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Contents

Scorpiones

Solifugae

Opiliones

Araneae

Volume 13 (2012-2013)
Back issues: Vol. 1 (1987-1990), Vol. 2 (1990-1992), Vol. 3 (1992-1993), Vol. 4 (1994-1996),
Vol. 5 (1996-1997), Vol. 6 (1998-2000), Vol. 7 (2000-2001), Vol. 8 (2002-2003),
Vol. 9 (2004-2005), Vol. 10 (2006-2007), Vol. 11 (2008-2009), Vol. 12 (2010-2011).
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At the end of the current issue, pp. 191-199, a numerical summary of the 12 volumes of Serket; parts, pages, papers, authors and their countries, and new taxa.

The continuity of Serket depends on the efforts of arachnologists in Egypt, the Middle East, and the whole world. Serket will be hopefully better after the current issue.

All the best for arachnology and arachnologists.

The Editor

Serket (2012) vol. 13(1/2): 1-7.

About the enigmatic presence of the genus Scorpio Linnaeus, 1758 in Congo with the description of a new species from Niger (Scorpiones, Scorpionidae)

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Abstract

For almost a century, Scorpio maurus L., 1758 (Scorpiones, Scorpionidae) has been considered to be no more than a widespread and presumably highly polymorphic species. Recent investigation of the ancient classifications by Birula (1910) and Vachon (1952) have led to the consideration of several African populations at the rank of species. Two new species have also been described from Cameroon (Lourenço, 2009) and Sudan Lourenço & Cloudsley-Thompson, 2009), countries not previously recorded as containing members of the genus Scorpio. In the present paper, the enigmatic presence of the genus Scorpio in Congo has been tentatively clarified, and this record is attributed to mislabelling. A new species is also described from Niger. It is the first confirmed record of a species of Scorpio from that country.

Keywords: Scorpion, Scorpio, Scorpionidae, Congo, new species, Niger.

Introduction

In a recent publication, Lourenço (2009) reinvestigated the taxonomic position of several species of the genus Scorpio. Analysis of a number of characters, already defined by Vachon (1952), confirmed that these are valid for the precise definition of true species. Using this approach, eight forms or subspecies were raised to the rank of species, although subsequent adjustments may prove to be necessary yet. In this same publication, a new species, S. savanicola Lourenço, 2009, was described from Cameroon. This was the second Scorpio species, together with S. occidentalis Werner, 1936 from Senegal, to be reported from beyond the Saharan region. Shortly afterwards, another new species, Scorpio sudanensis Lourenço & Cloudsley-Thompson, 2009, was described from Sudan (Lourenço & Cloudsley-Thompson, 2009). In both cases, these records from Cameroon and Sudan proved to be the first to be confirmed for these countries.

Another interesting point concerning the genus Scorpio was its supposed presence in Congo. Vachon (1952) refers to a paper by Pallary (1938) in which this last author indicated a Scorpio (Heterometrus maurus L.) in the 'Moyen Congo'. The possible presence of a Scorpio in Congo was rejected by Vachon (1952), who consider it to be doubtful. In the Catalog of the Scorpions of the World (Fet, 2000), the genus Scorpio is recorded for Congo, but with an interrogation. Although, the initial position by Vachon (1952) was to reject any possible presence of Scorpio in Congo, one specimen was located in the collections of the Muséum national d'Histoire naturelle in Paris, labelled by himself as from the 'Moyen Congo'. Naturally, this specimen drew attention to, and invited further investigation. The conclusions are as follows: 1. The indication of 'Moyen Congo' in a label written by Vachon himself is most certainly the result of some mislabelling. Another label, even older, found in the same jar indicates 'Bassin du Moyen Niger', region of Gono (in Niger). This specimen was in fact collected in Niger, somewhere in the region of Gono. 2. The initial opinion of Vachon (1952), about the absence of any Scorpio species from Congo seems to be correct. The specimen cited by Pallary (1938) may, in our opinion, be a juvenile specimen of Pandinus Thorell. Although Pallary (1938) actually described a number of new species, he was not very precise in the assignment of the species to their correct genera. 3. After a careful study of the Scorpio specimen from Niger, we concluded that it belongs to a new species, described here. This is the third Scorpio species to be reported from beyond the Saharan region of Africa (Sahel), and is the first record of the genus Scorpio in Niger.

Methods

Illustrations and measurements were made with the aid of a Wild M5 stereo-microscope with a drawing tube (camera lucida) and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Taxonomic treatment

Family Scorpionidae Latreille, 1802
Genus Scorpio Linnaeus, 1758

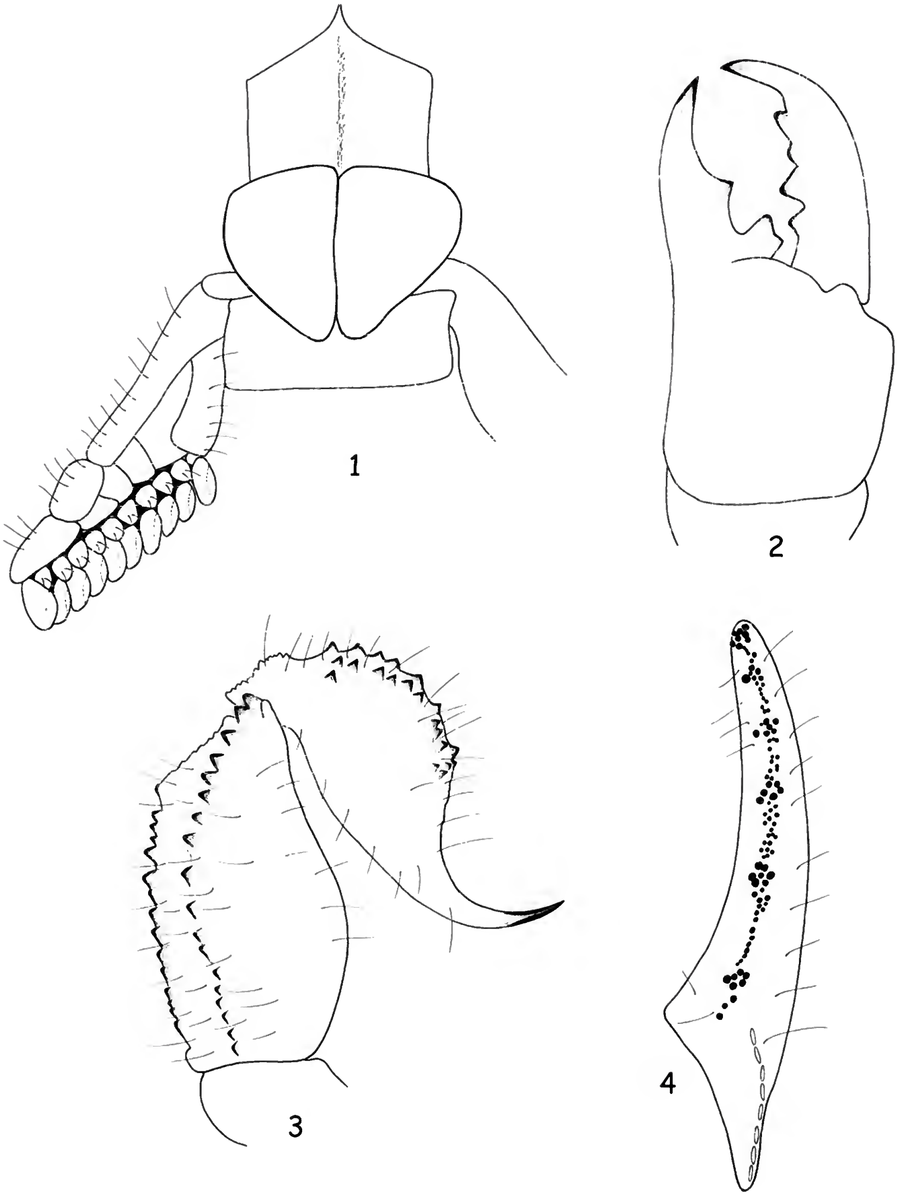
Scorpio niger sp. n. (Figs. 1-11)

Type material: 1 female holotype Niger, Bassin du Moyen Niger, region of Gono, 6/VI/1909 (R. Chudeau). Deposited in the Muséum national d'Histoire naturelle, Paris, RS-7045 (S-11).

Etymology: The specific name is placed in apposition to the generic name and refers to the country in which the new species was found.

The indication 'Moyen Congo' is definitely the result of mislabelling.

Diagnosis: Scorpion of moderate size with respect to the genus. Female reaching 40.9 (45.6) mm in total length. Coloration, basically light yellow to reddish-yellow, without any dusty markings. Pedipalps, especially the chela, almost acarinate; dorsal and dorso-external carinae vestigial. Chela manus with weakly marked granules on dorso-external aspect. Telson globular and strongly granulated, with spinoid granules ventrally. Pectines moderately narrowed with 10-10 teeth. Trichobothriotaxy of type C, orthobothriotaxic. Genital operculum with semi-triangular plates.

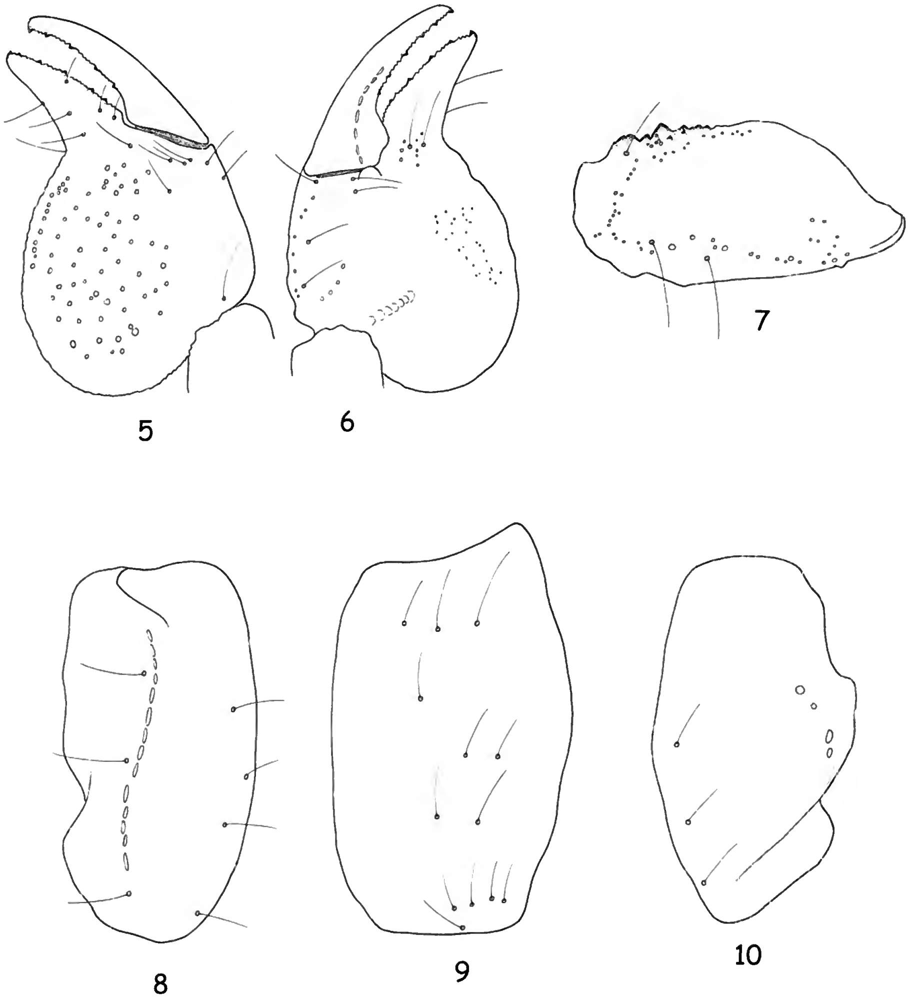


Figs. 1-4. Scorpio niger sp. n. Female holotype. 1. Ventral aspect, showing sternum, genital operculum and pecten. 2. Chelicera, dorsal aspect. 3. Metasomal segment V and telson, lateral aspect. 4. Dentate margin of movable finger with rows of granules.

Relationships: Scorpio niger sp. n., can be distinguished from other Scorpio species, and in particular from S. occidentalis Werner, 1936 and Scorpio savanicola Lourenço, 2009, the two species most closely related geographically (Lourenço, 2009) by the following features: (i) pedipalps almost acarinated; dorsal and dorso-external carinae vestigial; chela manus with weakly marked granules, (ii) telson globular, with strong spinoid granules ventrally, (iii) genital operculum with semi-triangular and elongated plates (iv) distinct morphometric values – see Table (1).

Description: Based on female holotype. Measurements in Table (1).

Coloration. Body basically light yellow to reddish-yellow. Prosoma: carapace reddish-yellow with some blackness near the eyes. Mesosoma: tergites reddish-yellow, as the carapace; sternites yellow to pale yellow. Coxapophysis, sternum, genital operculum and pectines pale yellow. Metasoma: all segments yellowish, with carinae slightly reddish. Telson yellowish; aculeus yellow at the base and dark reddish at the extremity. Chelicerae yellowish with variegated pale reddish spots; fingers yellowish with reddish teeth. Pedipalps: femur and patella yellowish; chela reddish-yellow; dentate margins of fingers dark. Legs yellowish.



Figs. 5-10. Scorpio niger sp. n. Female holotype. Trichobothrial pattern. 5-6. Chela, dorso-external and ventro-internal aspects. 7. Femur, dorsal aspect. 8-10. Patella, dorsal, ventral and external aspects.

Morphology. Carapace acarinate with some vestigial granulations on median zone; anterior margin with a moderately pronounced concavity; posterior furrows moderately pronounced; median ocular tubercle distinct in the centre of the carapace; three pairs of lateral eyes; the first two of equal size, the third slightly reduced. Mesosoma: tergites acarinate and smooth (lustrous) with sparse granulation only on VII. Sternum pentagonal, wider than high. Venter: genital operculum formed by two semi-triangular elongated plates. Pectines moderately narrowed; pectinal tooth count 10-10; fulcra strongly developed. Sternites smooth and shiny, with two longitudinal parallel furrows on III to VI; VII with four moderately marked carinae; spiracles linear and conspicuous. Metasoma with strongly marked carinae on segments I to IV; granulation becomes spiniform on segment V; ventral and latero-ventral carinae intensely spinoid on V; all intercarinal surfaces weakly granular. Telson globular and strongly granular with four ventral carinae formed by strong spinoid granules; aculeus shorter than vesicle and moderately curved. Cheliceral dentition characteristic of the Scorpionidae (Vachon, 1963); movable finger with one subdistal tooth, and conspicuous basal teeth. Pedipalps with weak granulations; femur with four incomplete carinae; patella with dorsal carina almost complete; chela with weakly marked ventral carinae; other carinae inconspicuous or absent; dorso-external aspect of the manus weakly granular. Dentate margin on fixed and movable fingers with a series of granules divided by 4 or 5 strong accessory granules. Trichobothriotaxy of type C; orthobothriotaxic (Vachon, 1974); femur with 3 trichobothria, patella with 19, and chela with 26. Legs: tarsi of legs I to IV with 7/6: 6-7/5-6: 6-7/5-6: 6/4 internal and external spines arranged in series.

Table 1. Morphometric values (in mm) of the ♂ neotype of Scorpio occidentalis, the ♂ holotype and ♀ paratype of Scorpio savanicola and the ♀ holotype of Scorpio niger sp. n.

	Scorpio occidentalis	Scorpio savanicola		Scorpio niger sp. n.
	♂ Neotype	♂ Holotype	♀ Paratype	♀ Holotype
Total length	47.1(52.9*)	42.4(47.2*)	51.1(56.5*)	40.9(45.6*)
Carapace:				
- length	8.7	7.5	8.7	7.9
- anterior width	5.7	5.2	6.0	5.4
- posterior width	9.0	8.0	9.2	8.4
Mesosoma length	15.1	15.0	21.7	14.6
Metasomal segment I:				
- length	3.3	2.8	2.9	2.6
- width	5.0	4.5	4.7	4.2
Metasomal segment V:				
- length	6.4	5.5	5.8	4.9
- width	3.3	2.9	3.0	2.9
- depth	2.7	2.4	2.8	2.6
Telson:				
- length	5.8	4.8	5.4	4.7
- width	2.3	2.5	2.7	2.4
- depth	2.2	2.3	2.3	2.0
Pedipalp:				
- Femur length	4.9	4.4	4.8	4.5
- Femur width	2.8	2.6	2.9	2.3
- Patella length	6.3	5.8	5.9	5.5
- Patella width	3.3	2.7	3.0	2.7
- Chela length	12.8	10.7	12.4	11.2
- Chela width	4.4	3.9	4.6	4.4
- Chela depth	8.0	7.2	7.6	6.8
Movable finger: length	6.3	5.6	7.0	6.0

* including telson length.

Taxonomic comments

Scorpio tunetanus Birula, 1910 (now Scorpio punicus Fet, 2000 was the first species of the genus to be characterized as having a pale coloration, varying from light yellow to reddish-yellow. Subsequently, other species having a similar pattern of coloration were described: Scorpio occidentalis Werner, Scorpio savanicola Lourenço and now Scorpio niger sp. n. All these species are probably members of a single group, which originated from a common ancestor, but today occupy distinct regions of distribution. The range of distribution of S. punicus seems to be limited to the high plateaus of Tunisia and North of Algeria (Vachon, 1952, 1958), whereas the other three species are distributed much further to the South, in the Sahel region (Fig. 11). Vachon (1958) referred to Scorpio maurus from the mountains of the Tassili N'Ajjer in the South of Algeria without reaching a final determination. We were not able to locate the specimen studied by Vachon (1958), or other specimens collected in the same region. However, the future study of Scorpio specimens from the mountain range in the South of Algeria should reveal yet another distinct species of this group.

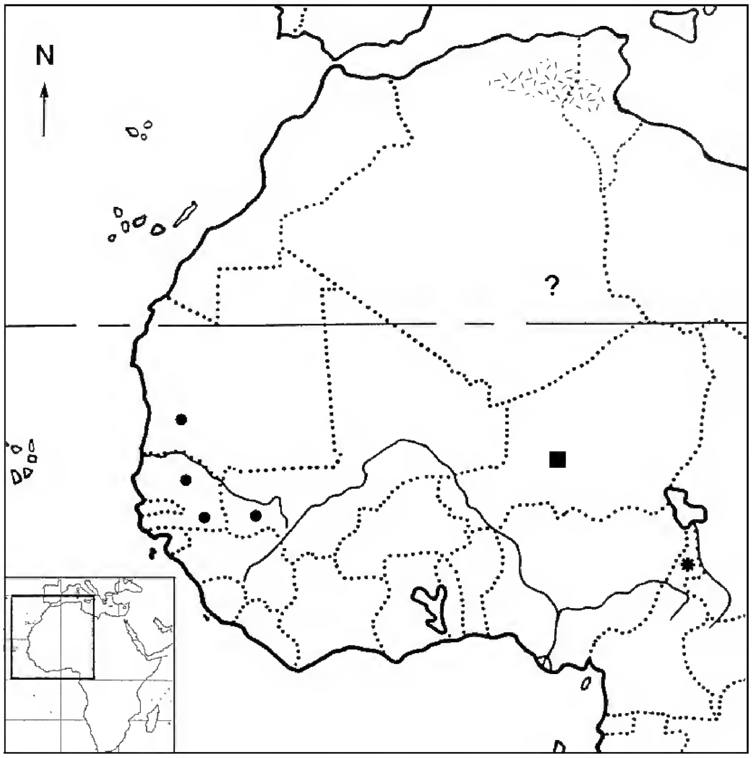


Fig. 11. Map of Western Africa with the known distribution of Scorpio punicus (=Scorpio tunetanus) (hatched zone); Scorpio occidentalis (black circles); Scorpio savanicola (black star); Scorpio niger sp. n. (black square). Scorpio sp. from Tassili N'Ajjer indicated by an interrogation mark.

Ecological and Biogeographic comments

Present vegetation zones in Niger can be described as follows: The Sahara covers the whole northern part of the country. The transition between the Northern and Southern Sahel covers a strip about 200 km in the south (between 14 to 15°N). The Northern Sudanian Zone is restricted to the south-west and small areas of southern Niger.

In general, the physiognomy of the vegetation zones changes from contracted vegetation in the Sahara to tree, shrub or grass savannas in the Sahel with Mimosaceae and Combretaceae tree and shrub species sparsely distributed. In the Northern Sahel, grass savannas are mostly found in depressions, sometimes on plateaus, whereas (thorn) shrub savannas predominate on sandy soils. This zone is a pastoral zone, where persistent rain fed agriculture is not possible because precipitation (200-400 mm) is too low. Combretum thickets on laterite plateaus and grass or (thorn) shrub savannas on sandy terraces, dry valley floors or fixed dunes are characteristic for the Southern Sahel (400-600 mm precipitation). Ancient river valleys, so-called Dallols are a peculiarity. In these valleys a tree savanna with Faidherbia albida and Hyphaene thebaica has its northernmost occurrence. Gallery forests occur along rivers, if water supply is sufficient during at least few months of the year (Aubréville, 1949; AETFAT, 1959; Schnell, 1976; White, 1983).

The new species of Scorpio is undoubtedly an element of the Sahel zone in Niger. By the time the specimen was collected, the expansion of the Sahara was less important than it is today. The borders between Sahara and Sahel were further north (AETFAT, 1959; Schnell, 1976).

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Confirmation of a new species of Buthus Leach, 1815 from Alexandria, Egypt (Scorpiones, Buthidae)

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† Former research fellow in the Muséum national d'Histoire naturelle at the Laboratoire de Zoologie (Vers et Crustacés) which became the Laboratoire of Arthropodes in 1960.

Abstract

During the last decade, the genus Buthus Leach, 1815 (Family Buthidae) was the subject of several studies. These concerned in particular the 'Buthus occitanus' complex of species. Several populations previously considered as subspecies or varieties were raised to the rank of species and many new species were also described. The majority of the species considered in these studies come mostly from Northwest Africa. In a recent paper, the questionable presence of the genus Buthus in Egypt, in other regions than Sinai, was reconsidered and one new species was described from the region of Siwa. In some unpublished notes by E. Simon, the genus Buthus was recorded from Alexandria, but these data were not confirmed subsequently. The material studied by E. Simon was recently 'relocated' in the collections of the Muséum national d'Histoire naturelle in Paris. It is described here as a new species.

Keywords: Scorpion, Buthus, new species, Egypt, Alexandria.

Introduction

As already explained in some recent papers (Lourenço & Cloudsley-Thompson, 2012; Lourenço et al., 2010) the problems and difficulties related to the taxonomy of the genus Buthus Leach were the subject of discussions in already old papers (Kraepelin, 1899). In his monograph about North African scorpions, Vachon (1952) attempted to establish a better definition of the genus and transferred to other genera several species previously included in it (Lourenço, 2003). The classification proposed by Vachon (1952) for the species of Buthus, and in particular for those belonging to the 'Buthus occitanus' complex of species, remained, however, unsatisfactory mainly because of the existence of several poorly defined subspecies and even varieties.

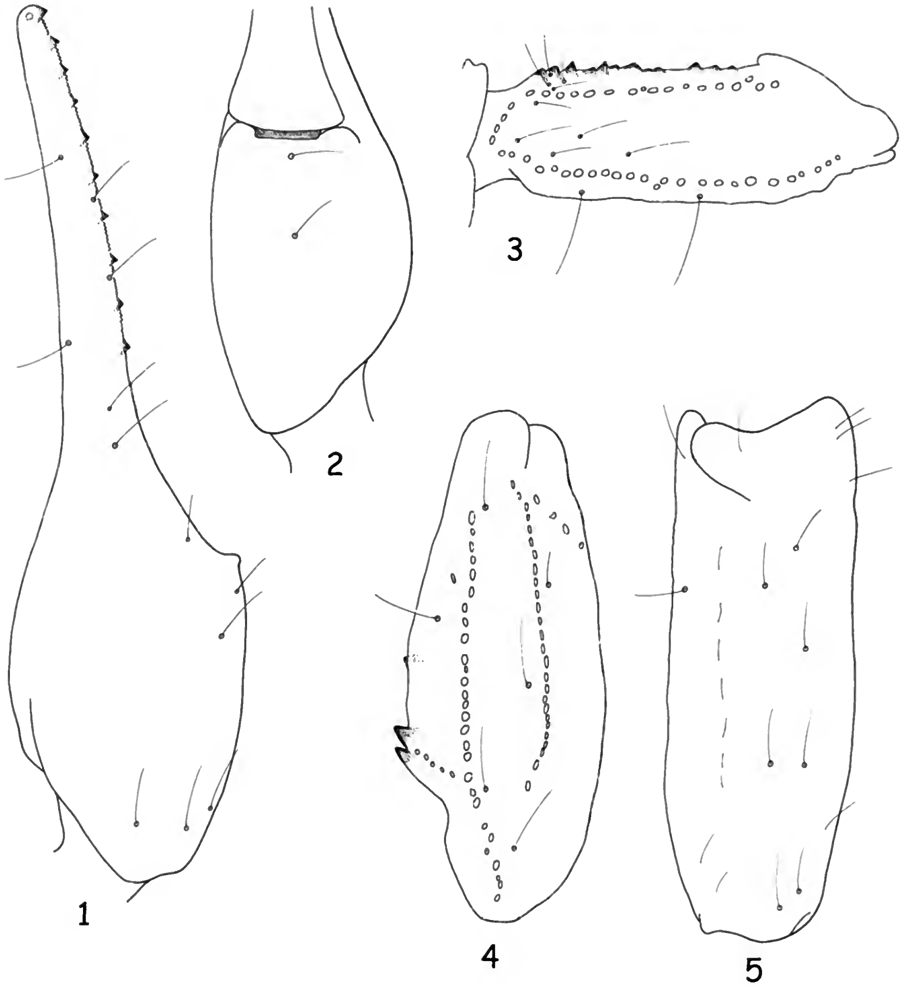
Since the publications by Lourenço (2002, 2003), a more precise definition of the Buthus species belonging to the 'Buthus occitanus' complex, was attempted, followed by the description of several new species and the promotion of some subspecies to species rank (Lourenço, 2002, 2003, 2005, 2008; Lourenço & Slimani, 2004; Lourenço & Vachon, 2004; Lourenço & Qi, 2006; Lourenço et al., 2009a, 2010). This procedure, started by Lourenço, was also followed by other authors (Kovařík, 2006, 2011; Yağmur et al., 2011).

With a few exceptions, most of the recent studies focused on the species distributed in north-western Africa, while little attention was given to the species of the north-eastern regions (Lourenço, 2003). According to the "Catalog of the Scorpions of The World" (Fet & Lowe, 2000) and recent taxonomic elevations, records for two species of the genus Buthus can be attributed to Egypt: B. tunetanus (Herbst, 1800) and B. israelis Shulov & Amitai, 1959. Vachon (1952) limited, however, the distribution of B. tunetanus ("typicus") to Algeria and Tunisia; consequently records for Egypt are questionable. The presence of B. israelis in Egypt is confirmed exclusively for the Sinai Peninsula (Levy & Amitai, 1980; Lourenço et al., 2010).

In a very recent paper (Lourenço & Cloudsley-Thompson, 2012) a new species of Buthus was described from the region of Siwa, based on material collected by our late colleague, Prof. P. M. Brignoli. This new species proved to be quite distinct from both Buthus tunetanus and Buthus barcaeus Birula, 1909; this last species was described from Libya.

Eugène Simon, in some unpublished notes, recorded the genus Buthus from Alexandria in Egypt. This material, composed of several specimens was registered under the n° 3228 of the Simon's collection and designated as "Buthus orientalis sp. n.", but the new species was never published. Curiously, Simon associated also to his new species one specimen from Cyprus, registered under the same number 3228. This specimen was recently studied and proved to be a new species of Buthus described from Cyprus (Yağmur et al., 2011). The Alexandria specimens cited by Simon, however, remained enigmatic. Only very recently I was able to 'locate' the original jar in the collections of the Muséum national d'Histoire naturelle in Paris. The original material registered by Simon under the number 3228, was in fact subsequently divided by M. Vachon in two jars: one under the number RS-6622 with the single female specimen from Cyprus and the second, RS-6623, with the material from Alexandria. The material from Alexandria is composed of several specimens, including males, females and juveniles. A detailed analysis of the material shows it to be distinct from Buthus kunti Yağmur, Koç & Lourenço, 2011, recently described from Cyprus, but also from Buthus tunetanus, B. barcaeus and B. egyptiensis Lourenço & Cloudsley-Thompson, 2012. Consequently, a new species of Buthus from Egypt is described here.

According to Dr. H. El-Hennawy (in litt.) the region of Alexandria today became a very large city surrounded by industrial activities. These activities drastically changed the area in the last 3-4 decades and most certainly destroyed the local fauna. Consequently no scorpion species can be found in this area anymore. Several years ago, Dr. El-Hennawy collected scorpions in the Omayed Protectorate, located about 80 km W of Alexandria. Four species were collected: Androctonus australis (L.), Buthacus leptochelys (Ehrenberg), Leiurus quinquestriatus (Ehrenberg) and Orthochirus innesi Simon. No species of Buthus, however, were found. It can be suggested that Buthus species become very rare or even extinct in the area, as consequence of environmental changes.



Figs. 1-5. Buthus orientalis sp. n., female holotype. Trichobothrial pattern. 1-2. Chela, dorso-external and ventral aspects. 3. Femur, dorsal aspect. 4-5. Patella, dorsal and external aspects.

Methods

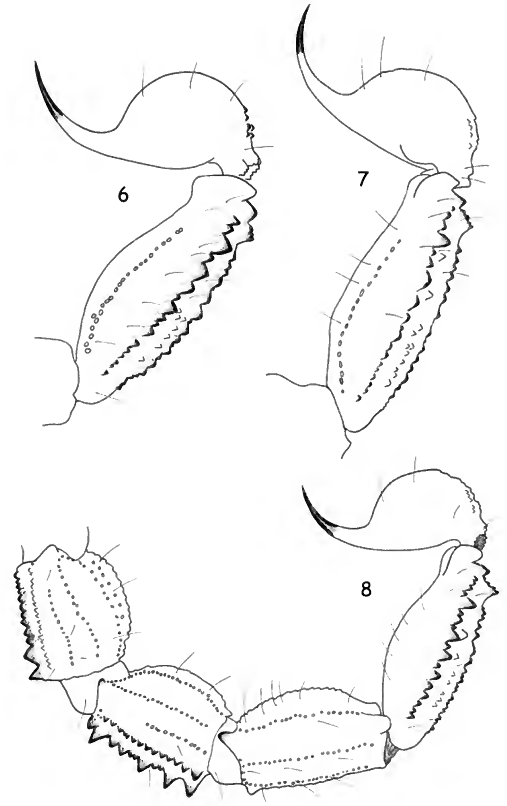
Illustrations and measurements were produced using a Wild M5 stereo-microscope with a drawing tube and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

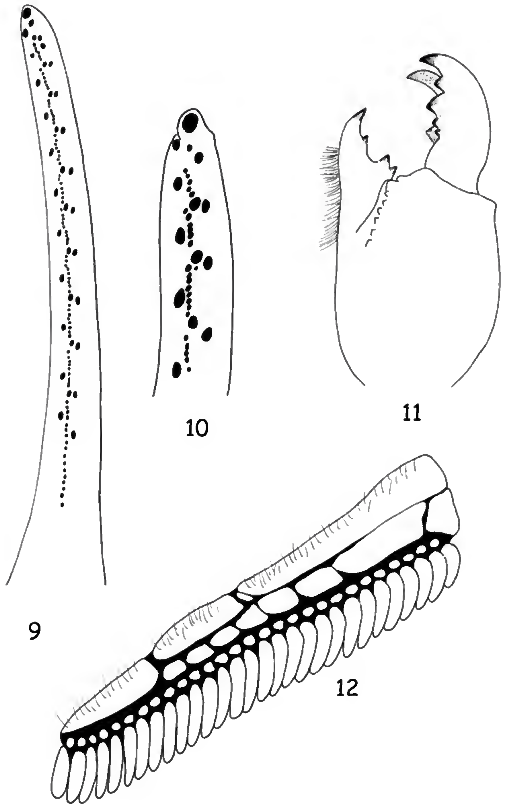
Taxonomy

Family Buthidae C. L. Koch, 1837
Genus Buthus Leach, 1815

Buthus orientalis sp. n. (Figs. 1-12)

Type material. Female holotype, 7 males and 13 females paratypes. Egypt, Alexandria, no date, collector unknown, Simon's collection N° 3228; deposited in the Muséum national d'Histoire naturelle, Paris (RS-6623).





Figs. 6-8. Buthus orientalis sp. n. 6-7. Metasomal segment V and telson lateral aspect. 6. Female holotype. 7. Male paratype. 8. Idem, segments II to V and telson, lateral aspect; female paratype.

Figs. 9-12. Buthus orientalis sp. n., male paratype. 9. Movable finger of pedipalp chela with rows of granules. 10. Extremity of the finger in detail. 11. Chelicera. 12. Pecten.

Comparative material: Buthus barcaeus Birula. Libya, Cyrenaica, Latrun, 12/IV/1954 (K. M. Guichard), 1 female (RS-2639). Tolmeitha, 12/III/1958 (K. M. Guichard), 1 male (RS-2637). Misurata, II/1958 (A. Lukmely), 4 males, 5 females.

Etymology: The specific name is the one originally defined by E. Simon and refers to the eastern distribution of the species in North Africa.

Diagnosis. Scorpion of moderate size for the genus, reaching a total length of 68 mm in males and 62 mm in females. Base colour yellowish with only the carapace marked with brown to blackish spots around median eyes; tergites with one longitudinal brown strip; metasomal segments yellowish; metasomal carinae reddish-yellow; telson yellowish; tip of the aculeus dark, almost blackish. Venter yellowish. Pedipalps yellowish with carinae reddish; legs yellowish without spots. Carinae and granulations moderately to strongly marked; ventral carinae on metasomal segments II and III strongly lobated. All metasomal segments longer than wide; metasomal and pedipalpal chetotaxy weak; pedipalps slender in both sexes with short fingers; fixed and movable fingers with 10 rows of granules. Pectines with 28 to 31 teeth in males (mode 29) and 24 to 27 teeth in females (mode 26).

Relationships. Buthus orientalis sp. n., belongs to the ‘Buthus occitanus’ complex of species. It can be distinguished from other species of Buthus and in particular from B.

egyptiensis also described from Egypt, and from Buthus barcaeus Birula, 1909 known from Libya by the following characters: (i) smaller global size, (ii) much paler coloration on carapace and tergites, (iii) weaker marked carinae on carapace and tergites, but stronger marked ventral carinae on metasomal segments II and III, lobated, (iv) smaller number of pectinal teeth, (v) weak chetotaxy on pedipalps and metasomal segments, (vi) 10 rows of granules on pedipalp fingers. Moreover, the new species is confirmed for a distinct locality in Egypt.

Taxonomic note: Simon (1910) in his revision of the scorpions of Egypt refers only to Buthus 'sensu stricto' as Buthus europaeus (L.), as a common species in the Lower Egypt. He insisted, however, to the fact that he was not able to found valuable characters to distinguish the forms from Egypt from those from Algeria or Spain. No references are made to the 'new species' Buthus orientalis sp. n. From the date of his notes, it can be suggested that he took the decision to describe this new species after the publication of his 1910 paper. Also, this material was not examined by K. Kraepelin when he visited the Muséum in Paris in 1900.

Table 1. Morphometric values (in mm) of female holotype and male paratype of Buthus orientalis sp. n., male and female of Buthus barcaeus from Libya, female holotype of Buthus egyptiensis and a female of Buthus tunetaus from Libya.

	Buthus orientalis		Buthus barcaeus		Buthus egyptiensis	Buthus tunetanus
	♂	♀	♂	♀	♀	♀
Total length*	67.3	61.6	68.6	69.1	85.6	68.3
Carapace:						
- length	6.6	6.8	7.2	7.5	9.2	7.4
- anterior width	4.4	4.8	4.9	5.4	6.3	5.5
- posterior width	7.0	8.2	7.7	8.7	10.8	8.8
Mesosoma length	14.1	15.8	17.3	19.1	26.0	19.0
Metasomal segment I:						
- length	5.5	5.1	5.8	5.4	6.7	5.4
- width	4.6	4.7	5.4	4.8	6.2	5.4
Metasomal segment V:						
- length	8.4	8.2	8.4	8.5	10.2	8.4
- width	3.4	3.8	4.0	4.6	5.1	4.1
- depth	2.9	3.4	3.3	3.4	4.4	3.3
Telson length	6.7	6.9	7.5	7.9	9.1	7.8
Vesicle:						
- width	2.9	3.4	3.2	3.7	4.2	3.5
- depth	2.8	3.1	3.2	3.7	3.7	3.2
Pedipalp:						
- Femur length	5.7	5.7	6.1	6.0	7.1	6.3
- Femur width	1.7	1.9	2.1	2.2	2.7	2.1
- Patella length	6.6	6.9	7.0	7.3	8.7	7.2
- Patella width	2.5	2.8	2.8	3.0	3.8	2.8
- Chela length	10.4	11.5	11.0	12.2	15.2	12.2
- Chela width	2.2	2.7	2.3	2.8	4.2	3.2
- Chela depth	2.4	2.9	2.6	3.2	4.5	3.6
Movable finger:						
- length	6.9	7.5	7.4	8.3	9.5	7.8

* Including telson length

Description based on female holotype and paratypes. Measurements on Table (1).

Coloration. Base colour yellowish. Prosoma: carapace yellowish with some infuscated zones around median eyes which are marked by brown to blackish pigment.

Mesosoma: yellowish with tergites marked by one dark longitudinal strip; carinae are slightly reddish. All metasomal segments yellowish; carinae reddish; vesicle yellowish; aculeus yellowish at its base and dark at its extremity. Venter yellowish; pectines pale yellow. Chelicerae yellowish without variegated spots; fingers yellowish with dark reddish teeth. Pedipalps yellowish with some carinae reddish; without any spot; fingers with the oblique rows of granules dark to blackish. Legs yellowish, without spots.

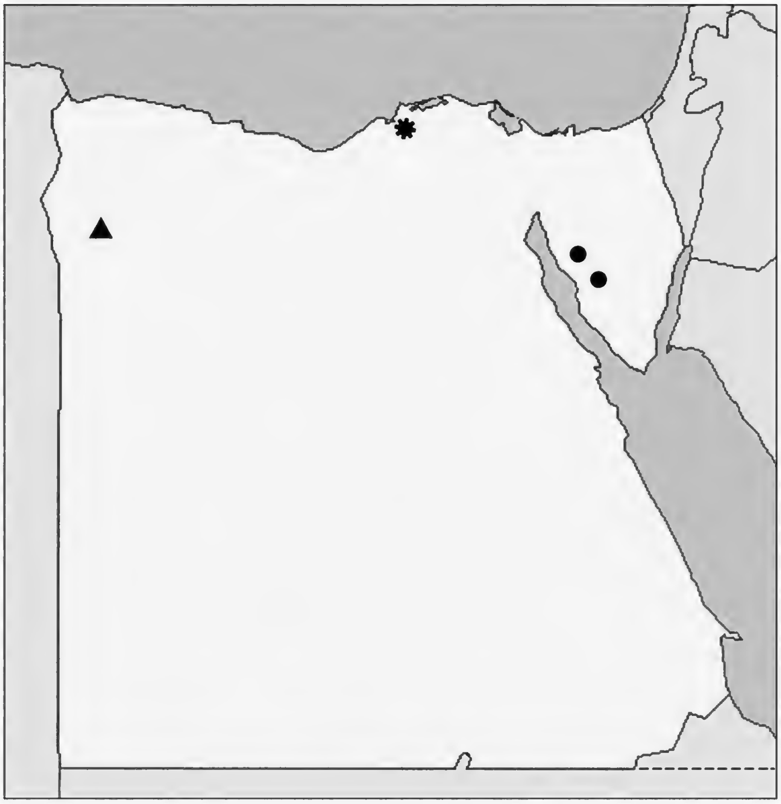


Fig. 13. Map of Egypt, showing the type localities of the new species (black asterisk), and that of Buthus egyptiensis (black triangle). The distribution of Buthus israelis in Sinai is indicated by black circles.

Morphology. Carapace moderately granular; anterior margin without any median concavity, almost straight. Carinae strong; anterior median, central median and posterior median carinae strongly granular, with 'lyre' configuration. All furrows moderate to strong. Median ocular tubercle at the centre of carapace. Eyes separated by almost three ocular diameters. Four pairs of lateral eyes: the first three of moderate size, the last only vestigial. Sternum triangular and short; wider than long. Mesosoma: tergites moderaly granular. Three longitudinal carinae moderately to strongly crenulate in all tergites; lateral carinae reduced in tergites I and II. Tergite VII pentacarinate. Venter: genital operculum divided longitudinally in two semi-oval plates. Pectines: pectinal tooth count 26-26 in female holotype (see diagnosis for variation); middle basal lamella of the pectines not dilated. Sternites without granules, smooth with elongated spiracles; four weak to vestigial carinae on sternites VI and VII; other sternites acarinated and with two vestigial furrows. Metasomal segments I to III with 10 moderately to strongly crenulated carinae, ventral carinae strongly marked on segments II and III with lobate denticles; segment IV with 8 carinae, moderately crenulated; the first four segments with a smooth dorsal depression; segment V with five carinae; the latero-ventral carinae crenulate with 3-4 lobate denticles posteriorly; ventral median carina not divided posteriorly; anal arc composed of 7-8 ventral teeth, and two lateral lobes. Intercarinal spaces weakly granular to smooth. Chetotaxy weak. Telson with a strongly globular vesicle, almost smooth; aculeus weakly curved and slightly shorter than the vesicle, without a subaculear tooth. Cheliceral dentition as defined by Vachon (1963) for the family Buthidae; external distal and internal distal teeth approximately the same length; basal teeth on movable finger small but well distinct; ventral aspect of both fingers and manus covered with long dense setae. Pedipalps: femur pentacarinate; patella with eight carinae weakly marked; chela without carinae, smooth. Fixed and movable fingers with 10 oblique rows of granules. Internal and external accessory granules present, strong; three accessory granules on the distal end of the movable finger next to the terminal denticle. Chetotaxy weak. Legs: tarsus with two longitudinal rows of spinoid setae ventrally; tibial spur strong on legs III and IV; pedal spurs moderate to strong on legs I to IV. Trichobothriotaxy: trichobothrial pattern of Type A, orthobothriotaxic as defined by Vachon (1974). Dorsal trichobothria of femur arranged in Beta-β-configuration (Vachon, 1975).

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Euscorpius sicanus (Scorpiones: Euscorpiidae) from Tunisia: DNA barcoding confirms ancient disjunctions across the Mediterranean Sea

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Abstract

We used a DNA barcoding marker (mitochondrial cox1) to investigate the controversial natural occurrence of Euscorpius sicanus (C.L. Koch) in North Africa. We tested this hypothesis by comparing a sample collected from a mountain in Tunisia to disjunct populations in Sardinia, Malta, and Greece. Using these samples, and a few additional Euscorpius spp. from southern Europe as outgroups, we reconstructed the maternal phylogeny. We then used a molecular clock to place the phylogeny in a temporal context. The Tunisian sample grouped closest to a specimen from Sardinia, with both being more distantly related to E. sicanus from Malta, which is known to be genetically similar to samples from Sicily. Molecular clock estimates suggest an ancient disjunction across the Mediterranean Sea, with the divergence between samples from Sardinia and Tunisia estimated to have occurred between the Late Miocene and late Pliocene. The divergence date (mean = 5.56 Mya) closely corresponds with the timing of a sudden refilling of the Mediterranean Sea after it had evaporated during the Messinian salinity crisis. This rapid influx of water, in conjunction with tectonic activity, could have sundered connections between Euscorpius in North Africa and what is now the island of Sardinia. These results provide yet another case in which DNA barcodes have proven useful for more than just identifying and discovering species.

