra soudanica Berland & Millot, 1941 (54-55, ♀ holotype), *Phlegra lugubris* Berland & Millot, 1941 (56-57, ♀ holotype of *P. tuzetae* Berland & Millot, 1941). (54, 57) Epigyne, ventral view. (55, 56) Spermathecae, dorsal view. Scale lines: 0.1mm.

DIAGNOSIS: Of other African species, *P. soudanica* is most similar to *P. lugubris* (see above). The females of *P. soudanica* can easily be separated from those of the latter species by the narrower median septum of the epigyne, the stronger twisted ridges of the fossae and the wider, stronger and more heavily sclerotized insemination ducts (compare Figs 54, 55 with 26, 27, 56, 57). The male of *P. soudanica* remains unknown.

DESCRIPTION: MALE unknown. FEMALE (the ♀ holotype). *Measurements.* Carapace 3.4, long, 2.1 wide, 0.7 high at PLE. Ocular area 1.3 long, 1.5 wide anteriorly and 1.6 wide posteriorly. Diameter of AME 0.5. Abdomen 4.5 long, 2.7 wide. Chelicera length 1.0. Clypeus height 0.3. Length of leg segments: I 1.7+1.1+1.0+0.8+0.6; II 1.7+1.0+0.9+0.8+0.6; III 1.9+1.0+1.1+1.4+0.8; IV 2.3+1.2+ 1.7+2.0+0.8. *Leg spination.* Leg I: Fm d 0-1-1-3; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 0-1-1-3; Tb pr 0-1, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 0-1-2-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt d 1-1-0, pr and rt 1-2ap, v 2-2ap. Leg IV: Fm d 0-1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 2-0-2ap; Mt d 1-1-0, pr and rt 1-1-2ap, v 1-2ap. *Coloration.* Carapace light brown, without a colour pattern and with dark brown veins on thorax region. Eye field dark brown, with black around eyes. Clypeus yellow and 'naked'. Sternum, maxillae and labium light brown. Chelicerae brown. Abdomen: dorsum brown, with a thin median white line and two white lateral stripes; venter brown, with two longitudinal yellowish stripes. Book-lung covers yellow. Spinnerets brown. All legs mostly yellowish brown, but tibiae I and II dark brown. Palps brow-yellow. Epigyne and spermathecae as in Figs 54, 55.

DISTRIBUTION: Two localities in SW Mali (Bamako and Sangha).

***Phlegra touba* sp. n.** Figs 58-71

TYPES: Holotype ♂ (MHNG) from Ivory Coast, nr. Touba (08°17'N, 05°56'W), upland rice field (pitfall traps), 3-6 September 1994, A. Russell-Smith. – Paratypes: IVORY COAST. 3 ♂ 2 ♀ (MHNG), collected together with the holotype; 4 ♂ 5 ♀ (PCRS), nr. Gagnoa (06°08'N, 05°56'W), upland rice field (pitfall traps), 26-30 March 1995, A. Russell-Smith; 1 ♂ (PCRS), Bouaké (07°52'N, 05°06'W), degraded savanna (under stones), 31 July 1994, A. Russell-Smith; 3 ♂ 2 ♀ (MHNG), 'West African Rice Development Association', Mbé, nr. Bouaké (07°52'N, 05°06'W), upland rice field, 17 August 1994, A. Russell-Smith.

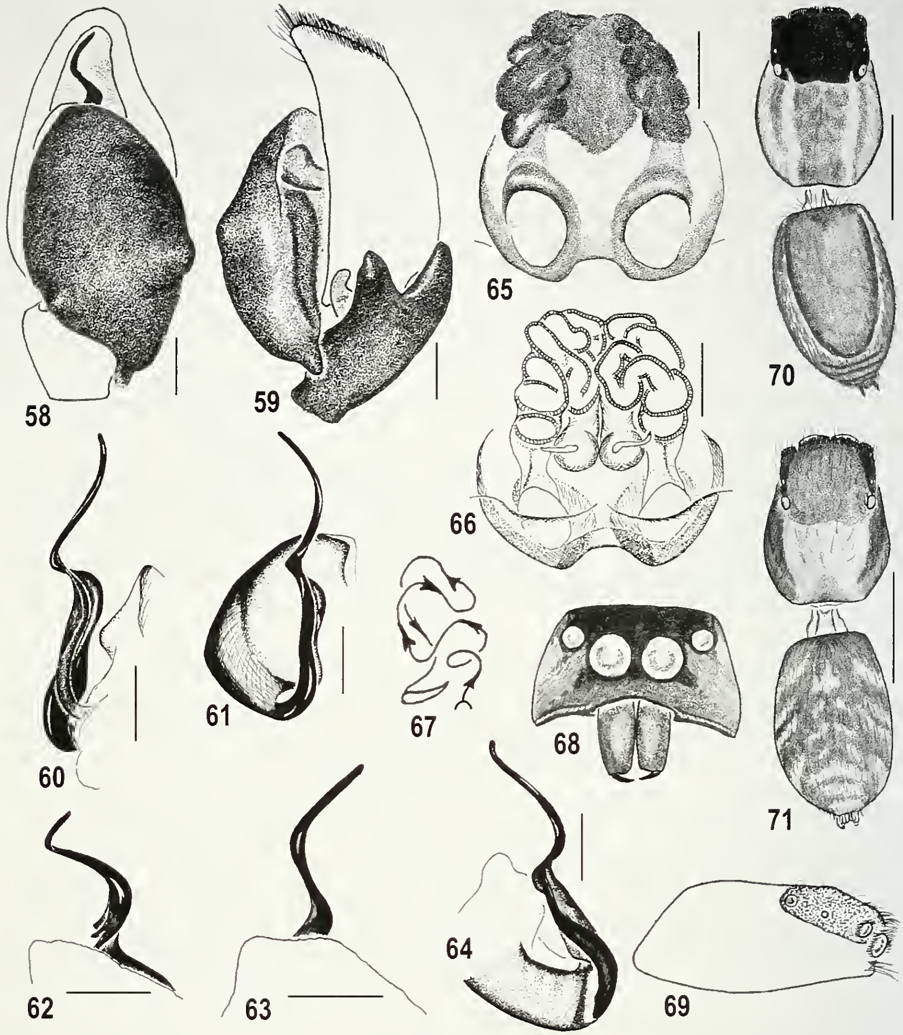
ETYMOLOGY: The specific name is used as a noun in apposition referring to the type locality Touba in Ivory Coast.

DIAGNOSIS: The female of this species is similar to that of *P. levis* Próchniewicz & Hęciak, 1994 described from a single female from Kenya (Próchniewicz & Hęciak, 1994), but can be distinguished from it by the absence of lateral edges of the epigyne and the larger fossae (compare Figs 65, 66 with figs 5b, c in Próchniewicz & Hęciak, 1994). The thorax region of *P. levis* is brownish orange, whereas it is whitish in *P. touba* sp. n.

The epigyne of *P. touba* sp. n. is also similar to that of *P. lugubris* (see above), but the spermathecae of both species clearly differ in the number of loops and the length of insemination ducts (compare Figs 66 with 27). Besides, the specimens of *P. lugubris* are almost twice as big as those of *P. touba* sp. n.

The male of *P. touba* sp. n. has a very characteristic embolus structure (Figs 60-64), being different from that of all other described *Phlegra* species known to us.

DESCRIPTION: MALE (from Touba). *Measurements.* Carapace 1.7 long, 1.2 wide, 0.8 high at PLE. Ocular area 0.6 long, 1.0 wide anteriorly and 0.9 wide posteriorly. Diameter of AME 0.3. Abdomen 1.6 long, 1.0 wide. Chelicera length 0.7. Clypeus height 0.2. Length of leg segments: I 0.7+0.4+0.4+0.4+0.3; II 0.6+0.4+0.4+0.3+0.3; III 0.9+0.4+0.5+0.5+0.4; IV 1.1+0.5+0.9+0.7+0.4. *Leg spination.* Leg I: Fm d 1-1-3; Tb pr 0-1-0, v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-2-3; Pt pr 1; Tb pr 0-1-0, v 1-1-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 0-1-0, pr and rt 1-0-2, v 2-2ap. Leg IV: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-1-0, pr 1-1-2, rt 1-0-2, v 1-1-2ap. *Coloration.* Carapace brown to dark brown, with black eye field and two longitudinal white stripes (Fig. 70); sides sparsely covered with white hairs. Sternum brown. Clypeus, 'cheeks' and chelicerae brown (Fig. 68); 'cheeks' partly covered with white hairs. Scales around AMEs mostly white, but brown on dorsal sides of the eyes. Abdomen yellowish grey, with large scutum covering 3/5 to 4/5 of dorsum length (Fig. 70). Book-lung covers and spinnerets grey brown. All legs mostly yellow to grey-yellow, all femora dark brown and patellae I brown dorsally. Palps brown, femora and tibiae sparsely covered with white and black hairs, cymbium covered with dark brown hairs. Palpal structure as in Figs 58-64.



FIGS 58-71

Phlegra touba sp. n. (♂ ♀ paratypes from Ivory Coast: Touba). (58) Male palp, ventral view. (59) Ditto, prolateral view. (60) Embolus, median view. (61) Ditto, dorsal view. (62, 63) Ditto, ventral view. (64) Ditto, lateral view. (65) Epigyne, ventral view. (66) Spermathecae, dorsal view. (67) Diagrammatic course of insemination duct. (68) Colour pattern of male face, frontal view. (69) Male carapace, lateral view. (70) Male, general appearance, dorsal view. (71) Female, general appearance, dorsal view. Scale lines: 0.1 mm (58-66), 1 mm (70-71).

FEMALE (from Touba). *Measurements*. Carapace 1.7, long, 1.2 wide, 0.8 high at PLE. Ocular area 0.6 long, 0.9 wide anteriorly and 1.0 wide posteriorly. Diameter of AME 0.3. Abdomen 2.2 long, 1.7 wide. Chelicera length 0.6. Clypeus height 0.2. Length of leg segments: I 0.8+0.5+0.5+0.3+0.4; II 0.8+0.4+0.4+0.3+0.3; III 0.9+0.5+0.5+0.6+0.4; IV 1.2+0.6+0.9+0.9+0.5. *Leg spination*. Leg I: Fm d 1-1-2; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 1-1-2; Tb pr 0-1-0, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 0-1-1-0, v 1-0-2ap; Mt pr and rt 1-0-2, v 2-2. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0-0, pr and rt 1-1-1, v 1-0-2ap; Mt pr and 1-1-2, v 1-1-2ap. *Coloration.* Carapace brown, with dark brown eye field and whitish thorax region (Fig. 71). Sternum brownish grey. Clypeus and 'cheeks' brown-yellow, with white scales and hairs around eyes. Chelicerae brownish. Abdomen yellow-grey, with brownish yellow dorsum and with a poorly marked colour pattern of yellowish patches and stripes (Fig. 71). Book-lung covers and spinnerets grey. All legs yellow, with brownish rings. Epigyne and spermathecae as in Figs 65-66.

DISTRIBUTION: Three localities in Ivory Coast (Touba, Bouaké and Gagnoa).

Phlegra trifoveolata **Lessert, 1927** Figs 76-78

Phlegra trifoveolata Lessert, 1927: 439-440, fig. 21 (D♂♀; ♀ syntypes in the MHNG, examined).

TYPES: Two ♀ syntypes (MHNG) from Congo, "Faradji I" [most probably, Faradje (3°41'N, 29°42'E)], American Museum Congo Expedition [one ♀ is without legs on its right side].

DIAGNOSIS: This species displays a unique conformation of the ♀ copulatory organs. The fossae are not developed, the epigynal pocket is displaced from the epigastric furrow and resembles the central blind-ending pocket of the Pelleninae. The insemination ducts are heavily sclerotized (Figs 77-78), a feature absent in other *Phlegra* species known to us. All these characters are unique in *Phlegra* and therefore are reliable diagnostic characters of *P. trifoveolata*. It is likely that this species is not a member of *Phlegra*, but its correct placement can be resolved only when males have been found and described.

DESCRIPTION: MALE unknown. FEMALE (the ♀ with all legs). *Measurements.* Carapace 3.9, long, 2.9 wide, 1.7 high at PLE. Ocular area 1.5 long, 1.9 wide anteriorly and 2.0 wide posteriorly. Diameter of AME 0.6. Abdomen 5.1 long, 3.5 wide. Chelicera length 1.2. Clypeus height 0.7. Length of leg segments: I 2.0+0.6+1.1+0.7+0.7; II 1.9+1.2+1.0+0.7+0.7; III 2.6+1.5+1.3+1.4+0.9; IV 2.4+1.2+1.4+1.7+0.9. *Leg spination.* Leg I: Fm d 0-1-1-3; Tb pt 1-0, v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 0-1-1-3; Tb pr 1-1, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt d 1-1, pr and rt 1-2ap, v 2-2ap. Leg IV: Fm d 1-1-2; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt d 1-0, pr and rt 1-1-2ap, v 2-2ap. *Coloration.* Carapace yellowish brown, with eye field dark brown, black around eyes and two thin longitudinal lines running from AMEs to rear edge of thorax region. Sternum, maxillae and labium yellow. Chelicerae yellowish brown. Abdomen: dorsum brown, with thin longitudinal yellow stripe; sides and venter yellow. Book-lung covers yellow, spinnerets yellow, tinged with brown. All legs mostly brownish yellow, Tb, Mt and Tr I and II dark brown. Epigyne and spermathecae as in Figs 76-78.

DISTRIBUTION: Known from the type locality only, Congo (Faradje).

Phlegra tristis **Lessert, 1927** Figs 72-74

Phlegra tristis Lessert, 1927: 437-438, figs 20A,B (D♂♀; ♀ lectotype in the MHNG, designated here).

TYPES: Lectotype ♀ (MHNG; designated here; Figs 72, 73) from Congo, "Faradji I" [most probably, Faradje (3°41'N, 29°42'E)], American Museum Congo Expedition [the ♀ lectotype is without legs on its right side]. – Paralectotypes: 1 ♂ 2 ♀ (MHNG; from the type series), collected together with the lectotype [one ♀ is without carapace, the ♂ is without both palps].

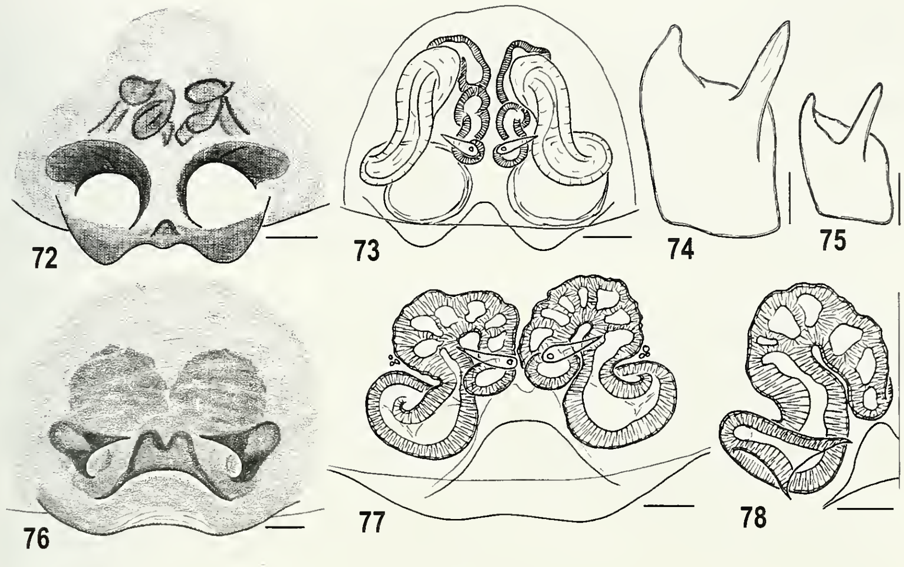
OTHER MATERIAL EXAMINED: KENYA. 1 ♀ (MHNG, 77/31), Tana River, c. 10 km N of Garsen, 23 October 1977, V. Mahnert.

DIAGNOSIS: *P. tristis* belongs to the *fasciata* species group (*sensu* Logunov, 1996) and is most closely related to *P. lugubris* (see above). The females of *P. tristis* can be easily distinguished from those of the latter species by the wider and shorter median septum of the epigyne and by the different shape of the rear epigynal margin (compare Figs 72 with 26, 57). We have been unable to properly compare the males of both species, as the ♂ paralectotype of *P. tristis* lacks both palps. The only relevant structure available for study was the three remaining palpal segments (femur, patella and tibia). A comparison of these segments with those of *P. lugubris* showed that the tibia and tibial apophysis of *P. tristis* are almost twice the size of those of *P. lugubris* (compare Figs 74 with 75; both apophyses are illustrated to the same scale) and hence left no doubt that these species are different.

COMMENTS: The type series of *P. tristis* containes one male and three females, all specimens are partly destroyed. One female has no legs on its right side and we think that this female was described and illustrated by Lessert (1927). This is why we designated this ♀ as the lectotype and illustrated it (Figs 72, 73).

DESCRIPTION: MALE (paralectotype). *Measurements.* Carapace 3.7 long, 2.4 wide, 1.4 high at PLE. Ocular area 1.4 long, 1.6 wide anteriorly and 1.7 wide posteriorly. Diameter of AME 0.5. Abdomen 3.3 long, 2.2 wide. Chelicera length 1.0. Clypeus height 0.2. Length of leg segments: I 1.9+1.1+1.2+0.6+0.6; II 1.8+1.0+1.0+0.8+0.6; III 2.0+1.1+1.0+1.3+0.7; IV 2.4+1.2+1.5+1.9+0.8. *Leg spination.* Leg I: Fm d 0-1-1-3; Tb v 2-2-2ap; Mt v 2-2ap. Leg II: Fm d 0-1-1-3; Tb pr 0-1, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 1-1-4; Pt pr and rt 0-1-0; Tb pr and rt 1-1-1, v 2-2ap; Mt d 1-1-0, pr and rt 1-2ap, v 2-2ap. Leg IV: Fm d 0-1-2-4; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt d 1-0, pr, rt and v 1-1-2ap. *Coloration.* Carapace yellowish brown, with eye field dark brown. Clypeus yellowish. Sternum, maxillae and labium yellow. Chelicerae brown. Abdomen yellowish grey, dorsum with brownish scutum occupying 1/2 of dorsum length. All legs mostly yellowish brown, Tb, Mt and Tr I and II dark brown. Both palps missing, except for the palpal femur, patella and tibia; palpal tibia as in Fig. 74.

FEMALE (lectotype). *Measurements.* Carapace 3.15, long, 2.10 wide, 1.03 high at PLE. Ocular area 1.18 long, 1.45 wide anteriorly and 1.55 wide posteriorly. Diameter of AME 0.46. Abdomen 4.05 long, 2.33 wide. Chelicera length 0.98. Clypeus height 0.18. Length of leg segments: I 1.43+0.88+0.85+0.63+0.53; II 1.35+0.85+0.75+0.63+0.53; III 1.60+0.69+0.85+1.05+0.60; IV 2.03+0.09+1.35+1.53+0.68. *Leg spination.* Leg I: Fm d 0-1-1-3; Tb v 2-2-2ap: Mt v 2-2ap. Leg II: Fm d 0-1-1-3; Tb pr 0-1, v 1-1-2ap; Mt v 2-2ap. Leg III: Fm d 0-1-1-2; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt d 1-1, pr and rt 1-2ap, v 2-2ap. Leg IV: Fm d 0-1-1-2; Pt pr and



Figs 72-78

Phlegra tristis Lessert, 1927 (72-74, ♀ lectotype and ♂ paralectotype), *Phlegra lugubris* Berland & Millot, 1941 (75, ♂ from Ivory Coast: Touba) and *Phlegra trifoveolata* Lessert, 1927 (76-78, ♀ syntype). (72, 76) Epigyne, ventral view. (73, 77) Spermathecae, dorsal view. (74, 75) Tibial apophysis, prolateral view. (78) Spermatheca, ventral view. Scale lines: 0.1 mm.

rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt pr, rt and v 1-1-2ap. *Coloration.* Carapace entirely brownish yellow. Clypeus yellowish. Sternum, maxillae and labium yellow. Chelicerae light brown. Abdomen mostly yellow-grey, dorsum with two poorly visible brownish longitudinal stripes. Book-lung covers grey, spinnerets brown. Only legs of left side present, all of them mostly yellowish brown, Tb, Mt and Tr I and II dark brown. Palps yellow, tinged with brown. Epigyne and spermathecae as in Figs 72, 73.

Distribution. Known from Congo (Faradje) and Kenya (Garsen).

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Re-assessing *Platyceps ventromaculatus* (Gray, 1834) (Reptilia: Squamata: Colubrinae)

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Re-assessing *Platyceps ventromaculatus* (Gray, 1834) (Reptilia: Squamata: Colubrinae). - The morphology and distribution of Gray's racer has been examined. *Platyceps ventromaculatus* seems to frequent habitats below 500 m altitude throughout most of its range. Its occurrence in the Himalayan foothills (Himachal Pradesh, Uttaranchal) and the specific identity of the holotype of *P. semifasciatus* Blyth, 1860 need further investigations. *P. ventromaculatus* crosses the Indus Valley and is found, for instance, along the Makran littoral to as far west as the border area with Iran. *Coluber chesneii* Martin, 1838 may be a valid northern Saharo-Arabian taxon of the genus *Platyceps* Blyth, 1860.

Keywords: morphology - distribution - taxonomy - systematics - *Coluber chesneii* Martin - *Platyceps semifasciatus*.

INTRODUCTION

The description of *Coluber ventromaculatus* simply consists of an illustration in Gray (1834) after a drawing from Major-General Thomas Hardwicke's collection of water-colour sketches of Indian animals in the British Museum (Natural History). Günther (1858) thought that *Coluber chesneii* Martin, 1838 from Mesopotamia was identical with Gray's racer. Based on this and the alleged occurrence of "Z.[*amenis*] *ventrimaculatus*" [sic] in Iran (Blanford, 1876), the species' distribution range was reported "From the Euphrates through Persia, Afghanistan, and Baluchistan to Kashmere, the Punjab, Sind, Cutch, and Bombay" (Boulenger, 1893).

Wall (1914) considered various Middle East racer taxa including *Zamenis rhodorachis* Jan, 1863, *Z. ladacensis* Anderson, 1871, and *Gonyosoma dorsale* Anderson, 1872 to be junior synonyms of Gray's racer. This author distinguished a "few shielded" and a "many shielded variety" (or "form") within the reputed range from Egypt and Somalia to the Indian subcontinent including the Himalayas. Smith (1943) and Minton (1966) notified *Coluber ventromaculatus* from "North-western India [...] west to Palestine" and "Israel", respectively. According to Khan (1997), however, "*C. ventromaculatus* reported from west of the Indus (Fig. 6) are actually color morphs of *C. rhodorachis* [...]."

Coluber ventromaculatus belongs to the Saharo-Sindian racer genus *Platyceps* Blyth, 1860 (Inger & Clark, 1943; Schätti & McCarthy, 2001; Schätti & Utiger, 2001).

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Populations formerly referred to Rogers' racer are conspecific with *P. ventromaculatus* auct. from the Near East and Gulf region. *Zamenis rogersi* Anderson, 1893 is considered a junior synonym of *P.* cf. *ventromaculatus* which inhabits comparatively mesic areas from northeast Africa to the Middle East (Schätti, 2005, 2006).

The present study, based on material from the eastern portion of the distribution range of Gray's racer, intends to clarify the systematic concept of *Platyceps ventromaculatus* and stimulate further investigations of the *P. rhodorachis - ventromaculatus* species group.

MATERIAL AND METHODS

Ninety specimens of Gray's racer (Appendix) loaned by the following institutions were examined: American Museum of Natural History, New York (AMNH); The Natural History Museum (British Museum [Natural History]), London (BMNH); California Academy of Sciences, San Francisco (CAS); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); Muséum d'histoire naturelle, Genève (MHNG); Muséum National d'Histoire Naturelle, Paris (MNHN); Staatliches Museum für Tierkunde, Dresden (MTKD); Naturhistorisches Museum, Wien (NMW); Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main (SMF). Further acronyms used in the text are BNHM (Bombay Natural History Museum, Mumbai), UMMZ (University of Michigan, Museum of Zoology, Ann Arbor), ZFMK (Zoologisches Forschungsmuseum Alexander Koenig, Bonn), and ZSI (Zoological Survey of India [Indian Museum, formerly Museum of the Asiatic Society of Bengal], Kolkata [Calcutta]).

Morphological terms and measurements are explained in Schätti (1988) and Schätti & McCarthy (2004). Numbers in parenthesis indicate intraspecific variation. The scale formulae give the dorsal scale row (dsr) counts at the 15th ventral, midbody, and five ventrals in front of the vent. The reduction pattern is expressed in terms of ventrals and as a percentage of their total number (%ven), based on the average of the right and left side. Maxillary teeth were usually examined on the right bone. The length of the hemipenis *in situ* and the insertion of the *M. retractor penis magnus* are given in absolute numbers of subcaudals and as a percentage thereof (%sub).

Scientific names of the taxa discussed in this paper are usually given in full only at their first appearance in the text. The synonyms and chresonyms include references presenting new locality records, systematic papers, and publications with new combinations of names. Material not seen by the authors is quoted in brackets.

Due to the enormous systematic confusion within the *Platyceps rhodorachis - ventromaculatus* species group for the past 150 years or so, it is not possible to correctly assign a number of references. Apart from certain specimens reported by Blanford (1876), Murray (1892), or Wall (1914), this is also the case with, for instance, Flower's (1925) indication of the longevity of "*Zamenis ventrimaculatus*" or "West Asian Spot-bellied snake" in captivity (over 5 years and 10 months) or anatomical details reported by Underwood (1967).

The coordinates are from the Gazetteers of the U.S. Board on Geographic Names, the GEONET database (http://earth-info.nima.mil), and Mertens (1969), and are given at their appropriate place (synonymy, Discussion, or Appendix). Two collecting sites in the Punjab (Pakistan) reported by Sclater (1891) and Khan (1997), i.e., Nurpur (a frequent name) and Rajanpur (31°09'N 71°06'E or 32°11'N 73°23'E), as well as Dadu in Sind (two villages between 24°37'-26°44'N 67°47'-68°10'E), two localities (Devdyani, Khokhara) in Rajasthan and three places in Jodhpur District (Beldarpura, Beriganga, "Massoria Hills") mentioned by Biswas & Sanyal (1977) and Sharma & Vazirani (1977), respectively, could not be precisely located. "Larkaa" in Sind (Khan, 1997) is identified with Larkana (27°33'N 68°13'E) and not Larka (two localities between 27°31-33'N 68°27-36'E).

RESULTS

Platyceps ventromaculatus (Gray, 1834) – Gray's racer

Coluber ventromaculatus Gray, 1834: Pl. 80.1 – no origin given (BMNH 1946.1.11.42, see Type Material).

C.[*oluber*] *diadema* [non Schlegel, 1837]. - Blyth, 1855: 291 ("origin uncertain", syn. Günther, 1864; see, e.g., Theobald, 1868: 53).

Zamenis ventrimaculatus [sic] var. A [partim]. - Günther, 1858: 106 ("Bengal", see Type Material, Taxonomy and Systematics).

?*Pl.*[*atyceps*] *semifasciatus* Blyth, 1860: [113] 114 – "Subathoo" [Subathu, 30°58'N 77°00'E] (ZSI 7240 [not examined], see Taxonomy and Systematics).

Tyria ventrimaculata [sic]. - Cope, 1862: 338 (comb. n., see Schätti *et al.*, 2005).

Zamenis ventrimaculatus [sic] [partim]. - Günther, 1864: 252 (see Type Material).

?*C.*[*oluber*] (*Platyceps*) *semi-fasciatus* [sic]. - Theobald, 1868: 52 (holotype of *P. semifasciatus* Blyth).

?*Platyceps fasciatus* [sic]. - Stoliczka, 1870: 134 (in error for *P. semifasciatus* Blyth, see Distribution, Habitats and Ecology).

Zamenis ventrimaculatus [sic]. - Stoliczka, 1872a: 82 ([Rann of] Kachh: NMW 25452.3-4); Stoliczka, 1872b: 89 ("Sind": BMNH 89.2.1.4862-63, NMW 25452.8-9).

?*C.*[*oluber*] *semifasciatus*. - Nicholson, 1874: 82 ("Subathoo", *fide* Blyth, 1860).

?*Zamenis ventrimaculatus* [sic]. - Blanford, 1875: 208 (holotype of *P. semifasciatus* Blyth, see Taxonomy and Systematics).

Zamenis ventrimaculatus [sic] [partim]. - Theobald, 1876: 169 ("India, probably Western").

?*Compsosoma semifasciatum* [sic] "(Blyth)". - Atkinson, 1882: 75 ("common").

Zamenis ventrimaculatus [sic] [partim]. - Murray, 1884: 378 ("Bengal", Bombay [Mumbai, 18°58'N 72°50'E], Poona [Pune, 18°32'N 73°52'E]; "Sind"; see footnote 7); Boulenger, 1890: [324] 325 (see Discussion); Sclater, 1891: 238 ("Sabathu [Subathu, holotype of *P. semifasciatus* Blyth], Rajanpur in the Punjab [see Material and Methods], Jeypore Rjpt. [Jaipur, 26°55'N 75°49'E], and Karachi" [ZSI specimens], see Taxonomy and Systematics); Boulenger, 1892: 632 ("South-western Asian species"); Boulenger, 1893: [381, 383] 399 (incl. "Bengal (??)" ["type"], "N.W. India" [BMNH 70.11.30.35], "West of Jodhpur, Sind" [India]; Gwadar [25°07'N 62°19'E, BMNH 80.11.10.201 (nos. "i-k"), see footnote 2], Karachi, "Sind": BMNH 69.8.28.132 and 134, 81.7.23.3, 91.9.11.20, 1946.1.11.42).

?*Acanthocalyx ventrimaculatus* [sic] Cope, 1896: 203, Pl. 21.5 [spread hemipenis] – "W. Asia" (see Taxonomy and Systematics).

Zamenis ventrimaculatus [sic] [partim]. - Wall, 1914: [37] 38 [42], Tb. [unnumbered], map 1, Pl. XXII 3-4 (incl. Bombay [Mumbai], Deesa [24°15'N 72°10'E], Delhi [28°40'N 77°13'E], Deolali [19°57'N 73°50'E], "Rajputana" [Desert, centering around 27°N 71°E]; Hyderabad [25°22'N 68°22'E], Sukkur [27°42'N 68°52'E]; see Distribution, Habitats and Ecology, Discussion, footnotes 1-3).

Zamenis ventrimaculatus [sic]. - Ingoldby & Procter, 1923: [118] 128, map ("D. I. K." [Dera Ismail Khan: 31°50'N 70°54'E], "Kaur Bridge" [ca. 32°08'N 70°16'E]).

Zamenis ventrimaculatus [sic] [partim]. - Wall, 1923: 618 (Gujerat [Gujarat, 22°51'N 71°30'E], Khandesh [District, ca. 21°00'N 75°30'E], see Distribution, Habitats and Ecology); Werner, 1929: [64] 71 (data from Boulenger, 1893).

Coluber ventromaculatus auct. - Schmidt, 1930: 226 (see Taxonomy and Systematics).

Platyceps ventromaculatus. - Inger & Clark, 1943: 143 (comb. n.).

Coluber ventromaculatus [partim]. - Smith, 1943: [167] 168 ("India [....] south to Kandesh in the Bombay Presidency" [Gujarat], see Distribution, Habitats and Ecology, Discussion).

Coluber ventromaculatus. - Constable, 1949: 127 (Karachi [F. Wall 1921]: MCZ 15819).

?*P.[latyceps] subfasciatus* [sic]. - Loveridge, 1957: 257 (in error for *P. semifasciatus* Blyth).

Coluber ventromaculatus. - Sundersingh, 1960: 55, Tb. 1 [food, parasites] (vicinity of Pilani ["vicinity of Shivaganga", ca. 28°22'N 75°36'E]); Minton, 1962: 18, Fig. 56 (key and checklist); Minton, 1966: [47] 121 [123, 171], Pl. 24.1 [same specimen as in Minton, 1962] (Dabeji, Ghizri, Hab Chauki, Hinidan crossing, Jamrao Head, Karachi, Landhi, Malir, Mohenjodaro, "between Pir Patho and Gullham Ullah" [ca. 24°33'N 67°53'E, UMMZ 123428], and "Tatta Dist.: Jampir": AMNH 81506, 81994, 82001, 84020-21, 84245-46, 85302, 85455, 85580, 85864-67, 88257-59, 88465, 89294).

Coluber ventromaculatus [partim]. - Haas & Werner, 1969: 363 (Tatta: MCZ 54401).

Coluber ventromaculatus. - Mertens, 1969: 60 (Bahawalpur, Gaj River, Ghizri, Jati [incl. SMF 57326], Jungshahi, Landhi [SMF 69929], East of Lahore [ca. 31°33'N 74°20'E, SMF 57303], Malir, Mirpur Batoro, Mirpur Sakro, Mohenjodaro [SMF 50459], Tatta: SMF 50411-13, 50415-18, 57309-10, 62950-54); Biswas & Sanyal, 1977: 262 (Devdyani, Jodhpur, Khokhara ["Jadhpur"], Naraina [26°47'N 75°12'E], Nokh [27°34'N 72°16'E], "Phulera road" [ca. 26°52'N 75°14'E], Pugal [28°30'N 72°48'E], "Rajputana" [Desert], see Material and Methods); Khan, 1977: 149 (Ahmadpur Sial [30°41'N 71°45'E], "Chak Bhadur Plantation" [Chak Bahadur, 31°48'N 72°50'E], Jhang "City" [J. Maghiana, 31°16'N 72°19'E], Majoka [31°50'N 72°14'E], Rabwah); Sharma & Vazirani, 1977: 89 (Beldarpura, Beriganga, Jodhpur, "Massoria Hills, Jodhpur", Paota [26°58'N 76°56'E], see Material and Methods).

?*Coluber ventromaculatus*. - Chopra, 1979: 30 ("Corbett National Park" [ca. 29°45'N 78°45'E], see Distribution, Habitats and Ecology).

Coluber ventromoculatus [sic]. - Khan, 1982: [225] 226 ("from all plain parts of Pakistan up to an elevation of 185 meters").

Haemorrhois [sic] *ventromaculatus* [partim]. - Welch, 1983a: 69 (comb. n.).

Eremiophis ventromaculatus [partim]. - Welch, 1983b: 108 (comb. n.).

Coluber (Coluber) ventromaculatus [partim]. - Mahendra, 1984: [286] 288 (see Distribution, Habitats and Ecology).

A.[rgyrogena] ventromaculatus. - Murthy, 1985: 64 (comb. n., see Taxonomy and Systematics).

Coluber ventromaculatus. - Khan, 1986: 123, Fig. 1 [map], Tb. 4 (Makerwal [Makarwal, 32°53'N 71°09'E]).

?*Argyrogena ventromaculatus*. - Lamba, 1987: 82 (Bijrani [ca. 29°27'N 79°10'E, Naini Tal], Khinanauli [ca. 29°34'N 78°54'E, Pauri], sight records, see Distribution, Habitats and Ecology).

Coluber ventromaculatus [partim]. - Schätti, 1987: [402] 412, Tb. 1 [pholidosis, osteology, hemipenis], Fig. 2 [vertebra ratios] ("*C. rhodorachis* [group]"); Leviton *et al.*, 1992: [89, incl. Fig. C] 93, Pl. 15H ["Ghizri, Karachi" ("CAS")] (synopsis); Disi, 1993: 111 ("Pakistan, Sind" and "30 km Qu North Karachi": "GM" [MHNG] 1359.7, 2443.19).

?*Argyrogena ventromaculatus*. - Husain & Ray, 1995: 160, Tb. [unnumbered] ("Uttar Pradesh" [Uttaranchal] incl. Naini Tal and Pauri Districts [*fide* Lamba, 1987]) and Husain & Tilak, 1995: 100 ("Rajaji National Park" [ca. 30°03'N 78°07'E], see Distribution, Habitats and Ecology).

Coluber ventromaculatus. - Akram & Qureshi, 1997: 35 (Bhera [32°29'N 72°55'E], Chak [ca. 31°59'N 72°35'E], Sahiwal [31°58'N 72°20'E], Sargodha [32°05'N 72°40'E]); Khan, 1997: 57 [58], Figs 2C and 5-6, Tbs 1-3 ("Plains of Punjab and Sind" [incl. Bahawalnagar (30°33'N 73°23'E), Bhakkar (31°38'N 71°04'E), Chiniot (31°43'N 72°59'E), Dera Ghazi Khan (30°03'N 70°38'E), Fort Marot (29°11'N 72°26'E), Gujranwala (32°09'N 74°11'E), Gujrat (32°34'N 74°05'E), Jhelum (32°56'N 73°44'E), Khushab, Lala Musa (32°41'N 73°58'E), Lalian (31°49'N 72°47'E), Leiah (30°58'N 70°56'E), Mianwali (32°35'N 71°33'E), Multan (30°12'N 71°29'E), Nurpur, Rahimyar Khan (28°25'N 70°18'E), Rajanpur, Sargodha, Sialkot (32°35'N 74°36'E), Toba Tek Singh (30°58'N 72°29'E), Wazirabad (32°27'N 74°07'E); Dadu (see Material and Methods), Diplo (24°28'N 69°35'E), "Larkaa" (Larkana, 27°33'N 68°13'E), Mithi (24°44' 69°48'E), Nawabshah (26°15'N 68°25'E), Sehwan (26°26'N 67°52'E)], "south-eastern Thar Pakar" [Thar Parkar District, ca. 24°50'N 70°00'E]; see Material and Methods [Dadu, Nurpur, Larkana], Discussion, footnote 5).

?*Argyrogena ventromaculatus*. - Das *et al.*, 1998: 150 (holotype of *P. semifasciatus* Blyth).

Coluber ventrimaculatus [sic] [partim]. - Latifi, 2000: 270 (Iran, see Discussion).

Coluber ventromaculatus bengalensis Khan & Khan, 2000: 50, Fig. 1 ["*Coluber rhodorachis*" ssp.] – based on Gray's (1834: Pl. 80.1) illustration (see Taxonomy and Systematics, Morphology [smallprint]).

Coluber ventromaculatus indusai Khan & Khan, 2000: 51, Figs 3A-B – "Upper and Lower Indus Valley" (see Taxonomy and Systematics).

Platyceps ventromaculatus. - Schätti & McCarthy, 2001: 81 [88] (revalidation of *Platyceps* Blyth); Schätti & Utiger, 2001: 935, Tbs 8-9 (based on molecular evidence).

Coluber ventromaculatus. - Khan, 2002: [24, 27, 30, 46, 57] 104, Figs 45d [dorsal colour pattern] and 67, map 7 (see Distribution, Habitats and Ecology incl. Fig. 3, Discussion [smallprint]).

Coluber ventromaculatus bengalensis. - Khan, 2002: [25] 105 ("Bengal" and Punjab, see Taxonomy and Systematics, Discussion).

Coluber ventromaculatus indusai. - Khan, 2002: [25, 46] 105 (see Taxonomy and Systematics).

Coluber ventromaculatus khanorum Barabanov, 2002: 255 (nom. n. for *C. ventromaculatus bengalensis* Khan & Khan, see Taxonomy and Systematics).

Coluber ventromaculatus. Whitaker & Captain, 2004: [21, footnote 6] 134, Plate [unnumbered: "Sikkar district"] (Sikar [27°37'N 75°09'E, Rajasthan], see Distribution, Habitats and Ecology).

TYPE MATERIAL

The caption to Fig. 1 of Plate 80 in Gray (1834) merely says "*Coluber ventromaculatus*", and the corresponding text has never been published. Günther (1858) listed two specimens from "Bengal. Presented by General Hardwicke", but noted that these "typical specimens [...] more probably [...] came from the western part of the Indian region" (Günther, 1864). A single syntype (BMNH 1946.1.11.42), i.e., the pregnant female (Günther, 1858) figured in Gray (1834), is deposited in the former British Museum (Natural History) collection (Boulenger, 1893). It has 207 ventrals (last incompletely separated from penultimate) and 100 subcaudals (98 *fide* Boulenger, 1893).

TAXONOMY AND SYSTEMATICS

Günther's (1858) etymologically correct spelling of the species' name, i.e., *ventrimaculatus*, was perpetuated by virtually all subsequent authors including Boulenger (1893, as *Zamenis* auct.). Schmidt (1930) re-introduced Gray's (1834) original and, thus, taxonomically correct name for racer populations from Iraq so far assigned to *Platyceps ventromaculatus* (see Discussion), and referred the taxon to *Coluber* auct.

Records of Gray's racer from Iran westwards and conspecific populations from Syria and Jordan to Libya formerly considered to deserve specific status, i.e., *P.* (or *Coluber*) *rogersi* auct., are referred to as *Platyceps* cf. *ventromaculatus* (Schätti, 2005, 2006). Except in the case of Sclater (1891), all partial synonyms of *P. ventromaculatus* auct. listed above are due to the inclusion of racers from the northern Saharo-Arabian region (see Distribution, Habitats and Ecology).

The juvenile holotype of *Platyceps semifasciatus*, the type species of *Platyceps* Blyth, 1860, was received from reverend "J. Cave Browne, late of Subathoo." Apart from details of the dorsal colour pattern and size ("Length about 10 1/2 in."), Blyth (1860) noted that the specimen is "white below" and has 187 ventrals ("Scutae"). However, the exceedingly low number of ventrals may be inaccurate as the individual is "not [...] perfect" (Stoliczka, 1870).

Blanford (1875) "venture[d] with some diffidence to suggest that" the holotype of *Platyceps semifasciatus* "is a young specimen of *Zamenis ventrimaculatus* [sic], a snake [...] which is not common in India except in the extreme west, and is necessarily not easily recognised in the young state except by one who knows its appearance well." However, as evidenced by Blanford's (1876) identification of racers of the *P. rhodorachis - ventromaculatus* species group from southeast Iran, determinations by this author are unreliable and his systematic concept of Gray's racer is deficient (see Discussion).

The holotype of *Platyceps semifasciatus* is deposited in the Indian Museum (e.g., Theobald, 1868; Blanford, 1875; Sclater, 1891) under the accession number ZSI 7240 (Das *et al.*, 1998). Unfortunately, various attempts to get in contact with this institution and the Zoological Survey of India failed. Therefore, we had no opportunity to examine the specimen nor was it possible to obtain any further information or a photograph. By all means, the identity of *P. semifasciatus* Blyth is in need of re-examination and the alleged occurrence of *P. ventromaculatus* in northern India requires further investigations (see Distribution, Habitats and Ecology).

The monotypic genus *Acanthocalyx* Cope, 1896 ("Type *Zamenis ventrimaculatus* Gray"), described on the basis of an *in situ* hemipenis of a racer from "W. Asia", is doubtful as to the specific identity of the voucher specimen (Schätti, 2006). At any rate, the number and distribution of spines as well as the apical ornamentation of the hemipenis (Cope, 1896: Pl. 21.5) reminds of western populations of Gray's racer, i.e., *Platyceps* cf. *ventromaculatus* (see Discussion).

Murthy (1985), Lamba (1987), Husain & Tilak (1995), Husain & Ray (1995), Das *et al.* (1998), and other scientists working on the Indian herpetofauna referred Gray's racer to *Argyrogena* Werner, 1924 which is considered, for instance, by Mertens (1969) and the present authors to be a monotypic genus for *Coluber fasciolatus* Shaw, 1802 (Wilson, 1967).

Khan & Khan (2000) described two subspecies of Gray's racer, *Coluber ventromaculatus bengalensis* and *C. ventromaculatus indusai*. The "holotype" of the latter is based on "Specimens from Upper and Lower Indus Valley (Minton, 1966; Mertens, 1969; Khan, 1997)". This description violates, for instance, articles 16.4, 72.3, and 73.1 of the ICZN (1999) and does not meet the criteria for availability (see Hallermann *et al.*, 2001). *C. ventromaculatus bengalensis* Khan & Khan, 2000 and *C. ventromaculatus khanorum* Barabanov, 2002, an unwarranted replacement name (nomen novum), are based on the illustration of the syntype of *C. ventromaculatus* (see Morphology, smallprint) and, thus, objective junior synonyms of *Platyceps ventromaculatus* (Schätti & Stutz, 2005: footnote 6). Furthermore, virtually identical morphological data are given in the diagnoses of *C. v. bengalensis* and *C. v. indusai*, and the captions of two illustrations in Khan & Khan (2000: Figs 1-2) are mixed-up (see synonymy).

MORPHOLOGY

Rostral 1.43-1.88 times broader than high. Internasals usually slightly shorter than prefrontals (about equal in AMNH 89294, distinctly shorter in, e.g., AMNH 81994, 88259, 88465, MCZ 54401, MHNG 1359.10, NMW 25452.9); the latter not entirely divided in AMNH 81506. Frontal 1.22-1.45 times longer than broad, 1.15-1.53 times longer than internasals and prefrontals, 0.84-1.03 times as long as parietals. Posterior border of parietals more or less straight or forming an obtuse (concave) angle (slightly convex in AMNH 85455); lateral left border distinctly constricted at the level of the second row of temporals in, for instance, CAS 100073-74, MHNG 2629.97, MNHN 1962.263, and 1962.265 (left side). Head 2.02-2.40 times longer than broad.

Distance from the nostril to the eye 0.83-1.0 times the length of the internasals and prefrontals. Loreal usually longer than high, situated on the posterior portion of the second and the third supralabial. Preocular normally single, in contact with frontal or not; partly divided in AMNH 85865 (right), 89294, and MCZ 15819 (almost completely divided); MNHN 1962.181 (left) and 1962.183 with two preoculars. Anterior subocular usually single and smaller than loreal; two scales (incl. presubocular) in AMNH 89294 (left, both small), BMNH 89.2.1.4863, 1946.1.11.42 (syntype, small presubocular), CAS 100074 (small presubocular), MHNG 1359.9, 1359.11 (right), 1359.13 (very small presubocular), 1560.46 (right), MNHN 1962.182, 1962.183, 1962.186, 1962.188 (all on right side), NMW 25452.8 (right presubocular), SMF 50411 (right), 50412 and 50415 (both with a tiny presubocular), and 50416.

Stoliczka (1872a) reported a specimen from the Rann of Kachh with "portions of the fourth and fifth labials detached, forming a third long ant- or rather sub-ocular." Constable's (1949) indication of two "loreals" most probably includes the subocular or a presubocular.

Nine supralabials, fifth and sixth or only fifth entering eye, seventh, seventh and eighth or last three largest; ten supralabials in MNHN 1962.265 (sixth and seventh in contact with eye) and on right side of AMNH 2859. Constable's (1949) record of eight supralabials (fifth and sixth touching eye) may be in error (see above). Two postoculars ("rarely one" *fide* Minton, 1966), upper larger; upper left fused with supraocular in MNHN 1962.264. Posterior subocular present in AMNH 81994 and CAS 100073 (detached upper part of sixth supralabial), MCZ 15819 (right), MHNG 1359.7 (right), 1359.11 (left), 2443.20, MNHN 1962.181-83 and 1962.263 (left), SMF 50416 (right, upper part of sixth supralabial), and 62954 (Mertens, 1969). Two anterior temporals and two or three scales in second row; lower anterior temporal in most cases larger (distinctly larger in, e.g., AMNH 84020, 85302); upper anterior temporal particularly small in NMW 25452.4, divided in AMNH 85864, 88258 (left), 89294 (left), MHNG 2443.10 (right), and 2629.97 (left). BMNH 89.2.1.4862 (left) with a small scale between the lower anterior temporal, the lower postocular, and the sixth and seventh supralabials.

Usually ten (nine) sublabials, four in contact with first inframaxillary, sixth (fifth) largest; rarely eleven sublabials according to Minton (1966). Anterior and posterior pair of chin shields about equal in length and width (anterior sometimes shorter and broader); posterior chin chields in front separated by two (none or one in some specimens) rows of normally small scales (sometimes very small and hidden) and usually four (three to five, rarely two) scales behind. Gulars in three to four oblique rows between the posterior chin shields and the first ventral.

Ventrals in specimens examined 194-214 (♂♂ 194-207, ♀♀ 199-214), anal scute divided; 97-124 (106-124, 97-114) paired subcaudals. Sum of ventrals and subcaudals 297-328, 297-327, respectively). An annulus of very small scales between the last ventral and the anal scute in SMF 50412-13.

Günther (1864) reported as few as 90 subcaudals, and even lower counts (minimum 82) were given by Boulenger (1890, 1893); most probably, they all originate from specimens of the Near East and Gulf region (see Discussion and Schätti, 2006). This also applies to Günther's (1864) maximum for ventral scales (220). The latter value (probably including preventrals) and the minimum for subcaudals were perpetuated by Khan (1997).

Khan & Khan (2000: 50) noted, for instance, 195-220 ventrals and 82-119 subcaudals for the species and as few as "70 divided subcaudals" in BMNH 1946.1.11.42 (syntype). Apart from the latter figure and the maximum for ventrals, miraculously ascertained from the "holotype" (see Taxonomy and Systematics), these data as well as other statements (e.g., "rarely one" postocular, "rerely [sic] 8" supralabials) are, most probably, from literature.

Ingoldby & Procter (1923) recorded 215 ventrals in a specimen (probably a female) from the northern Indus plain, and Khan (1986: Tb. 4) as few as 193 for the Punjab [1]. Minton (1966) gave a maximum of 209 ventrals for males; this may stem from UMMZ 123428 (not examined, see synonymy) or is, more likely, due to a different counting system (see above). The range for ventrals and subcaudals (as well as the maximum total length) given by Whitaker & Captain (2004) are from Minton (1966) and do not refer to Indian material.

Five *Platyceps ventromaculatus* from India (see Appendix incl. remark on NMW 25452.3) including BMNH 1946.1.11.42 (syntype) have 197-207 ventrals (♂♂ 197-202, ♀♀ 205-207), 99-124 subcaudals (108-124, 99-100, respectively), and a sum of 304-321 (310-321, 304-307). Stoliczka (1872a) noted 208 ventrals and 118 subcaudals for a specimen from the Rann of Kachh; by all means, NMW 25452.4 collected in that area (leg. Stoliczka) has only 202 and 108, respectively. Biswas & Sanyal (1977) reported four specimens from Rajasthan with 201-207 ventrals and 95-109 subcaudals (see footnote 3).

Dorsal scales with paired apical pits, in 19-19-13 (15) rows. AMNH 84021 (201 ventrals) with 13-15-13 (etc.) dsr between ventrals 155 and 185. BMNH 89.2.1.4863 and MHNG 2443.19 (13 dsr on posterior part of trunk) increase to 14 dsr before the anal scute. AMNH 82001 (199 ventrals) reduces to 14 dsr at ventral 185 and increases to 15 at ventral 192 (96%ven); 15 dsr in front of the vent are also found in SMF 50412 and 50418 (see below). Minton (1966) noted "occasionally an increase to 20 or 21 on neck"; this might be due to counts taken immediately behind the head, i.e., before the 15th ventral.

