

The genus *Microananteris* Lourenço, 2003
in French Guiana (Scorpiones: Buthidae)

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COUVERTURE / COVER:

Mitaraka Sud Massif showing dense humid forest of altitude, type locality of *M. inselberg* n. sp. Photo: Xavier Desmier.

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KEY WORDS

Scorpion,
Microananteris,
humicolous,
endemic,
French Guiana,
new species.

ABSTRACT

Two new humicolous micro-buthid species belonging to the genus *Microananteris* Lourenço, 2003 are described from French Guiana. The descriptions are based on two adult specimens collected in organic soil with the use of extraction by the Berlese method. The new discoveries bring further support to the validity of the genus *Microananteris*. The geographic distribution of the known species of *Microananteris* remains limited to the only territory of French Guiana.

RÉSUMÉ

Le genre Microananteris Lourenço, 2003 en Guyane (Scorpiones: Buthidae).

Deux nouvelles espèces humicoles des micro-Buthidae appartenant au genre *Microananteris* Lourenço, 2003 sont décrites de la Guyane. Les descriptions sont basées sur deux exemplaires adultes collectés dans du sol organique à l'aide des méthodes d'extraction du type Berlese. Ces nouvelles découvertes apportent un nouveau soutien à la validité du genre *Microananteris*. La distribution géographique des espèces connues du genre *Microananteris* reste limitée au seul territoire de la Guyane.

MOTS CLÉS
Scorpion,
Microananteris,
humicole,
endémique,
Guyane,
espèces nouvelles.

INTRODUCTION

As already outlined in previous papers, humicolous scorpions are globally rare (Lourenço 2003, 2005, 2009) and new discoveries remain rather confidential (Lourenço *et al.* 2019). The first instance to be precisely reported was that of *Akentrobuthus leleupi* Lamoral, 1976, a buthid scorpion found in forests of the Kivu Province in Congo (Lamoral 1976). Just before this latter publication (Lamoral 1976), Vachon (1974) described a new genus and species, *Lychasioides amieti* Vachon, 1974 from the forest of Otomoto in the Cameroon. According to the collector of this species, J. L. Amiet, the studied specimens were exclusively found in organic soil. Therefore, it was subsequently classified as humicolous (Vachon, in litt.). In more recent years a new genus of truly humicolous buthid scorpions, *Microcharmus* Lourenço, 1995 was described from Madagascar (Lourenço 1995). In the following years a second genus and several new species were discovered confirming the usefulness of accommodating microcharmids in their own family Microcharmidae Lourenço, 1996. For a global synopsis refer to Lourenço *et al.* (2019).

Humicolous species appear to be even more confidential in regions other than the Afrotropical realm. Isolated examples are known for Europe with *Belisarius xambeui* Simon, 1879 (family Belisariidae Lourenço, 1998) known from France and Spain (Lourenço 2015); for Asia with *Chaerilus telnovi* Lourenço, 2009 (family Chaerilidae Pocock, 1893) from Indonesia (Lourenço 2009); for North and South America (Vignoli & Prendini 2009; Sánchez-Vialas *et al.* 2020) with species in the genera *Typhlochactas* Mitchell, 1971 (family Typhlochactidae Mitchell, 1971) and *Troglotayosicus* Lourenço, 1981 (family Troglotayosicidae Lourenço, 1998).

Known examples of humicolous buthid species belonging to the subfamily Ananterinae (*sensu* Pocock 1900) or to the “*Ananteris* group” as suggested by Lourenço (2011) are more informative concerning the possible evolution of genera, such as *Ananteris* Thorell, 1891 and *Microananteris* Lourenço, 2003, from endogenous to epygean environments (see discussion). At least two known *Ananteris* species, *Ananteris cryptozoicus* Lourenço, 2005 from Brazil (here corrected to *Ananteris cryptozoica*) and *Ananteris intermedia* Lourenço, 2012 from French Guiana are exclusively soil dwellers. A second genus, *Microananteris* with a single known species *M. minor* Lourenço, 2003 known from French Guiana is equally a soil dweller (Lourenço 2003, 2005, 2012).

The morphological traits of *Ananteris* Thorell, 1891 and *Microananteris* demonstrate their relationships. The species are small in size and show the persistence of neotenic structures in the adults. In most instances, they show cryptozoic behaviour and a number of species are humicolous. Their ecology and general biology is poorly known, but detailed inventories carried out during the last 45 years, demonstrate that the total number of species is significantly greater than what was initially expected (Lourenço & Motta 2019); most, however remain extremely rare and show very limited and patchy ranges of distribution.

Another characteristic observed for several species of the genus *Ananteris* is the rarity of juvenile forms collected with the classical sampling methods such as overturning rocks, the use of ultraviolet light and pitfall traps. Only the use of extraction methods, such as these of Berlese, Winkler and Kempson, has resulted in more frequent collections of juvenile forms, and also led to the discovery and description of new humicolous species.