Keywords: Zanclean Flood, post-Messinian Flood, Messinian salinity crisis, molecular clock, cox1, mitochondrial DNA, barcode.

Introduction

Most of North Africa's rich scorpion fauna, which primarily consists of members of family Buthidae, is relatively well known (Vachon, 1952; Kovařík, 2006). However, species of the genus Euscorpius Thorell from North Africa have not been adequately characterized, even though records from the region date back to more than 100 years. Original reports documented "E. carpathicus (L.)" from isolated localities along the North African coast in Tunisia, Libya, and Egypt (Fet et al., 2003). Many Euscorpius spp. are known to disperse with humans (Fet et al., 2006), so the legitimacy of these reports has been controversial. Some introduced species, such as E. italicus (Herbst) in Yemen and Iraq, are even known to establish reproducing populations in non-native areas (Fet & Kovařík, 2003). Furthermore, some of the African populations of Euscorpius are represented by E. flavicaudis De Geer, a potential postglacial relict that presumably represents a recent introduction (Gantenbein et al., 2001). As a result, when specimens identified as "E. carpathicus sicanus (C.L. Koch)" were reported from coastal regions of North Africa, it was brought into question whether the specimens were introduced from the northern Mediterranean, or if they represented an isolated relict population (Fet et al., 2003).

Based on morphological and molecular characters, E. carpathicus sicanus was recently elevated to E. sicanus (C.L. Koch), and the degree of intraspecific genetic structure suggested that it might even represent a species complex (Fet et al., 2003). With the type locality from Sicily, and other populations occupying portions of southern Italy, Sardinia, central and southern Greece, Malta, Madeira, and several North African localities, the geographic range of E. sicanus is highly fragmented by the Mediterranean Sea. Genetic samples (mitochondrial DNA) of E. sicanus were studied from a number of localities in Italy (including Sicily and Sardinia), Greece, and Malta (Fet et al., 2003; Salomone et al., 2007), but no African populations were analyzed.

In 2008, we (P. Stoev & N. Akkari) collected new Euscorpius specimens from North Africa that were identified in 2009 as E. sicanus (det. V. Fet). The scorpions were collected from Jebel Zaghouan (Fig. 1), a mountain range situated in northeastern Tunisia that reaches an elevation of 1,295 meters at Ras el Gossa. The mountain range is within the Semi-arid bioclimatic zone (Emberger, 1966) characterized by temperate winters and an average annual precipitation of 450–500 mm. Jebel Zaghouan lies in the major structural NE-SW lineament that was active since the Jurassic and is characterized by a predominance of red soils developed on Jurassic limestone. The vegetation near the summit is mostly dominated by Quercus coccifera L., the slopes are characterized by Ceratonia siliqua L., Olea europaea L. and Pistacia lentiscus L., and the shrub floor is composed mainly of Tetraclinis articulata (Vahl), Phillyrea angustifolia L., Lavandula sp. and Thymus capitatus (L.).

This non-desert habitat suggests that Euscorpius from Jebel Zaghouan could potentially represent native populations. We tested this hypothesis by comparing a DNA barcode (mitochondrial cox1) from one of the E. sicanus specimens (Fig. 2) collected from the Jebel Zaghouan of Tunisia with barcodes obtained from E. sicanus from Greece, Malta, and Sardinia, as well as outgroup congeneric species from southern Europe (Fig. 3). We used these data to investigate the matrilineal phylogeny, and to estimate divergence dates between mitochondrial lineages. If E. sicanus was recently introduced to North Africa, then we would expect the barcode from the Tunisian sample to be similar to that from Sardinia, Malta, or Greece. Alternatively, if the Tunisian specimen represents a relict population, then we would expect the barcode to be quite different than the E. sicanus barcodes from Greece, Sardinia, and Malta. Furthermore, molecular clock estimates should indicate an ancient (Pre-Pleistocene) divergence between the sample from Tunisia, and those from Greece, Malta, and Sardinia.

Fig. 1. A view of Jebel Zaghouan Mts. in Tunisia where Euscorpius sicanus (C.L. Koch) was collected. Photo: N. Akkari.

Material and Methods

We analyzed 10 sequences obtained at Marshall University (V. Fet; two specimens from Greece) and the Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario, Canada (G. Blagoev; all other specimens). Label data of the specimens used for DNA analysis are listed below. All sequence data were submitted to GenBank and can be accessed through BOLD (http://www.boldsystems.org, Ratnasingham & Hebert, 2007) under project "Scorpions of the Ancient Mediterranean 2 (AMSCO)". Voucher specimens are in a private collection of V. Fet and in the Biodiversity Institute of Ontario.

Material Examined: Euscorpius sicanus (C.L. Koch, 1837): GREECE, Thessaly, Mt. Pelion, Visitsa, 39°20'N, 23°08'E, 7 May 2001, leg. V. Fet, VF-0454 (JX414017); Thessaly, Mt. Ossa (Kissavos), Spilia, 39°47'45"N, 22°38'49"E, 9 May 2001, leg. V. Fet, VF-0455 (JX414018); ITALY, Sardinia, S. Niccolo Gerrei, near Grotta Saturru, 39.49816°N, 09.31503°E, 395 m, April 2006, leg. A. v.d. Mejden, VF-0789, AMSCO052-10 (JX133089). MALTA, Buskett Gardens, 35°51'41"N, 14°23'56"E, 17 September 2001, leg. P. Schembri, VF-0792, AMSCO053-10 (HM418288). TUNISIA, Zaghouan Governorate, Jebel Zaghouan Mts., along the trek, 36°22.423'N, 10°06'E to 36°22.924'N, 10°06.789'E, 650-780 m a.s.l., mixed forest, March 2008, leg. P. Stoev & N. Akkari, VF-0793, AMSCO054-10 (HM418289). **Euscorpius carpathicus** (L., 1767): ROMANIA, Caraş-Severin County, Băile Herculane, 44°52'43"N, 22°24'51"E, 4 June 2008 (F. Šťáhlavský), VF-0768, AMSCO044-10 (HM418284). **Euscorpius concinnus** (C.L. Koch, 1837): FRANCE, Alpes-Maritimes, Grasse, 43°40'N, 06°55'E, September 2004, leg. E. Ythier, VF-0782, AMSCO049-10 (HM418287). **Euscorpius hadzii**

Caporiacco, 1950: BULGARIA, Blagoevgrad District, Gorna Breznitsa, 41°45'N, 23°07'E, 27 May 2005, leg. V. Fet & D. Dobrev, VF-0798, AMSCO059-10 (HM880289); MONTENEGRO, Budva District, Visnjevo, 42°17'52"N, 18°46'37"E, sea level, 29 October 2005, leg. F. Franeta, VF-0807, AMSCO066-10 (HM418296). ***Euscorpius flavicaudis*** (DeGeer, 1787): FRANCE, Vaucluse, Pernes-les-Fontaines, 43°59'55"N, 05°03'35"E, 230 June 2007, leg. V. Fet, VF-0700, AMSCO001-10 (HM418267).

NOTE. Additional specimens of *E. sicanus* (not included in the DNA study) were collected from the same area by us (N.A. and P.S.): 2 juv., NE Tunisia, Zaghouan Governorate, Jebel Zaghouan Mts., surroundings of a small limestone cave 'Gouffre du courant d'air', 36°21.980'N, 10°05.513'E, 561 m a.s.l., *Quercus ilex, Pistacia lentiscus, Jasminum fruticans*, under stones and leaf litter, 17 March 2008, N. Akkari & P. Stoev leg.

Fig. 2. Dorsal view of the habitus of *Euscorpius sicanus* (C.L. Koch) female collected from Tunisia for which a DNA barcode was sequenced and analyzed in this study. Note a weak darker reticulation pattern on carapace, typical of *E. sicanus*. Photo: P. Stoev and R. Bekchiev.

Molecular Techniques: The V.F. lab used a DNeasy Blood & Tissue Kit (Qiagen) to isolate genomic DNA from leg or muscle tissue. A portion of the mitochondrial protein-coding gene cytochrome oxidase subunit I (*cox1*) was then amplified and sequenced using primers Nancy (Simon *et al.*, 1994) and LCO (5' – GGT CAA CAA ATC ATA AAG ATA TTG G – 3') following protocols outlined by Simon *et al.* (1994).

Barcodes (*cox1* sequences) generated at the Canadian Centre for DNA Barcoding, University of Guelph, were obtained using standard protocols for DNA extraction, polymerase chain reaction (PCR) and sequencing (Ivanova *et al.*, 2006, DeWaard *et al.*, 2008). In brief, tissue from a single scorpion leg was used for extraction of genomic DNA using a 96 AcroPrep™ 1 ml filter plate (PALL) with 3.0 µm Glass fiber. DNA was eluted in 40 µl of dH2O. Full-length *cox1* barcodes (649 bp) were amplified using two newly designed primer sets (Ivanova, unpublished): ScorpF1_t1 (5' – TGTAAAACGACGG CCAGTTTTCTACTAATCAYAAAGAYATTGG – 3') and ScorpR1_t1 (5' – CAGG AAACAGCTATGACGGRTGTCCAAAAAAYCAAAAYAAATG – 3'). All PCR products were sequenced bi-directionally on an ABI3730XL using the primer pair of

M13F and M13R (Messing, 1983). The forward and reverse sequences were used to generate a single consensus sequence using CodonCode Aligner v. 3.0.2 (CodonCode Corporation). Coxl was chosen because it is commonly used in barcoding and has been demonstrated as highly effective in discriminating among insect (Zhang & Hewitt, 1997; Foottit et al., 2009; Zhou et al., 2009) and arachnid species (e.g. Barrett & Hebert, 2005; Thomas & Hedin, 2008; Wang et al., 2008; Robinson et al., 2009; Graham et al., 2012; Sousa et al., 2012).

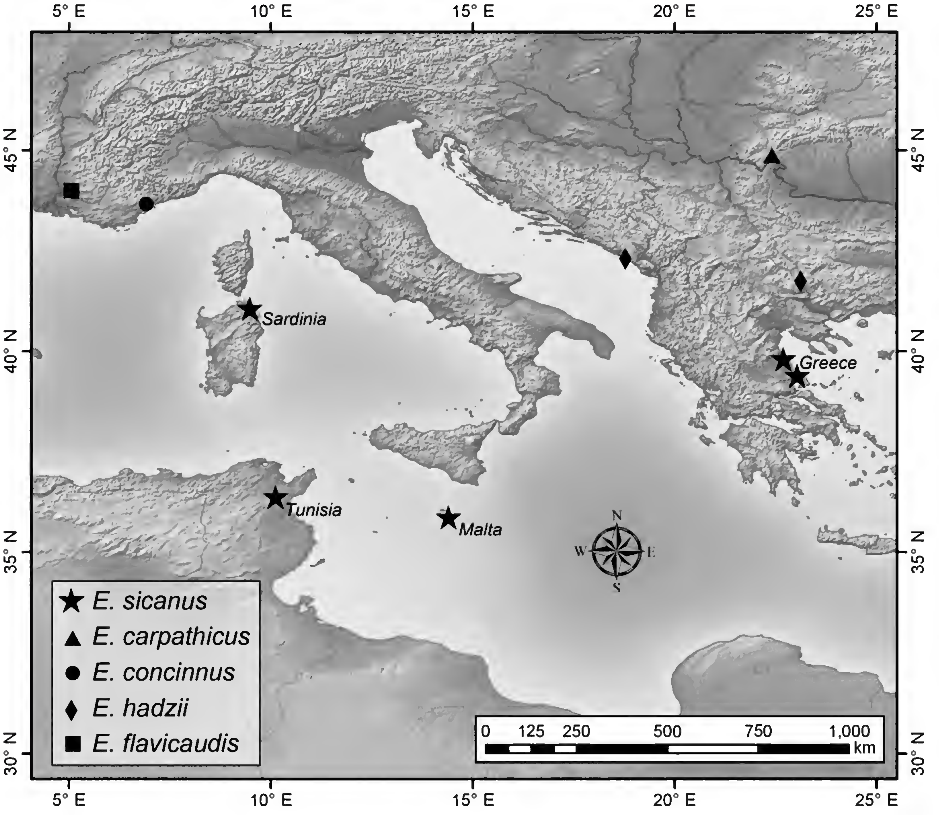

Fig. 3. Map depicting locations for Euscorpius Thorell specimens used in this study.

Phylogenetic analysis and divergence time estimation: Sequences were aligned using SEQUENCHER v. 4.9 (Gene Codes Corp., Inc., Ann Arbor, MI, USA) and verified by eye. The alignment was then imported into the program MEGA 5 (Tamura et al., 2011) which was used to find a suitable model for nucleotide substitution through the Akaike Information Criterion (Posada, 2008). The program chose the GTR+I+G model, so phylogeny was then estimated via this model and the criterion of Maximum Likelihood (ML) with 1,000 bootstrap replicates, again using MEGA 5.

We also estimated tree topology and divergence dates for the Euscorpius samples in BEAST v. 1.5.3 (Drummond & Rambaut, 2007) using the same substitution model. We applied the Yule tree prior and a mutation rate of 0.007 substitutions/site/million years for coxl (Gantenbein et al., 2005), and set the mean standard deviation to 0.003 to accommodate a similar rate estimated for 16S (Gantenbein & Largiadèr, 2002). Analyses were conducted for 40 million Markov Chain Monte Carlo generations, sampling every 1,000 generations, and with the first 20% of the generations discarded as burn-in. We used LOGCOMBINER v. 1.6.1 (Drummond & Rambaut, 2007) to combine trees and parameter estimates, and TRACER to examine the estimated sample sizes (ESS) to avoid poor estimates of the parameters (ESS < 200).

Results

ML and Bayesian analyses produced identical topologies. We chose to present the Bayesian tree with both posterior probabilities and bootstrap support values for each node (Fig. 4, Table 1). A total of 6 out of 9 nodes were supported under BI (PP > 0.9), and 5 nodes were supported by the ML (bootstrap values > 0.75).

Table 1. Molecular clock estimates and support values for nodes presented in Fig. (4).

Node	Age	95% HPD	Posterior Probability	ML Bootstrap (%)
a	25.57	14.32 - 39.56	1	100
b	15.28	9.74 - 22.7	1	100
c	12.65	8.23 - 18.54	0.74	59
d	9.73	5.38 - 15.4	0.98	64
e	8.59	5.52 - 12.25	1	81
f	7.18	4.44 - 10.13	0.66	37
g	5.56	3.29 - 8.14	0.81	38
h	4.67	2.7 - 6.99	1	98
i	3.57	1.72 - 5.67	1	79

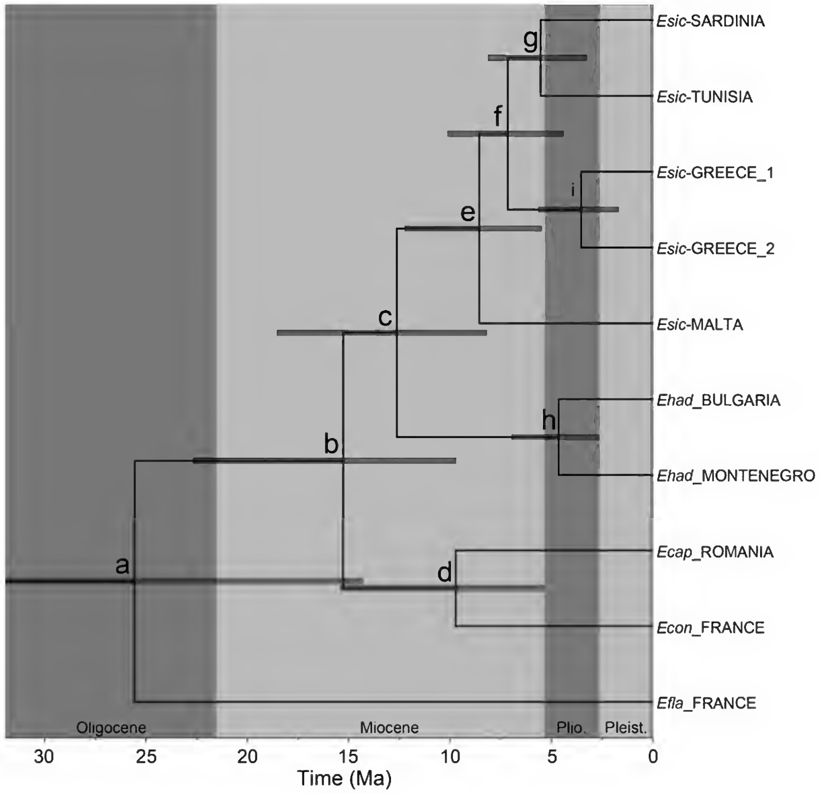

Fig. 4. Ultrametric tree estimated in BEAST. Mean divergence times, 95% highest posterior densities (HPD), and support values for nodes (a - i) are presented in Table 1. Dark bars represent variation (95% HPD) for the age estimate of each node.

The tree is rooted with Euscorpius flavicaudis, which was estimated to have diverged from the remaining samples sometime between the mid-Oligocene and mid-

Miocene. The next oldest node diversified between the Late Oligocene and Middle Miocene, resulting in two clades: one that was strongly supported by BI but weakly supported by ML consisting of E. concinnus and E. carpathicus, and another showing sister relationships between E. hadzii and E. sicanus, which is supported by morphological data (Fet & Soleglad, 2002, 2007; Fet et al., 2003). The E. concinnus and E. carpathicus were estimated to have diverged in the Middle to Late Miocene. Within the other clade, E. hadzii and E. sicanus were estimated to have split sometime in the Middle Miocene. Of the E. sicanus, the specimen from Malta was most basal and estimated to have diverged from the rest between the Middle and Late Miocene. Of the remaining E. sicanus, two specimens from Greece (eastern Thessaly) formed a strongly supported group that was predicted to have diverged from the Late Miocene to early Pleistocene. Although poorly supported, the specimens from Sardinia and Tunisia grouped together in both analyses and were predicted to have diverged from the other E. sicanus in the Late Miocene to early Pliocene. The Tunisia specimen was estimated to have diverged from the specimen from Sardinia sometime between the Late Miocene and late Pliocene, with a mean divergence date estimate of 5.56 Ma (Table 1).

Discussion

In a review of E. sicanus, Fet et al. (2003) wrote that “No DNA is available from the northern African enclaves yet; it remains to be seen if these are true relict populations or if they have been introduced via human activity.” The analyses presented herein support the former hypothesis, that North African E. sicanus from Tunisia are genetically distinct and represent a relict population. Our sample of E. sicanus from Tunisia grouped most closely with a sample from Sardinia. Both Sardinia and Tunisia samples were more distantly related to samples from Greece and Malta. Molecular dating estimated samples from Sardinia and Tunisia to have diverged between the Late Miocene (3.29 Mya) and early Pliocene (8.14 Mya), with a mean estimate near the Mio-Pliocene transition (5.56 Mya), suggesting that the disjunction across the Mediterranean Sea is quite ancient (Fig. 4, Table 1). Intriguingly, this timeframe very closely matches that of a widespread drying and refilling of the Mediterranean Basin in the late Miocene (more precisely the Messinian).

Approximately 5.96 Mya, marine gateways between the Atlantic Ocean and Mediterranean Sea closed due to uplift along the African and Iberian continental margins (Duggen et al., 2003). This resulted in a pervasive desiccation of the Mediterranean Basin known as the ‘Messinian salinity crisis’, which was one of the most dramatic earth history events during the Cenozoic era (Krijgsman, 2002). Evaporation of the Mediterranean Sea is thought to have allowed many terrestrial organisms that were previously isolated by marine waters (e.g. Martín-Piera & Sanmartín, 1999; Sanmartín, 2003; Wilke, 2003), to more easily disperse throughout the region. Tectonic subsidence then allowed Atlantic water to make its way through the Gibralter Strait at 5.33 Mya. This refilling of the Mediterranean Basin, known as the ‘Zanclean’ or ‘post-Messinian’ flood, then appears to have caused vicariance between terrestrial organisms in North Africa and Europe (Sanmartín, 2003). Such a scenario could account for the genetic divergence between E. sicanus from Tunisia and Sardinia. Although we have not studied samples from the Italian mainland (Apennine Peninsula), paleogeographic reconstructions suggest that terrestrial connections occurred between Italy, North Africa, Sicily, Sardinia, and Corsica until the Late Miocene or Pliocene (Rosenbaum & Lister, 2002). Therefore, E. sicanus may have dispersed between these regions, which may have been made even easier during the Messinian salinity crisis. Increased longitudinal crustal extension could have then worked synergistically with the refilling of the Mediterranean basin to effectively sever land connections between our samples from Sardinia and Tunisia, which is concordant with our estimated divergence dates (Fig. 4, Table 1).

If the Zanclean flood was responsible for vicariance in Euscorpius, then our rate-calibrated molecular clock was remarkably accurate. Therefore, for similarly distributed taxa (in North Africa and Sardinia) that lack reliable rates, we propose that the Zanclean flood could potentially be used as an incredibly precise geologic calibration. Paleogeographic events like uplift and marine transgressions have commonly been used to date vicariant events, but these events happen gradually and the actual timing of the reduction in gene flow cannot be pinpointed. However, the Zanclean Flood is thought to have filled the Mediterranean in 2 months to 2 years (Garcie-Castellanos et al., 2009), and as similarly proposed for river capture and reversals with freshwater-limited organisms (Waters et al., 2007), the event could potentially be used as a 'sharp' vicariant event, allowing for more precise calibrations. Other authors have already used this sharp vicariant event to calibrate molecular clocks for organisms in the eastern Mediterranean, as it is thought to have isolated populations on Crete and Cyprus (e.g. Beerli et al., 1996; Gantenbein & Keightley, 2004; Lymberakis et al., 2007; Akin et al., 2010; Kornilios et al., 2012). As far as we are aware, however, this method has not yet been employed for organisms from Tunisia and Sardinia.

The placement of our sample from Malta as the most basal lineage within E. sicanus is curious. Based on mtDNA data from 16S (Fet et al., 2003), the same specimen is most closely related to samples from Nebrodi, Sicily, which is the type locality for E. sicanus. Although Malta is closer to Sicily than Sardinia and Tunisia, this relationship is somewhat surprising when considering earth history. As mentioned above, land connections occurred between Sardinia, Corsica, Sicily, and Tunisia until the Late Miocene to early Pliocene. Although an underwater ridgeline connects the Maltese Islands with Sicily and Tunisia, paleogeographic reconstructions suggest that the archipelago may have remained insular for at least several million years longer (Rosenbaum & Lister, 2002). Therefore, the Maltese Islands could have been colonized by mainland populations of E. sicanus that dispersed to the islands prior to the Messinian salinity crisis. Alternatively, E. sicanus could have colonized the island of Malta and dispersed to the mainland, probably Sicily, where it may now occur in sympatry with other lineages (represented by our sample in Sardinia) that diverged during the Zanclean Flood. Additional sampling along the along the Apennine Peninsula, Sicily, and the remaining Maltese Islands would be needed to address this hypothesis.

Whatever the mechanism, DNA barcodes imply that North African populations of E. sicanus were probably not recently introduced and instead represent an ancient and isolated natural population. If E. sicanus had recently colonized the area via human introduction, then the cox1 barcode should have been similar to those from E. sicanus collected in Malta, Greece, or Sardinia, from which the Tunisian population would have most likely been founded. However, we recognize that our sampling is limited, especially in Italy, and that additional cryptic lineages could occur within the species, so recent colonization of North Africa should not be completely ruled out. Furthermore, the age of the intraspecific lineages recovered in E. sicanus (some with estimates in the Miocene) suggest that the species might actually represent a cryptic species complex, calling attention to the need for a rigorous and comprehensive assessment of the genus Euscorpius. To date, most systematic studies of Euscorpius have focused on western Mediterranean and central European species (Gantenbein et al., 2000, 2001; Fet et al., 2003; Salomone et al., 2007). However, recent work has revealed that Euscorpius is most diverse in the poorly studied eastern Mediterranean, especially the Balkans, the Aegean region, and Anatolia (Fet et al., in progress). Finally, our analyses provide yet another example of how DNA barcodes can be used for more than just identifying and discovering species (Hebert et al., 2003; Stoeckle, 2003), and that ‘sharp’ vicariant events like the Zanclean Flood may be useful for fine-tuning molecular clocks.

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First data on scorpion diversity and ecological distribution in the National Park of Belezma, Northeast Algeria

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Abstract

This study refers to the observations and collections of scorpions at National Park of Belezma (NPB), in Batna, Northeast Algeria. During the summer of 2006, the investigations conducted in the forests of Atlas cedar (Cedrus atlantica M.), of Aleppo pine (Pinus halepensis L.) and Holm oak (Quercus ilex L.) resulted in collecting a total of 103 scorpion specimens representing three species, belonging to two different families. The family Buthidae is represented by Androctonus bicolor (relative abundance “RA” = 1.9%) and Buthus occitanus (RA = 82.5%). The family Scorpionidae is represented only by Scorpio maurus (RA = 15.5%). According to the canonical correspondence analysis (CCA), two groups with more or less homogeneous distribution are distinguished: A. bicolor and S. maurus frequent foothills dominated by the herbaceous layer between 900 to 1100 meters of altitude, while B. occitanus was found in high mountain habitats at more than 1300 meters of altitude where the covering of woody vegetation is high. The main habitats colonized by these species are discussed according to their orographic characteristics, general appearance of the substrate and the structure of vegetation cover.

Keywords: scorpion, Androctonus bicolor, Buthus occitanus, Scorpio maurus, biodiversity, species range, montane landscape, Belezma, Algeria.

Introduction

The terms biodiversity or biological diversity were introduced by naturalists who were concerned about the rapid destruction of natural environments (Lévêque &

Mounolou, 2008). Becoming aware of their impact on natural environments and threats of exhaustion of biological resources, researchers proceeded to the study and the conservation of these natural heritages. Among the poorly investigated items of animal diversity, the scorpions, which are one of the oldest terrestrial groups on the planet, have a wide distribution, and are excellent biological models to be explored (Polis, 1990).

Currently more than 1500 species of scorpions, distributed in 18 families, are described worldwide (Prendini & Wheeler, 2005). Although comprising a relatively small group of terrestrial arthropods, scorpions are subjects of considerable interest to both the scientist and the layperson. Ecologically, scorpions are important components of arid and semiarid ecosystems, but they are not limited to these areas. They may be found over different biomes in other habitats including forests, grasslands, and high mountains, and caves (Sissom & Hendrixson, 2006). In general, scorpion species distributions depend on a range of climatic and environmental variables such as temperatures, rainfall, elevation, slope, aspect, soil properties, vegetation type and land cover (Polis, 1990; Prendini, 2005).

Scorpions are carnivorous and cannibalistic arthropods, occupying an important position in the food chain because they are considered highly efficient predators of different taxa, namely: Coleoptera, Blattaria, Orthoptera, Araneida, other Scorpionida, and even small mammals and reptiles (Gouge & Olson, 2001; Sadine, 2005).

North Africa was the subject of several studies on scorpions, which showed a relatively high scorpion diversity (Vachon, 1952; Lourenço, 2003). This group poses a real public health problem by the high incidence of scorpion envenomation (Goyffon & Billiald, 2007). New species and even genera are still being discovered in Ethiopia, Niger, Morocco, Egypt and Algeria (Lourenço, 1998, 1999a, 1999b, 2005; Lourenço & Leguin, 2011; Touloun & Boumezzough, 2011).

Algeria by its vast geographic scope, its various climates and diverse ecosystems houses a diverse scorpion fauna. More than 28 species, belonging to 13 genera and three families (Buthidae, Euscorpiidae and Scorpionidae) are described for the country (Vachon, 1952; El-Hennawy, 1992; Dupré, 2011). The northern Sahara in the east of Algeria is particularly rich with this fauna; it houses more than 30% of national richness (Sadine, 2012), where the Souf region itself represents almost 28% (Sadine et al., 2011) and the Ouargla region more than 21% (Sadine & Idder, 2009).

However, huge gaps exist in the knowledge of this fauna in the north of the country, particularly in forest and mountain regions. From this point of view, this work aims to enrich the existing knowledge on scorpion diversity in the protected area of the National Park of Belezma (NPB) on the one hand, and to describe the environmental conditions of habitats in which each species lives, on the other hand.

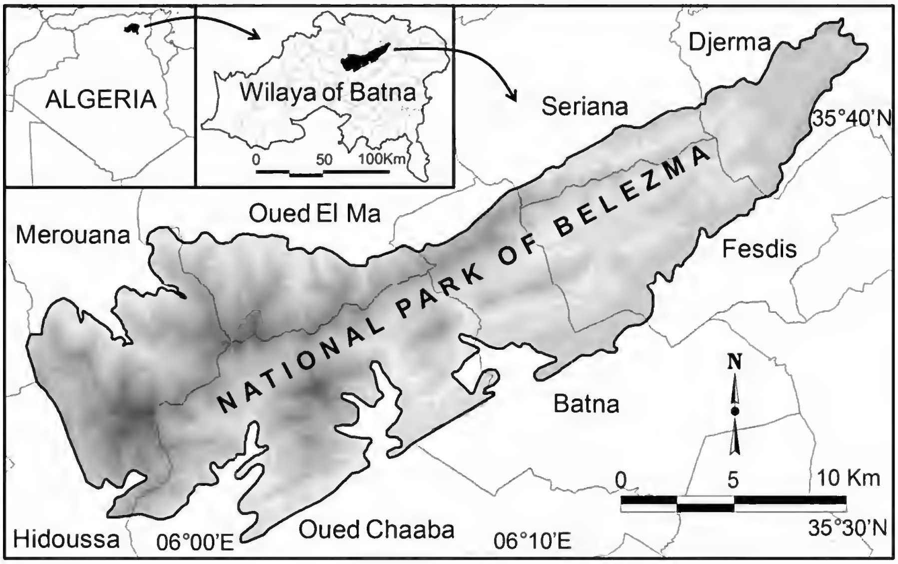
Material and Methods

Study area

The National Park of Belezma (26,250 ha) is located at the western end of the Aures Mountains in the eastern part of northern Algeria, northwest of Batna City (~ 300.000 inhabitants). Its geographic coordinates are 35°32'40"N to 35°37'46"N and 5°55'10"E to 6°10'45"E (Map 1). The massif of Belezma is a protected high mountain area characterized by a very rugged relief, with slopes often exceeding 75° and peaks up to 2136 m (Djebel Tichaou) and 2078 m (Djebel Reffaa).

Minimum temperatures are recorded in January (0-8°C) and maximum temperatures, in July (30-35°C). The annual average of rain precipitation is about 350 mm. The general bioclimate is semi-arid with a cold winter. However, the altitudinal gradient brings up subhumid and humid bioclimates while climbing the altitude

(Chenchouni et al., 2010). This bioclimatic diversity corresponds to an impressive biodiversity in flora (510 species) and fauna (over 400 species) as well as in ecosystem structure (Chenchouni et al., 2008). Tree species characteristic of the NPB are Quercus ilex (Fagaceae), Cedrus atlantica (Pinaceae), Pinus halepensis (Pinaceae), Juniperus oxycedrus (Cupressaceae), Juniperus phoenicea (Cupressaceae) and Fraxinus xanthoxyloides (Oleaceae).



Map 1. Location map of the National Park of Belezma (Batna, Northeast Algeria).

Sampling and data collection

During the period stretching between July and August of the year 2006, investigations were conducted at the NPB in forests of Atlas cedar (Cedrus atlantica M.), of Aleppo pine (Pinus halepensis L.) and of Holm oak (Quercus ilex L.).

A systematic sampling of scorpions, based on observations and direct captures in situ was applied. In each habitat, areas suspected of housing scorpions (under rocks, pieces of wood, ...) were systematically explored. At each sampling point, habitat descriptors were recorded: elevation above sea level “a.s.l.” (m), Aspect, ground physiognomy, vegetation layers and cover (%). During the identification of specimens collected, we referred to morphological criteria, among others: the total length, the carina arrangement on the body (cephalothorax, abdomen and sting), the shape of the sting and the pedipalps and the number of teeth of the pectine. Species identification was based on identification keys established by Vachon (1952), Kovařík (2009) and Lourenço (2009).

Data Analysis

To detect gradients in species composition and in species-environment relations, canonical correspondence analysis (CCA) was performed. Specifically, we used the CCA to allow us to relate the abundance of species to environmental variables and thus to highlight relationships between environmental variables and the distribution of scorpion species. With its ability to combine ordination and gradient analysis functions, the CCA is convenient to visualize dimensional ecological data in a readily interpretable manner without prior transformation (Ter Braak, 1986; Palmer, 1993). During CCA computation, elevation and vegetation cover were taken as quantitative explanatory variables, while

Aspect, ground physiognomy and vegetation layers were considered as qualitative explanatory inputs. The permutation test was used to test the significance of CCA with 1000 permutations at a significance level of 5%.

Results

The systematic inventory, following to the identification of a set of 103 specimens, consists of three species, belonging to two families: the Buthidae represented by Androctonus bicolor Ehrenberg, 1828 and Buthus occitanus Amoreux, 1789, and Scorpionidae represented by Scorpio maurus Linnaeus, 1758 (Table 1).

Table 1. Relative abundance of scorpion species recorded in NPB, with characteristics of surveyed habitats.

Family	Buthidae	Buthidae			Scorpionidae
Species	Androctonus bicolor Ehrenberg, 1828	Buthus occitanus Amoreux, 1789			Scorpio maurus Linnaeus, 1758
Relative Abundance (%)	1.9	10.6	4.9	67.0	15.5
Elevation (m)	900–1100	800–1100	1100–1300	1300–2000	900–1100
Aspect	south	south, south-east, south-west			south
Ground physiognomy	Gravelly and stony grounds				
Vegetation layer	Herbaceous	Herbaceous	Upper tree	Upper tree	Herbaceous
Vegetation cover (%)	50	>50	<60	80	>50

At the NPB, A. bicolor (Fig. 1A) appears only with two individuals (RA = 1.9%). It frequents the foothills of Belezma between 900 to 1100 meters of altitude where the herbaceous layer is dominant (covering > 50%) on a predominantly stony soil. B. occitanus (Fig. 1B) is most abundant in the NPB with a relative frequency of 82.5%. It is found more abundantly (RA = 67.0%) in high mountain habitats at over 1300 meters of altitude where the tree layer, mainly composed of Cedrus atlantica, has a large covering (> 80%). S. maurus (Fig. 1C) with RA = 15.5%, is encountered only in southern orientation foothills at altitudes ranging from 900 to 1100 meters. Sites where the species is found are mainly characterized by Quercus ilex, Pinus halepensis and Juniperus oxycedrus, where the herbaceous layer occupies a covering > 50% on stony soil surface (Table 1).

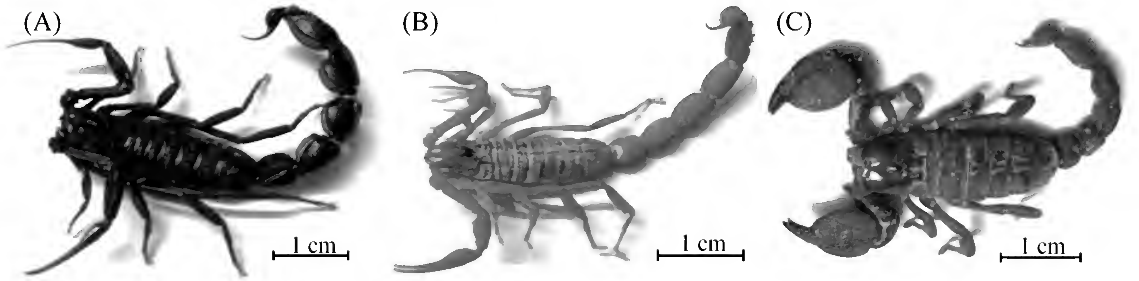


Fig. 1. Photographs of the censused scorpions of NPB: (A) Androctonus bicolor, (B) Buthus occitanus, and (C) Scorpio maurus, by Salah Eddine Sadine (2010).

CCA Eigenvalues of species and environment scores in canonical axis 1 and 2 were high and explaining 93.8 % and 6.2 % of the constrained inertia, respectively. A test for significance with a permutation test (1000 permutations) confirmed the significance of the first two axes (p = 0.011) (Table 2). As the computed p-value is lower than the significance level alpha = 0.05, we should accept the hypothesis that the sampled habitats/species abundances data are linearly related to the habitats/variables data.

Table 2. The results of canonical correspondence analysis (CCA) and permutation test for studied environmental traits.

Summary of CCA	**Axis 1**	**Axis 2**
Canonical Eigenvalue	0.54	0.04
Constrained inertia (%)	93.75	6.25
Cumulative %	93.75	100.00
Total inertia	77.37	5.15
Cumulative % (%)	77.37	82.52

Summary of the permutation test	
Permutations	1000
Pseudo F	1.574
p-value	0.011
alpha	0.050

From the intra-set regressions of the habitat factors with the two axes of CCA; elevation, vegetation cover and vegetation layer were the most significant parameters in axis 1. Upper-tree vegetation was positively correlated with elevation and vegetation cover, while herbaceous layer was negatively correlated with elevation and vegetation cover. Ground physiognomy, vegetation cover and elevation a.s.l. show comparatively high regression coefficient values with axis 2 (Table 3).

Table 3. Intraset regression coefficients of habitat variables with axes of CCA ordination.

Environmental variables	**Axis 1**	**Axis 2**
Elevation	0.479	-0.002
Vegetation cover	0.229	-1.665
Vegetation layer		
Herbaceous	-0.180	-0.656
Upper tree	0.180	0.656
Aspect		
South	-0.034	-0.285
South-east	-0.004	0.574
South-west	0.044	-0.093
Ground physiognomy		
Gravelly (2–15 cm)	0.035	-0.313
Stony (>15 cm)	-0.035	0.313

According to CCA analysis, Scorpio maurus was associated herbaceous vegetation in southern aspects. Vegetation layers and aspects indicated a strong trend of variation from left to right. Ground physiognomy varied from up to down where stony grounds separated, from other species on axis 2, the Androctonus bicolor, which was also associated with herbaceous vegetation in southern aspects. In addition, axis 1 showed several factors influencing the distribution of Buthus occitanus, which was positioned on the opposite site of the axis 1 as compared to the other species. This species was positively associated with elevation, upper-tree vegetation, vegetation cover, SW and SE aspects. Both A. bicolor and S. maurus were negatively associated with elevation, upper-tree vegetation and vegetation cover (Fig. 2).

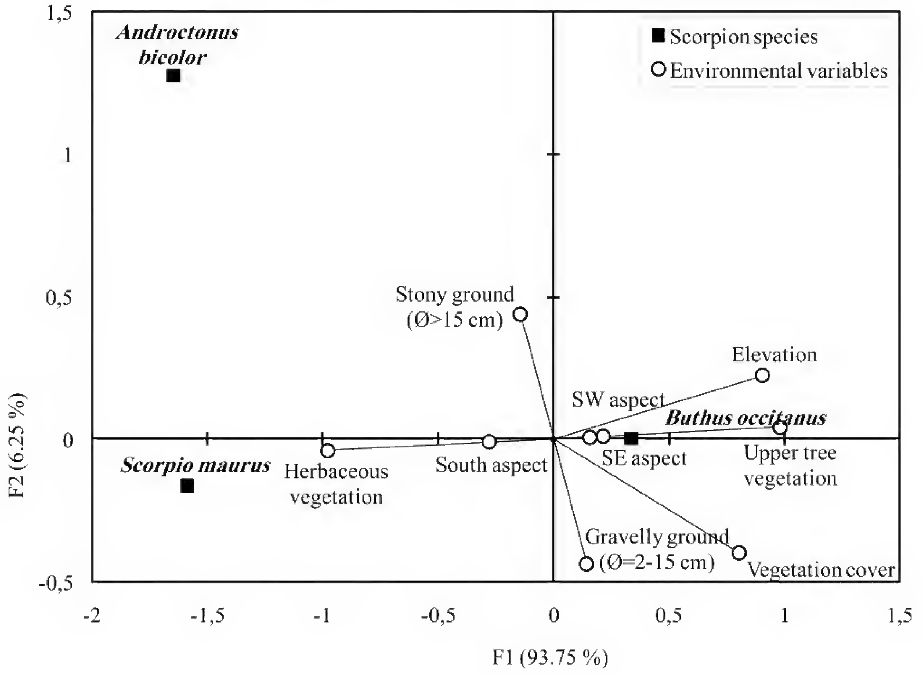


Fig. 2. Canonical Correspondence Analysis (CCA) diagram for habitat traits and scorpion species.

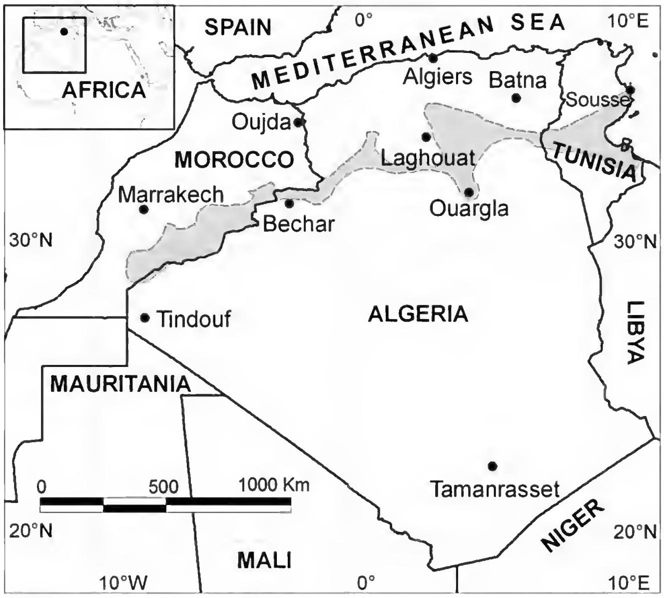
Discussion

Although this study was carried out during the hot summer period permitting good sampling of the arthropodofauna, species diversity is low at the NPB. This could be due to more or less cold climatic conditions unfavourable to the existence of a significant diversity in species of scorpions which are more abundant in deserts and arid areas (Polis, 1990; Qi & Lourenço, 2007).

Androctonus bicolor Ehrenberg, 1828

Androctonus bicolor was synonymised with Androctonus aeneas by Lourenço (2005). The distribution of this species is North African, occurring from Tunisia to Morocco through the Hauts plateaux region in Algeria where it occupies the central horizontal band of Tebessa and Khenchela in East Algeria, to Naama in the west (Map 2) (Vachon, 1952; Sadine, 2012).

The rarity of this species in the NPB (RA = 1.9%) is explained by the occurrence of the species outside its limit of distribution in altitude and high latitude, which is defined by Vachon (1952), in Eastern Algerian, in the Zibans and in the southern limits of Saharan Atlas chain (Map 2). Furthermore, the CCA showed that the abundance of the species is negatively correlated with the dense forest vegetation (vegetation structure) on the one hand and with altitude that determines the climatic conditions of the site on the other hand. However, the analysis revealed that A. bicolor has an affinity to herbaceous habitats more or less warm (south aspects) whose surface is dominated by large boulders. Indeed, Vachon (1952) captured individuals in geomorphological forms, with sparse rangeland-floristic compositions, similar to foothills of Belezma in Laghouat (Messaad and Taguine) and Biskra (Ouled Djellal). In the Lower Sahara, Sadine et al. (2011) stated that A. bicolor is found in specific biotopes like Reg or plain lands with a stony bottom.