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[1] Wall (1914: 38, 42) reported 190-246 ventrals and 82-145 subcaudals (190-222 and 82-125, respectively, for the "few shielded", 214-246 and 124-145 for the "many shielded form"). These counts include data from other taxa of the *rhodorachis - ventromaculatus* species group (see Introduction). Therefore, his scale counts and other pholidosis data, information on colouration, dimensions ("The largest specimen I have seen which had its tail slightly imperfect was a ♂ which taped four feet, and half an inch in the fresh state"), and dentition, as well as ecological notes (food, breeding, growth) and locality records (see Distribution, Habitats and Ecology) cannot be correctly assigned to a particular species.

In males, the first and second posterior reduction occurs between ventrals 113 and 136 (58-65%ven; average of right and left side) and 120-136 (61-67%ven), respectively; the third (last) reduction is situated from ventrals 148-179 (74-86%ven). For females, the values are 115-134 (56-65%ven) and 121-139 (59-66%ven) for the first and second reduction. Most females have the third fusion situated between 156-184 (75-87%ven). MHNG 1359.8 (207 ventrals) as well as SMF 50412 (209 ventrals) and 50418 (211) reduce to 13 dsr far caudal (ventral 194) or 92-93%ven; the latter two specimens increase to 15 dsr at ventral 204 (row 6 = 6+7) or 96-98%ven. In both sexes, the sequence of the first and second reduction is variable, viz., lateral (usually rows 3 and 4, sometimes involving row 2 and 5) or high (paravertebral or vertebral: rows 7-9). The third (last) fusion is always high (rows 6-7).

Longest specimens 852 + 308 mm (♂, MHNG 2443.16: Fig. 1) and ca. 940 mm snout-vent length (♀, MNHN 1962.186, tail truncated). Ingoldby & Procter (1923) noted a length of four feet (ca. 1,2 m) for a specimen from Dera Ismail Khan area, northern Indus Plain (see footnote 1). According to Minton (1966), males attain a maximum total length of 1260 mm (♀♀ 913 mm), and the "smallest specimens collected measured 280-290 mm." Stoliczka (1872a) noted "about 8 inches" (ca. 203 mm) for a "very young snake" from the Rann of Kachh; this may refer to the snout-vent length of the individual. The juvenile holotype of *Platyceps semifasciatus* with "its extreme tip [of tail] being lost" has a total length of less than 270 mm (see Taxonomy and Systematics). Tail/body ratio 0.36-0.43 in ♂♂ (0.35 in some juveniles), ♀♀ 0.33-0.40.

A black transverse interorbital bar of variable shape and irregular but mostly symmetrical mottling on the fronto-parietal region (more conspicuous in smaller specimens); a dark spot below the eye and an oblique stripe on the temple. Usually a short dark nuchal streak, or with a broad transverse collar in AMNH 2859. Dorsal ground colour greyish white, pale sandy, yellowish olive, brownish grey, or reddish brown, with up to at least 74 transverse blotches (centre of scales often lighter) throughout the trunk (less prominent towards the vent) and a lateral series of spots or oblong bars usually alternating with the median markings. Tail without pattern and often lighter than remaining parts of body. Venter yellow or ivory with a pearly iridescence; lateral edges of ventrals irregularly spotted with small black dots (sometimes absent on posterior part of trunk).

An individual from the Rann of Kachh has "along the centre [of the back] a distinct yellowish white band, interrupted by somewhat broader blackish spots" (Stoliczka, 1872a). A specimen illustrated in Minton (1962: Fig. 56, 1966: Pl. 24.1) has a distinct dark vertebral line along the anterior portion of the trunk. Mertens (1969) mentioned "das zur Längsstreifung neigende Jungtier SMF 62954", and Khan (1997) "a pair of snakes from southeastern Thar Pakar" (Thar Parkar) with "a single scale-wide uninterrupted median nuchal streak, running to the midbody, passing through dorsal saddles". Some specimens including the female syntype have two longitudinal series of ventral spots (the median one running along the keel of the ventrals) on the anterior part of the belly. According to Stoliczka (1872a), the lateral "angle" of the ventrals "is usually indicated by a thin dark line, and the colour between the two lines is bluish or pale ashy white".

FIG. 1

Platyceps ventromaculatus MHNG 2443.16 (♂) from Sind Province, Pakistan.

Maxillary normally with 15 teeth (14 in NMW 25452.4, MHNG 1359.13, 2443.20, SMF 62954; 16 in AMNH 84020, 88465, MCZ 54401, MHNG 2643.44), anterior series subisodont, diastema usually distinct, posterior two teeth enlarged (last offset laterad). Palatine 9-10, pterygoid 16-19, dentary 16-18 teeth.

Günther's (1864) maxillary tooth count ("armed with twelve teeth") is in error. Based on a skull "from a specimen killed at Campbellpore, Punjab", Wall (1911) noted that *Platyceps ventromaculatus* had no maxillary diastema "and the posterior teeth are not enlarged." His conclusion that this was of "sufficient importance to warrant generic distinction" from *P. rhodorachis* auct. is completely inadmissible and probably due to an incorrect identification of the voucher specimen (see footnote 1).

Hemipenis subcylindrical and spinose, *sulcus spermaticus* simple; size of basal spines subequal, denticulate calyces restricted to apical region (Fig. 2). Apex *in situ* at subcaudals 7-12 (6-10 %sub); insertion of retractor muscle at subcaudals 26-29 (23-25 %sub) and 35 (tail incomplete) in BMNH 89.2.1.4862.

DISTRIBUTION, HABITATS AND ECOLOGY

Platyceps ventromaculatus is recorded from the Makran coast (Gwadar) in southwest Baluchistan (Pakistan) and the Indus Valley east to the vicinity of Lucknow (26°51'N 80°55'E) in Uttar Pradesh (India) and as far south as Pune (Poona, 18°32'N 73°52'E) in Maharashtra (Fig. 3) [2]. Its presence in Indian Punjab is confirmed by

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[2] Boulenger (1893) listed two juveniles (BMNH 80.11.10.201, don. W. T. Blanford) from Gwadar (25°07'N 62°19'E, see also Wall, 1914: map 1) with 194-203 ventrals and 104-110 subcaudals. They undoubtedly belong to *Platyceps ventromaculatus* as evidenced by a photograph taken by Colin McCarthy.

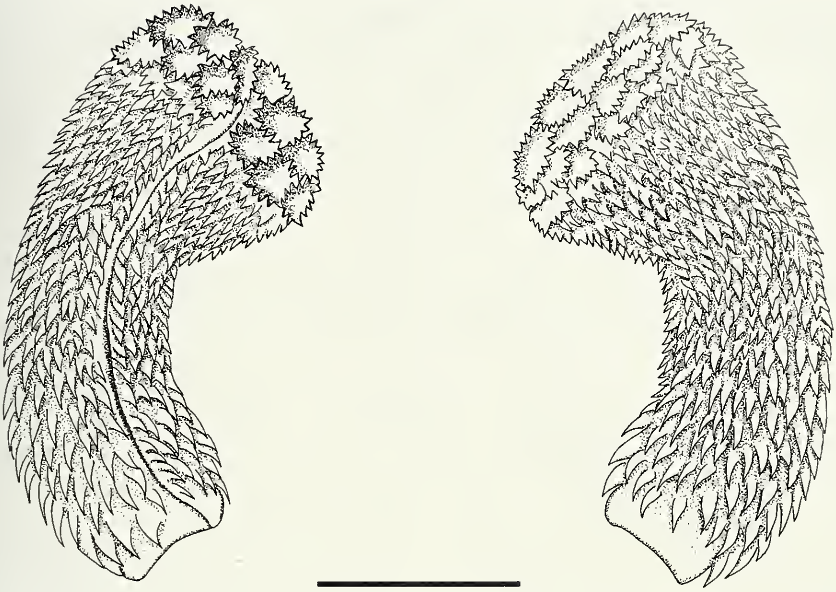

FIG. 2
Sulcate (left) and asulcate side of left hemipenis of *Platyceps ventromaculatus* MHNG 2643.44. Line equals 5 mm. Drawing by C. Charvet and H. Laubscher.

AMNH 2859 (see Appendix). The occurrence of *P. ventromaculatus* in Himachal Pradesh (Subathu) and Uttaranchal needs verification.

Subathu (30°58'N 77°00'E), the type locality of *Platyceps semifasciatus*, is at a higher altitude (close to or above 1'000 m above sea level) than any verified record of Gray's racer (see Taxonomy and Systematics). Furthermore, a "*Compsosoma semifasciata*, Blyth" reported by Stoliczka (1870: Pl. XI.2) from the "lower hills about Subathoo, south of Simla" and mentioned in Sclater (1891: "Below Simla, Sabathu") is *P. rhodorachis* auct. (in prep.).

Quoting a specimen in the BNHM collection ("Bo. M.") which is no longer found (Varad B. Giri *in litt.*), Wall (1914) reported "*Zamenis ventrimaculatus*" at, for instance, Mussoorie (30°27'N 78°05'E) 3). This missing racer and BMNH 1930.5.8.395, i.e., Wall's (1914, 1923) skull from "Lamgarrah" ("West of Almora" [Wall, 1914: 42] at 29°37'N 79°40'E), also in Uttaranchal ("United Provinces", Smith, 1943), may belong to *Platyceps rhodorachis* auct.

Apart from "Almora", Husain & Ray (1995) notified *Platyceps ventromaculatus* (as *Argyrogena*, see Taxonomy and Systematics) and "*Argyrogena rhodorhachis*"

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3) This also holds true for a racer from Kasauli (30°54'N 76°58'E) in Punjab assigned to the "many shielded" variety (Wall, 1914: map 2, "Bo. M.") and apparently missing today. According to Wall (1914: 38), these populations from "Almora to Gilgit, and Chitral" have a minimum of 216 ventrals and 126 subcaudals (sum 347), far beyond the range ascertained for *Platyceps ventromaculatus* (see footnotes 1 and 4). A maximum of 221 ventrals and 125 subcaudals (sum 335) is reported for the "few shielded" variety from the same area (e.g., Mussoorie).

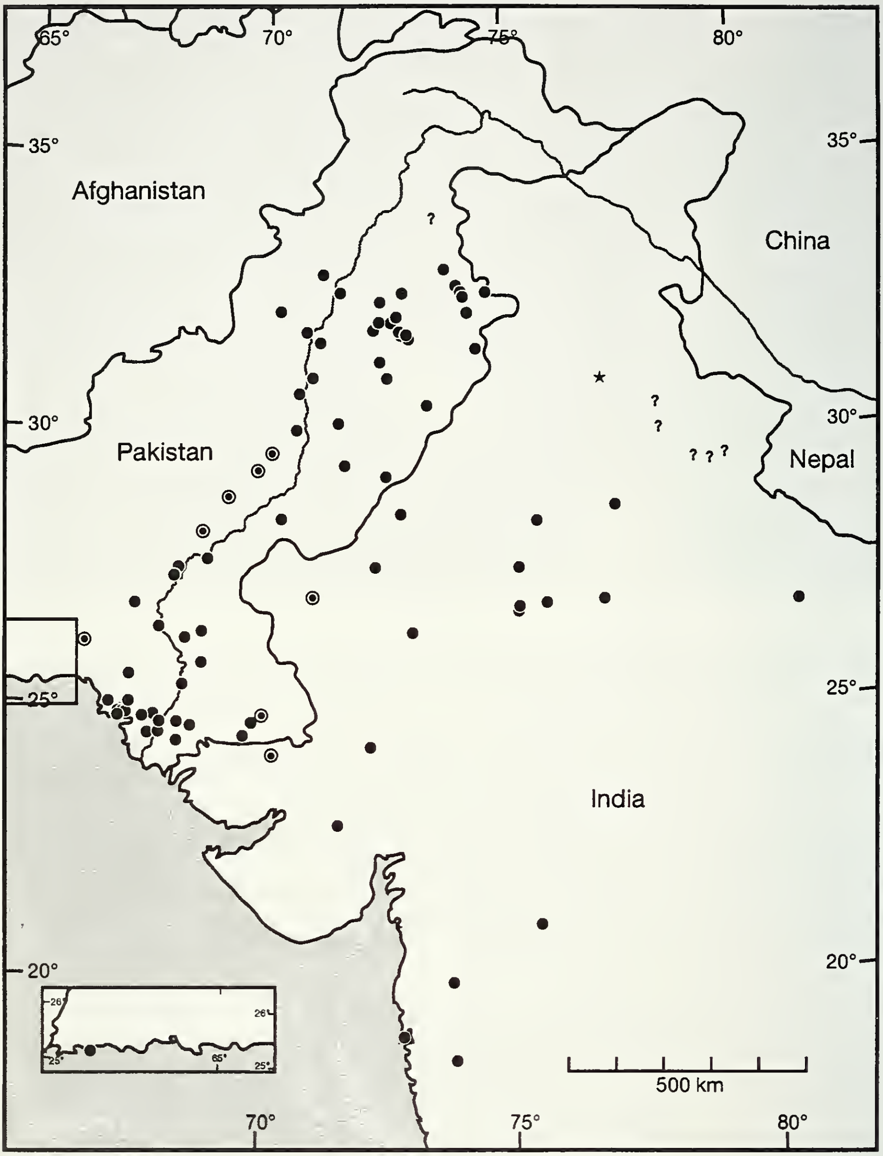

FIG. 3 - Distribution of *Platyceps ventromaculatus* based on specimens examined for this study except AMNH 2859 from Indian Punjab and literature records (see Material and Methods, synonymy, and Appendix). A ⦿ denotes approximate collecting sites (Rann of Kachh, "Rajputana" [Desert], SE Thar Parkar) including five unspecified localities west of the Indus mapped in Khan (2002). The star gives the position of Subathu in Himachal Pradesh, the type locality of *P. semifasciatus* Blyth (see Taxonomy and Systematics). Question marks indicate Bijrani, Khinanauli, Lamgarrah ["West of Almora"], Mussoorie, and "Rajaji National Park" in Uttaranchal (see Distribution, Habitats and Ecology) and an unspecified record from North Pakistan in Khan (1997) (see footnote 5). The inset shows the position of Gwadar (25°07'N 62°19'E) in the southwestern tip of Baluchistan, Pakistan (see footnote 2).

from the plains to 1'800 m a.s.l. in Naini Tal and Pauri Districts, Uttaranchal ("Uttar Pradesh"). Without further comment, Chopra (1979) listed both species from Corbett National Park. The presence of Gray's racer (as *Argyrogena*) "throughout" this Park (Lamba, 1987) relies on two sight records near Bijrani and Khinanauli. Also, Husain & Tilak's (1995) report of Gray's racer from Rajaji National Park (ca. 450-1'000 m a.s.l.) "is based on local information and its occurrence in the adjoining area (Chopra, 1979; Lamba, 1987)" (see Fig. 3).

Whitaker & Captain (2004) voiced legitimate doubts regarding the presence of *Platyceps ventromaculatus* in Uttaranchal ("need to be confirmed as this species is not a highland form") but their indication of Gray's racer in "Jammu & Kashmir" is erroneous. This is also the case with alleged records of Gray's racer from "Nepal" (Mahendra, 1984) [4)].

In Pakistan, *Platyceps ventromaculatus* is found at least as far north as Makarwal (32°53'N 71°09'E) in the Indus Valley (Khan, 1986: Fig. 1) and the vicinity of Jhelum (32°56'N 73°44'E), i.e., the foothills of the northern Punjab mountains [5)]. To the west, it is documented, for instance, from western Sind (e.g., Dadu and Larkana Districts), the Federal District and Las Bela in extreme southeast Baluchistan (see Fig. 3, Discussion), and the Makran coast close to the Iranian border (Boulenger, 1893; Minton, 1966; footnote 2). Although Gray's racer may occur farther west, the alleged occurrence of the species in Iran relies entirely on doubtful literature records (e.g., Blanford, 1876; Werner, 1936; Anderson, 1963; Latifi, 1991, 2000), i.e., likely confusion with other *Platyceps* spp. (see Discussion).

The species is "common" in Pakistan and found "throughout the area in arid or semi-arid habitat" (Minton, 1962; see also Ingoldby & Procter, 1923; Stoliczka, 1872b). Minton (1966) recorded *Platyceps ventromaculatus* "at elevations below 600 feet" in "sparse grassland or clay or sandy desert with scrubby vegetation." According to Khan (1997), Gray's racer "rarely extends above 300 m elevation" in Pakistan.

In northern Rajasthan, *Platyceps ventromaculatus* hibernates during the "extreme winter", i.e., at least from December to February or "even in the month of October" (Sundersingh, 1960). In southern Pakistan, specimens were "collected during every month and are plentiful throughout the warm season. They are most active from sunset until about two hours after darkness. A few have been found late at night or during the early morning. Resting individuals have been taken under stones and in euphorbia mounds" (Minton, 1966). Akram & Qureshi (1997) mentioned *P. ventromaculatus* from "Wheat and sugracane [sic] fields" in the Sargodha region (Punjab).

[4)] A male racer from Pithoragarh at 29°35'N 80°13'E (Uttaranchal) close to the border with Nepal with 19 midbody scale rows, 212 ventrals, 113 paired subcaudals (see footnote 3), and a total length of ca. 1230 (920 + 310) mm probably belongs to *Platyceps rhodorachis* auct. (Ashok Captain *in litt.* August 2005). This conclusion relies on details of the dorsal colour pattern, in particular the neck ("crossbars on the nape" and no "longitudinal marking", see Discussion), and the altitude (ca. 2'000 m a.s.l.) of the collecting site ("about 6000 ft.").

[5)] Khan (1997: 58) is probably correct that "Reports of this species from Chitral, Dir and Swat (McMahon, 1901a, b), actually pertain to *C.[oluber] rhodorachis*." Without further details, Khan (1997: Fig. 6) and Khan (2002: map 7) plotted a record of *Platyceps ventromaculatus* from the Wah – Nowshera area (Indus Valley) in extreme northern Punjab or adjacent Northwest Frontier Province (see Fig. 3).

According to Stoliczka (1872a), Gray's racer is "not a common species" in the Rann of Kachh where it was "found on the ground between brush-wood."

Platyceps ventromaculatus is largely terrestrial but sometimes climbs into bushes, buildings, and rocks. AMNH 84245, collected in early February, had devoured two bats, "and the stomach of another large individual contained a young musk shrew. A young individual had fed on an *Acanthodactylus*, and [...] another small specimen contained a gecko, *Hemidactylus flaviviridis*. Captives fed readily on most sorts of lizards but usually refused skinks. Nestling mice were occasionally eaten by the larger snakes. Prey is chewed vigorously and often immobilized or killed before being swallowed" (Minton, 1966). Sundersingh (1960: Tb. 1 and p. 56) found a "Tail of a rodent" ("probably of the common field rats") as stomach content. Sharma & Vazirani (1977) reported *Hemidactylus brooki* and the agamid *Calotes versicolor* (Daudin) as well as a "young bird" as food items. "The young ones subsist on insects and small frogs" (Husain & Tilak, 1995).

Minton (1966) recorded juveniles "from late July through January. A subadult individual measuring about 625 mm. when captured grew approximately 150 mm. during 18 months in captivity" (see footnote 1).

DISCUSSION

Many scientists working on the Middle East herpetofauna are by and large aware that the current systematics of the *Platyceps rhodorachis* complex and presumably allied species including *P. ventromaculatus* auct. are confusing and the identification of specimens often problematical even in comparatively limited areas (e.g., Minton, 1966; Anderson & Leviton, 1969; Mertens, 1969; see also footnote 3). Leviton (1959) noted that the distribution ranges of, for instance, *P. rhodorachis* auct. and Gray's racer "overlap most extensively", and "they exhibit the same ranges of morphological variation, the same color pattern variations, and are found in similar environmental situations", concluding that "their recognition is based upon characters of rather nebulous taxonomic value, and their present partition is not entirely satisfactory."

Although Khan (1997: Fig. 6) mapped *Platyceps ventromaculatus* (as *Coluber* auct.) to as far west as Mesopotamia (see below), he regards "all reports of this snake from Iran and Iraq as pertaining to local races of *C. rhodorachis* with low ventral and subcaudal counts" and is "inclined to believe that all *C. ventromaculatus* reported from west of the Indus [...] are actually color morphs of *C. rhodorachis*, and *C. ventromaculatus* does not extend westward beyond the Indus" (Khan, 1997: 56, 58; see also Khan & Khan, 2000). However, the species is distributed along the Makran littoral (footnote 2) to Las Bela (Hinidan) and Karachi (Federal District) in southeast Baluchistan and the delta of the Indus (Tatta Province), in Dadu and Larkana Districts, western Sind (e.g., "Gaj River", Mohenjodaro), and the Northwest Frontier Province ("Kaur Bridge", Makerwal) as evidenced by AMNH 84245, 88257, and SMF 57309 as well as literature records (Ingoldby & Procter, 1923; Minton, 1966; Mertens, 1969) including Khan (1986).

Khan (1997: 57) and Khan & Khan (2000: 52) argue that *Platyceps ventromaculatus* and *P. rhodorachis* auct. "sometimes indistinguishably intergrade into each other in appearance, scale counts and dorsal body pattern." Minton (1962: 17) demonstrated that these racers can be separated on the basis of their dorsal colour pattern, i.e., the "short vertebral dark stripe" on the neck of *P. ventromaculatus* (absent in *P. rhodorachis*) and "dark cross bars or rhombs" instead of "small, dark spots" along the trunk. Mertens (1969) noted differences in the sum of ventrals and subcaudals (328-387 in *rhodorachis*, see Morphology) and dorsal colour pattern ("wenig deutliche oder fehlende Kopfzeichnung, niemals einen länglichen Nuchalfleck und weit kleinere und sich wenig von der Grundfarbe abhebende Querflecken [auf dem Rücken]" in *rhodorachis*).

Khan (2002) is full of contradictory information (see, e.g., Tillack & Kucharzewski, 2004) and a plethora of minor errors and carelessness about details "add to the general inaccuracy and greatly undermine confidence in the biological data presented" (In den Bosch, 2003). Therefore, that book is no longer taken into consideration in this text except for the preparation of the map (Fig. 3, see footnote 5) and three quotations in the synonymy. Regarding *Platyceps* spp., Khan (2002) claimed, for instance, that *P. ventromaculatus* (type locality: "probably Bengal", see Type Material) was absent from India (p. 30) and west of the Indus (p. 106) but indicated its presence in "Western Balochistan" (p. 23), which is not shown on his map, and a distribution to as far west as Uzbekistan and Israel (*fide* Smith, 1943; Minton, 1966). Furthermore, Khan (2002: 46) did not list a doubtful subspecies (*bengalensis*, see Taxonomy and Systematics) described by himself two years earlier and cited in the descriptive part (p. 105), presented inconsistent scale data including subcaudal counts (pp. 57, 105), and perpetuated uncorroborated ideas regarding the systematics of the *rhodorachis-ventromaculatus* group of species which conflict with other of his statements (e.g., Khan, 2002: 24, 104, 106).

Leviton (1959: 462) quoted "*Coluber ventromaculatus* Gray & Hardwick" [sic] in his checklist of the Afghan herpetofauna and Leviton & Anderson (1970) noted that "Boulenger (1890, pp. 325-326) includes Afghanistan in the distribution, although we find no documented records."

Boulenger (1889) reported "*Zamenis ventrimaculatus*" BMNH 86.9.21.100 obtained by the Afghan Delimitation Commission at 35°12'N 60°26'E in eastern Iran ("One large specimen of this species was got at Bezd, Khorasan. The body was greatly injured, only the head and tail were therefore preserved."). Strangely, this mutilated racer, belonging to a taxon different from *Platyceps ventromaculatus* (Schätti, 2006), was registered as from "Afghanistan" in the files of the former British Museum of Natural History (see Boulenger, 1893; Wall, 1914: map 1). In fact, there are no records of *P. ventromaculatus* known from that country. The specimens from "Beloochistan and southern Afghanistan" (Bibinani [29°42'N 67°23'E], Gulistan [30°36'N 66°35'E], Kirta [29°36'N 67°29'E], and "Zandra") reported by Murray (1892, as "*Zamenis ventrimaculatus*") were not found in the institutional collections consulted for the purpose of this study and, most probably, belong to *Platyceps* spp. other than *P. ventromaculatus* as understood in this paper.

Regarding Iran, Blanford (1876) averred the presence of Gray's racer at, for instance, "South of Rigán, Narmashir", and Kerman (Province?), stating that he had found this species "abundantly in Persia" (Blanford, 1875). BMNH 74.11.25.11 (leg. W. T. Blanford) from Rigan (28°39'N 59°01'E) is *Platyceps rhodorachis* auct. and at least one of the Kerman racers (BMNH 74.11.25.10) belongs to *P. karelini* (Brandt) (Boulenger, 1893).

Due to the lack of morphological data, some of Blanford's (1876) "Z.[*amenis*] *ventrimaculatus*" [sic] from "Balúchistán" are difficult to classify. One individual from "Zamrán" may belong to *Platyceps karelini* (in prep.). Sclater (1891: 238) noted that "there are no specimens of *Z. ventrimaculatus* in the Indian Museum (Zoological Survey of India) from Persia or anywhere outside the Indian Empire" and referred those from, for instance, "Karman" and "Rigán" in southeast Iran (don. W. T. Blanford) to "*Z. ladaccensis*" [sic] [6].

Records of *Platyceps ventromaculatus* auct. annotated by Blanford (1881) from western Iran ("Bushire", Shiraz) possibly belong to a different taxon (see below). Apart from BMNH 86.9.21.100 (Khorasan, see above), this also holds true for one of Werner's (1917) "*Zamenis ventrimaculatus* Gray var. *semifasciatus* Blyth?" (Schätti, 2006); furthermore, this series includes ZFMK 31601, a paratype of *P. najadum schmidtleri* (Schätti & McCarthy, 2001) (see Schätti *et al.*, 2005).

Latifi (1991) briefly noted Gray's racer under *Platyceps rhodorachis* (as *Coluber* auct.) stating that the former differs from "*Coluber rhodorachis ladacensis* [...] occasionally in body color." Latifi's (2000) mention of "*C. ventrimaculatus*" auct. from various regions of Iran including unspecified localities in Sistan-va-Baluchistan may include *Platyceps* ssp. other than Gray's racer. However, the record of *P. ventromaculatus* from the Makran coast in westernmost Pakistan, roughly 75 km east of the border with Iran (see Fig. 3 and footnote 2), indicates its likely occurrence in the southeastern part of the latter country.

Smith (1943) reported Gray's racer from "Uzbekistan, and west to Palestine" (see, e.g., Minton, 1966; Gasperetti, 1977). Earlier, Wall (1914) had promoted the opinion that *Platyceps ventromaculatus* occurred in Egypt and the Horn of Africa (Somalia). These records are based on mis-identified taxa of the *P. rhodorachis* complex and include, in the case of Near East populations, *P.* cf. *ventromaculatus* (Schätti, 2005, 2006) [7].

Ultimately, the occurrence of *Platyceps ventromaculatus* auct. in the Near East and Gulf region relies on the systematic status of *Coluber chesneii* Martin, 1838 originally described from the "Euphrates" in Iraq. Günther (1858) considered this taxon to be identical with *P. ventromaculatus*, stating that the syntype of *C. chesneii* "agrees completely with the types" of Gray's racer (Günther, 1864).

Western populations of *Platyceps ventromaculatus* auct. including those formerly referred to Rogers' racer (*Zamenis rogersi* Anderson), i.e., *P.* cf. *ventromaculatus* (*sensu* Schätti, 2006) are similar to Sindian *P. ventromaculatus* (*sensu stricto*) in pholidosis and colour pattern including the spotted lateral edges of the ventrals that led to the scientific name of the species. However, they show differences in hemipenis features, i.e., the size of basal spines, distribution of apical calyces, and the insertion (%sub) of the retractor muscle (Schätti, 2006: Fig. 1, Tb. 2). This, the lack of verified records of genuine *P. ventromaculatus* from southeast Iran (see above) and *P.* cf.

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[6] *Zamenis ladacensis* Anderson, 1871 is usually considered a junior synonym or subspecies of *Platyceps rhodorachis* (Jan).

[7] Murray (1884) included "the whole of South Western Asia to Egypt" in the range of "*Zamenis ventrimaculatus*" (see also Tristram, 1884). Boettger (1888) considered the Irano-Turanian *Platyceps karelini* (Brandt, 1838) a subspecies ("var.") of Gray's racer. Nikolskij (1905), for instance, referred specimens of *P. rhodorachis* from Iran and Central Asia without vertebral stripe to *P. ventromaculatus*. Terentjev & Chernov (1949) correctly stated that "Specimens of *C. ventrimaculatus* (Gray) from the U.S.S.R. mentioned by several authors are actually *C. r. ladacensis*" (Anderson) (see footnote 6).

ventromaculatus from the Gulf area east of the vicinity of Bushehr, and preliminary molecular data (mtDNA) support the view that *Coluber chesneii* Martin may be specifically distinct from Gray's racer.

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Appendix

Platyceps ventromaculatus examined for the purpose of this study; specimens marked with an asterisk were used for the calculation of cephalic indices; two juveniles, MNHN 1962.154 and NMW 25452.3, are without data. India: AMNH *2859 ("Sutlej Valley or Punjab", ♂); BMNH 91.9.11.20 (Jodhpur, 26°17'N 73°02'E, ♂), 1946.1.11.42 ("Bengal (??)", ♀ syntype), 1947.3.2.38 (Lucknow, 26°51'N 80°55'E, ♀); NMW 25452.3 ("Katch" [Rann of Kachh], juv.), *25452.4 ("Katch", ♂). Pakistan: AMNH *81506 (Malir, 24°53'N 67°11'E, ♀), *81994 (3.5 mi. NE Karachi, ca. 24°55'N 67°05'E, ♂), 82001 (2 mi. E Landhi, ca. 24°51'N 67°13'E, ♀), *84020-21 (Karachi, 24°52'N 67°03'E, ♂♂), *84245 (Mohenjodaro, 27°19'N 68°07'E, ♂), *84246 (Karachi, ♂), *85302 (4 mi. N Dhabeji [Dabeji], ca. 24°50'N 67°31'E, ♂), 85455 (Karachi, sex unknown), *85580 (Karachi [International airport], ♀), *85864 (2 mi. W Hab Chauki [Chawki], ca. 25°02'N 66°53'E], ♀), *85865-66 (11 mi. SW Jamrao Head, ca. 26°21'N 68°45'E, ♀♀), 85867 (Karachi, juv. ♂), *88257 (Hinidan, 25°36'N 67°17'E, ♂), *88258-59 (near "Jampir" [Jampur, 25°44'N 68°52'E], ♂♂), *88465 (Karachi, ♂), *89294 (Ghizri, 24°49'N 67°03'E, juv. ♂); BMNH 69.8.28.116 (Karachi, ♀), 69.8.28.132 and 69.8.28.134 ("Sind" [Dr. Leith], ♀♀), 81.7.23.3 (Karachi, ♂), 89.2.1.4862-63 ("Sind", ♂♀), 1901.1.30.99-100 (Karachi, ♂♀); CAS *100073-74 (Ghizri, ♂♀), 101496-97 (Karachi, subad.), *101589 (Karachi, ♂); MCZ 15819 (Karachi, juv. ♀), *54401 (Tatta, 24°45'N 67°55'E, ♂); MHNG *1359.7-8 ("Sind", ♂♀), *1359.9-11 (Jungshahi, 24°51'N 67°47'E, ♀♀), *1359.13 (Karachi, ♀), 1560.46 (Karachi, subad.), *2443.10 ("Pakistan", ♂), 2443.13 (Rabwah, 31°45'N 72°55'E, ♀), 2443.14 (Khushab, 32°18'N 72°21'E, ♂), 2443.15 (Rabwah, ♀), *2443.16 ("Sind", ♂), 2443.18 ("Sind", subad. ♀), 2443.19-20 and 2629.96 (30 km NE Karachi, ca. 25°03'N 67°12'E, ♂, ♀♀), *2629.97 ("Pakistan", ♂), *2643.44 ("Pakistan", ♂); MNHN 1962.154 (Tatta, juv.), 1962.178-79 (Ghizri, ♀♂), 1962.180-81 (Jati, 24°21'N 68°16'E, juv. ♂, ♀), 1962.182 (Ghizri, subad. ♀), 1962.183-85 (Jungshahi, ♂♂, ♀), 1962.186 (Badin, 24°39'N 68°50'E, ♀), 1962.188 ("W Pakistan", ♀), *1962.263 (Ghizri, ♀), 1962.264-265 (Ghizri, ♀♂); MTKD *9011 and 9014 ("W Pakistan", ♀♂); NMW *25452.8-9 ("Sind", ♂♂); SMF 50411 (Bahawalpur, 29°24'N 71°41'E, ♀), 50412-13 (♀♂) and 50415 (Mirpur Sakro, 24°33'N 67°38'E, ♀), 50416-18 (Tatta, ♀♀), 57309 (Gaj River, ca. 26°55'N 67°18'E, ♂), 57310 (Mirpur Batoro, 24°44'N 68°16'E, ♂), 62950-51 (Ghizri, ♂♂), 62952 (Jati, ♂), 62953 (Malir, ♀), *62954 (Jungshahi, ♂).

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A new *Drapetisca* species from China and comparison with European *D. socialis* (Sundevall, 1829) (Araneae: Linyphiidae)

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A new *Drapetisca* species from China and comparison with European ~~***D. socialis* (Sundevall, 1829) (Araneae: Linyphiidae).** A new *Drapetisca*~~ species, *Drapetisca bicruris* sp. n. is described from China. It has been earlier confused with the European *D. socialis* (Sundevall, 1829). The two species are compared with each other and figures are provided for both species.

Keywords: Taxonomy - Palearctic region - Micronetine - genital structures - specimens.

INTRODUCTION

According to Platnick's spider catalogue (Platnick, 2006), the genus *Drapetisca* Menge, 1866 currently comprises four species: *D. alteranda* Chamberlin, 1909 and *D. oteroana* Gertsch, 1951 from the USA; *D. australis* Forster, 1955 from the Antipodes Island near New Zealand and *D. socialis* (Sundevall, 1833) from the Palearctic region, including China (Li, Song & Zhu, 1994; Tao, Li & Zhu, 1995; Song, Zhu & Chen, 1999; Hu, 2001). Examination of *D. socialis* samples from Europe and comparison with Chinese material previously identified as *D. socialis* deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) and in the Muséum d'histoire naturelle de Genève, Switzerland (MHNG), have revealed that they in fact belong to different species. They share a number of characters, including the same somatic appearance and similar genital structures, but differ in details. Accordingly, a new species, *Drapetisca bicruris* sp. n. is described from the specimens collected in China.

METHODS AND MATERIAL

Specimens were examined and measured under an SZ11-Olympus stereomicroscope. Left palps of males and epigyna of females were illustrated after they were dissected and detached from the spider's body; vulvae were cleared in boiling KOH solution. For examination under a compound microscope, genital organs were immersed in 75% alcohol; embolic divisions and vulvae were mounted in Hoyer's Solution. All illustrations were made under an Olympus BX41 compound microscope by using a drawing tube.

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For *D. socialis*, only the reference to the original description is cited in the text. The complete synonymy of this species name is given in Platnick's spider catalogue (Platnick, 2006).

Leg measurements are given in the following sequence: Total (femur, patella + tibia, metatarsus, tarsus). All measurements are in millimetres. Terminology of genital structures follows Saaristo & Tanasevitch (1996). Abbreviations are as follow:

Somatic morphology: AER—anterior eye row; ALE—anterior lateral eye; AME—anterior median eye; AME-ALE—distance between AME and ALE; AME-AME—distance between AMEs; AMEd—diameter of AME; PER—posterior eye row; PLE—posterior lateral eye; PME—posterior median eye; PMEd—diameter of PME.

Male palp: CA—carina; DSS—serrated extension of distal suprategulum; DTA—dorsal tibial apophysis; E—embolus; EP—embolus proper; FG—Fickert's gland; LC—lamella characteristeca; MM—median membrane; P—paracymbium; PCA—proximal cymbial apophysis; R—radix; SPT—suprategulum; TA—terminal apophysis; TH—thumb of embolus.

Epigynum: EG—entrance groove; LP—lateral pocket; PMP—posterior median plate; S—spermatheca.

TAXONOMY

Drapetisca bicruris sp. n. Figs 1-13

Drapetisca socialis Li, Song & Zhu, 1994: 80, f. 20-22; Tao, Li & Zhu, 1995: 245, f. 51-57; Song, Zhu & Chen, 1999: 167, f. 92G-J; Hu, 2001: 496, f. 329.1-3. (Misidentification)

Material examined: ♂ holotype, Huangyuan County, Qinghai Province, China, coll. Zhongshan Li, Oct. 1983 (IZCAS). Paratypes: 1♂2♀, same data as holotype (IZCAS); 1♂1♀, Huangyuan County, Qinghai Province, China, coll. Zhongshan Li, Aug. 1983 (MHNG); 2♂, Huangyuan County, Qinghai Province, China, coll. Zhongshan Li, Aug. 1983 (IZCAS); 1♂1♀, Mt. Changbaishan, Jilin Province, China, coll. Ye Tao, Sept. 1988 (IZCAS).

Etymology: The specific name, Latin: *bicruris* (bifurcate), refers to the fork-shaped apex of the longer branch of the lamella characteristica.

Diagnosis: The male of *D. bicruris* sp. n. can be distinguished by the forked apex of the longer branch of the lamella characteristica (Fig. 4). The female is distinct by the protruding, somewhat four-square, centrally hollowed epigynum (Fig. 9).

Description of male: Total length: 3.10. Carapace: 1.45 long, 1.30 wide. Abdomen: 1.90 long, 1.00 wide. Both sexes similar in general appearance. Carapace pale brown, with black margin. Eyes with black surroundings; AMEs small, others subequal; AER recurved, AME-ALE about AMEd, AME-AME shouter; PER straight, their interdistances shorter than PMEd; ALE and PLE juxtaposed. Chelicera brown, with two macrosetae on base of frontal face; fang groove with five promarginal and five retromarginal teeth, the last one of promargin bifid (Fig. 13). Sternum darker than carapace. Abdomen with white and black spots. Legs pale brown with black alternations. Lengths of legs: I 7.70 (2.25+2.40+2.40+0.65), II 7.45 (2.15+2.30+2.35+0.65), III 5.15 (1.55+1.50+1.55+0.55), IV 7.05 (2.00+2.05+2.25+0.75). Dorsal spines of tibia: 2-2-2-2. Tm I: 0.97. Tm IV present.

Male palp: Patella and tibia each with one dorsal macroseta. Four tibial trichobothria present, one prodorsally, three retrodorsally (Fig. 1). Proximal part of cymbium posteriorly prolonged into large, stout apophysis termed here posterior cymbial apophysis (PCA) (Fig. 3), additional lateral apophysis in front of it (Fig. 1). Paracymbium U-shaped, with bifid apex distally, one slender, one triangular; short hairs on basal part. Distal part of suprategulum with serrated extension pointing anteriorly, pit-hook absent (Fig. 8). Embolic division: anterior part of boat-shaped radix turning backwards (Fig. 5); lamella characteristica with large basal part, two narrow branches arising there: anterior one short, furnished with teeth apically, posterior one long, extending posteriorly, accompanying basal part of paracymbium, then turning back with forked apex pointing forwards (Figs 1, 4-6); terminal apophysis strongly sclerotized, extending out from base of lamella characteristica, bifid apically, with one spindle-like and one thin sclerite with scaled outer surface (Fig. 4); embolus short (Figs 5, 7), with large thumb and large sclerotized carina at each side of triangular embolus proper.

Description of female: Total length: 3.40. Carapace: 1.25 long, 1.00 wide. Abdomen: 2.40 long, 1.90 wide. Lengths of legs: I 5.50 (1.60+1.75+1.60+0.55), II 5.40 (1.60+1.65+1.60+0.55), III 3.90 (1.25+1.15+1.10+0.40), IV 5.15 (1.60+1.50+1.55+0.50). Dorsal spines of tibia: 2-2-2-2. Tm I: 0.95. Tm IV present. Other somatic characters as in male.

Epigynum: Protruding in lateral view (Fig. 10). As seen in ventral view, rounded four-square, central hollow on dorsal side forming large, shallow epigynal cavity (Figs 9, 11). Scape as well as stretcher lost, two lateral pockets well-developed (Fig. 12). Posterior median plate somewhat pentagonal.

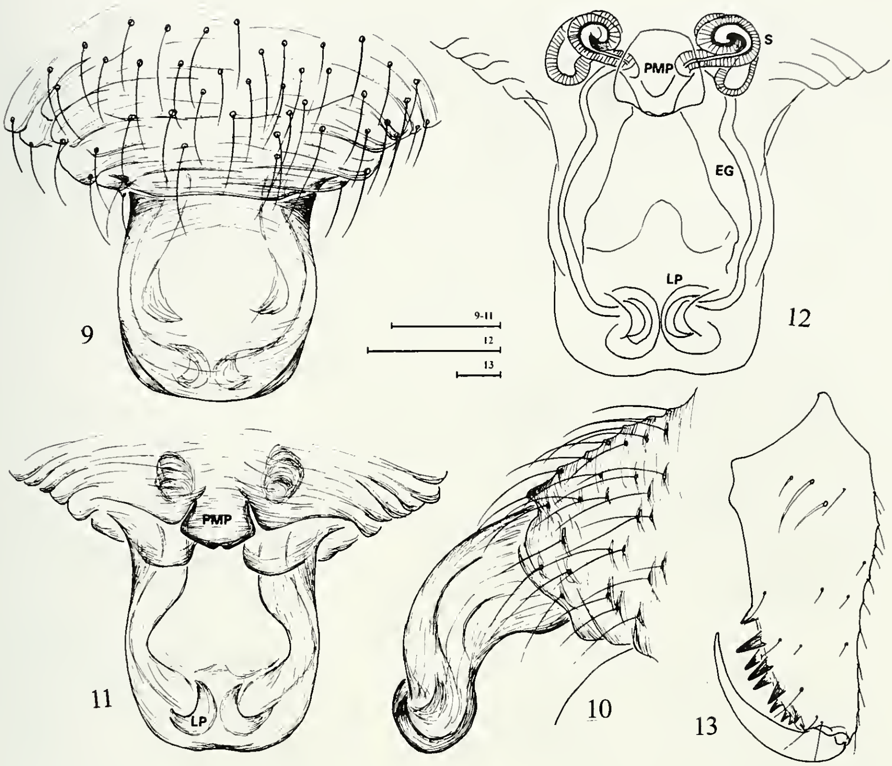
Variation: Male cephalothorax ranges in length from 1.35 to 1.45 (n = 5). Female cephalothorax ranges in length from 1.25 to 1.30 (n = 3). The total length varies from 2.80 to 3.15 in males examined (n = 5) and from 3.10 to 3.40 in females examined (n = 3).

Distribution: China (Jilin, Qinghai).

Remarks: The specimens examined were identified as the European species *D. socialis* in previous publications (Li, Song & Zhu, 1994; Tao, Li & Zhu, 1995; Song, Zhu & Chen, 1999; Hu, 2001) because they have similar genital structures, but males differ by: 1) there are two macrosetae along the promargin of the palpal cymbium in *D. socialis* (Fig. 16), but none in the new species (Fig. 3); 2) in *D. socialis*, the anterior margin of the basal sclerite of the lamella characteristica is folded inwards, strongly sclerotized, forming a pointed tip (Figs 14, 18), not so in the new species (Figs 1, 4); 3) the apex of the longer branch of the lamella characteristica is pointed in *D. socialis* (Fig. 17), forked in the new species (Fig. 4). In females of *D. socialis*, the epigynum is about twice as long as wide and its posterior margin is notched (Fig. 22), whereas that in the new species it is about as long as wide and the posterior margin is almost straight (Fig. 9). Furthermore, females of the new species differ from those of *D. socialis* by having a well-discernable epigynal cavity (Fig. 11).

Figs 1-8

Drapetisca bicruris sp. n. (male). (1) Left male palp, retrolateral view. (2) Left male palp, ventral view. (3) Left male palp, prolateral view. (4) Embolic division, dorsal view. (5) Embolic division, ventral view. (6) Embolic division (embolus removed), ventral view. (7) Embolus, dorsal view. (8) Distal part of suprategulum, ventral view. [Scale bars: 0.1mm].



FIGS 9-13

Drapetisca bicruris sp. n. (female). (9) Epigynum, ventral view. (10) Epigynum, lateral view. (11) Epigynum, dorsal view. (12) Vulva, dorsal view. (13) Left female chelicera, frontal view. [Scale bars: 0.1mm].

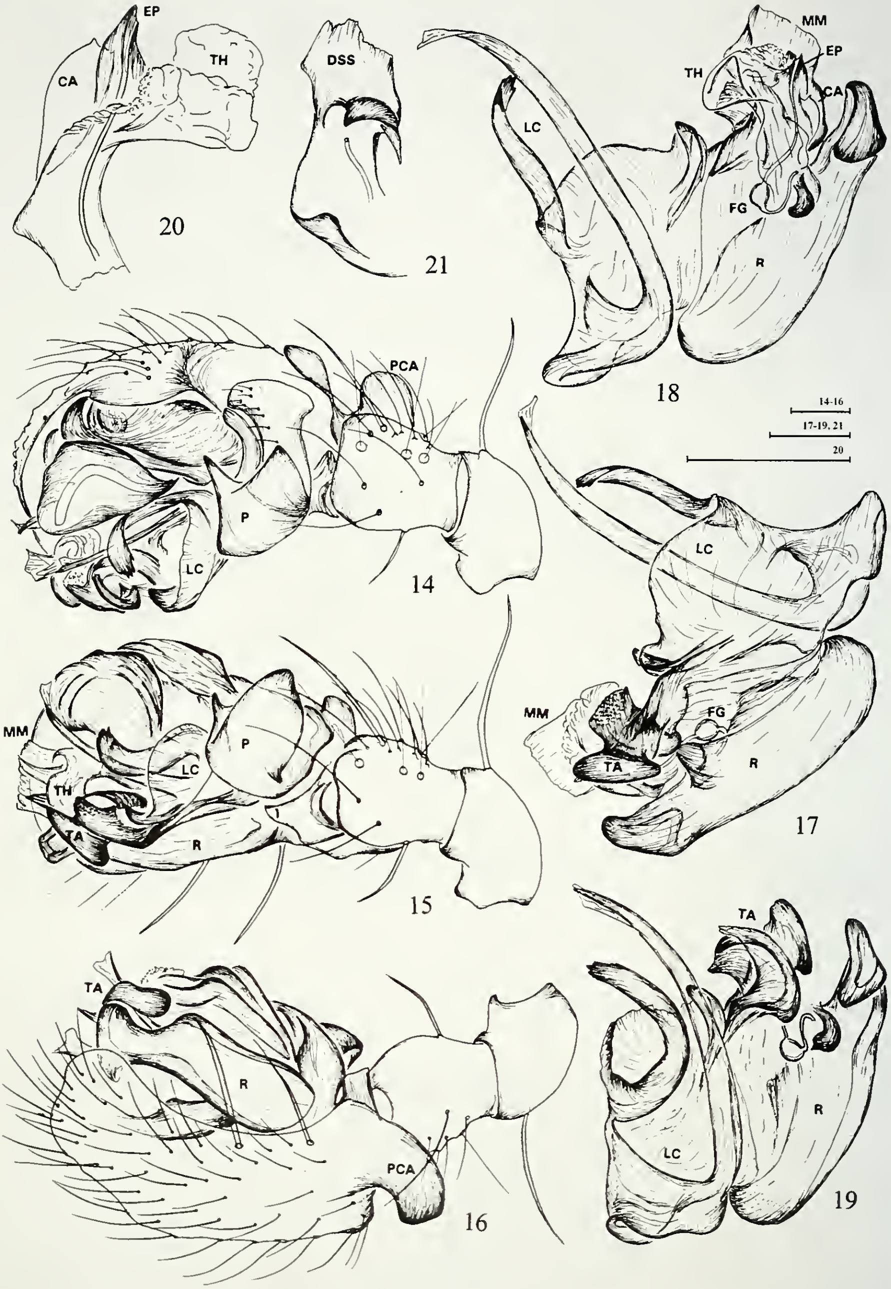
Drapetisca socialis (Sundevall, 1833) Figs 14-26

Linyphia socialis Sundevall, 1833: 260.

MATERIAL EXAMINED: 5♂5♀, Parainen, Mustfinnö, Finland, coll. M. Saaristo, Sept. 1968 (IZCAS); 2♂1♀, E-Köln, Nordrhein-Westfalen, Germany, coll. P. Jäger, 6 Sept. 1994 (IZCAS).

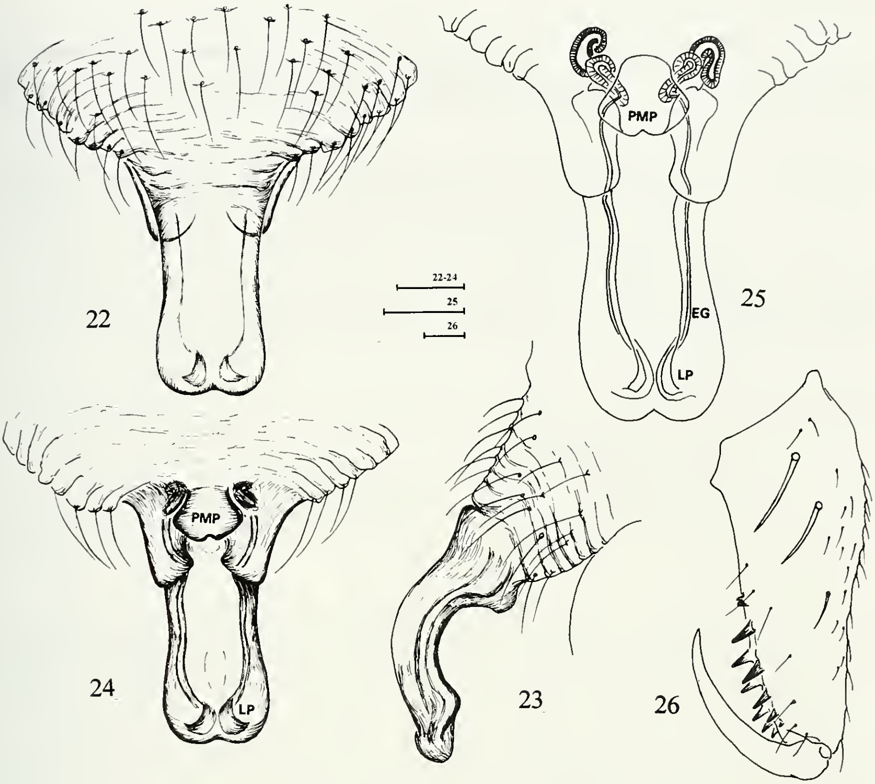
DIAGNOSIS: The male of *Drapetisca socialis* can be distinguished by the pointed apex of the longer branch and by the inward-folded basal sclerite of the lamella characteristica (Fig. 17); the female by the long, arched epigynum (Fig. 23).