The genus *Microananteris* was described on the basis of a single adult female collected in the Central region of French Guiana in an area of dense humid forest with the use of extraction by Berlese Method (Lourenço 2003). The validity of this genus was rejected by Botero-Trujillo & Noriega (2011) who synonymized it with *Ananteris*. The conclusions of Botero-Trujillo & Noriega (2011) were, however biased by a number of imprecisions, already exposed (Lourenço 2011), and reaffirmed once again here: 1) most, if not all, data proposed by these authors were simply collected in the literature (mainly from my own publications); 2) the holotype of *Microananteris minor*, type specimen of the genus was not examined, as well as the material of the several groups they used to support their argumentation; 3) the key characters used to separate *Microananteris* and *Ananteris*, based on the shape of peg sensillae and the presence of a setae-like structure of the tegument (see Lourenço 2003 for details and illustrations) were equally rejected by Botero-Trujillo & Noriega (2011). Nevertheless, as I explained in a previous paper (Lourenço 2011), the scanning electronic microscope (SEM) photos presented by Botero-Trujillo & Noriega (2011) clearly suggest that the material used by these authors was very poorly preserved for the production of SEM photos, explaining the “absence” of some structures, such as the seta-like tegument, which was most certainly lost during the preparation of the material for SEM observation.

Subsequently to the revalidation of the genus *Microananteris* (Lourenço 2011), other authors (Esposito *et al.* 2018) continued to reject the validity of *Microananteris*, simply ignoring the revalidation by Lourenço (2011). Esposito *et al.* (2018) stated as follows: “all New World buthids except one genus occurring in South America, *Ananteris* Thorell, 1891 (*Microananteris* Lourenço, 2003 was justifiably synonymized with *Ananteris* by Botero-Trujillo & Noriega 2011)...”

Recently, new material belonging to the genus *Microananteris* from French Guiana was studied and this leads to the description of two new species. The addition of these two new species brings further evidence about the validity of this genus which remains endemic to French Guiana until now (Fig. 1). A key for identification of *Microananteris* species is proposed.

MATERIAL AND METHODS

Illustrations and measurements were produced using a Wild M5 stereo-microscope with a drawing tube (camera lucida) and an ocular micrometer. Measurements (in mm) follow Stahnke (1970), trichobothrial notations Vachon (1974), morphological terminology mostly Hjelle (1990), and cheli-

TABLE 1. — Morphometric values (in mm) of the holotypes of *Microananteris* Lourenço, 2003 species: *M. minor* Lourenço, 2003; *M. serrulata* n. sp.; *M. inselberg* n. sp. Symbol: *, including telson.

	<i>M. minor</i>	<i>M. serrulata</i> n. sp.	<i>M. inselberg</i> n. sp.
Total length*	13.90	14.00	13.07
Carapace			
- length	1.70	1.80	1.60
- anterior width	1.20	1.07	0.93
- posterior width	1.80	1.73	1.53
Mesosoma length	3.70	4.07	2.93
Metasomal segment I			
- length	0.90	0.80	0.87
- width	1.10	1.13	1.07
Metasomal segment II			
- length	1.00	0.87	0.93
- width	1.10	1.07	0.93
Metasomal segment III			
- length	1.10	1.00	1.00
- width	1.20	1.07	0.93
Metasomal segment IV			
- length	1.20	1.20	1.27
- width	1.10	1.07	0.94
Metasomal segment V			
- length	2.10	2.13	2.20
- width	1.10	1.07	1.00
- depth	0.90	0.87	0.80
Telson length	2.20	2.13	2.27
Vesicle			
- width	0.90	0.87	0.80
- depth	0.80	0.80	0.67
Pedipalp			
- Femur length	1.40	1.40	1.40
- Femur width	0.40	0.53	0.33
- Patella length	1.80	1.87	1.80
- Patella width	0.60	0.60	0.53
- Chela length	2.20	2.27	2.13
- Chela width	0.40	0.47	0.33
- Chela depth	0.40	0.53	0.40
Movable finger			
- length	1.60	1.73	1.60

cerae dentition Vachon (1963). The type material of the new species described here will be deposited in the Muséum national d'Histoire naturelle (MNHN), Paris.

TAXONOMIC RESULTS

Family BUTHIDAE C. L. Koch, 1837

Genus *Microananteris* Lourenço, 2003

TYPE SPECIES. — *Microananteris minor* Lourenço, 2003.