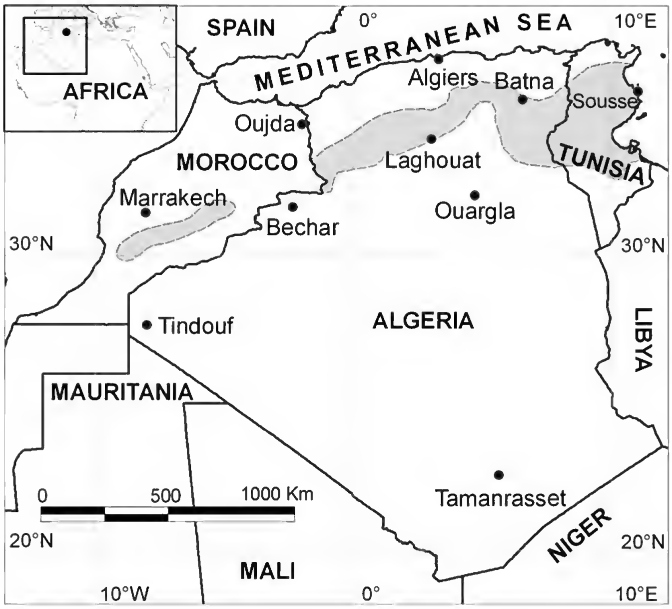


Map 2. Distribution of Androctonus bicolor in North Africa (map according to Vachon, 1952).

Buthus occitanus Amoreux, 1789

B. occitanus and its subspecies have a wide distribution in North Africa. It was the subject of several studies in North Africa (Vachon, 1952; Fet & Lowe, 2000), Morocco (Touloun et al., 1999), Algeria (Lourenço, 2002) and Tunisia (Kovařík, 2006). It frequents preferentially arid and semi-arid areas of southern slopes of the Atlas Mountains (Map 3). This eurytopic species occupies various types of environments; low altitude, under stones, in sand, in the forests as well as in altitude, in the mountains, even near snow line (Vachon, 1952). These findings are supported by the CCA. As an indication, the related species B. tunetanus (formerly subspecies B. occitanus tunetanus) is one of the scorpions that can populate the habitats of high mountains, namely; Oued Nail Mountains and High tablelands (near Djelfa) and the Mountains of Ksour and Abiodh (El-Hennawy, 1992).

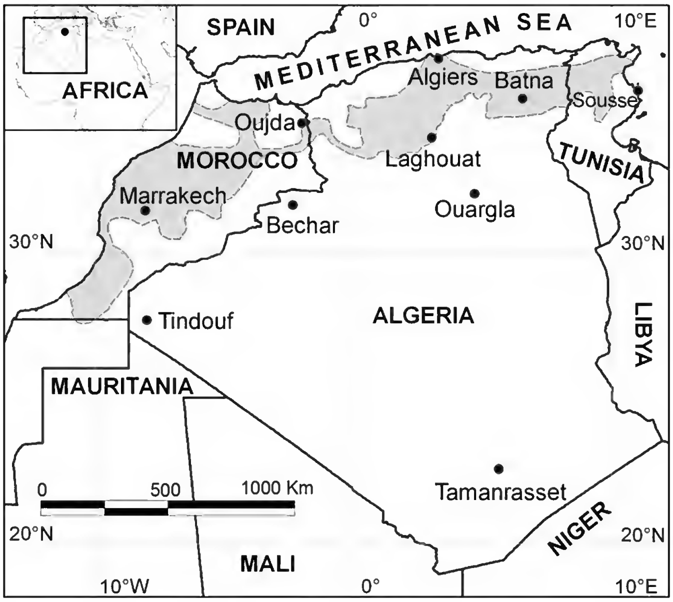
Although the NPB constitutes the upper latitudinal limit of the distribution of the species (Vachon, 1952), the abundance of this species may provide information about its plasticity and wide geographic distribution. Indeed, according to El-Hennawy (1992), the species has a wide distribution extending from northern Algeria (from Constantine in the east) to the south of the country in the Hoggar. The CCA confirms the wide ecological valence of the species whose abundance is strongly associated with altitude (climate staging), the vegetation covering and the tree layer.



Map 3. Range of B. occitanus in Maghreb (map according to Vachon, 1952).

Scorpio maurus Linnaeus, 1758

The genus Scorpio with its numerous subspecies was the subject of several taxonomic revisions (Lourenço, 2009; Kovařík, 2009). Currently, two species are recognized in Algeria, S. maurus and S. tunetanus (Simon, 1910; Fet, 2000; Acosta & Fet, 2005). Although S. maurus or its subspecies are known to be able to live at high altitude (Abdel-Nabi et al., 2004; Sadine & Idder, 2009), particularly in North Africa (Vachon, 1952) (Map 4), it has a localized altitudinal distribution (900 to 1100 m a.s.l.).



Map 4. Population distribution of S. maurus (map according to Vachon, 1952).

Similarly, The CCA revealed a strong influence of the herbaceous layer (open habitats) despite that it frequents shrubby habitats, the "garrigue" composed of Quercus ilex, Pinus halepensis and Juniperus oxycedrus. Moreover, S. maurus is a fossorial species that prefers soils relatively moist (Vachon, 1952) or freshly worked (Sadine, 2009, 2012). Pallary (1929) mentioned the presence of the subspecies S. maurus palmatus in the high peaks of the Hoggar at 2450 m a.s.l.

Conclusion

This study is the first to highlight the composition of scorpion community in the National Park of Belezma. It described some environmental factors of sampled habitats in relation with scorpion distribution. Despite the relatively small area surveyed in the NPB, three scorpion species from different genera are identified, which constitutes a generic richness of 10.7% compared to the national level. Distribution patterns and habitats occupied by the surveyed species are heterogeneous, which deserves to be studied further by advanced approaches to identify the different ecological status of species recorded. Taking into account the high montane location of the NPB, which is also the southern limit of latitudinal distribution of several scorpions, it is recommended to carry out morphometric and molecular studies to investigate the existence of taxa or geographically differentiated populations.

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Scorpion envenomation in the region of Marrakesh Tensift Alhaouz (Morocco): epidemiological characterization and therapeutic approaches

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Abstract

Morocco is a country in northwest Africa on the Mediterranean Sea and the Atlantic Ocean which presents an extremely diversified and rich scorpion fauna. In the Marrakesh Tensift Alhaouz region, scorpions have great medical importance where scorpionism remains a genuine public health problem for local populations. Scientific expeditions in this region, carried out since 1994, allowed us to record 11 species and subspecies that represent 28% of Moroccan scorpion fauna, including ten that are endemic to the country. The distribution maps of all these species had already been established and then updated, which allowed us to specify new factors affecting their distribution modes. The present epidemiological study on scorpionism through prospective investigation has shown the severity of this problem. Of 724 scorpion sting cases, 32 deaths were reported between 1996 and 2006. Androctonus mauritanicus (Pocock, 1902) is the most medically important scorpion species in the study area (responsible for 53% of cases). Respective elevated morbidity and mortality rates of 30% and 48% have been recorded from accidents occurring in dwelling interiors. Limb extremities comprise the body areas that most exposed to stings (59%) which occurred predominantly during the summer period (53%). The age group most affected ranged from 16 to 30 years old (42%). This study determined some epidemiological characteristics of these envenomations and established their causes, origins and consequences.

Keywords: scorpions, Marrakesh Tensift Alhaouz region, scorpionism, epidemiology.

Introduction

Scorpionism is a current public health problem in several parts of the globe that involves an at-risk population of 2.3 billion. The annual number of scorpion stings exceeds 1.2 million leading to more than 3250 deaths (0.27%) (Chippaux & Goyffon, 2008). In Morocco it represents the most frequent cause of poisoning according to the Poison Control and Pharmacovigilance Center of Morocco. The Moroccan scorpion fauna is known to be the richest and most diversified not only in North Africa but also in the entire Mediterranean circumference. The monograph of Max Vachon (1952) on the systematics and distribution of North African scorpions reports that the majority of the Moroccan scorpion fauna was known at that moment.

Between 2001 and 2004, 81471 scorpion stings were registered by the Poison Control and Pharmacovigilance Center of Morocco with an average incidence of 1.2% (Soulaymani et al., 2005). Marrakesh Tensift Alhaouz is certainly one of the most severely affected regions by the existence of severe scorpionism, as expressed by 7,703 scorpion stings registered during the same period, a 2.8% incidence and a lethality rate of 0.011% (Soulaymani et al., 2005).

In the province of El Kelaa Seraghna, located in our study area, the average incidence was 3.2 per 1000 inhabitants. Patients aged less than 15 years accounted for 34% and the envenomation rate was 12%. The average lethality rate was 0.7% (El Oufir et al., 2008). Underestimated cases, not captured by these statistics, were more frequent in populations situated far from health establishments. This high incidence is also related to the presence of a rich scorpion fauna that presents high venom toxicity (Touloun et al., 2001). A rational fight against the envenomations in this region as in the other Moroccan regions more affected by scorpionism requires the identification of the dangerous species and their distribution. In this context, the present study aims to synthesize a framework in which to analyze the taxonomical, ecological, biogeographical and epidemiological aspects of Moroccan scorpions, to achieve the most complete possible inventory of the scorpion fauna of the study area, and to map the distribution areas of diverse forms as well as to determine the epidemiological characteristics of the scorpionic envenomations by means of a prospective study of the local populations.

Methodology

Study area

The region of Marrakesh Tensift Alhaouz (Fig. 1) covers an area of 31,160 km^2, equivalent to 4.3% of the national territory. It is bounded on the north by the region of Chaouia-Ouardigha and the region of Doukkala-Abda, to the east by the region of Tadla-Azilal, in the south by the region of Souss Massa-Drâa and to the west by the Atlantic Ocean. It includes the provinces of Alhaouz, Chichaoua, El Kelâa des Sraghna, Essaouira and Marrakech. These lands contain 198 rural and 18 urban communes. The region's population comprised 3,102,652 inhabitants in 2004.

Capture of scorpions

To locate scorpions, the ground was examined by lifting stones and tree bark. The burrows considered to be occupied by scorpions were destroyed with a shovel to try to dislodge them. For the anthropophilic species, we investigated under stones and near indoor dwellings. The property that renders the scorpion carapace strongly fluorescent under ultraviolet light creates an excellent opportunity to detect these nocturnal arachnids. For this, the nocturnal missions in the field have been carried out with portable ultraviolet lamps. Scorpions were usually collected with large forceps by seizing the last segment of the tail to avoid the risk of sting. Moults and corpses were also collected and identified. In the laboratory, the scorpions were identified by determination keys of Vachon (1952) and Lourenço (2003).

Fig. 1. Map of the region of Marrakech Tensift Alhaouz.

Epidemiological study of scorpion envenomations

Our survey aimed to specify certain epidemiological characters of scorpion stings in order to delineate the consequences that will serve as methodological basis for estimating morbidity and mortality. Data collection is done through direct contact with local populations. All persons stung by a scorpion were interviewed via a questionnaire that collected data about the envenomation, the scorpion species and the measures taken after the sting.

Results and Discussion

The scientific expeditions in the studied area between 1994 and 2010 have enabled us to identify 11 species and subspecies (thus 21% of species listed in the country) including ten endemic to Morocco.

Family Buthidae is represented by eight species, all endemic to Morocco except Buthus paris (C.L. Koch), distributed into four genera. Family Scorpionidae is represented by a single genus Scorpio that has been differentiated into three species endemic to Morocco. The following is the list of scorpion species recorded in the study area:

Family **Buthidae** C.L. Koch, 1837
Androctonus mauritanicus (Pocock, 1902)
Butheoloides maroccanus Hirst, 1925
Buthus atlantis atlantis Pocock, 1889
Buthus lienhardi Lourenço, 2003
Buthus malhommei Vachon, 1949
Buthus mardochei Simon, 1878
Buthus paris (C.L. Koch, 1839)
Hottentotta gentili (Pallary, 1924)

Family **Scorpionidae** Latreille, 1802
Scorpio fuliginosus (Pallary, 1928)
Scorpio mogadorensis Birula, 1910
Scorpio weidholzi Werner, 1929

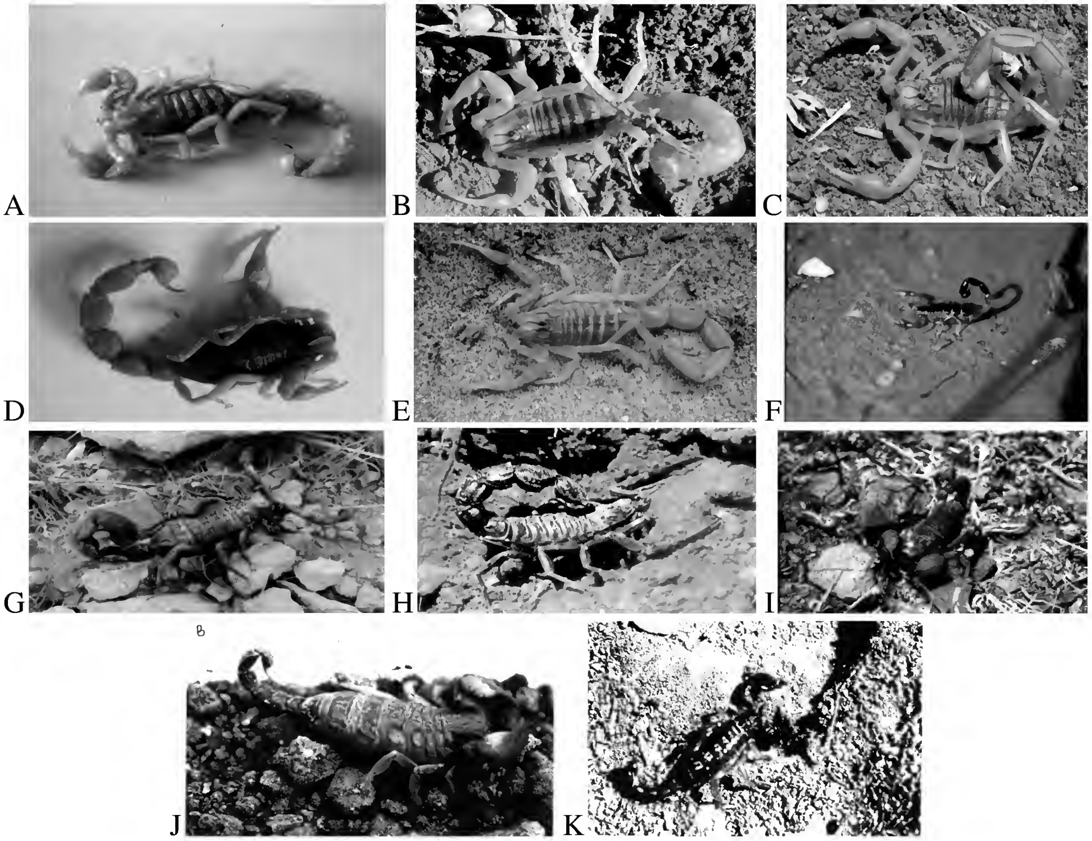

Fig. 2. Scorpions recorded in the region of Marrakesh Tensift Al Haouz.
A. Buthus malhommei B. Buthus paris C. Buthus lienhardi D. Buthus mardochei E. Buthus atlantis atlantis F. Butheoloides maroccanus G. Hottentotta gentili H. Androctonus mauritanicus I. Scorpio weidholzi J. Scorpio fuliginosus K. Scorpio mogadorensis

Description and distribution of the scorpion fauna

Family **Buthidae** C.L. Koch, 1837

- Buthus malhommei Vachon, 1949 (Fig. 2 – A) is a yellow-brown scorpion with a darker abdomen but without differentiated bands. Its size can reach 7.5 cm and it may be found in the area that covers the Haouz plain and extends north toward the Jbilets small mountain range to occupy the Central Bahira and El Kelâa des Seraghna. The Chichaoua hills represent the southern boundary of its presently known distribution (Fig. 3).
- Buthus paris (C.L. Koch, 1839) (Fig. 2 – B) is a yellow-brown scorpion with a darker dorsal abdomen which size can reach 8.5 cm. This species is adjusted to the foothills north of the High Central and Western Atlas below 1300 m altitude (Fig. 3).
- Buthus lienhardi Lourenço, 2003 (Fig. 2 – C) presents a straw-like yellowish colour with a darker abdomen without differentiated bands. Its size can reach 7.4 cm. This species is one of the representatives of the Moroccan fauna of high mountains. In the High Atlas Mountains, we have found it in Tizrag (Oukaimeden mountain) at altitudes between 1100 m and 2600 m. In these regions, this ubiquitous scorpion occupies also the asylvatic biotopes where the snow persists several months (seven months sometimes in Tizrag) (Fig. 3).
- Buthus mardochei Simon, 1878 (Fig. 2 – D) is a yellowish scorpion with a slight dark axial line and two dark lateral bands on the dorsal part of the abdomen and a size not

exceeding 6 cm. It occupies the central west High Atlas region and the regions of Smimou, Tamanar, Aourir and Haha (Fig. 3).

- Buthus atlantis atlantis Pocock, 1889 (Fig. 2 – E) is a large yellow scorpion. Its size may reach 8.5 cm. It is fossorial and also may hide under stones and rocks. It occupies the sandy substrates around the Atlantic coast where it is more frequent (Touloun, 1997). In the interior of the land, it penetrates up to 20 km into the Argan forest to the east of Essaouira at an altitude of approximately 300 m, but always in sandy substrates with stones or rocks (Fig. 3). It is rarely found in other types of substrates.
- Butheoloides maroccanus Hirst, 1925 (Fig. 2 – F) is a small brown-black scorpion which size does not exceed 2.8 cm. It is essentially found on rocky substrates and is extremely rare, probably because of its size and low population density. It occupies the Jbilets, the High Atlas and the south of the Anti Atlas (Touloun, 1997; Touloun et al., 1996). The Jbilets region provides a good refuge for this species. In the High Atlas, Tizi n' Test (2,000 m) represents its highest station. Its distribution area in Argana (High Occidental Atlas at 650 m of altitude) and in Toufliht (High Central Atlas at 1,300 m) extends towards the west and towards the east of the Atlas Mountains. This scorpion has long been considered endemic in the north High Atlas. However, it has been discovered 10 km northwest of Tiznit on rocky hills near the town of Sidi Moussa in 550 m of altitude in a Euphorbia echinus steppe (Touloun, 2004). This station is still considered the most southern for the species, thus amplifying significantly towards the south into its formerly known distribution area. It is very likely that future prospecting could reveal other capture sites.
- Hottentotta gentili (Pallary, 1924) (Fig. 2 – G) is a black scorpion which slim form is easily recognizable by its lengthened caudal segments that are thin and very hairy. Its size may reach 9.5 cm. It is a lithophilic scorpion that is aggressive, agile and fearful. It climbs easily and lives under rocks and stones, but does not burrow. In the southern portion of the studied area, it even penetrates into dwellings. It is a very frequent species in the southern portion of the High Atlas range (Touloun, 2004). In north of the High Atlas, its presence in the Jbilets suggests either a fragmentation of its range or a liability due to transport by humans (Fig. 3). Outside of the studied area, the species reaches the region of Boumalene Dades and the region of Errachidia. The line of Semara-Laayoune still represents the southern limit of the species.
- Androctonus mauritanicus (Pocock, 1902) (Fig. 2 – H) is a big black scorpion with a very thick tail. The size of the adult can reach 9.5 cm. This scorpion enters human dwellings in search of dark wet places. Outside human agglomerations, this species also frequents stony or rocky places, gardens, cemeteries, sewers, manure and old buildings. Furthermore, this scorpion can occupy lizard burrows and rodent tunnels. Its distribution covers the Haouz plain (Fig. 3). It presents little preference for high altitudes where its relative abundance thus remains low. However, it still shows high frequencies (Touloun et al., 2002).

Family **Scorpionidae** Latreille, 1802

In Morocco, family Scorpionidae comprises a single genus, Scorpio Linnaeus, 1758, among which ten species have been described (Lourenço, 2009). Their robust claws of Scorpio serve as supports to dig underground tunnels to oval-shaped openings whose depth sometimes exceeds one meter. Those burrows are built preferably under or near clumps of vegetation where the substrate is soft and easy to widen. In the studied area we have surveyed three species:

- S. weidholzi Werner, 1929 (Fig. 2 – I) is a light brown to dark brown scorpion which adult size can reach 7.5 cm. It is the most common of the three subspecies encountered in the studied area and occupies the Haouz. However, it can rise to an altitude of 1,000 m in the foothill areas of the Ourika valley, Aït Ourir, Amizmiz, Guemassa and Oumnast. Towards the south, it reaches the western extremities of the High Atlas (Fig. 3).

- S. fuliginosus (Pallary, 1928) (Fig. 2 – J) is dark brown to dark reddish brown and the size of the adult can reach 7 cm. This species, endemic to Morocco, lives along the flanks of the High Atlas at altitudes between 900 and 2,000 m (Fig. 3).
- S. mogadorensis Birula, 1910 (Fig. 2 – K) is a brown-black scorpion. The size of the adult can reach 7 cm. It occupies the region of Haha, west of the western High Atlas. On the Atlantic coast only a few meters from the sea, it abounds on rocky substrates. However, it is absent on the dunes formed by the sandy substrates occupied by B. atlantis atlantis (Fig. 3).

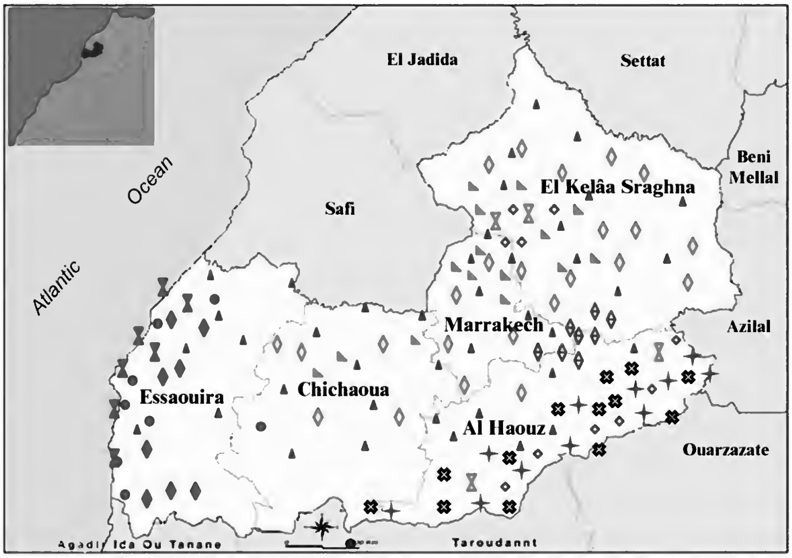

Fig. 3. Scorpion distribution in the region of Marrakesh Tensift Al Haouz.

▲ Androctonus mauritanicus ⧗ Butheoloides maroccanus ⧗ Buthus atlantis atlantis

✢ Buthus lienhardi ◣ Buthus malhommei ● Buthus mardochei ◊ Buthus paris

◇ Hottentotta gentili ✖ Scorpio fuliginosus ♦ Scorpio mogadorensis ◊ Scorpio weidholzi

Epidemiology of scorpion envenomations in the Marrakech Tensift Alhaouz region

During this study, conducted between 1994 and 2006, a total of 724 envenomation cases including 32 fatalities (4.4% of the identified cases) have been reported.

Medically important scorpion species in the study area

In the studied area, some scorpion stings are associated with mild reactions while others may give rise to very serious symptoms which may lead to death. The chi-square test shows that the numbers of both stings ($p < 0.001$) and deaths ($p < 0.001$) depend on the species of scorpion implicated. A strong positive correlation ($r = 0.7$) exists between the sting and death numbers.

A. mauritanicus is responsible for 53% of envenomation cases, followed by Buthus sp. with 31% (Table 1). The former, which lives in houses and their neighbourhood surroundings, is closer to its victims than the latter.

H. gentili causes 11% while Scorpio sp. is responsible for 5% of registered envenomation cases. This scorpion is a strictly burrowing species. It spends the majority of its time hidden deeply in its burrow. Thus, its contact with humans is occasional or very rare and it stings only if it is dislodged from its burrow.

A. mauritanicus is the most dangerous among these scorpions. It is responsible for 68% of deaths (Table 1) while H. gentili is responsible for 32%.

Table 1. Scorpion species divided into numbers of stings and deaths.

Scorpion species	Number of stings	Number of deaths
A. mauritanicus	384	22
H. gentili	80	10
Buthus sp.	224	0
Scorpio sp.	36	0
Total	**724**	**32**

Distribution of scorpion envenomations by area

A scorpion sting is the consequence of an encounter between a human and a scorpion explained by the activities of the former and the ecology and the social or economic behaviour of the latter. The scorpion, when surprised in its hideaway, has no choice other than to sting to defend itself.

This study determines the characteristics of certain scorpion species that sting essentially in the interior of dwellings and their neighbourhood, thus causing 51% of sting cases and 79% of fatal cases (Table 2). The highest morbidity and mortality, respectively 30 and 48%, have been recorded within dwellings.

In certain circumstances, there is a large proportion of aggressions occurred indoor or near houses in the case of species well adapted to places inhabited by humans.
The chi-square test shows that the numbers of both stings ($p = 0.02$) and deaths ($p = 0.013$) depend on the place of the sting. A positive correlation on the order of 0.172 exists between these two numbers.

A specific at-risk population of sting victims cannot be specified given that farmers as much as city dwellers, adults as well as children, and men as much as women are afflicted. However, there are regional variations that place some categories of persons at greater exposure to the risk, namely, in the fields, far from human dwellings, agricultural work poses a major risk of envenomation by species of genus Buthus with 122 envenomation cases (54.5% of sting cases) (Goyffon & El Ayeb, 2002).

Table 2. Scorpion stings divided according to accident place.

Sting place	Number of stings	Number of deaths
House	217	15
House neighbourhood	152	10
Fields	239	3
Diverse	116	4
Total	**724**	**32**

Human body areas more prone to scorpion stings and envenomation severity

According to our study, the registered scorpion stings occurred either recklessly by lifting stones, putting hands into the interior of ravines or walking barefoot or accidentally when scorpions had been hidden inside shoes, clothes or beds or encountered during agricultural work.

As has been noted in relation to snakes in Brazil and scorpions in Saudi Arabia, data collected during our investigation show that limb extremities constitute the area most exposed to stings (427 cases, that is, 59% of the total) (Fig. 4) (Sgarbi et al., 1995;

Touloun et al., 2001; Al-Sadoon & Jarrar, 2003; Chippaux & Goyffon, 2008). The feet may become the target of these stings by walking barefoot at night or by putting on shoes in the morning without shaking their contents (especially during the hot summer nights). The hands may also be affected by introducing them recklessly into scorpion shelters (holes, burrows or under stones). These stings are essentially recorded during sleep, but sometimes also while a person is dressing without shaking the clothes before. Stings at the level of the trunk, head, neck or any region rich in blood vessels could be a factor in seriousness.

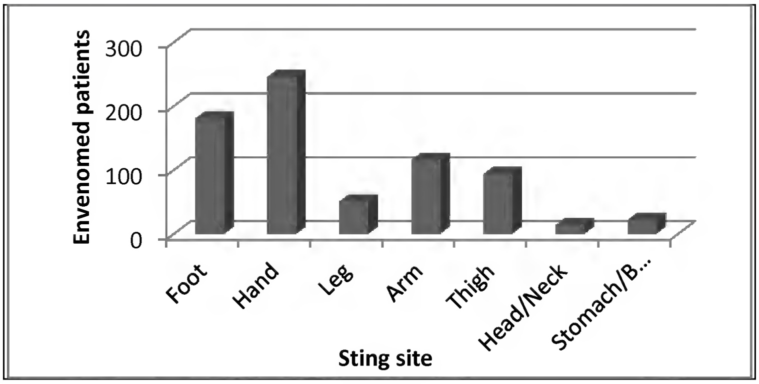

Fig. 4. Envenomed patients classified by sting site.

The fact that the ends of limbs are the body parts most affected suggests that the scorpion is not aggressive spontaneously and a program to educate the population could significantly reduce the incidence. Agriculture still practiced by traditional methods leads to a high exposure incidence especially when the hands are close to the soil or when the tools used are rusty and short.

All sting cases caused by Scorpio sp. were recorded in children who had been intentionally manipulating the scorpion after dislodging it from its burrow.

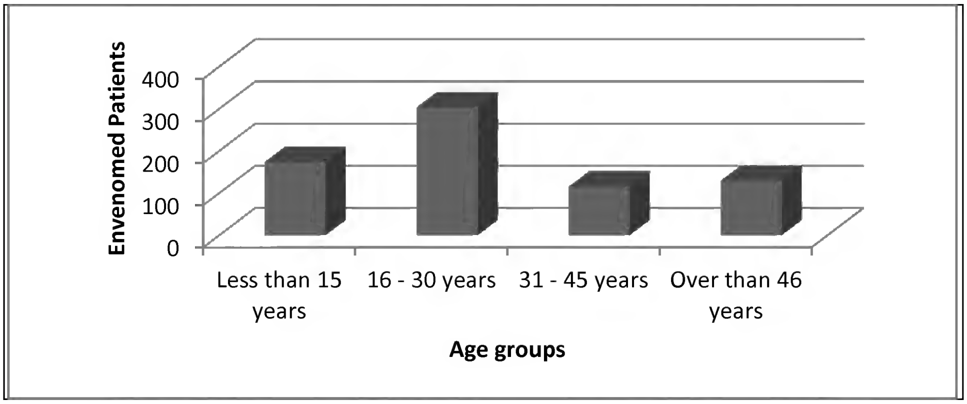

Fig. 5. Envenomed patients divided into age groups.

Distribution of envenomed cases by age groups

The most affected age group ranges from 16 to 30 years, with 42% of cases (Fig. 5). Children less than 15 years old represent 24% of the reported victims and constitute a high-risk group of clinical and epidemiological importance. The registered fatalities were mostly within the age range from seven months to 22 years, but also included one man of 45 years and two older women of approximately 66 and 70 years.

Twenty-four cases (75%) were aged less than 15 years, although children of this age represent only 24% of the total stings. The envenomation severity among children is aggravated by the added impact of their lower body mass in relation to a similar venom quantity received by a heavier person. These results precisely corroborate observations made in Tunisia (Goyffon et al., 1982), USA (Berg & Tarantino, 1991), Israel (Gueron et al., 1992), Saudi Arabia (El Amin et al., 1994), Venezuela (De Sousa et al., 2000) and Morocco (Touloun et al., 2001) which emphasize that the younger, the subject, the greater, the vital risk (Goyffon et al., 1982; El Oufir et al., 2008).

Monthly evolution of scorpion envenomations

Envenomations by all species of scorpions vary by month with the dry season presenting the period of highest risk. The seasonal peak of envenomations has been observed in the summer period, comprising 53% of cases (Fig. 6).

Deaths were registered between May and October, including 32 cases of death (86.5%) that had taken place between June and August. Scorpions are generally thermophilic animals. The hot season matches to their period of maximum activity which corresponds to the greatest risk of encounters. They are relatively less active and less daunting during the cold season. However, some individuals retain a certain potential for activity even during the cold season.

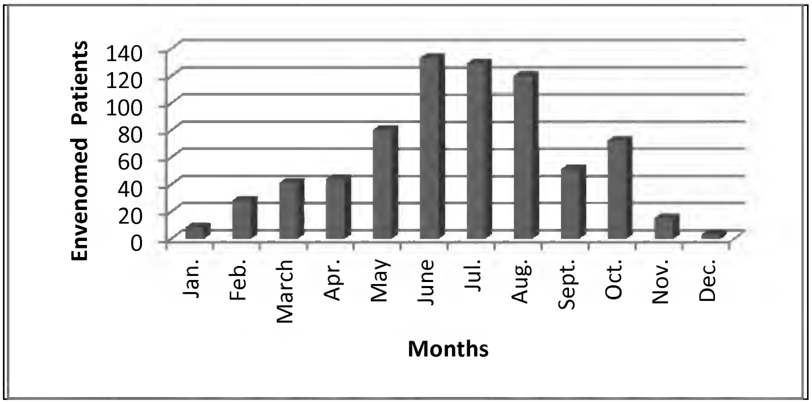

Fig. 6. Monthly distribution of cases of envenomation.

Modern care and traditional treatments used against scorpion envenomations

This epidemiological study has shown that the majority of patients were directed to traditional medicine and that few victims directly consulted the closest hospital centre. Also, 38% of cases were treated exclusively by traditional care (Fig. 7). In 29% of cases, the patients were directly hospitalized while 27% of cases practiced both types of care.

Envenomations were not treated in 6% of cases. Among fatal cases, only 24.3% were hospitalized, while 32.4% received traditional care exclusively and 43.2% got both types of care.

It is not surprising that scorpion stings remain a common cause of morbidity and even mortality especially in some areas with primarily rural populations. The lack of information on the pathology and on the rarity, and even absence, of health structures in rural areas, forcing people, even those close to the health centres, to use preventive or curative methods closely related to traditional medicine.

In most cases, the patients use traditional treatments or prefer to go to herbalists or traditional healers. Empirical practices vary depending on the region. According to the local populations, some of them relieve the patient by methods such as tourniquet, scarification of the poisoned region or direct suction of the venom with the mouth. However, all these practices are very dangerous for the patient and are therefore discouraged. Indeed, the tourniquet can entail gangrene, while scarification most often leads to infections and complications. The direct suction of the venom, the most popular practice, may be dangerous for operators whose oral mucosa is ulcerated (Soulaymani et al., 2000). In snakes it has been shown experimentally and clinically that the laying of tourniquet delays the onset of symptoms and that the latter are brutally aggravated as soon as they are lifted (Chippaux, 2002).

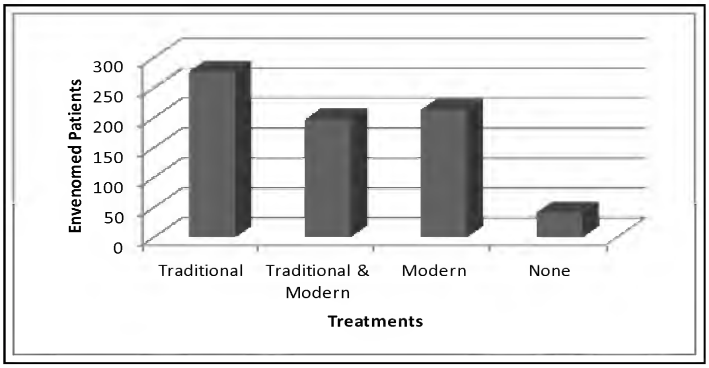

Fig. 7. Distribution of cases according to the used care.

After having carried out an incision until bleeding at the point of the sting, other traditional care may be administered; the most common is the pulverization of the envenomated site with cold cooking gas. Other materials are placed at the sting site such as raw meat, chopped garlic, henna, camphor, natural honey, amber or cotton moistened by a mixture of ammonia and water. Some people crush the scorpion and place it on the wound. Other materials are used orally such as concentrated tea containing amber, while some are satisfied with a little salt, sugar or honey.

The use of traditional care by rural populations is due to their beliefs and to the scarcity of health centres which sometimes are far from human agglomerations. It is necessary to indicate that simultaneous use of both care types does not give the hoped success when traditional care is considered preliminary until the evacuation of patient to the nearest health centre, or when traditional medicine is requested as the first intention.

In 6% of situations no treatment is used; in such cases the implicated species is recognized as not dangerous, or the sting is not followed by the inoculation of venom (manageable phenomenon among scorpion stings).

Strategy required in the study area

Given the seriousness of scorpion stings in this part of Morocco, it has seemed useful to outline some necessary prophylactic measures to reduce accidents and to decrease the morbidity and mortality related to scorpion envenomation.

Prophylactic measures designed to minimize scorpion accidents

To reduce the scorpion sting incidence, we must act at the scorpion level on the one hand and on the other hand at the population level:

At the scorpion level

- Reducing scorpion population densities.
- The manufacture of more species specific scorpion antivenom.
- Increasing domestic predators of scorpions such as chickens, ducks, turkeys, cats and hedgehogs.

- Disinfect dwelling interiors and the surrounding neighbourhood houses with the most environmental friendly insecticides.

At the population level

Attempts have been made to change the behaviour of people who live in areas of endemic envenomation and inform them that circumstances favourable to envenomation are usually linked to lack of hygiene and unhealthy houses. Such directions include:

- Sealing breaches in walls.
- Removing garbage and clusters of stones that constitute scorpion shelters.
- Avoiding creepers near houses because scorpions are good climbers.
- Paving and power repel scorpions.
- Wearing shoes after the sunset is strongly recommended.
- Divert and shake shoes vigorously before putting them on, particularly in the morning.
- Avoid sleeping on the ground at night (mainly during summer).
- Shaking clothes vigorously before wearing them.
- Growing repellent plants in the area surrounding the house that can affect scorpions, especially Calotropis procera (Hutt & Houghton, 1998).

Measures to reduce the morbidity and mortality associated with scorpion stings

The scorpion is a venomous animal so each sting must be taken into consideration even if the implicated scorpion is not deemed dangerous. After each sting, it is recommended to:

- Calm the patient and his entourage, and urge rest and the avoidance of walking or any other activity requiring effort.
- Immediately after the sting, put a tight band moderately upstream of the injection to delay the venom spread, place a piece of ice on the sting site until the whole region is put in a container of water and crushed ice to reduce the pain and slow down the blood circulation.
- Systematically hospitalize all sting victims at the closest health structure.
- Teach people to recognize the scorpion and transport it to the health centre.
- Propagate antivenom centres throughout the country, so the population can benefit from quick therapeutic treatment.
- The antivenom must be administered under strict medical surveillance for several hours and be ready to make new injections of antivenom in case severe symptoms reappear even several hours after an improvement that may be misleading.
- Make available to the citizens an instrumental venom suction system (Aspivenin, Extractor, Venom-Ex) recommended also against snake venom (Chippaux, 2002).

Conclusion

According to this epidemiological study, it appears that in the Marrakesh region, scorpion envenomation constitutes a major public health problem. The epidemiological factors of severity following these envenomations depend on: the species implicated, the place of the accident, the victim's age, care used, and season of the accident. Fast intervention as expressed by minimizing delay in hospitalization is a prime factor of success. It is advisable to hospitalize all victims, especially children. Early intervention is a critical factor in success (Goyffon & El Ayeb, 2002).

Prophylaxis by means of health education and good environmental hygiene can significantly reduce the number of accidents. In fact, when environmental hygiene is neglected, we sometimes observe an extension of the distribution of certain dangerous scorpion species as they search for prey (arthropods). Similar observations have been postponed in certain scorpion species in Latin America and the USA (Lourenço et al., 1996).

The disruption of the health system, the dispersion of health centres, the harm from displacement and the difficulty of supplying necessary serum are factors that diminish success in treating scorpion envenomation.

Serotherapy remains, after prevention, the most effective defence against scorpion envenomations. For this, the fight against these envenomations requires serious and specific mobilization of the concerned services for the preparation of scorpion antivenom in order to prepare the populations affected by this scourge.

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The Scorpion and its Venom
(Review Article)

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I'm delighted and honoured to contribute an article in the 25th anniversary issue of **SEREKT** "The Arachnological Bulletin of the Middle East and North Africa". Since its inception in August 1987, **SERKET** "taking its name from the ancient Egyptian language for 'scorpion' ", it has been one of the important sources of new knowledge and discoveries in the field of Arachnology in North Africa and the Middle East.

The current article describes one of the most fascinating animals, the scorpion, and its miraculous and amazing venom. Also, it will deal with and focus on the concept of intraspecific diversity of scorpions' venom (a major source of novel pharmacologically important toxins) and its relation to the microevolution within a single species of scorpion as well as its implication on the pathophysiological effects. This commentary will be divided into several "scenes" trying to make it interesting rather than boring scientific subject.

Scene I, Background

The animal kingdom comprises more than 100,000 venomous species spread through numerous main phyla such as the chordates (reptiles, fishes, amphibians, and mammals), echinoderms (starfishes, sea urchins), molluscs (cone snails, octopi), arthropods (arachnids, insects, myriapods) and cnidarians (sea anemones, jellyfish, corals). Venomous animals naturally hold venom-producing exocrine glands coupled to a delivery system "e.g. fangs, needles or harpoons" (Mebs, 2002). The venom is the sum of all natural toxic substances formed by the animal. Each individual venom is an exceptional cocktail of up to 100 different peptides and proteins, making the venom a source of millions of peptides and proteins modified to act on many of exogenous targets, such as ion channels, receptors and enzymes inside cells and on the plasma membrane. Venoms supply animals with a variety of advantages, including an ability to control and digest prey efficiently and to defend themselves against predators. Also, venoms often contain protease inhibitors and stabilizing agents that protect them from internal and external (high temperature) harmful effects, and hence save them in the glands for weeks

(Menez et al., 2006). The analysis of the products of the venom gland as a reference for the recognition and classification of specimens within a group is a very promising idea (Pimenta et al., 2003).

Invertebrate and vertebrate venoms provided a wealthy collection of pharmacologically vital neurotoxins; many of them are directed at ion channels with a precise degree of specificity. Venoms contain small molecular weight peptides capable of inducing cell function impairment by interfering with ion channel permeability in cell membranes (Gordon et al., 1998; Anderson & Greenberg, 2001). Most animal toxins evolve at high rates by gene duplication and point substitution (Duda & Lalumbi, 1999; Smertenko et al., 2001) making venomous animals often use a diverse number of toxins. High mutation rates in snake venoms, for example, allow significant intraspecific toxin variation (Chippaux et al., 1991; Daltry et al., 1996a, 1997). Intraspecific variations in the Egyptian scorpions, Leiurus quinquestriatus and Scorpio maurus palmatus, collected from different geographical and ecological regions, have been documented (Omran & McVean, 2000; Abdel Rahman et al., 2006, 2009, 2010). It is not clear, however, whether intraspecific venom variation is due to changes in diet (Daltry et al., 1996a), a result of arms race between predator and prey (Duda & Lalumbi, 1999), or just a product of natural evolution (Sasa, 1999). There is some evidence that in pit vipers, variation is related to diet. There is also some indication that sex plays a part, since male and female pit vipers have different toxin peptides (Daltry et al., 1997) as do male and female spiders of the genus Loxosceles intermedia. Moreover, in the fire ant Solenopsis invicta, toxin components change with body size (Deslippe & Guo, 2000).

Scorpions have been found in many fossil records, including marine Silurian deposits, coal deposits from the Carboniferous period and in amber. The oldest known scorpions lived around 430 million years ago in the Silurian period, on the bottom of shallow tropical seas (Andrew, 1990). These first scorpions had gills instead of the present book lungs. Currently, 111 fossil species of scorpion are known (Dunlop et al., 2008). In North Africa and South Asia, the scorpion is a significant animal culturally which appears as a motif in art, especially in Islamic art in the Middle East. Scorpions are used in folk medicine in South Asia especially in antidotes for scorpion stings (Jürgen 2004). The ancient Egyptians knew the scorpion and its toxicity, and venerated it since pre-dynastic era (El-Hennawy, 2011) so that the ancient Egyptian goddess Serket was often depicted as a scorpion, one of several goddesses who protected the pharaoh.

Scorpions are relatively large among terrestrial arthropods, with an average size of about 6 cm. They exhibit few sexual differences, although males usually are more slender and have longer tails than females. Giants among scorpions is the black emperor scorpion (Pandinus imperator), an African species found in Guinea, which attains a body length of about 18 cm and a mass of 60 grams. The longest scorpion in the world is the rock scorpion (Hadogenes troglodytes) of South Africa; females attain a length of 21 cm. The length of the smallest scorpions, the Caribbean Microtityus fundorai, is 12 mm. Fossils of two species (Gigantoscorpio willsi and Brontoscorpio anglicus) measure from 35 cm to one meter or more. Most species from deserts and other arid regions are yellowish or light brown in colour; those found in moist or mountain habitats, however, are brown or black. The anatomy of scorpions has changed little since the Silurian period (443 to 417 million years ago). Consequently, their body plan is relatively primitive. Segments and associated structures were lost or fused during evolution from ancestral arthropods and arachnids to more highly evolved descendants (Yamashita & Fet, 2001).