MEASUREMENTS OF MALE: Total length: 3.00. Carapace: 1.45 long, 1.20 wide. Abdomen: 1.75 long, 1.10 wide. Chelicera brown, with two macrosetae on base of frontal face; fang groove with six promarginal and five retromarginal teeth, the last one of promargin bifid (Fig. 26). Lengths of legs: I 8.05 (2.25+2.5+2.60+0.70), II 7.60 (2.10+2.35+2.45+0.70), III 5.15 (1.65+1.50+1.60+0.40), IV 7.15 (2.10+2.05+2.35+0.65). Dorsal spines of tibia: 2-2-2-2. Tm I: 0.94. Tm IV present.



Figs 14-21

Drapetisca socialis (Sundevall, 1833) (male). (14) Left male palp, retrolateral view. (15) Left male palp, ventral view; (16) Left male palp, prolateral view. (17) Embolic division, dorsal view. (18) Embolic division, ventral view. (19) Embolic division (embolus removed), ventral view. (20) Embolus, dorsal view. (21) Distal part of suprategulum, ventral view. [Scale bars: 0.1mm].



FIGS 22-26

Drapetisca socialis (Sundevall, 1833) (female). (22) Epigynum, ventral view. (23) Epigynum, lateral view. (24) Epigynum, dorsal view. (25) Vulva, dorsal view. (26) Left female chelicera, frontal view. [Scale bars: 0.1mm]

MEASUREMENTS OF FEMALE: Total length: 3.90. Carapace: 1.60 long, 1.10 wide. Abdomen: 2.80 long, 2.00 wide. Lengths of legs: I 7.05 (2.00+2.30+2.05+0.70), II 6.80 (1.90+2.10+2.20+0.60), III 4.95 (1.45+1.45+1.55+0.50), IV 6.75 (1.90+2.00+2.20+0.65). Dorsal spines of tibia: 2-2-2-2. Tm I: 0.98. Tm IV present.

For other somatic characters and genital structures see descriptions and remarks under *D. bicruris* sp. n.

VARIATION: Male cephalothorax ranges in length from 1.40 to 1.70 (n = 7). Female cephalothorax ranges in length from 1.30 to 1.60 (n = 6). The total length varies from 3.00 to 3.75 in males examined (n = 7) and from 2.90 to 3.90 in females examined (n = 6).

DISTRIBUTION: Palearctic region.

ACKNOWLEDGEMENTS

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Coelotine spiders of the *Draconarius incertus* group (Araneae: Amaurobiidae) from southwestern China

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Coelotine spiders of the *Draconarius incertus* group (Araneae: Amaurobiidae) from southwestern China. – Five new coelotine species are added to the *Draconarius incertus* group: *Draconarius auriculatus* sp. n., *Draconarius falcatus* sp. n., *Draconarius immensus* sp. n., *Draconarius mupingensis* sp. n. and *Draconarius papillatus* sp. n. Detailed descriptions and illustrations of the new species are provided. The *Draconarius incertus* group now includes 8 species, all of which are from southwestern China.

Keywords: Taxonomy - new species - endemism - topography - variation.

INTRODUCTION

The coelotine genus *Draconarius* Ovtchinnikov, 1999 comprises nearly 100 species arranged into several species groups (Platnick, 2006). Three species are currently included in the *Draconarius incertus* group: *Draconarius exilis* Zhang, Zhu & Wang, 2005, *Draconarius incertus* Wang, 2003 and *Draconarius pseudobrunneus* Wang, 2003. According to the revision by Zhang *et al.* (2005), these three species were known only from the provinces of Sichuan and Yunnan in southwestern China. Because this region is famous for its varied topography and because coelotine spiders are well know for high endemism, we believe that more species can be found in southwestern China. Our collection trips to this region in the last years confirmed our assumption and several species of the *Draconarius incertus* group were collected. The current study is mainly based on the new collection from southwestern China, and only new species are reported.

METHODS

All the specimens examined in the current study are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) and in the Muséum d'histoire naturelle de Genève, Switzerland (MHNG).

Measurements are given in millimeters. Eye diameters are taken at the widest point. Leg measurements are shown as: Total length (femur, patella, tibia, metatarsus, tarsus). The terminology used in text and figure legends mainly follows Wang (2002). Abbreviations used in the text and figures are: A = atrium; ALE = anterior lateral eye; AME = anterior median eye; AME-ALE = distance between AME and ALE; AME-AME = distance between AME and AME; ALE-PLE = distance between ALE and PLE; C = conductor; CD = copulatory duct; CDA = dorsal apophysis of the conductor;

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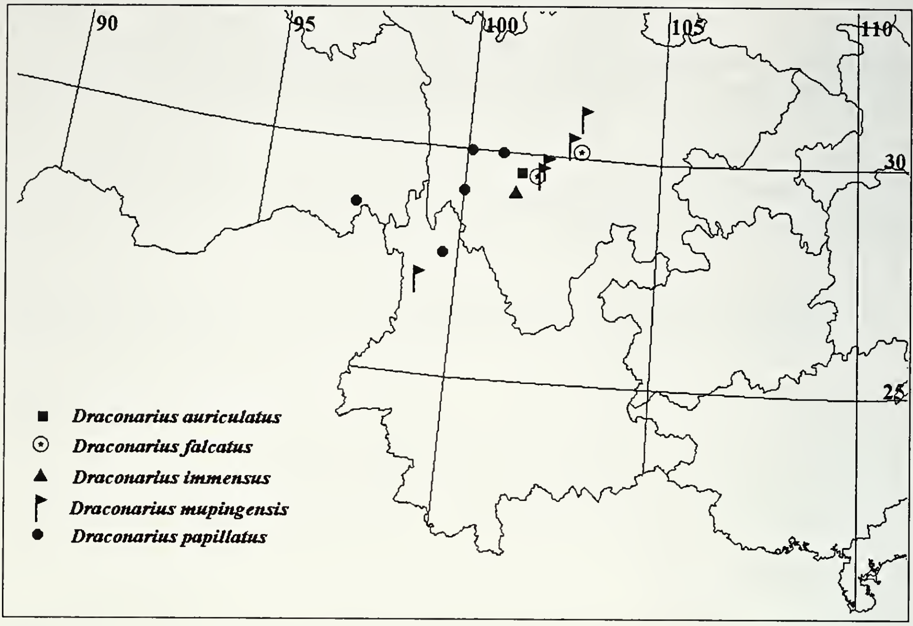


MAP 1
Locality records of five new *Draconarius* species in southwestern China.

CF = cymbial furrow; E = embolus; FD = fertilization duct; LTA = lateral tibial apophysis; MA = median apophysis; MOA = median ocular area; MOA-L = length of MOA; MOA-WA = anterior width of MOA; MOA-WP = posterior width of MOA; n = the number of specimens; PA = patellar apophysis; PES = posterior epigynal sclerite; PLE = posterior lateral eye; PME = posterior median eye; PME-PLE = distance between PME and PLE; PME-PME = distance between PME and PME; RTA = retrolateral tibial apophysis; S = spermathecae; SH = spermathecal head; T = tegulum; TS = tegular sclerite.

TAXONOMY

Draconarius incertus group species have 3 promarginal and 2 retromarginal teeth on the cheliceral groove of males and females; male palp with patellar apophysis, retrolateral tibial apophysis and lateral tibal apophysis; cymbial furrow short, less than half of cymbium length; conductor with bifurcated apex; dorsal apophysis of conductor present; median apophysis simple, not spoon-shaped; embolus moderately long, originating probasally. Female epigynum with distinct hood and without epigynal teeth; atrium strongly reduced into a slit, with distinct or indistinct, connected or unconnected anterior margin, and a sclerite on the posterior margin, termed here posterior epigynal sclerite (PES); spermathecae simple; copulatory ducts short or indistinct; spermathecal head situated anteriorly or mesally.

DISTRIBUTION: China (Sichuan, Tibet, Yunnan) (Map 1).

Draconarius auriculatus sp. n. Figs 1-4

HOLOTYPE ♂ (IZCAS): Gaer Town, Jiulong County (29.0° N, 101.5° E), Sichuan Province, China, collected by Dr Hongzhang Zhou and Mr Xiaodong Yu, June 29, 2001.

ETYMOLOGY: The species name refers to the conductor with an auriculate apex (Figs 2, 3).

DIAGNOSIS: This species can be easily distinguished from *D. incertus* by its broad conductor apex.

DESCRIPTION: MALE (holotype). Total length 11.62; carapace length 6.12, width 4.05; abdomen length 5.50, width 3.20. Eye measurement: AME 0.18; ALE 0.28; PME 0.23; PLE 0.25; AME-AME 0.06; AME-ALE 0.06; ALE-PLE 0.07; PME-PME 0.18; PME-PLE 0.20; MOA-L 0.58; MOA-WA 0.38; MOA-WP 0.50; clypeus 0.28. Cheliceral groove with 3 promarginal and 2 retromarginal teeth (Fig. 4). Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 20.2 (5.1 + 6.7 + 5.2 + 3.2); II: 18.3 (4.5 + 6.0 + 4.8 + 3.0); III: 15.4 (4.3 + 4.5 + 4.2 + 2.4); IV: 20.7 (5.3 + 6.3 + 6.2 + 2.9). Patellar apophysis slightly curved (Fig. 3); RTA modified into a shallow groove ventrally, and with distal end extended beyond tibia (Figs 2, 3); lateral tibial apophysis small (Fig. 3); cymbial furrow short, less than half of cymbium length (Fig. 3); conductor short, its apex divided into a sharply pointed part and an auriculate part (Figs 2, 3); dorsal apophysis of conductor small (Fig. 3); median apophysis very small, not spoon-like (Figs 2, 3); embolus moderately long, originating probasally (Fig. 2).

FEMALE: Unknown.

DISTRIBUTION: China (Sichuan) (map 1).

Draconarius falcatus sp. n. Figs 5-12

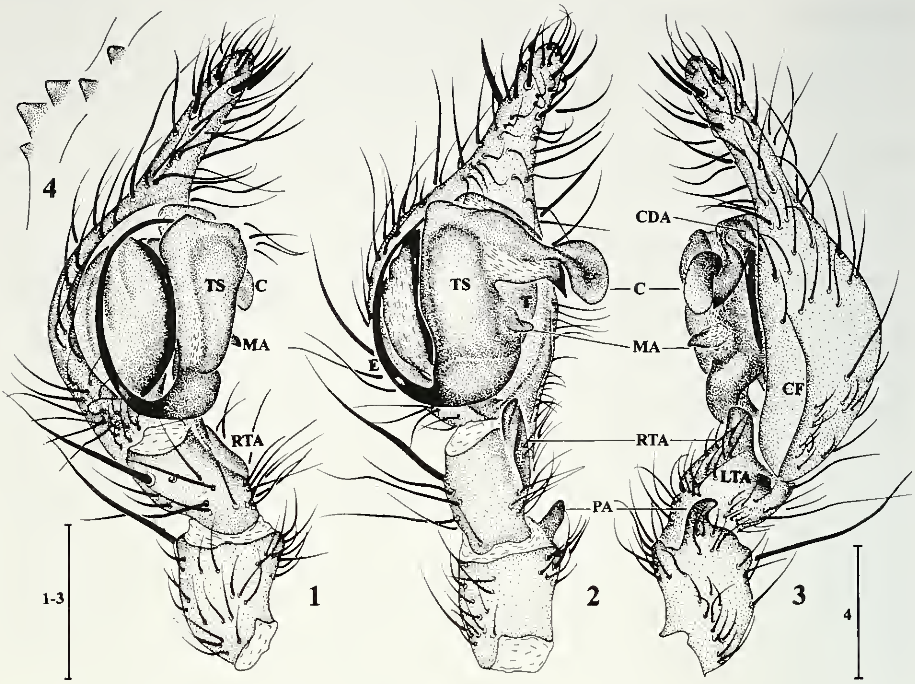
HOLOTYPE ♂ (IZCAS): Caohaizi, Hailuogou National Glacier Forest Park (29.6° N, 102.0° E), Luding County, Sichuan Province, China, collected by Ms Xiang Xu, October 3, 2005.

PARATYPES: 3♀ (IZCAS), same data as for the holotype; 1♂ (IZCAS), the eastern slope of Mountain Gongga (29.6° N, 101.8° E), Luding County, Sichuan Province, collected by Mr Yangong Xu, June 5, 1983; 1♀ (IZCAS), road from Moxi Town to Yajiageng (29.8° N, 102.1° E), Luding County, Sichuan Province, collected by Ms Xiufeng Zhang, October 10, 2005; 2♀ and 1♂ (MHNG), Yanzigou (29.7° N, 102.0° E), Moxi Town, Luding County, Sichuan Province, collected by Ms Xiang, Xu, October 9, 2005; 10♀ and 2♂ (IZCAS), Mt. Paoma (30.2° N, 102.9° E), Kangding County, Sichuan Province, collected by Ms Xiufeng Zhang and Ms Xiang Xu, October 12, 2005 and July 16, 2004.

ETYMOLOGY: The species name refers to the conductor with a falcate apex.

DIAGNOSIS: Males can be easily distinguished from those of other species of this group by the distinctly long conductor apex and by the presence of two patellar apophyses (Figs 6, 7); females by the spermathecae with the middle part distinctly expanded (Figs 10, 12).

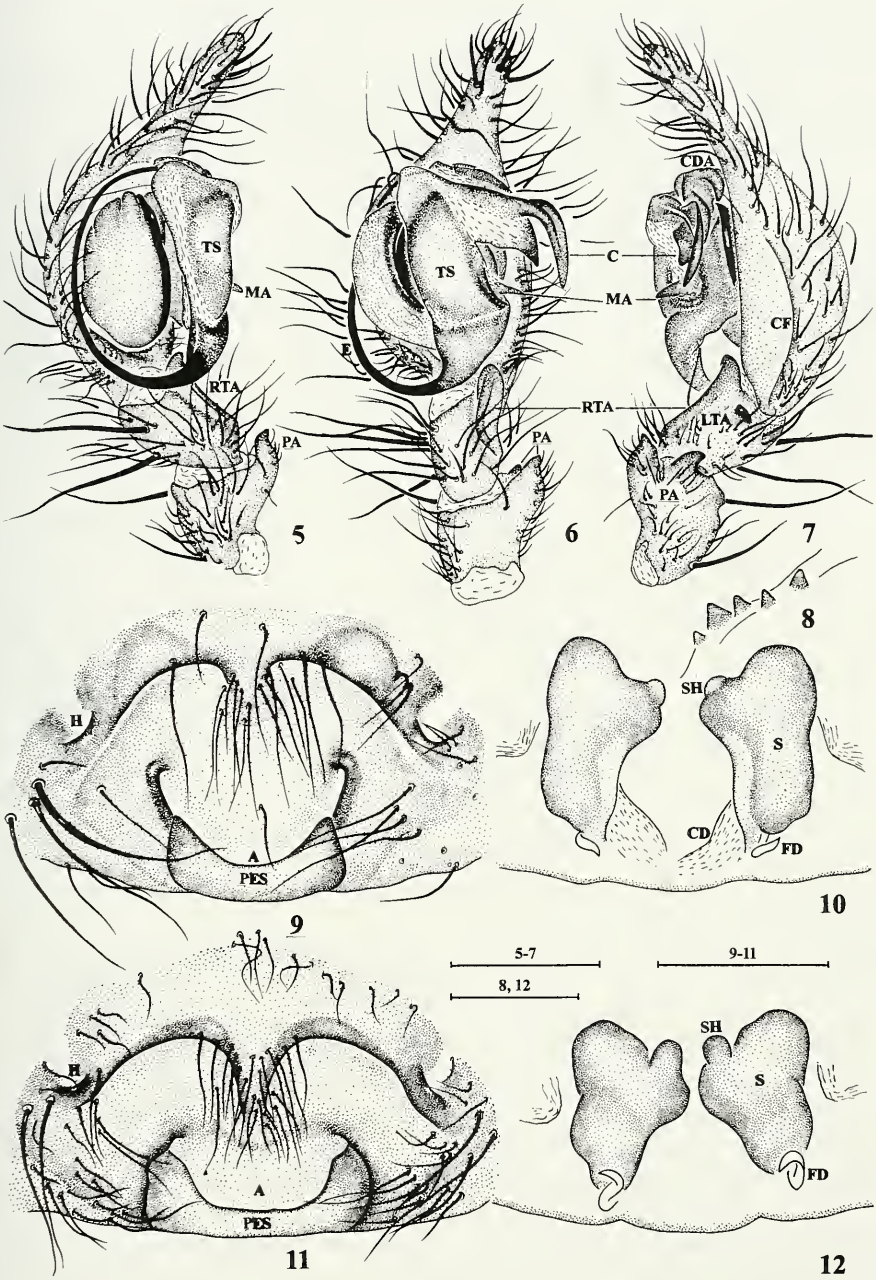
DESCRIPTION: MALE (holotype). Total length 10.10; carapace length 5.20, width 3.55; abdomen length 4.90, width 3.10. Eye measurements: AME 0.18; ALE 0.25; PME 0.20; PLE 0.23; AME-AME 0.05; AME-ALE 0.05; ALE-PLE 0.05; PME-PME 0.13; PME-PLE 0.18; MOA-L 0.53; MOA-WA 0.25; MOA-WP 0.53; clypeus 0.18.



FIGS 1-4
Draconarius auriculatus sp. n., male. (1) Palp, prolateral view. (2) Palp, ventral view. (3) Palp, retrolateral view. (4) Cheliceral groove. Scale lines: 1-3 = 1 mm; 4 = 0.5 mm.

Cheliceral groove with 3 promarginal and 2 retromarginal teeth (Fig. 8). Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 18.4 (4.7 + 6.0 + 4.7 + 3.0); II: 16.5 (4.3 + 5.2 + 4.4 + 2.6); III: 14.9 (3.9 + 4.3 + 4.5 + 2.2); IV: 19.3 (4.7 + 5.6 + 6.0 + 3.0). Male palp with two patellar apophyses (Figs 6, 7); RTA with distal end slightly extended beyond tibia (Figs 5-7); lateral tibial apophysis normal (Fig. 7); cymbial furrow about half of cymbium length (Fig. 7); conductor with bifurcated apex, one part flat, the other falcate (Figs 6, 7); dorsal apophysis of conductor moderately strong (Fig. 7); median apophysis small and sharply pointed (Figs 5-7); embolus moderately long, originating probasally (Figs 5, 6).

FEMALE: Total length 10.2; carapace length 5.2, width 3.3; abdomen length 5.0, width 3.1. Eye measurements: AME 0.15; ALE 0.25; PME 0.20; PLE 0.23; AME-AME 0.10; AME-ALE 0.06; ALE-PLE 0.10; PME-PME 0.15; PME-PLE 0.23; MOA-L 0.55; MOA-WA 0.40; MOA-WP 0.58; clypeus 0.25. Cheliceral groove with 3 promarginal and 2 retromarginal teeth. Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 13.7 (3.8 + 4.7 + 3.2 + 2.0); II: 12.0 (3.5 + 4.1 + 2.5 + 1.9); III: 11.5 (3.1 + 3.7 + 3.1 + 1.6); IV: 15.2 (4.0 + 4.8 + 4.4 + 2.0). Epigynum with atrium strongly reduced to a slit; anterior margin of atrium distinct and disconnection; PES with anterior margin distinctly concave; copulatory duct short, situated posteriorly;



FIGS 5-12

Draconarius falcatus sp. n., male (5-8), female (9-12). (5) Palp, prolateral view. (6) Palp, ventral view. (7) Palp, retrolateral view. (8) Cheliceral groove. (9) Epigynum, ventral view (typical form). (10) Epigynum, dorsal view (typical form). (11) Epigynum, ventral view (variant). (12) Epigynum, dorsal view (variant). Scale lines: 5-7 = 1.0 mm; 8-12 = 0.5 mm.

spermathecae anteriorly broader than posteriorly; spermathecal head small, papillary and situated mesally (Figs 9, 10).

VARIATION: The total length varies from 10.1 to 10.4 in males examined (n = 5) and from 8.1 to 13.8 in females examined (n = 16). Variation in shape of epigynum see Figs 9, 10 (typical form) and Figs 11, 12 (variant form).

DISTRIBUTION: China (Sichuan) (map 1).

Draconarius immensus sp. n. Figs 13-19

HOLOTYPE ♂ (IZCAS): Wuxuhai Nature Reserve (29.2° N, 101.4° E), Jiulong County, Sichuan Province, China, collected by Ms Xiang Xu, Ms Qian Wang and Mr Yanfeng Tong, July 26, 2004.

PARATYPES: 9♂ and 22♀ (IZCAS), same data as for the holotype; 2♂ and 24♀ (MHNG), same locality as for the holotype, collected by Ms Xiang Xu and Ms Xiufeng Zhang, October 17, 2005; 5♂ and 17♀ (IZCAS), Tanggo (29.1° N, 101.4° E), Jiulong County, Sichuan Province, collected by Ms Xiang Xu and Ms Xiufeng Zhang, October 17, 2005; 1♀ (IZCAS), same locality as for the former, collected by Ms Xiang Xu, July 27, 2004.

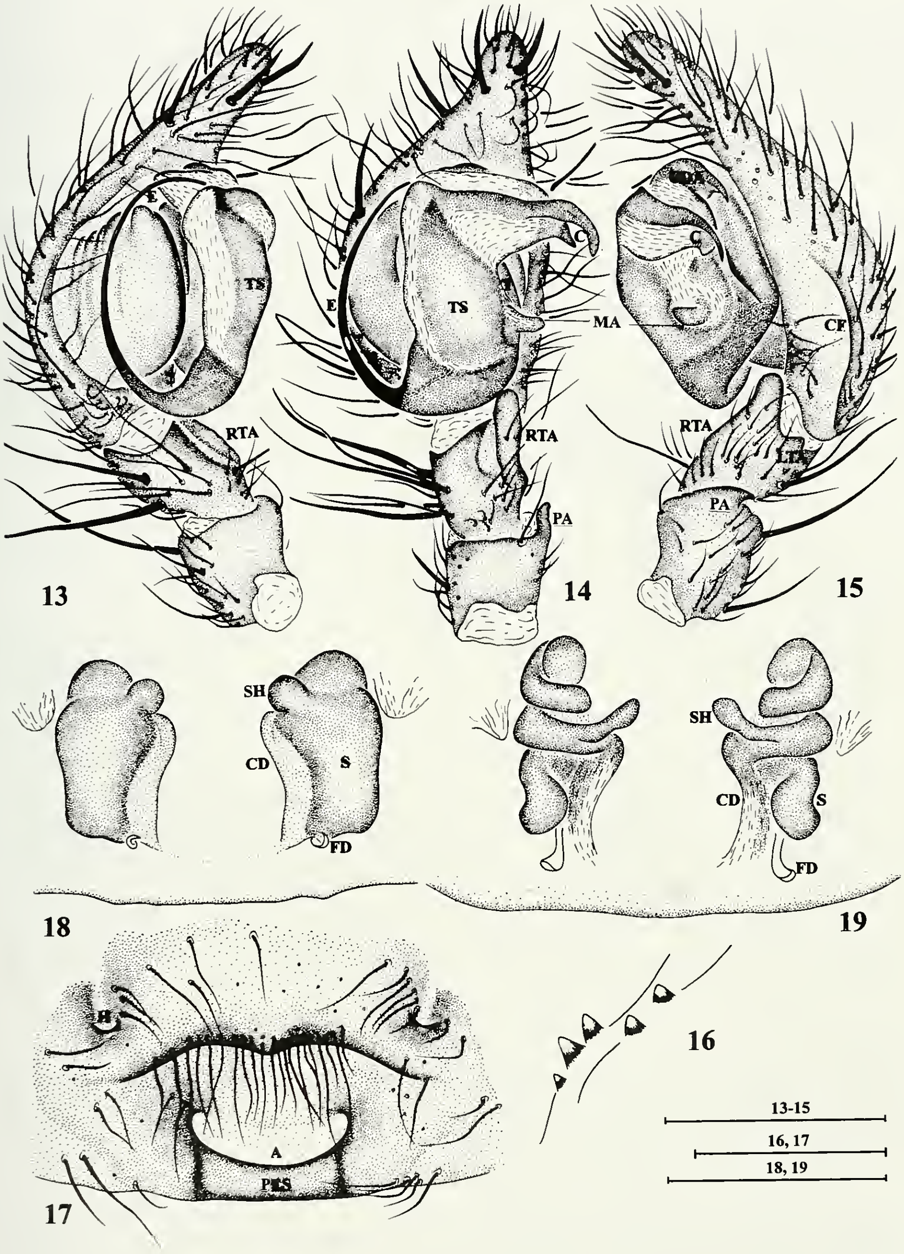
OTHER MATERIAL: 2♀ (sub-mature), same data as for the holotype.

ETYMOLOGY: The specific name, *immensus*, an adjective, is Latin for "boundless" and was given in reference to the habitat of the species.

DIAGNOSIS: This new species is similar to *D. incertus* but can be distinguished by the slightly longer conductor apex and slightly smaller median apophysis in males (Figs 14, 15) and by the different position of the spermathecal head in females (Fig. 18).

DESCRIPTION: MALE (holotype). Total length 9.5; carapace length 4.8, width 3.4; abdomen length 4.7, width 2.8. Eye measurements: AME 0.13; ALE 0.19; PME 0.10; PLE 0.18; AME-AME 0.09; AME-ALE 0.06; ALE-PLE 0.07; PME-PME 0.13; PME-PLE 0.15; MOA-L 0.33; MOA-WA 0.33; MOA-WP 0.45; clypeus 0.18. Cheliceral groove with 3 promarginal and 2 retromarginal teeth (Fig. 16). Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 17.2 (4.3 + 5.5 + 4.5 + 2.9); II: 15.4 (3.9 + 4.8 + 4.2 + 2.5); III: 13.7 (3.5 + 4.2 + 4.0 + 2.0); IV: 17.8 (4.3 + 5.3 + 5.5 + 2.7). Patellar apophysis small (Figs 14, 15); RTA strong, with distal end blunt (Figs 14, 15); lateral tibial apophysis small (Fig. 15); cymbial furrow short, about one third of cymbium length (Fig. 15); conductor with bifurcated apex (Figs 14, 15); dorsal apophysis of conductor small and sharp (Fig. 15); median apophysis small, membranous (Figs 14, 15); embolus moderately long, originating probasally (Figs 13, 14).

FEMALE: Total length 10.4; carapace length 5.2, width 3.4; abdomen length 5.2, width 3.5. Eye measurements: AME 0.13; ALE 0.23; PME 0.18; PLE 0.17; AME-AME 0.13; AME-ALE 0.09; ALE-PLE 0.13; PME-PME 0.18; PME-PLE 0.23; MOA-L 0.53; MOA-WA 0.38; MOA-WP 0.53; clypeus 0.18. Cheliceral groove with 3 promarginal and 2 retromarginal teeth. Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 12.7 (3.5 + 4.4 + 3.0 + 1.8); II: 11.6 (3.3 + 3.8 + 2.8 + 1.7); III: 10.7 (3.0 + 3.4 + 2.9 + 1.4); IV: 14.2 (3.7 + 4.5 + 4.1 + 1.9). Epigynum with atrium strongly reduced; anterior margin of atrium distinct and not disconnected; PES with anterior margin recurved; copulatory duct situated laterally; spermathecae simple; spermathecal head strumae-like and situated anteriorly (Figs 17, 18).



Figs 13-19

Draconarius immensus sp. n., male (13-16), female (17-19). (13) Palp, prolateral view. (14) Palp, ventral view. (15) Palp, retrolateral view. (16) Cheliceral groove. (17) Epigynum, ventral view; (18) Epigynum, dorsal view; (19) Epigynum (of sub-mature spider), dorsal view. Scale lines: 13-15 = 1.0 mm; 16-19 = 0.5 mm.

REMARKS: Spermathecae of sub-mature female convoluted; spermathecal head originating mesally (Fig. 19).

VARIATION: The total length varies from 8.00 to 9.50 in males examined (n = 17) and from 8.70 to 10.04 in females examined (n = 63).

DISTRIBUTION: China (Sichuan) (map 1).

***Draconarius mupingensis* sp. n.** Figs 20-26

HOLOTYPE ♂ (IZCAS): Muping Town, Baoxing County (30.3° N, 102.8° E), Sichuan Province, China, collected by Dr Hongzhang Zhou and Mr Xiaodong Yu, July, 2001.

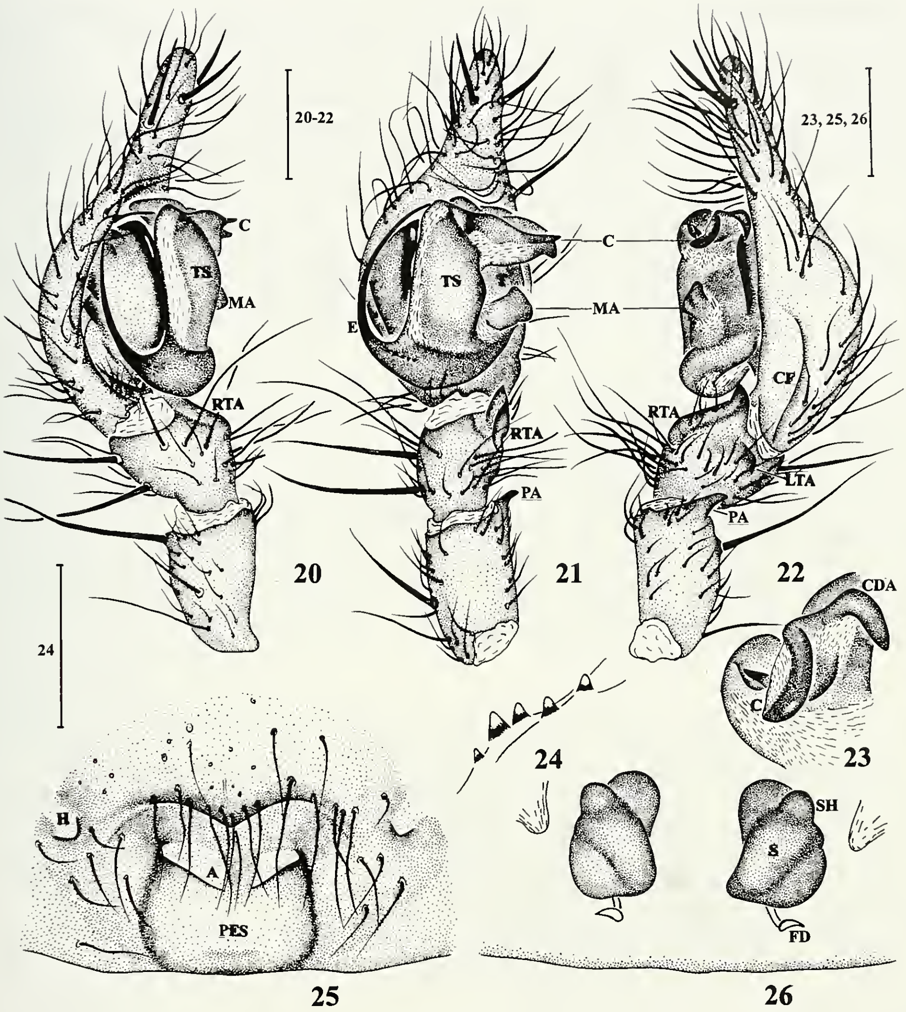
PARATYPES: 2♂ and 3♀ (MHNG), same data as for the holotype; 7♂ and 2♀ (IZCAS), same locality as for the holotype, June, 1997; 5♂ and 1♀ (IZCAS), same locality as for the holotype, June 7, 2001; 1♂ and 1♀ (IZCAS), Mountain Erlangshan (29.8° N, 102.2° E), Sichuan Province, collected by Mr Xiaodong Yu, July 6, 2001; 2♂ (IZCAS), Yajiageng, Moxi Town (29.6° N, 102.1° E), Sichuan Province, collected by Dr Lihong Tu, July 20, 2004; 1♂ (IZCAS), Wolong Nature Reserve (30.9° N, 103.1° E), Wenchuan County, Sichuan Province, collector unknown, September 25, 1993; 1♀ (IZCAS), Pantiange, Weixi County (27.1° N, 99.2° E), Yunnan Province, collector unknown, July 15, 1981.

ETYMOLOGY: The species is named after its type locality, Muping (formerly called Moupin), type locality for hundreds of species, including the giant panda *Ailuropoda melanoleuca* (David, 1869)(Anonymous, 1874).

DIAGNOSIS: Males are similar to those of *D. incertus* but can be separated by the broad median apophysis and the short conductor apex (Figs 21, 22), and females by the distinctly longer PES and the different position of the spermathecal head (Figs 25, 26).

DESCRIPTION: MALE (holotype). Total length 7.8; carapace length 4.1, width 2.8; abdomen length 3.7, width 2.3. Eye measurements: AME 0.10; ALE 0.18; PME 0.15; PLE 0.18; AME-AME 0.08; AME-ALE 0.05; ALE-PLE 0.05; PME-PME 0.13; PME-PLE 0.13; MOA-L 0.44; MOA-WA 0.28; MOA-WP 0.45; clypeus 0.13. Cheliceral groove with 3 promarginal and 2 retromarginal teeth (Fig. 24). Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 15.6 (3.9 + 4.9 + 4.1 + 2.7); II: 14.4 (3.6 + 4.5 + 3.8 + 2.5); III: 12.6 (3.2 + 3.8 + 3.7 + 1.9); IV: 16.0 (3.9 + 4.8 + 4.9 + 2.4). Patellar apophysis present (Figs 17, 18); RTA slightly modified into forming an indistinct groove ventrally, and with distal end slightly extended beyond the tibia (Figs 21, 22); lateral tibial apophysis broad (Fig. 22); cymbial furrow short, about one third of cymbium length (Fig. 22); conductor short, with slightly bifurcated apex, one part pointed and the other blunt (Figs 21-23); dorsal apophysis of conductor moderately developed (Figs 22, 23); median apophysis quadrate (Figs 21, 22); embolus moderately long, originating probasally (Figs 20, 21).

FEMALE: Total length 9.2; carapace length 4.0, width 2.4; abdomen length 5.2, width 3.2. Eye measurements: AME 0.13; ALE 0.23; PME 0.16; PLE 0.20; AME-AME 0.10; AME-ALE 0.05; ALE-PLE 0.08; PME-PME 0.13; PME-PLE 0.18; MOA-L 0.45; MOA-WA 0.33; MOA-WP 0.48; clypeus 0.13. Cheliceral groove with 3 promarginal and 2 retromarginal teeth. Leg IV longest; leg formula: IV, I, II, III; leg measurements as follows: I: 10.6 (3.0 + 3.7 + 2.5 + 1.4); II: 9.5 (2.8 + 3.2 + 2.2 + 1.3); III: 9.0 (2.5 + 3.0 + 2.3 + 1.2); IV: 11.6 (3.1 + 3.8 + 3.2 + 1.5). Epigynum with atrium strongly reduced; anterior margin of atrium distinct and not disconnected; PES long,



FIGS 20-26

Draconarius mupingensis sp. n., male (20-24), female (25, 26). (20) Palp, prolateral view. (21) Palp, ventral view. (22) Palp, retrolateral view. (23) Conductor in detail. (24) Cheliceral groove. (25) Epigynum, ventral view. (26) Epigynum, dorsal view. Scale lines: 20-22, 24 = 0.5 mm; 23, 25, 26 = 0.2 mm.

with anterior margin disconnected; copulatory ducts indistinct; spermathecae simple, widely separated from each other; spermathecal head situated anterolaterally (Figs 25, 26).

VARIATION: The total length varies from 5.9 to 7.8 in males examined (n = 19) and from 9.2 to 12.7 in females examined (n = 8).

DISTRIBUTION: China (Sichuan, Yunnan) (map 1).

Draconarius papillatus sp. n. Figs 27-30

Holotype ♀ (IZCAS): Sumdo (29.1° N, 100.1° E), Xiangcheng County, Sichuan Province, China, collector unknown, June 6, 1982.

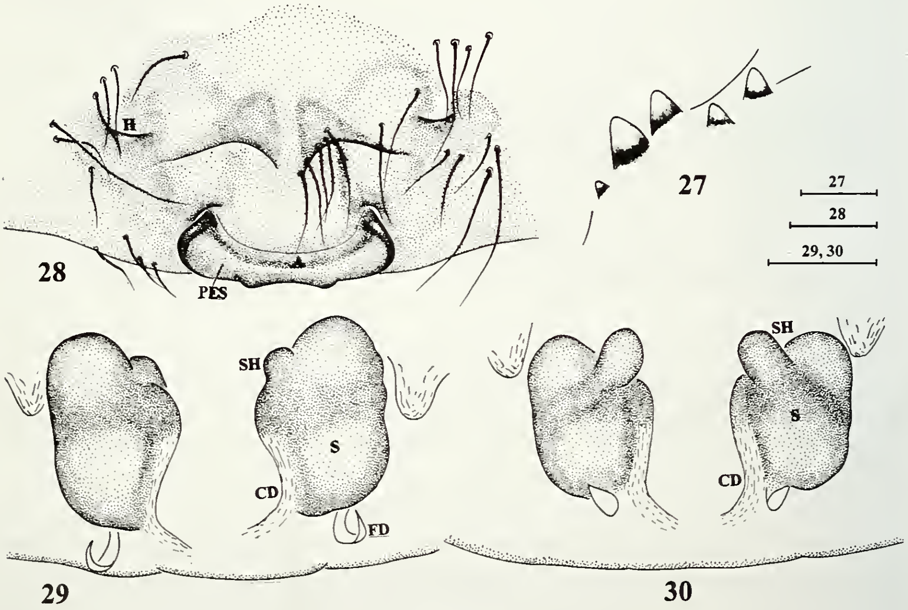
Paratypes: 2♀ (IZCAS), same locality as for the holotype, collector unknown, June 11, 1982; 2♀ (MHNG), same locality as for the holotype, collector unknown, June 11, 1982; 1♀ (IZCAS), Yajiang County (30.0° N, 101.0° E), Sichuan Province, collected by Mr Xiaodong Yu, June 7, 2001.

Other material: 1♀ (IZCAS), Zayu County (28.6° N, 97.4° E), Tibet, collector unknown, June 27, 1980; 2♀ (IZCAS), Zhongdian County (27.7° N, 99.7° E), Yunnan Province, collected by Mr Xiaodong Yu, July 24-25, 2000; 1♀ (sub-mature) (IZCAS), Litang County (30.0° N, 100.2° E), Sichuan Province, collector unknown, July 28, 1981.

Etymology: The specific name refers to the PES with papillae on its posterior margin.

Diagnosis: This species is similar to *D. immensus* sp. n. but can be distinguished by the disconnected anterior margin of the atrium and by the PES with papillae on its posterior margin (Fig. 28).

Description: Female (holotype). Total length 9.9; carapace length 4.7, width 3.3; abdomen length 5.2, width 3.6. Eye measurements: AME 0.18; ALE 0.28; PME 0.21; PLE 0.23; AME-AME 0.15; AME-ALE 0.11; ALE-PLE 0.13; PME-PME 0.20; PME-PLE 0.33; MOA-L 0.48; MOA-WA 0.53; MOA-WP 0.60; clypeus 0.25. Cheliceral groove with 3 promarginal and 2 retromarginal teeth (Fig. 27). Leg IV



Figs 27-30

Draconarius papillatus sp. n., female. (27) Cheliceral groove. (28) Epigynum, ventral view (typical form). (29) Epigynum, dorsal view (typical form). (30) Epigynum, dorsal view (variant). Scale lines: 27-30 = 0.2 mm.

longest; leg formula: IV, I, II, III; leg measurements as follows: I: 11.6 (3.2 + 4.1 + 2.7 + 1.6); II: 10.3 (2.7 + 3.6 + 2.5 + 1.5); III: 9.8 (2.5 + 3.3 + 2.6 + 1.4); IV: 13.1 (3.3 + 4.4 + 3.6 + 1.8). Epigynum with atrium strongly reduced to a slit; anterior margin of atrium disconnected; PES narrow, its anterior margin hidden and its posterior margin with two papillae; copulatory ducts situated laterally; spermathecae simple, widely separated from each other; spermathecal head situated anteriorly (Figs 28, 29).

MALE: Unknown.

VARIATION: The total length varies from 9.3 to 9.9 in females examined (n = 9). Variation in the shape of the spermathecal heads, see Figs 29, 30.

DISTRIBUTION: China (Sichuan, Tibet, Yunnan) (map 1).

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New species of coelotine spiders (Araneae, Amaurobiidae) from northern Thailand III

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New species of coelotine spiders (Araneae, Amaurobiidae) from northern Thailand III.- Two new species of coelotine spiders are described from northern Thailand: *Draconarius globulatus* sp. n. and *D. papai* sp. n., both from Phu Soi Dao National Park, Uttaradit Province. The unique patellar apophysis can easily distinguish *Draconarius globulatus* sp. n. from all other *Draconarius* species. *Draconarius papai* sp. n. is similar to the *venustus*-group species.

Keywords: Thailand - *Draconarius* - *venustus*-group - zoogeography.

INTRODUCTION

The northern part of Thailand is essentially a series of mountain ridges lying in roughly north-south direction with broad plains and valleys in between. Although this region makes up only approximately twenty percent of the country's land area, it processes evergreen hill forests where many species of high-altitude flora and fauna are abundant and cannot be found elsewhere. Over the past decades forest cover on most mountain slopes above 1,000 m was greatly reduced, mainly for cultivation. Fortunately several national parks have recently been established to protect forested areas all over the kingdom, particularly the evergreen forests of the north. Northern Thailand is undoubtedly home to many interesting species that still await discovery.

Recent publications have revealed and emphasized the richness of the spider fauna of northern Thailand and particularly of evergreen hill forests, where much of the natural habitats have remained relatively undisturbed by human activity (Dankittipakul & Wang, 2003, 2004; Dankittipakul *et al.*, 2005, 2006). Coelotine spiders were described from the Inthanon (15 species), the Khuntan (2 species) and the Phi Pan Nam ranges (5 species). In this study two new species of the subfamily Coelotinae are described from the Dan Lao range: *D. globulatus* sp. n. and *D. papai* sp. n. Both species were collected from Phu Soi Dao (650-1600 m asl), Phu Soi Dao National Park, Uttaradit Province.

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MATERIAL AND METHOD

All illustrations were made with a Nikon SMZ 800 and an Olympus SZX 9 stereomicroscope equipped with a drawing tube. Body measurements are in mm. Measurements of leg segments were taken from the dorsal side. Epigynes were drawn in natural and cleared state (after immersing them in lactic acid for 10-20 minutes). Male palps were drawn in lateral and ventral view.

The specimens examined are deposited in the collections of the Muséum d'histoire naturelle, Genève (MHNG) and in the collection of the first author (TC, Department of Biology, Chiang Mai University), which will be deposited in MHNG later.

Abbreviations used in the text and in the figures are as follow: A, atrium of epigyne; AER, anterior eyes row; ALE, anterior lateral eyes; AME, anterior median eyes; C, conductor; CD, copulatory duct; CL, conductor lamella; DC, dorsal apophysis of conductor (= conductor dorsal apophysis, according to Wang, 2002); E, embolus; ET, epigynal tooth; FD, fertilization duct; H, epigynal hood; LE, lateral eyes; MA, median apophysis; ME, median eyes; MOQ, median ocular quadrangle; PA, patellar apophysis; PD, posterior duct system; PER, posterior eyes row; PLE, posterior lateral eyes; PME, posterior median eyes; RDTA, retrolateral dorsal tibial apophysis (= lateral tibial apophysis according to Wang, 2002); RTA, retrolateral tibial apophysis; SC, subtegular sclerite; SH, spermathecal head; SP, spermatheca; SS, spermathecal stalk.

TAXONOMY

AMAUROBIIDAE Thorell, 1870

Draconarius Ovtchinnikov, 1999

Draconarius globulatus sp. n. Figs 1-5

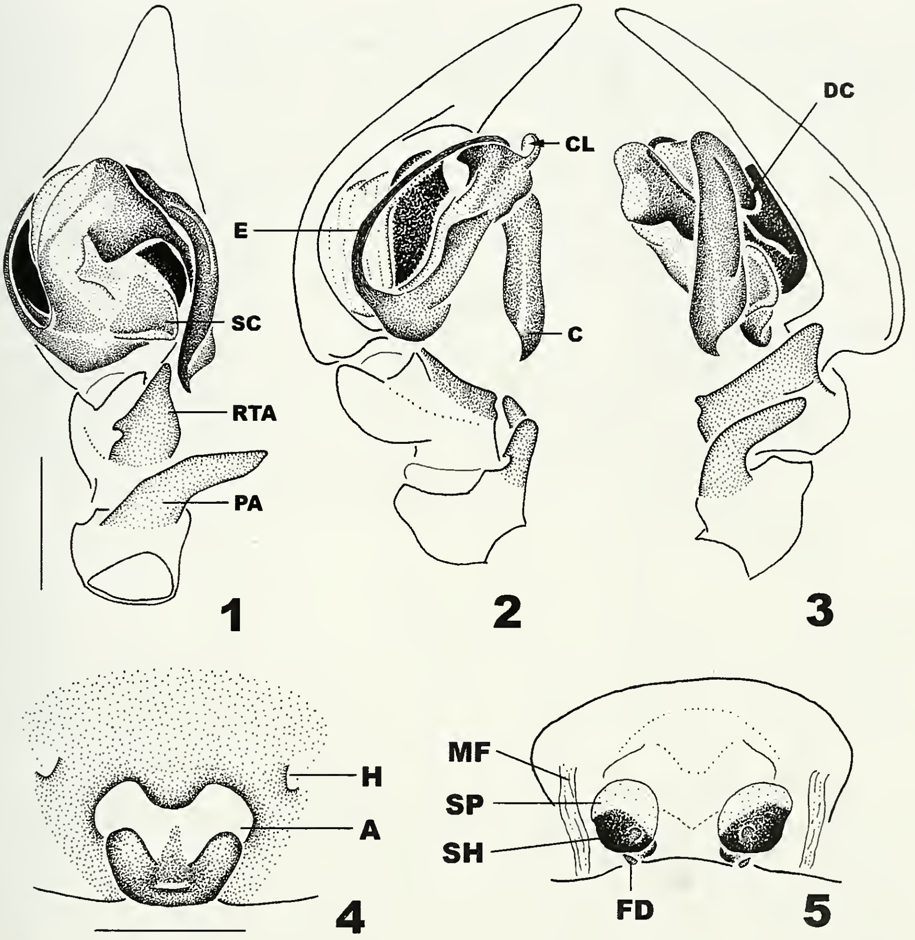
TYPE MATERIAL: Holotype: ♂, Thailand, Uttaradit Province, Phu Soi Dao National Park, Phu Soi Dao, mixed evergreen-deciduous forest, 1200 m, 22.XII.2005; leg. P.J. Schwendinger (MHNG TC x023). Paratype: 5♂, 8♀, lower montane forest, 650-830 m, 21.-23.XII.2005; leg. T Chami-Kranon & P Dankittipakul (MHNG TC x010-022).

ETYMOLOGY: The specific epithet refers to the strongly compacted spermathecae of females. Latin adjective of *globulus* = globule, a minute spherical or rounded structure.

DIAGNOSIS: *Draconarius globulatus* sp. n. has four unique characters that separate it from all other known *Draconarius* species: the extraordinary large and elongate patellar apophysis; the long, broad, posteriorly extending conductor; the absence of a median apophysis (Figs 1, 3); and the large epigynal atrium (Fig. 4).

DESCRIPTION: ♂ (holotype). Total length 9.94. Carapace 4.58 long, 3.15 wide. Abdomen 5.47 long.

Eye sizes and interdistances: AME 0.18, ALE 0.22, PME 0.18, PLE 0.21; AME–AME 0.10, AME–ALE 0.75, PME–PME 0.20, PME–PLE 0.25, ALE–PLE 0.10; MOQ 0.53 long, front width 0.50, back width 0.54. Clypeus height 0.22. Promargin and retromargin of chelicerae with 5 teeth.



Figs 1-5

Draconarius globulatus sp. n., ♂ holotype (1-3) and ♀ paratype (4, 5). Left palp: ventral (1), prolateral (2) and retrolateral (3) view. Epigyne, ventral view (4); its internal structures, dorsal view (5). Scale lines 0.5 mm (1-3); 0.25 mm (4, 5). Abbreviations: A, atrium of epigyne; C, conductor; CL, conductor lamella; DC, dorsal apophysis of conductor; E, embolus; H, epigynal hood; MF, muscle filaments; PA, patellar apophysis; RTA, retrolateral tibial apophysis; SC, subtegular sclerite; SH, spermathecal head; SP, spermatheca.

Leg measurements:

	I	II	III	IV
Femur	3.51	3.38	3.05	4.08
Patella + Tibia	4.53	4.08	3.57	4.76
Metatarsus	3.47	2.87	2.73	3.69
Tarsus	1.72	1.56	1.49	1.56
Total	13.23	11.89	10.84	14.09

Male palp (Figs 1-3). Patellar apophysis (PA) large and strongly elongated, anterolaterad-directed, with blunt apex in retrolateral view, pointed in ventral view. Retrolateral tibial apophysis (RTA) broad and high, strongly sclerotized, occupying approximately 3/4 of tibia length. Retrolateral dorsal tibial apophysis indistinct. Cymbial furrow basolaterally broad, occupying about half cymbium length. Basal lamella (CL) of conductor (C) indistinct in ventral view, distinct in prolateral view. Base of conductor strongly sclerotized; conductor elongate, posterad-directed, slightly curved in the middle, provided with sharply pointed tip. Dorsal apophysis of conductor (DC) triangular, its apex rounded. Median apophysis absent. Subtegular sclerite (SC) a simple plate with membranous margin. Embolus (E) long, relatively broad at base, originating posteriorly.

♀. Total length 10.58. Carapace 4.89 long, 3.21 wide. Abdomen 5.20 long.

Eye sizes and interdistances: AME 0.18, ALE 0.20, PME 0.16, PLE 0.20; AME–AME 0.14, AME–ALE 0.10, PME–PME 0.18, PME–PLE 0.24, ALE–PLE 0.08; MOQ 0.55 long, front width 0.49, back width 0.51. Clypeus height 0.25. Promargin of chelicerae with 5 teeth, retromargin with 6 teeth.

Leg measurements:

	I	II	III	IV
Femur	4.41	4.10	3.65	4.35
Patella + Tibia	5.74	5.05	2.69	5.50
Metatarsus	4.61	4.08	3.89	5.10
Tarsus	3.57	2.23	1.98	2.14
Total	18.33	15.46	12.21	17.09

Epigynum (Figs 4, 5). Epigynum strongly sclerotized, clearly elevated from epigastric area. Epigynal teeth absent. Atrium (A) large and deep. A transverse epigynal plate partly sclerotized. Epigynal hoods (H) distinct. Internal structures of epigynum with two more or less spherical spermathecae (SP) widely separated from each other; anterior part of each spermatheca lightly sclerotized, posterior part strongly sclerotized; posterormesally located spermathecal heads (SH) small, slightly rising from the spermathecae. Fertilization ducts (FD) simple, originating posteriorly.

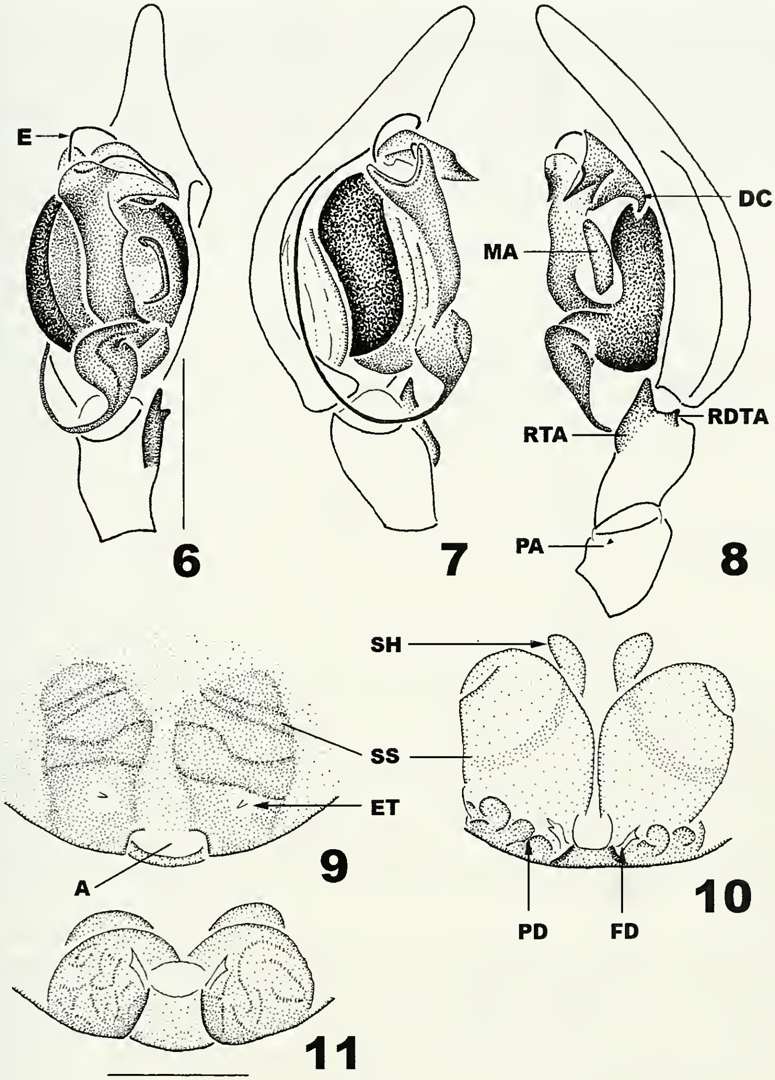
Natural history: The male holotype was collected on a fairly dry ridge in a mixed evergreen-deciduous forest. The paratypes were from a gallery evergreen forest (interspersed with bamboo stands along a stream). The lower sites are clearly more humid than the upper site. *Draconarius globulatus* sp. n. has a moderately wide altitudinal distribution, ranging from 650 to 1200 m. The holotype was collected as it was running across the trail, probably in search of a mate. The paratypes were collected from rotten logs along the stream. A few specimens were found from the same log.

Distribution: Known only from the type locality.

Draconarius papai sp. n. Figs 6-11

Type material: Holotype: ♂, Thailand, Uttaradit Province, Phu Soi Dao National Park, Phu Soi Dao, evergreen gallery forest, 650-830 m, 21.-23.XII.2005; leg. T. Chami-Kranon & P. Dankittipakul (MHNG TC x001).

Paratype: 2♂, 4♀, data as for the holotype (MHNG TC x002–009); leg. S. Sonthichai.



Figs 6-11

Draconarius papai sp. n., ♂ holotype (6-8) and ♀ paratype (9-11). Left palp: ventral (6), prolateral (7) and retrolateral (8) view. Epigyne, ventral view (9); its internal structures, dorsal (10) and caudal (11) view. Scale lines 0.5 mm (6-8); 0.25 mm (9-11). Abbreviations: A, atrium of epigyne; DC, dorsal apophysis of conductor; E, embolus; ET, epigynal tooth; FD, fertilization duct; MA, median apophysis; PA, patellar apophysis; PD, posterior duct system; RDTA, retrolateral dorsal tibial apophysis; RTA, retrolateral tibial apophysis; SH, spermathecal head; SS, spermathecal stalk.

Etymology: The specific epithet refers to the habitat where this new species was collected, a forest with sparse canopy which allows bamboo to grow and become relatively abundant. Thai: *Pa Pai* = bamboo forest; noun in apposition, thus invariable.

DIAGNOSIS: *Draconarius papai* sp. n. is similar to *D. phuhin* Dankittipakul, Sonthichai & Wang 2006 (Dankittipakul *et al.*, 2006) previously described from Phu Hin Rong Kla National Park (approximately 100 km direct distance away) in having a short conductor, but can be distinguished by the presence of a tiny patellar apophysis and by the short RTA (less than half the tibia length) (Figs 6-8). The broad spermathecae situated close to each other and the anteriorly situated spermathecal head are characteristics for the female (Figs 6-11).

DESCRIPTION: ♂ (holotype). Total length 3.58. Carapace 1.70 long, 0.85 wide. Abdomen 1.64 long.

Eye sizes and interdistances: AME 0.10, ALE 0.11, PME 0.08, PLE 0.12; AME–AME 0.08, AME–ALE 0.06, PME–PME 0.06, PME–PLE 0.12, ALE–PLE 0.04; MOQ 0.30 long, front width 0.28, back width 0.29. Clypeus height 0.15. Promargin and retromargin of chelicerae each with 5 teeth.

Leg measurements:

	I	II	III	IV
Femur	1.65	1.45	1.40	1.82
Patella + Tibia	1.83	1.51	1.58	1.88
Metatarsus	1.42	1.15	1.08	1.64
Tarsus	0.98	0.88	0.85	1.12
Total	5.88	4.99	4.91	6.46

Male palp (Figs 6-8). Patellar apophysis (PA) minute, difficult to see. Retrolateral tibial apophysis (RTA) relatively short, occupying approximately half of tibia length. Retrolateral dorsal tibial apophysis (RDTA) small and triangular, situated close to RTA. Cymbial furrow narrow, about 3/4 of cymbial length. Basal lamella of conductor moderately developed. Conductor short, beak-like, lightly sclerotized. Dorsal apophysis of conductor (DC) small and triangular, clearly visible in ventral view. Median apophysis (MA) spoon-shaped. Embolus (E) long and slender, originating posteriorly.

♀. Total length 6.25. Carapace 2.68 long, 1.84 wide. Abdomen 3.10 long.

Eye sizes and interdistances: AME 0.12, ALE 0.12, PME 0.10, PLE 0.13; AME–AME 0.08, AME–ALE 0.06, PME–PME 0.10, PME–PLE 0.13, ALE–PLE 0.06; MOQ 0.38 long, anterior width 0.35, posterior width 0.36. Clypeus height 0.11. Promargin of chelicerae with 5 teeth, retromargin with 6 teeth.

Leg measurements:

	I	II	III	IV
Femur	2.29	1.98	1.85	2.53
Patella + Tibia	2.70	2.21	1.93	2.75
Metatarsus	1.73	1.43	1.51	2.04
Tarsus	1.02	0.95	0.78	1.05
Total	7.74	6.57	6.07	8.37

Epigynum (Figs 9-11). Epigynal area relatively large, occupying 1/3 of the ventral side of the abdomen. Epigynal teeth (ET) small, lightly sclerotized, located in the middle of the epigynum. Atrium (A) small, situated close to epigastric furrow, provided with a posterior lip. Copulatory ducts indistinct, presumably arising near the membranous area in between the spermathecae. Spermathecal heads (SH) drumstick-shaped, medium-sized, situated anteriorly on spermathecae; spermathecal stalks (SS) originating mesally; spermathecal bases broad, close to each other, with strongly convoluted posterior duct system (PD). Fertilization ducts (FD) leaf-shaped.

NATURAL HISTORY: *Draconarius papai* sp. n. was found in a disturbed evergreen gallery forest where much of the canopy is open, allowing saplings (of bamboo in particular) to grow rapidly and fill the canopy space.

DISTRIBUTION: Known only from the type locality.

AFFINITIES

As currently understood, *Draconarius* is predominantly Paleartic (Wang 2002: 4, Fig. 1), with a large radiation into Southeast Asia (Nishikawa, 1995; Wang & Ono, 1998; Wang *et al.*, 2001), especially into the mountains of northern Thailand (Dankittipakul & Wang, 2003, 2004; Dankittipakul *et al.*, 2005, 2006). The genus currently includes nearly 100 nominal species, approximately 40 of which belong to nine species groups (Wang, 2003; Dankittipakul & Wang, 2004; Zhang *et al.*, 2005; Platnick, 2006). Two species groups were proposed for species collected from evergreen forests of northern Thailand: the *elatus*-group and the *lateralis*-group (Dankittipakul & Wang, 2004). The *lateralis*-group compromises three species, namely *D. lateralis* Dankittipakul & Wang, 2004, *D. paralateralis* Dankittipakul & Wang, 2004, *D. pseudolateralis* Dankittipakul & Wang, 2004. Members of the *lateralis*-group can be recognized by the following set of characters: the absence of a median apophysis in males; the presence of an additional subtegular sclerite (Fig. 1, SC); the absence of female epigynal teeth; the strongly sclerotized and compacted spermathecae; and the poorly developed or indistinct copulatory ducts. The species of the *lateralis*-group occur at relatively low altitudes (510-1200 m) and are adapted to deciduous forests where the humidity is much lower than in evergreen forests.

Draconarius globulatus sp. n. shares some of the characteristics of the *lateralis*-group: the presence of a subtegular sclerite (Fig. 1, SC); the absence of epigynal teeth; and the partly membranous spermathecae. We presume that members of the *lateralis*-group belong to a separate clade. All three species possess the characters described above as diagnostic of the species-group. However, no cladistic analysis has been published to resolve this debate and therefore the wider concept of *Draconarius* (*sensu* Ovtchinnikov, 1999 and Wang, 2002, 2003) is used in the present article. Additional material is required to confirm the above synapomorphic characters as evidence for the monophyly of the *lateralis*-group.

Draconarius papai sp. n. belongs to the *venustus*-group that comprises more than 20 nominal species. The known distribution of this species group ranges from Central Asia, the Himalayas (Nepal, Bhutan, Tibet), East Asia (China, Korea) to Southeast Asia (Thailand). The new species described here provides additional taxonomical information on the *venustus*-group and expands its known zoogeographical distribution.

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New yellow-legged *Hybos* from Nanling, Guangdong, China (Diptera, Empidoidea, Hybotidae)

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New yellow-legged *Hybos* from Nanling, Guangdong, China (Diptera, Empidoidea, Hybotidae). - Five species of the genus *Hybos* with yellow legs are reported from the Nanling National Nature Reserve, Guangdong province. The following 3 species are described and illustrated: *Hybos ruyuanensis* sp. n., *H. trispinatus* sp. n., and *H. wangae* sp. n. They are compared with morphologically similar species.

Keywords: Diptera - Hybotidae - *Hybos* - new species - Nanling-Guangdong

INTRODUCTION

Hybos Meigen is a cosmopolitean genus belonging to the subfamily Hybotinae of the family Hybotidae. It is characterized by the following features: anal cell longer than basal cell, Rs rather short, R4+5 and M1 divergent apically and basal cells separated by distinct vein M1+2 (Chvála, 1983). The Oriental Region is the most diverse with 37 described species up to the mid eighties (Smith, 1975) and only 9 species were known from the Palaearctic region (Chvála & Kovalev, 1989) prior to the extensive studies of the Chinese fauna which started some 20 years ago. Currently 85 species are known to occur in China, most of which have black legs. They have been mainly described by Yang & Yang (1986, 1987, 1988a, b, 1989, 1991, 1995a, b), Saigusa & Yang (2002), and Yang *et al.* (2002). A comprehensive revision of the present knowledge of the genus was recently published by Yang & Yang (2005). Other major references dealing with *Hybos* in the Old World are Brunetti (1920), Frey (1953), Smith (1965), Saigusa (1963, 1965), and Chvála (1983).

Guangdong with a subtropical and tropical climate is situated in southern China and the fauna belongs to the Oriental realm. Before 2003, no studies on the empidoid fauna were available. A short survey in 2003, as part of a co-operation between China

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Agricultural University (Beijing), South China Agricultural University (Guangzhou) and the Royal Belgian Institute of Natural Sciences (Brussels) revealed the presence of numerous new species (Daugeron *et al.,* 2003; Grootaert *et al.,* 2003; Zhang *et al.,* 2003). Nanling National Nature Reserve (23°20'N, 115°23'E) situated in North of Guangdong, is one of the largest Nature Reserves in South China and famous for its biodiversity. In the present paper, 5 species of the genus *Hybos* with yellow legs are reported, based on the material collected by Mr Xingyue Liu and Ms Shuwen An by sweeping in July 2003. Three species are described as new to science. A key is given to separate the five closely related species to facilitate their identification.

MATERIAL AND METHODS

The specimens on which this study is based are deposited in the following collections:

CAU Insect collection of China Agricultural University, Beijing, China.
MHNG Muséum d'histoire naturelle, Genève, Switzerland.

Basic terminology follows McAlpine (1981) and Steyskal & Knutson (1981). The following abbreviations are used: acr = acrostichal, ad = anterodorsal, av = anteroventral, dc = dorsocentral, oc = ocellar, npl = notopleural, pd = posterodorsal, pprn = postpronotal, presc = prescutellar, psa = postalar, pv = posteroventral.

KEY TO SPECIES OF *HYBOS* FROM NANLING (MALES ONLY)

1 Hind femur with 2-3 rows of ventral spines; hind tibia with 1-2 dorsal bristles at middle; scutellum black; femora entirely yellow or with dark apex 2
1* Hind femur with one row of ventral spines; hind tibia without dorsal bristles at middle; femora and scutellum yellow . . . . *trispinatus* sp. n.
2 Hind tibia with 1 ad and 1 pd at middle; hind femur entirely yellow or with dark apex 3
2* Hind tibia with 1 dorsal bristle at middle; mid tibia with 2 dorsal bristles on basal half; hind femur dark brown apically . . . *orientalis* Yang & Yang, 1986
3 Mid tibia with 2 bristles in dorsal to anterodorsal position on basal half; hind femur with brown apex 4
3* Mid tibia with 1 dorsal bristle on basal half; all femora entirely yellow . . . . *ruyuanensis* sp. n.
4 Only hind femur dark brown apically . . . . . . *gutianshanus* Yang & Yang, 1995
4* All femora brown or dark brown apically . . . . *wangae* sp. n.

TAXONOMIC PART

Hybos gutianshanus Yang & Yang, 1995

Hybos gutianshanus Yang & Yang, 1995c: 237.

Type locality: Zhejiang (Gutianshan Mountain).

MATERIAL: 2 males, Guangdong: Ruyuan, Nanling National Nature Reserve, 23. VII. 2003, Xingyue Liu & Shuwen An (CAU); 1 male, Guangdong: Ruyuan, Nanling National Nature Reserve, 24. VII. 2003, Xingyue Liu (MNHG).

DIAGNOSIS: Femora yellow, but hind femur dark brown apically; the latter with two rows of ventral spines. Mid tibia with 2 dorsal bristles on basal half; hind tibia with 2 dorsal birstles at middle.

DISTRIBUTION: China (Guangdong, Zhejiang).

Hybos orientalis Yang & Yang, 1986

Hybos orientalis Yang & Yang, 1986: 82.

Type locality: Guangxi (Longsheng), Fujian (Jianyang).

MATERIAL: 2 males, Guangdong: Ruyuan, Nanling National Nature Reserve, 25. VII. 2003, Xingyue Liu & Shuwen An (CAU & MNHG).

DIAGNOSIS: Femora yellow, but hind femur dark brown apically, the latter with two rows of ventral spines. Mid tibia with 2 dorsal bristles on basal half; hind tibia with 1 dorsal bristle at middle.

DISTRIBUTION: China (Guangdong, Guangxi, Fujian, Henan).

Hybos ruyuanensis sp. n. Figs 1-5

MATERIAL: Holotype male, Guangdong: Ruyuan, Nanling National Nature Reserve, 23. VII. 2003, Xingyue Liu (CAU). Paratypes 10 males, 3 females, same data as holotype (CAU & MNHG); 17 males, 8 females, Guangdong: Ruyuan, Nanling National Nature Reserve, 25. VII. 2003, Xingyue Liu (CAU).

ETYMOLOGY: The species is named after the type locality Ruyuan.

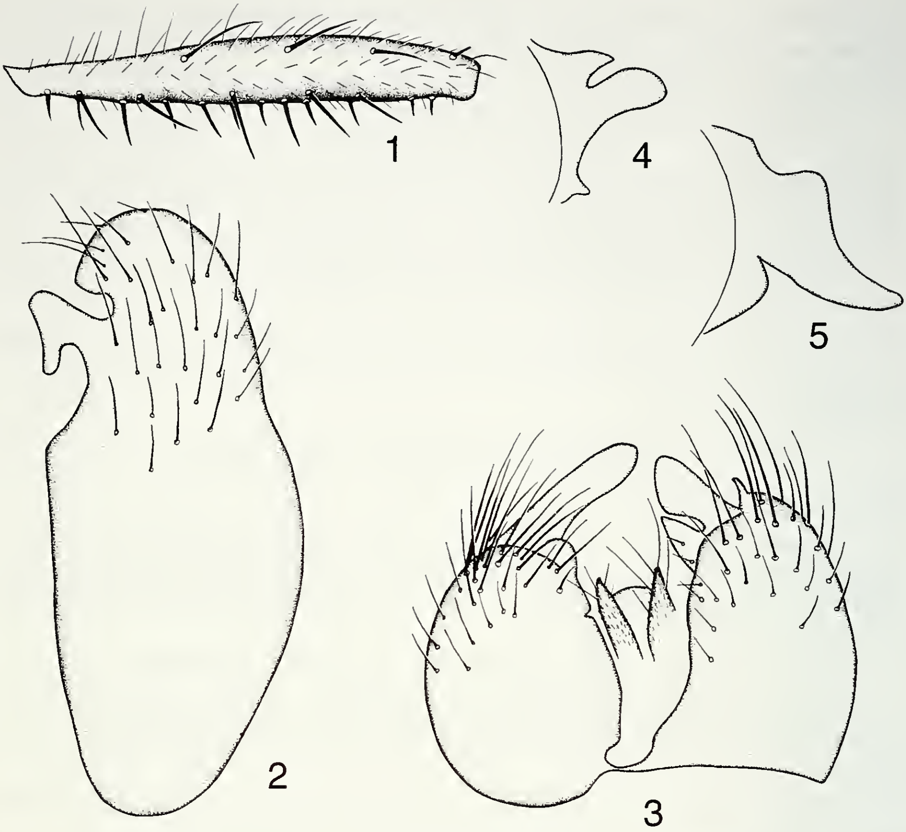
DIAGNOSIS: Scutellum black. All femora yellow; hind femur with 2-3 rows of ventral spines. Mid tibia with 1 ad on basal half; hind tibia with 1 ad and 1 pd at middle.

DESCRIPTION (MALE): *Measurements*: Body length 4.5-4.9 mm, wing length 4.0-4.2 mm.

Head: Black, pale grey microtrichose. Eyes brown but enlarged upper facets pale brownish yellow, contiguous on frons for a long distance which is 3.0 times the length of the 1st flagellomere. Bristles on head black, hairs mostly pale; ocellar tubercle weak, with 2 very short oc and without posterior hairs. Antenna black; scape without hairs; pedicel with a circle of subapical hairs; 1st flagellomere without dorsal hairs; arista black, short pubescent except apical 1/4 thin and bare. Proboscis brown; palpus blackish with 2 ventral hairs.

Thorax: Black (including scutellum), pale grey microtrichose. Bristles on thorax black, hairs mostly pale; postpronotal lobe with 3-4 hairs (posterior one slightly longer); pprn absent, 2 npl (anterior npl slightly shorter), acr in about 8 more or less regular rows, 1 long posterior dc and 6-8 hairs anteriad, 1 long presc, 1 long psa; scutellum with 6 pale marginal hairs and 2 very long black subapical bristles.

Legs: Entirely yellow including coxae, only tarsomeres 3-5 dark brown; bristles black and hairs mostly pale except coxae and trochanters with pale bristles and hairs. Fore femur as wide as mid femur, with one row of hair-like short av and slightly longer pv; mid femur with several ad on basal half and one row of hair-like av and pv; hind femur (Fig. 1) twice as wide as mid femur, with 4 anterior bristles, and with 2-3 rows of ventral spines (spines of av row rather long). Fore tibia with 1 ad at middle, apically



FIGS 1-5

Hybos ruyuanensis sp. n. (male). (1) hind femur anterior view. (2) hypandrium, ventral view. (3) genitalia, dorsal view. (4) left surstylus. (5) right surstylus.

with 1 long ad and 1 short pv; mid tibia with 1 very long ad and 1 very long av in basal half, 1 preapical ad, and 1 preapical posterior bristle, apically with 4 bristles (of which 1 pv is very long); hind tibia with 1 very long strong ad and 1 slightly shorter pd on median portion, and 1 preapical anterior bristle, apically with 1 av and 1 pd. Fore tarsomere 1 with 1 long ventral bristle at extreme base; mid tarsomere 1 with 1 long av and 1 short pv at extreme base and 1 pv at middle, apically with 5 bristles; hind tarsomere 1 with short, strong ventral bristle.

Wing: Slightly tinged greyish; veins dark brown; stigma about as long as one third of cell R1 and brown. Squama dark yellow, bordered with pale hairs. Halter brownish yellow.

Abdomen: Nearly straight or slightly curved downward, black, grey microtrichose. Hairs on abdomen mostly pale. Male genitalia (Figs 2-5): left epandrial lobe rather wide in dorsal view, left surstylus short and broad with three short apical processes; right epandrial lobe rather wide in lateral view, right surstylus short and broad with oblique and curved tip; hypandrium much longer than wide, obtuse apically, and with apico-lateral incision bearing a hook-like curved process.

FEMALE: Body length 3.7-4.3 mm, wing length 3.9-4.0 mm. Similar to male, but hind femur with only 1 strong preapical bristle (rarely with a weak additional bristle), and hind tibia with only 1 dorsal bristle at middle.

DISTRIBUTION: China (Guangdong).

REMARKS: The new species is similar to *Hybos aurifer* Saigusa, 1963, from Japan in having yellow legs with pale hairs and hind femur with 2-3 rows of ventral spines, but can be easily separated from the latter by having the mid tibia with only 1 dorsal bristle on basal half. In *H. aurifer*, the mid tibia has 2 dorsal bristles. The two species differ also in details of structure and chaetotaxy of male terminalia.

Hybos trispinatus sp. n. Figs 6-10

MATERIAL: Holotype male, Guangdong: Ruyuan, Nanling National Nature Reserve, 24. VII. 2003, Xingyue Liu (CAU). Paratype 1 male, same data, 25. VII. 2003 (MNHG).

ETYMOLOGY: The species is named after the right epandrial lobe with 3 long strong apical spines.

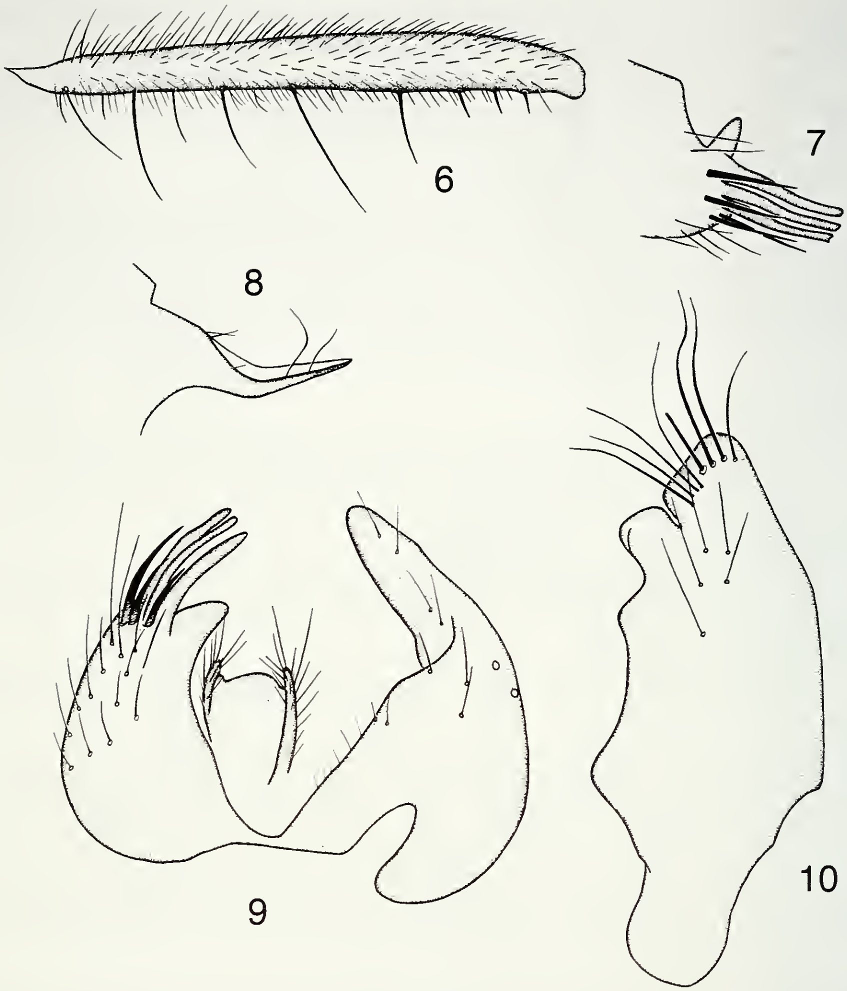
DIAGNOSIS: Scutellum and all femora yellow. Hind femur with one row of 6 or 8 ventral spines. Mid tibia with 1 very long ad on basal half; hind tibia without dorsal bristle at middle.

DESCRIPTION (MALE): *Measurements*: Body length 4.1-4.2 mm, wing length 3.7-4.0 mm.

Head: Black, pale grey microtrichose. Eyes brown but enlarged upper facets pale brownish yellow, contiguous on frons for a long distance which is 2.6 times the length of the 1st flagellomere. Bristles and hairs on head black; ocellar tubercle weak with 2 very short, hair-like oc and 2 very short posterior hairs. Antenna black; scape without hairs; pedicel with a circle of subapical hairs; 1st flagellomere black without dorsal hairs; arista black, short pubescent except apical 2/5 thin and bare. Proboscis brown; palpus blackish with 2 ventral hairs.

Thorax: Black (including pleuron), pale grey microtrichose, but posteriormost part of postpronotum, postalar callus and scutellum yellow. Colour of bristles on thorax varying from blackish to pale brown depending on illumination, hairs pale; 1 short, rather pale pprn, 2 npl (anterior npl short, about two third as long as posterior npl), acr in about 6 more or less regular rows, 1 long posterior dc and 8 hairs anteriad, 1 slightly shorter presc, 1 long psa; scutellum with 8 pale marginal hairs and 2 very long blackish subapical bristles.

Legs: Entirely yellow including coxae, only tarsomeres 3-5 darker brown; bristles and hairs black except coxae and trochanters with pale bristles and hairs, femora with pale ventral hairs. Fore femur 1.2 times as wide as mid femur, with one row of short hair-like av and longer hair-like pv which are about as long as diameter of femur; mid femur with 2-3 short ad at base (shorter than diameter of femur) and one row of short hair-like av and pv; hind femur (Fig. 6) 1.8 times as wide as mid femur, without preapical bristles, and with only one full row of 6 or 8 av spines; posteroventrally at apex with 1-2 stout, short black spines. Fore tibia with 1 dorsal bristle at middle,



FIGS 6-10
Hybos trispinatus sp. n. (male). (6) hind femur anterior view. (7) right surstylus. (8) left surstylus. (9) genitalia, dorsal view. (10) hypandrium, ventral view.

apically with 1 long ad, 1 av and 1 pv; mid tibia with 1 very long ad in basal third and 1 very long av at middle, apically with 4 bristles (of which 1 av is very long); hind tibia apically with 1 av and 1 pd. Fore tarsomere 1 with strong ventral bristle as well as 1 strong pv at extreme base; mid tarsomere 1 with 1 strong pv in basal third; hind tarsomere 1 with strong ventral bristle.

Wing: Slightly tinged greyish; veins dark brown; stigma as long as one third of cell R1 and dark brown. Squama dark yellow, bordered with pale hairs. Halter brownish yellow.

Abdomen: Slightly curved downward, black, grey microtrichose. Hairs on abdomen mostly pale. Male genitalia (Figs 7-10): left epandrial lobe rather wide in dorsal view, left surstylus long, finger-like, and flattened; right epandrial lobe rather wide in dorsal view, right surstylus with three long spine-like apical processes and 1 short finger-like lateral process; hypandrium much longer than wide, obtuse apically, and with very narrow apico-lateral incision.

FEMALE: Unknown.

DISTRIBUTION: China (Guangdong).

REMARKS: The new species is very similar to *Hybos flaviscutellum* Yang & Yang, 1986 in having a yellow scutellum and the mid tibia with 1 very long ad on basal half, but *H. trispinatus* can be easily separated from the latter by having the thoracic pleuron wholly black and hind femur with only one row of av spines. In *H. flaviscutellum*, the thoracic pleuron is dark brownish yellow with yellow lower half, and the hind femur has two entire rows of av and pv spines.

Hybos wangae sp. n. Figs 11-15

MATERIAL: Holotype male, Guangdong: Ruyuan, Nanling National Nature Reserve, 25. VII. 2003, Xingyue Liu (CAU). Paratype 1 male, same data as holope (MNHG).

ETYMOLOGY: The species is named after Mrs. Mengqing Wang.

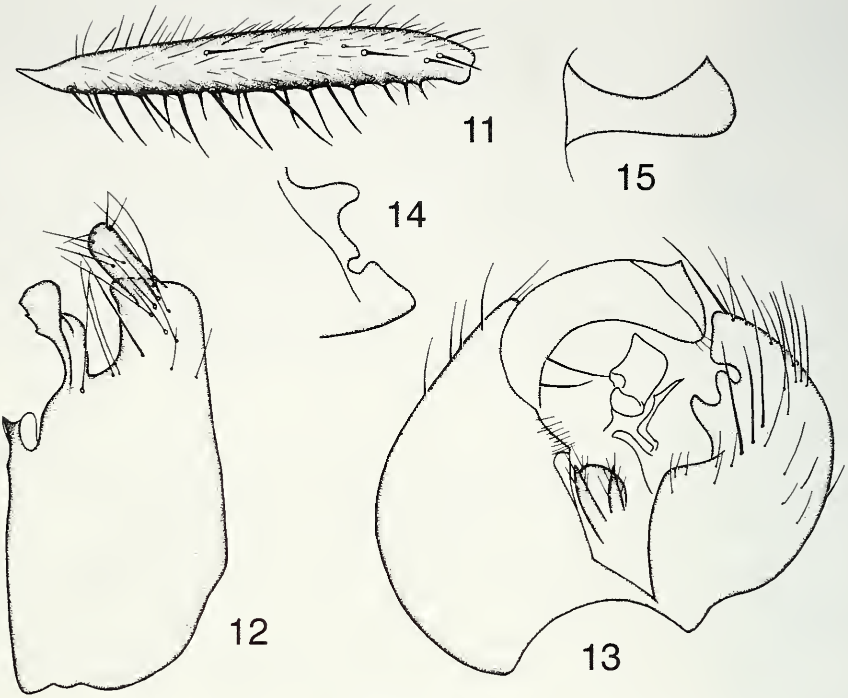
DIAGNOSIS: Scutellum black or yellow. Femora yellow, but with brown or dark brown apex. Hind femur with 2-3 rows of ventral spines. Mid tibia in basal half with 2 bristles in dorsal to anterodorsal position; hind tibia with 1 ad and 1 pd at middle.

DESCRIPTION (MALE): *Measurements*: Body length 4.7-5.0 mm, wing length 4.0-4.2 mm.

Head: Black, pale grey microtrichose. Eyes dark brown but enlarged upper facets pale yellow, contiguous on frons for a long distance which is 2.2 times the length of the 1st flagellomere. Bristles and hairs on head black; ocellar tubercle weak, with 2 very short oc hair-like and 2 very short posterior hairs. Antenna black; scape without hairs; pedicel with a circle of subapical hairs; 1st flagellomere without dorsal hairs; arista black, short pubescent except apical 1/3 thin and bare. Proboscis brown; palpus blackish with 2 ventral hairs.

Thorax: Black, pale grey microtrichose, scutellum black or yellow. Bristles and hairs on thorax black; postpronotal lobe without bristles, but with 4 hairs (posterior one slightly longer); 2 npl (anterior npl slightly shorter), acr in about 4 more or less regular rows, 1 long posterior dc and 8 hairs anteriad, 1 long presc, 1 long psa; scutellum with 8 pale marginal hairs and 2 very long black subapical bristles.

Legs: Mainly yellow, but all femora with brown apex; coxae entirely yellow; tarsomeres 3-5 dark brown; bristles and hairs black except coxae and trochanters with mainly pale bristles and hairs. Fore femur 1.1 times as wide as mid femur, with one row of hair-like short av and long pv; mid femur with several ad on basal half and one row of hair-like av and pv; hind femur (Fig. 11) 1.9 times as wide as mid femur, with 4-5 anterior bristles, and with 2-3 rows of long ventral spines. Fore tibia with 1 ad at middle, apically with 1 very long ad and 1 short pv; mid tibia in basal half with 2 very long bristles in dorsal to anterodorsal position and 1 very long av, 1 preapical ad and 1 preapical posterior bristle, apically with 5 bristles (of which 1 av is long); hind tibia in middle with 2 more or less dorsally inserted bristles (the lower one slightly more



FIGS 11-15

Hybos wangae sp. n. (male). (11) hind femur anterior view. (12) hypandrium, ventral view. (13) genitalia, dorsal view. (14) left surstylus. (15) right surstylus.

posteriorly directed), apically with 1 av, 1 preapical anterior bristle and 1 pd. Fore tarsomere 1 with 1 long ventral bristle at extreme base, apically with 1 long ad and 1 very short ventral bristle; mid tarsomere 1 with 1 short av and 1 long ventral bristle at extreme base and 1 long pv at middle, apically with 1 long dorsal bristle and 1 long pv; hind tarsomere 1 with short, but strong ventral bristle.

Wing: Slightly tinged greyish; veins dark brown; stigma nearly half as long as cell R1 and brown, which reaches the tip of R2+3. Squama dark yellow, bordered with pale hairs. Halter brown.

Abdomen: Slightly curved downward, black, grey microtrichose. Hairs on abdomen mostly pale. Male genitalia (Figs 12-15): left epandrial lobe slightly narrow in dorsal view, left surstylus short and broad with three short apical processes; right epandrial lobe rather wide, right surstylus long, thick and strongly curved inward; hypandrium distinctly longer than wide, basally rather wide, with apico-lateral incision bearing 1 ridge-like process.

FEMALE: Unknown.

DISTRIBUTION: China (Guangdong).

REMARKS: The new species is very similar to *Hybos ruyuanensis* sp. nov. in having the hind tibia at middle with 2 more or less dorsal bristles, but can be easily separated from the latter by the hind femur with brown apex and the mid tibia with 2 dorsal to anterodorsal bristles in basal half. In *H. ruyuanensis*, the hind femur is entirely yellow, and the mid tibia has only 1 ad in basal half.

CONCLUSIONS

Nanling National Nature Reserve is situated in the Guangdong Province of Southern China which belongs to the Oriental realm with a subtropical and tropical climate. The species of *Hybos* usually have black legs. But it is very interesting that not less than 5 species with yellow legs are found together in this area based on the material collected in July. The two already described species are distributed also in Central China. Concerning the three new species, it seems that *Hybos trispinatus* is a sister species of *Hybos flaviscutellum* Yang & Yang, 1986, from South China, and the other two new species, *Hybos ruyuanenis* and *Hybos wangae*, are closely related and have some similarities with *Hybos aurifer* Saigusa, 1963, from Japan.

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REVUE SUISSE DE ZOOLOGIE 113 (4): 807-815; décembre 2006

Four interesting psocids (Psocodea: 'Psocoptera') from European parts of Russia and from the eastern Mediterranean

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Four interesting psocids (Psocodea: 'Psocoptera') from European parts of Russia and from the eastern Mediterranean. - The following two new species are described from the central and southern parts of European Russia: *Valenzuela labinae* sp. n. (Caeciliusidae), *Peripsocus golubae* sp. n. (Peripsocidae). The macropterous morph (female) of *Valenzuela labrostylus* Lienhard is described for the first time and the species is newly recorded from Greece (Island of Kefallinia). The sexually dimorphic species *Oreopsocus buholzeri* Lienhard (Psocidae) is newly recorded from Israel and the wing of the macropterous morph (male) is illustrated for the first time.

Keywords: Caeciliusidae - Peripsocidae - Psocidae - new species - Greece - Israel.

INTRODUCTION

At present the 'Psocoptera', i.e. barklice and booklice, are considered to belong to the order Psocodea, comprising also the former order Phthiraptera, i.e. parasitic lice (Yoshizawa & Johnson, 2006). In my review of the western Palaearctic Psocoptera (Lienhard, 1998a) I stated that the psocid fauna of many parts of this region is still quite poorly known. Thus it is not surprising that almost every collecting trip to south-eastern Europe and the Mediterranean basin leads to the discovery of some interesting or even new species of Psocoptera. Since the above mentioned monograph was published, the following complements concerning systematics and nomenclature of Mediterranean psocids have been added: Lienhard & Smithers (2002): adaptation of classification and nomenclature to the most recent literature; Lienhard & Kanervo (2002): reinstation of *Psocus flavonimbatus* Rostock, which is not a synonym of *Loensia variegata* (Latreille); Lienhard (2002): synonymisation of *Valenzuela rhenanus* (Tetens) with *V. corsicus* (Kolbe) and description of a new species, *V. labrostylus* Lienhard, from Corsica; Lienhard & Baz (2004): description of the macropterous morph of *Nymphotroctes denisi* Badonnel from Italy; Lienhard (2005): description of *Reticulopsocus besucheti* Lienhard, a new genus and species of Protroctopsocidae from Turkey.

Most of the material treated by these papers was sent to me for identification by non-specialists, which had collected it during field work on other groups of insects or

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arthropods. Sometimes these specimens were collected in biotopes, which actually are not considered as characteristic for psocids (see Lienhard, 1998b). This shows that even the smallest series of psocids collected in this region can be of interest to science and should be sent to a specialist for identification, even if initially considered by its collector as an “accidental contamination” of his samples.

Four interesting psocids, collected in Greece, Israel and European Russia and sent to me by several colleagues (see “Acknowledgements”), are recorded in the following. The Russian specimens belong to two new species which are dedicated to their collectors.

Nomenclature and classification in this paper follow Lienhard & Smithers (2002). The following abbreviations are used: MHNG = Muséum d’histoire naturelle, Genève, Switzerland. – A = antenna length; AP = areola postica (cubital loop in fore wing); BL = body length (in alcohol); f1, f2, f3 = length of the three basal antennal flagellomeres; F = hind femur length; FW = fore wing length; IO/D = shortest distance between compound eyes divided by antero-posterior diameter of compound eye in dorsal view of head; P2 = second article of maxillary palpus; P4 = fourth (apical) article of maxillary palpus; T = hind tibia length; t1, t2 = tarsomeres of hind tarsus (lengths measured from condyle to condyle). – For standard abbreviations concerning wing venation, see Lienhard (1998a).

TAXONOMIC TREATMENT

FAMILY CAECILIUSIDAE

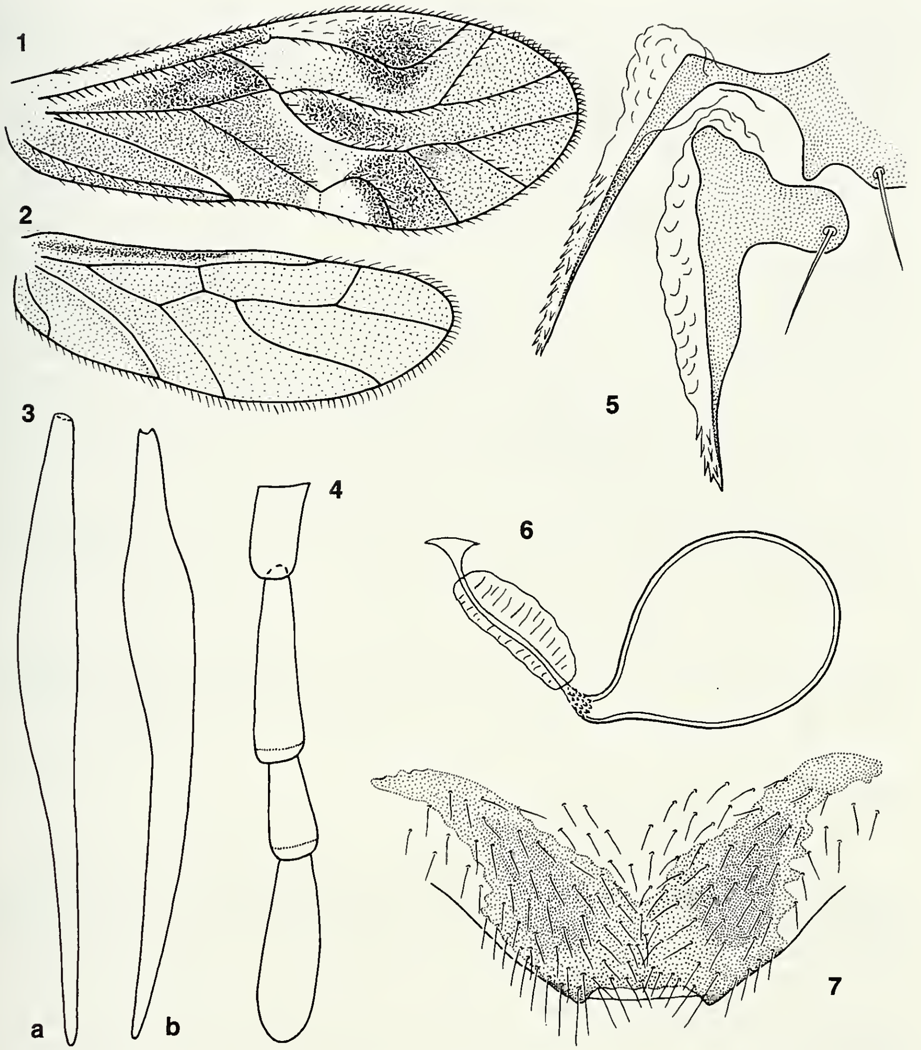
Valenzuela labinae sp. n. Figs 1-7

TYPE MATERIAL: MHNG, holotype ♀ (slide no. 7664 and in alcohol), Russia, Belgorodskaja Province, Borisovka, Reserve “Belogorie”, 12.IX.2004, leg. E. Labina. – MHNG, paratypes: 8♀ (in alcohol and on slide no. 7665), same data as for holotype; 6♀, same locality, 11.IX.2004, leg. E. Labina; 6♀, same locality, 10.III.2004, Dendrarium, leg. E. Labina; 3♀, same locality, 7.IX.2004, Monastirskiy jar, leg. E. Labina; 2♀, Belgorodskaja Province, Novoborisovka, 8.IX.2004, leg. E. Labina.

ETYMOLOGY: This species is dedicated to its collector, M.Sc. Eugenia Labina from the Zoological Institute of the Russian Academy of Sciences, St Petersburg.

DESCRIPTION (only female; male not known, see discussion below): Fore wing with characteristical brown pattern (Fig. 1) of somewhat variable intensity, with darkest zones in apical half of pterostigma, in basi-radial cell, in proximal part of cell R5 and between apical part of AP and vein *m*3; hind wing slightly tinged with brown, somewhat darker along anterior margin in basal half, vein *pcu* situated in a narrow hyaline zone; head and thorax medium to dark brown, sometimes with some red-brown hypodermal pigment; compound eye black; antenna and legs medium brown; abdomen yellowish white, with variable amount of red-brown to carmine-red hypodermal pigment forming a variable pattern, terminalia light brown.

Labrum without stylets, bearing 5 distal inner labral sensilla (as in Lienhard, 2002: fig. 14) of “type 2”-arrangement (see Mockford, 2000: fig. 48). P4 and P2 about equal in length (Fig. 4). Ocelli well-developed and compound eyes relatively large (IO/D of holotype = 1.6). Inner clypeal shelf well-developed (as in Figs 10 and 11).



FIGS 1-7

Valenzuela labinae sp. n., female (Fig. 3b paratype; all others holotype). (1) fore wing. (2) hind wing. (3) lacinia (a, b: different aspects). (4) maxillary palpus (pilosity not illustrated). (5) gonapophyses. (6) spermatheca. (7) subgenital plate.

Lacinial tip narrow, slightly indented (Fig. 3). Antenna shorter than fore wing. Margin and veins of fore wing densely pilose, except for bare *pcu* (Fig. 1). Margin of hind wing pilose from apex of *r*1 to posterior wing base, veins bare (Fig. 2). Pearman's organ of hind coxa well-differentiated. Abdomen with two ventral vesicles. Paraproct without tubercle on hind margin. Subgenital plate (Fig. 7) with small but distinct and well-pigmented latero-apical lobes. Gonapophyses as in Fig. 5, rudiment of external valve occasionally lacking seta, membranous zones of ventral and dorsal valves with some well-developed denticle-like microtrichia. Spermatheca (Fig. 6) with a relatively long sheath on its duct and with a rugose transitional zone between duct and sac.

MEASUREMENTS (♀ holotype): BL = 2.7 mm; FW = 3.0 mm; A = 2.3 mm; f1 = 365 µm; f2 = 300 µm; f3 = 250 µm; F = 600 µm; T = 1020 µm; t1 = 320 µm; t2 = 135 µm.

DISCUSSION: The male of *Valenzuela labinae* sp. n. is not known; according to Nokkala & Golub (2006: as *Valenzuela* sp.) this species reproduces by thelytokous parthenogenesis. It is the second western Palaearctic species of *Valenzuela* known to be parthenogenetic, the other one is *V. flavidus* (Stephens) (see Lienhard, 1998a: 46). The new species is easy to distinguish from all other western Palaearctic members of the genus by its characteristic fore wing pattern. According to the key to species groups given by Mockford (2000) it belongs to the *confluens*-group as most of the other *Valenzuela* species known from the western Palaearctic [i. e. *V. corsicus* (Kolbe), *V. fortunatus* (Enderlein), *V. gynapterus* (Tetens), *V. piceus* (Kolbe); NB: *V. despaxi* (Badonnel) has been transferred from the *confluens*-group to the *albus*-group by Mockford, 2003]. Within this species group *V. labinae* sp. n. is characterized by its fore wing pattern, the very narrow lacinial tip and the presence of a rugose transitional zone between spermathecal duct and sac.

DISTRIBUTION: The species is only known from Belgorodskaja Province, situated approximately in the centre of the European part of Russia. According to Golub (in litt.) it seems to be common on fruit-trees (*Malus* sp., *Prunus* sp.).

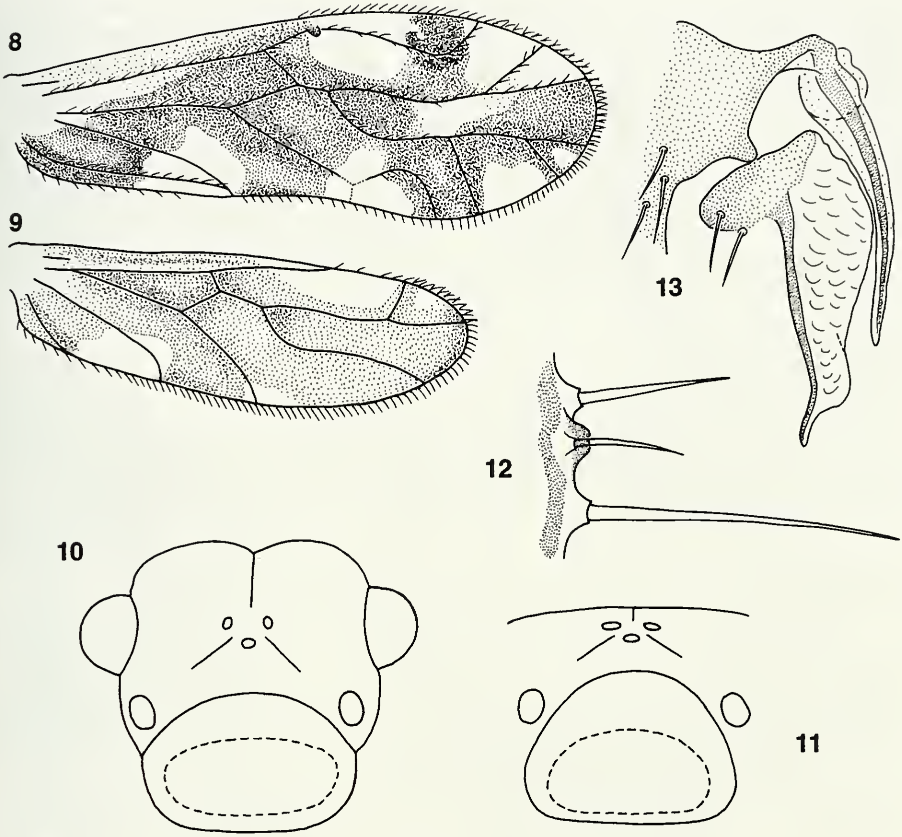
Valenzuela labrostylus Lienhard Figs 8-13

Valenzuela labrostylus Lienhard, 2002: 688.

MATERIAL EXAMINED: MHNG, 1 macropterous ♀ (slide no. 7598 and in alcohol), Greece, Ionian island of Kefallinia (=Cephalonia), Aenos mountain, about 1530m (near summit), by beating trees of *Abies cephalonica*, 14.V.2002, leg. B. Knoflach-Thaler & K. Thaler (Th-426) (Ke 02/3).

REMARKS: This species has been known only from the holotype, an apterous female, described from Asco mountain (1000 m) on the island of Corsica (France). The macropterous morph (female) is described in the following; the male of this species remains unknown.

DESCRIPTION OF MACROPTEROUS FEMALE: Coloration and general morphology as in apterous female (see Lienhard, 2002). Fore wing (Fig. 8) and hind wing (Fig. 9) with characteristical colour pattern. Fore wing slender, with relatively small cells R3 and M1 (identical in both fore wings of the specimen examined, compare with Fig.1 of *V. labinae* sp. n.). Margin and veins of fore wing densely pilose, except for bare *pcu*. Margin of hind wing pilose from apex of *r*1 to posterior wing base, veins bare. Details of head morphology (Figs 10, 11) and in particular of mouthparts as in the apterous female, but compound eyes slightly larger than in the latter (IO/D = 2.15). Both antennae damaged but remaining (3/6) flagellomeres of same shape and length as in the apterous holotype. Meso- and metathorax as usual in winged Caeciliusidae. Pearman's



Figs 8-13

Valenzuela labrostylus Lienhard, macropterous female from Kefallinia island (Greece). (8) fore wing. (9) hind wing. (10) head (dorsal view, inner clypeal shelf represented by interrupted line). (11) postclypeus (frontal view, inner clypeal shelf represented by interrupted line). (12) details of distal margin of left paraproct (dorsal side towards top of page). (13) gonapophyses.

organ of hind coxa well-differentiated. No adhesive vesicle observable on ventral side of abdomen.

Terminalia in general as in apterous female. Paraprocts with 13 (left) and 17 (right) trichobothria inserted in basal rosettes and with a small rounded or weakly bilobed tubercle on hind margin (Fig. 12). Subgenital plate with pigmentation almost reaching the apex of each of the latero-apical lobes, its hind margin regularly pigmented (the holotype has hyaline latero-apical lobes and its hind margin is particularly dark in the middle; see Lienhard, 2002: fig. 7). Spermatheca and gonapophyses as in the apterous female, but right external valve with two setae instead of one (Fig. 13).

Measurements (♀ from Greece): BL = 1.9 mm; FW = 2.2 mm; f1 = 400 µm; f2 = 260 µm; f3 = 205 µm; F = 470 µm; T = 780 µm; t1 = 195 µm; t2 = 95 µm.

DISCUSSION: Due to the presence of labral stylets, this species was only provisionally placed in the genus *Valenzuela* by Lienhard (2002) and it has not been assigned to one of the species groups defined by Mockford (2000). The winged morph can be easily distinguished from all other western Palaearctic species of the genus by its very characteristical wing pattern. In the absence of significant differences in general morphology, the winged female from Kefallinia is here considered as belonging to the same species as the apterous holotype from Corsica. *V. labrostylus* is only known from the mountains (above 1000 m) of these two fairly distant Mediterranean islands, where the apterous form has been found under stones and the winged form on old trees of a natural forest of *Abies cephalonica*.

FAMILY PERIPSOCIDAE

Peripsocus golubae sp. n. Figs 14-21

TYPE MATERIAL: MHNG, holotype ♂ (slide no. 7660 and in alcohol), Russia, Krasnodar Province, 12 km N of Adler, on *Buxus colchica*, 11.VIII.2004, leg. N. Golub. – MHNG paratypes: 1♀ allotype (slide no. 7661 and in alcohol), same data as for holotype; 1♂, 1♀ (slides no. 7662, 7663 and in alcohol), same data as for holotype but collected on 7.VIII.2004.

ETYMOLOGY: The species is dedicated to its collector, Dr Natalia Golub from the Zoological Institute of the Russian Academy of Sciences, St Petersburg.

DESCRIPTION: General colour light to medium brown, ocellar field dark brown, compound eyes blackish brown, preclunial segments of abdomen yellowish white, with narrow segmental annulation of brown hypodermal pigment. Membrane of wings slightly tinged with brown, lacking distinct colour pattern, only central areas of apical marginal cells of fore wing somewhat lighter in colour (Fig. 14).

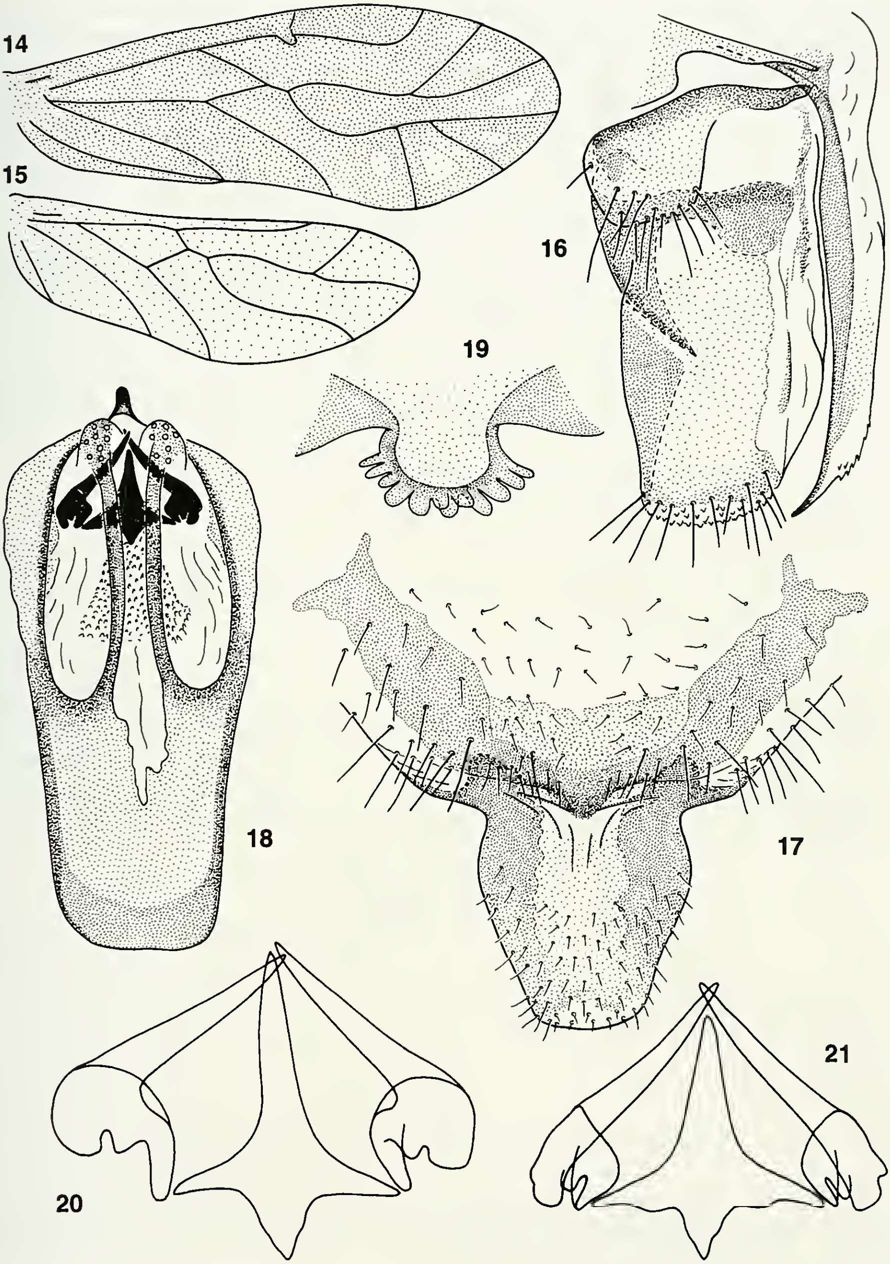
Both sexes macropterous. Antenna distinctly longer in male than in female, but shorter than fore wing in both sexes. Compound eyes much larger in male (IO/D: 0.7-0.8) than in female (IO/D: 1.8-2.0). Wing venation normal for the genus (Figs 14, 15).

Male terminalia: Clunial comb on distinctly protruding lobe, with 9-12 somewhat irregularly shaped teeth (Fig. 19). Phallosome as in Fig. 18, phallobase wide, endophallic sclerites (Figs 18, 20, 21) somewhat variable in shape (partially due to degree of compression of the slide-mounted phallosome), central sclerite with a long posterior and a short anterior extension.

Female terminalia: Subgenital plate as in Fig. 17; egg guide wider near base than at apex, its distinct dorso-lateral sclerotisation reaching apical zone of basal plate; basal plate near base of egg guide with a transversal fold bearing some long hairs laterally and shorter hairs towards the middle; anterior margin of V-pigmentation of basal plate broadly rounded. Gonapophyses as in Fig. 16, ventral valve long and slender, dorsal valve wide and subrectangular, external valve short and square.

MEASUREMENTS (♂ holotype / ♀ allotype): BL = 1.53/1.84 mm; FW = 2.0/2.25 mm; A = 1.84/1.43 mm; f1 = 305/300 µm; f2 = 230/185 µm; f3 = 200/155 µm; F = 395/410 µm; T = 740/780 µm; t1 = 230/185 µm; t2 = 105/110 µm.

DISCUSSION: *Peripsocus golubae* sp. n. is rather closely related to *P. milleri* (Tillyard), a widespread species also known from the south-western part of the western



FIGS 14-21

Peripsocus golubae sp. n. (14-17 female paratypes; 18, 21 male paratype; 19, 20 male holotype). (14) fore wing. (15) hind wing. (16) gonapophyses. (17) subgenital plate. (18) phallosome. (19) median hind margin of male clunium with clunial comb. (20, 21) endophallic sclerites.

Palaearctic, but not yet known from eastern Mediterranean and from the eastern Palaearctic (see Lienhard, 1998a and Lienhard & Smithers, 2002). Both species have almost identical gonapophyses, but the new species can easily be distinguished from *P. milleri* by its wide phallobase, by the shape of the endophallic sclerites (in particular central sclerite with a long anterior and a short posterior extension in *P. milleri*), by details of morphology and pigmentation of the subgenital plate, and by the absence of a contrasted fore wing pattern (for a comparison see illustrations of *P. milleri* in Lienhard, 1998a).

Peripsocus golubae sp. n. also resembles the recently described *P. varidentatus* Li, which is only known from south-eastern China (Zhejiang and Hainan Provinces) (Li Fasheng, 2002). The new species differs from the Chinese species by the pigment pattern of the subgenital plate (see Li Fasheng, 2002: fig. 1032).

DISTRIBUTION: *Peripsocus golubae* sp. n. is only known from the type locality in Northern Caucasus, where it has been beaten from *Buxus colchica* shrubs.

FAMILY PSOCIDAE

Oreopsocus buholzeri Lienhard Fig. 22

Oreopsocus buholzeri Lienhard, 1986: 315.

MATERIAL EXAMINED: MHNG, 1♂, Israel, Negev, Hazeva, Wadi Shezaf, Malaise trap, 2.-9.III.2000, leg. N. D. Springate.

REMARKS: This species was previously known only from the type locality in Egypt (Wadi Digla, 30 km SE of Cairo) (Lienhard, 1986, 1998a). *O. buholzeri* is a sexually dimorphic species with macropterous males and micropterous females. The only previously known male specimen is the damaged holotype, the fore wings of which are broken. In Fig. 22 the fore wing of the new specimen is illustrated to show its venation and its very restricted pigmentation; it is similar to the fore wing of the type species of the genus, *Oreopsocus montanus* (Kolbe) (see figures in Lienhard, 1998a). General mophology and structure of the terminalia of the male from Israel correspond very well to the holotype from Egypt.

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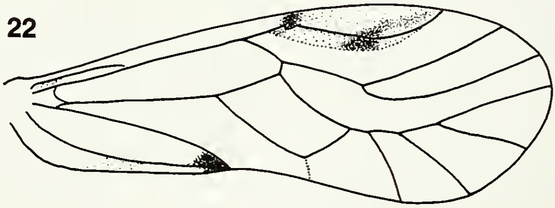

FIG. 22

Oreopsocus buholzeri Lienhard, male from Israel: fore wing.

MEASUREMENTS (♂ from Israel): BL = 1.9 mm; FW = 3.1 mm; F = 510 µm; T = 1120 µm; t1 = 360 µm; t2 = 140 µm; IO/D = 2.0.

DISTRIBUTION AND BIOLOGY: The new material from Negev confirms the initial observation (Lienhard, 1986) that *O. buholzeri* lives in desert biotopes. The appearance in Malaise traps unfortunately does not give any further indication about the biology of the Negev population. It is interesting to note that the type series from Egypt was found in empty snail shells (Lienhard, 1986, 1998a), a very unusual biotope for psocids (Lienhard, 1998b).

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Many thanks go to Natalia Golub and Eugenia Labina (St Petersburg), Neil Springate (London), Barbara Knoflach-Thaler (Innsbruck) and the late Konrad Thaler for entrusting their psocids to me. I am also very grateful to Peter Schwendinger (Geneva) for critical reading of the mansucript and for valuable suggestions.

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REVUE SUISSE DE ZOOLOGIE 113 (4): 817-828; décembre 2006

Hyphessobrycon togoi, a new species from the La Plata basin (Teleostei: Characidae) and comments about the distribution of the genus in Argentina

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***Hyphessobrycon togoi*, a new species from the La Plata basin (Teleostei: Characidae) and comments about the distribution of the genus in Argentina.** - A new species of the characid genus *Hyphessobrycon* is described from tributaries of the Río de la Plata and the Salado River system in middle-eastern Argentina *Hyphessobrycon togoi* can be distinguished from all congeners, except *H. langeanii* Lima & Moreira, by the presence of a well-defined, round to horizontally oval humeral spot. Other diagnostic characters defining *Hyphessobrycon togoi* are the possession of a short expanded maxilla with one large multicuspid tooth; premaxilla with an outer row of 3 small teeth, with 5 or 6 cusps, relatively apart from each other; inner series with 5 teeth that are distally broader, with numerous cusps (6-11) and overlapping each other; iv-v, 17-20 anal-fin rays; 31-36 scales on longitudinal series. *Hyphessobrycon togoi* is also distinguished by the presence of bony hooks on all fins of the mature males. Considerations about the distribution of the species of genus *Hyphessobrycon* in Argentina are included.

Keywords: Ostariophysi - *Hyphessobrycon* - new species - systematic - biodiversity - taxonomy - distribution - middle eastern Argentina.

INTRODUCTION

The genus *Hyphessobrycon* Durbin includes more than 100 valid species (Lima *et al.*, 2003; Lima & Moreira, 2003; Lucena, 2003; Almirón *et al.*, 2004; Bertaco & Malabarba, 2005), occurring from Mexico and Central America to Mar Chiquita lagoon in Buenos Aires, Argentina, reaching its highest diversity in the Amazonian basin. *Hyphessobrycon* is diagnosed among the remaining characids by the combination of the presence of incomplete lateral line, naked caudal fin, presence of adipose

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fin, two series of premaxillary teeth (the inner row with 5 or more teeth), second infraorbital not contacting the preopercle inferiorly, and supraoccipital process usually bordered by 2 1/2 scales on each side (Eigenmann, 1917; Ringuelet *et al.*, 1967; Géry, 1977). Authors that have recently addressed the systematics of the genus are unanimous in noticing the poorly defined nature of the group and the uncertainty of its monophyly (e.g., Costa & Géry, 1994; Weitzman & Palmer, 1997; Moreira *et al.*, 2002; Malabarba & Weitzman, 2003; Bertaco & Malabarba, 2005). The following species have been recorded from the Río de la Plata and Paraná River basins: *H. anisitsi* (Eigenmann); *H. bifasciatus* Ellis; *H. eques* (Steindachner); *H. elachys* Weitzman; *H. guarani* Mahnert & Géry; *H. igneus* Miquelarena, Menni, López & Casciotta; *H. luetkenii* (Boulenger); *H. meridionalis* Ringuelet, Miquelarena & Menni; *H. reticulatus* Ellis; and *H. wajat* Almirón & Casciotta (López *et al.*, 2003). Later *H. auca* Almirón, Casciotta, Bechara & Ruiz Diaz was described from Esteros del Iberá wetlands.

We describe herein a new species of *Hyphessobrycon* from tributaries of the Río de la Plata and the Salado River system in the province of Buenos Aires, Argentina. We assign the new species to *Hyphessobrycon* in accordance with the present diagnosis of the genus.

MATERIAL AND METHODS

Measurements to the nearest 0.01 mm were made using a Digimess digital caliper following Fink & Weitzman (1974: 1-2). Osteological observations were made on four specimens cleared and stained (c&s) for bone and cartilage following the protocol by Taylor & Van Dyke (1985). All measurements are expressed as percentage of standard length (SL), except for head measurements, which are expressed as percentage of head length (HL). For all counts, frequencies are given in parentheses and the holotype is indicated by an asterisk. Institutional abbreviations are taken from Leviton *et al.* (1985). The material examined are deposited at Instituto de Limnología "Dr. Raúl A. Ringuelet" (ILPLA), Museo de La Plata (MLP), Argentina and Muséum d'histoire naturelle (MHNG), Suisse.

COMPARATIVE MATERIAL:

Cyanocharax lepiclastus Malabarba, Weitzman & Casciotta, ILPLA 1689, 8 ex., 33.2-46.0 mm SL, Fortaleza creek (26° 46' S-54° 10' W), Misiones, coll.: R. Filiberto *et al.*, Jan. 2001; *Cyanocharax macropinna* Malabarba & Weitzman, ILPLA 1688, 8 ex., 34.1-42.5 mm SL, Chirimay Miní creek, Misiones, coll.: R. Filiberto *et al.*, Jan. 2001.

Hemigrammus anisitsi, CAS 44366, 6 paratypes, 19.8-23.0 mm SL, South America, Paraguay, Caapucu?, Paraná/de La Plata, arroyo Carumbey, Estancia La Armonia, coll.: Anisits, J. D., Jan. 1900. *H. anisitsi*, ILPLA 1315, 2, (1 c&s), 36.2-37.0 mm SL, Cañada alta, Rabon creek basin, Entre Ríos, coll.: M. Montenegro, 17/03/01. MACN 7654, 7, (1 c&s), 32.0-40.5 mm SL, laguna del Colastiné, Santa Fe, 29/07/75.

H. arianae (Uj & Géry), MHNG 2412.80, 5 paratypes, 19.9-22.4 mm SL, Paraguay: Caaguazu, Rio Güyraugua (affluent du Rio Monday), 3 Km Est. Lta. Juan Frutos, coll.: F. Baud, C. Dlouhy & V. Mahnert, 16/04/85.

H. bifasciatus, ILPLA 147, 4, 27.1-30.2 mm SL, parallel canal BR-471 Km 115, Estação Ecológica do Taim, R. S., Brasil, coll.: P. A. Buckup & C. F. M. Souto, 21/IV/79; ILPLA 1587, 2, 28.7-33.7 mm SL, Estação Ecológica do Taim, Rio Grande, R. S., Brasil, coll.: P. A. Buckup & C. Souto, 22/IV/79; ILPLA 1590, 3, 33.4-39.8 mm SL, Entrada do Ayo. Taim, Estação Ecológica do Taim, Rio Grande, R. S., Brasil, coll.: L. R. Malabarba & C. F. M. Souto, 17/XII/80.

H. cf. *bifasciatus,* MLP 8408, 1, (1 c&s), 33.3 mm SL, pond on Bella Vista (28° 31' S-59° 02' W)-San Roque (28° 35' S-58° 41' W) Road (across from School N° 12), Corrientes, coll.: A., Miquelarena, 12/IX/79; MLP 8409, 1, (1 c&s), 29.3 mm SL, creek Batel (29° 15' S-58° 48' W), Corrientes, coll.: A. Miquelarena, 10/X/79.

H. guarani, MHNG 2366.100, 5 paratypes, 18.3-26.2 mm SL, Paraguay, río Alto Paraná à Puerto Bertoni, Depto. Alto Paraná, coll.: M. C. Durette-Desset *et al.*, 13/11/82; MHNG 2370.13, 7, 18.0-29.8 mm SL, Argentina, Misiones, Río Alto Paraná à Puerto Iguazú, coll.: C. Dlouhy, 01/02/87; USMN 290840, 3 paratypes, Paraguay: Depto. Alto Paraná, Alto Paraná River at Puerto Bertoní (25° 33'S 54° 40'W).

H. igneus, MLP 8413, holotype, 26.6 mm SL, pond along Bella Vista-San Roque Road (across from School N° 12), Corrientes, coll.: C. Darrieu *et al.*

H. lüetkenii, ILPLA 1589, 3, 39.0-51.7 mm SL, Estação Ecológica do Taim, Rio Grande, R. S., Brasil, coll.: N. A. Menezes & P. A. Buckup, 13/XII/79; ILPLA 12, 2, 22.8-23.9 mm SL, Arroyo Batel, Corrientes, coll.: R. Menni *et al.,* XI/80; MLP 8822, 1, 25.2 mm SL, pond along Route 11 to Tte. Gral. J. C. Sánchez, Formosa, coll.: R. Menni, *et al.*

H. meridionalis, ILPLA 10, 3, 39.4-40.9 mm SL, Los Talas, Berisso, Buenos Aires; ILPLA 45, 3, 38.5-39.1 mm SL, Zapata creek, outskirts of La Plata, Buenos Aires, coll.: R. Menni, *et al.*; MLP 8339, holotype, 43.7 mm SL, marsh on the road from La Plata to Magdalena, Buenos Aires; MLP 8407, 2, 31.0-32.0 mm SL, pond along Bella Vista-San Roque Road (across from School N° 12), Corrientes, coll.: A. Miquelarena.

H. reticulatus, ILPLA 486, 3, 34.6-39.8 mm SL, Estação Ecológica do Taim, Rio Grande, R. S., Brasil, coll.: L. R. Malabarba & C. F. M. Souto, 17/12/80; ILPLA 131, 4, 24.5-29.3 mm SL, Delta, INTA, coll.: Bachmann, 17/VII/64; MLP 8776, 3, 29.5-34.7 mm SL, Irigoyen Canal, Talabera Island, Campana, Buenos Aires, coll.: L. Lunaschi & C. Sutton, 19/II/89.

H. wajat, MLP 9321, holotype, 1, 27.4 mm SL, Brava pond (58° 44' W 27° 33' S), Corrientes, coll.: R. J. Fernández, 15/XI/89; MLP 7853, paratypes, 4, 24.4-26.3 mm SL, Negro River (59° 00' W 27° 26' S), Resistencia, Chaco, coll.: M. Galván; MLP 9322, paratypes, 5, 27.8-30.8 mm SL, Iberá pond (57° 08' W 28' S), coll.: A. Almirón & J. Casciotta, XI/97.

RESULTS

Hyphessobrycon togoi sp. n. Fig. 1

MATERIAL EXAMINED: *Hyphessobrycon anisitsi* (*nec* Eigenmann): Ringuelet *et al.*, 1978: 254 (29 specimens from Chascomús lagoon, Buenos Aires, 49.0-73.5 mm SL); Miquelarena, 1982: 281, 296, 297 (10 specimens c&s from Chascomús lagoon, Buenos Aires, 42.0-83.0 mm SL); Miquelarena, 1986: 5, 32, 33 (6 specimens c&s from Chascomús lagoon and shell quarry in Berisso, Buenos Aires, 42.0-83.0 mm SL).

Holotype: ILPLA 1704, 59.0 mm SL, ♀, Argentina, Buenos Aires Province, Chascomús lagoon (35° 45' S-58° 30' W), March 1973, coll.: A. Miquelarena.

Paratypes: ILPLA 47, 2 ♀ and 1 ♂ 55.2-62.4 mm SL, same locality as holotype, October 1965, coll.: C. Togo *et al.*; ILPLA 1080, 2 ♀ (1 c&s), 53.1-64.3 mm SL, same locality as holotype, April 1984, coll.: O. Padin and J. Iwaszkiw; ILPLA 1231 2 ♂, 44.5-48.0 mm SL, Argentina, Buenos Aires Province, Matanza-Riachuelo River (34° 39' S-58° 22' W), tributary of Río de la Plata, November 1974, coll.: R. Taberner and Bellonni; ILPLA 1232, 1 ♀, 64.4 mm SL, Argentina, Buenos Aires Province, Lobos lagoon (35° 11' S-59° 06' W); ILPLA 1246, 2 ♀ c&s, 35.5-41.0 mm SL, same locality as holotype, June 1977, coll.: H. López; ILPLA 1257, 3 ♀ and 2 ♂ (1 c&s), 46.4-55.7 mm SL, Argentina, Buenos Aires Province, El Destino creek, Road 11 to Punta Indio, Partido de Magdalena (35° 15' S-57°40' W), tributary of Río de la Plata, October 1975, coll.: O. Padin, C. Fiorito and L. Protogino; ILPLA 1637, 2 ♂, 46.5-56.0 mm SL, Argentina, Buenos Aires Province, Salado River, Ruta Pilar-Lezama (35° 45' S-58° 30' W), October 1975, coll.: O. Padin, L. Protogino and C. Fiorito; ILPLA 1705, 4 ♀, 61.1- 68.4 mm SL, same data as holotype; ILPLA 1706, 2 ♀, 46.1-57.6 mm SL, same locality as holotype, March 1983, coll.: J. Iwaszkiw; ILPLA 1707, 1 ♀ c&s, 83 mm TL, Argentina, Buenos Aires Province,

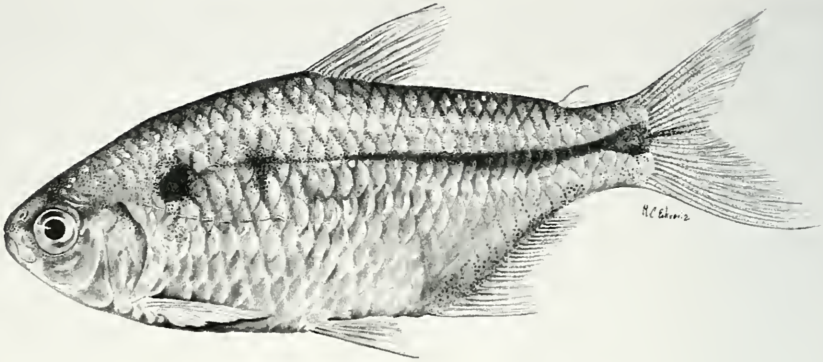

FIG. 1

Hyphessobrycon togoi sp. n., ILPLA 1211, holotype, male, 42.2 mm SL.

shell quarry in Berisso, November 1976, coll.: A. Miquelarena & H. López; MHNG 2679.013, 2 ♀, 64.5-65.0 mm SL, same data as holotype; MLP 9669 5 ♀, 53.0-56.0 mm SL, Argentina, Buenos Aires Province, Lacombe Lagoon (35° 50' S-57° 53' W), April 2006, coll.: D. Colautti.

DIAGNOSIS: *Hyphessobrycon togoi* can be distinguished from all congeners, except *H. langeanii* Lima & Moreira, by the presence of a well-defined, round to horizontally oval humeral spot. *Hyphessobrycon togoi* differs from *H. langeanii* by the possession of a second humeral spot (vs. absent), maxilla not reaching anterior edge of orbit (vs. maxilla reaching middle of orbit) and infraorbitals 3 and 4 separated (vs. co-ossified).

Other diagnostic characters defining *Hyphessobrycon togoi* include a short expanded maxilla with one large multicuspid tooth; premaxilla with an outer row of 3 small teeth, with 5 or 6 cusps, relatively apart from each other; inner series with 5 teeth that are distally broader, with numerous cusps (6-11) and overlapping each other; iv-v, 17-20 anal-fin rays; 31-36 scales on the longitudinal series. *Hyphessobrycon togoi* is also distinguished by the presence of bony hooks on all fins of the mature males.

DESCRIPTION: Morphometrics are shown in Table 1. Body compressed, moderately deep, greatest body depth at dorsal-fin origin. Predorsal body profile convex, slightly concave at level of supraoccipital process. Body profile convex between dorsal-fin origin and adipose-fin origin. Ventral profile convex from tip of mandible to end of anal fin. Dorsal and ventral margins of caudal peduncle straight or slightly concave. Caudal peduncle relatively high.

Head short. Snout short. Eye relatively small. Frontals broad at interorbital area, its width greater than eye diameter. Jaws equal, mouth terminal. Maxilla short not reaching anterior edge of orbit.

Dorsal-fin origin almost equidistant from tip of snout and base of caudal-fin rays. Tip of pectoral fin not surpassing pelvic-fin origin in both males and females. Pelvic fin tip does not surpasses the anal-fin origin. Presence of bony hooks on rays in all fins in mature males. Dorsal-fin rays ii, 9 (23*); iii, 8 (1 c&s); iii, 9 (3 c&s) posterior margin of dorsal fin typically straight, last unbranched ray and first two branched rays longest. First unbranched ray very small, only visible in cleared and stained specimens.

TABLE 1. Morphometric data of *Hyphessobrycon togoi* sp. n.

Characters	Holotype	Paratypes			
	♀	♀ (n=15)		♂ (n=7)	
		Range	Mean	Range	Mean
Standard length (mm)	59.0	46.1-68.4	59.4	44.5-56.0	49.6
Percents of Standard length					
Head length	24.7	21.3-24.9	23.1	22.3-26.8	24.0
Body depth	39.6	34.9-40.3	38.0	35.4-39.4	36.6
Snout to dorsal-fin origin	51.5	50.2-53.8	51.7	48.7-54.9	51.2
Snout to pectoral-fin origin	24.3	22.3-26.6	24.7	22.4-26.5	24.6
Snout to pelvic-fin origin	47.1	45.2-49.8	47.4	46.5-50.8	48.1
Snout to anal-fin origin	66.3	64.2-69.1	67.0	63.1-69.3	66.1
Caudal peduncle length	12.4	11.1-14.3	12.8	10.5-13.4	12.2
Caudal peduncle depth	14.0	12.0-14.0	13.0	12.0-14.6	13.2
Dorsal-fin base length	14.0	12.3-15.2	13.5	13.1-15.1	13.9
Longest dorsal-fin ray	28.3	24.5-28.3	26.8	25.5-28.1	26.3
Pectoral-fin length	18.1	15.5-21.7	19.6	18.2-20.6	19.3
Pelvic-fin length	14.3	15.1-19.2	17.2	16.3-17.9	17.2
Anal-fin base length	26.2	23.9-27.7	25.8	23.6-27.3	25.7
Percents of head length					
Horizontal eye diameter	35.6	30.7-36.7	33.9	34.9-36.7	35.7
Snout length	17.5	14.6-21.3	18.1	15.8-21.5	18.8
Interorbital width	38.0	36.0-43.2	39.3	36.8-41.9	39.1
Upper jaw length	31.4	29.4-35.6	32.5	28.8-36.3	32.9

Adipose fin well developed in all specimens. Pectoral-fin rays i, 9 (6); i, 10 (10 + 4 c&s); i, 11 (7*). Pelvic-fin rays i, 6 (4 + 3 c&s); i, 6, i (1); i, 7 (18* + 1 c&s). Pelvic fin with axillary scale. Anal-fin rays iv, 17 (4); iv, 18 (10); v, 18 (1 + 1 c&s); iv, 19 (4 + 2 c&s); v, 19 (*); iv, 20 (3 + 1 c&s). Anal-fin origin located posterior to vertical through base of last dorsal-fin ray. Pelvic fin fallen short of anal fin by 2-3 scales. Caudal fin forked, lobes rouded, and similar in size. Principal caudal-fin rays i, 17, i. Dorsal procurrent rays 11 (1); 12 (1); 13 (2); ventral procurrent rays 10 (4).

Scales cycloid, relatively large-sized. Lateral line incomplete, perforated scales 8 (1); 9 (10); 10 (9*); 11 (1); 13 (1); 14 (1). Longitudinal scale series 31 (1); 32 (3); 33 (4); 34 (10*); 35 (4); 36 (1). Scales rows between dorsal-fin and anal-fin origins 10 (2); 11 (9*); 12 (12). Predorsal scales 12 (21*); 13(2), arranged in irregular series. Single row of scales covering base of anteriormost anal-fin rays.

Infraorbital bones 6, distal border of third infraorbital not reaching sensory canal of preopercle. Supraneurals 6 (n=4). Total vertebrae 35 (n=4). Gill-rakers 7+12 (n=2), 6+13 (n=1), 6+14 (n=1). Gill rakers very developed. Each raker has several short spicules of bone arranged in irregular rows along its length.

Two tooth rows in premaxilla. Outer row with 3 teeth, with 5 or 6 cusps, very small and noticeable apart from each other; each tooth situated between two inner series teeth (Fig. 2a). Inner row with teeth well-developed, multicuspid, very broadened distally and overlapping each other on the lateral process. Five inner-row teeth decreasing in size from symphysis: first one with 7 cusps, second and third ones with 11 cusps, fourth with 8 cusps, and fifth with 6 cusps (Fig. 2b). Maxilla short, with expanded distal portion and one tooth with 7-8 cusps at its ventral margin (Fig. 2c).

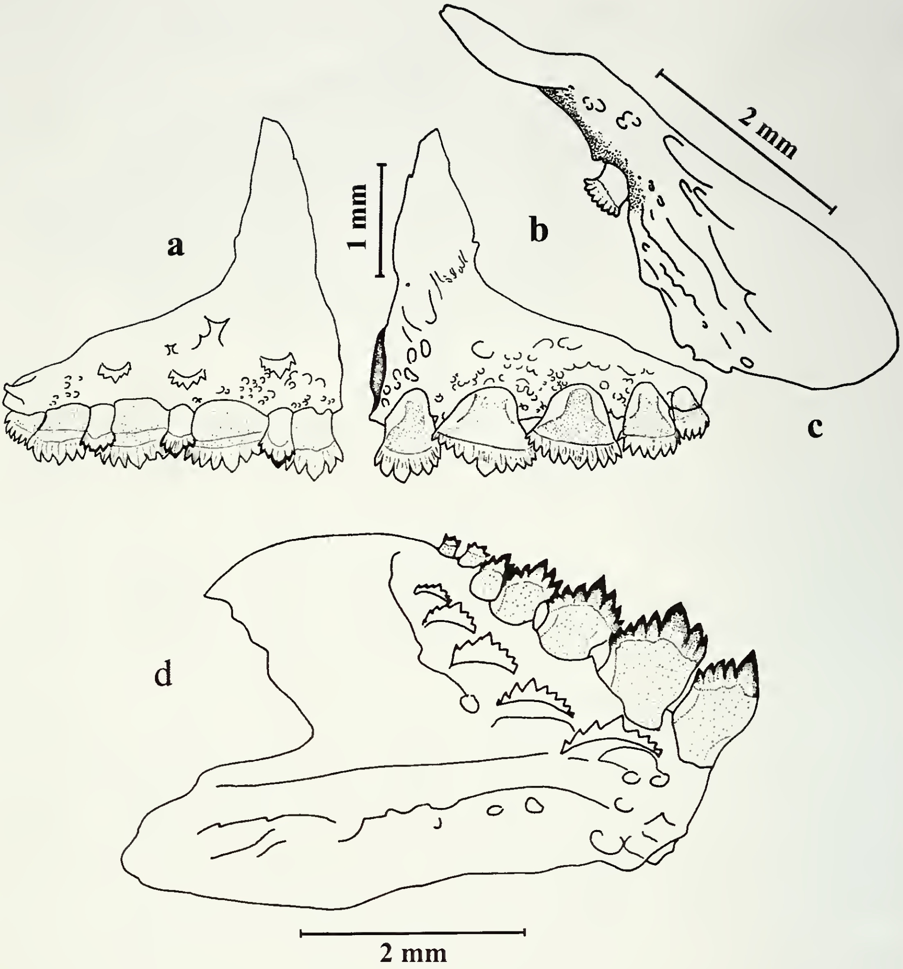

Fig. 2

Hyphessobrycon togoi sp. n., ILPLA 910, paratype, male, 40.6 mm SL: a. Right premaxilla, external view (scale bar: 1 mm); b. Right premaxilla, internal view (scale bar: 1 mm); c. Right maxilla, internal view (scale bar: 2 mm); d. Right dentary, internal view (scale bar: 2 mm).

Dentary with 6 to 8 teeth, the first 4 large and well-developed, remaining teeth smaller. The larger for teeth very close to each other and with 7-8 cusps, remaining teeth with 3 or 4 cusps (Fig. 2d).

Color in life: Ground color in life iridescent with silvery, greenish, yellowish, bluish, and lilac hues. Dorsal and anal fins grayish. Pectoral and pelvic fins translucent, with silvery hues. Caudal fin reddish with middle caudal-fin rays darkened. First humeral spot rounded, black, well defined; second humeral spot formed by dark, scattered melanophores (Fig. 3).

FIG. 3
Hyphessobrycon togoi sp. n., about 30 mm SL, flooded areas near Chascomús lagoon, not preserved. Photo by A. Miquelarena.

Lateral longitudinal stripe very narrow from anterior portion of body through tip of medial caudal-fin rays, slightly iridiscent anteriorly, darkening at level of adipose fin to base of caudal fin where it forms a wider black caudal spot. Small dark melanophores dotting most of head and body, especially in the mid-dorsal region and ventrally above the anal fin. Upper and lower lips with fine dark dotting.

COLOR IN ALCOHOL: Dorsum and head light brown. Dense concentration of chromatophores along dorsal profile, more conspicuous from end of adipose fin to dorsal procurrent rays. Posterior margin of scales above lateral longitudinal stripe darkened by higher concentration of small chromatophores.

Anterior humeral spot, rounded to oval, well defined, from third scale behind the opercle, above the perforated scales of the lateral line, extending to sixth scale. Frequently anterior and ventral part of this spot with a series of scattered melanophores extending vertically, more conspicuous in some specimens, second diffuse spot separated from anterior spot by 3 scales. Behind latter spot, sparse melanophores forming a narrow midlateral stripe, well defined (one scale high), becoming more conspicuous upon the caudal peduncle and broadening at caudal-fin base, forming a blotch of scattered melanophores continuing onto middle caudal-fin rays. Fins translucent, with few melanophores on rays. Snout, lips, and maxilla with scattered chromatophores. Ventral body light brown. Scales above the base of anal fin with chromatophores. Interradial membrane of paired and unpaired fins with small chromatophores, distributed along the rays. Anal fin with chromatophores more concentrated on distal end.

SEXUAL DIMORPHISM: Males with bony hooks in all fins. Ray bifurcations of dorsal, pelvic and caudal fins with few bony hooks. Bony hooks specially numerous at pectoral and anal fins, with 2-3 bony hooks in each ray segment. Morphology of anal fin similar for both sexes, somewhat more concave in females.

In addition, females with greater standard length and body depth than males (Table 1).

ETYMOLOGY: This species is dedicated to our friend Carlos Togo, a great expert and pioneer of ichthyofaunal research in pampasic lagoons.

GEOGRAPHICAL DISTRIBUTION: Salado River system and tributaries of the Río de la Plata in the Buenos Aires Province, Argentina (Fig. 4).

HABITAT NOTES: In Buenos Aires province *Hyphessobrycon togoi* is found in the Salado River and in ponds, marshes and creeks within the Salado basin. The Chascomús, Lobos and Lacombe lagoons are extensive water-bodies with abundant floating and submerged vegetation (Fig. 5). These lakes are a portion of a lenthic environment system which is one of the most remarkable features of the wet pampa (Menni, 2004). *H. togoi* is not especially abundant with respect to other species occurring in these lagoons, but it is sometimes caught in canals and flooded areas near the lagoons. The Salado River crosses Buenos Aires Province from northwest to southeast, running for approximately 690 km in the Pampasia and finally draining into Bahía de Samborombón. The new species was also found in Matanza River, a highly polluted environment draining into the Río de la Plata. Some of the most densely populated areas of Argentina lies along the middle and lower sections of this river, coupled with a high and complex industrial concentration (Aguglino, 1996).

DISCUSSION

Hyphessobrycon togoi differs from *H. anisitsi* by having lesser anal fin rays (iv-v, 17-20 vs. iv-v, 20-23); more cusps in the maxillary tooth (7-8 vs. 3-5); more cusps in the teeth of both premaxillary rows (5-6/6-11, vs. 2-4/3-6.); and higher number of total gill rakers (19-20 vs. 15-16). The mature males of *H. togoi* possess bony hooks in all fins; these structures have also been observed in the dorsal, anal and pelvic fins of *H. anisitsi* mature males. This character was reported in *H. auca* from the Esteros del Iberá wetlands by Almirón *et al.* (2004) and in *H. hamatus* from the upper Tocantins River drainage (with bony hooks on dorsal, anal, pelvic, and pectoral fins) (Bertaco & Malabarba, 2005). *H. togoi* differs from *H. auca*, among other characters, by having less anal-fin rays (iv-v, 17-20 vs. iii-v 21-25) and short broad maxilla (vs. long and narrow) and from *H. hamatus* by having more anal-fin rays (iv-v, 17-20 vs. iii-v, 16-18), less maxillary teeth (1 vs. 2-3) and more cusps in the teeth of both premaxillary rows (5-6/6-11, vs. 3/3-5, respectively). Moreover, the coloration pattern of *H. togoi* is distinct from the abovementioned species in possessing an anterior humeral spot round to horizontally oval (vs. vertically elongated).

H. socolofi Weitzman and *H. erythrostigma* (Fowler) have small bony hooks on the dorsal, anal, pelvic, and pectoral fins of males, but differ from *H. togoi* in several important traits (Weitzman, 1977).

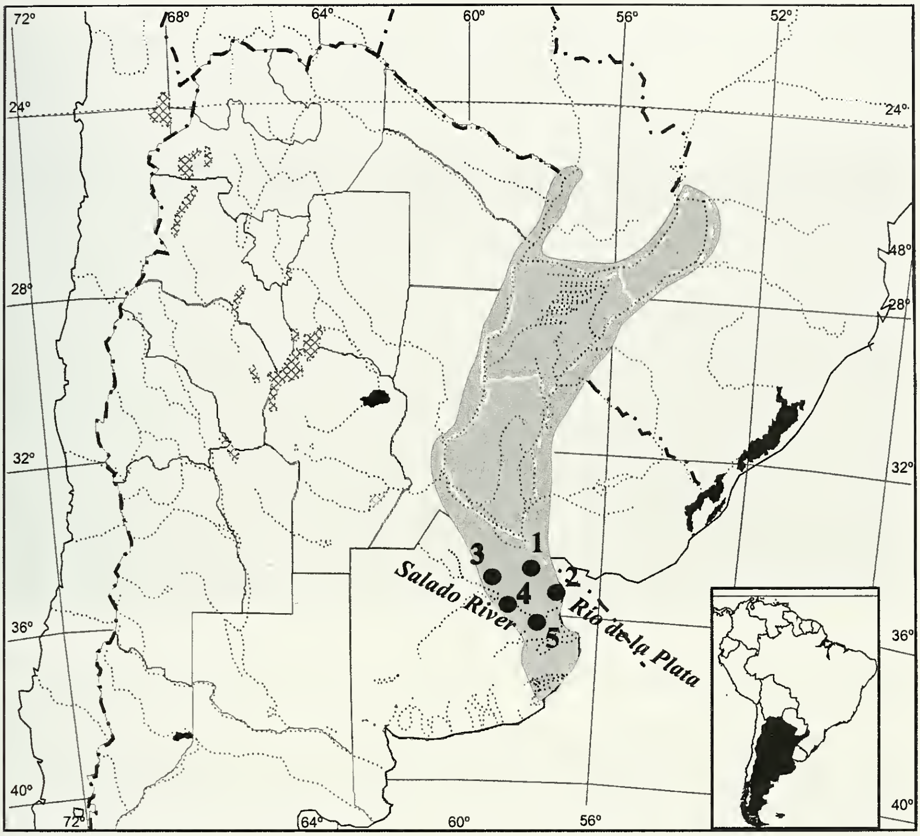

FIG. 4

Distribution of genus *Hyphessobrycon* in Argentina, circle black indicates the type locality of *Hyphessobrycon togoi* sp. n.: Tributaries of Río de la Plata (1, 2); Salado River System (3, 4, 5).

According to the ichthyogeographical schemes of Ringuelet (1975) and Arratia *et al.* (1983), the area of distribution of genus *Hyphessobrycon* in Argentina lies within the Paranoplatensean province. The species of the genus are extensively distributed in lotic and lenthic environments of the Río de la Plata and Salado basins, and the bonaerensean Atlantic drainage basins (sensu Mazza, 1961). This area is limited in the north by the Paraguay River, in the east by the Uruguay River, in the west by the Paraná River and Salado River basin, and in the south by Mar Chiquita, a coastal lagoon in Buenos Aires Province. The latter corresponds to the southernmost distributional limit (37° 37' S-57° 24' W) of the genus as established by the occurrence of *H. anisitsi* (Cousseau *et al.*, 2001).

An analysis of the distribution of *Hyphessobrycon* species shows that most of them occur in Paraná and Uruguay Rivers, the Paraná River Delta and the mesopotamic region (Fig. 4). The latter has the greater number of species: *H. anisitsi, H.* cf. *bifasciatus, H. elachys, H. eques, H. igneus, H. luetkenii, H. auca, H. meridionalis, H. reticulatus*, and *H. wajat.*

FIG. 5
Chascomús lagoon, Buenos Aires, Argentina, type locality of *Hyphessobrycon togoi* sp. n.

According to Menni *et al.* (1996), *H. anisitsi, H. luetkenii,* and *H. meridionalis* belong to a larger group of species recognized as typically paranoplatensean. Ringuelet (1975) considered *H. anisitsi,* along with *Bryconamericus iheringii* (Boulenger), *Cheirodon interruptus* (Jennys), *Oligosarcus jenynsii* (Günther), *Pimelodella laticeps* Eigenmann and *Rhamdia quelen* (Quoy & Gaimard), as components of the common fish fauna of the wet Pampa. The present analysis of material from Buenos Aires Province confirms that many references formerly assigned to *H. anisitsi* actually correspond to *H. togoi.* This will modify the known distribution range of *H. anisitsi.*

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Descriptions of adults, immature stages and venom apparatus of two new species of *Eudinostigma* Tobias (Hymenoptera, Braconidae), hyperparasitoids of *Phryxe caudata* (Rondani) (Diptera, Tachinidae)

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Descriptions of adults, immature stages and venom apparatus of two new species of *Eudinostigma* Tobias (Hymenoptera, Braconidae), hyperparasitoids of *Phryxe caudata* (Rondani) (Diptera, Tachinidae). - The imagines and cast skin of the final larval instar of two new species of Alysiini from Spain, hyperparasitoids of *Phryxe caudata* (Rondani), *Eudinostigma bienesae* Fischer, Tormos & Pardo, sp. n. and *Eudinostigma planiceps* Fischer, Tormos & Pardo, sp. n., and the venom apparatus of *E. bienesae* Fischer, Tormos & Pardo, sp. n. are described, illustrated, and compared with those of allied species. The morphological structures of phylogenetic value are discussed, and keys for the discrimination of the imagines are provided.

Keywords: Hymenoptera - Braconidae - new species - hosts - immature stages - venom apparatus - Spain.

INTRODUCTION

The Alysiinae, a subfamily of hymenopteran braconids, are largely characterized by their so-called «exodont» mandibles, a condition in which the teeth of the mandibles face anteriorly and do not overlap when the mandibles are closed (Wharton *et al.*, 1997). This subfamily has traditionally been divided into the tribes Dacnusini (with two cubital cells) and Alysiini (with three cubital cells). The latter have a well developed cc2 vein. *Eudinostigma* Tobias, 1986 is a genus of the *Aspilota* genus group of the tribe Alysiini with 9 species, including the two new species described here, in the Old World. Keys were presented by van Achterberg (1988), Belokobylskij (1998),

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Chen & Wu (1994), and Wu & Chen (1998). The species are very small, rare and their biology is unknown. They are distributed in the Palearctic region from West-and South Europe as far as the Russian Far East and China. Perhaps more species await discovery and description. *Eudinostigma* is not always accepted as a valid genus. In these latter cases the species are included in *Synaldis* Foerster, 1862 or *Dinotrema* Foerster, 1862. *Eudinostigma* is distinguished from both by having the vertex flat, not elevated above upper level of eyes. Additionally, this genus includes species with the vein cc1 present and absent as well.

Most of the taxonomy of braconid wasps is based on the external morphology of the adults, and relatively little attention has been paid to interspecific differences in larval or internal characters, even though these could be useful. In this respect, the Alysiinae, and hence the Alysiini, have received little attention. Thus, for the genus *Eudinostigma* no cast skin of the last larval instar has been described.

The reproductive apparatus of Hymenoptera, and its associated venom apparatus, vary in ways that may provide phylogenetic information and that may be useful for discriminating closely related species (Edson & Vinson, 1979; Quicke & Achterberg, 1990; Whitfield, 1992). For the Alysiini, detailed studies of variations in the gland and morphology of the reservoir of the venom apparatus have been conducted by Quicke *et al.* (1997). Nevertheless, the venom apparatus has not been described for any species of *Eudinostigma*.

In this report the imagines, cast skin of the final larval instar, and venom apparatus of one of the two new species of Alysiini are described. The authors discovered them in Spain hyperparasitizing a tachinid fly, which is a specific parasitoid of the processionary moth.

MATERIAL AND METHODS

Imagines and exuviae of the final larval instar of *Eudinostigma bienesae* Fischer, Tormos & Pardo, sp. n. and *Eudinostigma planiceps* Fischer, Tormos & Pardo, sp. n. were obtained in August and September 1990 from pupae of *Phryxe caudata* (Rondani, 1859), which were obtained from larvae of *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775) (Lepidoptera, Thaumetopoeidae) at Fuentelapeña and Vadillo de la Guareña (Zamora, Spain). In both cases, larvae of the Lepidoptera parasitized with Diptera larvae were collected and placed in plastic bottles of suitable dimensions, whose openings were covered with gauze held in place with a rubber band. These bottles were kept under ambient conditions of temperature, RH and photoperiod until emergence and pupation of the Diptera and their possible hyperparasitoids. The methodology used for opening the Diptera puparium and preparing the cast skins was that proposed by Wahl (1984).

The venom apparatus of both species was prepared and illustrated according to the method described by Quicke *et al.* (1992, 1997) (chlorazol black method) for dry museum specimens. The venom apparatus of one specimen of each species was treated with a hydroxide solution, which removed the soft tissue so that the remaining characters of the chitinous gland intima could be seen.

The morphological terms for the body of the imago, wing venation and the biometric data follow Fischer (1973). The terminology used to refer to the different structures of the immature stages is that of Finlayson & Hagen (1979), with the exception of the salivary orifice, which was taken from Sime & Wahl (1998). For the study and terminology of the characters of the gland and reservoir parts of the venom apparatus, Quicke *et al.* (1997) was followed. Concerning the material examined: a) the Holotypes are deposited at the Muséum d'histoire naturelle de Genève; b) the paratypes are deposited at the Naturhistorisches Museum Wien, and c) preparations of the cast skins and of the venom apparatus, and the specimens of *P. caudata* are deposited at the Fundación Entomológica "Torres-Sala" (Valencia, Spain). The following abbreviations were used: a) for the description of adults: 1) Antennae: F, Fl, F2, Fm, Fp = Flagellomere(s), flagellomere 1, 2, etc., middle flagellomere(s), penultimate flagellomere. 2) Metasoma: T, T1, T2 = tergite(s), first, second tergite. 3) Wings: Fore wing: st = pterostigma. r, r1+r2, r3 = radial vein, combined first and second abscissa of r, third abscissa of radius (r). cc1, cc2 = first, second transverse-cubital vein. cu2 = 2nd abscissa of cu (= cubital vein). d = discoidal vein. nr = recurrent vein (Nervus recurrens). np = parallel vein (nervus parallelus). nv = nervulus. R = radial cell. B = brachial cell. Hind wing: cu2' = second abscissa of cubital vein. M', SM' = Medial and submedial cell. nr' = radiellus (recurrent vein). r' = radial vein; b) for the preimaginal stage descriptions: d = diameter; l = length.

MORPHOLOGICAL AND SYSTEMATIC PART

Genus ***Eudinostigma*** Tobias, 1986

Eudinostigma, Tobias, 1986: 102, 152, 165 (Fig. 107: 3, 4). – Typus generis: *Eudinostigma fischeri* Tobias, 1986.
Eudinostigma, van Achterberg, 1988: 8 (key), 36.
Eudinostigma, Fischer, 1991: 12.

DIAGNOSIS: Vertex strongly flattened, antennal sockets near upper level of vertex, head not higher as long (lateral view). Body elongate. F2 shorter than F1 (or of equal length). Spiracle of propodeum more or less small. Wing venation complete, or, more often, vein cc1 absent, B closed, st linear or wedge shaped. Metasoma without sculpture beyond T1, apical segments folded dorsally and laterally compresed. Ovipositor sheaths with terebra curved upwards.

Taxonomic position of the genus (a) and of the two new species described here (b).

(a) This genus can be inserted in the key of Fischer (2002) for the genera of the *Aspilota*- group as follow:

A) Species with cc1 absent: it keys in the *Synaldis*-subgroup at couplet 5 from *Synaldis*:

1 Vertex arched, elevated above upper level of eyes . . . . *Synaldis* Foerster
\- Vertex flat, not elevated above upper level of eyes . . . . . . *Eudinostigma* Tobias

B) Species with cc1 present: it keys in the *Aspilota* –subgroup at couplet 22 from *Dinotrema* as follows:

1 Vertex arched, elevated above upper level of eyes . . . . *Dinotrema* Foerster
\- Vertex flat, not elevated above upper level of eyes . . . . . . *Eudinostigma* Tobias

(b) *Eudinostigma bienesae* Fischer, Tormos & Pardo, sp. n. and *E. planiceps* Fischer, Tormos & Pardo, sp. n. run to thesis 3 in the key of van Achterberg (1988), and can be integrated as follows:

1 cc1 absent 2
- cc1 present, although sometimes obsolescent 3
2 Propodeum predominantly reticulate, with short basal lamella. Face very arched, protruding beyond anterior edge of eyes (lateral view). T1 weakly longitudinally striate. 1 mm. Spain . . . . *E. bienesae* Fisher, Tormos & Pardo, sp. n. ♀♂
- Propodeum practically smooth, with a median longitudinal keel, with only some sculpture on either side. Face less arched, hardly protruding beyond anterior edge of eyes (lateral view). T1 nearly smooth. 1.4 mm. Spain . . . . *E. planiceps* Fischer, Tormos, Pardo, sp. n. ♂

Eudinostigma bienesae Fischer, Tormos & Pardo, sp. n. Figs 1a, 1b

HOLOTYPE (Bienes leg.): ♀, SPAIN, Zamora, Fuentelapeña, ex pupa *P. caudata* parasitic on larvae of *T. pityocampa*, VIII-1990 (MHNG).

PARATYPES (Bienes leg.): ♂, SPAIN, Zamora, Vadillo de la Guareña, IX-1990; ditto, VIII-1990, 1♀.

HOST: *Phryxe caudata* parasitic on *Thaumetopoea pityocampa*.

ETYMOLOGY: Dedicated to the collector Cristina Bienes.

TAXONOMIC POSITION: If attempts were made to identify this species within the genus *Synaldis*, it would run in the key by Fischer (2003) to *Synaldis concolor* (Nees von Esenbeck, 1814), from which it can be distinguished as follows:

1 Mesosoma 1.4 times as long as high; upper side evenly curved. Head 1.8 times as wide as long; in lateral view not longer than high. 1.5-1.9 mm. Europe: from the British Isles, across Central Europe to Croatia; Madeira . . . . *S. concolor* (Nees), ♀♂
- Mesosoma 1.6 times as long as high; upper side nearly flat, only in front and behind sloping. Head 1.6 times as wide as long; in lateral view slightly longer than high. 1 mm. Spain . . . . *E. bienesae* Fischer, Tormos & Pardo sp. n., ♀♂

FEMALE: Length of body: 1 mm.

Head: 1.6 times as wide as long, 1.5 times as long as high, upper side nearly flat; 1.7 times as wide as the face, twice as wide as mesoscutum. Temples 1.15 times as long as the eyes, dorsal aspect nearly rectangular; across the eyes as wide as across the temples. Antennal sockets very protuberant, ocelli small, distance between them greater than their diameter; distance of an ocellus from an eye almost greater than the ocellar area is wide, epicranial suture present; occiput highly excavated, upper surface bare. Face 1.5 times as wide as high; highly arched, without middle elevation, with scattered setae with no recognizable setae-points; bare only laterally; eye margins parallel. Clypeus 3 times as wide as high, not clearly arched, trapezoidal; lower edge slightly bent inwards, with a few setae. Distance between tentorial pits 2.5 times as great as their distance from an eye. Mandible as wide as long, upper margin bent upwards; tooth 2 pointed and slightly protruding, tooth 1 blunt, from here arises a lamella extending towards the base, a right angle between tooth 1 and tooth 2, tooth 3 round apically, a narrow incision between tooth 2 and tooth 3; outer surface smooth. Maxillary palpi shorter than height of head, 5 segments recognizable. Antennae not longer than body, 14-15-articulated; F1 narrower than others, 2.5 times as long as wide, F3 twice, Fm 1.5 times as long as wide; the F clearly separated from each other, the setae as long as the width of the F, 3 sensilla visible in lateral view.

Mesosoma: 1.6 times as long as high; upper side flat, upper and lower side parallel, much higher than wide. Mesoscutum as long as wide, oval in front, notauli developed only on the declivity, their imaginary course indicated by a few setae; dorsal fovea forming a short, weak line, edges weakly marginate. Praescutellar furrow divided; lateral areas more or less round, as long as wide, smooth. Postaxillae smooth. Lateral areas of the metanotum crenulated. Propodeum predominantly reticulate, with short basal lamella; anterior third horizontal; spiracles situated slightly behind middle of lateral edges. Anterior furrow of one side of the propodeum crenulated. Sternaulus narrow, crenulated, shortened on either side, posterior mesopleural furrow smooth; wider below, very narrow above. Metapleuron smooth. Hind femora 5 times as long as wide.

Wing: st forming together with the metacarp a uniform anterior marginal vein, which is narrowed distally; r arising a short distance behind the base of the st, r1 and r2 forming a common curve; r3 bent outwards, 2.5 times as long as r1+r2; R reaching apex of wing; d 1.3 times as long as nr; nv slightly postfurcal; B closed; distal veins forming an angle; np absent. r', cu2' and nr' absent; the longest fimbria on the hind margin as long as the width of the hind wing.

Metasoma: T1 twice as long as wide, weakly narrowed towards the base, dorsal carinae developed only in front, weakly longitudinally striate. Posterior half laterally compressed, the posterior segments folded above. Ovipositor sheaths (lateral view) as long as T1, hardly projecting behind tip of wing.

Colouration: Black, but yellow are: anellus, mouth parts, legs prevailing, tegulae, and wing venation. T2+3 yellowish. Femora and tibiae, except at their bases, dark yellow. Wing membrane hyaline.

MALE: Like female, but differing by: antennae 17-articulated, and F twice as long as wide.

IMMATURE STAGES: *Exuvia* (Figs 3a, 3b). Of the two exuviae available for study, all the absolute measurements refer to only one of them. Tegument non-sclerotized, with the exception of spiracles, smooth. Spiracle with atrium (d = 8 μm) and closing apparatus differentiated; closing apparatus not close to atrium. Cranial structures: complete epistomal arch. Mouthparts: mandibles (l = 58 μm), straight, thorn shaped, blade without teeth, smooth. Maxillary (d = 3 μm) and labial (d = 4 μm) palpi present; salivary orifice defined.

VENOM APPARATUS (Fig 4): This species has a venom apparatus with the characters specified by Quicke *et al.* (1997) for the *Aspilota* complex of genera. *Eudinostigma bienesae* has a venom reservoir with a long, parallel-sided neck region and a simple venom gland with two tubular regions divided at the apex into two small regions.

Eudinostigma planiceps Fischer, Tormos & Pardo, sp. n. Figs 2a, 2b, 2c, 2d, 2e

HOLOTYPE (Bienes leg.): ♂, SPAIN, Zamora, Carretera de Villaralbo, ex pupa *P. caudata* parasitic on larvae of *T. pityocampa*, VIII-1990 (MHNG).

PARATYPES (Bienes leg.): ditto, 1♂; SPAIN, Zamora, Vadillo de la Guareña, VIII-1990, 1♂.

HOST: *Phryxe caudata* parasitic on *Thaumetopoea pityocampa.*

ETYMOLOGY: Named after the flat head.

TAXONOMIC POSITION: If attempts were made to identify this species within the genus *Synaldis*, it would run in the key by Fischer (2003) to *Synaldis lacessiva* Fischer, 1975, from which it can be distinguished as follows:

1 Head not longer than high; not especially flattened. Toruli only slightly protruding. Mesosoma 1.25 times as long as high. Head 1.5 times as wide as the mesoscutum. 1.5 mm. Austria; Madeira . . . *S. lacessiva* Fischer, ♀

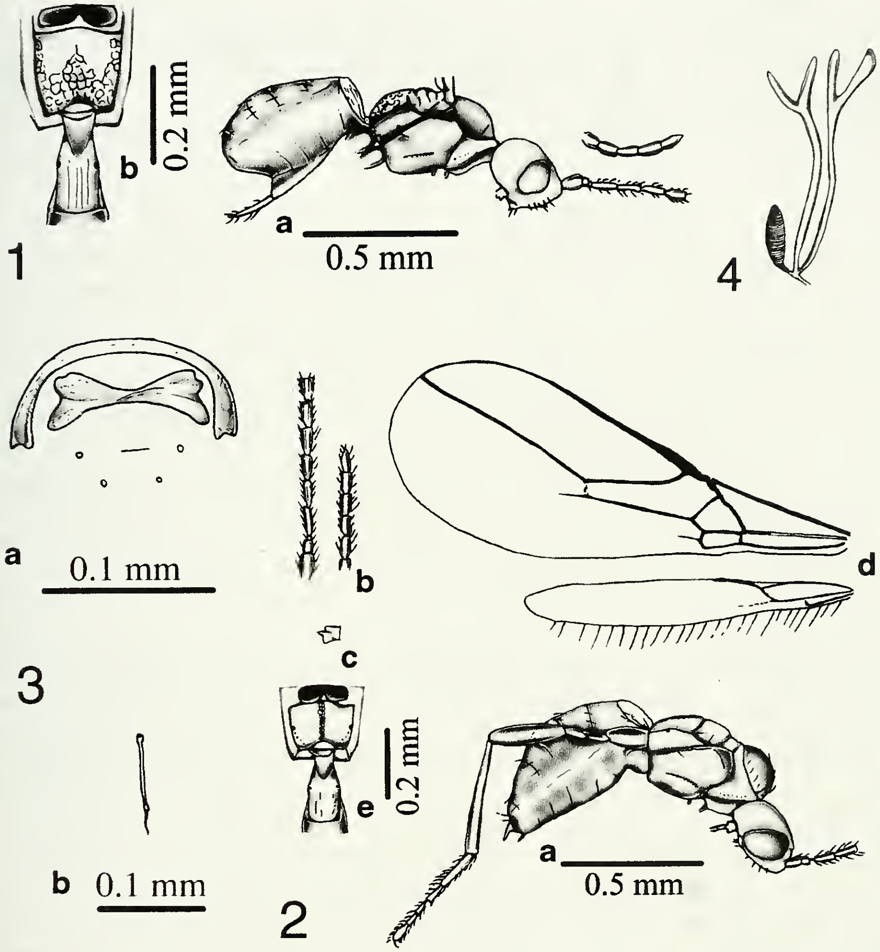
\- Head extremely flat, much longer than high. Toruli very protuberant. Mesosoma 1.6 times as long as high. Head nearly twice as wide as mesoscutum. 1.4 mm. Spain . . *E. planiceps* Fischer, Tormos & Pardo, sp. n., ♂

MALE: Length of body: 1.4 mm.

Head: Flat, 1.5 times as long as high, 1.5 times as wide as long, upper side extremely flat; 1.5 times as wide as the face, nearly twice as wide as mesoscutum; slightly wider across temples than across eyes; eyes nearly as long as temples; toruli very protuberant; occiput highly excavated; ocelli small, distance between them greater than their diameter, ocellar area as wide as the distance from the eyes, epicranial furrow distinct; upper side with a few inconspicuous setae. Face 1.33 times as wide as high, evenly arched, without middle elevation, with scattered upward-curved setae in middle, laterally bare, a few erect setae near eyes, the latter parallel-sided. Clypeus 3.5 times as wide as high, slightly arched, trapezoidal; diameter of tentorial pits smaller than their distance from the eyes. Mandible about as long as wide, upper margin slightly expanded upwards, tooth 1 and tooth 3 blunt, tooth 2 pointed, a sharp incision between tooth 1 and 2; maxillary palpi almost as long as the head high, 4 segments visible. Antennae as long as body, 17-18-articulated; F1 3 times as long as wide, following ones gradually shorter, Fm and Fp twice as long as wide; F clearly separated from each other, 2 sensilla discernable in lateral view, most setae as long as the F wide.

Mesosoma: 1.6 times as long as high, narrower than high, upper side flat or slightly arched behind, upper and lower sides nearly parallel. Mesoscutum as long as wide, oval in front of tegulae; notauli weakly indicated on declivity and straight, absent on disc, with narrow marginal furrows, dorsal fovea elongate, some setae on declivity and along the imaginary course of the notauli. Praescutellar furrow deep, smooth, divided, each lateral area as wide as long. The rest of mesosoma smooth. Propodeum with a median carina that is laterally crenulated to rugose, lateral marginal furrows narrow, crenulated. Side of pronotum with anterior furrow weakly crenulated. Prepectal furrow faintly crenulated. Sternaulus narrow, shortened behind, with small notches, hind mesopleural furrow smooth. Hind femur 4 times as long as wide.

Wing: st narrow, passing gradually into metacarp; r arising near base of st; r1 + r2 curved near base; r3 twice as long as r1 + r2; R reaching apex of wing; d twice as



FIGS 1-4

(1) *Eudinostigma bienesae* Fischer, Tormos & Pardo, sp. n.: a – body of adult in lateral view with detail of apex of the antenna; b – propodeum, metascutum and T1 (first tergite of metasoma) in dorsal view. (2) *Eudinostigma planiceps* Fischer, Tormos & Pardo, sp. n. : a – body of adult in lateral view; b – left antenna with detail of its apex; c – mandible; d – left wings; e – propodeum, metascutum and T1 in dorsal view. (3) *Eudinostigma bienesae*: a – cephalic structures of final instar larva; b – spiracle. 4 – *Eudinostigma bienesae*: venom apparatus.

long as nr, nv interstitial; B closed; np arising from middle of distal side of B. r', cu2' and nr' absent; setae (fimbria) on hind margin of the hind wing almost as long as the hind wing wide.

Metasoma: T1 1.8 times as long as wide, posterior half parallel-sided, narrowed toward base, dorsal carinae developed on basal third, upper surface nearly smooth.

Colouration: Black. Yellow: base of antennae, mouth parts, legs, tegulae, wing venation, and metasoma except apical third (in one specimen black behind T1). Wing membrane hyaline.

FEMALE: Unknown.

IMMATURE STAGES: *Exuvia.* Of the two exuviae available for study, all the absolute measurements refer to only one of them. In this description, all structures are assumed to be similar or of the same order as those of the previous species. Only differences detailed: Mandibles (l = 56 μm). Maxillary (d = 4 μm) and labial (d = 4 μm) palpi.

REMARKS AND DISCUSSION

The genus *Eudinostigma* was treated by Wharton (2002) as a synonym of *Dinotrema*. This author indicates that there is no basis for retaining *Eudinostigma*, as defined by "head expanded behind eyes" (Achterberg, 1988; Belokobylskij, 1998), in a phylogenetically based classification. This feature –"head strongly depressed, resulting in a flattened vertex and antennal sockets near upper level of vertex"– is developed in several species that are not very closely related to one another, meaning that the group becomes paraphyletic. According to Wharton (1988), the wing vein characters used by Tobias (1986) to define this genus initially are unsustainable. Despite the assertions advanced here, while waiting for new evidence derived from forthcoming studies of pre-imaginal and internal morphology, together with molecular evidence, we maintain the status of this genus following the criterion of Belokobylskij (1998).

Hyperparasitism is nearly absent from Braconidae. Some members of the *Aspilota*-genera-group are obviously exceptions. Little is known about the hosts, but the major hosts seem to be Phoridae. These Diptera have diverse life histories (see Disney (1994) for details). Some of them are parasitoids parasitizing groups such as Coccinellidae, Tipulidae, Bibionidae, Sciaridae, Simuliidae and perhaps other Diptera, ants, and termites. Humans are also said to be parasitized in tropic countries. Phoridae rank among the more abundant flies which can be netted, at least in my (Fischer) experience. This, together with the great diversity of the mode of life and the small size, may constitute an explanation for the great diversity of the *Aspilota*-group.

Most of the information available about the biology of the Alysiini refers only to the habitats where they were collected and from lists of parasitoids cited in the study of some host responsible for pests. Thus, from the several hundred species of these parasitoids described the biology has only been studied, to a greater or lesser extent, in some twenty species and accurate information is only available for one fifth of the species described.

References, confirmed or accepted, to species of facultative hyperparasitoid alysiines, of primary parasitoid diptera of Lepidoptera, are very rare. A few species of *Aphaereta*, hyperparasitoids of Lepidoptera, attacking species of Tachinidae and Sarcophagidae (Wharton, 1984) have been reported. It is striking that in that article the author included a species of Thaumetopoeidae among the rejected hosts of *Dinotrema lineola* (Thomson, 1895). A possible hyperparasitoid? Additionally authors such as Ruschka & Fulmek (1915), Kulman (1965) and Witter & Kulman (1979) have reported evidence to suggest that the references to alysiines that attack Lepidoptera and Coleoptera are almost certainly primary parasitoids of phorid diptera, sarcophagids or tachinids.

The two new species described here are very close to *Eudinostigma pulvinatum* (Stelfox & Graham, 1949) and *Eudinostigma alox* van Achterberg, 1988, from which they can be distinguished, in addition to the absence of vein cc1, by the following characters: a) *E. pulvinatum* differs in the face, which is nearly twice as wide as high, b) *E. alox* in the mandibles, which are 1.4 times as wide as long. Additionally, these species are different from all species of *Synaldis* listed in the key by Fischer (2003), in the flat and elongate body.

The differences between the exuviae of the species described here, *E. bienesae* and *E. planiceps*, and the previously described exuviae of the species of the phylogenetically more affine genera *Dinotrema* and *Synaldis* (Čapek, 1970; Finlaysson, 1987) lie in the number and arrangement of the sensilla[1].

The final larval instar of Alysiinae differs from the almost complete set of head sclerites in *Alysia* (Short, 1952) to the condition in *Aspilota*, where almost the only sclerotized structures are the epistoma and mandibles (Short, 1979; Finlaysson, 1987). The chief larval characters of mature larvae of Alysiini are: a) simple, smooth mandibles and b) a reduced labial sclerite (Čapek, 1970). The exuviae of *Eudinostigma* described here have these well defined characters and also show most of those of the phylogenetically closest genera, *Dinotrema* and *Synaldis*: a) Integument smooth (Short, 1952), b) epistoma and epistomal arch complete (Čapek, 1970, 1973), c) mandibles straight, thorn shaped (Čapek, 1970, 1973), d) mandibular blade without teeth (Finlaysson, 1987), e) labial sclerite absent (completely reduced) (Čapek, 1970, Finlaysson, 1987), f) of the mouthparts and their differentiations only mandibles and palpi are present (Čapek, 1973), g) all cephalic structures non-sclerotized, except epistoma and mandibles (Čapek, 1970), and h) spiracles with atrium and closing apparatus differentiated (Čapek, 1973), and with closing apparatus not close to atrium (Short, 1952).

The shape of the venom gland of *E. bienesae* is found in the phylogenetically closest genera *Dinotrema* and *Synaldis*. The only observed morphological difference between the venom apparatus of this species and those described previously, of *Dinotrema* and *Synaldis*, lies in the number of apical subdivisions of the venom gland.

From the data available on the preimaginal stages and morphology of the venom apparatus of the Alysiini, it is clear that further descriptions, both of the larvae and the venom apparatus, are necessary before inferring phylogenetic relationships from their morphological features.

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[1] The identity of the species studied previously, and their generic cut-off, are controversial. Thus, *Aspilota signifrons* Viereck, 1906 and *Aspilota nervosa* Haliday, 1833, whose exuviae of the last larval instar were studied by Čapek (1970) – the exuviae of *A. nervosa* was also studied by Evans (1933) –, are now placed within the genus *Dinotrema*. *Aspilota vesparum* Stelfox, 1943 whose exuvia of the last larval instar was described by Short (1952) and Finlaysson (1979), is currently considered to be a synonymy of *Dinotrema nervosum* (Haliday, 1833).

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Oribatids from Switzerland XIII (Acari: Oribatida: Brachychthoniidae). (*Acarologica Genavensia* CVII)

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Oribatids from Switzerland XIII (Acari: Oribatida: Brachychthoniidae). (*Acarologica Genavensia* CVII). – All published records and newly determined Swiss moss mites belonging to the family Brachychthoniidae are listed, discussed or described. From the 25 named species in the literature 16 are confirmed after critical discussion. New identifications of 28 species are given: 2 of which (*Liochthonius tumidus* sp. n. and *Liochthonius tumulosus* sp. n.) are new to science, 15 species are new for the Fauna of Switzerland and 5 are confirmations for the Swiss territory of doubtful species in the literature. As a synthesis a preliminary list of 36 Brachychthoniidae species belonging to 8 genera from Switzerland is given.

Keywords: Acari - Oribatida - Brachychthoniidae - taxonomy - new species - Switzerland.

INTRODUCTION

In continuing the study of the Swiss oribatids, the project that had been outlined in several earlier papers (e.g. Mahunka & Mahunka-Papp, 2003), this time we elaborated the species belonging to the family Brachychthoniidae Thor, 1934. The species of this group are well distributed in Switzerland and were investigated by several authors (Schweizer, 1922, 1948, 1956, 1957; Bader, 1963; Niedbała, 1972, 1974, 1976; Moritz, 1976a, 1976b; Evison, 1981; Borcard, 1991a, 1991b, 1993; Mahunka, 1993; Borcard & Matthey, 1995). So far, the presence of 25 species is recorded. The number of valid species is 16 belonging to six genera.

The species number of this family in Switzerland is also comparatively high like in Austria (see Schatz, 2004), but there are some old and unsolved problems and numerous misidentifications (Schweizer, 1922, 1948, 1956, 1957) in the literature. In the meantime these problems were partly solved by several authors, e.g. Niedbała (1972, 1974) and Moritz (1976a, 1976b).

We are able to add new identifications of 28 species, found on the territory of Switzerland. Among them 2 are new for science, 15 are new for the Fauna of Switzerland and 5 are confirmations for the Swiss territory of doubtful species in the literature.

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HITHERTO PUBLISHED SPECIES FROM SWITZERLAND

The following chronological list recapitulates all recorded species with the published name and the actual valid name or, in the case of misidentifications, the correct species.

SCHWEIZER, 1922
p. 74; 101: *Brachychthonius brevis* (Mich.) Berl. [*Liochthonius brevis* (Michael)] = ?

SCHWEIZER, 1948
pp. 5; 8; 17: *Brachychthonius berlesei* Willm. = ?
pp. 10; 11; 17: *Brachychthonius horridus* Sellnick [*Liochthonius horridus* (Sellnick)] = ?
pp. 10; 11; 17: *Brachychthonius perpusillus* Berl. [*Liochthonius brevis* (Michael)] = ?
pp. 8; 9; 10; 11; 12; 17: *Brachychthonius brevis* (Mich.) [*Liochthonius brevis* (Michael)] = ?
pp. 11; 17: *Brachychthonius laetepictus* Berl. = species inquirenda
p. 28: *Brachychthonius gisini* n. sp. = ***Liochthonius gisini*** (Schweizer)

SCHWEIZER, 1956
pp. 225; 370: *Brachychthonius gisini* Schweizer = ***Liochthonius gisini*** (Schweizer)
pp. 225-226; 370: *Brachychthonius sellnicki* Sig Thor = ***Liochthonius sellnicki*** (Thor)
pp. 226-227; 370: *Brachychthonius oudemansi* v. d. Hammen [*Eobrachychthonius oudemansi* Hammen] = ?
pp. 227; 370: *Brachychthonius immaculatus* Forsslund [*Sellnickochthonius immaculatus* (Forsslund)] = ?
pp. 227; 370: *Brachychthonius neosimplex* n. sp. = species inquirenda
pp. 227-228; 370: *Brachychthonius perpusillus* Berlese [*Liochthonius brevis* (Michael)] = ?
pp. 228-229; 370: *Brachychthonius laetepictus* Berlese = species inquirenda
pp. 229; 370: *Brachychthonius scalaris* Forsslund [*Liochthonius sellnicki* (Thor)] = ?
pp. 229; 370: *Brachychthonius hystricinus* Forsslund [*Liochthonius hystricinus* (Forsslund)] = ?
pp. 230; 370: *Brachychthonius berlesei* Willmann = ?
pp. 230-231; 370: *Brachychthonius helveticus* n. sp. = ***Brachychthonius bimaculatus*** Willmann

SCHWEIZER, 1957
pp. 37; 43; tab.VII: *Brachychthonius sellnicki* = ***Liochthonius sellnicki*** (Thor)
pp. 43; 48; tab. VII: *Brachychthonius perpusillus* [*Liochthonius brevis* (Michael)] = ?
p. 43; tab. VII: *Brachychthonius scalaris* [*Liochthonius sellnicki* (Thor)] = ?
pp. 45; 54; tab. VII: *Brachychthonius laetepictus* = species inquirenda
p. 47; tab. VII: *Brachychthonius neosimplex* = species inquirenda
p. 49; tab. VII: *Brachychthonius oudemansi* [*Eobrachychthonius oudemansi* Hammen] = ?
tab. VII: *Brachychthonius gisini* = ***Liochthonius gisini*** (Schweizer)
tab. VII: *Brachychthonius immaculatus* [*Sellnickochthonius immaculatus* (Forsslund)] = ?
tab. VII: *Brachychthonius hystricinus* [*Liochthonius hystricinus* (Forsslund)] = ?
tab. VII: *Brachychthonius berlesei* = ?
tab. VII: *Brachychthonius helveticus* = ***Brachychthonius bimaculatus*** Willmann

BADER, 1963:
pp. 67-68: *Brachychthonius gygeri* n. sp. = ***Sellnickochthonius immaculatus*** (Forsslund)

EVISON, 1981
pp. 225-227: ***Liochthonius andrewi*** n. sp.
pp. 227-229: *Mixochthonius moritzi* n. sp. = species inquirenda according toWeigmann, 2006

BORCARD, 1991a
pp. 177; 181: *Brachychochthonius cricoides* Weis-Fogh = ***Sellnickochthonius cricoides*** (Weis-Fogh)
pp. 171; 183-184: *Brachychochthonius* cf. *immaculatus* Forsslund = ***Sellnickochthonius immaculatus*** (Forsslund)

pp. 177; 184: *Brachychochthonius zelawaiensis* (Sellnick) = ***Sellnickochthonius zelawaiensis*** (Sellnick)
pp. 177; 184-185: ***Brachychthonius berlesei*** Willmann
pp. 177; 185 ***Eobrachychthonius latior*** (Berlese)
pp. 177; 185: *Eobrachychthonius* cf. *oudemansi* van der Hammen = ***Eobrachychthonius oudemansi*** Hammen
pp. 177; 185: ***Liochthonius alpestris*** (Forsslund)
pp. 177; 186: ***Liochthonius peduncularis*** (Strenzke)
pp. 177; 186: ***Liochthonius perfusorius*** Moritz
pp. 177; 186: ***Liochthonius tuxeni*** (Forsslund)
pp. 177; 186-187: ***Mixochthonius pilososetosus***(Forsslund)

BORCARD, 1991b
Liochthonius perfusorius Moritz, 1976
Brachychochthonius zelawaiensis (Selln.) 1928 = ***Sellnickochthonius zelawaiensis*** (Sellnick)

BORCARD, 1993
pp. 179; 180; 181; *Brachychochthonius zelawaiensis* (Sellnick) 1928 = ***Sellnickochthonius zelawaiensis*** (Sellnick)
pp. 179; 180: ***Brachychthonius berlesei*** Willmann 1928
pp. 179; 180: ***Liochthonius alpestris*** (Forsslund) 1958
pp. 179; 180: ***Liochthonius perfusorius*** Moritz 1976

BORCARD & MATTHEY, 1995
pp. 229; 230: ***Liochthonius perfusorius*** Moritz, 1976
pp. 229; 230: *Brachychochthonius zelawaiensis* (Sellnick, 1928) = ***Sellnickochthonius zelawaiensis*** (Sellnick)
pp. 229; 230: ***Brachychthonius berlesei*** Willmann, 1928
p. 230: *Eobrachychthonius* cf. *oudemansi* van der Hammen, 1952 = ***Eobrachychthonius oudemansi*** Hammen

MAHUNKA, 1993
p. 226: ***Verachthonius laticeps*** (Strenzke)

CRITICAL REMARKS ON EARLIER DATA

SCHWEIZER (1922, 1948, 1956, 1957)

In general, his data are unreliable and not well acknowledged. In his publication from 1922 he mentioned only one species: *Brachychthonius brevis* (Mich.) Berl. This reference has never after been referred to either by him or others. Since this species may easily be confused with several species (e.g. *B. pius* Moritz, 1976b, *B. impressus* Moritz, 1976b) it should be deleted from the Swiss fauna list.

A number of Brachychthoniidae species was listed in his paper from 1948, while in the „Nachtrag" attached to this paper he described a new species: *Brachychthonius* (= *Liochthonius*) *gisini*. Some of the listed species have been newly confirmed for Switzerland, but the data of Schweizer lacking authentic specimens are considered to be uncertain. Several authors (e.g. Niedbała, 1972, 1974; Moritz, 1976a) accept *Liochthonius gisini* as valid species, as we do also after having studied the holotype (Mahunka, 1969).

The identification of the following species notated in the paper from 1956 belonging in the family of Brachychthoniidae are unambiguous:

Brachychthonius (=Liochthonius) sellnicki (Thor, 1934): Moritz (1976a) accepted the reference of Schweizer, as we do.

Brachychthonius helveticus Schweizer, 1956: without doubt it is identical (see Niedbała, 1974 and Moritz, 1976b) with *Liochthonius bimaculatus* Willmann, 1936. The figure of Schweizer subscribes to it.

On the other hand, we could not evaluate the following species (neither were these mentioned by Niedbała, 1972, 1974, nor by Moritz, 1976a, 1976b). Some of the names are among the species incertae sedis:

Brachychthonius berlesei Willmann, 1928
Brachychthonius immaculatus Forsslund, 1942
Brachychthonius (=Liochthonius) laetepictus Berlese, 1910
Brachychthonius (=Liochthonius) neosimplex Schweizer, 1956
Brachychthonius (=Liochthonius) perpusillus Berlese, 1910
Brachychthonius (=Eobrachychthonius) oudemansi Hammen, 1952

BADER, 1963

He described a new species found in the legacy of Schweizer under the name of *Brachychthonius gygeri*, however, this species is identical with *B. immaculatus* Forrslund, 1942. Subsequently, several authors accepted this synonymisation.

EVISON, 1981

Weigmann (2006) considered *Mixochthonius moritzi* Evison as «species inquirenda».

BORCARD (1991a, 1991b, 1993), BORCARD & MATTHEY, 1995

When writing his works he was aware of and he also used the recent literature (Niedbała, 1972b; Moritz, 1976a, 1976b; Balogh & Mahunka, 1983), thus his data are correct and may be referred to, excepting those with cf., but with our present study of new materials, we can confirm the presence of these species in Switzerland.

MAHUNKA, 1993

This is still the only record of *Verachthonius laticeps* (Strenzke, 1951) for Switzerland.

Neither NIEDBAŁA nor MORITZ described a new species from the territory of Switzerland, they simply investigated those already known.

LIST OF THE PUBLISHED SPECIES ACCEPTED FOR THE SWISS FAUNA

Brachychthonius berlesei Willmann,1928
Brachychthonius bimaculatus Willmann,1936
Eobrachychthonius latior (Berlese, 1910)
Eobrachychthonius oudemansi Hammen, 1952
Liochthonius alpestris (Forsslund, 1958)
Liochthonius andrewi Evison, 1981
Liochthonius gisini (Schweizer, 1948)
Liochthonius peduncularis (Strenzke, 1951)
Liochthonius perfusorius Moritz, 1976
Liochthonius sellnicki (Thor, 1930)
Liochthonius tuxeni (Forsslund, 1957)

Mixochthonius pilososetosus (Forsslund, 1942)
Sellnickochthonius cricoides (Weis-Fogh, 1948)
Sellnickochthonius immaculatus (Forsslund, 1942)
Sellnickochthonius zelawaiensis (Sellnick, 1928)
Verachthonius laticeps (Strenzke, 1951)

LIST OF LOCALITIES

BE-12: SWITZERLAND: **Berne:** Niesen, sifting of mosses, 2300 m; 29.VII.2002; leg. C. Besuchet — (Bp—230).

BL-1: SWITZERLAND: **Bâle-campagne:** «Reinacher-Heide» near Reinach, Nature Reserve, xerothermic meadows, sifting, 600-700 m; 12.X.1989; leg. C. Besuchet — (Bp—85).

GE-9: SWITZERLAND: **Genève:** Allondon, Les Granges, old tree stump; 30.VI.1982; leg. C. Besuchet — (Bp—208).

GR-1: SWITZERLAND: **Grisons:** Gafia St. Antönien, mosses and grass roots; 20.IX.1983; leg. C. Besuchet — (Bp—51).

GR-9: SWITZERLAND: **Grisons:** Santa Maria – Umbrail Pass, sifting, 2000 m; 5.VIII.1974; leg. C. Besuchet — (Bp—37).

GR-15: SWITZERLAND: **Grisons:** Umbrail Pass, 2000 m; 25.VIII.1968; leg. C. Besuchet — (Bp—149).

GR-19: SWITZERLAND: **Grisons:** Val Poschiavo, above Selva, mosses and dead leaves, 1850 m; 28.VIII.1983; leg. C. Besuchet — (Bp—143).

LU-1: SWITZERLAND: **Lucerne:** Eigenthal, peat-bog Forenmoos near the village of Eigenthal, *Sphagnum* sp., 970 m; 2.VIII.1996; leg. C. Besuchet — (Bp—108).

LU-2: SWITZERLAND: **Lucerne:** above Gettnau (between Zell and Willisau), old ant-hill of *Formica rufa* L.; 1.VIII.1996; leg. C. Besuchet — (Bp—107).

LU-5: SWITZERLAND: **Lucerne:** Wohlhusen, old tree stumps; 17.III.1979; leg. C. Besuchet — (Bp—176).

SO-2: SWITZERLAND: **Soleure:** Ammansegg, litter and dry leaves in mixed forest; 14.V.1972; leg. S. Mahunka & L. Mahunka-Papp — (Bp—11).

SO-5: SWITZERLAND: **Soleure:** Schnottwil, Bucheggberg, mosses on bark of a live deciduous tree; 27.IX.1987; leg. S. Mahunka & L. Mahunka-Papp — (Bp—47).

SO-6: SWITZERLAND: **Soleure:** Schnottwil, Bucheggberg, dry needles in pine (*Pinus sp.*) forest; 27.IX.1987; leg. S. Mahunka & L. Mahunka-Papp — (Bp—48).

SO-7: SWITZERLAND: **Soleure:** Schnottwil, Bucheggberg, rotten wood and humus from trunk of an old deciduous tree; 27.IX.1987; leg. S. Mahunka & L. Mahunka-Papp — (Bp—49).

TG-3: SWITZERLAND: **Thurgovie:** Hudelmoos near Hagenwil, peat-bog with *Sphagnum* sp.,600 m; 13.IX.1993; leg. C. Besuchet — (Bp—88).

TG-7: SWITZERLAND: **Thurgovie:** Müllheim, dry leaves in mixed forest; 13.IX.1987; leg. S. Mahunka & L. Mahunka-Papp — (Bp—42).

TG-8: SWITZERLAND: **Thurgovie:** Müllheim, rotten trunk with mosses; 13.IX.1987, leg. S. Mahunka & L. Mahunka-Papp — (Bp—43).

TG-9: SWITZERLAND: **Thurgovie:** between Bischofszell and Hauptwil, moss on forest floor with ferns; 11.VI.1983; leg. T. & Z. Adamis — (Bp—21).

TG-10: SWITZERLAND: **Thurgovie:** between Bischofszell and Hauptwil, moss on forest floor and dry needles in pine (*Pinus* sp.) forest; 11.VI.1983; leg. T. & Z. Adamis — (Bp—22).

TI-3: SWITZERLAND: **Tessin:** Bordei at base of Mount Gridone («massif de refuge»), old chestnut stumps in forest, sifting, 700 m; 24.IV.1992; leg. C. Besuchet — (Bp—90).

TI-5: SWITZERLAND: **Tessin:** Monadello - Moneto, in decaying leaves, 850 m; 23.IV.1992; leg. C. Besuchet — (Bp—91).

TI-9: SWITZERLAND: **Tessin**: Nufenen Pass, dry leaves and rotten wood in larch forest; 15.VI.1979; leg. S. Mahunka & L. Mahunka-Papp — (Bp—18).

TI-13: SWITZERLAND: **Tessin:** Scudellate, moss on trees; 14.VI.1979; leg. S. Mahunka & L. Mahunka-Papp — (Bp—13).

TI-22: SWITZERLAND: **Tessin:** Cortascio above Brissago, sifting in ravine, 1050 m; 22.IV.1992; leg. C. Besuchet — (Bp—157).

TI-23: SWITZERLAND: **Tessin:** Alpe d'Arena above Vergeletto, at base of rocks, 1700 m; 22.VII.1983; leg. C. Besuchet — (Bp—142).

TI-38: SWITZERLAND: **Tessin:** Ascona, Mte Verità, dead leaves and soil, 450 m; 5.XI.1984; leg. C. Besuchet — (Bp—210).

TI-42: SWITZERLAND: **Tessin:** Cortascio above Brissago, sifting of mosses, 900 m; 20.V.1998; leg. C. Besuchet — (Bp—229).

UR-4: SWITZERLAND: **Uri:** Oberalp Pass, 2040 m; 23.IX.1965; leg. A. Comellini — (Bp—193).

VD-7: SWITZERLAND: **Vaud:** Le Séchey, lake Ter, under willows (*Salix* sp.), sifting, 1017 m; 21.VI.1989; leg. C.Besuchet — (Bp—82).

VD-9: SWITZERLAND: **Vaud:** Vallorbe, source of the river Orbe, roots and soil at base of rocks; 13.V.1982; leg. C. Besuchet & I. Löbl — (Bp—81).

VS-1: SWITZERLAND: **Valais:** Bourg-St-Bernard (near Pass of Grand-St-Bernard), roots of stinging nettles (*Urtica* sp.) and a mole nest, 1950 m; 12.X.1994; leg. C. Besuchet — (Bp—94).

VS-4: SWITZERLAND: **Valais:** Daubensee, mosses and grass, 2200 m; 11.VIII.1980; leg. C. Besuchet — (Bp—32).

VS-5: SWITZERLAND: **Valais:** Fluhalp near Leukerbad, mosses and dead leaves, 2000 m; 14.VIII.1980; leg. C. Besuchet — (Bp—2).

VS-6: SWITZERLAND: **Valais:** Fluhalp near Leukerbad, under alders (*Alnus* sp.) and willows (*Salix* sp.), 1950 m; 9.IX.1988; leg. C. Besuchet — (Bp—125).

VS-8: SWITZERLAND: **Valais:** Finges Forest, pine (*Pinus* sp.) stumps ; 14.VIII.1980; leg. C. Besuchet — (Bp—5).

VS-10: SWITZERLAND: **Valais:** Gornergrat, sifting, 3050 m; 15.IX.1982; leg. C. Besuchet — (Bp—27).

VS-11: SWITZERLAND: **Valais:** Grammont, sifting of mosses, 2000 m; 30.VI.1989; leg. C. Besuchet — (Bp—79).

VS-12: SWITZERLAND: **Valais:** Grand-St-Bernard, mosses on and at base of rocks, 2150 m; 10.IX.1996; leg. C. Besuchet — (Bp—109).

VS-19: SWITZERLAND: **Valais:** Praz-de-Fort, mosses and dead leaves, 1200 m; 16.VIII.1989; leg. C. Besuchet — (Bp—80).

VS-20: SWITZERLAND: **Valais:** Praz-de-Fort, mosses in swamp, 1200 m; 26.VIII.1989; leg. C. Besuchet — (Bp—95).

VS-23: SWITZERLAND: **Valais:** Simplon Pass, mosses in swamp (with *Sphagnum* sp.), 2030 m; 23.VIII.1997; leg. C. Besuchet — (Bp—112).

VS-24: SWITZERLAND: **Valais:** Torrenthorn near Leukerbad, alpine meadows, sifting, 2500-2600 m; 12.VIII.1980; leg. C. Besuchet — (Bp—3).

VS-25: SWITZERLAND: **Valais:** Vercorin, moss cover on the ground; 30.V.1989; leg. H. Borrer — (Bp—83).

VS-30: SWITZERLAND: **Valais:** Torrenthorn above Leukerbad, 2575-2750 m; 6.VIII.1968; leg. C. Besuchet — (Bp—155).

VS-32: SWITZERLAND: **Valais:** Zermatt, Riffelberg, mosses, 2500 m; 14.VIII.1969; leg. C. Besuchet — (Bp—148).

VS-34: SWITZERLAND: **Valais:** Monthey, outside of the cave «Grotte de Saint-Martin» (VS 1), 540 m; 2.V.1980; leg. P. Strinati & V. Aellen — (Bp—199).

VS-40: SWITZERLAND: **Valais:** above Vernayaz, 700 m; 7.X.1980; leg. C. Besuchet — Bp—221).

VS-41: SWITZERLAND: **Valais:** Val d'Anniviers, mosses, 1100 m; 11.V.1980; leg. S. Vit — (Bp—222).

VS-43: SWITZERLAND: **Valais:** Val de Bagnes, Mauvoisin, waterlogged mosses near spring-head, c. 2000 m; 15.III.1997; leg. C. Besuchet — (Bp—224).

VS-47: SWITZERLAND: **Valais:** Val d'Anniviers, St.Jean, ash-tree and *Lasius* sp., 1400 m; 11.V.1980; leg. S. Vit — (Bp— 228).

VS-50: SWITZERLAND: **Valais:** Grand-St-Bernard, mosses, 2450-2500 m; 24.VI.1976; leg. C. Besuchet — (Bp—239).

VS-51: SWITZERLAND: **Valais:** Rotboden below Gornergrat, mosses, grass and saxifrages, 2700-2800 m; 6.VIII.1976; leg. C. Besuchet — (Bp—240).

LIST OF NEWLY DETERMINED SWISS SPECIES
(including also the data already published by Mahunka, 1993)

Brachychthonius Berlese, 1910

Brachychthonius berlesei Willmann, 1928
Brachychthonius berlesei Willmann, 1928: 160, fig. 11.
Localities: LU-5; SO-2; TI-5; UR-4.
Distribution: Holarctic Region.

Brachychthonius impressus Moritz, 1976
Brachychthonius impressus Moritz, 1976b: 264, figs 9a, 9c, 11a-d.
Localities: LU-2; TG-10; VS-25.
Distribution: Europe; **first record for Switzerland.**

Brachychthonius pius Moritz, 1976
Brachychthonius pius Moritz, 1976b: 268, figs 12a-c.
Localities: GR-9; VS-24; VS-43.
Distribution: South and Central Europe; **first record for Switzerland.**

Eobrachychthonius Jacot, 1936

Eobrachychthonius latior Berlese, 1910
Brachychthonius latior Berlese, 1910: 220, pl. 19: 38.
Locality: TI-9.
Disrtribution: Holarctic Region.

Note: The interpretation of the identity of this species varies following the authors. We can confirm that our Swiss material is identical with the specimens from Austria and we thank Dr H. Schatz for checking our specimens.

Eobrachychthonius oudemansi Hammen, 1952
Eobrachychthonius oudemansi Hammen, 1952: 17, fig. 1b.
Locality: TG-3.
Distribution: Holarctic Region and South America; **confirmation of the Swiss record.**

Liochthonius Hammen, 1959

Liochthonius alpestris (Forsslund, 1958)
Brachychthonius alpestris Forsslund, 1958: 78, figs 5-7.
Localities: GR-15; TG-3.
Distribution: Central and North Europe.

Liochthonius brevis (Michael, 1888)
Hypochthonius brevis Michael, 1888: 539, pl. 49: 14.
Localities: LU-2; TG-9; TI-38; VS-30; VS-51.
Distribution: Holarctic Region; **confirmation of the Swiss record.**

Liochthonius clavatus (Forsslund, 1942)
Brachychthonius clavatus Forsslund, 1942: 6, fig. 6.
Locality: VS-24.
Distribution: Europe; **first record for Switzerland.**

Liochthonius horridus (Sellnick, 1928)
Brachychthonius horridus Sellnick, 1928: 23.
Locality: TG-7.
Distribution: Europe; **confirmation of the Swiss record.**

Liochthonius hystricinus (Forsslund, 1942)
Brachychthonius hystricinus Forsslund, 1942: 4, fig. 5.
Localities: SO-5; TI-5; VS-23.
Distribution: Holarctic Region; **confirmation of the Swiss record.**

Liochthonius lapponicus (Trägårdh, 1910)
Hypochthonius brevis Michael var. *lapponicus* Trägårdh, 1910: 549, fig. 352.
Localities: SO-5; VS-43.
Distribution: Holarctic Region; **first record for Switzerland.**

Liochthonius leptaleus Moritz, 1976
Liochthonius leptaleus Moritz, 1976a: 45, figs 8a+b.
Locality: SO-2.
Distribution: Central and Western Europe; **first record for Switzerland.**

Liochthonius muscorum Forsslund, 1964
Liochthonius muscorum Forsslund, 1964: 236, figs1-5.
Localities: TI-3; TI-42.
Distribution: Palaearctic Region; **first record for Switzerland.**

Liochthonius neglectus Moritz, 1976
Liochthonius neglectus Moritz, 1976a: 57, figs 12a-b.
Locality: VS-24.
Distribution: Europe; **first record for Switzerland.**

Liochthonius sellnicki (Thor, 1930)
Brachychthonius sellnicki Thor, 1930: 58, pl. 7: 2.
Localities: TI-22; TI-23; VD-9; VS-1; VS-5; VS-6; VS-8; VS-10;VS-12; VS-23; VS-24; VS-30; VS-32; VS-40; VS-41; VS-50.
Distribution: Holarctic Region.

Liochthonius strenzkei Forsslund, 1963
Liochthonius strenzkei Forsslund, 1963: 282.
Localities: BE-12; GR-1; GR-19; LU-5; TG-8; TI-13; VD-7; VS-5; VS-6; VS-20; VS-24; VS-41; VS-43; VS-50.
Distribution: Holarctic Region; **first record for Switzerland.**

Liochthonius tumidus sp. n.
Localities: VS-41; VS-43.
Description: see below.

Liochthonius tumulosus sp. n.
Locality: BE-12.
Description: see below.

Mixochthonius Niedbała, 1972

Mixochthonius pilososetosus (Forsslund, 1942)
Brachychthonius pilososetosus Forsslund, 1942: 8, figs 10a-b.
Locality: TI-3.
Distribution: Holarctic Region.

Poecilochthonius Balogh, 1943

Poecilochthonius italicus (Berlese, 1910)
Brachychthonius brevis Michael var. *italicus* Berlese, 1910a: 220, pl. 19: 40.
Localities: VS-20.
Distribution: Holarctic Region; **first record for Switzerland.**

Poecilochthonius spiciger (Berlese, 1910)
Brachychthonius brevis Michael var. *spiciger* Berlese, 1910a: 220.
Localities: BL-1; TI-3; TI-5; TI-22; TI-42; VS-11; VS-20; VS-40.
Distribution: Holarctic Region; **first record for Switzerland.**

Sellnickochthonius Krivolutsky, 1964

Sellnickochthonius hungaricus (Balogh, 1943)
Poecilochthonius hungaricus Balogh, 1943: 23, pl. 4: 9.
Locality: VS-19.
Distribution: Palaearctic Region; **first record for Switzerland.**

Sellnickochthonius immaculatus (Forsslund, 1942)
Brachychochthonius immaculatus Forsslund, 1942: 9, fig. 12.
Localities: BE-12; GR-9; SO-6; TG-8; TG-10; VS-47.
Distribution: Holarctic Region; **confirmation of the Swiss record.**

Sellnickochthonius oesziae (Balogh & Mahunka, 1979)
Brachychochthonius oesziae Balogh & Mahunka, 1979: 283, figs 1-3.
Locality: SO-2.
Distribution: Central Europe; **first record for Switzerland.**

Sellnickochthonius subcricoides (Balogh & Mahunka, 1979)
Brachychochthonius subcricoides Balogh & Mahunka, 1979: 283, figs 4-6.
Localities: TG-7; VS-4.
Distribution: Central Europe; **first record for Switzerland.**

Sellnickochthonius suecicus (Forsslund, 1942)
Brachychochthonius jugatus Jacot var. *suecica* Forsslund, 1942: 8, fig. 11.
Locality: GE-9.
Distribution: Holarctic Region and New Zealand; **first record for Switzerland.**

Sellnickochthonius zelawaiensis (Sellnick, 1928)
Brachychthonius zelawaiensis Sellnick, 1928: 23.
Localities: LU-5; SO-2; SO-7; TG-9; TI-3; TI-5.
Distribution: Holarctic Region.

Synchthonius Hammen, 1952

Synchthonius crenulatus (Jacot, 1938)

Brachychochthonius crenulatus Jacot, 1938: 133, fig. 16.
Locality: LU-1.
Distribution: Holarctic Region; **first record for Switzerland.**

Verachthonius Moritz, 1976

Verachthonius laticeps (Strenzke, 1951)

Brachychthonius laticeps Strenzke, 1951a: 240, fig. 5.
Locality: VS-34.
Distribution: Europe and Japan.

DESCRIPTION OF NEW SPECIES

Liochthonius tumidus sp. n. Figs 1-4

MATERIAL EXAMINED: Switzerland: Holotype: Valais: **VS-43**, 7 paratypes from the same sample and 2 paratypes: **VS-41**. Holotype and 5 paratypes: MHNG[1] and 4 paratypes (1681-PO-04): HNHM[2].

DIAGNOSIS: Colour light yellow, prodorsal and especially notogastral spots well observable. Prodorsum without transversal ridges, exobothridial tubercle protruding laterally. All prodorsal and notogastral setae slightly dilated, mostly dirk-shaped or phylliform. Clavus of sensillus concave apically.

MEASUREMENTS: Length of body: 210-218 µm, width of body: 124-130 µm.

Prodorsum: Rostrum wide, rounded in dorsal view. Exobothridial tubercle (*op*) large, extremely well developed. Transversal ridge between lamellar setae absent. Four pairs of mostly rectangular spots in interbothridial region, each pair separated transversally from each another, first one located farthest from each other, the third are the nearest (Fig. 3). Some other weak spots present on prodorsal surface. Prodorsal setae long, rostral one longest (23 µm). All setae more or less ensiform, with a thinly developed velum, mostly smooth, sometimes well visibly serrate, primarily on lamellar setae. Sensillus (Fig. 2) of medium length, head concave, seeming to be bifurcate, with well separated spines on its upper part.

Notogaster: Slightly narrower than broad. Spots on dorsal surface rather distinct, sometimes also punctate (Fig. 1). Some smaller spots present between setae f_1. Notogastral setae ensiform, dirk-shaped, comparatively long. Setae e_1 and f_1 longest (24-25 µm). Some setae broadened posteriorly, setae h_1 and p_1 much broader than others.

Lateral part of podosoma: Five pairs of lyrifissures well observable. Pleural plates of *Pa* comparatively narrow (Fig. 4). Suprapleural incision normal.

REMARKS: The new species belongs to the vicinity of *L. lapponicus* (Trägårdh, 1910), and is distinguished from the species belonging to this species group (*lappo-*

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[1] MHNG = deposited in the Muséum d'Histoire naturelle, Geneva.

[2] HNHM = deposited in the Hungarian Natural History Museum, Budapest, with identification number of the specimens in the Collection of Arachnida.

FIGS 1-4

Liochthonius tumidus sp. n. (1) Body in dorsal view. (2) Sensillus. (3) Median prodorsal spots (4) Body in lateral view.

nicus, muscorum and *sellnicki*) by the much longer prodorsal and notogastral setae, the distinct and punctate notogastral spots and the shorter sensillus.

DERIVATIO NOMINIS: The species is named after the large exobothridial tubercle.

Liochthonius tumulosus sp. n. Figs 5-8

MATERIAL EXAMINED: Switzerland: Holotype: Berne: **BE–12**, 8 paratypes from the same sample. Holotype and 5 paratypes: MHNG and 3 paratypes (1682-PO-04): HNHM.

DIAGNOSIS: Colour yellow, spots on prodorsum and on notogaster well observable. Prodorsum with median transversal elevation, some transversal and longitudinal crests also observable. Its anterior part peculiarly concave. All prodorsal and notogastral setae dilated, with a true velum. Sensillus broad, apex excised.

MEASUREMENTS: Length of body: 199-210 μm, width of body: 121-134 μm.

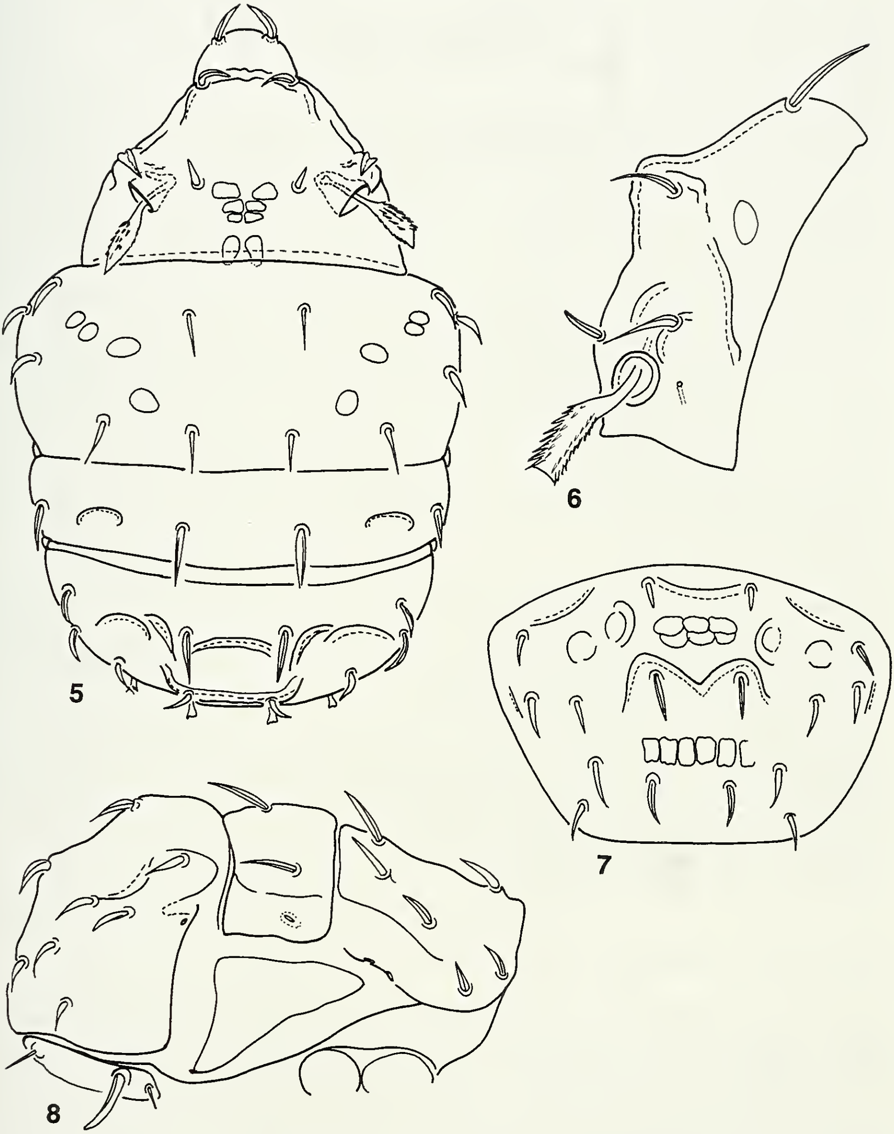
Prodorsum: Rostrum slightly elongated, with rounded front in dorsal view. Surface of prodorsum peculiar, protruding medially, beyond this part surface concave, sloping to rostral part in lateral view (Fig. 6). Median part ornamented by transversal crests or ridges, between the lamellar setae well sclerotised, thick, gradually narrowing laterally and backwards and clearly waved medially. Four pairs of mostly rectangular spots in interbothridial region, first ones separated transversally from each other, others touching medially. Some other weak spots present on the prodorsal surface. All prodorsal setae very short, broad, with a well-developed velum, so all setae apperaring ensiform or phylliform with smooth margins. Sensillus (Fig. 6) long, head bifurcate, with well-separated spines on its upper part and some shorter ones ventrally.

Notogaster: Conspicuously broad (Fig. 5), nearly as long as wide. Spots on shield *Na* well visible, but weakly framed. Spots on lateral part of shield *Nm* well framed, these crests sometimes strong, primarily in their anterior part. Shield *Py* with some very strongly sclerotised and characteristic partly arcuating crests (Fig. 5). Between these crests some smaller spots visible. This ornamentation is much more finely sclerotised than the preceding (Fig. 7). Notogastral setae very short, broad, ensiform, like the prodorsal ones. Posterior setae peculiarly broadened and bent inwards. Setae e_1 longest of all (17 μm).

Lateral part of podosoma: Five pairs of lyrifissures well observable. Pleural plates of *Py* comparatively narrow (Fig. 8), suprapleural incision hardly observable.

REMARKS: Only a few species of the genus *Liochthonius* Hammen, 1959 have a stronger, well visible sculpture [e.g. *L. strenzkei* Forsslund, 1963, *L. sellnicki* (Thor, 1930), *L. kirghisicus* Krivolutsky, 1971] on the surface of prodorsum or on the notogaster. The new species is well characterised by a strong, characteristic sculpture on segment *Py*. Based on this shape, the new species belongs to the relationships of *L. kirghisicus* (Krivolutsky, 1971) and is distinguished from those belonging to this species group (*lapponicus, muscorum, sellnicki* and *strenzkei*) by its much longer prodorsal and notogastral setae, and the shorter sensillus.

DERIVATIO NOMINIS: The species is named after its peculiar projection in the middle of the prodorsum.



Figs 5-8

Liochthonius tumulosus sp. n. (5) Body in dorsal view. (6) Prodorsum in lateral view. (7) Pygidium in posterior view. (8) Podosoma in lateral view.

A PRELIMINARY LIST OF SWISS BRACHYCHTHONIIDAE

Brachychthonius berlesei Willmann,1928
Brachychthonius bimaculatus Willmann,1936
Brachychthonius impressus Moritz, 1976
Brachychthonius pius Moritz, 1976
Eobrachychthonius latior (Berlese, 1910)
Eobrachychthonius oudemansi Hammen, 1952
Liochthonius alpestris (Forsslund, 1958)
Liochthonius andrewi Evison, 1981
Liochthonius brevis (Michael, 1888)
Liochthonius clavatus (Forsslund, 1942)
Liochthonius gisini (Schweizer, 1948)
Liochthonius horridus (Sellnick, 1928)
Liochthonius hystricinus (Forsslund, 1942)
Liochthonius lapponicus (Trägårdh, 1910)
Liochthonius leptaleus Moritz, 1976
Liochthonius muscorum Forsslund,1964
Liochthonius neglectus Moritz, 1976
Liochthonius peduncularis (Strenzke, 1951)
Liochthonius perfusorius Moritz, 1976
Liochthonius sellnicki (Thor, 1930)
Liochthonius strenzkei Forsslund, 1963
Liochthonius tumidus sp. n.
Liochthonius tumulosus sp. n.
Liochthonius tuxeni (Forsslund, 1957)
Mixochthonius pilososetosus (Forsslund, 1942)
Poecilochthonius italicus (Berlese, 1910)
Poecilochthonius spiciger (Berlese, 1910)
Sellnickochthonius cricoides (Weis-Fogh, 1948)
Sellnickochthonius hungaricus (Balogh, 1943)
Sellnickochthonius immaculatus (Forsslund, 1942)
Sellnickochthonius oesziae (Balogh & Mahunka, 1979)
Sellnickochthonius subcricoides (Balogh & Mahunka, 1979)
Sellnickochthonius suecicus (Forsslund, 1942)
Sellnickochthonius zelawaiensis (Sellnick, 1928)
Synchthonius crenulatus (Jacot, 1938)
Verachthonius laticeps (Strenzke, 1951)

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Review of the orientation behaviour in the bee parasitic mite *Varroa destructor*: Sensory equipment and cell invasion behaviour

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Review of the orientation behaviour in the bee parasitic mite Varroa destructor: Sensory equipment and cell invasion behaviour. - Cell invasion behaviour is a crucial phase in *Varroa destructor* (Anderson & Trueman, 2000) life history. This review gives a survey of what is known about the sensory equipment of *Varroa* suited for its orientation. Most attractive for *Varroa* females are nurse bees and drone larvae just before the capping by the nurse bees. In search of cues to determine the sex and age of the brood, the whole spectrum of approaches from direct observation of the invasion behaviour in observation hives to electrophysiological recordings of the sensilla was used. There was no single key factor identified to be responsible for the host recognition, but rather a complex mixture of chemical compounds from the brood and physical parameters of the comb. In consideration of our limited understanding of host parasite interaction there is no solution in sight for a biological *Varroa* treatment regime based on interference with *Varroa* orientation during the brood invasion phase.

Keywords: *Varroa destructor* - *Apis mellifera* - olfaction - host finding - orientation..

INTRODUCTION

The ectoparasitic mite *Varroa destructor* (Anderson & Trueman, 2000) originally infested the Asian honey bee, *Apis cerana*, and is currently causing severe damage to the European honey bee, *Apis mellifera*, worldwide (Spivak, 1999). Due to the rapid expansion of its range from East Asia all over the world, with the only exception of Australia, in the last twenty years, *Varroa* has become the most serious problem in beekeeping. Together with the applied research on pest management and the development of treatment concepts (Imdorf *et al.*, 2003), there have also been twenty years of basic research on a better understanding of what is going on in our beehives regarding this introduced bee parasite.

The female mite infests adult bees as well as larvae. To reproduce, the mite must move from adult nurse bees into the brood cells (Fuchs & Müller, 1988; Ifantidis, 1988, 1991). The mite invades the brood cell just before operculation (Berg *et al.*, 1999; Boot, 1995; Ifantidis, 1988). *Varroa* then hides behind the 5th instar bee larva until operculation by immersing itself in the food juice (Donzé & Guerin, 1997).

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We will try to shed light on research done on the mites' orientation behaviour in the context of the complex host-parasite interaction. For a better understanding of this behaviour we will take a short look at what is known about the sensory morphology, neurobiology and sensory ecology of *Varroa*. The aim of this review is to bring together the current knowledge about the different possible orientation mechanisms involved in the host finding behaviour of *Varroa destructor*, with a special focus on its olfactory orientation.

SENSORY EQUIPMENT OF *VARROA* MITES

Which are the sensory modes that help the bee parasitic mite *Varroa destructor* to orient itself in the bee colony? The knowledge on the sensory equipment of mites in general and of *Varroa destructor* in particular is still relatively scarce. Almost the whole body of *Varroa,* including the eight legs and the mouthpart with its appendages, is covered with different types of hairs (Fig. 1). At least part of them has mechanoreceptive functions.

Perception of chemical cues: *Varroa* uses its two front legs in the same way as insects use their antennae (Rickli *et al.*, 1992). These legs are only rarely used for movement and are more frequently displayed in the air. Scanning electron microscopy (SEM) shows the presence of a sensory pit organ (Fig. 2) on the front leg tarsi of *Varroa destructor* (Milani & Nannelli, 1988; Ramm & Böckeler, 1989). The pit organ consists of nine sensilla (S1-S9) inside the pit and nine longer hair sensilla (R1-R9) surrounding it. The structure reminds one of Haller's organ found in ticks (Hess & Vlimant, 1982, 1983a, b; Sonenshine *et al.*, 1986). According to Ramm and Böckeler (1989) the sensilla S1 and S3 to S5 are classified as wall pore sensilla. The ultra-structure and histology of these sensilla in *Varroa* bear a striking similarity to olfactory sensilla of other arthropods. So it can be assumed that some of these sensilla house receptors, which are involved in the perception of volatiles. Sensilla S7, S8 and S9 are non-pore sensilla serving as hygro- and thermo-receptors, whereas the morphology of sensilla S2 and S6 indicates a gustatory role. The edge bristles surrounding the tarsal pit are also divided in two groups. R1 to R3, R5, R6 show the characteristics of a contact chemo-receptor as seen in S2 and S6, while R4, R7, R9 have characteristics that remind us of sensilla seen in other arthropods serving as chemo-receptors with additional thermoreceptive function.

Furthermore Liu & Peng (1990) described chemoreceptive sensilla on the palptarsus for *Varroa*. The large setae on the palptarsus of *Varroa* (Fig. 1) resemble sensilla chaetica of insects, thick walled sensilla with an apical pore. They are of the same type as the S2 and S6 sensilla in the tarsal pit organ, known as gustatory sensilla. The smaller setae on the palptarsus resemble sensilla trichodea of insects that may function in olfaction (Kaissling, 1971). Nuzzaci and collaborators (1992) described the presence of some specialised sensilla on the mouthparts, suspected by ultrastructural evidence to be gustatory chemical sensilla and mechanosensilla. These are probably related to the feeding behaviour of *Varroa* and not so much involved in orientation.

The most important sensual modes of *Varroa* are supposed to be the chemical senses, olfaction and taste. Therefore a great part of the research done on *Varroa* orientation focuses on this subject.

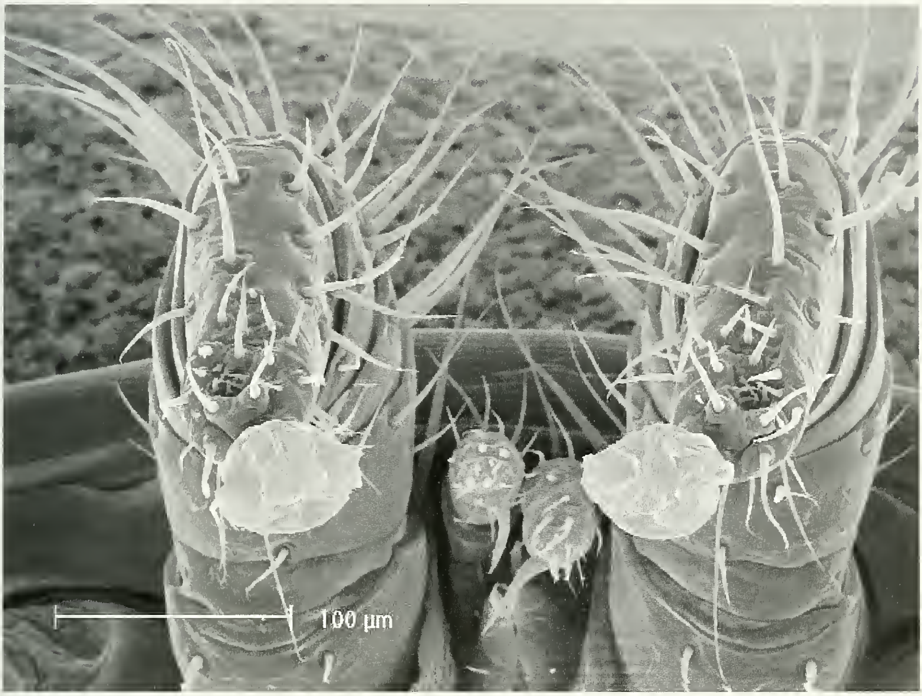

FIG. 1
Scanning electron micrograph of the front legs and the mouthparts, including the palptarsi in the centre, of *Varroa destructor*, covered with mechanosensitive and chemoreceptive hair sensilla (SEM by M. Vlimant, University of Neuchâtel).

The electrophysiology approach proved that *Varroa destructor* is indeed able to perceive volatile components in the air. Action potentials recorded from receptor cells in olfactory sensilla tell whether volatile products can be detected by the mite's sensory system. The synthetic volatiles, benzaldehyde, salicylaldehyde and methylsalicylate, provoked an increase in the firing rate of olfactory receptor cells (Blumer-Meyre *et al.*, 1998; Dillier *et al.*, 2001; Endris & Baker, 1993). Benzaldehyde is known as a volatile in royal jelly and on adult drones (Dillier *et al.*, 2002a), and benzaldehyde and methylsalicylate are also constituents of pollen, flowers and honey (Maga, 1983). Receptors for these products are known from some arachnids. A methylsalicylate and a benzaldehyde receptor were described from sensilla on the tarsus of the tick *Amblyomma variegatum* (Steullet & Guerin, 1994) and a metylsalicylate receptor occurs on the mite *Phytoseiulus persimilis* (de Bruyne *et al.*, 1991).

Varroa is well equipped with a machinery to detect a broad range of chemicals. Even if the mite's sensory system consists, in contrast to the situation in insects (Kaissling, 1971), only of a small number of specialised sensilla with a limited number of sensory cells, there is no evidence for a limitation to a single chemical cue used to invade brood cells. Each of its sensilla has individually different sensory characteristic and the neuronal network behind the sensilla is more important than the sheer number of receptor cells (Wehner, 1989; Wehner, 1991; Wehner, 2003) in the task of cue detection in a complex chemical environment.

TEMPERATURE AND HUMIDITY PERCEPTION: It is known that mites are very sensitive to small differences in temperature and relative humidity (Hess & Loftus, 1984). Le Conte & Arnold (1987, 1988a, b), using a four-arm airflow olfactometer, found that *Varroa* is strongly attracted to the source with the higher air temperature, and to a lesser degree also by vibrations as produced by caged bees in the test. The mite can discriminate temperature differences of 1.2°.

Varroa shows a positive thermotaxis in laboratory bioassays. In a temperature gradient female mites prefer temperatures in the range of 26 to 31°C (Anchakova, 1977; Bairak, 1976; Rosenkranz, 1988), which is significantly below the normal temperature of about 35°C in a honey bee brood nest (Kraus *et al.*, 1998). However experiments of le Conte & Arnold (1988a) in which *Varroa* mites could choose to settle at a point on a temperature gradient showed that they selected a slightly higher mean temperature of 32.6 ± 2.9°C. There also seems to exist a seasonal variation in the preferred temperature between summer- and winter-*Varroa* (31.8 to 37.3°C and 33.6 to 36.6°C, respectively) (Pätzold & Ritter, 1989). Nevertheless it should be kept in mind that the simultaneous control of humidity in a temperature gradient is difficult (a 1 °C increase in temperature results in a ~5% decrease of the relative humidity). The native host of *Varroa destructor* is *Apis cerana* and there it reproduces almost exclusively in drone brood (Anderson & Trueman, 2000; Boecking *et al.,* 1993; Boot *et al.,* 1997, 1999; de Jong, 1988; Oldroyd, 1999; Rath, 1992, 1999). The range of drone brood temperature of *Apis cerana* (30 to 34°C) is 0.4°C lower than the temperature range in *Apis mellifera* drone brood cells (Kraus *et al.*, 1998). This difference is very small compared to the uncertainties in measuring temperature preferences in *Varroa*. It does not explain the differences in *Varroa* behaviour in invading different host species. The observed, so called "preferences" of the mite in a temperature gradient probably reflect preferences for different relative humidities, or a combination of the two (Bruce *et al.*, 1997). This may explain why in most experiments the *Varroa* mite systematically seemed to prefer much lower temperatures than those observed in the brood nest of *Apis mellifera*. A model that uses infrared radiation for host location by the ectoparasite *Varroa* is proposed by Bruce (1997). The mite has appropriate sensory structures or setae located on the first pair of legs.

HEARING, VIBRATION AND AIR MOVEMENT PERCEPTION: In mites no sensory structures for detecting acoustic stimuli are known. If *Varroa* can detect sound with high acoustic amplitudes, then it does it with the help of mechanoreceptors sensitive to surface vibrations. The sensitivity to vibrations in *Varroa destructor* was proven to be comparable to the sensitivity of its host, the honey bee (Kirchner, 1993). If *Varroa* uses the substrate vibrations on the comb for its orientation is still unknown. The comb surface is especially suited as medium for the propagation of the honey bee dance language information (Tautz, 2002; von Frisch, 1965) in the form of substrate vibrations. Due to the mechanical dampening properties of wax, this information channel needs a very effective energy transfer as present in the bees' waggle dance (Tautz, 2002). *Varroa* is too small for an active use of this information channel. The *Varroa*

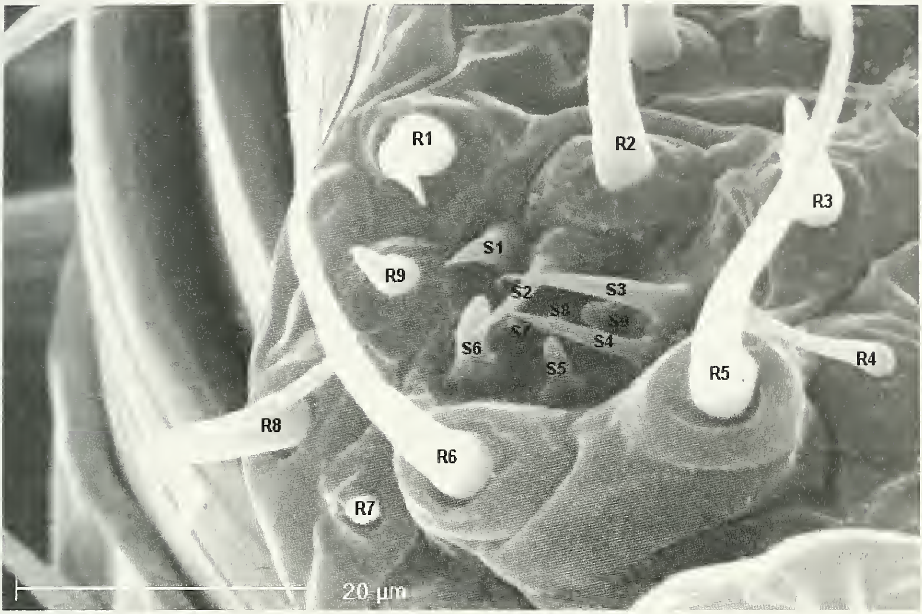

FIG. 2

Scanning electron micrograph of the pit organ on the front leg tarsus of *Varroa destructor* with sensilla (S1-S9) inside the pit and longer sensilla (R1-R9) surrounding it (SEM by M. Vlimant, University of Neuchâtel).

mites are very sensitive to movement of the air (Dillier *et al.*, 2002a; Kuenen & Calderone, 1998). The legs and also other body parts of *Varroa* are covered with mechanosensitive hair sensilla; possible receptors for the sense of touch as well as air movement (Fig. 2). The mite stops its translational movements and displays its frontal legs in the air in a typical manner for reorientation (Dillier *et al.*, 2002a; Rickli *et al.*, 1992; Rickli, 1994) in reaction to subtle air puffs. It has been shown by Kuenen and Calderone (1998) that *Varroa* can use single clean-air puffs in a wind tunnel as directional cues. *Varroa* turned nearly straight upwind in response to single 0.1-s puffs of clean air directed at 90 degrees to their anterior-posterior axis. This behaviour is probably part of the olfactory orientation system in *Varroa* and helps to add directionality to the volatile chemicals in an odour plume.

VISION: *Varroa destructor* has no eyes, but nevertheless behavioural responses to optical stimuli have been observed by Kirchner (1993). Part of the central nervous system, probably a small group of histaminergic cells, is light sensitive. Because there is no photoreceptor-like structure, the discrimination between different light source directions or shapes of objects is not possible. Low light sensitivity is hardly of much help in a specific orientation task outside a simple phototactic reaction.

HOST FINDING BEHAVIOUR IN *VARROA*

Cell invasion: There are two crucial decisions to be made during cell invasion behaviour of female *Varroa* mites: first, when to leave the phoretic stage on the nurse bee and then, how to choose an appropriate brood cell for successful reproduction. In the first step the mite has to decide at some distance from the larva whether to stay on a bee or invade a cell and then in the second step in contact with the cell if it is suitable to invade (Boot, 1994). Direct observation of this invasion behaviour is quite difficult because most of the action takes place underneath a layer of nurse bees covering the brood nest in the hive. It is also suspected that there is high selective pressure on the mite to keep the time span for freely walking around exposed to the nurse bees as short as possible. Behavioural observations show that the phoretic mites spend most of the time in a protected position under the sternites of the host bee before invading host cells where they hide behind the larvae. Therefore *Varroa destructor* mites may only invade worker or drone brood cells when worker bees bring them as close as possible to a suitable brood cells (Boot *et al.*, 1994a). The invasion behaviour of *Varroa destructor* into brood cells of *Apis mellifera* was studied using an observation hive (Beetsma *et al.*, 1999; Boot *et al.,* 1990, 1992a, b, 1994a; Boot, 1995) and videotaping half combs through a transparent back wall (Beetsma *et al.*, 1993, 1999). It has been observed on video recordings that the mites moved from the bees to the rim of the cell, walked quickly inside, crawled between the larva and the cell wall, and then moved on to the bottom of the cell, hiding in the food juice (Boot *et al.*, 1992a; de Jong *et al.,* 1982; Donzé & Guerin, 1997; Ifantidis, 1988; Rath, 1991). According to Beetsma and collaborators (1999), *Varroa destructor* mites were never seen walking across the comb and entering and leaving brood cells as has been described for *Tropilaelaps clareae* (Delfinado & Baker) (Boot *et al.*, 1994a). Mites stay longer on bees if there are few brood cells available in the colony. Boot (1995) interprets this behaviour as minimisations of the period spend searching for a cell. But the few observations of walking mites could also result from the special lateral observation technique used by Beetsma and collaborators (1993) and the rareness of direct observations of the actual invasion. During many hours of observation of brood frames to collect infested *Varroa*, we repeatedly observed mites leaving nurse bees and running several centimetres over the comb surface before disappearing. Kuenen & Calderone (2000) also assumed that the mites leave their host and walk along the comb surface until they locate an appropriate larva or reacquire a nurse bee. They regularly saw *Varroa* mites walking on undisturbed comb surfaces in test colonies and on video tapes of observation colonies, walking along open cell rims often dipping into the lumen of a cell and then alternate to the other side to dip into the lumen of the next cell and so on.

There is also indirect evidence for an active search for appropriate brood cells by *Varroa* females from laboratory behavioural bioassay, developed to measure transfer of *Varroa* mites from nurse bees to the honey bee brood cells for reproduction (Dillier *et al.*, 2002a, b). After the test more mites were found on the comb side of the test box, in test series where the mites were prevented from returning to a nurse bee by a mechanical trap or an insect glue trap, than in control series (Dillier *et al.*, 2002b). This can be interpreted as a hint that a certain number of female mites always leave the nurse bee to search actively for appropriate 5th instar larva cells. The situation in the hive remains unclear. A verification with a similar trap bioassay in test hives with a simultaneous choice between traps and unmanipulated brood was not possible (Dillier *et al.*, 2003). Because of the limited data available, it is not clear if the under representation of freely walking mites in behavioural records is a methodological artefact or the result of an ecological pressure.

For successful reproduction, the timing of the cell invasion is crucial. The mite invades the brood cell just before operculation. Only 5th instar larvae are attractive for the mites. This attraction lasts only for a short period prior to cell capping of 15-20 hours for worker brood and 40-50 hours for drone brood, respectively (Berg *et al.*, 1999; Blumer-Meyre *et al.*, 1998; Boot *et al.*, 1990, 1992a; Fuchs & Müller, 1988). The invasion of the mite into a brood cell is not related to the duration of its stay on adult bees (Boot *et al.*, 1995a). The condition of the hive has some influence on the infestation. The fraction of phoretic mites available in the hive which invades brood cells is determined by the ratio of the number of suitable brood cells and the number of bees in the colony (Boot *et al.*, 1994b, 1995c; Calis *et al.*, 1991). This means that the infestation of the brood cells does not only depend on the invasion behaviour of *Varroa*, but also on the amount and quality of the bee colony brood and on the strength of the worker force of the nurse bees. There is also a feedback from the *Varroa* infestation to the behaviour of the bees. A semiochemical from brood cells infested by *Varroa destructor* triggers hygienic behaviour in *Apis mellifera* (Nazzi *et al.*, 2004a).

PREFERENCES FOR AGE AND SEX OF THE HOST LARVAE: In experiments only the 5th instar larvae were infested by the mites. Several authors have reported preferences for drone cells over worker cells in the beehive (Boot *et al.*, 1992a, 1994b, 1995c; Calderone & Kuenen, 2001; Fuchs, 1990; Fuchs & Langenbach, 1989; Grobov, 1977; Ifantidis, 1984; Issa *et al.*, 1984; Le Conte *et al.*, 1989; Otten & Fuchs, 1988; Schulz, 1984a, b; Sulimanovic *et al.*, 1982; Vandame, 1996) or in laboratory bio-tests (Dillier *et al.*, 2002a; Rosenkranz *et al.*, 1984; Tewarson, 1983; Zaitoun, 1993).

The attractive period of drone brood cells is two to three times longer than that of worker brood cells (Boot *et al.*, 1992a; Calis, 2001). The distribution of mites over worker- and drone-brood in a colony is determined by the brood type specific rates of invasion and the numbers of both brood cell types. Drone brood cells were invaded 11.6 times more frequently than worker brood cells (Boot *et al.*, 1995c). Drone larvae produce greater quantities of attractive compounds (esters attractive to *Varroa*) and they produce them over a longer period of time (Calderone & Lin, 2001; Le Conte *et al.*, 1989). This preference could be partially due to the 1.7 fold larger cell surface of a drone cell (Boot *et al.*, 1995b), the 2-3 times longer attractive period of drone larvae (Boot *et al.*, 1991, 1992a, 1995b; Fuchs & Müller, 1988), and the larger size of drone larvae compared to worker larvae (346 mg and 147 mg respectively) (Beetsma *et al.*, 1999; Martin, 1998). But these effects are interdependent and not additive because in drone larvae cells as well as the larvae are already bigger in a younger developmental stage. There seems to be a still higher attractiveness of the drone larvae itself, stemming from differences in chemical recognition factors (Le Conte *et al.*, 1989, 1991, 1994; Trouiller *et al.*, 1991, 1992).

In behavioural bioassay experiments with two compartment polystyrene test boxes (Dillier *et al.*, 2002a), where either 5th instar worker or 5th instar drone larvae were presented in parallel tests, *Varroa* moved to the brood more often when drone instead of worker larvae were available on an standardized comb surface. This implies that there must be a higher motivation to leave bees in the proximity of drone larvae than in the proximity of worker larvae, or to stay longer on the comb side after having left the bees in the test situation.

Nurse bees also visit drone larvae more frequently, because they receive more food than worker bees Fuchs (1990).

Mite prevalence values in queen cells were 15 times smaller than in worker cells (Calderone *et al.*, 2002; Harizanis, 1991), where the development time of only 8.0 to 8.5 days in the capped cell stage is too short (*A lecture given to the Central Association of Bee-Keepers*) for successful *Varroa* reproduction (Rehm & Ritter, 1989; Romaniuk *et al.,* 1988). This could be caused by the fact that royal jelly contains a repellent to *Varroa* (Le Conte, 1990). These results raise the question of the origin of the cues responsible for age and sex specific differences in the brood infestation.

CHEMICAL ORIENTATION CUES: Behavioural bioassays in the laboratory of Rosenkranz (1990) do not confirm the presence of a stage- or sex-specific kairomon in bee larvae. A characterisation of the cuticular hydrocarbons of *Varroa* mites and their honey bee hosts by gas chromatography (GC) and coupled GC-mass spectroscopy (MS) (Nation *et al.*, 1992) found no qualitative differences in the chromatographic spike pattern between the mites and the host bee larvae. More likely are quantitative variations in the composition of some substances in the cuticle. The sex of the host was not an important factor affecting the behavioural responses of the mites in any assay (Calderone & Lin, 2001). They concluded that host kairomones play a role in the host acquisition process, but found no evidence to support the hypothesis that mites use such substances to differentiate between worker and drone brood.

More detailed analyses in different laboratories revealed the existence of sex- and age-specific differences, mainly in the quantitative composition of complex mixtures of compounds, even within the bee larvae. Living drone and worker larvae differ in their profile of volatiles analysed by means of Purge and Trap/Gas chromatography (Purge and Trap system LSC3100, Tekmar Cincinnati USA) (Dillier *et al.*, 2002a) and in cuticular volatile hydrocarbon profiles from bee larval extracts. Aumeier (Aumeier, 2001; Aumeier *et al.*, 2002; Chiroudi *et al.*, 1997) detected age- and caste-specific differences and Troullier and collaborators (1994) found characteristic quantitative differences especially in the esters present on worker, drone and queen brood.

It has been shown that *Varroa* can use bee-odour plumes in a wind tunnel as directional cues (Kuenen & Calderone, 1998). When released in odour plumes and control plumes mid-way between the plume's origin and the downwind end of the tunnel, mites responded to bee-odour by walking upwind in a zigzag fashion, or by walking along the edge of the odour plume. In the wind tunnel (Calderone & Lin, 2001) mites were attracted to odours from living 5th instar worker and drone larvae, but not to volatiles from cocoons, brood food or a blend of fatty acid esters found to be attractive in other bioassays (see below). Using a four-arm airflow olfactometer, also le Conte and collaborators (Le Conte *et al.*, 1989, 1991; Le Conte, 1990; Trouiller *et al.*, 1992, 1993, 1994) found that *Varroa* is attracted by odour to its preferred host, "drone larvae". The airflow containing the odour of either drone larvae or a total n-hexane extract of drone larvae was effective. The identified fractions and pure compounds were tested again with the same olfactometer set-up. Three methyl and ethyl esters of straight-chain fatty acids induced attraction (Le Conte *et al.*, 1989), in particular methyl palmitate but also ethyl palmitate and methyl linolenate.

In a bioassay the movement of individual mites on the surface of a servosphere was recorded while different odours were released at the top of the sphere (Rickli *et al.*, 1992; Rickli, 1994). The most attractive odour was that of living larvae, closely followed by larval headspace extract. The odour of live bees was also attractive, but to a lesser degree. Methyl palmitate, which has previously been reported to be attractive to mites (Le Conte *et al.*, 1989), was moderately attractive on the servosphere. However, palmitic acid, the precursor of this ester, was as attractive as were living larvae.

Wind tunnels and olfactometer tests as well as the servosphere are rather unnatural environments for *Varroa destructor*. The mites are not adapted to run over long distances. They tend to stop and try to hide themselves under a cover or in a depression of the surface or in a crack in reaction to any kind of disturbance. If hiding is not possible, the mite tries to jump away. Therefore tests for orientation cues in a situation more similar to the hive conditions are needed to confirm these results.

Zetlmeisl & Rosenkranz (1994) found in laboratory bioassays that dummies treated with methyl palmitate, ethyl palmitate and methyl linolenate had no effect on mites, but when put in hives, capping behaviour by workers was observed. This confirms that these esters have a pheromone effect on bees but the kairomone function on mites remains unclear.

Cuticle extracts of 8-day-old worker honey bee larvae occupying brood cells have an arrestment effect on the mite (Rickli *et al.*, 1994). Extracts induce a strong arrestment response in the mite, as indicated by prolonged periods of walking on the extracts applied to a semi permeable membrane stretched over a water bath to provide high relative humidity. Mites increased walking speed and path straightness in response to increasing doses of a nonpolar fraction of the cuticle extract. Saturated straight-chain odd- numbered C-19-C-29 hydrocarbons were identified by thin-layer argentation chromatography and gas chromatography-mass spectrometry as the most active constituents, with branched alkanes also contributing to the arrestment effect of this active fraction.

Aliphatic alcohols and aldehydes of the honey bee cocoon also induced arrestment behaviour in *Varroa* (Donzé *et al.*, 1998) in this test. Two thin-layer chromatography fractions of the cocoon extract eliciting arrestment were found to contain saturated C-17 to C-22 primary aliphatic alcohols and C-19 to C-22 aldehydes. Both aldehydes and alcohols were more abundant in the cocoon than in the cuticle of adult or developing bees. Analysis of the behavioural responses to synthetic n-alkanes indicates that the response is probably based on a synergism between the different alkane components of the fraction rather than on an individual compound. When these oxygenated chemo stimuli were mixed with C-19 to C-25 alkanes at the proportions found in the cocoon extract, a significantly lower threshold for the chemo stimulant mixture was observed.

In a contact bioassay on glass Calderone and collaborators (Calderone *et al.,* 2002; Calderone & Lin, 2000; 2001) found arrestment responses of mites to solvent extracts of the cuticula of worker and drone bee larvae obtained 0.24 and 48 hours prior to cell capping, to brood food and cocoons, and to a blend of synthetic fatty acids that were found to be attractive (Le Conte *et al.,* 1989; Le Conte, 1990; 1991; Trouiller *et al.,* 1992; 1993; 1994). There was no difference in the arrestment behaviour between extracts of worker and drone larvae but less arrestment with extracts of queen larvae (Calderone *et al.,* 2002; Calderone & Lin, 2001). Calderone and collaborators detected a repellent effect of royal jelly on *Varroa* but no arrestment or repellent effect of worker jelly or drone jelly. Findings of these authors (Calderone *et al.*, 2002; Calderone & Lin, 2001) suggest that the low incidence of mites in queen brood is in part due to the repellent activity of royal jelly, and possibly to intrinsic differences between larval chemistries.

Zaitoun (1993) found that nurse bees in contact with open brood of any age attract *Varroa*. Adult bees are at least as attractive as larvae (Kraus *et al.*, 1986; Kraus, 1993). Mites could distinguish between nurse bees, pollen foragers and larvae in simultaneous choice tests in Petri dishes, but tests in a Y-shaped olfactometer showed no clear difference in preferences for bees of different ages (Kraus, 1993, 1994). This contrast could stem from the different set-up of experiments. It is an indication that in choice tests not only volatiles but also less volatile cues or contact stimuli could play a role. The preference for nurse bees or for larvae and forager bees was dependent of the source of the mites, if they were kept before on nurse bees, larvae or forager bees. Phoretic mites from bees prefer again bees to larvae. The host preference is therefore not only influenced by factors stemming from the future host but also by past experience or intrinsic factors that depend on the female mite's reproductive stage.

Rosenkranz (1993) developed a laboratory choice test for preferences of *Varroa* females for different types of bee larvae, adult bees, or cuticular extracts on dummies. This test, in a closed arena with short distances of less than 2 cm ("Rosenkranz arena"), better corresponds to the natural situation in the beehive. When offered a choice between 5th instar larvae and adult workers phoretic *Varroa* again showed a preference for adult workers (Zetlmeisl & Rosenkranz, 1994). This bioassay confirmed the preference of *Varroa* females for certain developmental host stages and their corresponding extracts (Aumeier *et al.*, 2002). Although it was found in the laboratory bioassay that individual *Apis mellifera carnica* larvae were less attractive than Africanized larvae (Aumeier, 2001; Aumeier *et al.,* 2002; Aumeier & Rosenkranz, 1997), the infestation rate of *Apis mellifera carnica* in hive experiments was 2 to 6 times higher. The authors suggested that the quantity and composition of certain cuticular compounds are responsible only for the recognition of a suitable host stage by *Varroa* females (Aumeier, 2001; Aumeier *et al.*, 2002). There must be other factors that are also important for cell invasion behaviour, especially in the second step of the Boot-model (1994), to decide whether a larva cell is suitable for invasion.

In a similar bioassay larval food collected from drone cells before capping elicited a strong response from *Varroa* (Nazzi *et al.*, 2001). Both ether and acetone extracts of larval food induced the same response as larval food itself, thus suggesting the existence of semiochemicals attracting or arresting the mite. Linear, branched and aromatic carboxy-acids, as well as hydroxy-acids, were identified by GC-MS and SPME-GC-MS analysis in organic larval food extracts. Loss of activity after neutralization and air entrainment experiments suggested that the active substances were acidic and volatile. The carboxy-acids of low molecular weight identified were tested in a laboratory assay using a "Rosenkranz-arena". All the acids tested were inactive, with the exception of 2-hydroxyhexanoic acid. One hundred nanograms of 2-hydroxyhexanoic acid applied to worker brood cells before capping increased the number of mites per cell in the treated brood by 36% in comparison to the control cells (Nazzi *et al.*, 2004b).

There is an enhanced probability that *Varroa* is found on the comb side of test boxes of brood cells with living larvae or food jelly, contrary to clean empty cells (Dillier *et al.*, 2002a, 2002b). This demonstrates that cues associated with brood are involved in the decision by female mites to either leave host bees or to stay on the comb side. In tests where either 5th instar worker or 5th instar drone larvae were presented in parallel tests, *Varroa* decided to move to the brood more often then when drone larvae were available (Dillier *et al.*, 2002a, b). This implies that there must be a higher motivation to leave bees in the proximity of drone larvae than of worker larvae or to stay longer on the comb side after having left the bees.

In her experiments on brood attractivity in small test hives, Zaitoun (1993) found that a separation of the two compartments by more than 2 cm was enough to stop the transfer of mites between the compartments. The author concluded that the mite has to come in close contact with appropriate brood or cues transmitted by the nurse bees from the larvae to the mites. The aliphatic esters and their mixtures found attractive in the olfactometric tests (Le Conte *et al.*, 1989, 1991; Le Conte, 1990; Trouiller *et al.*, 1992, 1993, 1994) showed no effect in this set-up. The four fatty acid methyl esters (methyl palmitate, methyl oleate, methyl linoleate and methyl linolenate), secretions which are present on the surface of worker and drone larvae only a few hours before the cell is closed, also trigger the capping of brood cells by worker bees (Le Conte *et al.*, 1990b; Trouiller *et al.*, 1991, 1992).

Some of these observations from different laboratories suggest the possibility of an indirect transfer of information about the status of the brood, where the nurse bees act as intermediary. If *Varroa* uses the fatty acid methyl ester secretions on the cuticle of bee larvae as a cue for the timing of its cell invasion behaviour, then it is somehow "hitchhiking" on the information network of the honeybees.

INFLUENCE OF PHYSICAL PARAMETERS OF THE COMB ON *VARROA* INFESTATION

Under experimental fostering conditions in the broodless hive of a drone eggs laying Africanised honey bee queen (or of drone eggs laying workers) drone larvae in drone sized cells are significantly more heavily infested by Varroa mites (0.38 mites/larva) than in worker sized cells (0.188 mites/larva) (Cavicho Issa *et al.*, 1993). But the effect of cell size was outdone by the effect of the type of larvae in the cross fostering experiment of drone larvae in worker sized cells (1.86 mites/larva) and worker larvae in drone sized cells (0.379 mites/larva). Drone larvae are more attractive than worker larvae, even in combs with the inappropriate cell size. A similar pattern was found by Calderone & Kuenen (2001) in a cross fostering experiment with non-Africanised honey bees: the highest mite infestation levels were found in drone larvae reared in drone cells, followed by drone larvae reared in worker cells, worker larvae reared in worker cells and worker larvae reared in drone cells. This could not be interpreted as an indication of a pure size effect, but an interaction between larval sex and cell type. To complicate the issue even further, there is an additional strong colony effect on the level of this interaction, and small cells have a significant negative effect on the weight of 5th-instar drones, but large cells have no positive effect on worker larvae.

In empty cell frame transfer experiments with Africanised bee hives a 2.6 times higher infestation rate by *Varroa* of the Africanised bee brood was observed in the larger cells built by European bees, *Apis mellifera ligustica*, compared with smaller cells built by bees of their own race (11.9% versus 4.7% of the cells with female deutonymphs infested with *Varroa* respectively). This is an indication for an influence of the cell size (Message & Goncalves, 1995).

In manipulated (shortened) cells also larvae normally not attractive do attract mites (Boot *et al.,* 1995b). Cells with artificially raised, wax filled cell bottoms (de Ruijter & Calis, 1988) attract more mites. Cells shortened by placing a grid in front of the comb and restricting the builder bees to finish the cell construction (Goetz & Koeniger, 1993) are already attractive earlier, even though they contain larvae of a smaller size than normal ones. However, this effect is counterbalanced by the fact that the shorter distance to the cell rim also triggers the bees to begin cell-capping behaviour earlier. If the distance from the cell rim to the larvae was larger than in the control cells with larvae of the same age, the attractive period was shorter and vice versa (Beetsma *et al.*, 1999; Boot *et al.*, 1995b, c). There seems to be a critical larva-to-rim distance under which brood cells are attractive to mites. The maximal distance is 6.9 to 7.9 mm for natural cells, but longer (8.2 to 9.0 mm) for elongated worker cells or drone cells containing older worker larvae (Beetsma *et al.*, 1999). The number of *Varroa* mites found in the capped brood cells seems to be determined by the duration of the attractive period. The length of this period results from an interaction of the signal that triggers capping behaviour of the bees and the cues responsible for the attraction of the *Varroa* to the larvae.

The duration of the post capping stage, in which the bee larvae develop, and the proportion of the infertile mites in infested cells are not influenced by cell size (Fries, 1994). According to different observations (Boot *et al.*, 1995b; Calis *et al.,* 1993; Ramon *et al.,* 1993), small cells are much longer attractive to the mites and therefore accelerate the population dynamics of the *Varroa* infestation.

Natural cell size is a reliable race specific trait (Spivak & Erickson, 1992) not much influenced by the size of the commercial cell frame foundation on which the colonies were reared before natural comb building. This was confirmed by Piccirillo & de Jong (2003), who showed the brood cell infestation rates were significantly higher in the Carniolan-sized (5.27 mm, built naturally by Carniolan bees) comb cells than in the Italian (5.16 mm, that the bees made from Italian-sized commercial foundation) and Africanized cells (4.84 mm). European-sized worker brood cells were always more infested than the Africanized worker brood cells in the same colony (19.3% Carniolan cells, 13.9% Italian and 10.3% Africanized, respectively).

Because *Varroa* preferentially invades larger cells under experimental conditions with Africanized bees, it was expected that brood in old combs with reduced-size cells would be less infested than the brood in new comb cells (Piccirillo & de Jong, 2004). However in European beehives small cells are usually longer attractive to *Varroa* (Boot *et al.,* 1995b; Calis *et al.,* 1993). Indeed the percentage of brood cells infested in Africanized honey bee colonies was significantly higher in the old combs (22.6%) than in the new combs (9.75%), even though the inside width of the cells was significantly smaller in the old (4.58 mm) than in the new combs (4.85 mm) (Piccirillo & de Jong, 2004). But also some factor other than cell size, perhaps olfactory or gustatory cues from the cocoons (Calderone & Lin, 2001) or cell walls, can make old brood comb cells much more attractive to *Varroa destructor* than newly constructed brood combs. The study of Taylor (2002) on European bee nucleus colonies shows no significant difference in the infestation rates on frames with a mosaic of five different cell sizes (4.7, 4.8, 5.0, 5.1 and 5.4 mm cell diameter). The highest infestation level (46.6%) was not found in the biggest but in the rather small (4.8 mm) cells.

The inconsistent results from different studies indicate that cell size is not the decisive key factor in the invasion behaviour. The question remains whether slightly smaller cell diameters of naturally built combs, as compared to cells that bees made from commercial foundations provided by the beekeepers, can reduce the parasite load in hive conditions. It is also unclear if this effect can be observed only in Africanised honeybee colonies and/or if this phenomenon is coupled with other behavioural or physiological characteristics of these hybrid bee strains.

There is also evidence that the raised cells are more infested by *Varroa* (de Ruijter & Calis, 1988) and the raised borders of drone cell patches contribute to the clumped distribution of infested brood cells on mixed worker drone brood combs (de Jong & Morse, 1988; Kuenen & Calderone, 2000). It is still unclear if raised borders influence the behaviour of the nurse bees or if this is an effect of catching *Varroa* mites searching on the comb surface for suitable cells at the borders of raised cell patches. There is a 6 fold higher infestation of the edge cells of the raised patch, but not of the interior cells of the patch.

CONCLUSIONS

The orientation of *Varroa* and its cell invasion behaviour is certainly a key factor for the infestation of honeybee colonies. *Varroa* is equipped for orientation with a variety of senses, ranging from olfactory detection of volatiles over a certain distance to the contact senses of touch and taste. Research on *Varroa* orientation has mainly focused on the chemical senses olfaction and gustation. Perhaps this has led to an underestimation of the role of other sensory modalities like temperature, vibration and unspecific orientation cues like humidity or CO_2 concentration.

Calderone & Lin (2001) discussed four hypotheses on how female *Varroa* mites are guided to the appropriate brood cells for reproduction: chemical cues, physical parameters, interaction of chemical- and physical cues and passive transport by the nurse bees.

NURSE BEE BEHAVIOUR AND MOBILITY OF PHORETIC *VARROA*: Beetsma and collaborators (1999) postulated a passive transport of the female *Varroa* mites close to the appropriate brood cells by nurse bees, where the active cell invasion of the mite has only to cover a very short distance (of some Millimetres). In laboratory test situations, however a rather high mobility of *Varroa* females was observed. In box tests with glue and Fluon traps (Dillier *et al.*, 2002b) up to one third of the phoretic *Varroa* left the bees within 24 h. It is not clear yet if part of this unexpected active role of *Varroa* in the searching behaviour (Kuenen & Calderone, 2000) is due to the specific test situation or if it belongs to the normal behaviour of the species under natural conditions.

CHEMICAL HYPOTHESIS: A variety of extracts and compounds have been tested for their behavioural activity. A compilation of the assays and the tested substances is presented by Meier (1998) and Aumeier and collaborators (2002). Not single compounds but rather mixtures of them seem to provide the more active cues. Results on synergistic effects in arrestment behaviour caused by mixtures of rare saturated C-17 to C-22 primary aliphatic alcohols and C-19 to C-22 aldehydes with higher quantities of C-19 to C-25 alkanes indicate how *Varroa* may use mixtures of rarer products to differentiate between substrates and host stages during its developmental cycle within honey bee brood cells (Donzé *et al.*, 1998). Most results indicate that *Varroa* uses quantitative instead of qualitative differences in chemical cues presented by the bee larvae to determine their sex and age.

INTERACTION WITH PHYSICAL PARAMETERS: A variety of parameters of the comb, such as cell size, raised cell rims, shortened or elongated cells, have some influence on the infestation rate of the brood cells. Preference for cracks and narrow spaces, thigmotaxis, as expressed by the mites behaviour to hide between the folds of the abdominal segments of host bees (Ifantidis, 1988), could help the mites to find cells with large enough larvae to hide behind them. However the relative importance of these cues and their role in the orientation process remain unclear. Calderone & Kuenen (2001) stated that there is an interaction between physical and chemical effects, such as honey bee colony, cell type and larval sex, influencing the cell invasion behaviour of *Varroa destructor*. All together this can lead to the 5.5 to 12 times higher infestation rate of drone brood cells compared to worker brood cells in *Apis mellifera* (Martin, 1998) and to the precise timing of invading brood cells in the beehive.

The cell invasion behaviour in *Varroa destructor* seems to be influenced by a mixture of multiple factors and cues, which are detected through different sensory pathways. Test results produced under laboratory conditions need confirmation in the more complex hive situation before we can understand their relevance in the host-parasite interaction of *Varroa destructor* and *Apis mellifera*. Most likely the chemical contact sense (taste) plays an important role in the decision whether to stay in the chosen brood cell or to return to a bee, but the whole set of available sensory modes may be involved in the form of a “Gestalt”.

Any crude intervention in the host-parasite interactions risks to disturb the fine tuned information network of the beehive too much. In consideration of the present state of knowledge, there is no practicable biological *Varroa* treatment regime in sight for beekeepers based on *Varroa* orientation. For a deeper insight in the host-parasite interaction a multidisciplinary approach is needed.

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Origine des populations de rainette verte (*Hyla* spp.) de l'ouest de la Suisse

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Origin of tree frog (*Hyla* spp.) populations in western Switzerland. - DNA-based techniques are important tools for species assignment, in particular when identification with morphological criteria is difficult. The aim of this study was to genetically determine the species identity of tree frogs (*Hyla* spp.) populations from western and northern Switzerland (Swiss Plateau), this area being frequently subjected to introductions of species or sub-species from south of the Alps. We sequenced 261 base pairs of the mitochondrial DNA cytochrome b gene from 24 samples of tree frogs from the Swiss Plateau, Ticino (southern Switzerland) and the Dombes region (Ain, France), and compared them with homologous sequences retrieved from DNA databases. The phylogenetic analyses revealed two distinct clades. The first one is represented by samples of Green tree frog (*Hyla arborea*) from the Swiss Plateau, France, Germany and Greece, confirming the current knowledge about the species' distribution. The second clade includes samples belonging to the Italian tree frog (*Hyla intermedia*) from south of the Alps (Ticino and Italy), and unexpectedly from the Grangettes site in western Switzerland. These results suggest the introduction of the Italian tree frog *H. intermedia* north of the Alps, and raise questions about the management of the Grangettes protected area.

Keywords: Hylids - cytochrome b - conservation - invader.

INTRODUCTION

Les fluctuations climatiques liées aux glaciations du Pléistocène, ainsi que la géographie complexe du continent européen, traversé par de nombreuses chaînes montagneuses et bras de mer, ont fortement influencé la répartition actuelle des espèces animales et végétales, ainsi que leur diversification. En effet, les changements climatiques ont conduit les espèces des zones tempérées à se réfugier dans les péninsules européennes (Hewitt, 1999; Taberlet *et al.,* 1998), seuls endroits où les conditions permettaient leur survie, isolant ainsi les différentes populations. Lors des périodes interglaciaires plus favorables (telle que celle actuelle), les espèces ont pu recoloniser les territoires plus au nord, mais ont maintenu leur différenciation en plusieurs groupes génétiques distincts, ces divergences ayant parfois conduit à des processus de spécia-

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tion (Hewitt, 2001). Ces événements expliquent notamment la présence en Suisse d'espèces et de sous-espèces différentes entre le nord et le sud des Alpes (Tessin). Par exemple chez les reptiles, la sous-espèce *muralis* du Lézard des murailles (*Podarcis muralis*) se trouve au nord des Alpes, alors que la sous-espèce *maculiventris* est localisée uniquement au sud des Alpes. La situation est comparable pour la Couleuvre vipérine (*Natrix maura*) présente le long du bassin du Rhône et la Couleuvre tesselée (*Natrix tessellata*) naturellement limitée au sud des Alpes (Hofer *et al.*, 2001). Chez les Amphibiens, des observations analogues peuvent être effectuées entre la sous-espèce *vulgaris* du Triton lobé (*Triturus vulgaris*) et la sous-espèce *meridionalis*, ou le Triton crêté (*Triturus cristatus*) et le Triton crêté italien (*Triturus carnifex*).

Actuellement, l'homme influence fortement la distribution des espèces, notamment en détruisant et en fragmentant l'habitat ainsi qu'en introduisant des espèces de manière volontaire ou involontaire (espèces invasives). Dans l'ouest de la Suisse, nous pouvons citer comme exemple les introductions et l'établissement de populations de Triton crêté italien (*T. carnifex*) dans les cantons de Genève et Vaud (Grossenbacher, 1988) ainsi qu'en France voisine, la présence de la sous-espèce *meridionalis* du Triton lobé (*T. vulgaris*) en ville de Genève (Grossenbacher, 1988) ou l'existence de couleuvres tesselées dans le Lavaux vaudois (Hofer *et al.,* 2001).

Chez les rainettes, on retrouve une différenciation spécifique entre le nord et le sud des Alpes, avec la présence de la Rainette verte (*Hyla arborea*) au nord (la répartition de cette dernière allant de l'Espagne à la Turquie, en passant par le nord de la Suisse (Plateau) et le Danemark), alors que la Rainette intermédiaire (*H. intermedia*) la remplace au Tessin et en Italie (Gasc *et al.,* 1997; Grossenbacher, 1988). Cette dernière espèce n'a été présente au nord des Alpes que brièvement et artificiellement suite à un lâcher volontaire sans succès visant à la réintroduction de la «rainette verte» dans le canton de Genève (S. Monbaron, comm. pers.). Actuellement, aucune population de rainettes intermédiaires n'est connue au nord des Alpes. Néanmoins, les différences morphologiques entre les deux espèces présentes en Suisse étant très faibles, sa présence ne peut pas être totalement exclue.

Une manière fiable d'identifier une espèce lorsque les critères morphologiques ne sont pas suffisamment discriminants est le recours à des techniques d'analyse moléculaire, en particulier à la comparaison de séquences d'ADN telles que celle du gène mitochondrial codant pour le cytochrome *b*, celui-ci présentant une bonne résolution aux niveaux inter- et péri-spécifique (Bradley & Baker, 2001).

Afin de clarifier la répartition des deux espèces de rainettes (*H. arborea* et *H. intermedia*) dans différentes régions de la Suisse, ainsi qu'en France voisine, nous avons séquencé une portion du cytochrome *b* de différentes populations. En effet, la détermination précise de l'aire de répartition d'une espèce est un facteur primordial pour une gestion des populations efficace et adéquate, ainsi que pour l'évaluation du degré de menace et la mise en place de mesures de protection telles que l'établissement de listes rouges.

MATÉRIEL ET METHODES

ECHANTILLONNAGE: De 2002 à 2005, 24 échantillons de rainettes *Hyla* spp. (têtards ou prélèvements buccaux) ont été récoltés dans 10 sites suisses répartis dans les secteurs de la Côte lémanique (La Côte), de la rive sud du lac de Neuchâtel (Rive sud), d'Argovie, des Grangettes (delta du Rhône proche de Villeneuve) et au Tessin, ainsi qu'en France (Dombes, Ain; Fig. 1, Tab. 1). Des séquences d'ADN supplémentaires provenant d'individus d'Allemagne, de Grèce et d'Italie ont été obtenues par l'intermédiaire de la banque de données GenBank.

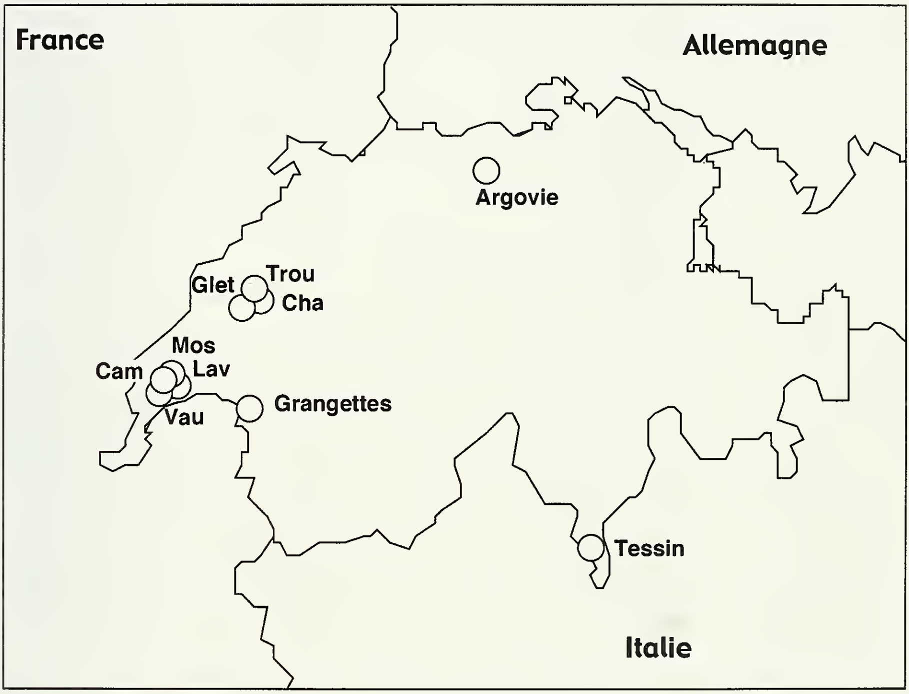

FIG. 1

Localisation des populations suisses analysées dans cette étude. Argovie, Mossière (Mos), Lavigny (Lav), Camp romain (Cam), Vaudalle (Vau), Chabrey (Cha), Gletterens (Glet), Trouville (Trou), Grangettes et Tessin.

EXTRACTION ET AMPLIFICATION DE L'ADN: L'extraction de l'ADN génomique a été effectuée à l'aide du kit QIAamp DNA Mini Kit (Qiagen), ainsi qu'avec la technique au CTAB (Milligan, 1992). Un fragment de 261 paires de bases (pb) du gène mitochondrial du cytochrome *b* a été amplifié avec l'amorce H15149 (Kocher *et al.*, 1989), ainsi qu'avec une amorce élaborée dans notre laboratoire (L14861Hyla, 5'-TTTGGCTCCCTACTCGGA-3') dans un volume total de 25 µl, contenant les produits suivants (concentrations finales): 0.5 U de *Taq* DNA polymérase (Qiagen), 0.2 µM de chaque amorce, 200 µM de dNTPs, 1 x tampon PCR Qiagen, 2 µl du produit d'extraction, ainsi que 1.75 mM de $MgCl_2$. Les réactions PCR ont été effectuées avec 45

TABLEAU 1: Echantillons de *Hyla* spp. séquencés dans cette étude ou obtenus de GenBank (*). Sont présentés la localité, l'abréviation des populations (correspondant à la Figure 1), l'haplotype mitochondrial obtenu pour le cytochrome b et le numéro d'accès GenBank.

Espèce	Localité	Abréviation	Numéro d'accès et Haplotype
Hyla intermedia	Tessin, Suisse	Tessin 1	H2, DQ521035
Hyla intermedia	Tessin, Suisse	Tessin 2	H2, DQ521035
Hyla intermedia	Tessin, Suisse	Tessin 3	H2, DQ521035
Hyla intermedia	Tessin, Suisse	Tessin 4	H3, DQ521036
Hyla intermedia	Tessin, Suisse	Tessin 5	H2, DQ521035
Hyla intermedia	Tessin, Suisse	Tessin 6	H5, DQ521037
Hyla spp.	Grangettes, Suisse	Grangettes 2	H5, DQ521037
Hyla spp.	Grangettes, Suisse	Grangettes 3	H5, DQ521037
Hyla spp.	Grangettes, Suisse	Grangettes 5	H5, DQ521037
Hyla spp.	Grangettes, Suisse	Grangettes 6	H5, DQ521037
Hyla spp.	Grangettes, Suisse	Grangettes 7	H5, DQ521037
Hyla arborea	Mossière, La Côte, Suisse	Mos12	H8, DQ521038
Hyla arborea	Camp romain, La Côte, Suisse	Cam13	H8, DQ521038
Hyla arborea	Lavigny , La Côte, Suisse	Lav14	H8, DQ521038
Hyla arborea	Lavigny , La Côte, Suisse	Lav15	H8, DQ521038
Hyla arborea	Vaudalle, La Côte, Suisse	Vau1	H8, DQ521038
Hyla arborea	Chabrey, Rive sud, Suisse	Cha 9	H10, DQ521034
Hyla arborea	Chabrey, Rive sud, Suisse	Cha 11	H8, DQ521038
Hyla arborea	Gletterens, Rive sud, Suisse	Glet 8	H10, DQ521034
Hyla arborea	Trouville, Rive sud, Suisse	Trou 4	H10, DQ521034
Hyla arborea	Argovie, Suisse	Argovie	H8, DQ521038
Hyla arborea	Dombes, France	Dombes 1	H8, DQ521038
Hyla arborea	Dombes, France	Dombes 2	H8, DQ521038
Hyla arborea	Dombes, France	Dombes 3	H9, DQ521039
**Hyla arborea*	Axiopouli, Grèce	Grèce	H7, AY093691
**Hyla arborea*	Petrade, Allemagne	Allemagne	H8, AY843822
**Hyla intermedia*	Italie Nord	Italie Nord 1	H4, AY093694
**Hyla intermedia*	Italie Nord	Italie Nord 2	H1, AY093693
**Hyla intermedia*	Italie Nord	Italie Nord 3	H2, AY093692
**Hyla intermedia*	Italie Sud	Italie Sud	H6, AY093695
**Pseudacris regilla*			AY363185

cycles et les conditions d'amplification suivantes ont été utilisées: 45 sec. de dénaturation à 94°C, 45 sec. d'hybridation à 50°C, 60 sec. d'élongation à 72°C. Les amplifications ont été précédées par 180 sec. de dénaturation initiale à 94°C, et achevées par 5 min. d'élongation finale à 72°C. Un contrôle négatif a été ajouté lors de chaque réaction d'amplification. La présence de produit d'amplification a été vérifiée à l'aide au bromure d'éthidium sur gel d'agarose 1.5%.

SÉQUENÇAGE DE L'ADN: Les produits d'amplification ont été purifiés sur colonnes QiaQuick (Qiagen) selon les instructions du fabricant. Le séquençage a été effectué à l'aide du ABI PRISM™ BigDye Terminator Cycle Sequencing Ready Reaction Kit 1.0 (Applied Biosystems) et avec les mêmes amorces utilisées lors de l'amplification (les deux brins d'ADN ont été séquencés). Les réactions de séquence ont ensuite été chargées sur un séquenceur automatique ABI PRISM® 3100 Genetic Analyzer (Applied Biosystems).

Les séquences obtenues ont été déposées dans GenBank, leur numéro d'accès étant DQ521034- DQ521039.

ANALYSES STATISTIQUES: Les séquences nucléotidiques du gène du cytochrome b ont été éditées avec le programme Sequence Navigator (Parker, 1997) et alignées à la main. Trois méthodes d'analyse phylogénétique, à savoir celle du maximum de vraisemblance (maximum likelihood, ML), de parcimonie maximale (maximum parsimony, MP) et une méthode de distance (neighbor-joining, NJ) ont été employées en utilisant le programme PAUP* version 4.0b10 PPC (Swofford, 1998). Les arbres produits par ces analyses ont été enracinés avec une séquence de *Pseudacris regilla* (numéro d'accession GenBank: AY363185). Les valeurs de soutien des branches ont été obtenues par ré-échantillonnage (méthode du bootstrap) avec 1000 pseudoréplicats pour les trois approches phylogénétiques. Les distances entre les haplotypes ont été calculées avec la distance de Kimura-2-paramètres (K2P; Kimura, 1980), et les écarts-types des distances de K2P entre les groupes et sous-groupes avec le programme Mega 3.0 (Kumar *et al.,* 2004).

RESULTATS

Dix haplotypes différents possédant 74 caractères variables, dont 47 parcimonieusement informatifs, ont été obtenus à partir des 30 individus de rainette *Hyla* spp. étudiés ou des séquences homologues issues de GenBank (Tab. 1). Les relations entre les haplotypes sont illustrées dans la Figure 2 pour l'analyse ML. Les arbres obtenus par les deux autres méthodes de reconstruction phylogénétique (MP et NJ) ne sont pas montrés, car leur topologie s'est avérée identique à celle obtenue par analyse ML.

Deux groupes distincts, avec un bon support de ré-échantillonnage bootstrap, ont été obtenus (Fig. 2): le premier (G1) est constitué d'individus de *Hyla arborea* provenant de la Rive sud, de La Côte, d'Argovie, des Dombes, d'Allemagne, et de Grèce (valeurs de support pour ML, MP, et NJ: 100%). Le deuxième groupe (G2) rassemble des individus de *Hyla intermedia* (valeurs de support respectivement 77, 70 et 86%); il est lui-même divisé en deux sous-groupes, le premier incluant des échantillons du Tessin, d'Italie du nord, ainsi que les échantillons du site des Grangettes; le deuxième est constitué d'un échantillon du sud de l'Italie. La distance génétique moyenne (K2P) entre G1 et G2 est de 17.2% +/- 2.7% et de 10.5% +/- 2.2% entre les sous-groupes de G2.

DISCUSSION

ORIGINE DES POPULATIONS: Nos résultats confirment les connaissances actuelles concernant la répartition de la Rainette verte (*Hyla arborea*) en Europe (Gasc *et al.,* 1997), les échantillons de Grèce, d'Allemagne, de France, et du Plateau suisse (Côte lémanique, rive sud du lac de Neuchâtel, Argovie) formant un clade monophylétique (G1) peu diversifié génétiquement (distance K2P moyenne: 0.71%) et caractérisé par un support élevé (100%). De même, les Rainettes intermédiaires (*H. intermedia*) forment un groupe monophylétique (G2), soutenu par des valeurs de bootstrap de 70 à 86%, à l'intérieur duquel se distingue un sous-groupe en Italie du sud et un sous-groupe constitué des échantillons du nord de Italie, du Tessin, ainsi que, contre toute

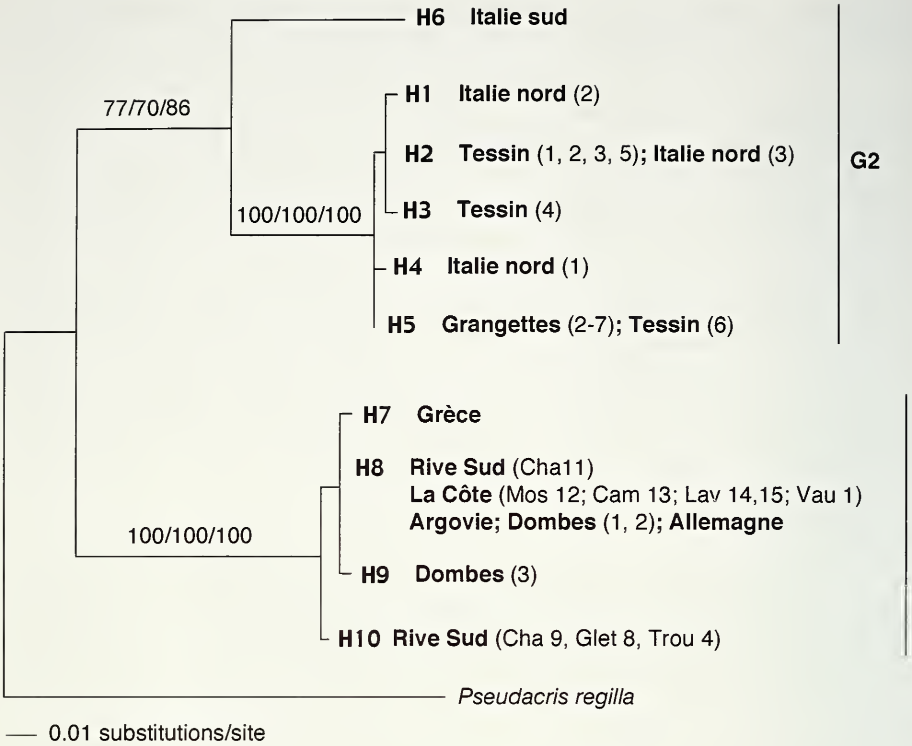

FIG. 2

Phylogénie du fragment du gène du cytochrome b de l'ADN mitochondrial de 261 pb effectuée par le biais de la technique du maximum de vraisemblance (ML). Les chiffres au-dessus des branches principales représentent respectivement les valeurs de ré-échantillonnage bootstrap des analyses ML, MP, et NJ, après 1000 pseudoréplicats. Les codes correspondent au Tableau 1.

attente, des échantillons du site des Grangettes. La présence dans la Péninsule italienne de deux sous-groupes extrêmement différenciés (distance K2P moyenne: 10.5%) suggère l'existence de deux espèces distinctes. Néanmoins, des analyses supplémentaires basées sur plusieurs individus, ainsi que sur d'autres marqueurs génétiques, sont indispensables pour confirmer cette hypothèse.

L'aire de répartition communément admise pour *Hyla intermedia* se limite à la Péninsule italienne et au canton du Tessin. Or la présence d'animaux correspondant génétiquement à cette espèce aux Grangettes, soit au nord des Alpes, est inattendue. Deux hypothèses peuvent être émises pour expliquer l'origine de la population de rainettes intermédiaires dans ce site. La première, en faveur d'une origine naturelle, suggère que *H. intermedia* aurait franchi les Alpes en passant par un ou plusieurs cols. Toutefois, ce scénario nous semble peu probable étant donné les exigences thermophiles de l'espèce. En effet, les seuls amphibiens représentés par la même sous-espèce au nord et au sud des Alpes appartiennent tous à des espèces adaptées à des altitudes élevées (par exemple, le Triton alpestre *Triturus alpestris*, la Grenouille rousse *Rana* *temporaria*, et le Crapaud commun *Bufo bufo*), contrairement aux membres du genre *Hyla*. La deuxième hypothèse, plus vraisemblable, plaide pour une origine non naturelle, tel qu'une introduction volontaire ou involontaire par l'homme. La datation de cet événement, qui ne peut pas être effectuée à partir de nos résultats, est par contre difficile à estimer. En effet, cette introduction peut être ancienne et remonter au début de notre ère, lorsque les Romains étaient présents en Valais et les échanges nombreux entre le nord et le sud des Alpes. Une introduction comparable a d'ailleurs été proposée pour expliquer la présence en Valais et au Chablais vaudois de la Couleuvre d'Esculape *Elaphe longissima* (Hofer *et al.,* 2001). Toutefois, une origine plus récente ne peut pas être exclue, soit à partir de lâchers volontaires, soit par l'intermédiaire de plantes ornementales ou de produits horticoles en provenance du sud des Alpes. Des exemples de transports par ce biais de Rainettes méridionales (*H. meridionalis*) depuis le sud de la France sont relativement fréquents dans les centres de jardinage de Suisse (S. Dubey, donnée non publiée) et démontrent qu'un transport passif pourrait expliquer la présence de *H. intermedia* aux Grangettes. Seule l'analyse génétique d'échantillons historiques (collections de musées) de rainettes en provenance du Chablais vaudois ou du canton du Valais permettrait de répondre plus précisément à cette question.

GESTION DE LA POPULATION DES GRANGETTES: Les résultats génétiques obtenus soulèvent plusieurs questions concernant la gestion future de la population de *H. intermedia* du site des Grangettes. La présence de la Rainette intermédiaire au nord des Alpes n'étant vraisemblablement pas naturelle, il est donc envisageable de la considérer comme espèce localement invasive et, en conséquence, d'envisager son éradication, afin de réintroduire ensuite l'espèce qui semble avoir été naturellement présente (*H. arborea*). Dans ce contexte, une solution consisterait notamment à cesser d'entretenir le milieu des Grangettes pendant quelques années, jusqu'à disparition de l'espèce introduite (*H. intermedia*). Cet événement aurait d'ailleurs déjà pu se produire involontairement avant les premiers travaux d'entretien du site effectués en 1994 (Fivat, 2002a). Cependant, une approche qui nous paraît plus avisée serait d'évaluer les risques éventuels posés par la présence de l'espèce invasive sur les populations endémiques de *H. arborea* de l'ouest de la Suisse, risques potentiellement liés à un problème de compétition interspécifique ou à une hybridation entre ces deux espèces. Une étude d'hybridation menée en laboratoire entre la Rainette méridionale (*H. meridionalis*) et la Rainette verte (*H. arborea*), deux espèces européennes bien distinctes (Smith *et al.,* 2005), a par exemple montré la possibilité d'obtenir des hybrides F1 viables (Rosa & Oliveira, 1994). Toutefois, de tels risques semblent négligeables dans le cas particulier du site des Grangettes, puisque cette population est complètement isolée par sa position géographique et les milieux environnants défavorables à l'espèce. Par conséquent, le risque d'expansion de cette population, voire de colonisation des régions du Plateau par *H. intermedia,* nous semble très limité.

Parmi les hypothèses à tester, nous devons également citer la possibilité d'une présence simultanée aux Grangettes de *H. arborea* et *H. intermedia*, et/ou d'hybrides entre ces deux espèces. Le marqueur moléculaire employé dans cette étude (hérité de façon matrilinéaire) ne nous permet pas de répondre à ces questions. Des analyses supplémentaires avec un nombre plus important d'échantillons en provenance du site des

Grangettes et du sud des Alpes, et des marqueurs recombinants (par exemple, microsatellites), seraient nécessaires pour pouvoir clarifier ces points.

La poursuite de la gestion actuelle nous paraît donc être la solution la plus judicieuse, car les interventions effectuées ne servent pas uniquement à protéger cette espèce probablement introduite, mais également à recréer et sauvegarder un type d'habitat devenu rare dans cette région. Or ces habitats sont essentiels à d'autres espèces d'amphibiens, tels que le Triton lobé (*Triturus vulgaris*) et la petite Grenouille verte (*Rana lessonae*), lesquels ont été observés à plusieurs reprises dans les points d'eau aménagés. Les effectifs de cette dernière ont d'ailleurs considérablement augmenté suite à la création de ces milieux (Fivat, 2002b). Ainsi, ces deux espèces doivent partiellement leur présence aux Grangettes aux travaux de gestion et d'aménagement de cette réserve naturelle. L'arrêt de ces derniers provoquerait une forte réduction ou une disparition de ces deux autres espèces d'amphibiens.

REMERCIEMENTS

Tous les prélèvements ont été effectués avec l'accord du KARCH, dont nous remercions les représentants (Silvia Zumbach et Jean-Claude Monney). Nous remercions également la Conservation de la Faune du Canton de Vaud pour les autorisations de capture et de prélèvements, ainsi que J-M. Fivat, T. Maddalena et J. Pellet.

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A new species of *Hyphessobrycon* (Characiformes, Characidae) from the río Uruguay basin, Argentina

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A new species of *Hyphessobrycon* (Characiformes, Characidae) from the río Uruguay basin, Argentina. - *Hyphessobrycon isiri* sp. n., is described from the río Uruguay basin. *Hyphessobrycon isiri* sp. n. differs from the remaining species of the genus by the presence of teeth of the inner series of the premaxilla with 5 to 11 cusps, one maxillary tooth with 7 cusps; 16 to 22 branched anal-fin rays; one humeral spot vertically elongated, and a midlateral stripe ending in a conspicuous caudal spot.

Keywords: Characiformes - systematics - *Hyphessobrycon* - río Uruguay basin - Argentina.

INTRODUCTION

The genus *Hyphessobrycon* includes small tetra fishes between 15 to 60 mm of length with attractive body colours. This genus comprises about 100 species (Lima *et al.*, 2003) distributed from Mexico to Argentina, ten of them are recorded in the southern area of the Río de la Plata basin (Almirón *et al.,* 2004).

Hyphessobrycon is currently identified by the presence of an adipose fin, incomplete lateral line, two tooth series in the premaxilla, and lack of scales on caudal fin (Eigenmann, 1917). The monophyly of *Hyphessobrycon* has not been demonstrated, therefore we conservatively include the new species in that genus as diagnosed by Eigenmann (1917).

MATERIAL AND METHODS

Specimens cleared and counterstained (C&S) were prepared according to Taylor & Van Dyke (1985). Measurements were taken using digital calliper to the nearest 0.1 mm. All measurements are expressed as percentages of SL or indicated length. Peduncle length is the distance between the last branched anal-fin ray and the hypural joint. Vertebral count excludes the vertebrae corresponding to the Weberian apparatus and also the complex centrum. Asterisk indicates holotype.

Material is deposited in the Asociación Ictiológica, La Plata, Argentina (AI); Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Argentina

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(MLP); Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Argentina (MACN-Ict); Muséum d'histoire naturelle, Genève, Switzerland (MHNG).

Comparative material examined (SL in mm). *Hyphessobrycon anisitsi* (Eigenmann, 1907): MHNG 2493.72, 12 ex., 41.4-42.7, (2 C&S), Paraguay, Caazapa, Arroyo Moroti 15 km SE from Tavai. MHNG 2493.063, 38 ex., 35.1-46.5, Paraguay, Caazapa, Arroyo Yvyra-pary, 2 km Tavai. MHNG 2493.86, 3 ex., 29.5-31.0, Paraguay, East of Guaira, arroyo Yhaca-ni, 2 km North of Nuni. MHNG 2054.2-43, 5 ex., 28.0-38.3, Paraguay, Asunción, stream in Colonia Thompson. MHNG 2493.88, 2 ex., 28.2-29.4, Paraguay, Guaira, arroyo Ovie, near of the road Villarica-Caazapa. AI 133 (ex MHNG 2493.063) 2 ex., 23.0-37.6, Paraguay, Caazapa, Arroyo Yvyra-pary, 2 km East of Tavai.

- *Hyphessobrycon arianae* Uj & Géry, 1989: MHNG 2412.79 (holotype), 1 ex. 22.7 mm SL, Paraguay, Caaguazu, río Güyrau-gua, affl. of the río Monday, 3 km East of Juan Frutos. MHNG 2412.80-81 (paratypes), 34 ex. 17.6-23.6, (2 ex. C&S), same locality as holotype.
- *Hyphessobrycon auca* Almirón, Casciotta, Bechara & Ruíz Díaz, 2004: MACN-Ict 8647 (holotype), 51.2, Argentina, Corrientes, Esteros del Iberá, pond in San Juan Poriahú farm.
- *Hyphessobrycon elachys* Weitzman, 1984: MLP 6431, 3 ex., 16.0-20.0, Argentina, Corrientes, San Cosme.
- *Hyphessobrycon eques* (Steindachner, 1882): MLP 8999, 3 ex., 23.3-27.9, Argentina, Corrientes, río Santa Lucía. JRC pers. collection, 2 ex., 28.7-29.6 (C&S), Argentina, Corrientes, Bella Vista, Riacho Carrizal.
- *Hyphessobrycon guarani* Mahnert & Géry, 1987: MHNG 2366.99 (holotype), 29.8, Paraguay, río Alto Paraná in Puerto Bertoni, Alto Paraná. MHNG 2366.100 (paratypes), 74 ex. 23.5-29.4, (2 ex. C&S), same locality as holotype.
- *Hyphessobrycon igneus* Miquelarena, Menni, López & Casciotta, 1980: JRC pers. collection, 3 ex., 25.9-29, Argentina, Corrientes, Esteros del Iberá, Laguna Fernández.
- *Hyphessobrycon luetkenii* (Boulenger, 1887): MLP 8796, 9 ex., 24.4-35.0, Argentina, Formosa, creek in the national road Formosa-Clorinda, 37 km from Clorinda. MLP 6451, 13 ex., 14.2-21.6, Argentina, Formosa.
- *Hyphessobrycon meridionalis* Ringuelet, Miquelarena & Menni, 1978: MLP 8407, 2 ex., 32.2-34.0, Argentina, Corrientes, pond in road Bella Vista-San Roque. JRC pers. collection, 3 ex., 33.0-40.9 (C&S), Argentina, Buenos Aires, Berisso, Los Talas ponds.
- *Hyphessobrycon wajat* Almirón & Casciotta, 1999: MLP 9321, (holotype), 27.6, Argentina, Corrientes, río Paraná basin, Laguna Brava. MLP 9322, 5 ex., 29.2-31.0, Argentina, Corrientes, Laguna Iberá. MHNG 2593.96, 5 ex., 28.5-30.0, Argentina, Corrientes, Laguna Iberá.

RESULTS

Hyphessobrycon isiri sp. n. Figs 1-5, Table 1

HOLOTYPE: MACN-Ict 8907, 44.6 mm SL, female, Argentina, Entre Ríos, río Uruguay basin, Arroyo Ubajay, a place called 'Manantiales' within the farm 'Los Monigotes' (31°48,94' S - 58°12,41' W), coll. S. Körber & J. Fernández Santos, March 2004.

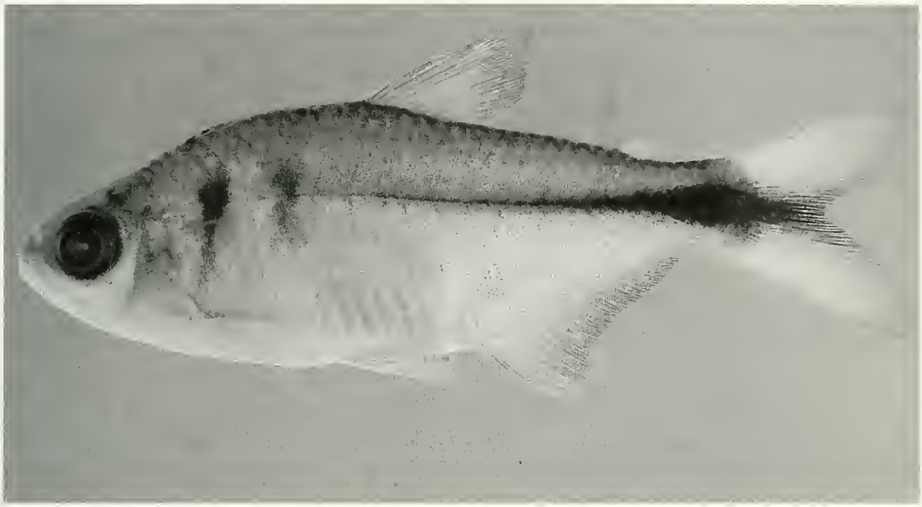


FIG. 1

Hyphessobrycon isiri sp. n., holotype: MACN-Ict 8907, 44.6 mm SL, female, Argentina, Entre Ríos, río Uruguay basin, Arroyo Ubajay.

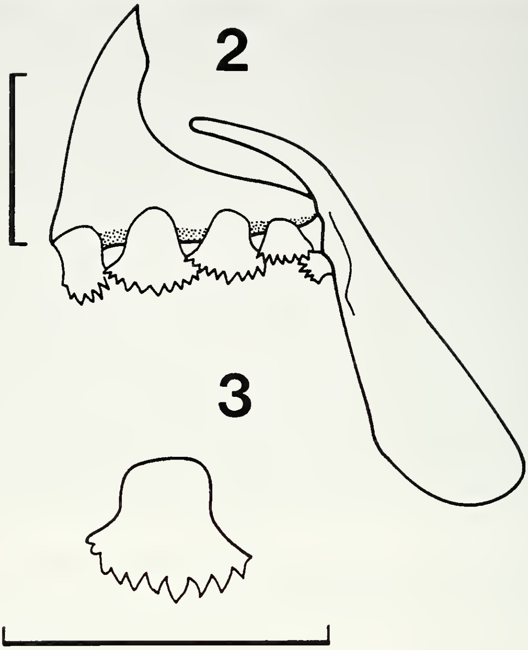
PARATYPES: AI 191, 1 ex., 31.5 mm SL, Argentina, Corrientes, río Uruguay basin, Arroyo Mota (30°28'55"S-57°59'12"W), coll. J. Pereyra, April 1990. MHNG 2666.080, 2 ex., 31.0-42.0 mm SL, Argentina, Entre Ríos, río Uruguay basin, Arroyo Mármol (32°03'44"S-58°15'44"W), coll. J. Pereyra, April 1990. AI 192, 19 ex., 3 (C&S) 18.8-48.1 mm SL, Argentina, Entre Ríos, río Uruguay basin, Arroyo Marmol (32°03'44"S-58°15'44"W), coll. J. Pereyra, April 2005. AI 193, 2 ex., 42.0-42.3 mm SL, same data as holotype.

ETYMOLOGY: The specific epithet *isiri*, a noun in apposition, comes from the Guaraní word *ysyry* meaning stream.

DIAGNOSIS: *Hyphessobrycon isiri* sp. n. is distinguished from its congeners by the following combination of characters: teeth of the inner series of the premaxilla with 5 to 10 cusps, one maxillary tooth with 7 cusps; 16 to 22 branched anal-fin rays; one humeral spot vertically elongated, and a midlateral stripe ending in a conspicuous caudal spot.

DESCRIPTION: Morphometrics of holotype and 14 paratypes are presented in table 1. Maximum body depth located immediately anterior to dorsal-fin origin (Fig. 1). Dorsal profile slightly convex from snout tip to base of first dorsal-fin ray. Dorsal profile slanting ventrally from dorsal-fin origin to caudal peduncle. Dorsal and ventral profile of caudal peduncle straight or slightly concave. Ventral profile of body arched from tip of lower jaw to anal-fin origin, posterodorsally slanted along anal-fin base. Vent between bases of pectoral and pelvic fins transversally rounded.

Dorsal-fin origin almost equidistant from tip of snout and base of caudal fin. Pelvic-fin base slightly anterior to vertical through dorsal-fin origin. Adipose fin slightly anterior to base of last branched anal-fin rays. Pectoral fin not reaching pelvic-fin origin and the later one not reaching the anal-fin origin.



FIGS 2-3

Hyphessobrycon isiri sp. n. (2) upper jaw in medial view. (3) detail of third tooth of inner premaxillary series in medial view. Scale = 1 mm.

Dorsal fin with ii, 8-9 rays, an additional small unbranched ray only visible in cleared and stained specimens; posterior margin of dorsal fin slightly curved, first and second branched dorsal-fin rays longest.

Anal fin with iii-iv, 16-22 rays; 16(1), 17(2), 18(2), 19(9), 20(6*), 21(3), 22(2). Females with last unbranched and first seven branched rays produced forming a lobe.

Caudal fin with 1 unbranched and 9 branched principal rays in upper lobe; 8 branched and 1 unbranched principal rays in lower lobe. Lower lobe slightly longer than upper lobe.

Pectoral fin with i, 11*-13 rays. Posterior margin of pectoral fin slightly rounded.

Pelvic fin with i, 7 rays, posterior margin of fin slightly rounded.

Head short, less than 1/3 of SL, mouth terminal and horizontal; snout short, blunt; third infraorbital not reaching sensory canal of preopercle. Length of lower jaw nearly equal than upper jaw. Premaxillary ascending process triangular; alveolar process bearing two series of teeth. Teeth of outer row with a central cusp longer than the remaining. Outer row with 2 or 3 teeth with 3 to 5 cusps. Inner series of premaxilla with 4 or 5 wide teeth bearing low cusps (Figs 2-3); symphysial tooth slender, with 6-7 cusps; remaining teeth with 5 to 10 cusps, central cusp slightly longer than the others. Maxilla with long anterodorsal and laminar processes, the last one reaching

FIG. 4
Hyphessobrycon isiri sp. n., right lower jaw in medial view. Scale = 1 mm.

vertical through anterior orbital margin. One wide maxillary tooth with 7 cusps (Fig. 2). Dentary with 6 or 7 teeth decreasing in size anteroposteriorly. Three or four large teeth with 5 to 8 cusps, 1 smaller with 3 and 2 much smaller with 1 cusp (Fig. 4).

Scales cycloid. Lateral series with 33-37 scales; 33(1), 34(7), 35(14*), 36(2), and 37(1). Lateral line with 6 to 29 perforated scales; 6(1*), 7(4), 8(1), 9(10), 10(6), 11(7), 12(1), 29(1). Six* (7 in 1 ex.) scales between dorsal-fin origin and lateral line; 4-5* between lateral line and anal-fin origin. Eleven to fourteen scales between supraoccipital process and dorsal-fin origin. A single row of six to ten scales on anal-fin base. Gill rakers: 18. Vertebral counts: 30-31.

Color of specimens preserved in alcohol: Background pale brown, dorsal region of flanks and head darker, a dark midline stripe along dorsum. Dark humeral spot vertically elongated, a second lateral spot faint and vertically elongated. Dark narrow midlateral stripe extending from second lateral spot to caudal peduncle, ending in a caudal spot. Dorsum of head, premaxilla, and dorsal half of maxilla with dark chromatophores.

Dorsal fin hyaline with black chromatophores on unbranched rays, dark chromatophores on anterior and posterior margins of branched rays. Anal fin hyaline with small, black chromatophores. Black caudal spot on caudal peduncle extended on middle caudal-fin rays; remaining caudal-fin rays with scattered dark chromatophores on margins. Dark chromatophores on distal margin of caudal fin. Pectoral and pelvic fins hyaline, few chromatophores along ray surfaces.

Chromatophores completely covering scales surface on upper half of flank, more densely concentrated on posterior margin. Scales on lower half of flanks with scattered chromatophores on surface.

DISTRIBUTION: *Hyphessobrycon isiri* sp. n. is known from streams flowing in the río Uruguay basin (Fig. 5).

HABITAT: The arroyo Ubajay in its lower portion forms the limit of the 'Parque Nacional El Palmar' towards the south and 'Los Monigotes' farm towards the north. The upper portion is completely located on farm grounds. Its two springs are found in grassland hills typical for the area used for cattle. At the junction of the two brooks a

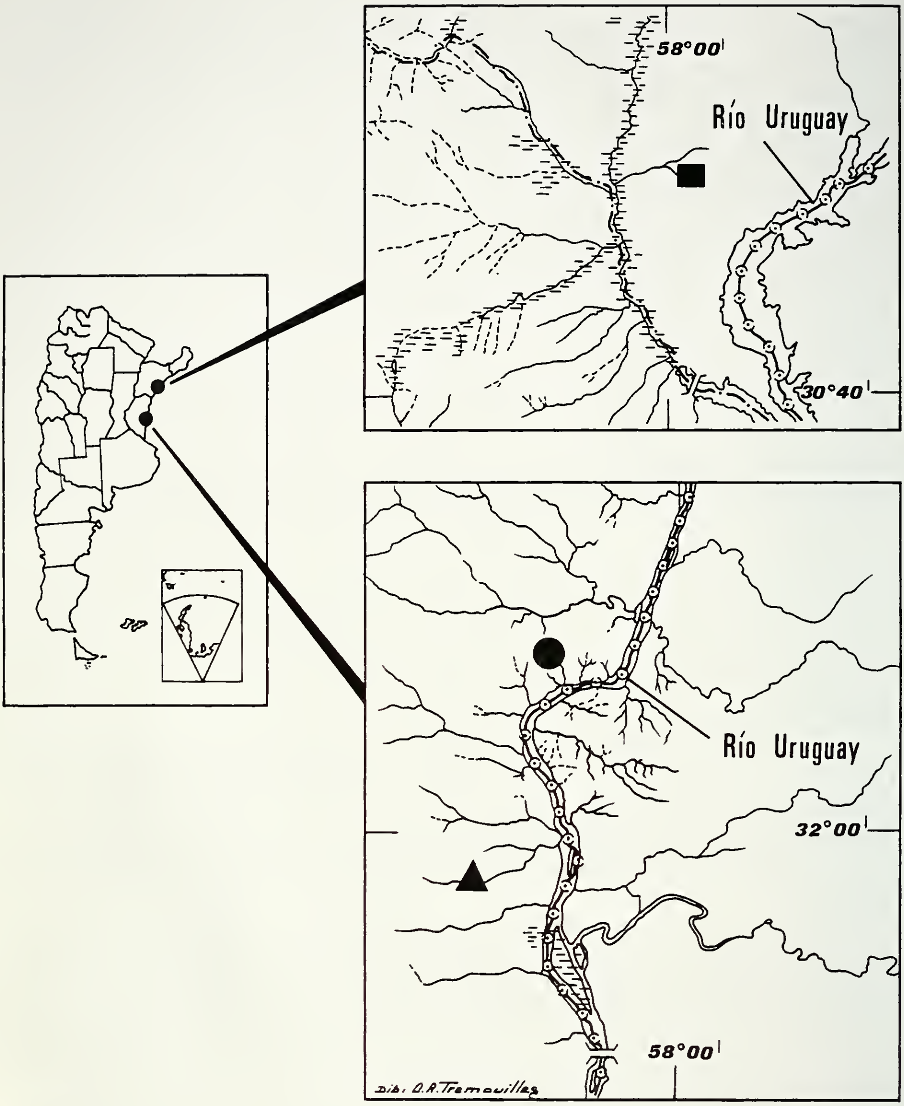


FIG. 5

Ge[illegible]l distribution of *Hyphessobrycon isiri* sp. n., black circle: arroyo Ubajay (type locality), [illegible]angle: arroyo Marmol and black square: arroyo Mota.

small farm dam 2 meters deep probably allowed the permanence of some species which apparently remaining length of the brooks (which are only 20 cm deep in average). This pond, located about 3 km from the Río Uruguay at 31°48.94' S-58°12.41' W, is the type locality of the new species. The bottom is covered with gravel

TABLE 1: Morphometric data of the holotype and 14 paratypes of *Hyphessobrycon isiri* sp. n. Standard length expressed in mm.

	Holotype	**Range**	**Mean**	**SD**
Standard length	44.6	26.8-48.1		
% of standard length				
Body depth	35.2	34.0-40.3	36.2	1.72
Head length	25.3	24.5-29.9	27.1	1.78
Predorsal distance	51.6	51.6-53.9	52.6	0.80
Caudal peduncle length	9.9	8.1-10.8	9.7	0.72
Caudal peduncle depth	11.7	11.0-12.9	12.2	0.52
Dorsal-fin base	13.0	12.2-15.9	13.9	0.98
Anal-fin base	26.7	24.1-30.6	27.8	1.92
% of head length				
Orbital diameter	42.5	38.7-42.9	41.1	1.22
Snout length	26.5	23.0-28.8	25.6	1.63
Interorbital distance	31.0	29.7-34.4	32.0	1.32

and rocks in the areas with current and with sand and mud in the stretches devoid of, or with low current. The vegetation is reduced to grasses hanging from the banks and aquatic species as *Nymphoides indica*, *Ludwigia* sp. and *Bacopa* sp. The pond was almost completely exposed to sunlight, except for small shadow provided by a few marginal bushes. At the time of collecting the water was turbid after rains during the previous days.

REMARKS

The following species of the genus *Hyphessobrycon* were registered from the Río de la Plata basin in Argentina: *H. anisitsi*, *H. auca*, *H. elachys*, *H. eques*, *H. guarani*, *H. igneus*, *H. luetkenii*, *H. meridionalis*, *H. reticulatus*, and *H. wajat*. All of them and also *H. isiri* sp. n., described herein, inhabit the eastern portion of that basin.

Hyphessobrycon isiri sp. n. is similar to *H. anisitsi* and *H. auca*, from which it can be diagnosed by having premaxillary teeth of the inner series much more expanded distally (Figs 2-3) with 5 a 10 cusps instead of 5 to 6 cusps in *H. anisitsi* and 4 to 9 in *H. auca* (see Almirón *et al.*, 2004, figs 4 and 5).

Hyphessobrycon isiri sp. n. differs from *H. eques*, *H. guarani*, *H. igneus*, and *H. reticulatus* in the color pattern. *Hyphessobrycon eques* has the ground colour of body red whereas *H. isiri* sp. n. is mostly silvery. *Hyphessobrycon guarani* bears a black spot on dorsal-fin rays, absent in *H. isiri* sp. n.; *H. igneus* has the caudal fin red whereas in *H. isiri* sp. n. the caudal fin is black, yellow and red. *Hyphessobrycon reticulatus* has a dark line along the base of anal fin whereas *H. isiri* sp. n. lacks a line along the anal-fin base.

Males of *H. isiri* sp. n. has the distal margin of the anal fin straight whereas males of *H. elachys* has anal fin with broad anterior lobe with rays thickened and flattened medially.

The number of maxillary teeth differenciates *H. isiri* sp. n. with only one tooth from *H. guarani*, 2 to 5; *H. luetkenii*, 2 or 3; and *H. wajat*, 3 to 5. Finally, *H. meridionalis* has 26 to 30 branched anal-fin rays whereas *H. isiri* sp. n. has 16 to 22.

Ahl (1923) described *Hemigrammus caudovittatus* from Buenos Aires. This species was considered a junior synonym of *Hyphessobrycon anisitsi* by Myers (1923) and a valid species by Eigenmann & Myers (1929). The type locality of this species has been intensely collected, and no *Hemigrammus* species is known for the area inhabiting this region. The only species similar to *H. caudovittatus* found in this area are identified as *Hyphessobrycon anisitsi* and, probably, *Hyphessobrycon isiri* sp. n. (see distribution). A decision about the validity of *Hemigrammus caudovittatus* with respect to *H. anisitsi* is rather difficult because the type specimens of *H. caudovittatus* were lost during or in the aftermath of World War II (Zarske & Gery, 2003). *Hyphessobrycon isiri* sp. n. differs from *H. caudovittatus* in having inner premaxillary teeth with 5 to 10 vs. 5 cusps, and one maxillary tooth with 4 vs. 3 cusps.

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