REVISED DIAGNOSIS. — Small scorpions, when compared with the average size of a large number of species of micro-buthid genera; the total length of the three known species ranges from 13.07 to 14.00 mm in total length (see Table 1). *Microananteris* is characterized among several micro-buthoids and in particular in relation

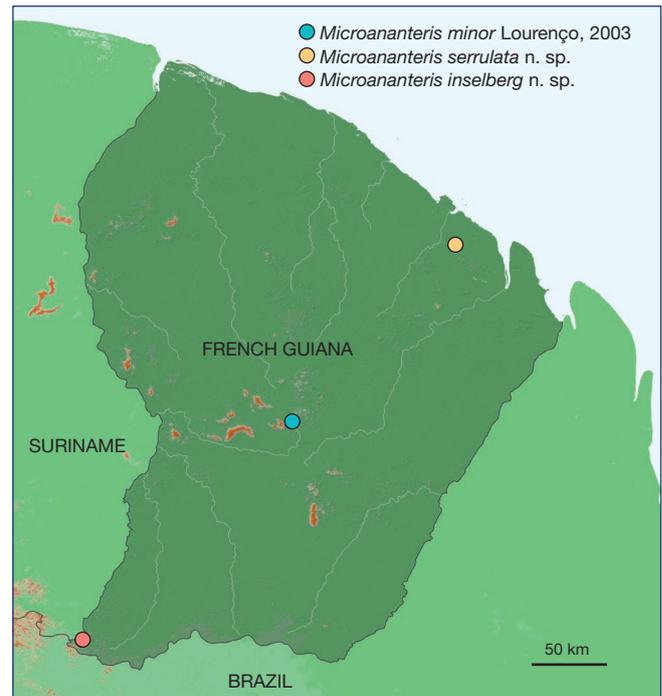


FIG. 1. — Known distribution of the *Microananteris* Lourenço, 2003 species.

to the genus *Ananteris* Thorell, 1891 by the presence of very small pectines, with the most distal tooth rounded and the most proximal absent (Fig. 2); the total number of teeth ranges from 10 to 11 in both sexes; the structure of the peg sensillae of the pectines is distinct, showing a rounded structure instead of the spatula-like structure observed in *Ananteris* species. Spiracles have a semi-oval shape. The sternum is subpentagonal. The Telson is more to globular in shape and the aculeus is short. Trichobothriatixy: orthobothriatixy type A-β (Vachon 1974, 1975). Tibial spurs developed on leg IV but reduced on leg III.

The species of the genus *Microananteris* are exclusively known from humid forests of French Guiana and correspond to possible endemic elements of the soil fauna.

Microananteris minor Lourenço, 2003 (Fig. 3)

Microcharmus minor Lourenço, 2003: 1152.

TYPE MATERIAL. — **French Guiana. Holotype.** ♀; Central region, near to the village of Saül, 2 km SW of the airfield; 3°37'22"N, 53°12'30"W; 19.III.1999; J.-M. Betsch leg.; dense humid forest at low altitude, in organic soil (extracted by the Berlese method); MNHN-RS-RS8602.

REVISED DIAGNOSIS. — Total length, including telson 13.90 mm (see Table 1). Anterior margin of carapace with a weak median concavity. Very small pectines with 10-10 teeth. Spiracles with a semi-oval shape. Telson without granulations, almost smooth. Dorsal carinae of metasomal segments II-IV with weakly marked spinoid granules. Trichobothria: Eb_{2,3} of chela hand in a distal position; dt and db of fixed finger basal in relation to et; d₅ and e₁ of femur aligned at the same level.