Many scorpion species exist in many parts of the world, especially in tropical and subtropical areas. Scorpions are normally associated with deserts (El-Hennawy, 1987, 1992, 2002). The severe physical and climatic conditions of desert environments have provoked in them a number of consistent morphological, behavioural and physiological adaptations (Hadley, 1972). Scorpions usually live in greater habitat range than is generally known. However, they are most abundant and diverse in arid environments of lower temperate latitudes. Indeed some forms, such as Serradigitus deserticola, are found in habitats that may only receive rainfall every few years. At the other extreme, Uroctonus mordax may be found under humid mosses in moist habitats of northern California (Williams, 1987). Moreover, Cloudsley-Thompson & Constantinou (1983) showed that the scorpion Euscorpius flavicaudis manage to survive in Britain below freezing temperature.

Scorpions possess a venom apparatus composed of two glands and a stinger. Scorpion venom has received increasing attention in human medicine. It seems to be that scorpion venom is more than a potentially harmful defence mechanism for this famous looking arachnid. Investigations on scorpion venom concerning valuable uses of its components are slow going, but there are a number of medical promises. Researchers believe that scorpion venom can one day be used to treat Lupus and Rheumatoid Arthritis. It has already been discovered to help with some cases of multiple sclerosis and cancer (Omran, 2003), and to help with heart transplants (Suhr et al., 2007).

Scorpions are chelicerate arthropods, members of the class Arachnida and distant relatives to other arthropods such as the Crustacea, Insecta, Myriapoda, and Onychophora. Compared to spiders and mites, scorpions are a modest group containing 1259 described species in 16 living families and 155 genera (Fet et al., 2000). They are very ancient animals, and numerous fossil species have been described. The classification of class Arachnida is based on morphological characters. However some researchers use techniques involving DNA sequencing, to identify species, subspecies and varieties (Sissom, 1990). Seventeen extant families and about two dozen subfamilies are identified by the structure of the sternum, gnathobase, legs, cheliceral dentition, and venom gland and by the number and allocation of lateral eyes and pedipalpal trichobothria. Embryological patterns and the structure of the reproductive system are also significant diagnostic traits (Yamashita & Fet, 2001).

Scorpions of family Buthidae holds 598 species widely spread, even into moderate regions and considered the oldest living family. It comprises the most dangerous and extremely toxic scorpion species. They are found all over the world in an area approximately limited by the 50th parallels north and south. The separation of South America from Gondwanaland to join North America during the Mesozoic era possibly divided buthids into the New and Old World groups and set the stage for divergent evolution of their venoms. Neurotoxins of New and Old World buthids differ in amino acid sequence, pharmacological action, and immunological properties (Watt & Simard, 1984; Granier et al., 1989) but still share characteristics indicative of their common ancestry and conserved function.

The most potent toxins in Buthidae have developed particular effects limited to either vertebrate or insect targets (Zoltkin et al., 1971). For example, some insect-specific toxins can be 2500 times more toxic to insects than insecticides such as DDT, yet they have no effect on mammals (Loret et al., 1992). Specificity of toxins for particular targets evolved by variation of length and composition of amino acid chain in toxin proteins (Possani, 1984), and this characteristic feature is especially useful for classification, localization, and purification of biological receptors of delicately different types. This is especially true of toxins acting on ion channels because channel activity is difficult to measure by methods other than molecular binding assays. Thus, as research improves our understanding of toxin structure in diverse species, it can expect to find common pattern of molecular structure that are critical for toxin action and related functions.

Scorpion venoms consist of a combination of many pharmacological active proteins, and they have higher toxin contents than their snake counterparts. Most scorpion toxins contain four disulphide bridges, the location of which is relatively different from that found in snake toxins. These differences may in part clarify the diverse modes of neurotoxin action of the venoms from these species (Tu, 1977).

The venom of the most scorpion species has been intensively studied and revealed to hold a battery of toxins, directed at diverse cellular targets (Omran & Abdel-Rahman, 1992, 1994; Omran et al., 1992 a, b). However, the molecular structure of the toxins is unique to each species. No single toxin is shared between the species despite minimal morphological differentiation. In this respect, Omran & McVean (2000) reported significant geographically related intraspecific variation in Leiurus quinquestriatus venom composition which associated with the severity of the pathophysiological effects. Also, Smertenko et al. (2001) found individual polymorphism in the venom of some scorpion species. One of the important issues is that, this variation in toxin components might cause problems with production and application of effective therapy (antivenoms).

There are hints in the literature that the toxin components in scorpions vary intraspecifically. For example there are measurable differences in the concentration of alpha-type toxins between individual Tityus serrulatus from Brazil (Kalapothakis & Chávez-Olórtegui, 1997). Polis (1990) reported some instances where variation occurs when a single species live in different geographical locations. However, there has been no systematic investigation into the degree of variation, its cause or the clinical implications. This variation is very important in two respects. If antivenom therapy is to be efficient, the antibodies must match the toxins that were injected and if the toxin composition varies with geographic location, then so should the antivenom. At the moment we do not know the geographic level of toxin variation. Secondly, the venom from scorpions inhabiting different areas may contain undiscovered toxins, which may show precious novel tools to neuroscience research.

Scene II, Composition of Scorpion Venom

Scorpion venom is a complex combination of peptides with diverse physiological and pharmacological effects, showing high specificity toward mammals and insects. Scorpion venom also comprises enzymes, nucleotides, lipids, biogenic amines, and other unidentified substances. The toxic fractions of scorpion venom are classified according to composition and physiological effects into several families and subfamilies of distinct peptides (Batista et al., 2006). Scorpion neurotoxins are molecules that often affect only the functions of the nervous system and thereby one key receptor molecule. Because of this specificity they are perfect tools for exploring and studying the important receptor molecules in the nervous system and for the examination of basic mechanisms concerning nerve functioning (Debont et al., 1996). The scorpion neurotoxins studied so far have to be peptides (30-70 residues), cross linked by 3 or 4 disulfide bridges, and having a net positive charge. Structural studies of all scorpion toxins show rather conserved secondary structure consisting of an α-helix adjacent to a double stranded antiparallel β-sheet (Dufton & Rochat, 1984; Bontems et al., 1991).

Two main groups of peptides have been isolated and shown to be responsible for human envenoming. These are long chain peptides (59 to 76 amino acid residues) and short (21–43 amino acid residues) that recognize ion-channels (Possani et al., 2000). These receptors are integral proteins of excitable and non-excitable cells that control ion fluxes through the cell membranes (Na^+, $K^{+,}$ Cl^- and Ca^{2+}). Peptides specific for each one of these ion-channels have been purified and characterized from scorpion venoms.

Scorpion sodium channel toxins are long chain peptides composed of about 59–76 residues with four disulfide-bridges (Possani et al., 1999). The Na^+-channel specific toxins are a family of about 200 peptides and genes encoding putative toxins (Possani et al., 1999; Zuo & Ji, 2004). These are modulators of the gating mechanism of the sodium channels (Possani et al., 1999; Blumenthal & Seibert, 2004). All members in this class share a similar gene organization and three-dimensional structure that have probably evolved from a common ancestor (Froy et al., 1999; He et al., 1999). Based on their different pharmacological features, these polypeptides are divided into two distinct classes, called α- and β-toxins (Gurevitz et al., 1998; Cestele & Catterall, 2000). The α-toxins chiefly cause a slowing of the inactivation process of sodium currents and a prolongation of the action potential by binding to receptor site 3 of the voltage-gated sodium channel (VGSC) (Catterall, 1995, 2000; Denac et al., 2000; Gordon & Gurevitz, 2003). This class of toxins can be further divided into three subgroups: (i) the classical α-group, which is highly active in the mammalian brain "e.g. AaHII", (ii) the insect α-toxins "e.g. LqhaIT", and (iii) the third group, which is active in both mammalian and insect central nervous system "e.g., BmKM1" (Gordon & Gurevitz, 2003). The β-toxins cause the VGSC to shift the voltage dependence of activation to more negative membrane potentials and cause a reduction of peak current amplitude by binding to receptor site 4 (Ceard et al., 2001). A voltage-sensor trapping mechanism was proposed to account for the effects of these toxins on channel gating (Ceard et al., 2001). Scorpion β-toxins display similar features to distinguish between mammalian and insect sodium channels (Possani et al., 1999). It appears that scorpions have developed various envenomization mechanisms beneficial for prey capture and for keeping an efficient defence against predators (Froy et al., 1999).

Venoms from scorpions are also rich naturally-occurring resources of small toxic polypeptides targeting potassium channels (Garcia et al., 1998). These polypeptides have provided powerful tools to study the structure-function relationship of potassium channels (MacKinnon, 1998). At present, about 120 different peptides have been isolated and characterized (Rodriguez-de-la-Vega & Possani, 2004), most of which are derived from family Buthidae, but very few from family Scorpionidae (Tytgat et al., 1999; Batista et al., 2002). On the basis of amino acid sequence similarity, these peptides have been classified into 18 distinct structural subfamilies (Tytgat et al., 1999; Batista et al., 2002). The great majority of the K^+ channel specific toxins (KTx) are blockers of the K^+-channels (Rodriguez-de-la-Vega & Possani, 2004). In addition to the ion-channel specific toxins, the venom of scorpions is a rich source of other bioactive peptides such as anti-microbial peptides Hadrurin (Torres-Larios et al., 2000) and Scorpin (Conde et al., 2000), and various enzymes such as hyaluronidase and phospholipases together with other components of unknown function (Barona et al., 2006).

Scene III, Venom Diversity

Animal venoms are important sources of novel and unique biological tools, useful in pharmacological studies and in the isolation and characterization of cellular receptors (Esccubas et al., 2002). Scorpion venom from a single species usually consists of numerous low molecular weight basic proteins, neurotoxins, mucus, salts, oligopeptides, nucleotides, amino acids and some other organic compounds (Gwee et al., 1996). Many scorpion venoms are highly poisonous to most animals and are used by scorpions to immobilize their prey and to protect themselves against predators. These two important functions, during evolution, could have favoured the production of multiple toxins within particular venom. Synergistic actions among the toxic components are another probable factor for making this deadly cocktail. Scorpion toxins also display a high degree of host specificity; thus, the venom of one species may contain one toxin favourably toxic to insects, another to crustaceans, and yet another to mammals (Polis, 1990). Venoms from medically important species are also used in the production of antivenoms, production of venom fractions and toxin purification which are crucial issues for biochemical and pharmacological studies (Esccubas et al., 2002).

Intraspecific venom variation has been previously studied in various animal species such as bees (Owen & Sloley, 1988), wasps (Mulfinger et al., 1986), ants (Hannan et al., 1986), fish-hunting Conus snails (Jakubowski et al., 2005), scorpions (Omran & McVean, 2000; Pimenta et al., 2003; Borges et al., 2006; Abdel-Rahman et al., 2006, 2009, 2010), spiders (Binford, 2001) and in snakes (Chippaux et al., 1991; Menezes et al., 2006). The complicated chemical structure of scorpion venoms, proteins and low molecular-weight components, require the power of high resolution analytical techniques for a precise characterization of their variability (Esccubas et al., 2002). As some previous studies may have emphasized biological activity over chemical characterization, they did not allow for individual component analysis since the complexity of the mixtures prevents a precise correlation between overall venom activity and the relative roles of individual toxins (Esccubas et al., 2002). The interest in animal toxins as tools for pharmacological studies has dramatically increased in recent years concomitant with a parallel fast progress and development of biochemical studies using HPLC, capillary electrophoresis, SDS-PAGE, 2D-PAGE electrophoresis, and mass spectrometric techniques, combined and associated with various bioassays for the characterization of venom variation (Esccubas et al., 2002).

The individual variability in the venom configuration of some scorpion species has also been examined. In the scorpion Tityus serrulatus, individual differences in venom composition between several samples collected in the same area were examined using ELISA technique (Kalapothakis & Chávez-Olórtegui, 1997). Polyclonal antibodies against whole venom, the α-type toxin and β-type toxin were used to study specific variations in the venom. The ELISA results indicated clear differences between the examined samples. Amongst the groups analyzed, the group with the highest concentrations of α-type toxin showed the highest toxicity. The results showed that the lethality of the venom varies from sample to sample and suggests that α-type toxin must be the major lethal component in the whole venom of T. serrulatus.

Venom variability in specimens of Tityus serrulatus scorpion was assessed using ten scorpions to study individual variations that might occur due to different rates in protein expression and/or processing (Pimenta et al., 2003). Important variations were observed in venoms of a single specimen extracted at different times, especially in later extraction events. These variations are most probably related to dynamics in cell gland production. Equivalent results were found in the scorpion Androctonus mauretanicus venom (El-Hafny et al., 2002). The results showed that venom lethality varies from specimen to specimen and that pharmacokinetic parameters of venom and anti-venom are totally different. This must be taken under consideration in anti-venom design as well as in the therapeutic protocols (dose, injection route) to improve serotherapy.

Omran & McVean (2000) examined intraspecific variation in the scorpion Leiureus quinquestriatus venom collected from Egypt (Sinai and Aswan deserts). Electrophoresis and a densitometric gel scan showed that in the molecular weight range above that known to include toxins, venom of Aswan origin contained several protein bands that were absent from Sinai–sourced venom. In contrast Sinai venom appeared to have a large proportion of protein in the molecular weight range known to include toxins. Such differences may reflect a response to local ecological conditions. Although intraspecific variation has been discussed by some investigators (Anderson, 1983;

Hassan, 1984; Polis, 1990; Omran & McVean, 2000), relatively few attempts have been made to investigate such differences and its cause (Yamashita & Polis, 1995; El-Hafny et al., 2002; Pimenta et al., 2003; Abdel-Rahman et al., 2006, 2009, 2010). A better understanding of intraspecific variation in quantity and types of venom components could help to pinpoint the optimal sources of the desired compound.

Scene IV, Genetic Diversity

Over a long term, the capability of a species to respond adaptively to environmental changes depends on the level of genetic variability it contains (Ayala & Kiger, 1984). The quantity and splitting of genetic variation among and within populations result from the dynamic processes of gene flow, selection, inbreeding, genetic drift, and mutation (Hartl & Clark, 1994). A species with slight genetic diversity is thought to be unable to respond to changing environments. Elucidation of populations within a species may not only illustrate the evolutionary process and mechanisms but also provide information useful for biological conservation and phylogenetic analysis (Schaal et al., 1991). Reliable estimations of population differentiation are crucial to understanding the connectivity among populations and represent important tools in the development of conservation strategies (Balloux & Lugon-Moulin, 2002). Ecological barriers, historical processes, and life history (e.g., mating system) may all shape the genetic structure of populations (Donnelly & Townson, 2000; Gerlach & Musolf, 2000; Palsson, 2000; Tiedemann et al., 2000).

The comparative study of proteins originating from different species has great importance in evolutionary and taxonomic aspects. Such studies are widely carried on for vertebrates, such as snakes, to examine not only evolutionary problems, but also to describe and explain the biological role of some proteins as well (Dufton, 1985). Also, protein analysis is a rich source of information on the biological function of the venom. For example, low molecular weight basic proteins or polypeptides possessing cytoloytic or pain-inducing action such as in the case of bee venom “apamin, bombolitins, melitin, phospholipase A2” suggest a defensive role of the venom apparatus (Blum, 1981; Banks & Shipolini, 1986; Piek, 1986).

Venom variability at the family, genus, species and subspecies levels has long been investigated by scientists and is a well documented phenomenon. Intraspecific variation in venom composition has been identified in many animals (Chippaux et al., 1991). As well as being of academic interest in the study of the evolution and biology of venomous animals, this phenomenon relevant to snake bite and scorpion sting therapy. For example, diagnosis of the species responsible for a bite or a sting can be confounded by variation in symptomatology, and the antivenom prepared against one venom type may be significantly less effective against another. Also, it is useful to determine whether the components of interest are more abundant in the venom of certain individual than others. Literature concerning the biochemistry/ pharmacology of venoms, and the systematic/ecology of scorpions have tended to travel separated pathways, but all of these disciplines need to be integrated in order to understand how variation arises (Daltry et al., 1997). Inter- and intraspecific geographic variation in the concentration and/or function of toxic components has been extensively documented for snake venom (Chippaux et al., 1991; Fry et al., 2003) but similar efforts to investigate diversity in arachnid venom, including scorpion, are only beginning to emerge in the last 20 years (Yamashita & Polis, 1995; Omran & McVean, 2000; Abdel-Rahman et al., 2006, 2009, 2010; Borges et al., 2006).

Although, the use of pooled venom is important in research and in the manufacture of antivenoms, the individual variability of venom content must be considered and analyzed. The individual and geographical variability in venoms of the same species has become extremely important for the production of effective antivenoms and for the understanding of the clinical symptoms of patients. Little is known about polymorphism of scorpion toxins at an individual level (El Ayeb & Rochat, 1985; Pimenta et al., 2003); whereas the study of snake venom composition has shown a complex variability between specimens of the same species (Chippaux et al., 1991), and some variations is depending on snake age (Furtado et al., 2003). At the level of intraspecific variation, the individualism impact to the venom composition is important but the effects reflected by environmental conditions, age and feeding habits also influence the proteome picture exhibited by each specimen (Menez, 2006).

The extensive and detailed study done by Abdel-Rahman et al. (2006, 2009, 2010) on the intraspecific variation of Scorpio maurus palmatus explained and elucidated many clues and significant aspects concerning this important scientific subject. Scorpio maurus palmatus (Ehrenberg, 1828) is widely distributed in arid and semiarid areas of Egypt (El-Hennawy, 1992, 2002) where it exhibits a morphological separation between populations. Intraspecific diversity of morphological characters of this species may be due to variation in the environmental conditions (Abdel-Nabi et al., 2004) or probably a reflection of the genetic diversity between populations (Abdel-Rahman et al., 2006). There has clearly been selective pressure on this scorpion, as in other scorpion species, to produce a diversity of toxins. Subtle changes have been achieved by the substitution of a few amino acids (Gordon et al., 1998). Equally there are striking homologies between toxins from different species, presumably a result of convergent evolution, since the target channels of prey or predators command the most effective toxin structure. Selection pressure dictates what proportion of each toxin should be included in the whole venom (Omran & McVean, 2000).

Individual venom collected from Scorpio maurus palmatus inhabiting 4 different geographical locations showed variation among the four populations and within each population. Individual venom variation can be viewed in two different ways. First, as population markers, i.e. in light of possible intraspecific variability related to geographic and/or sexual status. Second, as individual markers, which elicit variability within the same specimen that could be related to temporary influences such as age, seasonal changes, feeding behaviour or dynamics in gland production and peptide maturation. Furthermore, the variability in venom composition of this species is probably related to genetic variation. Control of toxin expression and the time of venom durability in the gland reflect mechanisms of toxin processing and ripening. Variation of the peptide profiles in the venomous animals has been associated with sex (Cristina de Oliveira et al., 1999; Binford, 2001; Esccubas et al., 2002), diet (Daltry et al., 1996b), age (Esccubas et al., 2002), geography (Binford, 2001; Creer et al ., 2003), season (Monteiro et al., 1998a) and venom regeneration time (Pimenta et al., 2003). Studies controlling many of these factors have still observed venom variation, implying that intraspecific differences can be a result of genetic as well as environmental factors (Daltry et al., 1996a; Kalapothakis & Chávez-Olórtegui, 1997; Monteiro et al., 1998a, b; Francischetti et al., 2000). Cellular and molecular mechanisms underlying and controlling such variation remain unknown.

Taking these results and facts together, Abdel-Rahman et al. (2006, 2009, 2010) concluded the following important points:

1. Scorpio maurus palmatus represents a useful terrestrial model system for studying molecular evolution. They are well distributed in different geographical regions in Egypt and the Middle East and they are believed to have low rates of dispersal.
2. There are clearly intraspecific differences in the composition of the scorpion venom collected from the same locality on a similar date, of the same gender. This probably

reflects innate individual variation in venom synthesis, since genetic variation is to be expected in the gene pool of most sexually reproducing species, and variation may also be due to nutritional status or time since the venom gland was last discharged.

3. The qualitative and quantitative variations in the venom composition of scorpions of the same species could partially explain the disparity of symptoms in the victims of scorpion envenomation.
4. Local environmental conditions and geographical separation play a major role in the intraspecific variation of venom of S. m. p.
5. More detailed analyses of intraspecific differences could help to determine rates of evolutionary changes in venom chemistry.
6. The RAPD markers and DNA sequences are suitable techniques for defining broad-scale genetic structures in scorpion populations and even sequence from a small sample yielded considerable variation.
7. Implications concerning the pathophysiological effects of intraspecific variability of the scorpion venom in the paralytic and cytotoxic efficiency on the adult cockroach among different populations of S. m. p. were observed. The neurotoxic and cytotoxic variability among populations might be related to the abundance of certain toxic components (e.g. MTX and MCa) in the crude venom of this species.
8. This is the first time that such an analysis is applied to invertebrates, particularly scorpions, which until now, have been treated by pharmacologists investigating venom structure as having no variation between geographical locations.
9. This work points to the importance of microevolution in understanding the relationship between animals and their environment, the significance of biodiversity and also provides a good grounding for future studies of geographical variation of populations of animals and plants worldwide.

Finally, the topic of the scorpion venom has no end, since we discover and realize a new *"scene"* every time. The only end that we have indeed is the truth and reality of the *presence of only one creator "ALLAH"* who shows us every day, every moment and every second a new miracle of his tremendous creations.

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The comparative morphology of the suctorial organ of the male Biton zederbaueri and Gluviopsilla discolor (Arachnida: Solifugae: Daesiidae)

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Abstract

Solifuges possess suctorial organs at the tip of the distal tarsus of each pedipalp, as distinct from other arachnids. By means of this organ solifuges can climb smooth, vertical surfaces and can also grasp prey. In the present study, the comparative morphology of male Biton zederbaueri (Werner, 1905) and Gluviopsilla discolor (Kraepelin, 1899) (Daesiidae, Solifugae) is studied by using light and scanning electron microscopy (SEM). The suctorial organ is covered with upper and lower cuticular lips. The corrugated-adhesive structure of the suctorial organ protrudes between these cuticular plates. On the matatarsi of the pedipalps, there are filiform spines and hollow tubular spines that vary from species to species. Pore-like structures are described on the apex of the tarsus of the pedipalp.

Keywords: Camel spiders, Solifugae, adhesive palpal organ, palpal setae.

Introduction

Solifuges are distributed in xeric and semi-xeric regions of the world (Muma, 1951). They are fast, nocturnal predators of insects and other arthropods (primarily). Solifuges pedipalps are leg-like appendages. The length of the pedipalp and the presence or absences of the lateroventral or mesoventral spines on the pedipalps are morphological characters used in taxonomy (Punzo, 1998). The pedipalps are involved with grasping food and mates, pulling prey closer to the chelicerae, climbing surfaces (including smooth vertical surfaces), digging burrows, displaying agonistically to conspecifics and to threats, etc. (Muma, 1966a-b, 1967; Wharton, 1987; Punzo, 1995, 1998; Cushing et al., 2005).

Pedipalps possess adhesive organs at the distal tip of the tarsus. Muma (1951, 1966a-b) and Punzo (1998) called this the adhesive palpal organ, but Cloudsley-Thompson (1954) and Savory (1964) described it as a suctorial organ.

Lichtenstein (1797) assumed an olfactory function to this organ. Dufour (1861) disagreed and was the first to suggest that the palpal organ functioned as a suction device. Bernard (1893), using morphological evidence, and Heymons (1902), using behavioural observations, indicated that this organ functioned in olfaction and for grasping things. Hingston (1925) expressed that these suckers are used for grasping prey. Barrows (1925) studied some species of Eremobatidae and Ammotrechidae and concluded that this structure is similar in these families. Cloudsley-Thompson (1954) observed the palpal organ of a species in Galeodes while climbing smooth vertical surfaces and he suggested that the organ might be adhesive. Panouse (1957) investigated the suctorial organ of Eusimonia mirabilis Roewer, 1933 (Karschiidae). Junqua (1962) identified the adhesive structure in Othoes saharae Panouse, 1960 (Galeodidae).

Cushing et al. (2005) demonstrated the fine structure of suctorial organs in adult specimens in Eremobates, Eremochelis, Eremorhax (Eremobatidae) and Ammotrechula (Ammotrechidae) by using Scanning Electron Microscopy (SEM). Klann et al. (2008) investigated the fine structures of suctorial organs in Oltacola gomezi Roewer, 1934, O. chacoensis Roewer, 1934 (Ammotrechidae), Galeodes caspius subfuscus Birula, 1937 (Galeodidae) and Eusimonia mirabilis Roewer, 1933 (Karschiidae). They examined the fine structure of the suctorial organs in mature and juvenile specimens by means of light, scanning and transmission electron microscopy. Willemart et al. (2011) demonstrated that the suctorial organ of Eremochelis bilobatus (Muma, 1951) is involved in prey capture using high-speed videography techniques. Cushing & Casto (2012) studied the morphology of setal and sensory structures on the pedipalps of 12 species representing each of the families in the order Solifugae. They described 13 recognizable setal types with the shape of the shaft and tip.

Material and Methods

Five adult males of Biton zederbaueri (Werner, 1905) were collected in Hasancalı Village, Kilis (36°53'09"N, 36°49'08"E) in June 2006. Also, three adult males of Gluviopsilla discolor (Kraepelin, 1899) were collected from 1 kilometer northwest of the Birecik Bridge in Şanlıurfa (37°01'38"N, 37°59'02"E) in July 2004. The pedipalps of both species were removed for examination under a light microscope (Nikon SMZ800). These pedipalps were preserved in ethanol before preparation for SEM. The surfaces of the samples were cleaned with steam and dehydrated with a series of 70, 80, 90, and 100% ethanol, respectively, for 10 minutes each. The specimens were dried and coated with a thin layer of gold by Polaron SC 500 sputter coater. The specimens were examined at an accelerating voltage of 20 kV with a Jeol JSM 5600. All palps and voucher specimens examined are deposited at The Zoological Research Laboratory of Kirikkale University.

Results

In this study, the fine structure of the tarsal and metatarsal sensory setae and spines and the suctorial organs were studied in males of B. zederbaueri and G. discolor (Daesiidae) by using stereo light microscopy and Scanning Electron Microscopy (SEM). Features of the pedipalps of two species were then compared with each other.

The total length of each pedipalp is 17 mm in B. zederbaueri. The tarsus of the palp is swollen and movable. Each metatarsus has six large spines. These spines are arranged in three rows. The pedipalps were covered with short setae or long sensory setae. The tarsal and metatarsal setae and spines are generally filiform (Fig. 1).

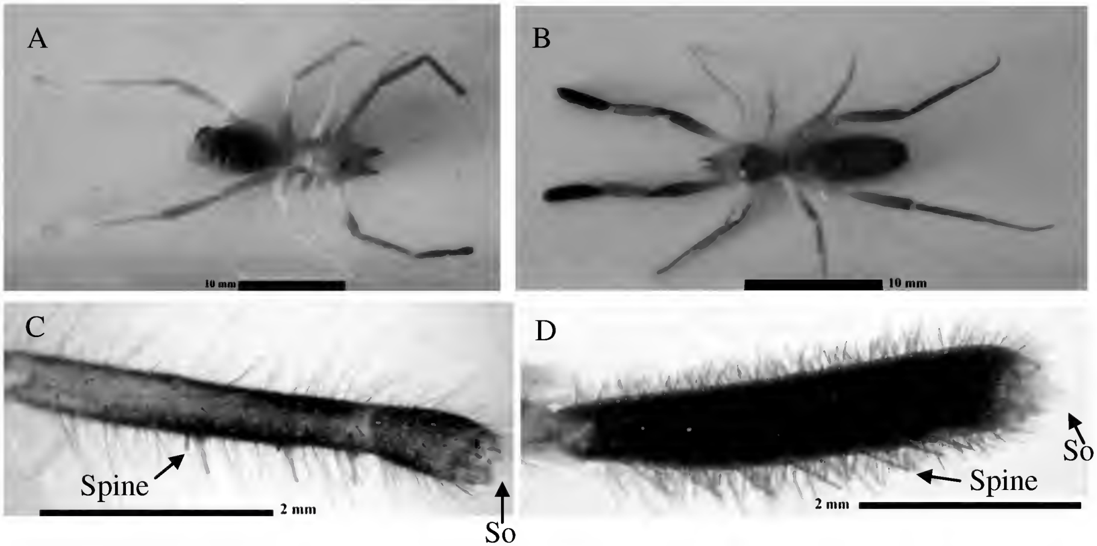

Fig. 1. A-B. Habitus, dorsal view of an adult male: Biton zederbaueri (A) and Gluviopsilla discolor (B). C-D. Palpal tarsus and metatarsus, with characteristic tarsal spines of B. zederbaueri (C) and G. discolor (D). Abbreviations: Spine = characteristic spine on the metatarsus, So = suctorial organ. [Figs. C and D were obtained by stereo microscopy].

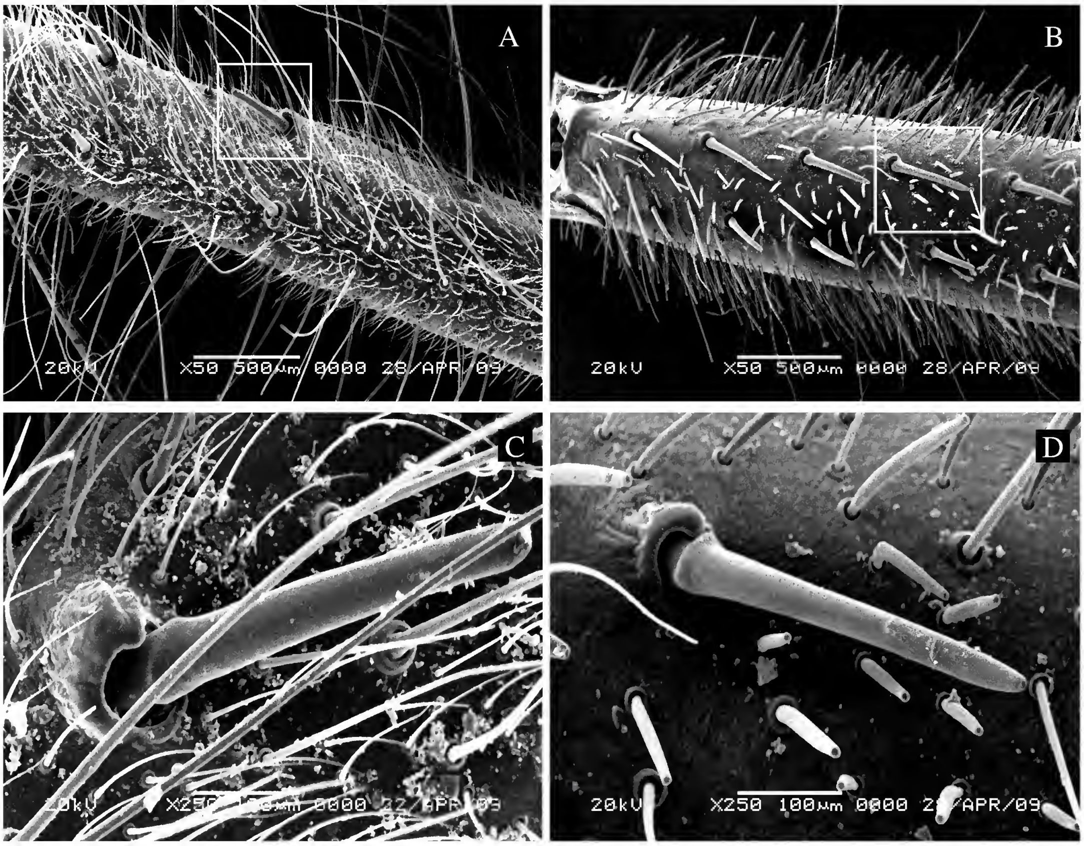

Fig. 2. Scanning electron micrographs of the pedipalpal metatarsus, metatarsal sensory setae and spines of adult male Biton zederbaueri (A, C) and Gluviopsilla discolor (B, D). C. smooth filiform spine. D. tubular or cylindrical spine.

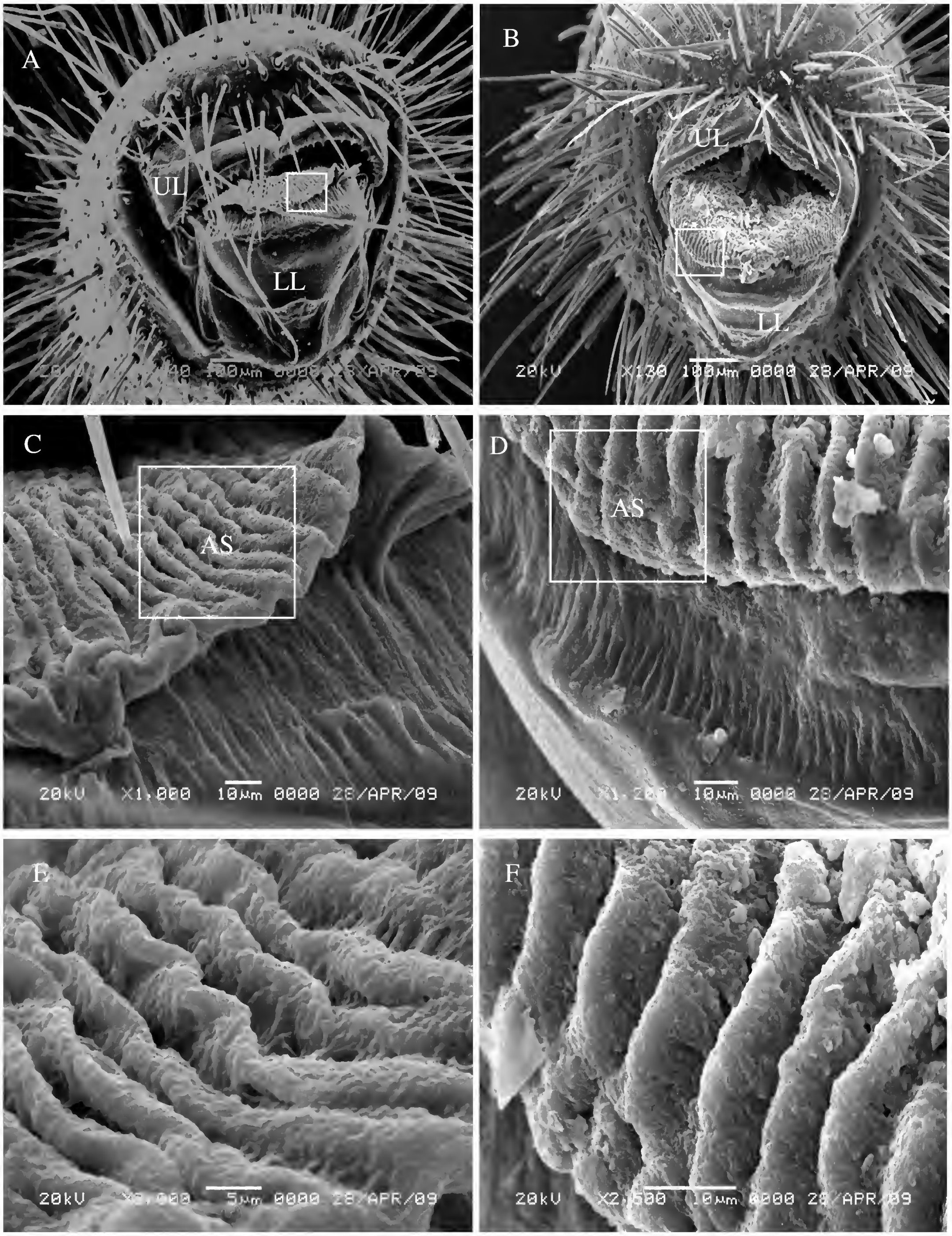

Fig. 3. Scanning electron micrographs of the suctorial organ in adult male of Biton zederbaueri (A, C, E) and Gluviopsilla discolor (B, D, F). The suctorial organ is inverted and covered with an upper and a lower cuticular lip. C-D. the surface structure of the suctorial organ. E-F. detail of the adhesive surface. (AS = adhesive surface, LL = lower lip, UL = upper lip)

The total length of each palp is 14 mm in males of G. discolor, and the pedipalp is completely swollen (especially the mesal surface of each segment). The pedipalp tarsus possesses a pair of spines. Each femur and metatarsus of pedipalp has 14 spines. These characteristic large spines are located on the ventral surface of the pedipalp in male G. discolor. Also, the apical portion of the tibia has two pairs of spines. The pedipalp tarsus is immovable. The entire pedipalp is covered with numerous short cylindrical setae, with a few thin elongated sensory setae interspersed among them. Even though B. zederbaueri and G. discolor belong to the same family (Daesiidae), the numbers and sizes of spines and setae are different for each species. The length of the sensory setae of the pedipalps of B. zederbaueri are longer than those of the pedipalps of G. discolor (Fig. 2).

In both species, the suctorial organs consist of a dorsal upper lip (UL) with two parts and a ventral lower lip (LL). The suctorial organ protrudes between the upper and lower lips. The suctorial organ is not conjoint to the lower lip. When the lower lip is pulled down, the suctorial organ protrudes with its adhesive surface like a tongue (Fig. 3).

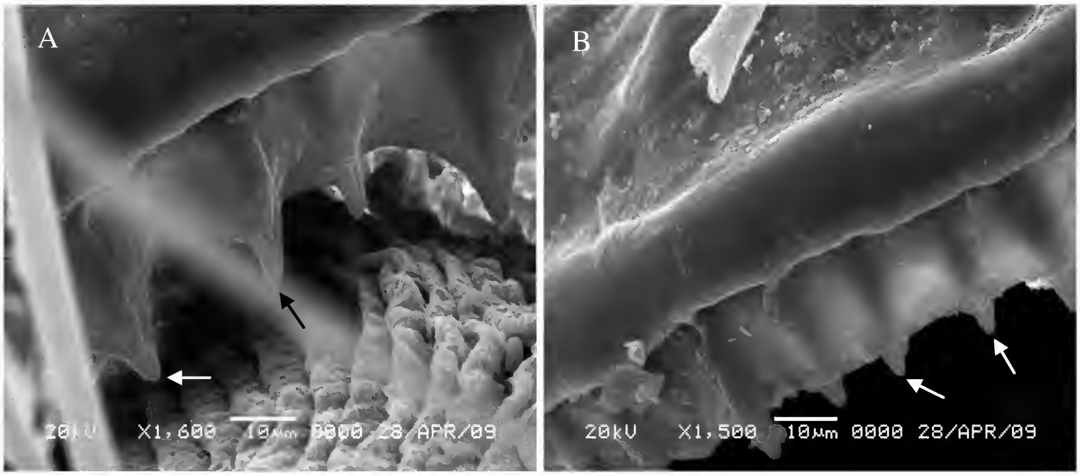

Fig. 4. Border of the cuticular upper lip provided with small conical teeth in different sizes. They are pointing in slightly different directions (indicated by arrows, Biton zederbaueri (A) and Gluviopsilla discolor (B).

Fig. 5. Scanning electron micrographs showing the bifurcate sensilla on the distal surface of the pedipalpal tarsus in adult male of B. zederbaueri (A) and G. discolor (B). The annulated integument and denticles are indicated by arrows.

The surface of the suctorial organ is similar in both species. Its surface has a corrugated structure. The ventral side of upper lips possesses conical teeth of different sizes. These teeth are pointed in slightly different directions (Fig. 4). These teeth have not been discussed before. Also, there are a few bifurcate setae arranged in series on the apical tarsus of both species (Fig. 5).

Also, we observed some pore-like structures on the distal apex of the palp of Gluviopsilla discolor (Fig. 6).

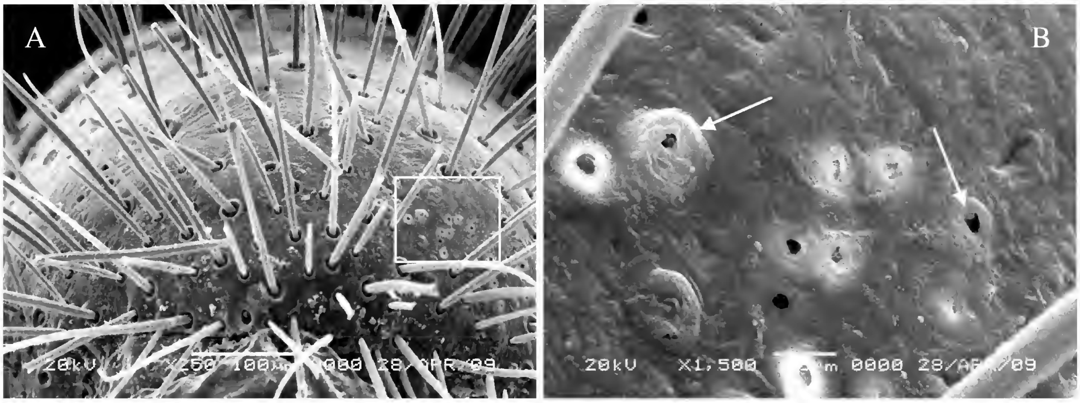

Fig. 6. A. Pore-like structures on the apex of the pedipalpal tarsus of Gluviopsilla discolor. B. Ibid, detail of pores at higher magnification.

Discussion

Solifuges possess suctorial organs that differ from other arachnids. In arachnids, members of Solifugae can climb smooth, vertical surfaces such as glass. These arachnids have an adhesive pedipalpal organ or suctorial organ at the tip of the distal segment of their pedipalps. Cushing et al. (2005) explained that these suctorial organs enable the animals to climb smooth vertical surfaces.

Betz & Kölsch (2004) indicated the role of adhesion in capturing prey in some arthropods, but didn’t mention anything about solifuges. Pedipalps of solifuges contain numerous sensory setae and spines. We think that the main function of these extremities is to serve as tactile organs as Cushing et al. (2005) emphasized.

Cushing et al. (2005) investigated the gross anatomy and fine structure of the suctorial organ of four genera of Solifugae. They found differences in surface structure of the suctorial organs, and attributed the difference in surface structure to differences in the degree of eversion of the organ, differences due to surface anomalies, and degradations of the organ caused by poor initial preservation of the specimen. When we compared the surface structure of the two species, we found that the surface structures are quite similar to each other.

Klann et al. (2008) investigated the anatomy and ultrastructure of the suctorial organ of some solifuges and found that the surface of the suctorial organs of studied species consists of very thin epicuticle overlaying the ramifying apices forming ridges and furrows on the ventral side of the suctorial organ. They compared the adhesive structures of solifuges with other arthropods.

Willemart et al. (2011) affirmed that the suctorial organ is predominantly used to capture prey in solifuges. Nevertheless, the mechanism and adhesion process of the suctorial organ are not exactly known in solifuges. More detailed studies are needed on these topics.

Cushing & Casto (2012) described 7 setal types (Bifurcated, Imbricate, Polymicrodigitus annulus, Polymicrodigitus imbricate, Simple, Tapered, Truncated) and tarsal pores in Biton browni (Lawrence) (Daesiidae). We observed the tarsal pores on the pedipalps in Gluviopsilla discolor (Kraepelin) (Daesiidae) but not in Biton zederbaueri (Werner) (Daesiidae).

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Four new harvestmen records from Turkey (Arachnida: Opiliones)

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Abstract

Up till now, a total of 97 harvestmen species have been recorded from Turkey. The present study adds four further records – Mediostoma stussineri, Rilaena buresi, Rafalskia olympica bulgarica, and Dasylobus beschkovi – to the Turkish opilionid fauna. For each of these, detailed data on the collecting locality and general distribution are provided, and their conservation status is commented upon.

Keywords: Opiliones, harvestmen, Fauna, new records, Turkey.

Introduction

The first data about the Turkish opilionid fauna were provided by Simon (1875) and Pavesi (1876). Subsequently more information on faunistics, taxonomy, and chorology of the Turkish harvestmen were published in Simon (1879a, b, 1884), Kulczyński (1903, 1904), Nosek (1905), Roewer (1911, 1912, 1923, 1950, 1951, 1956, 1957, 1959, 1961, 1962), Caporiacco (1925, 1934), Giltay (1932), Šilhavý (1955, 1956, 1965), Gruber (1963, 1966, 1968, 1969, 1976, 1978, 1979, 1998), Staręga (1966, 1967, 1973, 1976, 1978, 1981, 1984, 2003), Gruber & Martens (1968), Martens (1978, 2006), Chevrizov (1979), Cokendolpher (1990), Snegovaya (1999, 2004), Mitov (2000, 2003), Karaman (2002, 2009), Chemeris & Kovblyuk (2005), and Snegovaya & Marusik (in press). More recently, members of the local (Turkish) arachnological school (Bayram, 1994, Çorak, 2004, Kurt, 2004, Bayram et al., 2005, 2006, 2010, Bayram & Çorak, 2007, Çorak & Bayram, 2007, Yigit et al., 2007, Çorak et al., 2008, Kurt et al., 2008a,b, 2010, 2011, YMBP, 2010, Kurt & Erman, 2011, 2012) actively participated in the study of the Turkish opiliofauna. As a result of all these investigations the number of species recorded from Turkey has reached 97. Recent field trips by the author into the European part of Turkey have now resulted in further additions to the Turkish faunal list elucidated below.

Material and Methods

The material (117 specimens: 28♂♂, 16♀♀, 73 juv.) on which the present study is based, was hand-collected during scientific expeditions carried out in the European part of Turkey – mainly in the Strandzha [=Yıldız] Mountains – from 2009 to 2011. The material is deposited in the author's collection. Harvestmen were photographed under an Olympus BX41 SZ61 stereo microscope with a mounted Olympus Color View 1 digital camera. Digital images were assembled using Combine ZM.

Fig. 1. Opiliones collecting sites in the European part of Turkey: **a**. Open oak woodland with evergreen shrubs (near Kıyıköy, Black Sea coast, 22.V.2011); **b**. Park woodland with Hungarian oak, Turkey oak, single narrow-leafed ash and mesophilous meadows (Celepköy region, near Durugöl Lake coast, 23.V.2011); **c-d**. Oriental beech forests with Pontic Rhododendron: **c**. (above Demirköy, Kadın Kule locality, 25.V.2010), **d**. (above Sergen, 25.V.2011); **e**. Oak–Hornbeam forest on calcareous substrates (between Gökyaka and Sarpdere, 23.V.2010); **f**. Mixed oak–manna ash–oriental hornbeam forest with shrub layer of Butcher’s Broom (Yalıköy, Black Sea coast, 23.V.2011).

Results and Discussion

New faunistic data about three harvestmen species and one subspecies collected in the European part of Turkey are presented herein. The current Turkish list is thus considered to now contain 100 species and one subspecies of Opiliones.

List of Species

Family Nemastomatidae Simon, 1879

Mediostoma stussineri (Simon, 1885) (Fig. 2a-b)

Material examined: 2♂♂, 7 juv.
Marmara Region: Kırklareli Province: Vize District: In the region of Kıyıköy, Black Sea coast, N41°39'24.3/21.9" E28°05'11.5/12.7", 0-4 m altitude, in secondary (low-stemmed) Quercus-Fraxinus forest with Phillyrea latifolia and Arbutus unedo, near a small river (Fig. 1a), under stones among the grass, 22.05.2011, leg. P. Mitov (=P.M.). – 1 juv. (body length (=L): 1.05 mm); **Istanbul Province**: Çatalca District: Yalıköy, Black Sea coast, N41°29'27.7" E28°16'39.7", 2-3 m altitude, Quercus-Fraxinus-Carpinus betulus forest with Ruscus aculeatus undergrowth (Fig. 1f), ecotone, under stones, 23.05.2011, leg. P.M. – 1 juv. (L: 2.25 mm); Celepköy, in a small Quercus frainetto-Q. cerris forest patch near Duru Lake (Duru Göl, Durugöl) coast (Fig. 1b), N41°22'48.0" E28°30'47.0", 0-6 m altitude, 23.05.2011, leg. P.M. – 1♂ (L: 2.85 mm), 2 juv. (L: 1.25-1.30 mm); **Tekirdağ Province**: *Tekirdağ District*: in the region of Tekirdağ, Marmara Sea coast, near Ünal Camping, small beach park, N41°00'40.14" E27°46'45.60", 2-3 m altitude, under stones and branches, 27.05.2011, leg. P.M. – 1♂ (L: 2.8 mm), 3 juv. (L: 1.9-2.1 mm).
Distribution: This species was previously known only from Bulgaria and Greece (Mitov, 2002, Deltshev et al., 2005). According to its previously known distribution, Mitov (2002) predicted the occurrence of M. stussineri in Turkey; a prediction which has now been confirmed.

Family Phalangiidae Latreille, 1802

Rilaena buresi (Šilhavý, 1965) (Fig. 2c)
Platybunus buresi Šilhavý, 1965: 393 (transferred to Rilaena Šilhavý, 1965 by Staręga, 1973).

Material examined: 21♂♂, 10♀♀, 1 juv.
Marmara Region: Kırklareli Province: Demirköy District: SW of Sislioba, N41°57'43.09" E27°54'35.70", 46 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis, 03.10.2009, leg. R. Bekchiev. – 1 juv. (L: 1.2 mm); Iğneada region, N41°51'53.91" E27°56'39.09", 0-2 m altitude, longos (swamp) forest, 23.05.2010, leg. P.M. – 1♂; above Demirköy, N41°48'03.8", E27°44'19.1", 614 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis, 25.05.2010, leg. P.M. – 1♂ (L: 4.0 mm); above Demirköy, Kadın Kule locality, N41°47'43.1" E27°44'12.0", 638 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis (Fig. 1c), ecotone, on grass and litter, 25.05.2010, leg. P.M. – 1♂, 1♀ (L: 6.5 mm) (with many eggs in the egg reservoir (=uterus internus)); Vize District: South of Kızılağaç, N41°41'03.7" E27°52'57.1", 128 m altitude, Kızılağaç river bank, Assoc. Rhododendro pontici-Fagetum orientalis, under stones and in the grass, 24.05.2011, leg. P.M. – 2♂♂, 1♀; NW of Kızılağaç, N41°43'50.0/50.06" E27°50'06.0/06.8", 409-420 m altitude, Quercus-forest, 24.05.2011, leg. P.M. – 7♂♂, 1♀; above Sergen, N41°44'26.8" E27°42'41.1", 723 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis (Fig. 1d), under stones near stream, 25.05.2011, leg. P.M. – 8♂♂, 7♀♀; Kıyıköy, N41°38'02.98" E28°05'03.93", 30 m altitude, on the walls and under stones in the rocky St. Nicholas' Monastery, 26.05.2011, leg. P.M. – 1♂ (L: 3.8 mm).
Distribution: Previously known only from Bulgaria (Šilhavý, 1965, Staręga, 1976, Deltshev et al., 2005, Mitov, 2008).

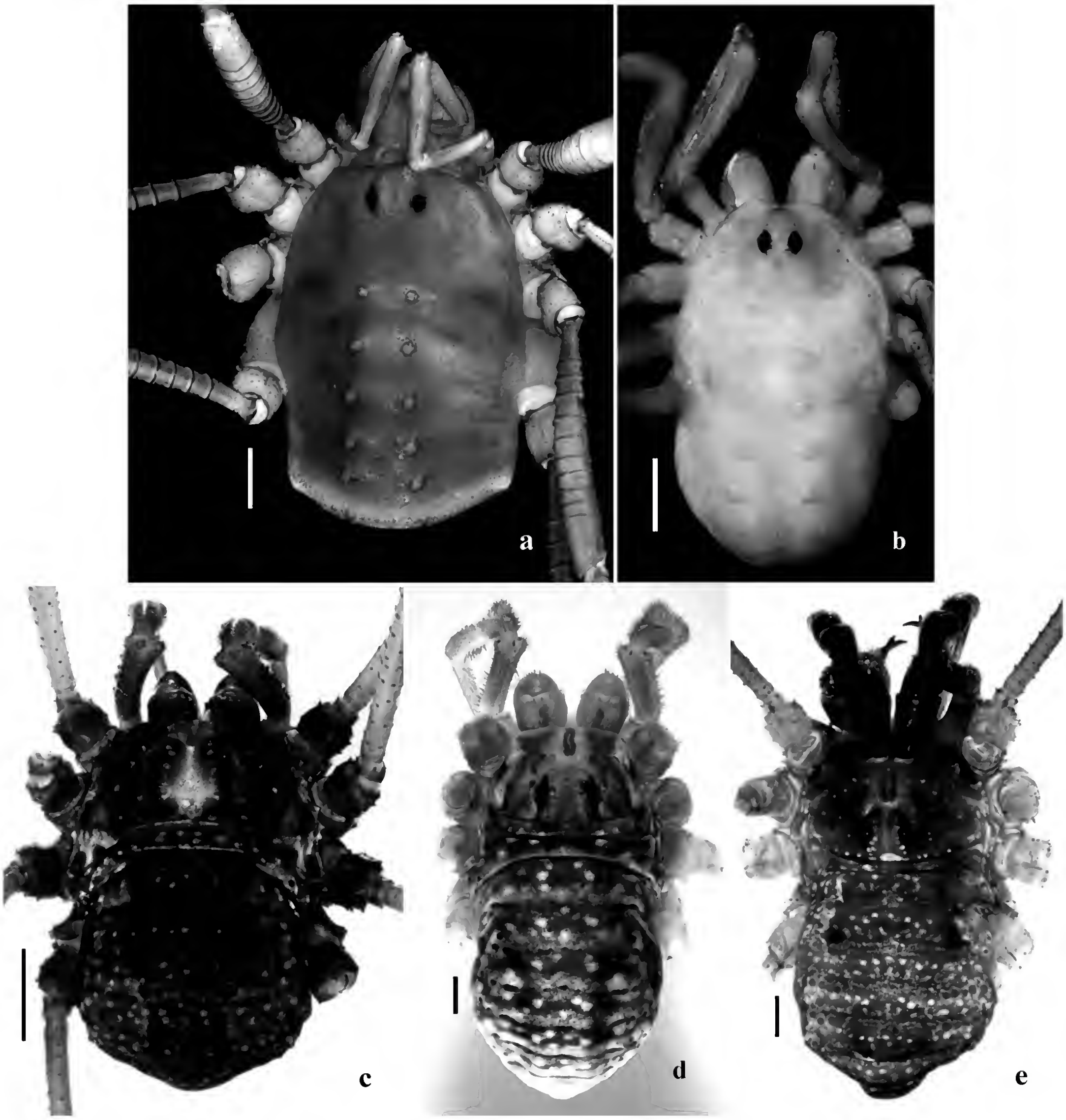

Fig. 2. Habitus of the harvestmen newly recorded for Turkey: **a–b**. Mediostoma stussineri: **a**. male, **b**. juv. (Istanbul Province: Celepköy region); **c**. Rilaena buresi, male (Kırklareli Province: Demirköy region); **d**. Dasylobus beschkovi, juv. (Kırklareli Province: Kıyıköy region); **e**. Rafalskia olympica bulgarica, male (Kırklareli Province: Demirköy region). Scales: a = 0.5, b = 0.3, c = 1, d = 0.3, e = 0.6 mm.

Dasylobus beschkovi (Staręga, 1976) (Fig. 2d)
Eudasylobus beschkovi Staręga, 1976: 386 (Eudasylobus Roewer, 1911 synonymized with Dasylobus Simon, 1878 by Chemini, 1989).

Material examined: 4♀♀, 65 juv.
Marmara Region: Kırklareli Province: Demirköy District: Iğneada, N41°52'41.10" E27°54' 26.94", 88 m altitude, hornbeam forest, 05.07.2009, leg. P.M. – 1♀ (L: 3.5 mm); Iğneada region, Iğneada river bank, N41°52'28.51" E27°56'15.66", 12 m altitude, under logs and under bark, 05.07.2009, leg. P.M. – 3♀♀ (L: 3.7 mm) (with eggs in the egg reservoir); Iğneada region, N41°51'53.91" E27°56'39.09", 0-2 m altitude, longos forest, 23.05.2010, leg. P.M. – 1 juv.; Iğneada region, Hamam Lake (Hamam Gölü),

N41°49'29.4/33.47" E27°57'20.3/35.19", 0-2 m altitude, swamp forest, on grass, 25.05.2010: leg. K. Kunt. – 4 juv. (L: 3.5 mm); leg. P.M. – 10 juv. (L: 3.5 mm); SW of Sarpdere, around cave Dupnitsa, N41°50'26.2" E27°33'22.5", 355 m altitude, 23.05.2010, leg. P.M. – 1 juv.; between Gökyaka and Sarpdere, near to crossroad to Gökyaka, Balaban and Demirköy, N41°52'21.8" E27°36'49.7", 355 m altitude, karst area, Quercus cerris- and hornbeam forest (Fig. 1e), 23.05.2010, leg. P.M. – 1 juv.; above Demirköy, Kadın Kule locality: N41°47'43.1" E27°44'12.0", 638 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis (Fig. 1c), in the ecotone, on grass and litter, 25.05.2010, leg. P.M. – 1 juv.; N41°47'46.2" E27°44'06.8", 671 m altitude, Fagus orientalis-forest with a sparse grassy undergrowth, 25.05.2010, leg. P.M. – 13 juv.; Vize District: In the region of Kıyıköy, Black Sea coast, in Quercus-Fraxinus dwarf-forest with Phillyrea latifolia and Arbutus unedo shrubs, N41°39'24.3" E28°05'11.5", 10 m altitude, 22.05.2011, leg. E. Tasheva & R. Kostova. – 1 juv.; N41°39'21.9" E28°05'12.7", 0-4 m altitude, near small river (Fig. 1a), under stones in the grass, 22.05.2011, leg. P.M. – 9 juv. (L: 1.7-3.0 mm); in the region of Kıyıköy, N41°38'05.8" E28°04'12.4", 5-10 m altitude, in a Carpinus betulus L., Fraxinus, Cornus forest with lianas (Smilax excelsa L.), under stones, 22.05.2011, leg. P.M. – 1 juv.; near the river, alders and lianas, under stones beneath water, 22.05.2011, leg. P.M. – 1 juv.; South of Kıyıköy, N41°36'54.3" E28°05'18.0", 12 m altitude, riverine alder forest, on grass, 25.05.2011, leg. P.M. – 1 juv. (L: 3.5 mm); South of Kızılağaç, N41°41'03.7" E27°52' 57.1", 128 m altitude, Kızılağaç river bank, Assoc. Rhododendro pontici-Fagetum orientalis, under stones, grass, 24.05.2011, leg. P.M. – 5 juv.; NW of Kızılağaç, N41°43'50.0/50.06" E27°50'06.0/06.8", 409-420 m altitude, Quercus-forest, 24.05.2011, leg. P.M. – 12 juv.; above Sergen, N41°44'26.8" E27°42'41.1", 723 m altitude, in Rhododendro pontici-Fagetum orientalis association (Fig. 1d), under stones near stream, 25.05.2011, leg. P.M. – 2 juv.; **Istanbul Province**: Çatalca District: Celepköy, in a small Quercus frainetto-Q. cerris forest-patch near Duru Lake (Duru Göl) coast (Fig. 1b), N41°22'48.0" E28°30'47.0", 0-6 m altitude, 23.05.2011, leg. P.M. – 2 juv.

Distribution: Previously known only from Bulgaria (sub Eudasylobus beschkovi: Staręga, 1976, Deltshev et al., 2005, Mitov, 2004, 2008).

Rafalskia olympica bulgarica Staręga, 1963 (Fig. 2e)

Material examined: 5♂♂, 2♀♀.

Marmara Region: Kırklareli Province: Demirköy District: above Demirköy, N41°48'03.8" E27°44'19.1", 614 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis, 25.05.2010, leg. P.M. – 1♂ (L: 4.6 mm); above Demirköy, Kadın Kule locality: N41°47'43.1" E27°44'12.0", 638 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis (Fig. 1c), under a stump in the ecotone, 25.05.2010, leg. P.M. – 1♂; N41°47'46.2" E27°44'06.8", 671 m altitude, Fagus orientalis-forest with a sparse grassy undergrowth, under stones and logs, 25.05.2010, leg. P.M. – 1♂; Vize District: Kıyıköy, N41°38'03.65" E28°05'16.50", 40 m altitude, Endorfina hotel, on wall, 2 m high, 23.05.2011, leg. P.M. – 1♀ (L: 6.8 mm) (with eggs in the egg reservoir); NW of Kizilağac, N41°43'50.0" E27°50'06.0", 420 m altitude, Quercus-forest, (net-swept from tree crowns at 5 m height), 24.05.2011, leg. I. Gyonov. – 1♀ (L: 7.2 mm) (with eggs in the egg reservoir); Sergen region, N41°44'26.8" E27°42'41.1", 723 m altitude, Assoc. Rhododendro pontici-Fagetum orientalis (Fig. 1d), under stones near stream, 25.05.2011, leg. P.M. – 1♂; **Istanbul Province**: Çatalca District: Celepköy, in a Quercus frainetto-Q. cerris forest-patch near Duru Lake (Duru Göl) coast (Fig. 1b), N41°22'48.0" E28°30'47.0"E, 0-6 m altitude, (found dead in a spider web), 23.05.2011, leg. P.M. – 1♂.

Distribution: According to Karaman (2002), the "Balkan population of Rafalskia olympica (Kulczyński, 1903) are distinguished as separate subspecies Rafalskia olympica bulgarica Staręga, 1963 nov. stat." The latter was hitherto known only from Bulgaria and Serbia (Staręga, 1976, Mitov & Stoyanov, 2004 (sub Rafalskia olympica); Karaman, 2002; Mitov, 2004, Deltshev et al., 2005), but this subspecies probably occurs in Greece as well (see Staręga, 1976).

Habitat preferences

All four newly recorded Turkish harvestmen, Mediostoma stussineri, Dasylobus beschkovi, Rafalskia olympica bulgarica and Rilaena buresi, inhabit specific habitats and have been found at only a few localities (Staręga, 1976; Mitov, 2002, 2004, 2008). These are thermophilous forest species, restricted more or less to the low-mountain zone (see Staręga, 1976; Mitov, 2002) where they inhabit oak and hornbeam forests. Most of these opilionids are forest ombrophiles, while D. beschkovi seems to prefer the forest ecotone where it mainly inhabits the shrub layer. Mediostoma stussineri, the most dependent on moisture, occurs in shady riverside habitats. Among these opilionids, only Rafalskia olympica bulgarica occurs higher up in the mountains (up to 2700 m in Bulgaria; Staręga, 1976), but it also inhabits forest habitats on the Black Sea coast where the climate is similar to that in the mountains (see also Josifov, 1976, 1988; Gruev, 1988).

Endemism and conservation status

None of the mentioned opilionids is currently protected by law, but in this respect the endemic and rare species of the Turkish (and Balkan) fauna, such as Mediostoma stussineri, Dasylobus beschkovi, Rafalskia olympica bulgarica, and Rilaena buresi, are of significant interest because Balkan endemics occur in only a very limited number of localities; all of which could easily be negatively influenced. Most interesting, as a Tertiary relict, is R. buresi, which was the most abundantly collected opilionid species on Strandzha Mt. This mountain can be considered a refugium for a substantial part of the relict populations of R. buresi. All this suggests that special measures need to be taken for the protection and conservation of the harvestmen species, and their habitats. Uncontrolled deforestation, burning, changes in the landscape terrain and the riverbeds, as well as the recent development of tourism are some of the most influential factors in this respect.

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Two interesting new ground spiders (Araneae) from the Canary Islands and Greece

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Abstract

A new Zelotes species from the tenuis group, Zelotes henderickxi, is described from Tenerife, Canary Islands. A new and remarkable spider genus from the Greek Peloponnese, Vankeeria, is described, and attributed to Liocranidae. The genus is monotypic and known to date only from the type species, Vankeeria catoptronifera.

Keywords: Arachnida, Araneae, Liocranidae, Gnaphosidae, Mediterranean, Greece, Canary Islands, Zelotes henderickxi, Vankeeria catoptronifera.

Introduction

Field work in subtropical and tropical regions frequently turns up spider specimens that can not be identified. In a number of cases, these specimens can be recognised as new and can be attributed to a genus or family, but are not described nevertheless, because only one sex or one specimen is available. This is especially true for difficult families such as Lycosidae or Gnaphosidae, and for less studied families such as Liocranidae and Corinnidae. Although it is understandable that authors prefer a larger number of specimens to base a description on, this practice hampers faunistic work executed in many interesting regions. In the present contribution, two remarkable ground spider species known from only a single specimen are described.

Methods

Specimens were observed, photographed and drawn using Euromex MIC465 and Olympus SZX9 binocular microscopes. Tarsal claws were observed, photographed and drawn using a Wild M12 compound microscope. All micrographs were made with a Praktica DC440 digital camera. All measurements are in millimetres. The format for leg spination follows Platnick & Shadab (1975), amended for ventral spine pairs according to Bosselaers & Jocqué (2000). Leg spination is also illustrated in a schematic representation (Figs. 14, 15) where pl, do, rl and ve sides of leg articles are flattened as a folding net (Dürer, 1525).

Abbreviations used: AE, anterior eyes; AER, anterior eye row; ALE, anterior lateral eyes; ALS, anterior lateral spinnerets; AME, anterior median eyes; CO, copulatory openings; do, dorsal; fe, femur; fr, frontal; ICS, intercoxal sclerites - ICS are six small triangular or elongated sclerites surrounding the sternum, their tips penetrating between the coxae of the legs - they may be free, or fused with the sternum (Bosselaers & Jocqué, 2002: fig. 1K); MA, median apophysis; MOQ, median ocular quandrangle; mt, metatarsus; pa, patella; PCT, precoxal triangles - PCT are small triangular sclerites surrounding the sternum, their tips facing the bases of the coxae (Penniman 1985: 16) - they may be free, or fused with the sternum (Bosselaers & Jocqué, 2002: fig. 1K); PER, posterior eye row; pl, prolateral; PLB, pleural bars - PLB are narrow, horizontal sclerites between coxae and carapace, one above each coxa ("pièces épimériennes" of Simon (1892: 11, fig. 29)) - they may be fused among each other (Bosselaers & Jocqué, 2002: fig. 1P), with intercoxal sclerites and/or with carapace; PLE, posterior lateral eyes; PLS, posterior lateral spinnerets; plv, prolateral ventral; PME, posterior median eyes; PMS, posterior median spinnerets; rh, retrocoxal hymen - the retrocoxal hymen is a weak spot, in most cases hyaline and lens- to dome-shaped, on the retrolateral face of coxa I (Raven, 1998; Bosselaers & Jocqué, 2002); rl, retrolateral; rlv, retrolateral ventral; RTA, retrolateral tibial apophysis; ta, tarsus; ti, tibia; ve, ventral; vt, ventral terminal; w, width.

Abbreviations of personal and institutional collections (curator in parentheses):
CJB, personal collection Jan Bosselaers
CJVK, personal collection Johan Van Keer
RBINS, Royal Belgian Institute of Natural Sciences, Brussels (L. Baert)

Taxonomy

Family Gnaphosidae

Zelotes Gistel, 1848

Zelotes henderickxi sp. n.

Figs. 1, 7-9, 14.

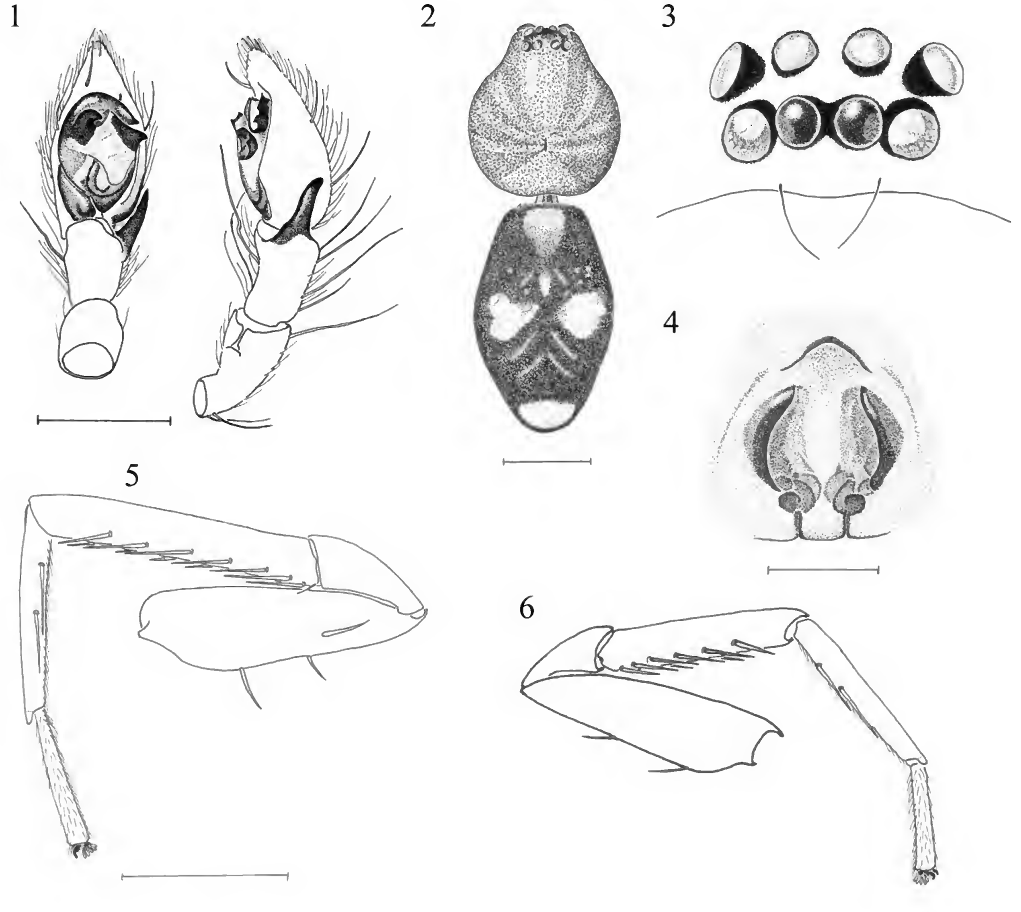
Type material. Holotype male, Spain, Canary Islands, Tenerife, Puerta de la Cruz, hand captured, 12 August 1994, H. Henderickx leg. [CJB1166], deposited in RBINS.

Diagnosis

Z. henderickxi is similar to Z. manytchensis (Ponomarev & Tsvetkov, 2006) by the shape of the arched embolar base, the MA and the terminal apophysis (Senglet, 2011), but differs from it by its larger size, a simpler embolus shape, a shorter do abdominal scutum and an RTA which is shorter than the ti. Z. henderickxi is also close to Z. fuscorufus (Simon, 1878), but differs from it by its larger size, a larger terminal apophysis, a less vertically oriented embolar base and a simple RTA. Z. henderickxi differs from all other species in the Z. tenuis group by its small PME (Senglet, 2011: 515).

Description

Male (holotype). Total length 6.25. Carapace length 2.80, w 2.15, yellowish brown with faint brown radiating striae, fovea brown, pronounced, length 0.3, anterior end 1.65 from front end of carapace. MOQ depth 0.26, anterior w 0.22, posterior w 0.24. AER w 0.42, recurved in do view, procurved from front, PER w 0.53, procurved in do view, procurved from front. AME small and dark, other eyes pearl. All eyes ringed with black. AME separated by 2/3 of their diameter, almost touching ALE. Diameter of ALE almost twice that of AME. PME subrectangular, separated from each other and from PLE by the length of their smallest axis. PLE as large as ALE, slightly larger than PME. Clypeus almost twice as wide as diameter of AME. Chilum very small, subtriangular, brown and sclerotised. Chelicerae brown, with four teeth along promarginal cheliceral rim, the two largest ones situated in the middle of the row, retromarginal rim with two small teeth. No shaggy hair in front of fang. Sternum oval to shield-shaped, not rebordered, yellowish brown, darker chestnut at border, length 1.60, w 1.25. Four pairs of PCT, three pairs of ICS, PLB inconspicuous and isolated. Labium brown, longer than wide. Endites about twice as long as wide, with a diagonal notch, an apical hair tuft and a serrula. Dorsal side of abdomen unicolorous yellowish grey, with four orange sigilla, a brown triangular scutum in anterior quarter and a frontal row of curved strong hairs. Ventral side of abdomen pale yellow, epigastric region orange brown and slightly sclerotised. ALS very large, cylindrical, three times as long and as wide as PLS, separated by 1/4 of their length. PMS short, slender, length 1/4 of length ALS. PLS short, subcylindrical, with a short, blunt apical segment. Legs unicolorous brown, trochanters not notched, no retrocoxal hymen present, no feathery hairs. Patellar indentation narrow, 2/3 of pa length.



Figs. 1-6: Line drawings of Zelotes henderickxi sp. n. and Vankeeria catoptronifera sp. n. 1. Zelotes henderickxi male palp ve (left) and rl (right) view. 2-6. Vankeeria catoptronifera, female. 2. Habitus, do view. 3. Eyes, dorso-frontal view. 4. Epigyne, ve view. 5. Leg I, pl. 6. Leg II, pl. Scale bars: 1 = 0.5; 3-4 = 0.25; 2, 5-6 = 1.

Leg formula 4123. Metatarsi III and IV with strong vt comb typical for the genus. Tarsi with two toothed claws and without claw tufts or tenent hairs. Leg spination (Fig. 14) fe: palp do 0-1-2; I pl 0-0-1 do 1-1-0; II pl 0-0-1 do 1-1-0; III do 1-3-2; IV do 1-3-2; pa: palp pl 1-0-0 do 0-0-1; III rl 1-0-0 ti: palp do 0-0-1; III pl 1-1-0 do 0-2-0 rl 1-1-0 ve 2-2-2; IV pl 1-1-0 do 0-2-0 rl 1-1-0 ve 2-2-2; mt: II plv 1-1-0 rlv 1-0-0; III pl 0-1-1 do 2-2-2 rl 0-1-

1 ve 2-2-0; IV pl 0-1-1 do 2-2-2 rl 0-1-0 ve 2-2-0; ta: palp pl 0-0-1 do 0-2-0 rl 0-1-0 ve 0-0-1.

Male palp as illustrated (Figs. 1, 8-9), with a large, arched embolar base, a large, hook-shaped terminal apophysis, a subtriangular MA and a long, simple blunt RTA.

Female: unknown.

Etymology

The species is named after Hans Henderickx, who collected the type specimen.

Distribution. Only known from the type locality.

Discussion

Z. henderickxi clearly belongs in the Z. tenuis group by its arched embolar base, the shape of its terminal apophysis and its distally oriented embolus (Senglet, 2011, for terminology of palpal sclerites see Senglet, 2004: fig. 1b and Platnick & Shadab, 1983: fig. 2). Although the spider fauna of the Canary Islands has been extensively studied (Wunderlich, 1987, 1992), only five species of the large genus Zelotes have been mentioned from them (Wunderlich, 2011). Only one of these, Z. manzae (Strand, 1908) is considered endemic for the islands (Platnick, 2012; Wunderlich, 2011). The present new species seems to be the second endemic Zelotes from the Canary Islands.

Family Liocranidae

Vankeeria gen. n.

Figs. 2-6, 10-13, 15.

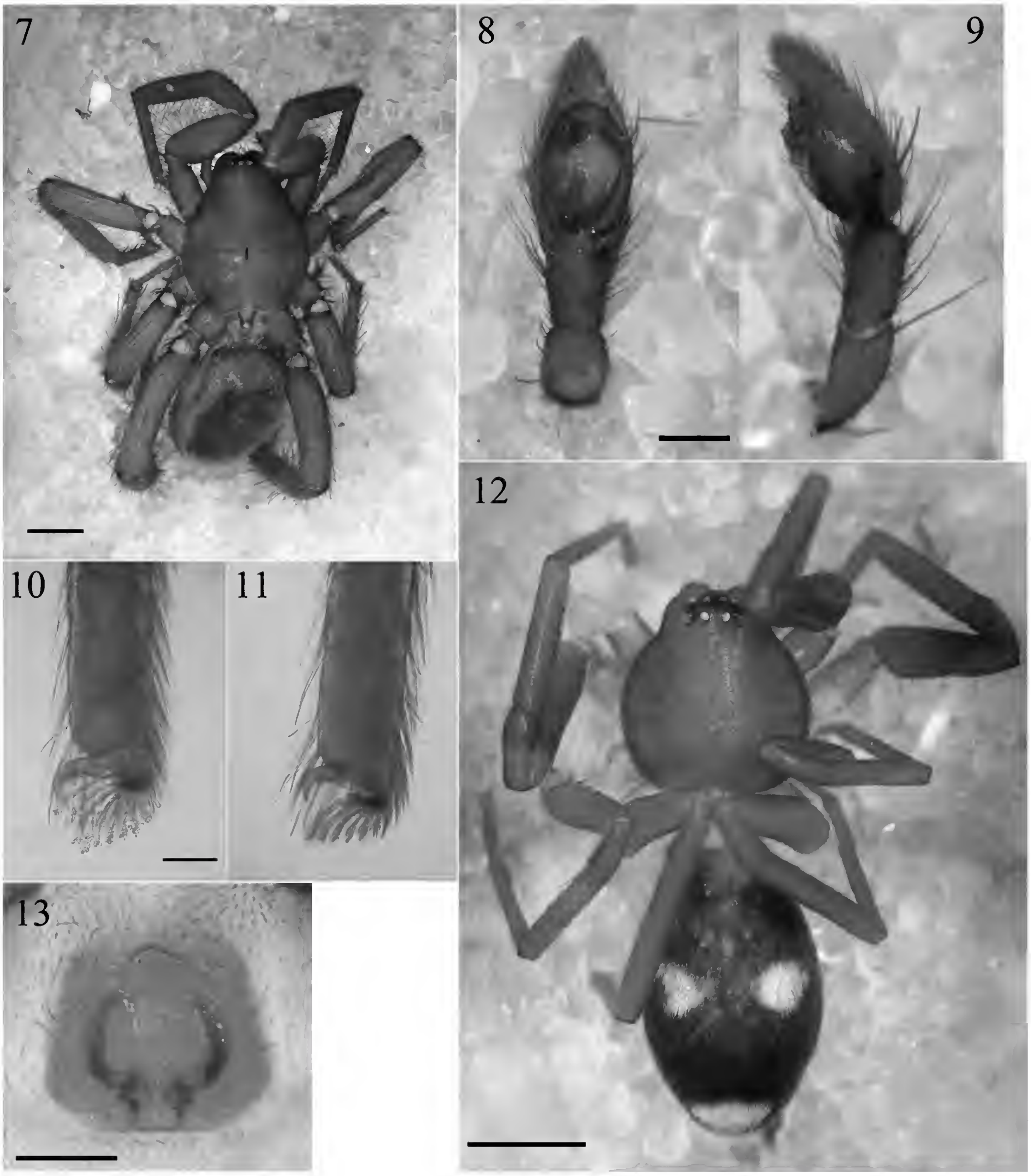
Diagnosis

Vankeeria is somewhat similar to Sphingius Thorell, 1890, but differs from it by the presence of strong ventral spine pairs on ti and mt I and II. Vankeeria also shows some affinties to Apostenus Westring, 1851, but differs from it by the absence of plv spines on fe I, the absence of do spines on ti III and IV, the large AME, the absence of a median septum in the epigyne and the abdominal pattern.

Description

Medium sized (5) spiders. Carapace orange brown, punctate (Fig. 12). A short but distinct fovea in posterior third. Chilum small and sclerotised, single, subtriangular. Eyes in two transverse rows of four, in fr view both eye rows procurved (Fig. 3); in do view AER slightly recurved, PER recurved (Figs. 2, 12). All eyes ringed with black, AME dark, other eyes pearl (Fig. 3). PME almost circular. MOQ widest posteriorly. Clypeus equal to diameter of AME. Chelicerae yellow, tapering towards tip. Fangs sickle-shaped, with one large, knee-shaped shaggy hair in front. Sternum shield shaped, smooth, yellow and shiny, not rebordered. Four pairs of PCT present, no ICS. PLB weak and thin, isolated. Labium subtrapezoidal, somewhat broader than long, with thickened white anterior rim. Endites subrectangular, twice as long as wide, with a diagonal transverse notch, a small apical hair tuft and a thin serrula. Dorsal side of abdomen dark grey with several large, striking white patches (Figs. 2, 12). Ventral side of abdomen pale cream, except for a dark grey ring around the spinnerets. No do or ve abdominal sclerites present. ALS conical, PMS subtriangular, PLS cylindrical. Legs unicolorous yellow brown (Fig. 12). No retrocoxal hymen, no trochanter notch. Patellar indentation long and narrow, half as long as patella. Leg formula 4123. Femora without median apical spine, ti I and II with 5-6 ve spine pairs, mt I and II with 2 ve spine pairs (Figs. 5-6, 15), ti and mt III and IV without do spines. Dense ve preening brush on mt III and IV. Tarsi without claw tufts, but with several pairs of tenent hairs, claws pectinate.

Epigyne a sclerotised plate with a wide anterior hood and anterior CO (Figs. 4, 13).



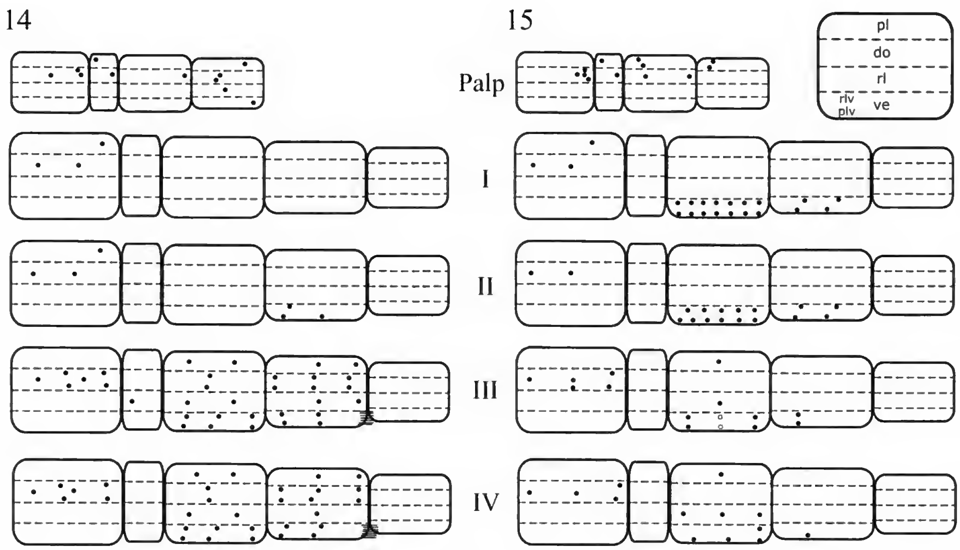
Figs. 7-13: Colour photographs of Zelotes henderickxi sp. n. and Vankeeria catoptronifera sp. n. 7-9. Zelotes henderickxi, male. 7. Habitus, do view. 8. Male palp ve view. 9. Male palp rl view. 10-13. Vankeeria catoptronifera, female. 10. Leg II, tarsal tip. 11. Leg I, tarsal tip. 12. Habitus, do view. 13. Epigyne, ve view.
Scale bars: 7, 12 = 1; 8-9, 13 = 0.25; 10-11 = 0.1.

Etymology

The genus is named in honour of Johan Van Keer, who collected the only specimen of the type species, and his brother Koen Van Keer, who spares no effort to popularise arachnology to the general public.

Discussion

Whether Vankeeria should be placed in Corinnidae or Liocranidae is complicated by the fact that both families lack distinct synapomorphies (Platnick & Baptista, 1995; Bosselaers & Jocqué, 2002; Wunderlich, 2008). However, the combination of a flat carapace, a shaggy hair in front of the fang base, absence of abdominal sclerotisation, ti and mt I and II with several ve spine pairs and an epigyne with an anterior hood pleads in favor of a place in Liocranidae.



Figs. 14-15: Leg spination schemes. Legend in upper right corner. White dots are spines present on one leg and absent on the other. 14. Zelotes henderickxi, male. 15. Vankeeria catoptronifera, female.

Vankeeria catoptronifera sp. n.

Figs. 2-6, 10-13, 15.

Type material. Holotype female, Greece, Peloponnese, Achaia, A. Zachlorou, Vouraikos Gorge, alt. 1000 m, hand captured, 14 April 2000, J. Van Keer leg. [CJVK1971], deposited in RBINS.

Description

Male unknown.

Female (holotype). Total length 4.70. Carapace length 1.85, w 1.70, fovea brown, length 0.20, anterior end 1.20 from front end of carapace. The orange brown, punctate carapace is covered by sparse white silky hairs in the cephalic region. AER w 0.48, PER w 0.58. AME separated from each other by half of their diameter, almost touching ALE. AME slightly smaller than ALE. PME almost circular, separated from each other by 1.5 times their diameter and from PLE by 3/4 of their diameter. PME slightly smaller than PLE. PLE slightly smaller than ALE, the same size as AME (Fig. 3). MOQ depth 0.27, anterior w 0.24, posterior w 0.27. Promarginal cheliceral rim with three teeth, largest one in the middle and smallest one furthest from fang base, retromarginal rim with two small teeth close to fang base, smallest one closest to fang base. Sternum length 1.18, w 1.05. Abdomen with a frontal row of a few sparse strong setae. Dorsal side of abdomen dark grey with a light grey triangular anterior patch, then, halfway between anterior and posterior end, two lateral subcircular white patches containing a faint sigillum, those patches in turn followed by two faint, light grey chevrons and an oval transverse posterior white patch (Figs. 2, 12). ALS separated by 1/3 of their length, PLS separated by their length. Small ve, non-erectile bristles on mt I and II. Feathery hairs present. Tarsi with toothed claws and six pairs of tenent hairs (Figs. 10-11). Leg formula 4123. Leg spination (Fig. 15) fe: palp do 0-1-3 rlv 1-1-1; I pl 0-0-1 do 1-1-0; II do 1-1-0; III do 1-2-2; IV do 1-1-2; pa: palp pl 1-0-0 do 0-0-1; ti: palp pl 2-0-0 do 1-0-1; I plv 1-1-1-1-1-1 rlv 1-1-1-1-

1-1-1; II plv 1-1-1-1-1-1 rlv 1-1-1-1-1; III pl 0-1-0 rl 0-1-0 ve 2-(2)-2; IV pl 0-1-0 rl 1-1-1 plv 1-1-1 rlv 0-0-1; mt: I plv 1-1 rlv 1-1; II plv 1-1 rlv 1-1; III ve 2-0-0; IV rlv 1-0-0. Epigyne (Figs. 4, 13) a subrectangular brown sclerotised plate with a wide anterior hood and large anterior entrances with a longitudinal sclerotised rim. Vulva: in order not to damage the unique type specimen, the vulva was not studied.

Etymology

The species epithet catoptronifera, from the Greek κατοπτρον, mirror, refers to the mirror-like white patches on the do side of the abdomen of the new species.

Discussion

Vankeeria catoptronifera sp. n. is one of the only liocranids known with a strikingly marked abdomen. Sphingius octomaculatus Deeleman-Reinhold, 2001 also has white spots on a dark abdomen, but these are much smaller and fainter than those of Vankeeria. Apparently this beautiful species is very rare and elusive. The type specimen is described by Van Keer as a fast runner.

Distribution. Known only from the type locality.

Acknowledgments

Thanks are due to Johan Van Keer for the loan of the type specimen of Vankeeria catoptronifera from his personal collection, and to Hans Henderickx for collecting and donating the type specimen of Zelotes henderickxi. The author is also grateful to Jörg Wunderlich for studying the type specimen of Zelotes henderickxi and recognising it as a new species, and to Antoine Senglet for confirming this. Thanks are also due to Charles Haddad, Martín Ramirez, Rudy Jocqué and Norman Platnick for fruitful discussions on Vankeeria, and to Christa Deeleman-Reinhold for the loan of a specimen of Sphingius octomaculatus.

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Theridion incanescens Simon, 1890 and Theridion jordanense Levy & Amitai, 1982 new to the fauna of Egypt (Araneae: Theridiidae)

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Abstract

Theridion incanescens Simon, 1890 and T. jordanense Levy & Amitai, 1982 are succinctly described and recorded for the first time from Egypt. The male of T. jordanense is introduced for the first time. As taxonomic novelty the synonymy of Theridion egyptium Fawzy & El Erksousy, 2002 with T. jordanense is proposed.

Keywords: Spiders, Theridiidae, Theridion, synonymy, Egypt.

Introduction

The genus Theridion Walckenaer, 1805 is the most comprehensive within the family Theridiidae, including almost 600 of the about 2300 total species (Platnick, 2012). As type genus it represents a conglomeration of well and poorly known species and species which have been placed herein owing to a lack of better understanding.

In the present taxonomic-faunistic note two species are introduced, which are clear members of the genus Theridion. They are both scarcely known and are now succinctly described from both genders and reported as new to the fauna of Egypt. Theridion incanescens is illustrated for the first time since its original description by Simon (1890) from Yemen, although a depiction of its mating behaviour already exists (Knoflach, 2004). Theridion jordanense has so far been known from the female only (Levy & Amitai, 1982; Levy, 1998). A short description of the hitherto unknown male is given. For both species a full and more detailed description is in preparation in the course of an investigation of the family Theridiidae of the Arabian Peninsula (Thaler-Knoflach & van Harten, in prep.).

The first record of Theridiidae from Egypt was that of Cambridge (1876) who described Theridion melanostictum from Alexandria, T. spinitarse from Cairo, and recorded T. varians Hahn, 1833 from Alexandria. The two other Theridion species reported from Egypt (El-Hennawy, 2006), T. nigrovariegatum Simon, 1873 and T. musivum Simon, 1873 have recently been transferred to Heterotheridion and Ruborridion by Wunderlich (2008, 2011). Finally, Wunderlich (2011) also added T. cairoense as a new species from Cairo.

A new synonymy is proposed concerning Theridion egyptium, a species which was described ten years ago by Fawzy & El Erksousy (2002) from Cairo and which was already regarded as ambiguous (El-Hennawy, 2004). In the following it is synonymised with T. jordanense.

Material and Methods

Specimens were examined using a Leica Wild M8 stereoscopic microscope with a micrometer eyepiece. Male and female genitalia were dissected and studied as temporary mounts by submerging them in glycerine, clove oil and Hoyer's compound solution on half-covered slides under a Wild M20 microscope with a drawing tube. Living spiders were photographed with a Nikon F3, Medical-Nikkor 120 mm lens, ring flash and a teleconverter.

Abbreviations: C – conductor, E – embolus, S – subtegulum, T – tegulum, MA – median apophysis, TTA – theridiid tegular apophysis (nomenclature of male palp sensu Agnarsson, 2004 and Agnarsson et al., 2007).

Depository and museum abbreviations: ACE – Arachnid Collection of Egypt Hisham El-Hennawy, CTB – Collection Theo Blick [private collection], CTh – Collection Thaler and Knoflach [private collection], MHNP – Muséum d'Histoire naturelle Paris.

Theridion incanescens Simon, 1890

(Figs. 1-9)

Theridion incanescens Simon, 1890: 97, males and females, type locality Aden, Shaykh 'Uthman ("Cheikh Othman"), Yemen.

Material examined: 2♀ (1♀ deposited in ACE, 1♀ MHNP), Egypt: Western Omraniya, Giza 29°59'44"N, 31°11'50"E, elev. 26 m, collected by Naglaa Ahmad on 22.05.2006 from Mottled Spurge Euphorbia lactea and succulent Aloe vera cultivated in a house's roof garden.

Type material: 3♂ 1♀ (AR 2329, MHNP), Yemen, Aden, E. Simon.

Comparative material: Numerous ♂♀ from Yemen collected by Antonius van Harten from various places (see Figs. 1-5; Thaler-Knoflach & van Harten, in prep.).

Description: Simon (1890).

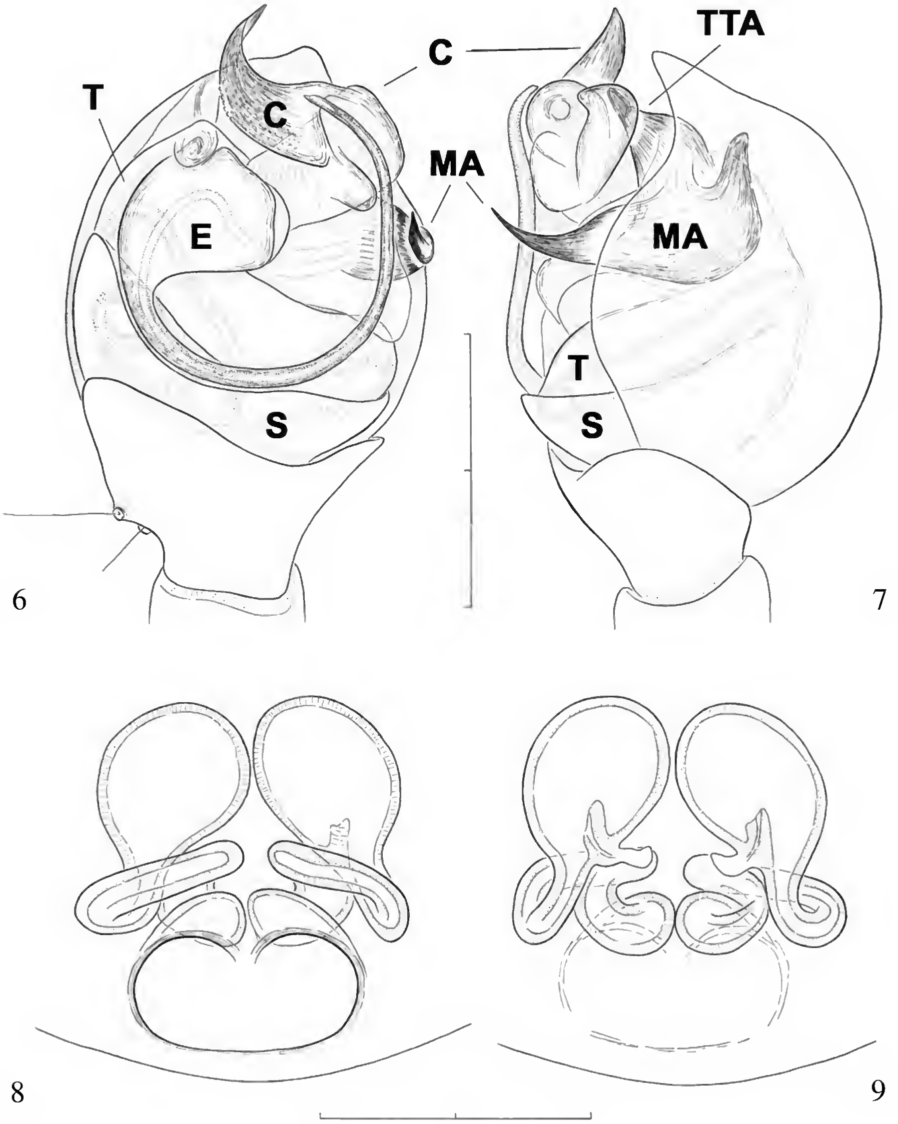
Measurements. Typical medium-sized Theridion species. Male types (n=2): Total length 2.1-2.4, carapace length 0.9-1.0, width 0.7-0.8, length femur I 1.3-1.6, tibia I 1.0-1.4 mm. Female type: Total length 2.5, carapace length 1.0, width 0.8, length femur I 1.4, tibia I 1.0 mm.

Female from Egypt: Total length 3.4, carapace length 1.1, width 1.0, length femur I 1.4, tibia I 1.1 mm.

Figs. 1-4. Theridion incanescens Simon, 1890. Female (1-2) and male (3-4) from Yemen, in dorsal (1, 3), ventral (2) and lateral view (4).

Fig. 5. Theridion incanescens Simon, 1890. Female and male from Yemen, copulation in final phase. Note protruding mating plug secretion.

Somatic features, colouration (Figs. 1-5): Colouration quite variable, with light yellowish-brown, reddish or sometimes also dark brown ground colour. Common form: Carapace light yellowish-brown, sometimes with indistinct fuliginous shading at sides but without clear marking. Sternum dark brown. Legs yellowish-brown, with a few dark annulations on distal femora, tibiae and metatarsi, especially on leg IV. Abdomen light brown, with characteristic creamy whitish folium. This evenly undulated longitudinal median band is encircled by dark pigmentation of variable extent. Male epigastric region bulging and dark (Fig. 5), seminal vesicle (part of male genital system) dark and sometimes translucent. Venter uniformly light brown. Spinnerets surrounded by a dark ring of pigmentation. A few specimens very dark, their legs with extended dark markings.



Figs. 6-9. Theridion incanescens Simon, 1890, types from Yemen. Male palp, ventral (6) and retrolateral view (7). Epigynum/vulva, ventral (8), dorsal view (9). Figs. 6-9 drawn at same scale. Scale lines: 0.2 mm.

Male palp (Figs. 6-7): Conformation of male palp agrees with other representatives of the Theridion varians group (see Knoflach, 1998). Tibia short, with two retrolateral trichobothria. Conductor markedly pointed and curved, its distal part forming a distinct sickle which is covered with minute scales and protrudes beyond cymbium. Prolateral part of median apophysis sharply pointed, sickle-shaped. Theridiid tegular apophysis tapering, rather small and hidden by conductor. Basal part of embolus on retrolateral side of tegulum. Embolus at base with typical knob-like condylar articulation at retrolateral tegulum. Distal part of embolus slender, 0.39 mm long. Subtegulum with guiding furrow for embolus.

Epigynum/vulva (Figs. 8-9): Epigynal cavity large, transverse and rounded (see also Fig. 2), its lateral and anterior border sclerotised, where copulatory orifices start. Copulatory ducts about as long as distal embolus, ca. 0.39 mm. They turn inwards, forming a small coil, and then diverge laterally before entering the receptacula posteriorly. In mated females the epigynal cavity is obviously filled by plug secretions (Fig. 5).

Generic placement: Simon (1890) already indicated the close affinity to Theridion pictum, type species of Theridion and typical representative of the T. varians group. This can be confirmed also from genital characters, from the protruding male epigastric region, and elements of the copulatory behaviour, especially formation of a mating plug, see below.

Distribution: The species is presently known only from Yemen and Egypt.

Behaviour: Copulation follows the pattern of Theridon varians, with numerous sperm inductions being part of copulation, with an initial pseudocopulation and a long concluding phase of mating plug production (see Knoflach, 1998, 2004). A male interrupted copulation four times for construction of sperm web and sperm induction. Copulation consisted of five sequences. The short first copulatory sequence is assumed to be a preinsemination phase without sperm transfer. In the course of the last sequence the conspicuous mating plug secretion is produced, which completely fills and seals the epigynal cavity (Fig. 5).

Theridion jordanense Levy & Amitai, 1982
(Figs. 10-13)

T. jordanensis Levy & Amitai, 1982: 103, figs. 41-42, female, type locality Nahal Samak, northern Sea of Galilee, Israel.
T. jordanense; Levy, 1998: 196, figs. 373-374, female.
Theridion egyptium Fawzy & El Erksousy, 2002: 832, figs. 1-4, male, female, type locality Giza, Cairo, Egypt. **Nov. syn.**

Material examined: 5♂ 5♀ (3♂ 3♀ deposited in ACE, 1♂ 1♀ CTh, 1♂ 1♀ MHNP), Egypt: Cairo University, Giza 30°01'05"N, 31°12'31"E, elev. 23 m, collected by Naglaa Ahmad on 22.02.2004 from olive trees, cultivated behind faculty of Agriculture.

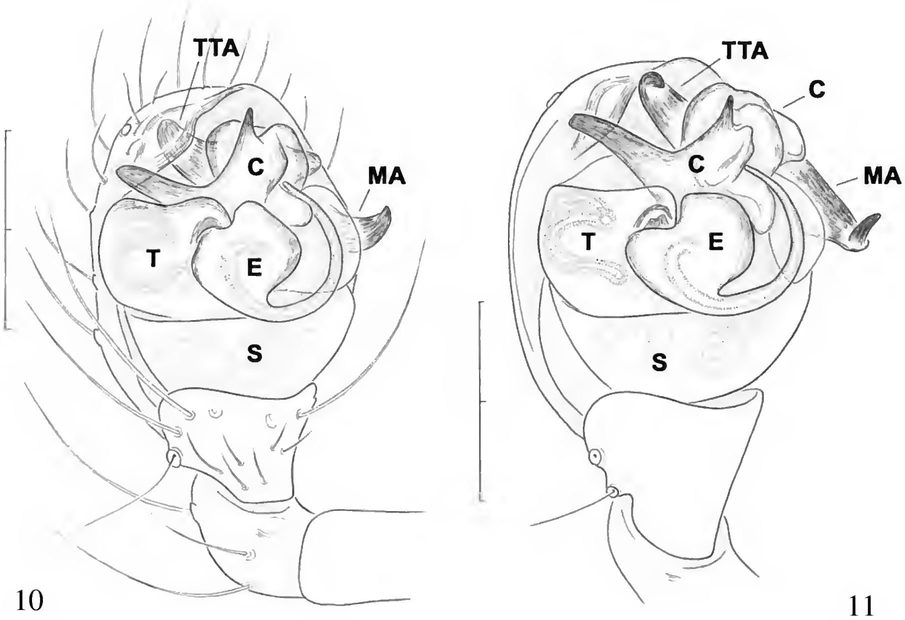
Comparative material: 2♂ (CTB), Syria: Hammaralkasra upon Euphrat at border to Iraq, 3.8.1989, collected by Ismail Al Hussein, dedit Theo Blick.
Numerous ♂♀ from United Arab Emirates collected by Antonius van Harten from several places (Thaler-Knoflach & van Harten, in prep.).

Description, identification: Levy & Amitai (1982), Levy (1998), females only.

Synonymy: Theridion egyptium Fawzy & El Erksousy, 2002 is synonymised with T. jordanense from the literature (figs. 1-4 in Fawzy & El Erksousy, 2002) because of the following distinct characters: Conformation of male palp and epigynum very similar (Figs. 10-13). Shape of conductor, median apophysis and theridiid tegular apophysis fully corresponds, albeit labelling of palpal structures in Fawzy & El Erksousy (2002) deviates from standard labelling. Figures of the internal female copulatory organ of Theridion egyptium largely resemble those of T. jordanense in the coiled course of the copulatory ducts and separate copulatory orifices (Figs. 12-13). Also colour pattern is in conformance, see median dark patch between spinnerets and epigastric furrow (fig. 3 Fawzy & El Erksousy, 2002; labelled as cribellum !) and carapace markings. The present specimens examined from the type locality Giza strengthen this synonymy.

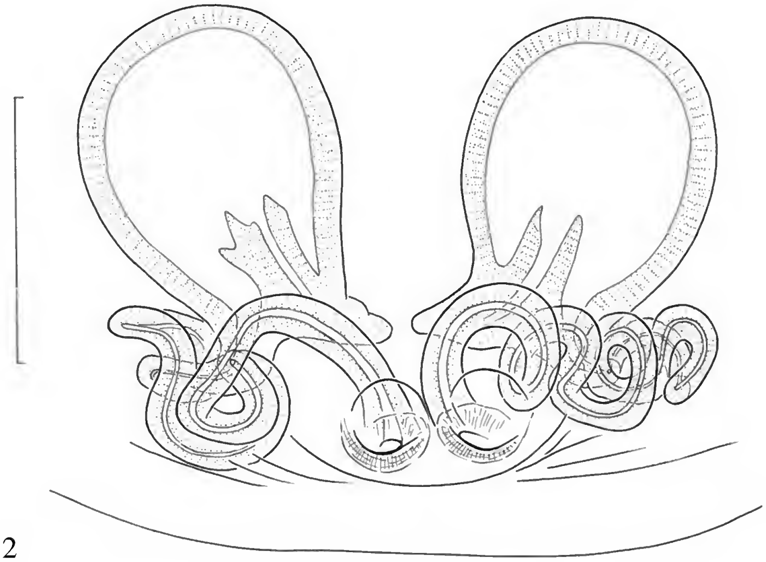
Measurements. Medium-sized Theridion species, males rather long-legged. Males from Egypt (n=2): Total length 2.4-2.6, carapace length 1.0, width 0.8-0.9, length femur I 2.2-2.3, tibia I 1.9-2.1 mm. Females from Egypt (n=2): Total length 2.6-2.9, carapace length 0.8, width 0.7-0.8, length femur I 1.6-1.7, tibia I 1.3-1.5 mm.

Somatic features, colouration: Overall light coloured, legs long and slender. Carapace yellowish, with narrow dark margins and dark median band. Sternum yellowish, sometimes with dark margins. Legs either uniformly light yellowish or with tiny dark speckles. Abdomen dorsal creamy white, with indistinct creamy white folium. On venter a median dark patch between spinnerets and epigastric furrow. Male epigastric region protruding and sometimes darkened. A few specimens very dark, showing numerous dark spots and extended dark markings on legs and abdomen.



Figs. 10-11. Theridion jordanense Levy & Amitai, 1982, from United Arab Emirates (10) and Syria (11). Male palp, ventral view (10-11). Scale lines: 0.2 mm.

Male palp (Figs. 10-11): Tibia with one or two retrolateral trichobothria. Conductor a complex, sclerotised structure with numerous lobes and two prominent finger-like outgrowths, one larger one directed retrolaterally and one smaller one directed to apex of cymbium. Median apophysis forming a conspicuous tip at prolateral side. Theridiid tegular apophysis finger-like, arresting towards cymbial hood. Basal part of embolus in centre of bulbus and tegulum. Distal embolus rather short, 0.20-0.21 mm long, not correlating with the length of the female's copulatory duct. Embolar base with knob-like locking device.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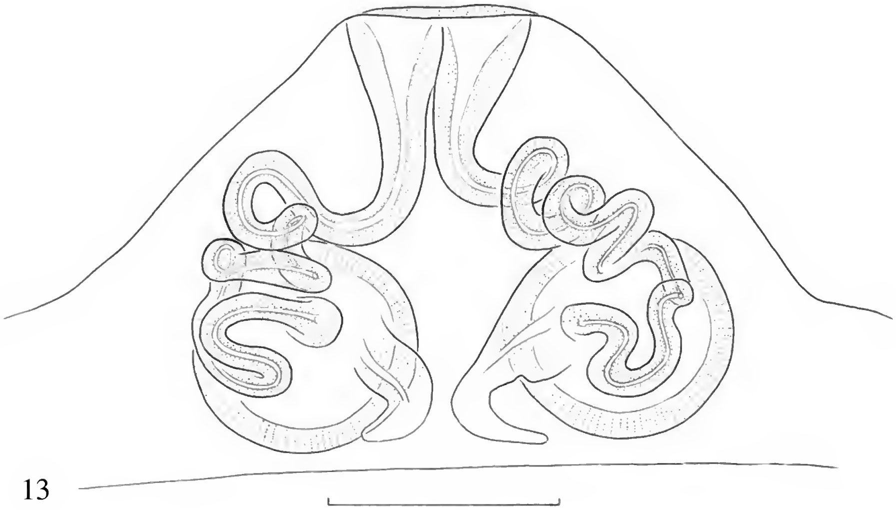
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Figs. 12-13. Theridion jordanense Levy & Amitai, 1982, from United Arab Emirates. Epigynum/vulva, ventral (12), and aboral view (13). Scale lines: 0.1 mm.

Epigynum/vulva (Figs. 12-13). Epigynal area raised and distinctly projecting, in side view conical. Copulatory orifices situated on top of projection, small and clearly separate.

Their posterior edges heavily sclerotised. Copulatory ducts form numerous small coils, their length about 0.4 mm. The lumina of these ducts are rather narrow and do not appear to match the size of the males' emboli and thus do not allow penetration at full length.

Distribution: Theridion jordanense was hitherto known from two regions in Israel (Dead Sea and Lake Kinneret, see Levy, 1998) and is now recorded from Syria and Egypt.

Acknowledgments

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A new synonymy in a linyphiid spider from Egypt (Araneae: Linyphiidae)

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Abstract

Bathyphantes extricatus (O.P.-Cambridge, 1876) is transferred to the genus Sengletus Tanasevitch, 2008 n. comb. and Sengletus longiscapus Tanasevitch, 2008 becomes its junior synonym (N. Syn.). The species occurs in Egypt, Iran and Israel (new record).

Keywords: Sengletus extricatus, Linyphiidae, Araneae, Egypt, Iran, Israel.

Introduction

The Linyphiid spiders of the Maghreb have well been studied in the past with distributions of all species summarized in Bosmans (2007). The family is most abundant in Algeria with 141 species, followed by Morocco (61), Tunisia (32) and Libya (7 species). On the contrary, in Egypt and in the Levant linyphiid spiders have been scarcely reported (Egypt (8, El-Hennawy, 2006), Israel (7), Jordan (1), Lebanon (4), the Palestinian Authorities (0) and Syria (1); Platnick, 2012). Actually, more than 35 linyphiid species were accounted currently in Israel, among them more than 20 species were found in the Negev desert, at the south of Israel (Gavish-Regev, unpublished data; Pluess et al., 2008). One of the most abundant linyphiid species found recently in some wheat fields in the northern Negev desert is Bathyphantes extricatus (O.P.-Cambridge, 1876) (Pluess et al., 2008; Gavish-Regev et al., 2009), a species described from Egypt by O.P.-Cambridge, yet never cited again till recently, since its original description, except for its transfer to the genus Bathyphantes by Simon (1884, in footnote) (El-Hennawy, 2006; Platnick, 2012). Material collected near the type locality in Egypt and in the south of Israel leads to an interesting new synonymy.

Methods

Specimens were examined using Wild M5 and Zeiss V20 stereomicroscopes. Further details were studied using an Olympus CH-2 stereoscopic microscope with a drawing tube.

Digital microscope images were taken using a BK Plus Lab System from Visionary Digital equipped with a Canon EOS 7D camera (http://www.visionarydigital.com). Multi layer pictures were combined using Zerene Stacker. All figures were edited using Adobe Photoshop Ver. CS3 or GIMP ver. 2.6.10.

One female and one male specimen were examined using scanning electron microscopy (SEM). Specimens were prepared for SEM by first placing them into series of ethanol concentrations from 75% up to absolute ethanol with 5% differences between two consecutive concentrations and for 10-15 minutes in each concentration and overnight in absolute ethanol. Then specimens were cleaned ultrasonically for 30 seconds in a Bransonic 2000. Subsequently cephalothorax, abdomen, left legs and pedipalps of both female and male were detached and critical-point dried in a Baltec CPD-030. Dried parts were attached to round-headed rivets using aluminium tape with conductive adhesive and coated with Platinum-Palladium in a JEOL JFC-2300HR high resolution coater for 140 seconds. Scanning electron micrographs were taken with a JEOL JSM-6335F SEM. All images were taken at the Zoological Museum, University of Copenhagen.

Abbreviations:

ARAHUJI: Arachnid National Collection, the Hebrew University of Jerusalem, Israel.
CRB: Collection Robert Bosmans.
RCBGU: Research Collection, Ben-Gurion University of the Negev, Israel.
TAUZMAr: Arachnid Collection, Tel-Aviv University, Zoological Museum, Israel.

Systematics

Sengletus extricatus (O.P.-Cambridge, 1876) **N. Comb.**

Linyphia extricata O.P.-Cambrdige, 1876: 572, pl. 59, fig. 7a-d (descr. male, female).
Bathyphantes extricatus; Simon 1884: 351 (transfer).
Sengletus longiscapus Tanasevitch 2008: 484, figs. 33-45 (descr. male, female); Tanasevitch 2009: 410 **N. Syn.**

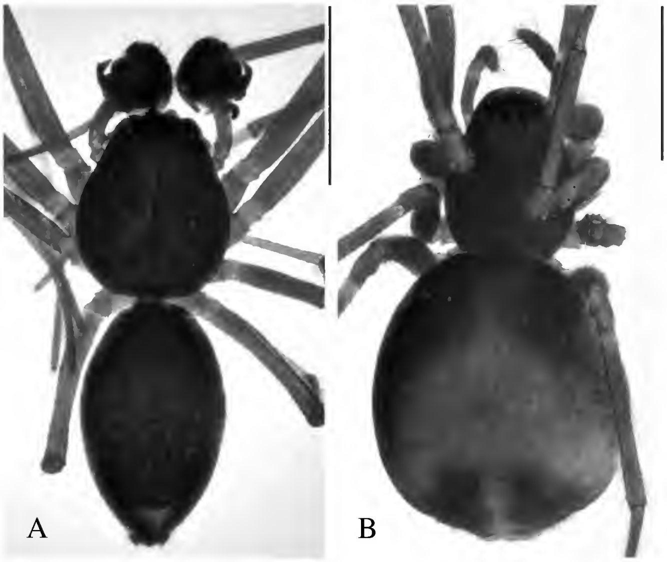

Plate 1. A-B. Sengletus extricatus (O.P.-Cambridge) N. Comb., habitus, dorsal view.
A. Male from Hazeva, Arava, Israel (TAUZMAr 74).
B. Female from Sede Teman, Northern Negev, Israel (TAUZMAr 63).
Scale bars: 1 mm.

Type material
Type series from Egypt, Alexandria and Cairo; not examined.

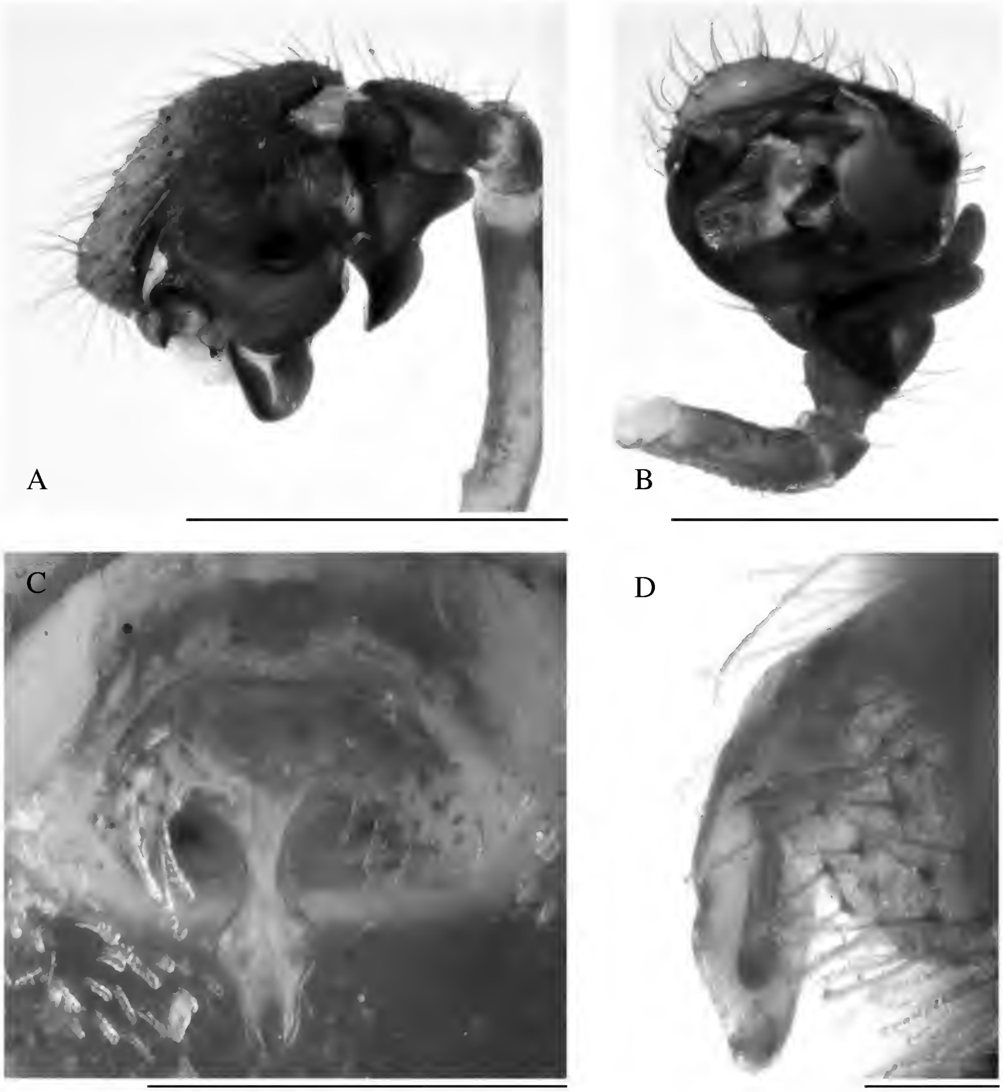

Plate 2. A-D. Sengletus extricatus (O.P.-Cambridge) N. Comb., A-B. Male from Hazeva, Arava, Israel (TAUZMAr 74), left palp. A. Ectal view. B. Ventral view. C-D. Female from Sede Teman, Northern Negev, Israel (TAUZMAr 63), epigynum. C. Ventral view. D. Lateral view. Scale bars: 0.5 mm (A-C), 0.1 mm (D).

Other material examined
Egypt: Alexandria, 1 female, in rice fields, 1986 (CRB).
Israel: - Sede Teman, Northern Negev, 1 male, 3 females, in wheat fields, 7.IV.2004, E. Gavish-Regev leg. (CRB); 8 males, 11 females, in wheat and sunflower fields, 23.I.2002, 10.IV.2002, 30.V.2002, 5.VI.2001, 19.VI.2002, 4.VII.2002, 11.VII.2002, 12.I.2003, 6.II.2003, 12.II.2003, 27.XI.2003, 29.XII.2003, 2004, E. Gavish-Regev leg. (TAUZMAr 58-78: RCBGU: 20; W8, 17; V184; P56; S60; SFP23, 63, 118, 185-6; SFV141, 283, 300; L.2, L.2.1-L.2.3; 12-03-13); (Coordinates: ITM 3049.433/3443.646, 3118.37/3440.009), 2 males, in wheat fields, 18.VII.2007, I. Opatovsky & T. Pluess leg. (TAUZMAr 47, 49: RCBGU 3019, 3220).

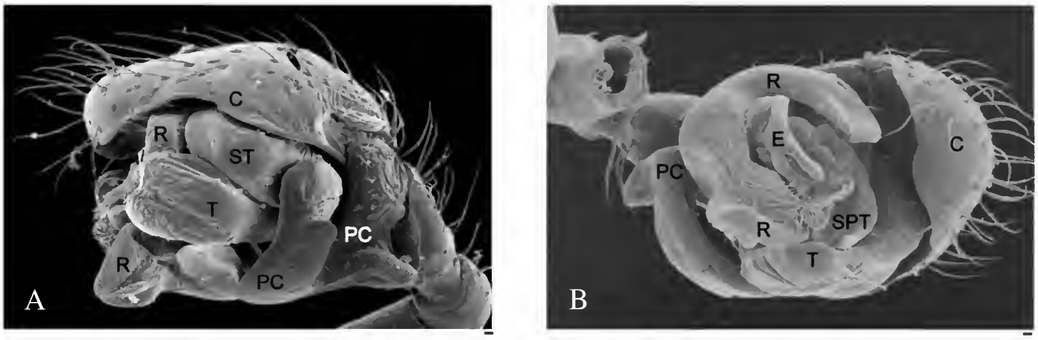

Plate 3. A-B. Sengletus extricatus (O.P.-Cambridge) N. Comb., male from Sede Teman, Israel (TAUZMAr 73), left palp (SEM). A. Ectal view, x 200. B. ventral view, x 220. Scale bars : 10 µm. Abbreviations: C = Cymbium; E = Embolus; PC = Paracymbium; R = Radix; SPT = Suprategulum; ST = Subtegulum; T = Tegulum.

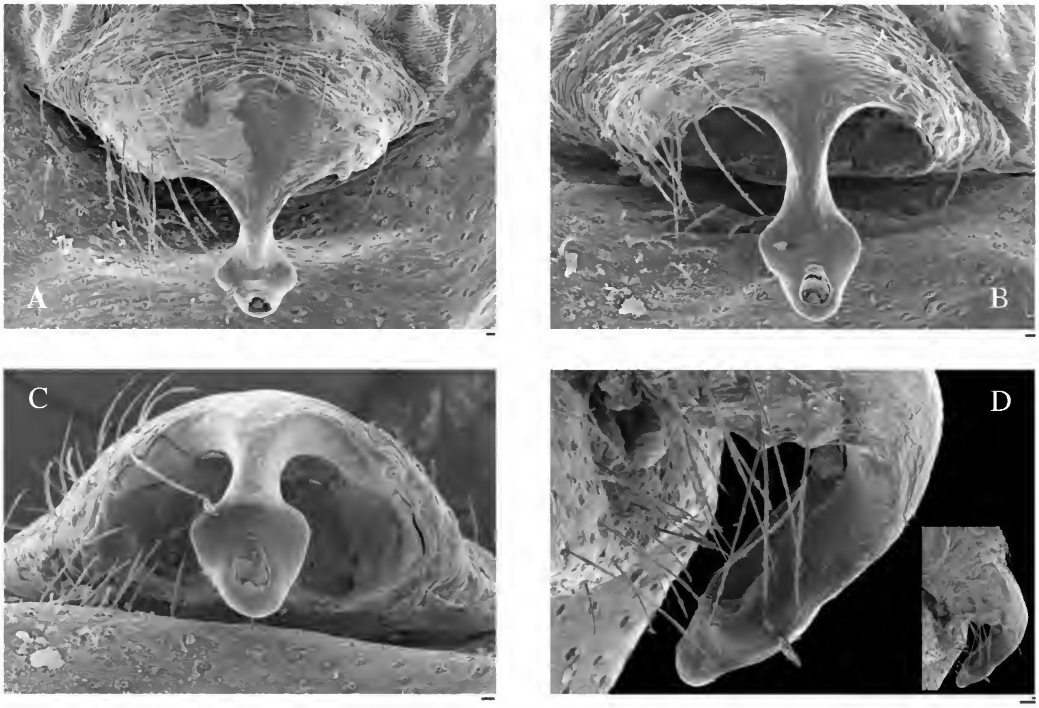

Plate 4. A-D. Sengletus extricatus (O.P.-Cambridge) N. Comb., female from Be`eri, North-Western Negev, Israel (RCBGU), epigynum (SEM). A. Ventral view, x 200. B. Postero-ventral view, x 250. C. Posterior view, x 300. D. Lateral view, x 300. Scale bars: 10 µm.

- Be`eri, North-Western Negev, 1 female, in wheat fields, 23.I. 2007, E. Gavish-Regev leg. (RCBGU); (Coordinates: ITM 3125.94/3430.365, 3124.016/3429.753), 2 males, in wheat fields, 15.XII.2006, 20.II.2007, I. Opatovsky & T. Pluess legs. (TAUZMAr 46, 52 (RCBGU 1908, 4441)).
- Tal Or, North-Western Negev (Coordinates: ITM 3121.395/3429.79), 4 males, in wheat fields, 15.XII.2006, 19.II.2007, I. Opatovsky & T. Pluess legs. (TAUZMAr 48, 50-51, 54 (RCBGU 1662, 1673, 1695, 3913)).

- Urim, Northern Negev (Coordinates: ITM 3117.305/3431.329), 4 males, in wheat fields, 16.XII.2006, 18.II.2007, I. Opatovsky & T. Pluess legs. (TAUZMAr 44-45, 53, 55 (RCBGU 1479, 3360, 3383, 3436)).
- East of Elifaz, Arava (Coordinates: WGS84 29.797536/35.040086), 1 male, 1 female, sands, 23.IV.2004, 25.IV.2004, U. Shanes leg. (TAUZMAr 56-57, (ARAHUJI)).
- Yair Agricultural Station, Hazeva, Arava, shade-house, 14.III.2010, V. Hochman-Adler leg. (TAUZMAr 74, (RCBGU)).

Description

See Tanasevitch (2008).

Comments

Comparing the figures of O.P.-Cambridge (1876) of Linyphia extricata and the excellent figures of Tanasevitch (2008) of Sengletus longiscapus with our material from Egypt and Israel (see plates 1-4), it becomes evident that both species are the same. The colour of the abdomen is grey with a small postero-dorsal white spot in the male, which can occupy almost the entire abdomen in the female (Plate 1 A-B: male and female habitus, respectively). The large paracymbium is U-shaped, when expanded in an angle of 90° with the cymbium, as visible in fig. 7c of O.P.-Cambridge (1876). The lamella and terminal apophysis of the male palp are strongly reduced (Plates 2 A-B, 3 A-B). The epigyne has a strongly curved scape directed prominently backwards (Plates 2 C-D, 4 A-D).

Distribution

Egypt, Iran, Israel (first record).

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First record of family Cithaeronidae (Arachnida: Araneae) from Turkey

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Abstract

Family Cithaeronidae is recorded for the first time from Turkey. Three males and four females of Cithaeron praedonius O.P.-Cambridge, 1872 were collected. Morphological features, zoogeographical distribution and description of the species are presented.

Keywords: Araneae, Cithaeronidae, Cithaeron praedonius, first record, Turkey.

Introduction

The spider fauna of Turkey, despite of its outstanding zoogeographical situation, is rather poorly studied compared to other regions of the world. So far, 921 species in 308 genera belonging to 52 families have been recorded from Turkey (Bayram et al., 2012).

The Cithaeronidae Simon, 1893 is a small gnaphosoid family that includes seven species in two genera. Cithaeron O. P.-Cambridge, 1872 has six species and Inthaeron Platnick, 1991 has only one species (Platnick, 2012; Carvalho et al., 2007).

According to Platnick (1991), this family is placed in the superfamily Gnaphosoidea not only because of the heavily sclerotized anterior lateral spinnerets of its species but also for their flattened and irregularly shaped posterior median eyes. However, they have long legs with pseudosegmented tarsi and procurved posterior eye row with posterior median eyes relatively larger then others.

Cithaeronids are regarded as “lower gnaphosid” family, those spiders that appear to be gnaphosids but still retain a complete distal article on the anterior lateral spinnerets (Platnick, 2002). Although the genus Cithaeron presents a widespread distribution, Inthaeron is only known from India.

In the present study, we record Cithaeron praedonius O.P.-Cambridge, 1872 for the first time from Turkey (Topçu et al., 2005; Bayram et al., 2012). Diagnostic drawings and a detailed description of the species is presented. The localities of the material examined and the world distribution of C. praedonius is given too.

Material and Methods

The specimens were obtained by hand collecting and were found under stones in South Turkey, from Adıyaman and Kahramanmaraş provinces. The specimens were preserved in 70% ethanol. They were identified under a SZX12 Olympus Stereomicroscope and deposited in Zoology Museum of University of Gaziantep.

We used identification keys and works of Platnick (1990, 1991, 2002), Platnick and Gajbe (1994), and Carvalho et al. (2007). All measurements are in millimetres. Abbreviations used: ALE = anterior lateral eye, AME = anterior median eye, PLE = posterior lateral eye, PME = posterior median eye.

Results

Family Cithaeronidae Simon, 1893

Ecribellate, entelegyne, gnaphosoid spiders. Only two genera of cithaeronids are known, Cithaeron and Inthaeron. Carapace rounded in dorsal view, abruptly narrowed at ocular area, widest between coxae II and III, truncated anteriorly and posteriorly, highest at rear of pars cephalica, pale yellow, surface often with dark maculations except on broad bands along lateral and posterior margins and on postocular portion of pars cephalica, with few weak setae near lateral margins and stronger setae in ocular area; cephalic area moderately elevated, level, deeply depressed around longitudinal thoracic groove; lateral margins usually with tiny tubercles (Platnick, 1991).

Clypeus very high and both eye rows strongly procurved. Chelicerae short and vertical. Promargin with cluster of stiff setae situated behind elevated ridge. Fang furrow without marginal teeth. Labium as wide as long or wider, truncated distally, not rebordered. Sternum shield-shaped, with heavily sclerotized lateral (but not posterior) margins, sparsely coated with long, dark, stiff setae, with sclerotized extensions to and between coxae. Legs I, II, IV subequal in length, leg III shorter and all are pale yellow (Platnick, 1991).

Abdomen pale yellow, with or without dark maculations, surface with weak, brown setae. Six spinnerets, anterior laterals conical, not widely separated, with subdistal sclerotized ring and small unmodified piriform gland spigots (Platnick, 1990, 1991).

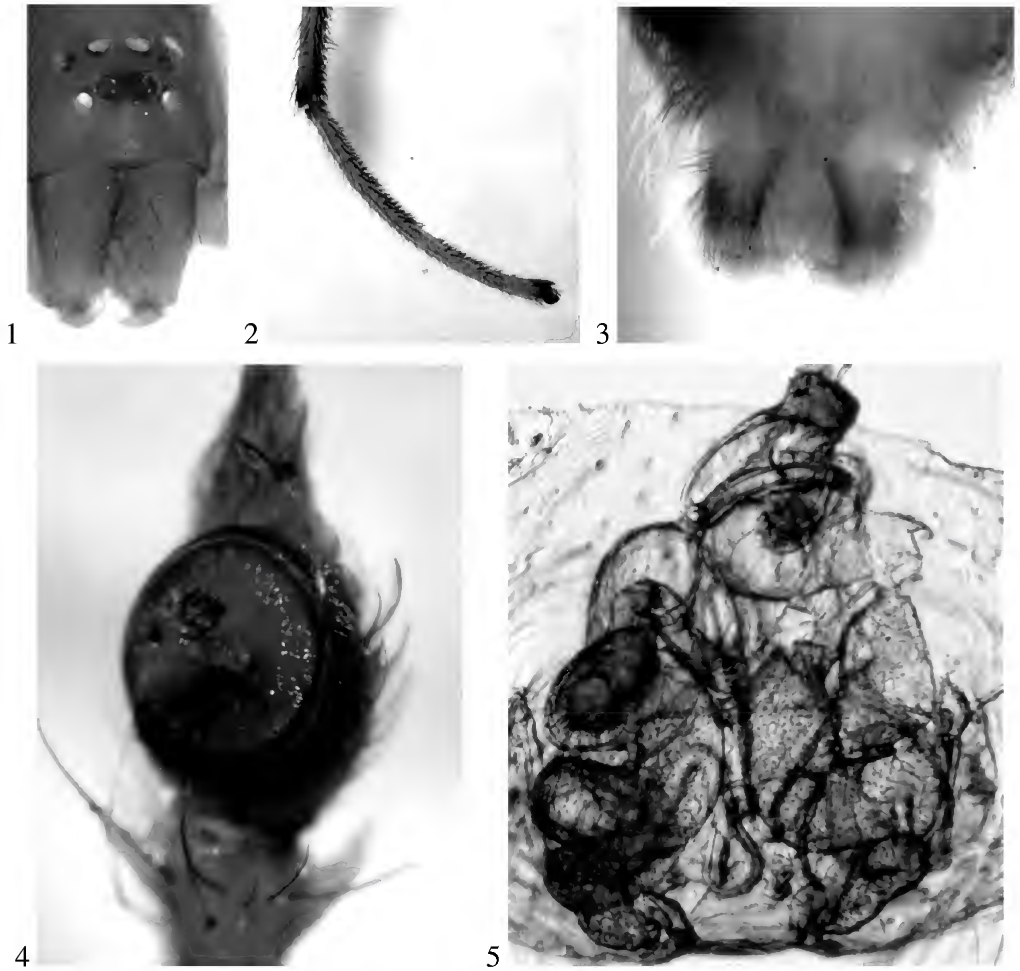
The presence of long, pseudosegmented tarsi separates cithaeronids from other lower gnaphosoid families. Cithaeronids lack the elongated fangs of gallieniellids and trochanteriids, and differ from ammoxenids in having a normal, rather than reduced, female palpal claw (Platnick, 2002).

Cithaeron O. P.-Cambridge, 1872

Females can be distinguished from those of Inthaeron by having the cylindrical gland spigots on the posterior median spinnerets arranged in a dense cluster rather than in two longitudinal rows (Platnick, 1991). Males lack the highly coiled embolus found in Inthaeron (Platnick and Gajbe, 1994). Type species is Cithaeron praedonius O.P.-Cambridge, 1872.

Cithaeron praedonius O.P.-Cambridge, 1872 (Figs. 1-5)

Material examined: TURKEY, Kahramanmaraş province: Pazarcık district, Memişkahya village (37°25'55"N, 37°18'59"W), 988 m, 23.06.2007 (1♂). Pazarcık distrint, Kizirli village (37°32'20"N, 37°28'24"W), 1061 m, 23.06.2007 (2♂). Center, Köseli village (37°36'18"N, 36°44'24"W), 519 m, 17.05.2008 (1♀). Ekinözü district, Kürtül village (37°37'50"N, 36°43' 53"W), 590 m, 17.05.2008 (3♀). The specimens were found usually under stones or pieces of dried mud.



Figs. 1-5. Cithaeron praedonius O.P.-Cambridge, 1872
1. Male eyes and chelicerae, frontal view. 2. Male pseudo-segmented tarsus of leg II.
3. Female spinnerets. 4. Male palp, ventral view. 5. Female vulvae, dorsal view.

Description

Male (Figs. 1, 2, 4): Total length 2.56. Carapace 1.14 long, 0.92 wide. Eye sizes and interdistances: AME 0.08, ALE 0.18, PME 0.05, PLE 0.03; AME-AME 0.10, AME-ALE 0.24, PME-PME 0.05, PME-PLE 0.05, AME-PME 0.08, ALE-PLE 0.08.

Retrolateral tibial apophysis small, triangular with broad base. Its tip is prolaterally directed. Cymbium greatly elongated, its length equals bulb's diameter, bulb with large subtegulum, rounded tegulum bearing prolaterally originating long embolus, and translucent, medially situated median apophysis.

Female (Figs. 3, 5): Total length 5.02. Carapace 1.32 long, 1.06 wide. Eye sizes and interdistances: AME 0.08, ALE 0.21, PME 0.11, PLE 0.03; AME-AME 0.08, AME-ALE 0.03, PME-PME 0.21, PME-PLE 0.05, AME-PME 0.08, ALE-PLE 0.08.

Epigynum with anteromedian hood, slightly depressed posteromedian atrium, and anterolateral openings; epigynal ducts highly, variably coiled.

This species can be distinguished from other species by the larger median apopyhsis on the male palp and the more highly coiled epigynal ducts of females (Platnick, 1991, 2002).

Distribution. North Africa (Libya and Egypt), East Africa (Eritrea), Middle East (Israel and Saudi Arabia), Yemen, India, Malaysia, Singapore (Platnick, 1991), Greece, Iran, Turkmenistan (Platnick & Gajbe, 1994), Australia's Northern Territory (Platnick, 2002), Brazil (Carvalho et al., 2007), and USA (Platnick, 2012). Now, Cithaeron praedonius is collected from the south of Turkey.

Acknowledgment

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A new clubionid spider record from Turkey (Araneae: Clubionidae)

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Abstract

This short paper reports one clubionid species which is new for the Turkish araneo-fauna. The characteristic features and photographs of Clubiona terrestris Westring, 1851 are presented. The total number of clubionid species recorded from Turkey is now eight.

Keywords: Araneae, Clubionidae, Clubiona terrestris, Taxonomy, New record, Turkey.

Introduction

A total of 579 species in 17 genera have been identified in the family Clubionidae all over the world (Platnick, 2012). Genus Clubiona Latreille, 1804 is well studied in the Palaearctic, Oriental, Australian, Nearctic, Neotropical and Afrotropical regions and hitherto 7 species are known from Turkey (Bayram et al., 2012). These species are C. caerulescens L. Koch, 1867, C. comta L. Koch, 1839, C. corticalis (Walckenaer, 1802), C. lutescens Westring, 1851, C. marmorata L. Koch, 1866, C. neglecta O.P.-Cambridge, 1862, and C. reclusa O.P.-Cambridge, 1863.

This paper deals with the characteristic features and distribution of C. terrestris Westring, 1851 adding a new species to the araneo-fauna of Turkey.

Material and Methods

The present study is based on the material deposited in the collection of the Arachnological Museum of Kırıkkale University (KUAM). One male specimen was examined in this study. The specimen was preserved in 70% ethanol. Pictures were taken using a Leica S8APO microscope by means of the Leica DC 160 camera. The keys of Almquist (2006), Heimer & Nentwig (1991) and Tyschchenko (1971) were used. All measurements are in millimetres.

Results

Clubiona terrestris Westring, 1851 (Figs. 1-4)

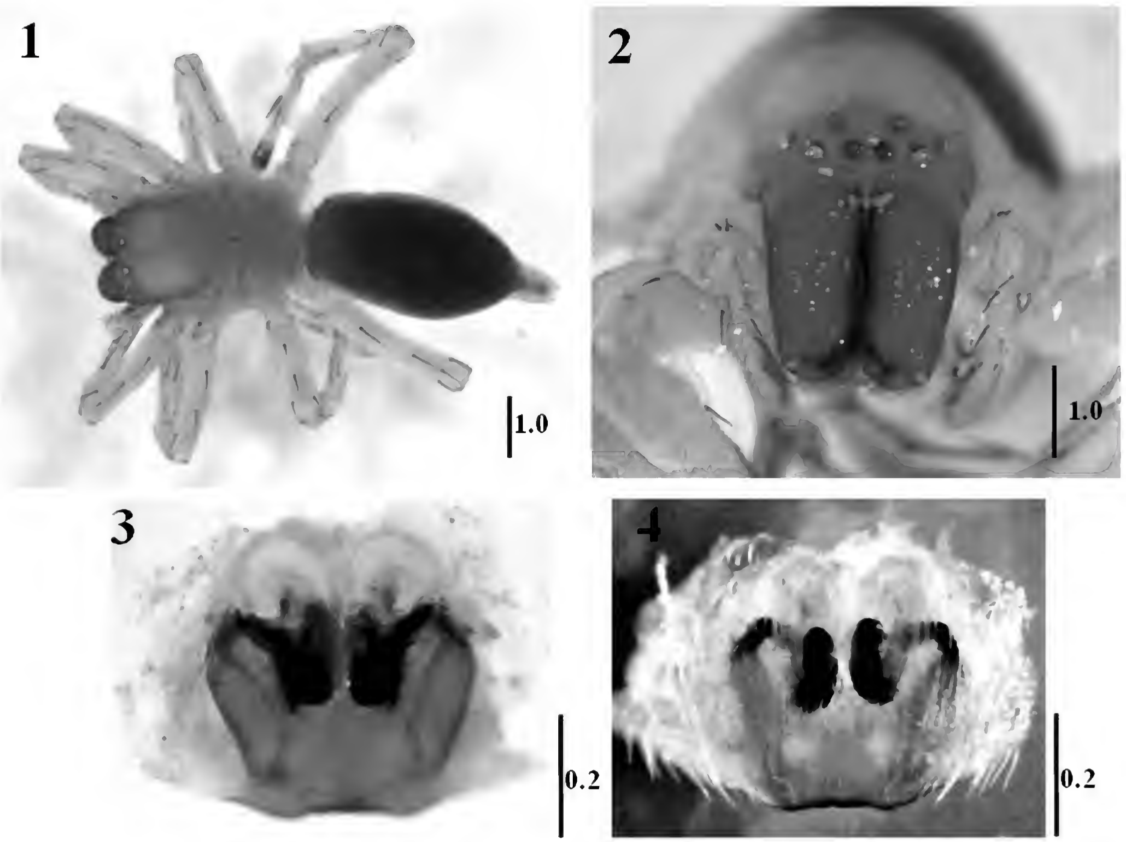
Material examined: 1♀, Sarıkum, Sinop (42º01'24"N, 34º55'35"E), from a garden, 09.05.2010; (KUAM-CLU.Clu.terr.01).

Description of female

Body length: 6.2, Prosoma: length 2.6, width 2.1. Opisthosoma: length 3.6, width 1.9. Prosoma yellowish brown and opisthosoma reddish brown (Fig. 1). Ocular area reddish. Chelicerae dark reddish brown (Fig. 2). Legs whitish yellow.

Epigyne with distinctively outstanding copulatory ducts. Internal genitalia consist of two receptacles different from each other in shape. Copulatory ducts obtuse-angled, narrowing before entering paired overly sclerotized primary receptacles. Other short ducts converted secondary receptacles. Copulatory opening close to epigastric line, not bordered by rims (Figs. 3-4). Leg formula: IV-I-II-III (Table 1).

Distribution: Europe (Platnick, 2012).



Figs. 1-4. Clubiona terrestris Westring, 1851 ♀. 1. Habitus, dorsal view. 2. Ocular area, frontal view. 3. Epigyne, ventral view. 4. Vulvae, dorsal view. (Scale lines = 1 mm f.1-2, 0.2 mm f.3-4)

Table 1. Measurements of the legs of Clubiona terrestris Westring, 1851 female

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.9	0.9	1.7	0.9	0.8	6.2
II	1.9	0.8	1.8	1.0	0.7	6.2
III	1.4	0.8	1.3	1.4	0.6	5.5
IV	2.1	0.9	1.8	2.0	0.8	7.6

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A new linyphiid spider record from Turkey (Araneae: Linyphiidae)

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Abstract

This short paper reports a linyphid species which is new for the Turkish araneo-fauna. The characteristic features and photographs of Meioneta punctata (Wunderlich, 1995) are presented. The total number of linyphid species recorded from Turkey is now 105.

Keywords: Araneae, Linyphiidae, Meioneta punctata, Taxonomy, New record, Turkey.

Introduction

A total of 4412 species in 587 genera have been identified in the family Linyphiidae all over the world (Platnick, 2012). Genus Meioneta Hull, 1920 is well studied in the Palaearctic, Neotropic, Nearctic, Afrotropical and Oriental regions and hitherto 2 species have been known from Turkey (Bayram et al., 2012). These species are Meioneta innotabilis (O.P.-Cambridge, 1863) and M. rurestris (C.L.Koch, 1836). Wunderlich (1995) described the male of Meioneta punctata from Greece for the first time, in genus Agyneta. This paper deals with the characteristic features and distribution of M. punctata adding a new species to the araneo-fauna of Turkey.

Material and Methods

The present study is based on the material deposited in the collection of the Arachnological Museum of Kırıkkale University (KUAM). One male specimen was examined in this study. The specimen was preserved in 70% ethanol. Pictures were taken using a Leica S8APO microscope by means of the Leica DC 160 camera. SEM microphotographs were made with JEOL JSM-5600 in the University of Kırıkkale. All measurements are in millimetres.

Results

Meioneta punctata (Wunderlich, 1995) (Figs. 1-2)

Material examined: 1♂, Kırıkkale Province, Karacalı Village (39º52'N, 33º33'E), from a garden, 21.11.2011; (KUAM-LIN.Mei.punc.01).

Description of male

Body length: 1.57, Prosoma: length 0.65, width 0.5. Opisthosoma: length 0.92, width 0.55.

Prosoma dark brown and elongated. Chelicerae long and strong. Opisthosoma is dark greyish brown with lighter bands. Legs yellow with some brown stained patches. Leg formula: IV-I-II-III. Spinnerets blackish-brown (Fig. 1). Male palpal tibia with 2 protrudings. Palpal tibia, cymbium and paracymbium markedly punctuated. Cymbium length is 230 µm. Lamella characteristica thin and long, thickens progressively towards baseline. Apical part of lamella characteristica has a few large, and almost equal in length, teeth (Fig. 2).

Distribution: Greece (Platnick, 2012).

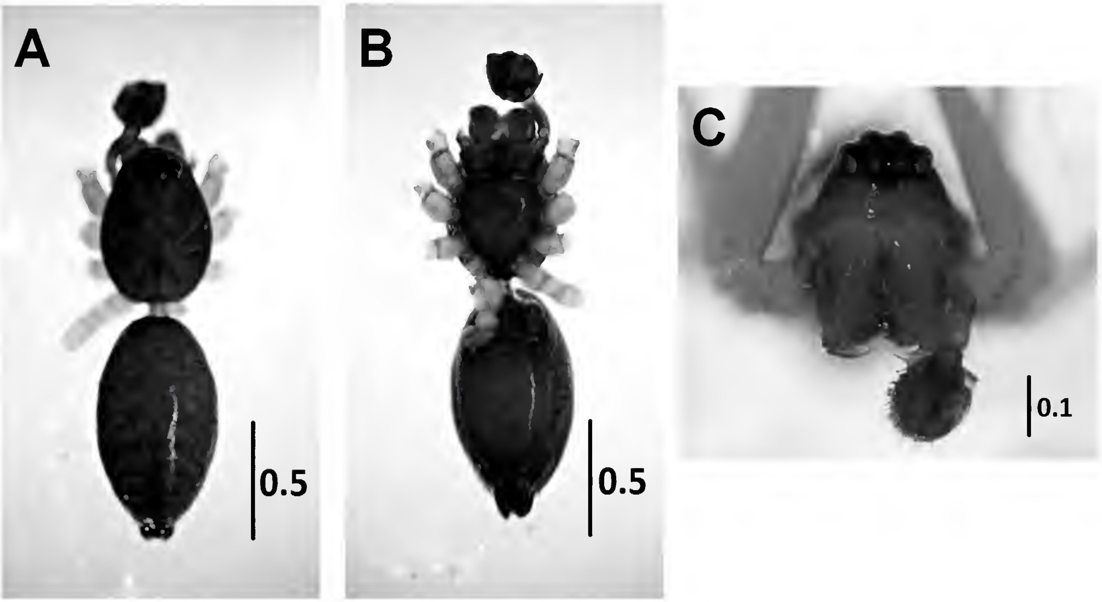

Fig. 1. Meioneta punctata (Wunderlich, 1995) ♂. A. Habitus, dorsal view. B. Habitus, ventral view. C. Ocular area, frontal view. (Scale lines = 0.5 mm A-B, 0.1 mm C)

Table 1. Measurements of the legs of Meioneta punctata (Wunderlich, 1995) male

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	0.66	0.14	0.60	0.56	0.42	2.38
II	0.64	0.14	0.56	0.46	0.38	2.18
III	0.48	0.12	0.38	0.40	0.22	1.60
IV	0.68	0.14	0.60	0.56	0.42	2.40

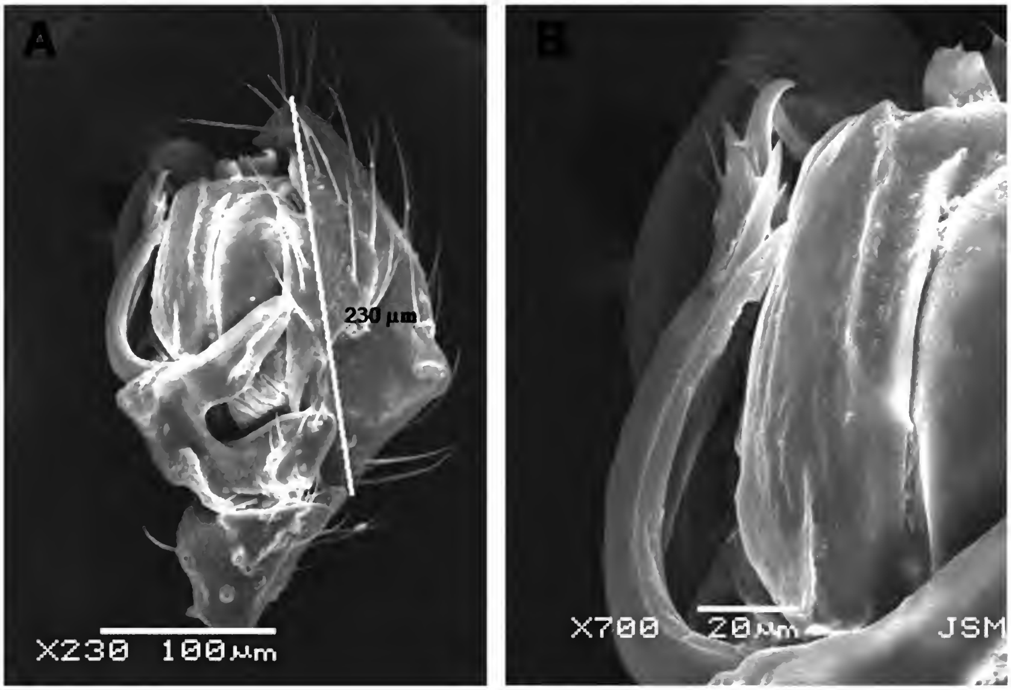

Fig. 2. Meioneta punctata (Wunderlich, 1995) ♂. A. Palpal organ, retrolateral view. B. Lamella characteristica, retrolateral view.

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New records of family Oonopidae (Araneae) in Turkey

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Abstract

In this study, Opopaea punctata (O.P.-Cambridge, 1872) and Silhouettella loricatula (Roewer, 1942) of family Oonopidae are recorded from Turkey for the first time. Silhouettella osmaniye Wunderlich, 2011 was collected again from Turkey. The characteristic features of these species are described and illustrated.

Keywords: Araneae, Oonopidae, Opopaea, Silhouettella, New records, Fauna, Turkey.

Introduction

The family Oonopidae is known as dwarf hunting spiders. Oonopids have quite small bodies (3 mm or smaller). Colouration is mostly yellowish, orange or reddish brown, sometimes whitish or even pink coloured. Oonopids usually have six eyes and the anterior median eyes are lost; at least one species has only two eyes and some species are eyeless. They can be roughly divided into two groups called Oonopidae loricati and Oonopidae molles according to the chitinization level of their bodies. The members of the first mentioned group have their cephalothorax closed inside a casing, which has a large frontal opening to allow insertion of the chelicerae and endites bearing the palps as well as lateral openings for the legs while their abdomen is enclosed between dorsal and ventral shields and also spinnerets are partially surrounded by a chitin ring. The members of the second group have no dorsal scutum and the ventral scutum is much reduced but apparently never totally absent (Saaristo, 2007).

The family Oonopidae is represented by 88 genera and 857 species in the world (Platnick, 2012). It was not known from Turkey until the last decade (Topçu et al., 2005). Wunderlich (2011) described Silhouettella osmaniye for the first time from Turkey to be the first record of this family from the country.

In this study, Opopaea punctata (O.P.-Cambridge, 1872) and Silhouettella loricatula (Roewer, 1942) of family Oonopidae are recorded from Turkey for the first time. Silhouettella osmaniye Wunderlich, 2011 was collected again from Turkey.

Material and Methods

Specimens were collected from Adana, Osmaniye, Hatay, Kahramanmaraş and Gaziantep provinces and near areas (totally 9 localites) in the Mediterranean region.

These specimens were preserved in 70% ethanol. Examined specimens were deposited in the Arachnology Museum of Niğde University (NUAM). The identification of spiders depended on the descriptions of Heimer and Nentwig (1991), Saaristo (2001, 2007), and Saaristo and Marusik (2008). Zoogeografic distributions of spider species have been given according to the world spider catalog (Platnick, 2012).

Results

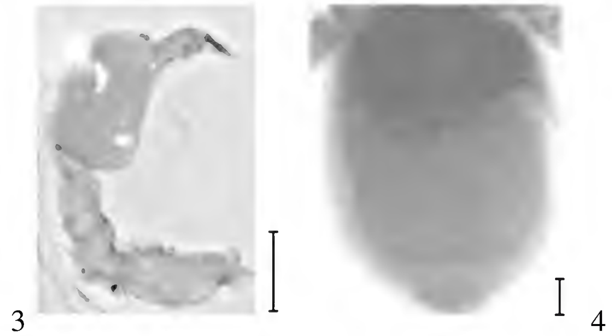
In this study, 3 species belonging to 2 genera (Opopaea Simon, 1891 and Silhouettella Benoit, 1979) of family Oonopidae were examined.

Opopaea punctata (O.P.-Cambridge, 1872) [1♂ 2♀]
Silhouettella loricatula (Roewer, 1942) [1♂ 3♀]
Silhouettella osmaniye Wunderlich, 2011 [4♂ 1♀]

Opopaea punctata (O. Pickard-Cambridge, 1872) (Figs. 1-2)
Description: Body length ♂/♀: 1.3/1.5 mm. The body of male is brownish orange, legs are pale. Sides of carapace have distinct longitudinal streaks, dorsal side is smooth. Posterior median eyes are bigger than anterior lateral eyes that are also bigger than posterior lateral eyes. Sternum has a distinctive streak. The distal part of maxilla has been strongly sclerotized with blunt-tipped horn like extension. Dorsal scutum is oval shaped, densely covered with short sub-decumbent hairs rising from small pits. Legs are stout and spineless. Patella of male palp is about the same size as cymbiobulbus. Female is similar to male except for maxilla.
Material examined: Turkey: 1♂, Gaziantep province, Islahiye district, (36°57.119N, 036°34.915E), 474 m, 2.V.2007; 1♀, Hatay province, Kırıkhan district, (36°29'.181N, 036°16'.617E), 541 m, 3.V.2007; 1♀, Osmaniye province, Kaman village, (37°10.540N, 036°39.170E), 820 m, 2.V.2007.
Distribution: Lebanon and Israel.

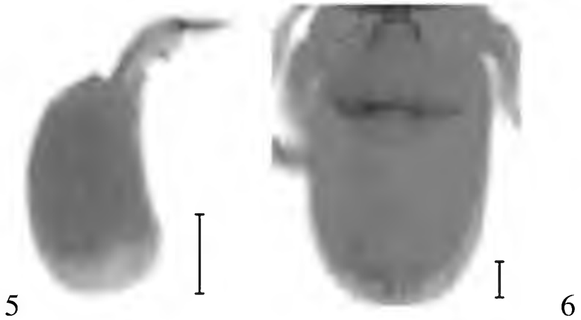
Figs. 1-2. Opopaea punctata (O.P.-Cambridge, 1872)
1. Palp, lateral view. 2. Epigyne. (Scale lines = 0.1 mm)

Silhouettella loricatula (Roewer, 1942) (Figs. 3-4)
Description: Body length ♂/♀: 1.8/2.3 mm. Colouration and pattern of male and female are similar. Carapace is orange and abdomen is dark yellow. Dorsal and ventral sides of abdomen with a hard scutum. The bulbus of the palp consists of one part; Embolus is thin like a needle distally. Epigynal region is not sclerotized.
Material examined: Turkey: 1♀, Adana province, Yumurtalık district, Hamzalı village, (36°54.123N, 35°52.083E), 86 m, 4.V.2007; 1♂ 1♀, Kahramanmaraş province, Çağlayancerit district, (37°39.313N, 37°28.079E), 1001 m, 21.V.2007; 1♀, Osmaniye province, Düziçi district, (37°10.790N, 36°25.239E), 380 m, 2.V.2007.
Distribution: From Europe to Middle Asia, North Africa and Canary Islands.



Figs. 3–4. Silhouettella loricatula (Roewer, 1942)
3. Palp, lateral view. 4. Epigyne. (Scale lines = 0.1 mm)

Silhouettella osmaniye Wunderlich, 2011 (Figs. 5-6)
Description: Body length ♂/♀: 1.8/2.4 mm. Female is similar to male. Carapace and abdomen are brownish. Sternum is yellowish brown. Legs are long and slender, without spines. Dorsal scutum is ovoid, densely decorated with tiny pits and is covered with depressed long dark hairs. Ventral scutum is smaller than dorsal scutum.
Material examined: Turkey: 1♂, Hatay province, Dörtyol district, Yahyalı plateau, (36°49.439N, 36°17.750E), 988 m, 4.V.2007; 2♂♂ 1♀, Osmaniye province, Bahçe district, Kaman village, (37°10.540N, 36°39.170E), 820 m, 2.V.2007; 1♂, Kahramanmaraş province, Kartalkaya dam, (37°28'.363N, 37°14'.492E), 753 m, 21.V.2007.
Distribution: Turkey.



Figs. 5–6. Silhouettella osmaniye Wunderlich, 2011
5. Palp, lateral view. 6. Epigyne. (Scale lines = 0.1 mm)

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Two new names of the specific epithets cubanum and maculatum in Trichopelma cubanum (Banks, 1909) and Trichopelma maculatum (Franganillo, 1930) (Araneae: Barychelidae)

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Abstract

According to the International Code of Zoological Nomenclature (ICZN, 1999), the authors request the rejection of the specific epithets of Trichopelma cubanum (Banks, 1909) and Trichopelma maculatum (Franganillo, 1930) [Family Barychelidae] and propose Trichopelma banksia comb. nov. and Trichopelma eucubanum comb. nov. instead of them.

Keywords: Nomenclatural change, homonymy, replacement name, Araneae, Barychelidae, Trichopelma cubanum, Trichopelma maculatum.

Introduction

According to the International Code of Zoological Nomenclature (ICZN, 1999), Trichopelma cubanum (Banks, 1909) and Trichopelma maculatum (Franganillo, 1930) [Araneae: Barycheloidea: Barychelidae: Trichopelmatinae] are not correct because the specific epithets are illegitimate. The authors request the replacement of the specific epithets cubanum and maculatum and suggest banksia nom. nov. and eucubanum nom. nov. respectively. They also request the rejection of the specific epithets cubanum in T. cubanum and maculatum in T. maculatum. Accordingly, new combinations are herein proposed for the species: Trichopelma banksia comb. nov. and Trichopelma eucubanum comb. nov. respectively.

Family Barychelidae Simon, 1889

Genus Trichopelma Simon, 1888

Trichopelma banksia nom. nov.
Trichopelma cubanum (Banks, 1909: 155).
Preoccupied by Trichopelma cubanum (Simon, 1903: 930).

The specific epithet cubanum was initially introduced by Simon (1903) with the original combination Hapalopinus cubanus Simon, 1903 from Cuba. Subsequently, Banks (1909) described a new species from Cuba with the same specific epithet as Stothis cubana Banks, 1909 by original combination.

Wunderlich (1988) transferred Hapalopinus cubanus to the genus Psalistops Simon, 1889 to be Psalistops cubanus (Simon, 1903).

Platnick (2012) listed both species in the genus Trichopelma according to Raven (1985) as Trichopelma cubanum.

Trichopelma cubanum (Simon, 1903) has priority over Trichopelma cubanum (Banks, 1909). Thus, T. cubanum (Banks, 1909) is illegitimate and consequently cannot be correct. It is a secondary junior homonym of the name T. cubanum (Simon, 1903). According to Article 60.3 of the International Code of Zoological Nomenclature (1999), it must be rejected and replaced. It has no specific synonym. So we propose for the specific epithet cubanum Banks, 1909 the replacement name banksia nom. nov.

Etymology: The name is dedicated to Banks, the author of the pre-existing species T. cubanum.

Summary of nomenclatural changes:
Trichopelma banksia **nom. nov.**
pro Trichopelma cubanum (Banks, 1909) **syn. n.**, [nec Trichopelma cubanum (Simon, 1903)]
Stothis cubana Banks, 1909 [original combination]

Trichopelma eucubanum nom. nov.
Trichopelma maculatum (Franganillo, 1930: 7).
Preoccupied by Trichopelma maculatum (Banks, 1906: 185).

The specific epithet maculatum was initially introduced by Banks (1906) with the original combination Acanthopelma maculata Banks, 1906 from Bahama Islands. Subsequently, Franganillo (1930) described a new species from Cuba with the same specific epithet as Stothis maculata by original combination.

Rudloff (1997) transferred Acanthopelma maculata to the genus Trichopelma Simon, 1888 to be Trichopelma maculatum (Banks, 1906). It is used as a valid name (Platnick, 2012).

Platnick (2012) listed Stothis maculata in the genus Trichopelma according to Raven (1985) as Trichopelma maculatum.

Trichopelma maculatum (Banks, 1906) has priority over Trichopelma maculatum (Franganillo, 1930). Thus, T. maculatum (Franganillo, 1930) is illegitimate and consequently cannot be correct. The name T. maculatum (Franganillo, 1930) is a secondary junior homonym of the name T. maculatum (Banks, 1906). According to Article 60.3 of the International Code of Zoological Nomenclature (1999), it must be rejected and replaced. It has no specific synonym. So we propose for the specific epithet maculatum Franganillo, 1930 the replacement name eucubanum nom. nov.

Etymology: Combination of the prefix eu- = true + the country Cuba.

Summary of nomenclatural changes: Trichopelma eucubanum **nom. nov.**
pro Trichopelma maculatum (Franganillo, 1930) **syn. n.**, [nec Trichopelma maculatum (Banks, 1906)]
Stothis maculata Franganillo, 1930 [original combination]

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Bioinformatics on the spiders of South Africa

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Abstract

Signatories of the Convention of Biological Diversity (CBD) are obligated to develop a strategic plan for the conservation and sustainable use of biodiversity. To meet the requirement of the CBD, the South African National Survey of Arachnida (SANSA) was initiated in 1997 by the Agricultural Research Council (ARC). The South African National Biodiversity Institute (SANBI) came on board for the project's second phase in partnership with the ARC. During this four-year project an attempt was made to consolidate all the available data on South African spiders into one database. Two modules of the database are available online containing bioinformatics on families, genera and species as well as a virtual museum providing images of spiders. All this data was used to compile the First Atlas of the Spider Species of South Africa. Presently 71 spider families, 471 genera and 2028 species are known from South Africa, representing approximately 4.8% of the world fauna. Of the 2028 spider species, 1241 (61%) are endemic to the country. The third phase of SANSA started in 2011 and several bioinformatics actions are planned, such as Red Listing of species, a handbook series for all the biomes, publication of the atlas, and description of new species.

Keywords: South African National Survey of Arachnida, Bioinformatics, spiders, South Africa.

Introduction

Signatories of the Convention of Biological Diversity (CBD) are obligated to develop a strategic plan for the conservation and sustainable use of biodiversity. The inclusion of invertebrates in these biodiversity inventories is clearly desirable, as invertebrates constitute more than 80% of all animal diversity, yet they are under-represented in studies of southern African diversity (McGeoch et al., 2011). Site biodiversity estimates that do not consider invertebrates as an important component thereby omitting a great portion of what they are attempting to measure and simultaneously ignoring groups that are very significant contributors to terrestrial ecosystem processes (Foord et al., 2011a).

In the past, knowledge on South African arachnids was largely limited to species descriptions while the ecological and diversity aspects remained largely unexplored. In 1997 the South African National Survey of Arachnida (SANSA) was launched in accordance with the country's obligations to the CBD. SANSA is providing essential information needed to address issues concerning the conservation and sustainable use of the arachnid fauna (Foord et al., 2011a). It is an umbrella project implemented at a national level in collaboration with researchers and institutions countrywide, dedicated to document and unify information on arachnids in South Africa. The information gathered is organised in a relational database. The material sampled is deposited into the National Collection of Arachnida (non-Acari) (NCA) which was established in 1976 at the Agricultural Research Council-Plant Protection Research Institutes (ARC-PPRI) in Pretoria, South Africa.

Natural history collections are not only responsible for the curation, preservation and management of specimens in collections, but also for providing accurate and current biodiversity information in the form of up-to-date faunal inventories with locality data. As a signatory to the CBD, South Africa is obliged to develop a strategic plan for the conservation and sustainable utilisation of this unique biological heritage. The CBD has shown the world the importance of good biodiversity data, and has contributed to renewed interest in specimen databases of natural history collections. The term "Biodiversity Informatics" or "Bioinformatics" which was used for the first time in 1991, can be defined as the 'application of informatics to recorded and yet-to-be discovered information specifically about biodiversity, and the linking of this information with genomic, geospatial and other biological and non-biological datasets' by Berendsohn (2001) and Rao (2009), and this term is now generally used for a variety of information.

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Fig. 1. The Biosystematics building: Arachnology Block, Roodeplaat, Pretoria, South Africa where the National Collection of Arachnida is housed.
Fig. 2. The storage facilities for specimen housed in the NCA.

For years, arachnid specimens have been collected and primary data about the specimens meticulously recorded and the specimens deposited in the NCA (Figs. 1 & 2). This primary data sampled with the specimens contain valuable information about the distribution and general behaviour that is important to the species. Specimen records are invaluable not only for identification, but also for the useful associated, collated biodiversity information. However, it is very important not only to sample specimens, but to utilize the data effectively. Before this can be done the data must be available and needs to be extracted from collections. Due to the sheer size of collections, the old accession and card systems became ineffective and the digitisation of collections came to be an important issue.

The digitisation of the arachnid specimens in the NCA began in 1991. A relational database was developed at the ARC for the collected specimens (NCAD) and included fields for taxon names, specimen information and literature references. In 2000, the data was migrated to a Microsoft Access relational database. The second phase of SANSA, which started in 2006, saw the consolidation of all existing arachnid data into a MySQL relational database with a browser front-end, enabling multiple users to gain access to the database simultaneously. It was standardised according to the Darwin Core for sharing information on biodiversity (Wieczorek et al., 2012). The taxonomic classification system follows the online catalogue of Platnick (2012), and taxonomic updates are regularly implemented. This data migration exercise provided an opportunity for extensive data cleaning and geo-referencing, and to develop procedures and support for data validation.

It is a complex database schema especially developed for the NCA and two of the modules can be browsed online. Tailor-made forms and reports were customised to meet all the requirements for arachnid research such as user friendly drop down boxes to select family, genus and species and the opportunity to add morphological data as well as photographs and other images.

The database presently used at the NCA consists of different modules:

African Arachnida Database (AFRAD): This is a taxon database module developed to eventually contain information on all the Arachnida (non-Acari) species of the Afrotropical Region. Descriptive, behavioural and distributional data and images are added for each family. This information is now available on family, genus and species level as online fact sheets that can be accessed on the Internet at http://www.arc.agric.za/home.asp?pid=3235.

National Collection of Arachnida Database (NCAD): This module was developed to capture primary data associated with specimens collected and housed in the NCA. Presently > 180 000 specimens have been data based and an annual growth of between 6000-10 000 new accessions has been maintained over the last 6 years. SABIF, the South African node of The Global Biodiversity Information Facility (GBIF) provided funding for the SANSA 2006-2010 and all the data are accessible from their website.

South African National Survey Database (SANSAD): In 2006, a new module was linked to AFRAD. It incorporates information on South African spiders gathered from the taxonomic and ecological literature housed in more than 17 institutions world-wide. A few examples of national institutions of which data is included in SANSAD are the National Museum, Bloemfontein, the Ditsong National Museum of Natural History (former Transvaal Museum) and the Iziko Museum of South Africa. While some international institutions included the National History Museum, London, the Royal Museum for Central Africa and the American Museum of Natural History. The SANSA dataset presently contains >13 000 records.

Virtual Museum (VM): Also as part of SANSA, a Virtual Museum database was developed to provide access to the photographs submitted by the public. It can be viewed at http://www.arc.agric.za/vmuseum/vmuseumMain.aspx. It presently contains >3000 images submitted by >100 photographers.

Results and Discussion

Spiders constitute a significant proportion of terrestrial and freshwater biodiversity, however, monitoring them is associated with a series of regularly cited and well-recognised challenges (Foord et al. 2011b). Some of these challenges include their enormous species richness and diversity of habitats, inadequate systematic and biological knowledge for many groups, and the associated shortage of expertise and capacity (Foord et al., 2011a). With SANSA, which is a joint national effort, some of these challenges were overcome due to shared knowledge and support.

Diversity: A wealth of information is now available on the spiders in South Africa including the first atlas for the spiders of South Africa (Dippenaar-Schoeman et al., 2010). Data from all the databases were used to compile the atlas: 1) SANSAD: information on all the preserved specimens housed in several natural history collections worldwide and published in the primary literature (13 000 records); 2) NCAD: primary data of specimens housed in the NCA (59 000 records); as well as 3) VM: >3000 digital photographic images of species recorded by the public.

Presently 71 families represented by 471 genera and 2028 species are known of which 1241 are endemic (61%). About 50 species are waiting to be described. SANSA helped to address various different focus areas and now for the first time, bioinformatics are available on spiders in agro-ecosystems, the different floral biomes and protected areas.

Agro-ecosystems: Spiders are one of the most ubiquitous predator groups in agro-ecosystems (Van den Berg & Dippenaar-Schoeman, 1991) and inventories in South Africa have provided valuable baseline information on species in agro-ecosystems. As predators, spiders have a two-fold function. Not only do they feed directly on their prey, but their presence also causes indirect mortality of arthropods. The presence of spiders can disturb larvae which then drop from the plant and die. The webs spun over the surfaces of leaves by spiders also seem to make them less suitable for oviposition and feeding by pests. While considerable effort has been put into baseline surveys in agro-ecosystems in South Africa, there is still a large scope for further experimental work on the biological control potential of the dominant agrobiont spiders in each agro-ecosystem.

The first surveys in an agro-ecosystem were undertaken in strawberry fields to examine the effect of spider predation on red spider mites (Dippenaar-Schoeman, 1979); this was followed by surveys in cotton fields (Van den Berg et al., 1990; Van den Berg & Dippenaar-Schoeman, 1991; Dippenaar-Schoeman et al., 1999); surveys in citrus (Dippenaar-Schoeman, 1998); subtropical orchards (Dippenaar-Schoeman, 2001); macadamia (Dippenaar-Schoeman et al., 2001a,b); pistachio orchards (Haddad et al., 2005); avocado orchards (Dippenaar-Schoeman et al., 2005) and Bt cotton (Mellet et al., 2006). Information on these surveys is available from www.arc.agric.za quick link SANSA.

Protected areas (PAs): One of the focus areas of SANSA is to survey PAs to obtain species-specific information, compile inventories and to determine which species in South Africa receive some protection. Several forms of participation have involved PAs, including SANSA surveys, surveys by PA managers and rangers, student research projects (seven MSc projects completed), by-catch data from other research projects and records submitted by the public.

One of the aims of SANSA is to document the number of arachnid species currently protected in protected areas in South Africa, and because SANSA is a team effort, it has overcome some of the problems associated with invertebrate monitoring such as sorting and identification of large sample sized and using a standardised sampling protocol. This information about their presence in protected areas is essential for the development of a Red Data List of the Arachnida of South Africa and to assist with decisions on how to preserve the arachnid biodiversity in South Africa successfully. More than 86 surveys in PAs are currently underway, of which 25 have already resulted in published annotated checklists that provide information on abundance, behaviour and the distribution of arachnid species from national parks (Dippenaar-Schoeman, 2006; Dippenaar-Schoeman & Leroy, 2003), reserves (Dippenaar-Schoeman et al., 2011; Dippenaar-Schoeman et al., 1999; Dippenaar-Schoeman et al., 2005; Dippenaar-Schoeman et al., 2009) and other PAs (Dippenaar-Schoeman & Myburgh, 2009). Since many of the surveys extend over periods of 12 months or longer, this data is extremely valuable and provides considerable insight into the annual and long-term trends in the diversity, number and distribution of the species involved.

PAs have proven to be particularly valuable sites to SANSA, both from the perspective of encountering pristine habitat and high diversity, as well as for the safety of survey teams (Dippenaar-Schoeman et al., 1999; Dippenaar-Schoeman et al., 2005) and investigating the impact of climate change. Information on all the surveys is available at www.arc.agric.za see quick link SANSA.

Floral Biomes: There are seven floral biomes recognized in South Africa (Low & Rebelo, 1996). Sampling was undertaken in all of the biomes. Presently the Savanna Biome (Foord et al., 2011b) is the best sampled with 1201 known species followed by the Grassland Biome with 655 spp., Fynbos Biome 636 spp, Forest Biome 508 spp., Nama Karoo and Thicket both with 464 spp., and Succulent Karoo Biome with 219 spp. (Foord et al., 2011a).

Awareness: Creating awareness about the importance of arachnids and SANSA to the public and other scientists included several aspects: the distribution of high quality and easy-to-understand information about arachnids from the SANSA website, educational outreach and training programmes to all communities (Spider Educare Programme), identifying target audiences and compiling packages to allow for dissemination of information in the appropriate medium through magazine and newspaper articles, pamphlets, TV and radio talks; the development of products such as books (Dippenaar-Schoeman, 2002; Dippenaar-Schoeman & Jocqué, 1997; Dippenaar-Schoeman & Van den Berg, 2010; Holm & Dippenaar-Schoeman, 2010) and CDs on medically important arachnids and general information about spiders. Four posters on medically important arachnids are also made available to the public.

Conclusion

This descriptive phase of spiders in South Africa provides the foundations for more integrative collaborations between taxonomists and ecologists in future, and any attempts to ignore the importance of providing baseline biodiversity and taxonomic data will hamper subsequent attempts to develop a deeper understanding and appreciation of this unique heritage. The two online bioinformatics systems contribute towards a better understanding of South African spider fauna and serve as a valuable tool in the training and awareness of the public towards spiders.

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A review and new records of the comb-footed spiders in North Africa (Araneae: Theridiidae)

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Abstract

All previous records of Theridiidae occuring in Morocco, Algeria, Tunisia, Libya and Egypt are summarized, and new data are presented. The following new synonyms are proposed: Theridion argus Lucas, 1846 = Steatoda lineiventris Pavesi, 1884 = Crustulina scabripes Simon, 1881 **N. SYN.** The following species are cited from North Africa for the first time: Asagena italica (Knoflach, 1996), Dipoena braccata (C.L. Koch, 1841), Parasteatoda lunata (Clerck, 1757), Robertus arundineti (O.P-Cambridge, 1871), Simitidion agaricographum (Levy & Amitai, 1982), Steatoda nobilis (Thorell, 1875), Theridion familiare O.P.-Cambridge, 1871 and Theridion hermonense Levy, 1991. A total of 99 species, of 30 genera, are recognised in North Africa at this time based on literature and own collecting efforts. Several other species await description.

Keywords: Spiders, Theridiidae, North Africa, new distribution data.

Introduction

The paper at hand collects all published data on the distribution of theridiid spiders in North Africa (Morocco, Algeria, Tunisia, Libya and Egypt). New data, originating from different journeys to several countries, are added.

Morocco was visited in February 1996 and 2007, April-May 1984, April 2012 and July 1999. Excursions to Tunisia took place in January 1995 and 2003, March 2005, May 2006, August 1979 and December 1999 and 2000. Algeria was visited in April 1982 and April 1984. The first author was a resident in Algeria from September 1985 to June 1990. Egypt and Libya were not explored.

History

The spiders of North Africa are still insufficiently known, except for the family Linyphiidae through a series of revisions by Bosmans, finished in 2007 (Bosmans, 2007). Theridiidae or comb-footed spiders had received little attention in the different countries. Egypt was the first country to be studied, as already in 1826, Audouin included two Theridiid species in his “Explication sommaire des planches d'arachnides de l'Égypte et de la Syrie”. In 1846, H. Lucas published his important work “Histoire naturelle des animaux articulés” in which all families occurring in Algeria; including Theridiidae (21 species) were described. Theridiidae of Algeria were further studied by Thorell (1875), Simon (1899a), Strand (1908) and Denis (1937, 1954). Egypt also knows an early, general paper treating all spider families: “Catalogue of a collection of spiders made in Egypt, with descriptions of new species and characters of a new genus”, by O.P.-Cambrige (1876). Studies including data on Theridiidae by Thorell (1875), Simon (1890, 1899b, 1907), Denis (1945, 1951), El-Hennawy (1990, 2006a-b), Sallam (2002, 2004), Hussein et al. (2003), Abdel-Karim et al. (2006), Ahmad et al. (2009) and Wunderlich (2011) followed. In Morocco, Tunisia and Libya no papers covering all spider families have been published. In Morocco, Simon (1909), Denis (1956a-b) and Melic (2000) contributed to the knowledge of Theridiidae. In Tunisia, Pavesi (1880, 1884) and Simon (1885, 1908) added to the distribution data of the Theridiidae and mainly Caporiacco (1928, 1932, 1933, 1934, 1936a-b, 1949) but also Karsch (1881) and Denis (1947, 1951, 1964) did the same for Libya. Some revisions of genera also included data on Theridiidae from North Africa: Lotz (1994) in a revision of African Latrodectus; Bosmans & Van Keer (1999) in a revision of Mediterranean Enoplognatha; Knoflach (1994, 1996, 1999), Knoflach & Thaler (2002) and Knoflach et al. (2005, 2009) in revisions of several Theridiid genera. Levy & Amitai (1981, 1982a-b) and Levy (1985) often cited North-African species in their most important works on the Theridiidae of Israel.

The number of known species of Theriidae cited from the five countries is now as follows:

Number of cited theridiid species in the literature from the five North African countries	
Algeria	62
Egypt	25
Libya	19
Morocco	35
Tunisia	38

The highest number of species is cited from Algeria (62), the lowest from Libya (19).

Methods

The following abbreviations are used in the text:
CJVK: collection Johan Van Keer;
CRB: collection Robert Bosmans;
MNHNP: Muséum national d’Histoire naturelle de Paris;
MRAC: Musée royal d’Afrique central, Tervuren.

All localities are arranged per country and per administrational unit (Italics) which all have specific names in the different countries of North Africa. They are:

Morocco: Region or wilaya.
Tunisia: Gouvernorat or wilaya.
Egypt: Governorate or muhafaza.
Algeria: Province or wilaya.
Libya: Municipality or baladiya.

List of Species

Genus **Anatolidion** Wunderlich, 2008
A monotypic genus recently described by Wunderlich (2008) for the species Anatolidion osmani Wunderlich, 2008 which appeared to be a junior synonym of Theridion gentile.

Anatolidion gentile (Simon, 1881)

Theridion crinigerum; Simon, 1881: 72; Simon, 1914: 297.
Theridion gentile; Simon 1914: 299.
Anatolidion osmani Wunderlich, 2008: 385.
Anatolidion gentile; Knoflach et al., 2009: 229, f. 1-9 (descr. male, female; synonymy).

Previous records: ALGERIA: Alger: Alger (Knoflach et al., 2009). Annaba: Massif de l'Edough (Simon, 1914). Biskra: Without precise locality (Knoflach et al., 2009). Tlemcen: Tlemcen (Simon, 1914). MOROCCO: Without precise locality (Simon, 1881, sub T. crinigerum).
New records: None.
Distribution: Algeria, Morocco, Corsica, Italy, Greece and Turkey (Knoflach et al., 2009).

Genus **Anelosimus** Simon, 1891
In North Africa, the genus Anelosimus contains two species of which one is very common.

Anelosimus pulchellus (Walckenaer, 1802)

Theridion pulchellum; Simon, 1885: 24.

Previous records: TUNISIA: Jendouba: Aïn-Draham (Simon, 1885).
New records: ALGERIA: Blida: Atlas Blidéen, Meurdja, 950m, 1♀, beating Cedrus branches, 15.VI.1982 (CRB). Bouira: Massif du Djurdjura, Tikjda, 1450m, 1♂, beating Cedrus branches, 11.IV.1989 (CRB). Boumerdes: Reghaia, 25m, 9♂♂ 20♀♀, beating branches in Quercus ilex maquis, 3.V.1988 (CRB). Chleff: 5 km E. Damous, 5m, 2♂♂ 12♀♀, beating Lentisca and Pinus halepensis in dunes, 17.IV.1987 (CRB). El Tarf: El Kala, Lake Oubeira, 10m, 1♂, beating Quercus suber, 29.III.1988 (CRB). Tipasa: Sidi Fredj, 10m, 3♀♀, beating Pinus halepensis branches, 12.VI.1987 (CRB); Zeralda, mouth of Oued Mazafran, 10m, 1♂, pitfalls in Quercus coccifera forest, 24.VI.1988 (CRB). MOROCCO: Tetouan: 10 km E. Chechaouen, 500m, 1♂ in litter of Quercus suber forest, 15.V.1984 (CRB). TUNISIA: Jendouba: Hammam Bourguiba, 1♂, beating in Quercus suber forest, 9.V.2006 (CRB).
Distribution: Europe to Russia, North Africa.

Anelosimus vittatus (C.L. Koch, 1836)

Theridion vittatum; Simon 1899a: 83.

Previous records: ALGERIA: Alger: surroundings of Alger (Simon, 1899a).
New records: ALGERIA: Blida: Atlas Blidéen, Meurdja 950m, 1♀, pitfalls in planted Cedrus forest, 28.V.1988 (CRB).
Distribution: Palaearctic. Rare in North Africa.

Genus **Argyrodes** Simon, 1864

Of this primarily tropical genus one species is cited from North Africa. A second, new species will be described in a separate paper.

Argyrodes argyrodes (Walckenaer, 1841)

Linyphia gibbosa Lucas, 1846: 254 (descr. female).

Argyrodes argyrodes; Pavesi, 1880: 328; Simon, 1881: 17; Strand, 1908: 87; El-Hennawy, 1990: 37; El-Hennawy, 2006b: 75.

Argyrodes gibbosus; Pavesi, 1884: 451.

Argyrodes ammonia Denis, 1947: 40 (descr. male).

Conopistha gibbosa; Denis, 1956a: 202.

Previous records: ALGERIA: El Tarf: El Kala (Lucas, 1846; type locality of Linyphia gibbosa). Unknown locality: Tuggast-Teman (Strand, 1908). EGYPT: Matruh: Siwa Oasis, near Khamissa (Denis, 1947; type locality of Argyrodes ammonia). MOROCCO: Chaouia-Ouardigha: Aïn Sferjla, 8 km from Boulhaut (Denis, 1956a); Boulhaut (Denis 1956a). Souss-Masssa-Drâa: Sidi Larbi (Denis, 1956a). TUNISIA: Tunis: Carthago (Pavesi, 1880); Tunis (Pavesi, 1884). Sousse: Bir-el-Buita, Sousse (Pavesi, 1880).

New records: ALGERIA: Skikda: W. Collo, Tamanart, 15m, 2♀♀, beating branches near rivulet (Alnus, Quercus suber, Cystus), 6.VI.1987 (CRB). TUNISIA: Jendouba: Ras Rajel, 1♀, beating in Quercus suber forest, 8.V.2006 (CRB).

Distribution: Mediterranean region, Canary Islands, West Africa, Seychelles.

Genus **Asagena** Sundevall, 1833

The genus was recently revalidated by Wunderlich (2008) and counts two species in North Africa.

Asagena italica (Knoflach, 1996)

Steatoda italica Knoflach, 1996: 391, f. 3-4, 9, 11, 15-16, 18-20, 33-35, 39-41, 48-53, 65, 68, 73 (descr. male, female).

Previous records: None.

New records: ALGERIA: Alger: El Harrach, garden of Institut national d'Agronomie, 25m, 2♂♂, pitfalls in garden, 9.V.1983 (CRB); les Eucalyptus, 35m, 3♂♂, pitfalls in wasteland, 29.X.1989 (CRB); Kouba, 50m, 1♂, around house, 25.IV.1987 (CRB). Bejaia: Col de Talmetz, 825m, 1♀, litter in Quercus suber forest, 20.X.1988 (CRB). TUNISIA: Bizerte: Lake Ichgeul, 1♂, stones along the lake, 10.V.2005, J. De Graef leg. (CJVK).

Distribution: Italy, France, Corsica. New to Africa.

Asagena phalerata (Panzer, 1801)

Latrodectus spinipes Lucas, 1846: 235 (descr. male).

Asagena phalerata; Pavesi, 1884: 463.

Previous records: ALGERIA: Constantine: Koudiat Ali (Lucas, 1846; type locality). TUNISIA: Tunis: Tunis (Pavesi, 1884).

New records: None.

Distribution: Palaearctic. The presence of this species in North Africa needs confirmation, as all our recently collected material belongs to the closely related Steatoda italica Knoflach. If A. phalerata does not occur in North Africa, Latrodectus spinipes described by Lucas (1846) from Algeria becomes the valid name for A. italica.

Genus **Coscinida** Simon, 1895
A tropical genus of which one species' range extends to the Mediterranean region.

Coscinida tibialis Simon, 1895

Coscinida tibialis Simon 1895: 137; Knoflach et al., 2005: 202, f. 1-10.
Euryopis euterpe Denis 1954: 311 (descr. female).

Previous records: ALGERIA: Alger: les Eucalyptus (Knoflach et al., 2005). Batna: 5 km S. Arris, valley of the Oued El Abiod (Knoflach et al., 2005). Biskra: Biskra (Simon, 1895). Tizi Ouzou: Boukhalfa (Knoflach et al., 2005). Tougourt: Tougourt (Denis, 1954, type locality of Euryopis euterpe). TUNISIA: Kebili: Douz W. (Knoflach et al., 2005).
New records: None. All records of the authors RB and JVK were mentioned in Knoflach et al. (2005).
Distribution: Tropical and Mediterranean Africa, Israel, Arabian Peninsula, SE Asia.

Genus **Crustulina** Menge, 1868
The genus Crustulina has representatives all over the world but many of them are insufficiently known and have probably been taxonomically misplaced. In the Mediterranean region as well, three species occuring in modern catalogues have an incertain status. Two of them were described by Lucas (1846) in the genus Theridion: T. erythropus and T. argus. C. erythropus has never been collected again since and C. argus is considered a junior synonym of C. guttata. Pavesi (1884) described Steatoda lineiventris from Tunisia. This species is now also placed in the genus Crustulina but was never collected again. A fourth species known from North Africa is C. scabripes, cited by several authors but not by Lucas.
The only Crustulina species present in recently collected material is C. scabripes. The original descriptions of Theridion argus, Theridion erythropus and Steatoda lineiventris have to be studied and analysed carefully.

Crustulina conspicua (O.P.-Cambridge, 1872)

Theridion conspicuum O. P.-Cambridge, 1872: 285, pl. 13, f. 11 (descr. male, female).
Crustulina conspicua; Simon, 1881a: 160; El-Hennawy, 1990: 37; Shereef et al., 1996: 29; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Giza: Giza (Shereef et al., 1996).
According to Simon (1881, footnote) the species was cited by O.P.-Cambridge (1872) from Egypt, but we found no trace of the citation in Cambridge’s paper. Shereef et al. (1996) confirmed the presence of the species in Egypt.
New records: None.
Distribution: Egypt, Israel, Syria.

Crustulina erythropus (Lucas, 1846)

Theridion erythropus Lucas, 1846: 265.

Previous records: ALGERIA: El Tarf: El Kala, around Lake Tonga (Lucas, 1846; type locality of Theridion erythropus).
New records: None.
Remark: Lucas (1846) described the species as follows: "Cephalothorax dark redbrown, median part yellowish, eyes on black spots; chelicerae and maxillae dark reddish brown, “glabre”, sternum brillant black; legs yellowish red; abdomen oval, dark reddish brown, dorsally with a row of paired yellowish spots, posteriorly with large undulated yellowish

spot, laterally with two irregular stripes. Living in Quercus suber forests with its nest between large herbs".
Distribution: Only known from the type locality.

Crustulina scabripes Simon, 1881

Crustulina scabripes Simon, 1881: 159; Simon, 1914: 302; Denis, 1937: 1040.
Theridion argus Lucas, 1846: 264 (**N. SYN.**).
Steatoda lineiventris Pavesi, 1884: 461 (**N. SYN.**).

Remarks: Already in 1881, Simon considered Theridion argus Lucas, 1846 a junior synonym of C. guttata (Wider, 1834). In the same paper, he described Crustulina scabripes. After a revision of European Crustulina species, Knoflach (1994) insisted that all citations of C. guttata from North Africa needed to be rechecked ("Meldungen aus N-Afrika bedürfen wohl einer Überprüfung"). In her key, she distinguishes C. scabripes from C. sticta by the presence in C. scabripes of a white spot on the ventral part of the abdomen. In Lucas' description of Theridion argus we read: "… l'abdomen qui est noir en dessous, avec un point blanc au milieu du ventre". Lucas' description thus clearly considers Crustulina scabripes and not C. guttata, as proposed by Simon (1881).
Theridion argus Lucas, 1846 is therefore removed from the synonymy list of Crustulina guttata (Wider, 1834) and considered here a synonym of C. scabripes Simon, 1881. For nomenclatorical stability it is proposed to continue to use the name C. scabripes. Crustulina guttata does not occur in North Africa.
Steatoda lineiventris is another enigmatic species placed now in the genus Crustulina, of which the type material is not available or lost. According to Roewer (1942) followed by Platnick (2012) the type locality is in Ethiopia. Pavesi however clearly wrote: "tre femmine, raccolte nei dintorni di Tunisi". It is the only Crustulina species mentioned by Pavesi in his two papers (1880, 1884) on the fauna of Tunisia. Analysing the description we find concerning the abdomen: "ventre bruno-marrone o nero, con una machia lineara bianca, …". It is obvious that Pavesi was describing Crustulina scabripes and C. lineiventris becomes a junior synonym.
Previous records: ALGERIA: Without precise locality (Simon, 1914). Mila: Djebel Daya (Denis, 1937). Oran: Djebel Santon (type locality of Theridion argus; Lucas, 1846). MOROCCO: Without precise locality (Simon, 1881). TUNISIA: Tunis: around Tunis (Pavesi, 1884; type locality of Steatoda lineiventris).
New records: ALGERIA: Aïn-Defla: Col Kandek, 600m, 1 ♂, pitfalls in Pistacia lentisca maquis, 18.VI.1988 (CRB). Alger: Bainem, south slope, 250m, 2♀♀, stones in Quercus ilex forest, 16.IV.1989 (CRB). Batna: Massif de l'Aures: Monts de Belezma, Col Telmet, 1800m, 1♀, pitfall in Cedrus forest, 15.XI.1988 (CRB); idem, S'Gag, 1650m, 1♀, pitfall in Cedrus forest, 9.IV.1988 (CRB). Blida: Atlas Blidéen, Chrea, 900m, 1♀, mixed Quercus ilex and Pinus halepensis forest, 30.XII.1986 (CRB); idem, Hakou Feraoun, 830m, 1♂, pitfalls in Pinus halepensis forest, 20.VI.1987 (CRB); idem, Chrea E., Pic Fertasse, 1450m, 1♂, pitfalls in Cedrus forest, 20.VIII.1988 (CRB); idem, Meftah, Djebel Zerouela, 480m, 1♂, pitfalls in Quercus suber forest, 23.VI.1988 (CRB). Boumerdes: Reghaia, 45m, 1♂ 1♀, pitfalls in degraded Quercus suber forest, 13.VI.1988 (CRB). El Tarf: El Kala, N. Lake Oubeira, N. Bou Merchen, 55m, 1♂ 3♀♀ in Juncus and Carex marsh, 5.IV.1982 (CRB). Medea: Col de Beni Chicao, 1230m, 1♀, pitfalls in mixed Quercus ilex and Quercus suber forest, 20.V.1990 (CRB); El Azizia, 550m, 1♂ 1♀, in litter of Pistacia lentisca and Pinus halepensis, 10.IV.1988 (CRB); Tablat, Col des deux Bassins, 1200m, 3♀♀, stones in maquis of Quercus ilex, 11.IV.1982 (CRB). Skikda: West of Collo, Tamanart, 15m, 1♂

4♀♀, stones in dunes, 6.VI.1987 (CRB); idem, 2♀♀, 20.VI.1985 (CRB). Tipasa: Bouchaoui, 95m, 1♂, pitfall in planted Ulmus and Eucalyptus forest, 27.V.1988 (CRB); Sidi Fredj, 25m, 2♂♂ 1♀, pitfalls in dense Pinus halepensis forest, 26.VI.1988 (CRB); idem, 10m, 3♂♂, pitfalls in Olea maquis, 1.X.1987 (CRB). Tizi Ouzou: Aïn el Hammam, 1080m, 1♀, stones around hotel, 9.X.1987 (CRB); Beni Yenni, 850m, 1♀, mosses in garden, 14.IV.1982 (CRB).
Distribution: Mediterranean region. It is the only Crustulina species present in recent material.

Genus **Dipoena** Thorell, 1869
The genus Dipoena (and also Lasaeola and Phycosoma, including former Dipoena species) is rich in species and certainly one of the most difficult to identify of all Theridiidae of the Mediterranean region. Furthermore, the determining differences between the genera Dipoena Thorell, 1869, Lasaeola Simon, 1881 and Dipoenata Wunderlich, 1988 remain to be resolved. Nine species have been mentioned from North Africa but most of them have never been depicted, and their status has to be cleared. Some of our material remains unidentified.

Dipoena braccata (C.L. Koch, 1841)

Remark: The catalogue of Roewer (1942), followed by several other authors, mentioned North Africa as part of the distribution area of this species. We did not find any precise citation of the species.
Previous records: None.
New records: ALGERIA: Boumerdes: Zemmouri, 5m, 1♂, litter in dunes, 22.III.1985 (CRB). Tipasa: Zeralda, 1♂, 10m, dunes around mouth of Oued Mazafran, 27.V.1988 (CRB).
Distribution: Europe, Mediterranean.

Dipoena lesnei Simon, 1899

Dipoena lesnei Simon 1899a: 86.

Previous records: ALGERIA: Laghouat: Between Laghouat and Metlili (Simon, 1899a).
New records: None.
Distribution: Hitherto only known from the type locality.

Dipoena leveillei (Simon, 1885)

Lasaeola leveillei Simon, 1885: 26.

Previous records: TUNISIA: Aïn Draham: Aïn-Draham (Simon, 1885).
New records: ALGERIA: El Tarf: El Kala, 50m, Lake Tonga N., 5♂♂, beating Pinus halepensis branches, 28.III.1988 (CRB).
Distribution: Until now only cited from North Tunisia and for the first time in Algeria near the Tunisian border.

Dipoena melanogaster (C.L. Koch, 1837)

Dipoena melanogaster; Simon, 1885: 25; Simon, 1899a: 83; Denis, 1937: 1040.

Previous records: ALGERIA: Mila: Djebel Daya (Denis, 1937). Tizi Ouzou: Yakouren (Simon, 1899a). TUNISIA: Jendouba: Aïn-Draham (Simon, 1885).
New records: ALGERIA: Bejaia: Tichi, 10m, 17♀♀, beating Acacia trees, 21.V.1988 (CRB); Tichi, 50m, 3♀♀, bushes along the Oued Djemaa, 20.V.1988 (CRB). Blida: Atlas

Blidéen, Meurdja 950m, 3♀♀, beating branches of Cedrus atlantica, 28.V.1988 (CRB); Chrea, 1100m, 4♂♂, beating Quercus ilex and Cedrus atlantica branches, 28.IV.1987 (CRB). TUNISIA: Jendouba: Hammam Bourguiba, 1♀, beating in Quercus suber forest, 9.V.2006 (CRB).
Distribution: Europe and North Africa to Azerbaijan.

Dipoena sedilloti (Simon, 1885)

Lasaeola sedilloti Simon, 1885: 25.
Dipoena sedilloti; Simon, 1914: 300.

Previous records: ALGERIA: Annaba: Edough massif (Simon, 1914). TUNISIA: Aïn Draham: Aïn-Draham (Simon, 1885).
New records: None.
Distribution: France, Algeria, Tunisia.

Dipoena umbratilis (Simon, 1873)

Dipoena umbratilis; Simon, 1914: 301; Denis, 1937: 1040.

Previous records: ALGERIA: Without precise locality (Simon, 1914). Annaba: Edough, 3♂♂ 1♀ (MNHNP). Mila: Djebel Daya (Denis, 1937).
New records: None.
Distribution: South France including Corsica, Iberian Peninsula, Italy and Algeria.

Dipoena xanthopus Simon, 1914

Dipoena xanthopus Simon, 1914: 276.

Previous records: ALGERIA: Without precise locality (Simon, 1914).
New records: None.
Distribution: Only known from the type locality.

Genus **Enoplognatha** Pavesi, 1880
Enoplognatha is a large genus with 13 species occurring in North Africa. For detailed descriptions and distribution maps: see Bosmans & Van Keer (1999). The following Enoplognatha species are recorded in North Africa: E. biskrensis Denis, E. carinata Bosmans & Van Keer, E. deserta Levy & Amitai, E. diversa (Blackwall), E. franzi Wunderlich, E.gemina Bosmans & Van Keer, E. hermani Bosmans & Van Keer, E. latimana Hippa & Oksala, E. mandibularis (Lucas), E. mordax (Thorell), E. nigromarginata (Lucas), E. quadripunctata Simon and E. verae Bosmans & Van Keer.

Enoplognatha biskrensis Denis, 1945

Previous records: See Bosmans & Van Keer, 1999.
New record: MOROCCO: Fès-Bouleman: Missour, 1♂, 18.III.2002 (CRB).
Distribution: Morocco, Algeria and Tunisia.

Enoplognatha carinata Bosmans & Van Keer, 1999

Enoplognatha carinata Bosmans & Van Keer, 1999: 237, f. 113-117 (descr. male, female).

Previous records: See Bosmans & Van Keer, 1999.
New records: None.
Distribution: Morocco, Algeria.

Enoplognatha deserta (Levy & Amitai, 1981)

Enoplognatha deserta; El-Hennawy, 2006b: 75.

Previous records: See Bosmans & Van Keer, 1999.
New records: MOROCCO: Fès-Boulemane: W. Fès, Missour, 1♂, pitfalls in wheat fields, 18.III.2002 (CRB). Meknès-Tafilalt: Col de Tizi n'Tairhemt, 1900m, 1♀, stone field, 19.IV.2012 (CJVK). Souss-Massa-Drâa: NE Jemâa-Ida-Oussemlal, 1285m, 1♀, stones along rivulet, 25.IV.2012 (CJVK).
Distribution: Morocco to Israel, but not yet observed in Libya.

Enoplognatha diversa (Blackwall, 1859)

Enoplognatha diversa; Bosmans & Van Keer, 1999: 226, f. 78-82.

Previous records: See Bosmans & Van Keer, 1999.
New records: ALGERIA: Aïn Temouchent: El Melah N., Rio Salado, 1♀, stones in salt marsh, 24.IV.1984 (CRB). MOROCCO: Fès-Boulemane: W. Fès, Douyet, 4♂♂, 3.VI.1998, S. Boksch leg. (CRB); Missour, 2♂♂, pitfalls in steppe, 18.III-16.IV.2002 (CRB). Meknès-Tafilalt: El Herri S., 850m, 2♀♀, stones bordering fields, 17.IV.2012 (CJVK, CRB); Ouaoumana SW, 800m, 2♀♀, stones in wasteland, 17.IV.2012 (CJVK); Zouala oasis, 935m, 1♂ 3♀♀, stones and litter in palm yard, 20.IV.2012 (CJVK). Souss-Massa-Drâa: Agadir, 1♂, stones in salt marsh, 16.II.2007 (CRB); Aït-ou-Mrbete S., 80m, dam on Oued Massa, 2♀♀, under stones, 27.V.2012 (CRB); Timiderte, Oued Drâa, 880m, 1♀, stones at sandy river border, 22.IV.2012 (CJVK). Tadla-Azilal: Kasba Tadla E., SW.-Aït Roadi, 560m, 1♂ 3♀♀, stones in grassland, 17.IV.2012 (CJVK, CRB). TUNISIA: Gafsa: Djebel Biada, S. Sened, 8♀♀, stones in steppe, 9.V.2006 (CRB). Le Kef: Kalaat Es Senam, 1♀, rubbish along the road, 10.V.2006 (CRB). Nabeul: Zaouïet el Mgalez N., 1♀, stones in Pinus forest, 26.I.2003 (CRB). Tunis: La Goulette, 1♂, stones in Pinus plantation, 30.I.2003 (CRB).
Distribution: Circummediterranean, the commonest species in the western part, rarer in the eastern part; not yet observed in Egypt and Libya.

Enoplognatha franzi Wunderlich, 1995

Enoplognatha franzi; Bosmans & Van Keer, 1999: 224, f. 73-77.

Previous records: See Bosmans & Van Keer, 1999.
New records: MOROCCO: Souss-Massa-Drâa: Agadir, 2♂♂ 9♀♀, stones in salt marsh, 16.II.2007 (CRB). TUNISIA: Jendouba: Tabarka, 2♂♂, grassland around medieval fortress, 7.III.2005 (CJVK).
Distribution: Circummediterranean but rare everywhere, recorded in Morocco, Spain, Portugal, Algeria, Tunisia, Israel and Iraq.

Enoplognatha gemina Bosmans & Van Keer, 1999

Pachygnatha mandibulare; O.P.-Cambridge, 1872: 294.
Steatoda mandibularis; O.P.-Cambridge, 1876: 568 (misidentification).
Enoplognatha mandibularis; El-Hennawy, 1990: 37.
Enoplognatha gemina Bosmans & Van Keer, 1999: 235; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Alexandria (O.P.-Cambridge, 1876, sub S. mandibularis). Cairo: Cairo (O.P.-Cambridge, 1872, sub E. mandibularis).
Comments: Enoplognatha mandibularis has a western Mediterranean distribution. Records from Egypt by O.P.-Cambridge (1872, 1876) are believed to be E. gemina (see Bosmans & Van Keer, 1999). Additional records should confirm this.

Distribution: Spain, France, Italy, Croatia, Greece, Cyprus, Turkey, Israel, Syria and Egypt.

Enoplognatha hermani Bosmans & Van Keer, 1999

Enoplognatha hermani Bosmans & Van Keer, 1999: 229, f. 88-90.

Previous records: See Bosmans & Van Keer, 1999.
Distribution: Only known from Algeria.

Enoplognatha latimana Hippa & Oksala, 1982

Enoplognatha latimana; Bosmans & Van Keer, 1999: 212.

Previous records: See Bosmans & Van Keer, 1999.
Distribution: Holarctic, in Africa known from Algeria and Morocco.

Enoplognatha mandibularis (Lucas, 1846)

Enoplognatha mandibularis; Bosmans & Van Keer, 1999: 231, f. 98-102.

Previous records: See Bosmans & Van Keer, 1999.
New records: TUNISIA: Bizerte: Lake Ichgeul, E. side, 1♂, stones in olive yard, 29.I.2003 (CRB). Jendouba: Fernana N., 4♂♂ 6♀♀, stones in maquis, 6.III.2005 (CJVK); Ouchtata, plage Zouaraa, 1♂ 2♀♀, stones in Pinus forest, 28.II.2005 (CJVK); Tabarka W., Melloula, 1♀, stones in maquis, 28.II.2005 (CJVK); Tabarka, 2♀♀, grassland around medieval fortress, 7.III.2005 (CJVK); Tabarka, 1♀, grassland along oued Kebir, 7.II.2005 (CJVK). Nabeul: Kerkouana S., 2♀♀, stones in Pinus forest, 26.I.2003 (CRB); Tazerka, 1♀, litter at border of salt marsh, 26.I.2003 (CRB). Tunis: Gammarth N., 1♀, litter at border of salt marsh, 30.I.2003 (CRB); La Goulette, 1♀, stones in Pinus plantation, 30.I.2003 (CRB).
Distribution: Circummediterranean.

Enoplognatha mordax (Thorell, 1875)

Enoplognatha mordax; Bosmans & Van Keer, 1999: 213, f. 6-11.

Previous records: See Bosmans & Van Keer, 1999.
Distribution: Palaearctic, in North Africa only known from Morocco.

Enoplognatha nigromarginata (Lucas, 1846)

Enoplognatha nigromarginata; Bosmans & Van Keer, 1999: 226, f. 78-82.

Previous records: See Bosmans & Van Keer, 1999.
Distribution: Spain to Greece, Morocco, Algeria.

Enoplognatha quadripunctata Simon, 1884

Enoplognatha quadripunctata; Bosmans & Van Keer, 1999: 218, f. 36-41.

Previous records: See Bosmans & Van Keer, 1999.
New record: MOROCCO: Meknès-Afilalt: Aït Barka, 1♀, 6.VI.1999 (CRB).
Distribution: Circummediterranean, in North Arica in Algeria and Morocco. The new record for Morocco is the second one.

Enoplognatha verae Bosmans & Van Keer, 1999

Enoplognatha verae; Bosmans & Van Keer, 1999: 213, f. 1-5.

Previous records: See Bosmans & Van Keer, 1999.
New records: MOROCCO: Souss-Massa-Drâa: Agadir, 2♂♂, stones in salt marsh,

16.II.2007 (CRB); Agadir, 1♀, stones in old kasba, 28.IV.2012 (CJVK); Gourizim 5 km E., 1♀, stones in Argania steppe, 26.V.2012 (CRB). TUNISIA: Nabeul: Kelibia, 1♂, litter in Eucalyptus forest, 26.I.2003 (CRB).
Distribution: A coastal circummediterranean species, actually known from Morocco, Tunisia, Spain, Italy and Greece.

Genus **Episinus** Walckenaer, 1809
Episinus is a rather small genus of which three species are cited from North Africa. Episinus maculipes numidicus is considered as a subspecies for the moment. More material and especially males are needed to prove if it can be elevated to species rank.

Episinus algiricus Lucas, 1846

Episinus algiricus Lucas, 1846: 269; Kulczyński, 1905: 434; Simon, 1914: 291; Denis, 1937: 1048; Knoflach & Thaler, 2000: 421; Knoflach et al., 2009: 232.

Previous records: ALGERIA: Alger: Kouba (Lucas, 1846). Mila: Djebel Daya, Forêt de Zouagha (Denis, 1937; Knoflach et al., 2009). TUNISIA: Without precise locality (Kulczyński, 1905). Monastir: Monastir, near airport (Knoflach et al., 2009).
New records: ALGERIA: Djelfa: Djelfa, Djebel Senalba, 1230-1450m, 1♂, pitfalls in Pinus halepensis forest, 9.IV.1991 (CRB); Djebel Djellal, 1310-1400m, 1♂, pitfalls in Pinus halepensis forest, 31.IX.1991 (CRB). Ech Chleff: Forêt de Tacheta, 850m, 1♀, pitfalls in Quercus faginea forest, 25.V.1990 (CRB). Oran: Forêt de Msila, 400m, 1♂, beating herbs in Quercus suber forest, 25.IV.1984 (CRB). Tlemcen: S. Tlemcen, forêt de Tal Terny, 1300m, 1♀, pitfalls in Quercus ilex forest 24.V.1990 (CRB). TUNISIA: Jendouba: Hammam Bourguiba, 1♂ 2 subadult ♀♀, beating in Quercus suber forest, 9.V.2006 (CRB).
Distribution: France, Italy, Portugal, Algeria, Tunisia.

Episinus maculipes Cavanna, 1876

Previous records: None.
New records: ALGERIA: Batna: Massif de l'Aures, Aïn Taga, 1600m, 1♂, pitfalls in Cedrus atlantica forest, 4.XI.1987 (CRB). Blida: Atlas Blidéen, Meurdja 950m, 1♀, pitfalls in planted Cedrus atlantica forest, 15.VI.1982, 1♂, 4.XI.1987 and 1♂, 17.VII.1988 (CRB). Boumerdes: Reghaia, 10m, 1♂, beating branches of Populus alba, 3.V.1988 (CRB). Chleff: Bai des Souhalia, 10m, 1♀, stones in Pinus halepensis forest, 7.V.1989 (CRB); El Tarf: El Kala, Lake Melah, El Melah E., 2m, 1♂ 1♀, litter in Fraxinus forest, 5.IV.1982 (CRB); El Kala E., Kef Oum Teboul, 200m, 1♀, litter in Quercus suber forest, 5.IV.1982 (CRB). Sétif: Djebel Babor, 1850m, 1♂, litter in mixed Cedrus, Abies and Quercus forest, 20.VI.1986 (CRB). Tipaza: Sidi Fredj, 10m, 1♀, pitfall in Olea maquis, 6.V.1987 and 1♀, 20.XII.1987 (CRB). Tissemsilt: Theniet el Had, Djebel Meddad, 1550m, 1♀, pitfalls in Cedrus atlantica forest, 2.VIII.1988 (CRB). TUNISIA: Tozeur: Tozeur oasis, 45m, 1♀, litter in palm orchard, 26.I.1995 (CJVK).
Distribution: England to Algeria in the south and Crimea and Caucasia in the east.

Episinus maculipes numidicus Kulczyński, 1905

Episinus maculipes numidica Kulczyński, 1905: 437; Simon, 1914: 291; Knoflach et al., 2009: 237.

Previous records: ALGERIA: Without precise locality (Kulczyński, 1905; Simon, 1914). TUNISIA: Without precise locality (Kulczyński, 1905). Jendouba: Aïn Draham (Knoflach et al., 2009).
New records: ALGERIA: Tissemsilt: Theniet el Had, Djebel Meddad, 1550m, 1♀, pitfalls

in Cedrus atlantica forest, 2.VIII.1988 (CRB).
Distribution: Algeria and Tunisia.

Episinus truncatus Latreille, 1809

Episinus truncatus; Simon, 1909: 22; Simon, 1914: 291.

Previous records: MOROCCO: Without precise locality (Simon, 1909). ALGERIA: Without precise locality (Simon, 1909).
New records: None.
Distribution: Palaearctic.

Genus **Euryopis** Menge, 1868
Six species are cited from North Africa of which only one is common in the region. Two are mentioned only from the type locality and two others are doubtfull identifications. It is most likely some of them will become synonyms.

Euryopis albomaculata Denis, 1951

Euryopis albomaculatus Denis, 1951: 313; El-Hennawy, 1990: 37; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Sharqiyah: Sawaleh, 5 km south of Fakous (Denis, 1951).
New records: None.
Distribution: Only known from the type locality.

Euryopis campestrata Simon, 1907

Euryopis campestrata Simon, 1907: 5 (descr. imm. female); El-Hennawy, 1990: 37; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Cairo: Cairo (type locality; Simon, 1907).
New records: None.
Distribution: Only known from the type locality.

Euryopis episinoides (Walckenaer, 1847)

Theridium acuminatum Lucas, 1846: 268 (homonym).
Theridion scriptum O.P.-Cambridge, 1872: 283 (descr. male, female).
Euryopis acuminata; Simon, 1874: 66; O.P.-Cambridge, 1876: 569; Simon, 1880a: 58; Pavesi, 1880: 333; Pavesi, 1884: 451; Simon, 1885: 27; Simon, 1909: 22; El-Hennawy, 1990: 37; Shereef et al., 1996: 29.
Euryopis quadrimaculata O.P.-Cambridge, 1876: 569 (descr. male, female).
Euryopis scripta; O.P.-Cambridge, 1876: 569.
Euryopis episinoides; El-Hennawy 2006b: 75.

Previous records: ALGERIA: Alger: Alger (Lucas, 1846; Simon, 1874). Annaba: Annaba (as Bône; Lucas, 1846). El Tarf: El Kala (Lucas, 1846). Oran: Oran (Lucas, 1846). EGYPT: Alexandria: Alexandria (O.P.-Cambridge, 1872, 1876; Simon, 1880a). Giza: Giza (Shereef et al., 1996). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). TUNISIA: Bizerte: Isola Galita (Pavesi, 1880). Tunis: Tunis (Pavesi, 1884; Simon, 1885).
New records: ALGERIA: Alger: Forêt de Bainem, 250m, 1♀, litter in Eucalyptus plantation, 16.IV.1989 (CRB); E. Bab Ezzouar, 20m, 1♀, marsh around the university campus, 8.XII.1986 (CRB); El Harrach, I.N.A., 25m, 1♂, stones in garden 19.I.1988 (CRB); idem, 4♂♂ 2♀♀, pitfalls in garden of I.N.A., III-VI.1983 (CRB); les Eucalyptus, 35m, 1♂, stones around house, 15.V.1990 (CRB); La Gravière, 2♀♀, in dunes 19.IV.1987, R. Jocqué leg. (MRAC). Batna: between Arris and Medina, 1100m, 1 juvenile, border of river, R. Jocqué leg. (MRAC 167.625). Bejaia: Oued Daas, 15m, 1♂, stones on beach, 22.V.1988

(CRB); 15 km S. Bejaia along Oued Soummam, 20m, 1♀, litter of Populus alba, 18.IV.1982 (CRB). Blida: Atlas Blidéen, Meurdja, 950m, 1♀, pitfalls in Quercus ilex maquis, 14.XI.1986 (CRB). Bouira: between Aomar and Kadiria, Oued Isser, 200m, 1♀, litter in small Eucalyptus plantation, 18.III.1988 (CRB); Col de Dirah, 900m, 1♂, pitfalls along Oued Djenane, 1.V.1988 (CRB). Boumerdes: Cap Djinet, barrage de l'Oued Arbaa, 150m, 2♀♀, litter and stones in maquis, 4.XII.1987 (CRB); idem, 1♂ 2♀♀, litter in maquis of Quercus ilex and Pistacia lentisca, 4.III.1988 (CRB); E. Keddara, Toulmout, 550m, 1♀, pitfall in Quercus suber, forest, 14.XI.1989 (CRB); Reghaia, 5m, 1♀, in tufts of Atriplex in mouth of Oued Reghaia, 11.IX.1987 (CRB); idem, 10m, 1♂, pitfall in Phragmites marsh, 3.X.1985 (CRB). Ech Cheliff: Bai des Souhalia, 10m, 1♀, stones in Pinus halepensis forest, 7.V.1989 (CRB). El Tarf: El Kala, S. Boumalek, Lake Melah, 3m, 1♀, litter in Quercus suber forest, 6.IV.1982 (CRB); El Kala, western side of Lake Tonga, 10m, 3♀♀, wet grassland along the lake, 27.III.1988 (CRB); idem, 1♀, pitfalls in Pinus halepensis forest, 1.III.1990 (CRB); Sidi Embarek, N Garaet el Mkaada, 5m, 2♂♂, in maquis in dunes, 24.XI.1989 (CRB). Guelma: Belkheir, 400m, 1♂, stones bordering fields, 28.II.1990 (CRB); Hammam Meskoutine, 410m, 1♀, grass tufts around big stones, 28.II.1990 (CRB). M'Sila: Djebel Maadid, S. slope, 1350m, 1♂ 3♀♀, stones along oued, 29.IV.1988 (CRB). Oran: Mers el Hadjad, 50m, 1♂ 1♀ in garden, VII-IX.1988 (CRB); Hasasna E., 5m, 1♀, dunes bordering marsh of la Macta, 20.I.1990 (CRB). Setif: N. Magra, Rasfa, 995m, 1♀, herbs along an oued 15.IV.90 (CRB). Skikda: West of Collo, Tamanart, 15m, 1♀, stones in dunes, 6.VI.1987 (CRB). Tipasa: Douaouda, Oued Mazafran, 50m, 1♂, pitfalls in Populus alba forest, 26.VI.1988 (CRB); Sidi Fredj, 10m, 2♀♀, stones in dunes, 20.III.1987 (CRB); Zeralda, 5m, 1♀, stones in dunes, 25.IV.1987 (CRB). Tissemsilt: Tasslemt, Sbaïn, 900m, 1♂ 4♀♀, stones, 17.I.1990 (CRB). Tizi Ouzou: Aïn el Hammam, 1080m, 6♀♀, stones around hotel, 9.X.1987 (CRB); idem, 3♀♀, 9.III.1990 (CRB); Beni Yenni, 850m, 1♂ 2♀♀, stones in garden, 14.IV.1982 (CRB); E. Yakouren, 820m, 1♂, litter in Quercus faginea forest, 3.XII.1986 (CRB); S. Tamda, 160m, 1♀, stones in Olea plantation, 27.IV.1990 (CRB); Takdempt, 30m, 1♀, stones in abandoned fields, 26.I.1990 (CRB). Tlemcen: 5 km E. of Tlemcen, 2♂♂, stones in grassland, 23.IV.1984 (CRB); Monts des Traras, between Bordj Arima and Remchi, 400m, 3♂♂ 6♀♀, stones bordering fields, 19.I.1990 (CRB). MOROCCO: Laâyoune-Boujdour-Sakia El Hamra: Laayoune N., 1♂, stones in oued near the town, 11.II.2007 (CRB). Marrakech-Tensift: Chichaoua, 1♀, stones in irrigated Olea yard, 8.VII.1999 (CRB); Smimiou N., 200m, 1♀, stones in Argania steppe, 15.IV.2012 (CJVK). Meknès-Tafilalt: Aït Koujmane, Oued Ziz, 1225m, 1♀, stone fields, 19.IV.2012 (CRB). Souss-Massa Drâa: Agdz, Vallée du Drâa, 1♀, stones in palm yard, 5.II.1996 (CRB); Mirleft, plage Imi n' Tourga, 1♂, stones in valley near the sea, 26.IV.2012 (CJVK); road Nekob-Mellal, 940m, 1♀, stones in palm yard, 22.IV.2012 (CRB); Timiderte, Oued Drâa, 880m, 1♂, stones at sandy river border, 22.IV.2012 (CJVK); Tizi n' Bachkoun, 1♀ 6 juveniles, stones along abandoned fields, 4.II.1996 (CJVK, CRB). Tadla-Azilal: Khemis des Oulad Ayad, 400m, 1♂, stones in irrigated fields, 16.IV.2012 (CRB). Tanger-Tetouan: Tetouan, 10m, 1♂, abandoned grassland along the Oued Hadjera, 20.IV.1984 (CRB). TUNISIA: Kasserine: Aïn Nouba, N. Hassi El Frid, 1♀, stones at spring, 3.III.2005 (CJVK); Thelepte, 1♂, stones in ruins, 1.III.2005 (CJVK); Nabeul: Kelibia, 1♀, litter in Eucalyptus forest, 26.I.2003 (CRB); Tazerka, 1 subadult ♂, litter bordering salt marsh, 26.I.2003 (CRB). Sousse: Sousse, under stone around hotel, 1♀, 22.I.1995 (CJVK). Tozeur: Oasis of Tozeur, 1♀, litter in palm yard, 26.I.1995 (CRB). Tunis: La Goulette, 1♀, stones in Pinus plantation, 30.I.2003 (CRB).

Distribution: Mediterranean region. A common species in North Africa.

Euryopis laeta (Westring, 1861)

Euryopis laeta; Pavesi, 1880: 333; Pavesi, 1884: 451.

Previous records: TUNISIA: Kairouan: Kairouan (Pavesi, 1880). Tunis: Tunis (Pavesi, 1884).
New records: None.
Distribution: West, Central and North Europe to Tadjikistan. For the Mediterranean region, it was only cited by Pavesi (1880, 1884), the most southern records in France for instance being the Vendée and Vaucluse departments. Pavesi's records (1880, 1884) are therefore most doubtful.

Euryopis quinqueguttata Thorell, 1875

Euryopis quinqueguttata; Denis, 1947: 41; El-Hennawy, 1990: 37; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Matruh: Siwa (Denis, 1947).
New records: None.
Distribution: Europe to the Urals, only once cited from North Africa. The only record was done by Denis (1947) but he doubts his own identification: "I am however a little doubtful about the correctness of this determination, because the legs are wholly yellow in the female of Siwa and the epigyne is too variable to give a sure identification".

Euryopis sexalbomaculata (Lucas, 1846)

Theridion sex-albomaculatum Lucas, 1846: 265.
Euryopis sexalbomaculata; Simon, 1885: 27; