Boletín Sociedad Entomológica Aragonesa, nº **38** (2006) : 59–70.

FURTHER CONSIDERATIONS ON THE GENUS *BUTHACUS* BIRULA, 1908 (SCORPIONES, BUTHIDAE), WITH A DESCRIPTION OF ONE NEW SPECIES AND TWO NEW SUBSPECIES

Wilson R. Lourenço

Département de Systématique et Evolution, USM 0602, Section Arthropodes (Arachnologie), CP 053, Muséum National d'Histoire Naturelle, 61 rue Buffon 75005 Paris, France: e-mail: arachne@mnhn.fr

Abstract: Considerations are outlined regarding the relationships of several species of the genus *Buthacus* distributed in northern Africa and the Middle East. The stability of the characters used to define the "*leptochelys*" and "*arenicola*" complexes is discussed for the first time. Based on the rediscovery of two of the specimens used by E. Simon to describe *Buthacus arenicola*, this species is redefined, and *Buthacus spatzi* is regarded as a junior synonym of *B. arenicola*. A lectotype is designated for *Buthacus occidentalis* Vachon, and the recently described *Buthacus ehrenbergi* Kovařík is considered as a synonym of this. One new species and two new subspecies are also described from Algeria and Morocco.
Key words: Scorpiones, Buthidae, *Buthacus*, new species and subspecies, northern Africa, Middle East.

Nuevas consideraciones sobre el género *Buthacus* Birula, 1908 (Scorpiones, Buthidae) y descripción de una nueva especie y dos subespecies

Resumen: Se presentan diversas consideraciones sobre las relaciones de varias especies del género *Buthacus* presentes en el norte de África y Oriente Medio. Se discute por primera vez la estabilidad de los caracteres utilizados para definir los grupos "*leptochelys*" y "*arenicola*". A partir del hallazgo de los dos especímenes en que se basó E. Simon para la descripción de *Buthacus arenicola*, se redefine esta especie y se considera a *Buthacus spatzi* como sinónimo posterior de *B. arenicola*. Se designa lectotipo para *Buthacus occidentalis* Vachon, y el recientemente descrito *Buthacus ehrenbergi* Kovařík se considera como sinónimo de dicha especie. Por otra parte, se describen una nueva especie y dos nuevas subespecies de Argelia y Marruecos.
Palabras clave: Scorpiones, Buthidae, *Buthacus*, nueva especie, nuevas subespecies, norte de África, Oriente Medio.

Taxonomy/Taxonomía:
Buthacus leptochelys algerianus **ssp. n.**
Buthacus arenicola maroccanus **ssp. n.**
Buthacus birulai **sp. n.**

Introduction

As already mentioned in several previous papers (Lourenço, 2000, 2001, 2004a,b), the genus *Buthacus* was erected by Birula (1908) as a subgenus of *Buthus* Leach, having as its type species *Buthus leptochelys* (Ehrenberg 1829), described from Sinai (Palestine) as *Androctonus (Leiurus) leptochelys*. Since its creation, *Buthacus* has been considered as a subgenus or as a genus by to different authors. It was finally defined as a valid genus, related to *Buthus*, by Vachon (1949, 1952).

In his important study of the North African scorpions, Vachon (1949, 1952) discussed the wide distribution of the genus *Buthacus*, which was then known from the Atlantic coast of Africa to Palestine. Today the known distribution of this genus is much wider since a new species, *Buthacus striffleri* Lourenço (2004b), has recently been described from Afghanistan. Vachon also drew the attention to the fact that it was impossible, at the time in which he carried out his studies, to be certain about the precise composition of this genus. He established, however, that at least four species could be diagnosed precisely within the genus *Buthacus*: *Buthacus foleyi* Vachon and *Buthacus villiersi* Vachon respectively from the south of Algeria and from Senegal, as well as *Buthacus leptochelys* (Ehrenberg) and *Buthacus arenicola* Simon. Vachon also drew attention to the fact that *leptochelys* and *arenicola* could represent two complexes of forms or subspecies. In his systematic remarks about *Buthacus arenicola* and *Buthacus leptochelys* (Vachon, 1952) he indicated his doubts about the real status of the different species and/or subspecies found in the North and Northwestern Africa, from Egypt to Mauritania and Morocco. He considered that several forms (or species) might well be present in the African range of distribution of the genus.

In their 'Fauna Palaestina' Levy and Amitai (1980) also attempted to divide the genus *Buthacus* in two groups mainly on basis of the structure of the dentition of the movable finger. They also discussed the difficulties of making a precise definition of several forms, and stated as follows: "These groups could be further divided according to other characters, however, the definite position of several forms from North Africa is still uncertain". This opinion follows that of Vachon (1952) in the sense that *Buthacus leptochelys* and also *Buthacus arenicola* undoubtedly represent not only individual species but also complexes of species.

My efforts to clarify the status of the species of the genus *Buthacus*, initially focused only on those distributed in the western portion of North Africa, mainly Morocco and Mauritania. In a recent paper, Kovařík (2005) criticised my work severely. Kovařík's publication, however, presents numerous inadequacies, and, to put it mildly can be regarded as questionable. To reply properly, however, I decided to examine the very old material used by Ehrenberg to

describe *Buthacus leptochelys*, specifically because this material was also consulted by Kovařík (2005). This was possible thanks to the assistance of Dr. Jason Dunlop of the Museum für Naturkunde, Berlin. Moreover, I was also able to locate in the collections of the Paris Museum, two of the specimens used by E. Simon to describe *Buthacus arenicola*. Although the original specimens of *B. leptochelys* and *B. arenicola* are very poorly preserved, their study allows a redefinition of several 'old' species, as well as the description of one new species and two new subspecies from *Buthacus* populations of North Africa, in Algeria and Morocco.

Only species from North Africa and nearby Middle East will be considered in the present publication. Those distributed in the southern range of the Sahara and in the Sahel will be the subject of a new paper which is in preparation. For didactic reasons, each species will be presented and discussed individually.

The stability of the characters used to define two groups and subgroups of species within the genus *Buthacus*

The dentition of the fixed and movable fingers

The dentition of the fixed and movable fingers was used both by Vachon (1952), Levy et al. (1973) and again by Levy and Amitai (1980) to distinguish between two groups of species within the genus *Buthacus*. The first group "*leptochelys*" was believed to have a complete (or almost complete) set of outer accessory denticles, whereas the second group "*arenicola*" had some or all outer denticles absent. This approximate dichotomy was used by Vachon (1952), with some caution, but was revived by Levy et al. (1973) and again by Levy and Amitai (1980). These authors were largely influenced by Vachon's earlier opinion. Kovařík (2005) redefined this character as being invariable in each group of species (see his figures 1 and 2). Study of all the available types of *Buthacus*, and also of a large series of specimens from Tunisia, Algeria and Morocco, demonstrated the existence of gradients in this character. In specimens of *B. arenicola* the external accessory granules, may be absent, present at the bases of the most basal rows, or be very small and masked by intense setation of the fingers. In the Algerian population of *B. leptochelys*, as in *B. mahraouii* Lourenço, the external accessory granules may be very reduced, but are present at the bases of all rows. Therefore, even if the two groups of species can be substantiated, the association of a given species to one or the other of them may pose some difficult problems. This character is herewith illustrated for most of the species studied.

Number of pectinal teeth

Pectinial tooth number was used in the identification of some 'closely related' species, such as *B. arenicola* and *B. spatzi* Birula. Due to repetitive misidentifications, the characters of two or sometimes even three distinct species have been combined in previous studies, including also the recent paper by Kovařík (2005). Further statistical values are used here in the diagnosis of species as *B. arenicola*, thereby eliminating previous confusion. This method should be used in the case of other species as soon as sufficient material becomes available.

Structure of the latero-ventral carinae of metasomal segment V, and of the anal arc; with the presence or absence of lobes

These characters have been often used, without a comparative analysis for the separation of distinct species. In certain species they can clearly be diagnostic, as in the new descriptions presented below. Moreover, the structure of the ventral carinae of metasomal segments I to III can be very pertinent in the definition of some species.

Slender forms, males with slender hands vs. broad forms, males with broad hands

This dichotomy was used by Levy et al. (1973), and by Levy and Amitai (1980), mainly to distinguish between *B. arenicola* and *B. sptazi*. These authors, have been partially influenced by Vachon (1952; and *in litt*.). The two forms have been arbitrarily defined as *B. arenicola* and *B. spatzi*, although their type material was not examined. The type material of *B. arenicola* has been considered as 'misleading' until now, and the type specimen of *B. spatzi* was not examined by Vachon until several years after his publication of 1952. This series of misidentifications, even led Levy and Amitai to suggest the existence of two subspecies of *B. spatzi* - in Tunisia and Algeria. This matter is discussed in the section below dedicated to *B. arenicola*.

Size of tibial spurs

The sizes of the tibial spurs on legs III and IV, can present some variation within individuals of a given population. For this reason, if this character helps in the diagnosis of certain species, it should not be used alone. Yet it has been in the description by Kovařík (2005) of *B. ehrenbergi* which is clearly a synonym of *B. occidentalis*.

Status of several species of *Buthacus* analysed in the present study

1. Forms associated with a "*leptochelys* group"

Buthacus leptochelys (Ehrenberg) ((= *Androctonus* (*Leiurus*) *leptochelys* Ehrenberg, 1829)). Fig. 1, 4.

This is a valid species. Distribution in Sinai, Egypt, Israel and Palestine. According to Kovařík (2005), one of the syntypes of this species is *B. spatzi* Birula. Naturally, this cannot be the case (see the section on *B. arenicola*). Examination of this syntype reveals that the external accessory granules on the movable finger of the pedipalp are indeed residual or absent (Fig. 2). This could ally the specimen to *B. arenicola* (Fig. 5). Levy and Amitai (1980) indicate that this species occurs in the Sinai. Even if the presence of this species in Sinai and Egypt is possible, however, it is extremely rare (El-Hennawy *in litt*.).

Vachon (1952), identified a population of *B. leptochelys* in the eastern range of Algeria, from Beni-Abbès and Adrar. I referred to this population while describing *B. mahraouii* (Lourenço, 2004a). Examination of the original types of Ehrenberg, have revealed some morphological differences. Moreover, the populations from Sinai and Algeria are at least partially isolated and separated by the range of distribution of *B. arenicola* (see Vachon, 1952 - figure 266; Lourenço, 2004a - figure 17). For this reason a distinct subspecies from Algeria is described here.

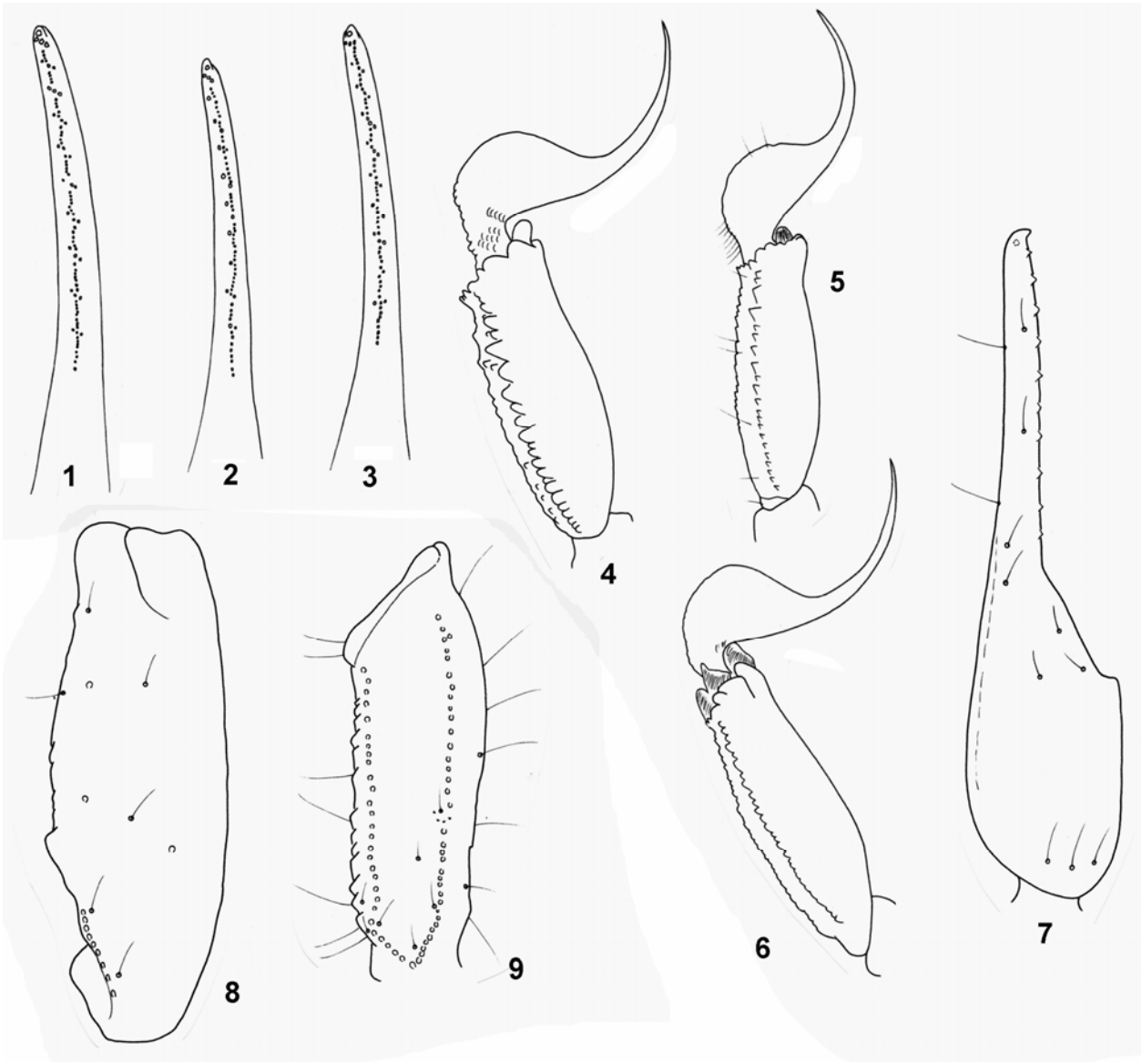

Fig. 1-3. Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **1.** *B. leptochelys*, syntype. **2.** Idem, syntype II, nec *B. spatzi* – sensu Kovařík (2005). **3.** *B. leptochelys algerianus* ssp. n., holotype. **Fig. 4-6.** Metasomal segment V and telson, lateral aspect. **4.** *B. leptochelys*, syntype. **5.** Idem, syntype II, nec *B. spatzi* – sensu Kovařík (2005). **6.** *B. leptochelys algerianus* ssp. n., holotype. **Fig. 7-9.** Trichobothrial pattern in *B. leptochelys algerianus* ssp. n., holotype. **7.** Chela, dorso-external aspect. **8-9.** Patella and Femur, dorsal aspect.

***Buthacus leptochelys algerianus* ssp. n.**
Figs. 3, 6-9.

TYPE MATERIAL: Algeria, Beni-Abbès, Algerian Sahara, IX/1966 (Cl. Junqua), 1 male holotype, 1 male and 2 female paratypes. Deposited in the Museum national d'Histoire naturelle, Paris. MNHN-RS-4496.

ETYMOLOGY: subspecific name refers to the country in which the new subspecies occurs.

DIAGNOSIS: Scorpions of small to moderate size with a total length of 43-44 mm in both sexes. General coloration yellowish without any spots. Pedipalps with 10 rows of granu-les on the fixed and movable fingers; external accessory granules reduced. Trichobothriotaxy A-β (beta) orthobo-thriotaxic. Latero-ventral carinae on metasomal segment V with spiniform granules but no lobes. Tibial spurs on legs III and IV moderate. Pectinal tooth count 28 to 31 in males, 22 to 24 in females.

DESCRIPTION based on male holotype and female paratype. Morphometric measurements in Table I.

Coloration. Generally yellowish to pale yellow without any spots or pigmented zones on the body and appendages. Prosoma: carapace yellowish; only the eyes surrounded by black pigment. Mesosoma: yellowish. Metasoma: all segments yellowish. Vesicle yellowish; aculeus yellowish at the base and reddish at its extremity. Venter yellowish; pectines pale yellow. Chelicerae yellowish; teeth reddish. Pedipalps: yellowish overall; the rows of granules on the dentate margins of the fingers reddish. Legs yellowish, paler than body.

Morphology. Prosoma: Anterior margin of carapace not emarginate, straight. Carapace carinae weak; anterior median carinae obsolete; central median, posterior median and central lateral carinae weak. All furrows weak to obsolete. Intercarinal spaces moderately to slightly granular. Median ocular tubercle slightly anterior to the centre of the cara-

pace; median eyes separated by one and a half ocular diameters. Five pairs of lateral eyes; the first three disposed in one line, the fourth and fifth situated behind eye three. Mesosoma: Tergites I-VI tricarinate; all carinae weak; lateral carinae vestigial on segments I-II; tergite VII pentacarinate, with lateral pairs of carinae strong; median carinae present on proximal one-half, moderately marked. Intercarinal spaces weakly granular. Sternites: all carinae absent from sternites III-VI; moderate to weak on VII. Pectines long; pectinal tooth count 28-29 in male holotype and 24-24 in female paratype. Metasoma: Segments I-II with 10 carinae; III-IV with 8 carinae. Ventral carinae weak on segments I-IV; dorsal and dorsolateral carinae with granules slightly spinoid on segments I and II. Segment V with 5 carinae; ventrolateral armed with spinoid granules; absence of lobes. Dorsal furrows of all segments weakly developed, smooth; intercarinal spaces slightly granular. Telson smooth. Aculeus long; subaculear tubercle absent. Chelicerae with two reduced but not fused denticles at the base of the movable finger (Vachon, 1963). Pedipalps: Trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β-beta configuration (Vachon, 1975). Femur pentacarinate; all carinae moderately crenulate. Patella and chela with vestigial carinae only, almost smooth. Dentate margins on fixed and movable fingers composed of 10 almost linear rows of granules; external accessory granules reduced. Legs: Ventral aspect of tarsi with numerous thin long setae. Tibial spurs moderate on legs III-IV. Pedal spurs moderate to strong on all legs.

RELATIONSHIPS: The new subspecies can be distinguished from *Buthacus leptochelys leptochelys* by the following characters: (i) smaller overall size, (ii) pectinal tooth counts in the new species show fewer teeth than in *B. leptochelys leptochelys*, (iii) external accessory granules on pedipalp fingers are reduced, (iv) a distinct geographic area of distribution.

Buthacus thebanus (Ehrenberg)
(= *Androctonus* (*Leiurus*) *thebanus* Ehrenberg, 1828).
Possible a senior synonym of *B. leptochelys* which has, however, won general acceptance (see Fet & Lowe, 2000; Kovařík, 2005).

Buthacus occidentalis Vachon
(= *Buthacus leptochelys occidentalis* Vachon, 1953).
Valid species. Population from Mauritania (Figs. 10-12, 43).

In a paper on the scorpions of Mauritania, Vachon (1953), described a new sub-species, *Buthacus leptochelys occidentalis*, but he did not indicate precise type specimens for it. He merely listed the material studied, from several localities in Mauritania: Fort Gouraud, Chinguetti, Akjoujt and Aïoun Lebgar. In his systematic remarks he also associa-ted with it some specimens from the south of Morocco (Tiznit and Draa), which he referred to as *B.l. occidentalis*, but with some hesitation. This material from South of Morocco is analysed in the section on *B. arenicola*. Among the specimens cited by Vachon (1953) for the description of *B. occidentalis*, I was able to locate in the collections of the Museum in Paris the adult male from Chinguetti illustrated by Vachon (1953 - figure 3; here Fig. 10). This specimen is designated as the lectotype, and a new diagnosis is proposed.

Mauritania, Chinguetti, III/1951 (P.L Dekeyser & A. Villiers). 1 male lectotype. Deposited in the Museum national d'Histoire naturelle, Paris. MNHN-RS-1676.
REVISED DIAGNOSIS: Scorpions of small to moderate size with a total length of 49 mm for males and 42 mm for females. General coloration yellowish to pale yellow without spots; female carapace with a single proximal inverted orange to reddish triangle (see Fig. 43). Pedipalps with 9 rows of granules on both the fixed and movable fingers; internal and external accessory granules of similar size. Trichobothriotaxy A-β (beta) orthobothriotaxic. Dorsal and laterodorsal carinae on metasomal segments I to IV without spiniform granules; latero-ventral carinae on segment V with spinoid granules but no lobes. Tibial spurs moderate on legs III and IV. Pectinal tooth count 27-26 for male lectotype; 25 to 27 in males and 19 to 22 in females.

Buthacus ehrenbergi Kovařík, from Mauritania, Chinguetti. One male holotype, in the author's collection.

The type specimen was not examined, but comparative analysis of several characters shared between *B. occidentalis* and *B. ehrenbergi*, based also on other new specimens of *B. occidentalis* recently collected in Mauritania, clearly shows that *B. ehrenbergi* is a junior synonym of *B. occidentalis*. New synonymy. The new species, described by Kovařík (2005), is distinguished only on the basis of the size of the tibial spurs, which are variable characters as already pointed out. Furthermore, both species came from the same locality in Mauritania.

Buthacus foleyi Vachon.
Valid species. Specimens from the high plateaux in the South of Algeria.

This species is not present in the Northern part of Algeria or Morocco. The citation of this species from Morocco by Kovařík (2005) is certainly based on misidentification. *B. foleyi* is an endemic element for the mountain formations of South Algeria and possibly Niger. This species will be the subject of more detailed consideration in a forthcoming paper on the genus *Buthacus* concerning species distributed in the Southern range of the Sahara and in the Sahel.

Buthacus ziegleri Lourenço.
Valid species. Specimen from the Central Atlas mountains in Morocco (for details, see Lourenço, 2000).

Buthacus mahraouii Lourenço.
Valid species. Specimen from the Atlas mountains in Morocco, near to the border with Algeria (Figs. 13-14).
Buthacus mahraouii was recently described from the Sahara region in Morocco, near to the border with Algeria. The type locality of the new species is not too far from Beni-Abbès in Algeria location where *B. leptochelys algerianus* ssp n. is also distributed.

In his recent publication, Kovařík (2005) again took an unjustified decision by proposing this species as a *nomen dubium*. This is not the first time this author has proceeded in this way. In a paper concerning the scorpions of Sudan I was obliged to reply to Kovařík's unfounded criticism of my work (Lourenço, 2005). It can only be assumed that Kovařík's reaction reflects a personal frustration at not getting recognition.

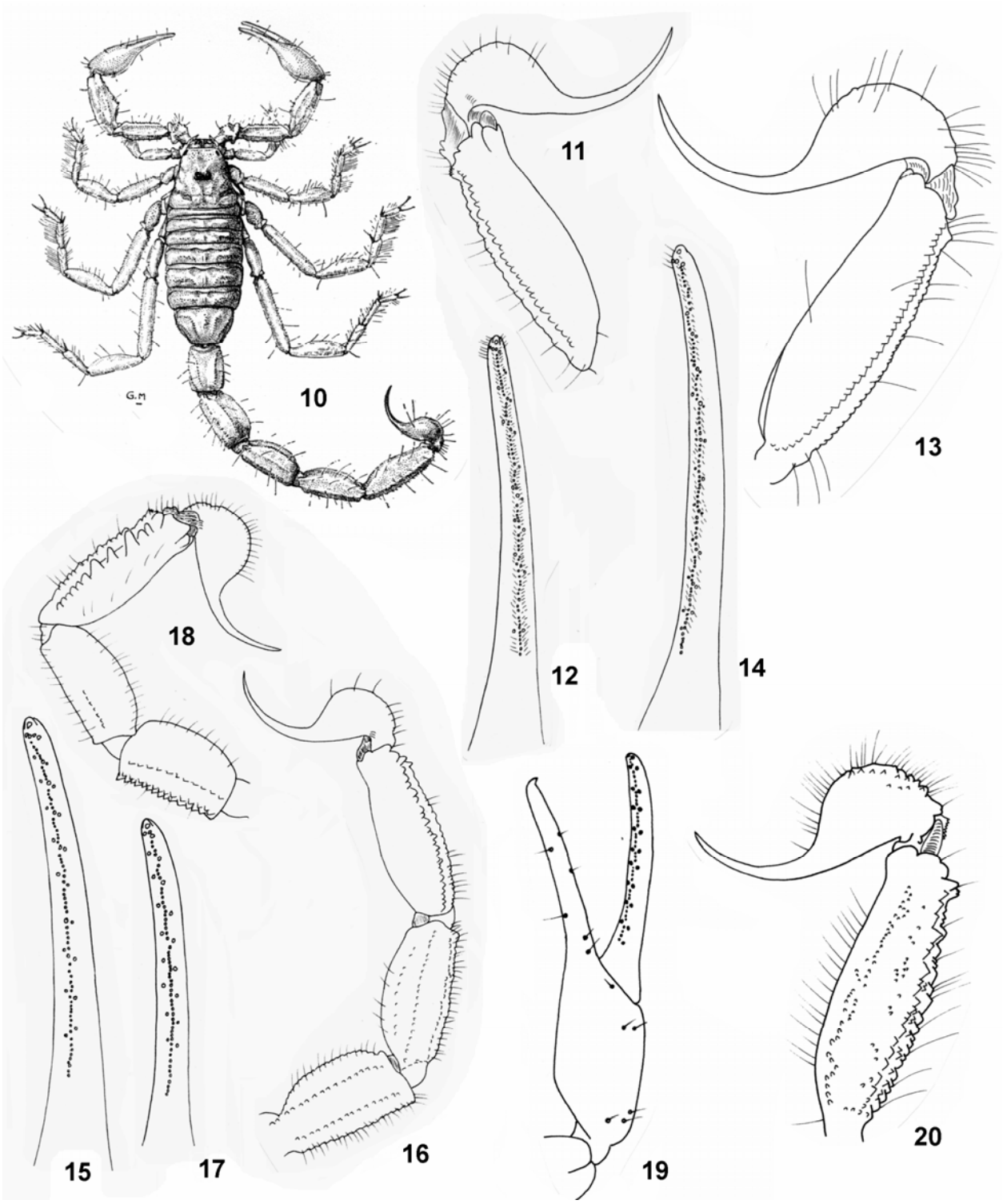

Fig. 10-20. 10-12. *Buthacus occidentalis*, male lectotype. **10.** Habitus. **11.** Metasomal segment V and telson, lateral aspect. **12.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **Fig. 13-14.** *Buthacus mahraouii*, male holotype. **13.** Metasomal segment V and telson, lateral aspect. **14.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **15-16.** *Buthacus macrocentrus*, female syntype. **15.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **16.** Metasomal segments III-V and telson, lateral aspect. **Fig.17-18.** Idem for *B. tadmorensis*, male from Palmyra. **Fig. 19-20.** Idem for *B. striffleri*, male holotype.

In his paper, he argued that *B. mahraouii* may be a synonym of *B. spatzi*. This, as will be explained below is a synonym for *B. arenicola*. Kovařík also argues that figure 3 in my original description (Lourenço, 2005) is incorrect. Due the variability observed in the structure of fixed and movable finger dentition, *B. mahraouii* shows very small external accessory granules which, possibly are not illustrated precisely in my figure 3. This point is corrected here in figure 14. Kovařík is very critical over details such as accessory granulation while, at the same time, proposing

'new species' without providing useful illustrations as, for example, in the case of *B. ehrenbergi*. More interesting is the fact that *B. mahraouii* has already been cited by Levy *et al.* (1973), on page 125 as follows: "Besides the above listed forms there still are in the collections of the Muséum National, Paris, several scorpions which have not yet been finally determined. Among others, probably four specimens are representing each a new and different form. These are from…..Algeria (Beni-Abbès, male with 36-37 denticles; RS-4496) belongs perhaps to group A.2."

Buthacus macrocentrus (Ehrenberg)
(= *Androctonus* (*Leiurus*) *macrocentrus* Ehrenberg, 1828).
Valid species. Specimens from Israel, Jordan, Siria (Figs. 15-16).

Examination of the original type material of *B. macrocentrus* led me to the conclusion that this species could be valid, and distinct from *B. leptochelys* as previously suggested by Kovařík (2005). Naturally, the very poor condition of preservation of Ehrenberg's types should call for prudence. In particular, freshly collected material from the original locality needs to be examined. Kovařík (2005) places in synonymy with *B. macrocentrus* at least three other species, *Buthacus tadmorensis* Simon, *Buthus pietschmanni* Penther and *Buthacus yotvatensis* Levy *et al*. He also suggested that *B. striffleri* Lourenço might also be a synonym of *B. macrocentrus*. These decisions are unjustified and made without examination of the types of the species concerned. The study of two specimens of *B. tadmorensis* (possibly from the type series of Simon) show that this species is valid and distinct from *B. leptochelys* and *B. macrocentrus* (see below). *B. strifferi* is only associated with *B. nigroaculeatus*, as already explained (Lourenço, 2004b) Finally the study of one paratype of *Buthacus yotvatensis* Levy *et al*., deposited in the Museum in Paris, attests to the possibility that this species may be a junior synonym of *B. macrocentrus*.

Buthacus nigroaculeatus (Levy, Amitai & Shulov, 1973).
Valid species. Specimens from Bahrain and Arabia (for details, see Lourenço, 2004b).

Buthacus striffleri Lourenço, 2004.
Valid species. Specimens from Afghanistan (for details, see Lourenço, 2004b) (Figs. 19-20).

Buthacus tadmorensis (Simon) (= *Buthus tadmorensis* Simon, 1892).
Valid species. Specimens from Syria and Israel (Figs. 17-18).

Buthacus tadmorensis was described by Simon (1892) from 'Palmyre' in Syria, and at the same time made reference to *Buthacus leptochelys* and *Buthacus arenicola*. Shortly after its description *B. tadmorensis* was placed in synonymy with *B. leptochelys* by Kraepelin (1895), an opinion supported by subsequent authors. This position was further confirmed by Levy *et al* (1973), who expressed their opinion as follows: "Having carefully examined Simon's collection from the whole Syrian region of that period, it should be noted that specimens belonging to *B. leptochelys* only have been found. Consequently, and basing also on its description, it seems that *tadmorensis* should be considered synonymous to *leptochelys*." Examination of two specimens of *B. tadmorensis* from Palmyra in the collections of the Museum in Paris (and possibly part of the type material of Simon), shows clear morphological differences from *B. leptochelys*. In particular, the very developed ventral carinae of metasomal segments II and III are noticeable. This feature was previously cited by Simon (1892), who associated this species with *Odontobuthus doriae* (Thorell) as follows: "segmentis caudae 2° et 3° carinis inferioribus apicem versus sensim validioribus et dente apicali reliquis majoribus (minus quam in *B. Doriae* Thorell)". In conclusion, *B. tadmorensis* is a valid species, not related to *B. macrocentrus* as affirmed by Kovařík (2005). Furthermore, analysis of the morphological characteristics of the species of *Buthacus* distributed in Sinai, Israel and Syria, indicates only that *Buthacus leptochelys nitzani* Levy, Amitai & Shulov, 1973, with a population in Israel, could be a junior synonym of *B. tadmorensis*.

2. FORMS ASSOCIATED TO AN "*ARENICOLA* GROUP"

Buthacus arenicola (Simon)
(= *Buthus arenicola* Simon, 1885)

HISTORICAL ACCOUNT

Buthacus arenicola, described by Simon (1885) as *Buthus arenicola*, was based on specimens collected in Gabès (Séd) and Tozzer (V. May) in Tunisia. Simon (1885) commented that this species could also be found in Algeria (Bou-Sadaa, Biskra and Debila) and in Lower Egypt (Ramleh and Port-Saïd). It is, however, uncertain whether the specimens from Egypt really belonged to *B. arenicola*. Shortly after the description by Simon (1885), the species was considered by Pocock (1895) and Kraepelin (1899) to be a synonym of *B. leptochelys*, an opinion also confirmed by Simon (1910). Birula (1908) regarded only the specimens cited by Simon (1885) from Egypt to be synonyms of *B. leptochelys*. Shortly afterwards, he described a new species, *Buthacus spatzi*, from Tunisia (Birula, 1911). At the time of his 1911 description, Birula knew Simon's opinion of 1910. However, he only compared *B. spatzi* and *B. leptochelys* with precision. Moreover, in 1914, Birula placed the *Buthacus* from Algeria in a distinct subspecies, *B. leptochelys arenicola*. *Buthacus arenicola* was revalidated as a species by Vachon (1949, 1952), but this author faced several difficulties in correctly identifing *B. arenicola* and *B. spatzi*, which he considered to be different subspecies. These difficulties arose mainly because the type species of *B. spatzi* was unknown to Vachon when he studied the genus *Buthacus*. Consequently, *B. spatzi*, was arbitrarily defined as being one of the two populations of *Buthacus* that are to be found in Tunisia and the North of Algeria. *B. arenicola* was defined as, "a slender form with males having slender hands", and with a number of pectinal teeth no greater than 30. In comparison, *B. spatzi* was defined as "a broad form with males having broad hands", and with a number of pectinal teeth reaching 35. This artificial dichotomy was largely resurrected by Levy *et al*. (1973), Levy and Amitai (1980), and subsequent authors. Levy and Amitai (1980), even suggested that populations of *B. spatzi* from Tunisia and Algeria might represented two distinct subspecies.

Table I. Morphometric values (in mm) of the male lectotype and female of *B. arenicola arenicola* and of the species and subspecies described in the note.

	B. leptochelys algerianus ssp. n.		*B. arenicola arenicola*		*B. a. maroccanus* ssp. n.		*B. birulai sp. n.*	
	♂ holotype	♀paratype	♂ lectotype	♀	♂ holotype	♀paratype	♂ holotype	♀paratype
Total length	43.4	43.9	51.8	54.7	40.4	42.3	56.8	62.1
Carapace:								
- length	5.1	5.2	6.3	6.3	5.1	5.0	6.9	7.9
- anterior width	3.2	3.2	3.9	4.1	3.2	3.2	4.3	4.8
- posterior width	5.4	5.7	7.4	7.4	5.5	5.2	7.8	9.7
Metasomal segment I:								
- length	4.1	4.3	5.4	5.4	3.8	3.8	5.7	6.2
- width	3.1	3.2	3.8	3.7	3.1	2.8	4.5	5.3
Metasomal segment V:								
- length	6.3	6.2	7.9	8.3	6.1	5.9	8.3	8.8
- width	2.2	2.3	2.8	2.7	2.3	2.2	3.3	3.6
- depth	2.0	2.1	2.5	2.6	2.1	2.0	2.9	3.4
Vesicle:								
- width	1.7	1.7	2.1	2.1	1.7	1.6	2.4	2.8
- depth	1.6	1.7	2.2	2.2	1.7	1.6	2.4	2.7
Pedipalp:								
- Femur length	4.8	4.3	5.4	5.3	4.4	3.9	5.9	6.2
- Femur width	1.3	1.3	1.8	1.7	1.3	1.3	2.0	2.2
- Patella length	5.6	5.4	6.5	6.3	5.3	5.0	7.2	7.9
- Patella width	1.9	1.8	2.3	2.2	1.8	1.6	2.6	2.9
- Chela length	8.1	7.6	9.3	8.7	8.3	7.0	10.2	10.7
- Chela width	2.2	1.3	2.1	1.8	2.0	1.3	2.2	2.1
- Chela depth	2.2	1.4	2.2	1.8	2.2	1.4	2.4	2.3
Movable finger:								
- length	4.7	5.2	6.0	6.0	4.9	4.6	6.8	7.4

Several years after the conclusion of his studies Vachon was able to visit the collections of the Museum of Leningrad (now St. Petersburg), and could finally examine the types of Birula, including the type of *B. spatzi*. A male specimen, labelled: 1m (ZIN-1354 (1389)), from Tunisia, Sahara dunes, 03.1898, P. Spatz leg. A slender form with slender hands, and a number of pectinal teeth of 30-30. The characteristics of this species showed it to be identical with *B. arenicola*, and Vachon (in litt), confirmed this to me during the 1980s. He never, however, published any note about the synonymy. Even if access to the type of *B. spatzi* remains problematic, the description of Birula (1911) is clear enough to confirm these characters. Moreover, I also received the same information from Alexander Gromov, who kindly examined the type specimen of *B. spatzi* for me in the Museum of Zoological Institute, St. Petersburg, Russia.

The types of *B. arenicola*, have long been thought to have been misplaced in the collections of the Paris Museum (Vachon, 1952). During this study, I was able to locate two specimens corresponding to those used by Simon (1885) for the description of *B. arenicola*. One was a adult male from Tozzer (V. May), and the second a female from Biskra. The rediscovery of Simon's mislaid types in the collections of the Museum, it is not unusual since this author had the habit of placing types with other specimens of the same species (Lourenço, 1982). Although these specimens are poorly preserved, they allow the synonymy of *B. arenicola* and *B. spatzi* to be confirmed: *Buthacus spatzi* (Birula) (= *Buthus* (*Buthacus*) *spatzi* Birula, 1911). Specimen from Tunisia. Junior synonym of *B. arenicola*. New synonymy.

Buthacus arenicola is thus a valid species, distributed in Tunisia, the North of Algeria and the West of Libya. Specimens from Sinai may well represent a distinct subspecies. A revised diagnosis is therefore proposed based on the male type, herewith designated lectotype. A distinct subspecies from Morocco is also described here.

A final question can be addressed: to what species do the "broad forms" (with males having broad hands, and with a number of pectinal teeth reaching 35) correspond? The study of several specimens corresponding with this description, collected in Tunisia and North Algeria, reveals that we have a species which has never been described. This has led to several cases of misidentifications. This new species, *Buthacus birulai* sp. n. is described below.

REVISED DIAGNOSIS OF *BUTHACUS ARENICOLA*

Figs. 21-30.

Tunisia, Tozzer (now Tozeur) (V. May) 1 male lectotype. Algeria, Biskra, 1 female. Deposited in the Muséum national d'Histoire naturelle, Paris. MNHN-RS-1672.

REVISED DIAGNOSIS: Scorpion of moderate size with a total length of 52 mm for males and 55 mm for females. General coloration yellowish to slightly reddish-yellow without any spots. Pedipalps with 8-9 rows of granules on the fixed and movable fingers; external accessory granules absent, or represented by 2-3 small basal granules. Trichobothriotaxy A-β (beta) orthobothriotaxic. Dorsal carinae on metasomal segments I to III with weak spiniform granules; latero-ventral carinae on segment V with spiniform granules and 3 to 4 lobes. Tibial spurs moderate on legs III and IV. Pectinal tooth count, observed in 84 males and 114 females from Central and South Tunisia (RS-2912, 2914, 2843), showed the following numbers: Males 27 to 31, mode 29/30. Females 21 to 25, mode 23. Morphometric measurements for male lectotype in Table I.

***Buthacus arenicola maroccanus* ssp. n.**

Figs. 31-32.

TYPE MATERIAL: Marocco, Vallée du Draa, North of Tagounite, Zagora, 10/X/1970 (J. Delacourt), 1 male holotype and 2 female paratypes. Deposited in the Museum national d'Histoire naturelle, Paris. MNHN-RS-5471.

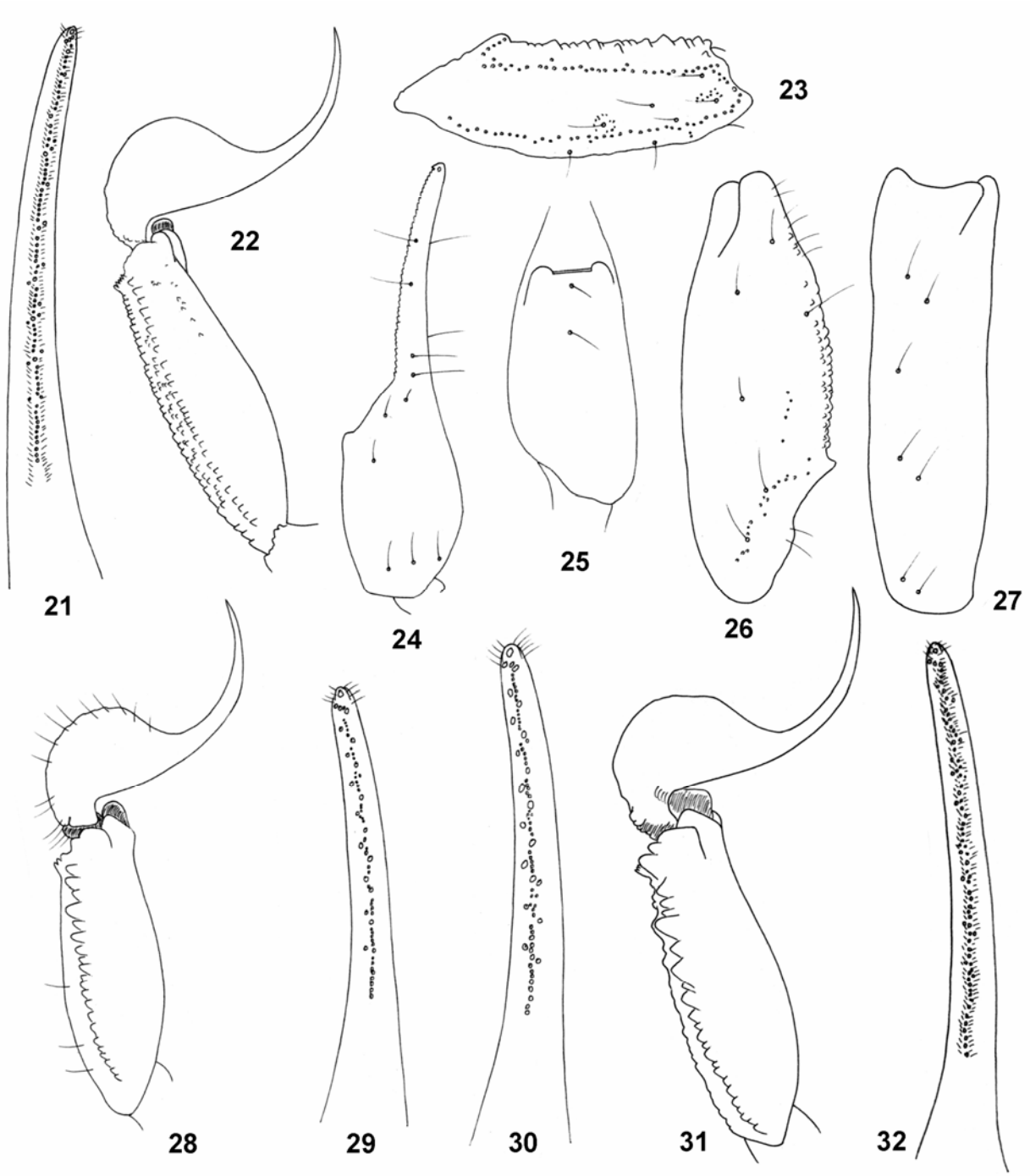

Fig. 21-32: 21-27. *Buthacus arenicola*, male lectotype. **21.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **22.** Metasomal segment V and telson, lateral aspect. **23-27.** Trichobothrial pattern. **23.** Femur, dorsal aspect. **24-25.** Chela, dorso-external and ventral aspects. **26-27.** Patella, dorsal and external aspects. **28-30.** *Buthacus arenicola* from South of Tunisia. **28.** Metasomal segment V and telson, lateral aspect (female). **29-30.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger (male and female). **31-32.** *Buthacus arenicola maroccanus* ssp. n. **31.** Metasomal segment V and telson, lateral aspect (female paratype). **32.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger (male holotype).

ETYMOLOGY: the subspecific name makes reference to the country where the new subspecies occurs.

DIAGNOSIS: Scorpions of small to moderate size with a total length of 40 mm for males and 42 mm for females. General coloration yellowish without spots. Pedipalps with 9 rows of granules on the fixed and movable fingers; external accessory granules absent or represented by very small basal granules; all the granulation is masked by a strong setation. Trichobothriotaxy A-β (beta) orthobothriotaxic. Dorsal carinae on metasomal segments I and II with some small spiniform granules; latero-ventral carinae on segment V with spinoid granules and 2/3 weakly marked lobes. Tibial spurs moderate to weak on legs III and IV. Pectinal tooth count, male 29, females 22 to 24.

DESCRIPTION based on male holotype and female paratype. Morphometric measurements in Table I.

Coloration. Generally yellowish to pale yellow without any spots or pigmented zones on the body and appendages. Prosoma: carapace yellowish; only the eyes surrounded by black pigment. Mesosoma: yellowish. Metasoma: all segments yellowish. Vesicle yellowish; aculeus yellowish at the base and reddish at its extremity. Venter yellowish; pectines pale yellow. Chelicerae yellowish; teeth reddish. Pedipalps: yellowish overall; rows of granules on the dentate margins of the fingers reddish. Legs yellowish, paler than body.
Morphology. Prosoma: Anterior margin of carapace not emarginate, straight. Carapace carinae weakly developed; anterior median carinae obsolete; central median, posterior median and central lateral carinae weak. All furrows weak to obsolete. Intercarinal spaces moderately to slightly granular. Median ocular tubercle slightly anterior to the centre of the carapace; median eyes separated by more than one and a half ocular diameters. Five pairs of lateral eyes; the first three disposed in one line, the fourth and fifth situated behind eye three. Mesosoma: Tergites I-VI tricarinate; all carinae very weak; lateral carinae vestigial on segment I; tergite VII pentacarinate, with lateral pairs of carinae moderate; median carinae present on proximal one-half, moderately marked. Intercarinal spaces moderately to slightly granular. Sternites: carinae absent from sternites III-VI; moderate to weak on VII. Pectines long; pectinal tooth count 29-29 in male holotype and 24-24 in female paratype. Metasoma: Segment I with 10 carinae; II-IV with 8 carinae (female segment II with 10 carinae). Ventral carinae weak on segments I-IV; dorsal carinae with weak spinoid granules on segments I and II. Segment V with 5 carinae; ventrolateral armed with spinoid granules, and some weak lobes. Dorsal furrows in all segments weakly developed, smooth; intercarinal spaces only slightly granular. Telson smooth. Aculeus long; subaculear tubercle absent. Chelicerae with two very reduced but not fused denticles at the base of the movable finger (Vachon, 1963). Pedipalps: Trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β-beta configuration (Vachon, 1975). Femur pentacarinate; all carinae moderately crenulate. Patella and chela with vestigial carinae only, smooth. Dentate margins on fixed and movable fingers composed of 9 almost linear rows of granules; external accessory granules either absent or represented by very small basal granules; all this granulation is masked by strong setation. Legs: Ventral aspect of tarsi with numerous long thin setae. Tibial spurs moderate to weak on legs III-IV. Pedal spurs moderate on all legs.

RELATIONSHIPS: The new subspecies can be distinguished from *B. arenicola arenicola* by the following characters: (i) smaller size, (ii) more intense setation on pedipalp fingers, (iii) the lobes on latero-ventral carinae of metasomal segment V less conspicuous, (iv) a distinct geographical area of distribution.

***Buthacus birulai* new species**
Figs. 33-41. nec: *Birulatus spatzi*: several cases of misidentification by different authors.

TYPE MATERIAL: Algeria, El Oued, 1949. 1 male holotype, 2 males and 1 female paratype. Deposited in the Museum national d'Histoire naturelle, Paris. MNHN-RS-1626.

ETYMOLOGY: Patronym in honour of Russian scorpiologist A. Birula, who described the genus *Buthacus*.

DIAGNOSIS: Scorpions of moderate to large size with a total length of 57 mm in males and 62 mm in females. General coloration yellowish to pale yellow without spots. Pedipalps with 9-10 rows of granules on the fixed and movable fingers; external accessory granules absent; setation slightly marked. Trichobothriotaxy A-β (beta) orthobothriotaxic. Dorsal and latero-dorsal carinae on metasomal segments I and II with spiniform granules; latero-ventral carinae on segment V with weak spinoid granules and no lobes. Tibial spurs moderate to weak on legs III and IV. Pectinal tooth count 32 to 35 in males and 29 in female.

DESCRIPTION based on male holotype and female paratype. Morphometric measurements in Table I.
Coloration. Generally yellowish to pale yellow without any spots or pigmented zones on the body and its appendages. Prosoma: carapace yellowish; only the eyes surrounded by black pigment. Mesosoma: yellowish. Metasoma: all segments yellowish. Vesicle yellowish to reddish-yellow; aculeus yellowish at the base and reddish at its extremity. Venter pale yellow. Chelicerae yellowish; teeth reddish. Pedipalps: yellowish overall; rows of granules on the dentate margins of the fingers reddish. Legs yellowish, paler than body.
Morphology. Prosoma: Anterior margin of carapace not emarginate, straigth. Carapace carinae weakly developed; anterior median carinae obsolete; central median, posterior median and central lateral carinae weak. All furrows weak to obsolete. Intercarinal spaces moderately to slightly granular. Median ocular tubercle slightly anterior to the centre of the carapace; median eyes separated by more than one and a half ocular diameters. Five pairs of lateral eyes; the first three disposed in one line, the fourth and fifth situated behind eye three. Mesosoma: Tergites I-VI tricarinate; all carinae very weak; lateral carinae vestigial on segments I-II; tergite VII pentacarinate, with lateral pairs of carinae strong and with some spinoid granules; median carinae present on proximal half, moderately marked. Intercarinal spaces moderately to slightly granular. Sternites: all carinae absent from sternites III-VI; moderate to weak on VII. Pectines very long; pectinal tooth count 35-35 for male holotype and 29-29 for female paratype. Metasoma: Segments I-II with 10 carinae; III-IV with 8 carinae. Ventral carinae weakly marked on segment I; moderate on segments II-IV; dorsal and dorsolateral carinae with spinoid granules on segments I and II. Segment V with 5 carinae; ventrolateral armed with weak spinoid granules; no lobes; anal arc inconspicuous. Dorsal furrows of all segments weakly developed, smooth; intercarinal spaces weakly granular. Telson smooth. Aculeus very long; subaculear tubercle absent. Chelicerae with two reduced but not fused denticles at the base of the ventral aspect of the movable finger (Vachon, 1963). Pedipalps: Trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β-beta configuration (Vachon, 1975). Femur pentacarinate; all carinae moderately crenulate. Patella with seven almost vestigial carinae; ventral and external absent in female; chela with vestigial carinae only, smooth. Dentate margins on fixed and mova-ble fingers composed of 9-10 almost linear rows of gra nules; external accessory granules absent;

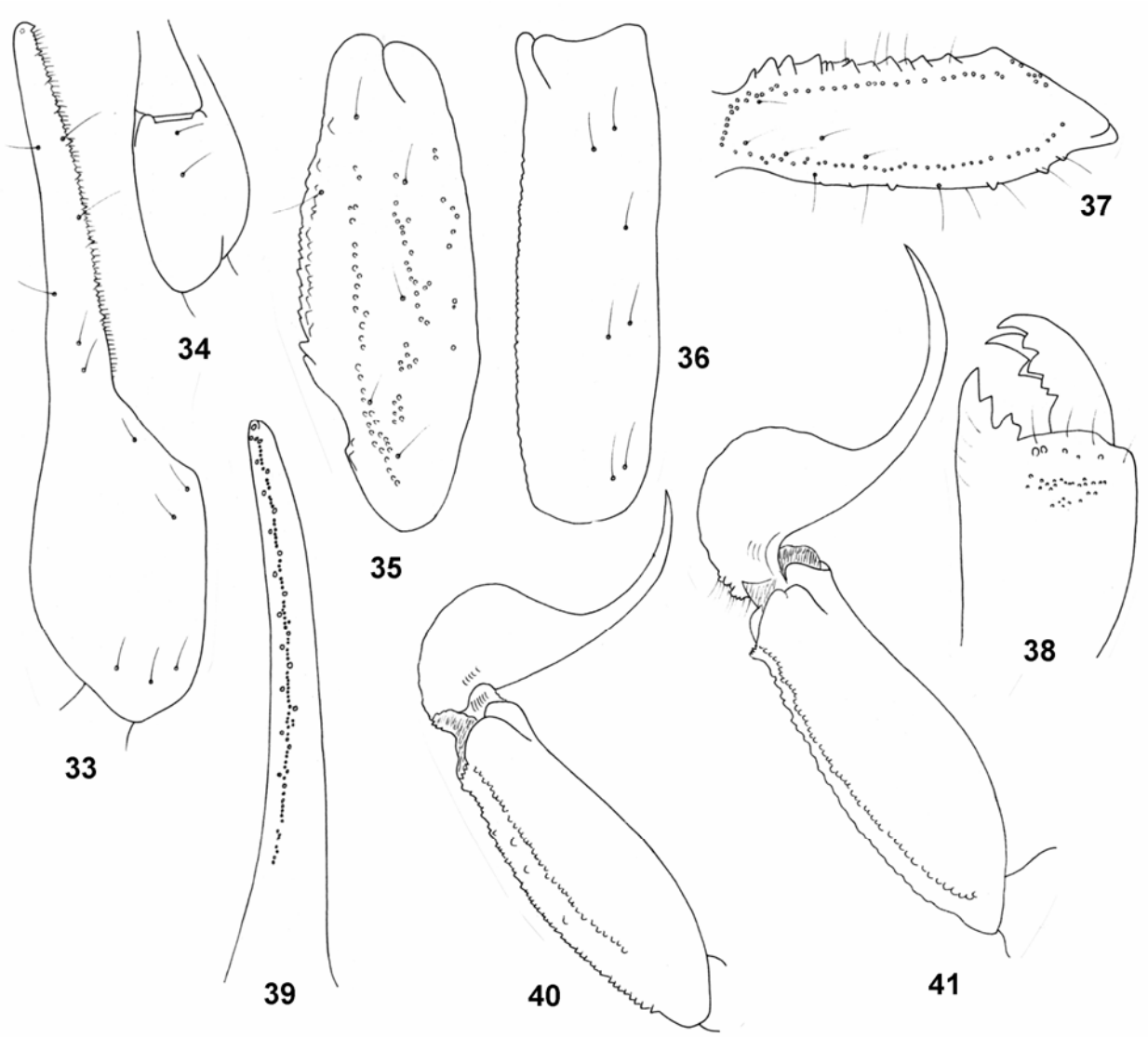

Fig. 33-40. *Buthacus birulai* sp. n., male holotype. **33-37.** Trichobothrial pattern. **33-34.** Chela dorso-external and ventral aspects. **35-36.** Patella, dorsal and external aspects. **37.** Femur, dorsal aspect. **38.** Chelicera. **39.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **40.** Metasomal segment V and telson, lateral aspect. **41.** Idem, female paratype.

setation reduced. Legs: Ventral aspect of tarsi with numerous long thin setae. Tibial spurs moderate to weak on legs III-IV. Pedal spurs present, moderate to strong on all legs.

RELATIONSHIPS: Within the genus *Buthacus*, the new species is allied to *Buthacus arenicola*. It can, however, be distinguished from this by the following characters: (i) larger overall size, (ii) pectinal tooth counts of the new species show more teeth than are found in *B. arenicola*: 32 to 35 against 29 to 31 in males, and 29 against 21 to 25 for females, (iii) latero-ventral carinae on metasomal segment V with only weak spinoid granules and no lobes.

Acknowledgements

I am very grateful to Dr. Jason Dunlop, Museum für naturkunde, Berlin, for the loan of the type material of *Buthacus* described by Ehrenberg, to Alexander Gromov for informations on the type specimen of *Buthacus spatzi*, and to Prof. John L. Cloudsley-Thompson, London, for reviewing the manuscript.

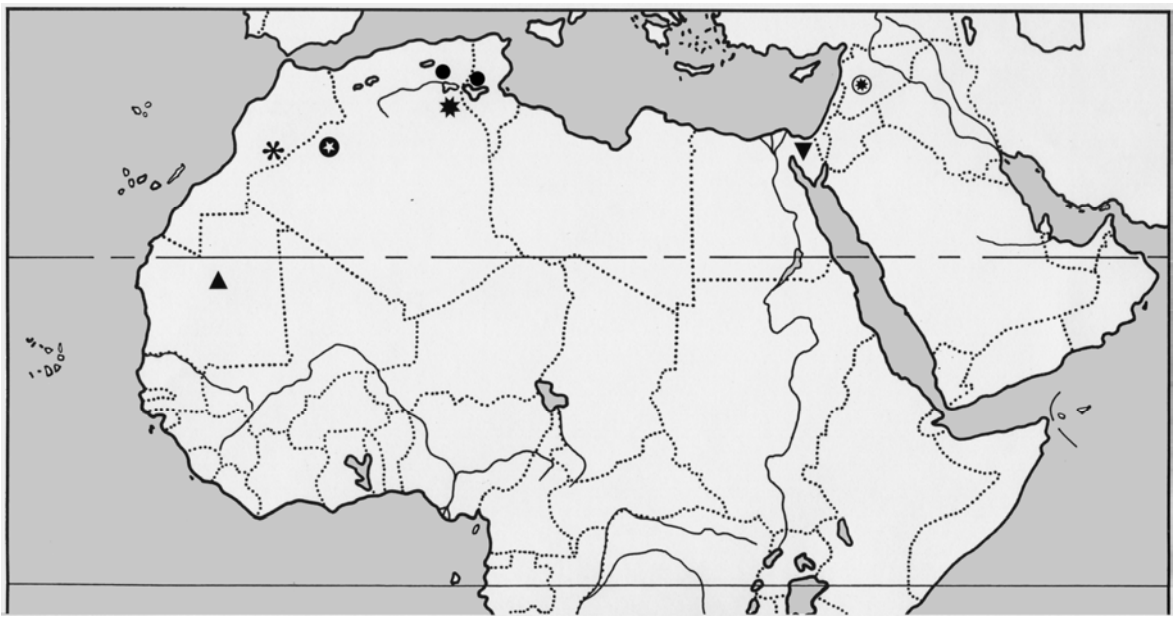

Fig. 42. Map of North Africa and Middle East with the type localities of the new species and subspecies described and, the sites of some species discussed in this publication. *B. leptochelys algerianus* ssp. n. (k black circle with white star). *B. arenicola maroccanus* ssp. n. (~black flower). *B. birulai* (y black star). *B. occidentalis* (• black triangle = Chinguetti). *B. arenicola arenicola* (●black circles = Tozeur and Biskra). *B. leptochelys leptochelys* (inverted black triangle = Sinai). *B. tadmorensis* (circle with black star = Palmyra).

Fig. 43. *Buthacus occidentalis*. Female from Chinguetti-Atar in its natural habitat (photo P. Geniez).
[See page 75 for color figure]

References

BIRULA, A. A. 1908. Ergebnisse der mit Subvention aus der Erbschaft Treitl unternommenen zoologischen Forschungsreise Dr. F. Werner's nach dem Anglo-Aegyptischen Sudan und Nord-Uganda. XIV. Skorpiones und Solifugae. *Sitzungsberichte der kaiserlich-königlichen Akademie der Wissenchaften*, Wien, **117**(1): 121-152.

BIRULA, A. A. 1911. Skorpiologische Beiträge. 9. *Buthus (Buthacus) spatzi* sp. n. *Zoologisher Anzeiger*, **37**(6-7): 137-142.

BIRULA, A. A. 1914. Ergebnisse einer von Prof. Franz Werner im Sommer 1910 mit Unterstützung aus dem Legate Wedl ausgefuhrten zoologischen Forschungrsreise nach Algérien. VI. Skorpione und Solifugen. *Sitzungsberichte der kaiserlich-königlichen Akademie der Wissenchaften*, *Wien*, **123**(1): 633-688.

FET, V. & G. LOWE 2000. Family Buthidae C. L. Koch, 1837. Pp. 54-286. *In*: FET, V., W.D. SISSOM, G. LOWE & M.E. BRAUNWALDER (eds.). Catalog of the Scorpions of the world (1758-1998). *New York, NY: The New York Entomological Society*.

KOVAŘÍK, F. 2005. Taxonomic position of species of the genus *Buthacus* Birula, 1908 described by Ehrenberg and Lourenço, and description of a new species (Scorpiones: Buthidae). *Euscorpius*, **28**: 1-13.

KRAEPELIN, K. 1895. Nachtrag zu Theil I der Revision der Scorpione. *Beiheft zum Jahrbuch der Hamburgischen wissenschaftlichen Anstalten*, **12**: 73-96.

KRAEPELIN, K. 1899. Scorpiones und Pedipalpi. In: F. Dahl (Ed.). *Das Tierreich*. Herausgegeben von der Deutschen zoologischen Gesellschaft. Berlin, R. Friedländer und Sohn Verlag, 8 (Arachnoidea): 1-265.

LEVY, G. & P. AMITAI 1980. *Fauna Palaestina. Arachnida I. Scorpiones*. The Israel Academy of Sciences and Humanities, Jerusalem, 130 pp.

LEVY, G., P. AMITAI & A. SHULOV 1973. New scorpions from Israel, Jordan and Arabia. *Zoological Journal of the Linnean Society*, **52** (2): 113-140.

LOURENÇO, W. R. 1982. Redécouverte de l'holotype d'*Opisthacanthus africanus* Simon 1876 (Scorpiones, Scorpionidae). *Revue Arachnologique*, **3**(4): 147-153.

LOURENÇO, W. R. 2000. A new species of *Buthacus* Birula from Morocco (Arachnida: Scorpiones: Buthidae). *Faunistische Abhandlungen Staatliches Museum für Tierkunde* Dresden, **22** (1): 5-9.

LOURENÇO, W. R. 2001. Further taxonomic considerations on the Northwestern African species of *Buthacus* Birula (Scorpiones, Buthidae), and description of two new species. *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg*, **12**(158): 309-316.

LOURENÇO, W. R. 2004a. New considerations on the Northwestern African species of *Buthacus* Birula (Scorpiones, Buthidae, and description of a new species. *Revista Ibérica de Aracnología*, **10**: 225-231.

LOURENÇO, W. R. 2004b. Description of a new species of *Buthacus* Birula (Scorpiones, Buthidae) from Afghanistan. *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg* **14** (170): 205-210.

LOURENÇO, W. R. 2005. Description of three new species of scorpion from Sudan (Scorpiones, Buthidae). *Boletin de la Sociedad Entomológica Aragonesa*, **36**: 21-28.

POCOCK, R. I. 1895. On the Arachnida and Myriopoda obtained by Dr. Anderson's collector during Mr T. Brent's expedition to the Hadramaut, South Arabia, with a supplement upon the scorpions obtained by Dr. Anderson in Egypt and the Eastern Soudan. *Journal of the Linnean Society*, **25**: 292-316.

SIMON, E. 1885. Etude sur les Arachnides recueillis en Tunisie en 1883 et 1884 par MM. A. Letourneux, M. Sédillot et Valéry Mayet, membres de la Mission de l'Exploration scientifique de la Tunisie. *In*: *Exploration scientifique de la Tunisie*. Imprimerie Nationale, Paris, 59 pp.

SIMON, E. 1892. Liste des Arachnides recueillis en Syrie par M. le Dr Théod. Barrois. *Revue biologique du nord de la France*, **5** (2): 80-84.

SIMON, E. 1910. Révision des Scorpions d'Egypte. *Bulletin de la Société entomologique d'Egypte*, Le Caire: 57-87.

VACHON, M. 1949. Etudes sur les Scorpions. III (suite). Description des Scorpions du Nord de l'Afrique. *Archives de l'Institut Pasteur d'Algérie*, **27** (1): 66-100.

VACHON, M. 1952. *Etudes sur les Scorpions*. Institut Pasteur d'Algérie: 482 p. Alger.

VACHON, M. 1953. Contribution à l'étude du peuplement de la Mauritanie. Scorpions. *Bulletin de l'Institut Français d'Afrique Noire*, **15** (3): 1012-1028. Dakar.

VACHON, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, *Paris* 2è sér., **35** (2): 161-166.

VACHON, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, *Paris*, 3è sér., n° **140**, Zool. 104: 857-958.

VACHON, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus de l'Académie des Sciences*, *Paris*, sér. D, **281**: 1597-1599.