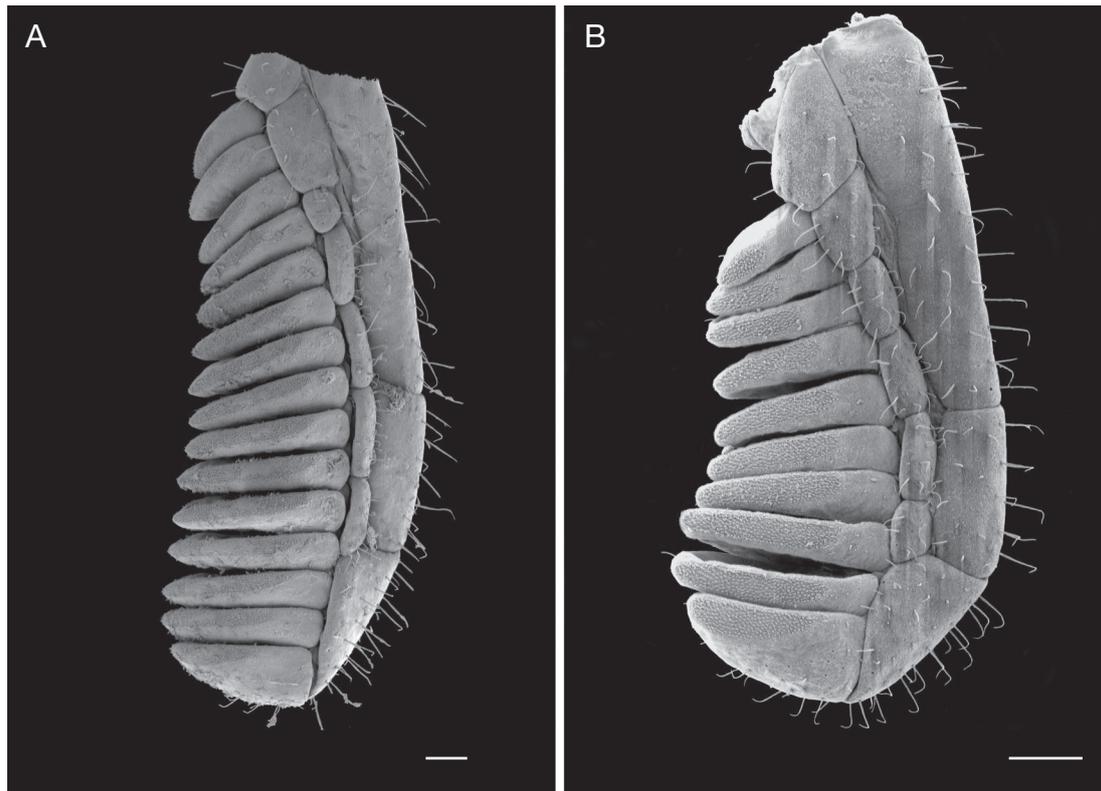


Fig. 2. — Comparative morphologies of the female pectines of *Ananteris balzanii* Thorell, 1891 (A) and *Microananteris minor* Lourenço, 2003 (B). Scale bars: 100 μ m.

Microananteris serrulata n. sp.
(Fig. 4)

[urn:lsid:zoobank.org:act:9D94680B-E248-40CF-A9D4-475B5A56EBDD](https://doi.org/10.21203/rs.3.rs-1234567/v1)

MATERIAL EXAMINED. — French Guiana. Holotype. ♀; RN Trésor; 4°35'28"N, 52°18'04"W; 27.IV.1999; J.-M. Betsch leg; dense humid forest of low altitude (Fig. 5), in organic soil (extracted by the Berlese method); MNHN-RS-RS9154.

ETYMOLOGY. — The specific name refers to the strong serrulas present on metasomal segments II to IV.

DIAGNOSIS. — Total length, including telson 14.00 mm (see Table 1). Anterior margin of carapace straight. Small pectines with 10-11 teeth. Spiracles with a semi-oval shape. Telson with a moderate granulations laterally. Dorsal carinae of metasomal segments II-IV with strongly marked spinoid granules forming serrulas. Trichobothria: Eb_{2,3} of chela hand in a more proximal position; dt and db of fixed finger distal in relation to et and est; i trichobothrium of patella very close to d₅; femur trichobothrium d₅ distal in relation to e₁.

DESCRIPTION BASED ON FEMALE HOLOTYPE

Coloration

Basically brownish-yellow, symmetrically marbled with dark brown, producing an overall spotted appearance. Prosoma: carapace yellow, largely covered with brown spots; eyes surrounded by black pigment. Mesosoma: pale brown-yellow with confluent yellow stripes. Metasomal segments I to V yellowish with several pale brown spots; segment V with better marked spots ventrally. Telson: vesicle yellow with brownish spots

laterally and ventrally; aculeus yellow at base and reddish at tip. Venter globally pale yellow. Chelicerae yellow with variegated spots over most of surface; better marked anteriorly; fingers yellow with reddish teeth. Pedipalps yellowish densely marked with pale brownish spots which are better marked on femur and patella; chela slightly paler than patella; fingers brownish with rows of granules slightly reddish. Legs yellow densely marked with brownish spots.

Morphology

Carapace moderately granular; anterior margin straight. Anterior median superciliary and posterior median carinae weak. All furrows moderate to weak. Median ocular tubercle distinctly anterior to the centre of carapace; median eyes separated by *c.* 0.60 of one ocular diameter. Three pairs of lateral eyes. Sternum subpentagonal. Mesosoma: tergites moderately to weakly granular. Median carina moderate to weak in all tergites. Tergite VII pentacarinata. Venter: genital operculum divided longitudinally, each plate having a more or less sub-oval shape. Pectines small; pectinal tooth count 10-11; most proximal tooth absent; basal middle lamellae of pectines not dilated; fulcra absent. Sternites smooth with short semi-oval spiracles; sternites III-IV with two longitudinal marked furrows; VII with a few granulations and vestigial carinae. Metasomal segments I and II with 10 carinae, crenulate; segments III-IV with 8 carinae, crenulate; dorsal and subdorsal carinae with spinoid granules forming serrulas; intermediate carinae incomplete on segment II; intercarinal spaces mod-

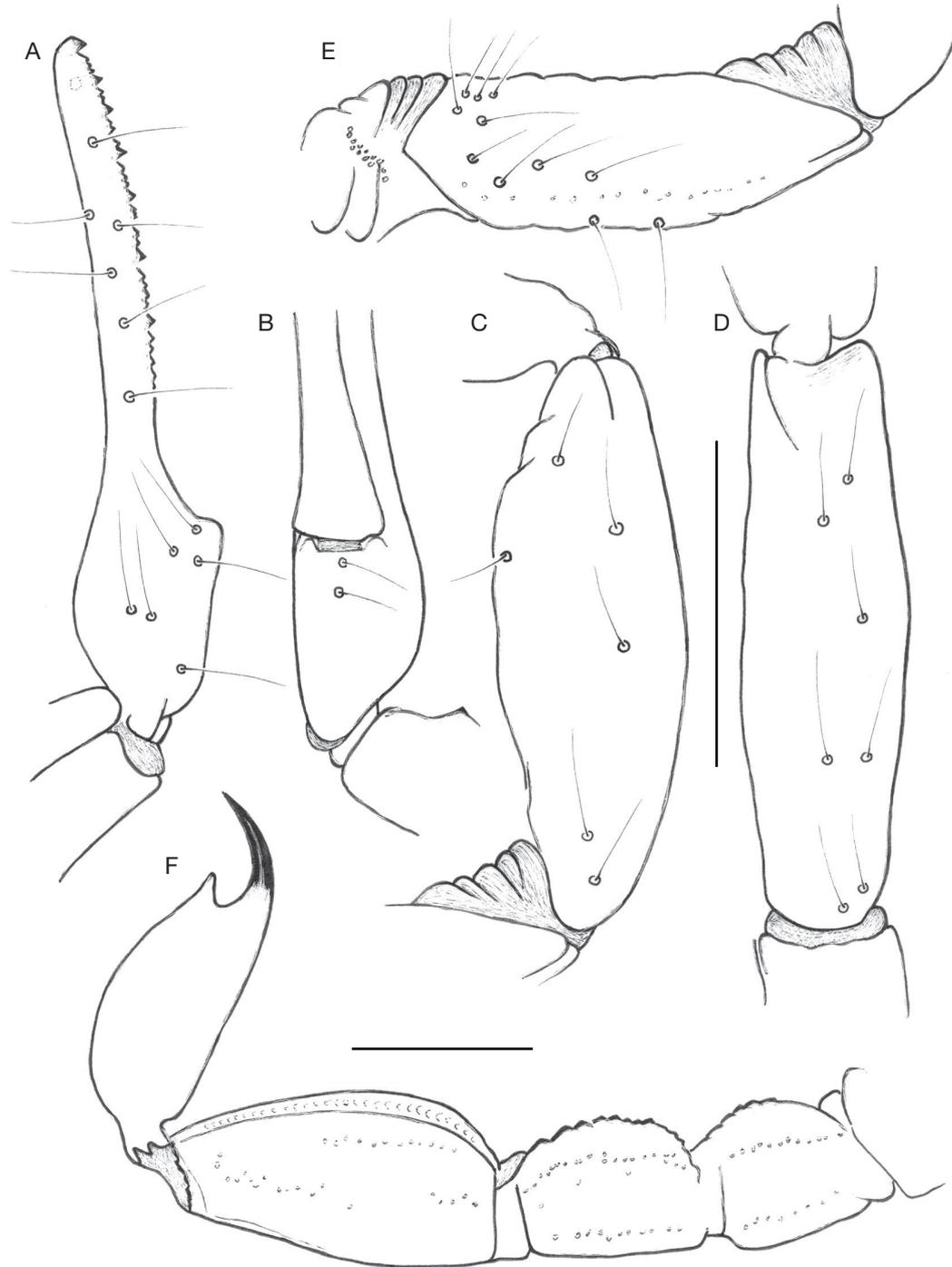


FIG. 3. — *Microananteris minor* Lourenço, 2003, female holotype: **A-E**, trichobothrial pattern: **A, B**, chela, dorso-external and ventral aspects; **C, D**, patella, dorsal and external aspects; **E**, femur, dorsal aspect; **F**, metasomal segments III-V and telson, lateral aspect. Scale bars: 1 mm.

erately to weakly granular; segment V rounded and with five carinae moderately marked. Telson with a ‘pear-like’ shape, almost smooth with dorsal and ventral carinae; presence of some lateral granulations; aculeus very short and moderately curved; subaculear tooth strong and almost rhomboid. Cheliceral dentition characteristic of family Buthidae (Vachon 1963); fixed finger with two moderate basal teeth; movable finger with two very weak basal teeth; ventral aspect of both

finger and manus with dense, long setae. Pedipalps: femur pentacarinata; patella and chela with a few vestigial carinae; internal face of patella with a few vestigial granules; all faces weakly granular, almost smooth. Movable fingers with 6-6 almost linear rows of granules; two accessory granules present at base of each row; extremity of movable fingers with three accessory granules. Trichobothriotaxy: orthobothriotaxy A-β (Vachon 1974, 1975). Legs: tarsus with very numerous fine

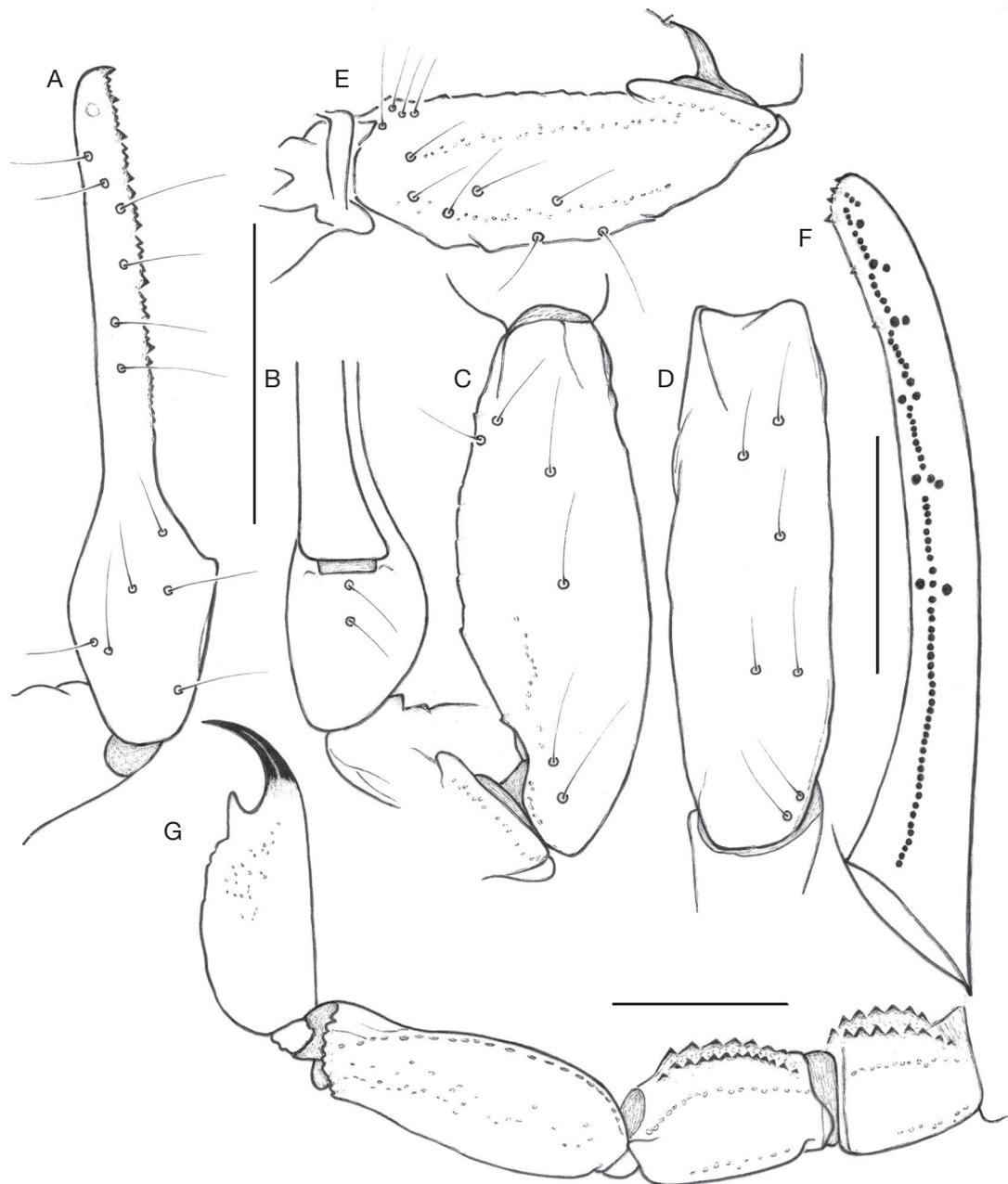


FIG. 4. — *Microananteris serrulata* n. sp., female holotype: **A-E**, trichobothrial pattern: **A, B**, chela, dorso-external and ventral aspects; **C, D**, patella, dorsal and external aspects; **E**, femur, dorsal aspect; **F**, cutting edge of movable finger showing rows of granules; **G**, metasomal segments III-V and telson, lateral aspect. Scale bars: 1 mm; except for F, 0.5 mm.

median setae ventrally. Tibial spurs developed on leg IV but reduced on leg. III.

Microananteris inselberg n. sp.
(Fig. 6)

[urn:lsid:zoobank.org:act:CAE403FE-8983-4CBC-B3DB-3EB6A928CB5E](https://doi.org/10.21203/rs.3.rs-1000000/v1)

MATERIAL EXAMINED. — French Guiana. Holotype. ♂; Mitaraka Sud; 2°16'00"N, 54°31'00"W; 22.IX.2001; J.-M. Betsch leg.; 560 m dense humid forest altitude (Fig. 7); in organic soil (extracted by the Berlese method); MNHN-RS-RS9155.

ETYMOLOGY. — The specific name is placed in apposition to the generic name and refers to the Mitaraka Inselberg where the new species was found.

DIAGNOSIS. — Total length, including telson 13.90 mm (see Table 1). Anterior margin of carapace straight. Large pectines with 10-10 teeth. Spiracles with a semi-oval shape. Telson more elongate without granulations, almost smooth. Dorsal carinae of metasomal segments II-IV with weakly to moderately marked spinoid granules. Trichobothria: Eb_{2,3} of chela hand in a proximal position; dt of fixed finger distal in relation to et and est; d₅ trichobothrium of patella very close to the internal face; femur trichobothrium d₅ slightly distal in relation to e₁.



FIG. 5. — Dense humid forest of low altitude in the RN Trésor, type locality of *M. serrulata* n. sp. Photo: Johan Chevalier.

DESCRIPTION BASED ON MALE HOLOTYPE

Coloration

Basically brownish-yellow, symmetrically marbled with dark brown, producing an overall spotted appearance. Prosoma: carapace yellowish, almost totally covered with brown spots; eyes surrounded by black pigment. Mesosoma: brown-yellow with confluent yellow stripes. Metasomal segments I to V yellow with several brownish spots; segment V slightly more spotted. Telson: vesicle yellow without spots laterally or ventrally; aculeus yellowish. Venter pale yellow; coxapophysis slightly marbled with brownish. Chelicerae yellow with variegated spots over the entire surface; more marked anteriorly; fingers yellow slightly spotted; teeth reddish-yellow. Pedipalps: brownish with some paler zones; brownish spots better marked on the femur and patella; chela paler than patella; fingers brownish with the rows of granules slightly reddish. Legs yellow, densely marked with brownish spots.

Morphology

Carapace moderately granular; anterior margin straight. Anterior median superciliary and posterior median carinae weak. All furrows moderate to weak. Median ocular tubercle distinctly anterior to the centre of carapace; median eyes separated by approximately 0.60 of one ocular diameter. Three pairs of lateral

eyes. Sternum subpentagonal. Mesosoma: tergites moderately granular; granulation more intense than on carapace. Median carina moderate to weak in all tergites. Tergite VII pentacarinata. Venter: genital operculum divided longitudinally, each plate having a more or less semi-oval shape. Pectines large; pectinal tooth count 10-10; most proximal tooth absent; basal middle lamellae of the pectines not dilated; fulcra absent. Sternites smooth with short semi-oval spiracles; VII with a few granulations and all carinae absent. Metasomal segments I and II with 10 carinae, crenulate; segments III-IV with 8 carinae, crenulate; intermediate carinae incomplete on segment II; dorsal carinae on segments II-IV with some moderate spinoid granules; intercarinal spaces moderately to weakly granular; segment V rounded with only latero-dorsal carinae marked. Telson with a 'pear-like' shape, almost smooth with one weak ventral carinae; aculeus very short and moderately curved; subaculear tooth strong and almost rhomboid. Cheliceral dentition characteristic of the family Buthidae (Vachon 1963); fixed finger with two moderate basal teeth; movable finger with two very weak basal teeth; ventral aspect of both finger and manus with dense, long setae. Pedipalps: femur pentacarinata; patella and chela with a few vestigial carinae; internal face of patella with 6-7 vestigial spinoid granules; all faces weakly granular,

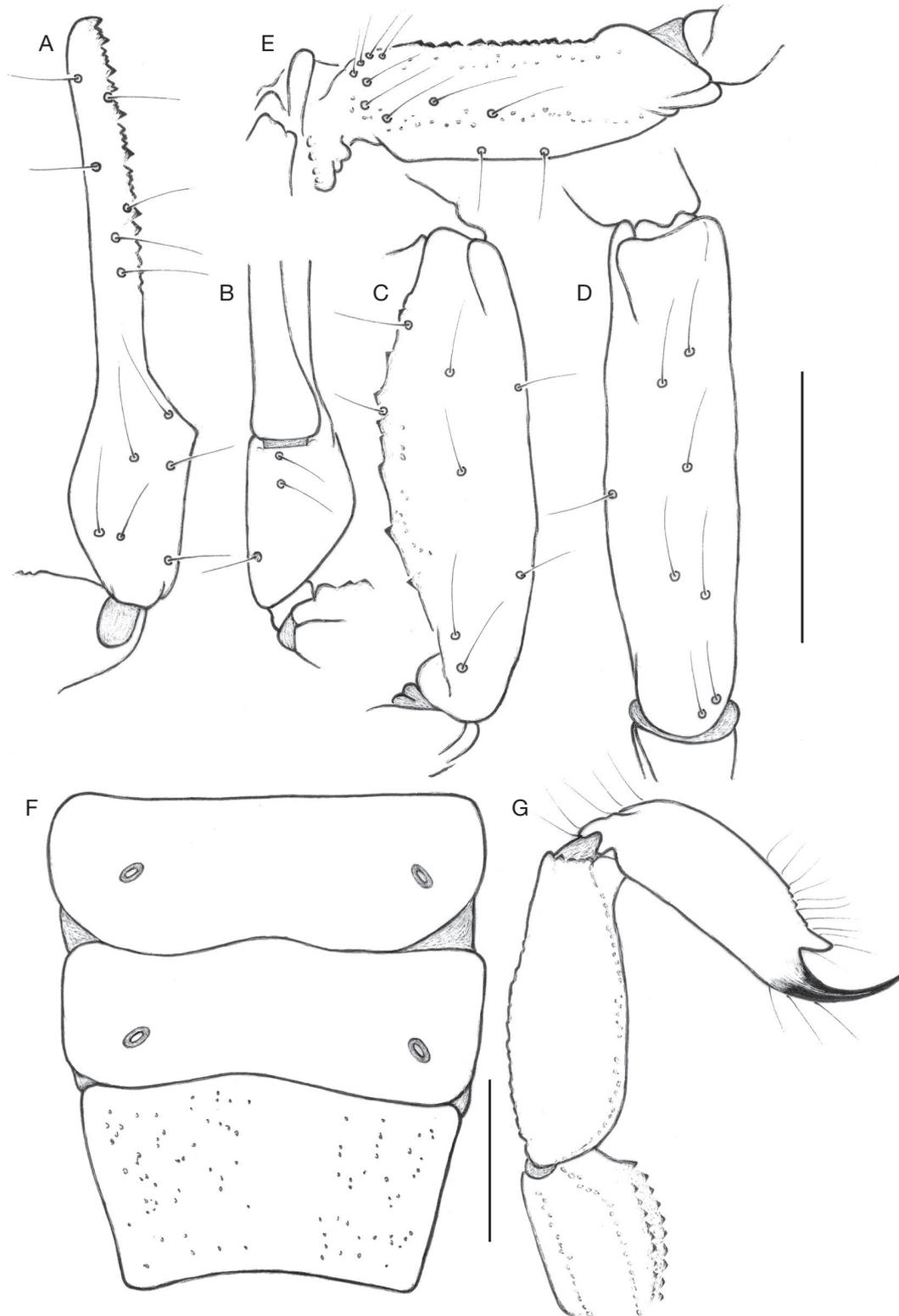


FIG. 6. — *Microananteris inselberg* n. sp., male holotype: **A-E**, trichobothrial pattern: **A, B**, chela, dorso-external and ventral aspects; **C, D**, patella, dorsal and external aspects; **E**, femur, dorsal aspect; **F**, sternites V-VII showing spiracles and weak granulation on VII; **G**, metasomal segments IV-V and telson, lateral aspect. Scale bars: 1 mm.

almost smooth. Movable fingers with 6-6 almost linear rows of granules; two accessory granules present at the base of each row; extremity of movable fingers with three accessory granules.

Trichobothriotaxy; orthobothriotaxy A-β (Vachon 1974, 1975). Legs: tarsus with very numerous fine median setae ventrally. Tibial spurs developed on leg IV but reduced on leg. III.



FIG. 7. — Mitaraka Sud Massif showing dense humid forest of altitude, type locality of *M. inselberg* n. sp. Photo: Xavier Desmier.

KEY TO THE KNOWN SPECIES OF *MICROANANTERIS* LOURENÇO, 2003

1. Dorsal carinae of metasomal segments II to IV with weak or moderately marked spinoid granules; femur trichobothria d_5 and e_1 aligned at the same level or with d_5 slightly distal in relation to e_1 2
- Dorsal carinae of metasomal segments II to IV with strongly marked spinoid granules; femur trichobothrium d_5 distal in relation to e_1 *M. serrulata* n. sp.
2. Anterior margin of carapace with a weak median concavity; sternite VII with weak carinae and granulations ...
..... *M. minor* Lourenço, 2003
- Anterior margin of carapace straight; sternite VII with a few granules but without carinae*M. inselberg* n. sp.

DISCUSSION

As previously discussed (Lourenço 2005), juvenile forms of Ananterinae proved to be rare when collected by standard methods. Most specimens of these cryptozoic but epygean species were obtained almost exclusively by extractions methods. This observation leads to consider the possible evolution of micro-scorpions from endogeous to epygean environments.

Scorpions became adapted to terrestrial environments between the Carboniferous and Triassic periods (Jeram 2001; Lourenço & Gall 2004). It can be therefore suggested that transitional forms probably existed then, although these are difficult to identify (Jeram 2001). The early terrestrial forms would have been unable to survive in dry or extreme environments such as savannas or deserts which are today colonized by

numerous species. According to their degree of adaptation to life on land, different types of substract were probably used in different stages of the evolution and adaptation of early scorpions. The evaporating power of the air is the most important physical factor of the environment affecting the distribution of cryptozoic animals. This is because small creatures have a very large surface in proportion to their mass; consequently, the conservation of water is the prime physiological problem of their existence (Cloudsley-Thompson 1967, 1988; Little 1983). The majority of cryptozoic animals are restricted to moist conditions, although these must be sufficiently drained to avoid waterlogging. It is probable that the evolutionary transition of many invertebrates from aquatic to terrestrial life may have taken place via the soil where aerial respiration is not associated with desiccation (Cloudsley-Thompson 1967, 1988;

Little 1983). The present eco-physiological characteristics of species belonging to the genus *Ananteris* and *Microananteris* suggest that this lineage was originally composed of soil dwellers. During evolutionary time adult forms learned to explore the epigeal environment, but juveniles, and also numerous species, remained endogean and kept the plesiomorphic character. This particular situation is more frequently observed in insects but rare within scorpions in general (Wallwork 1970; Gobat *et al.* 2003).

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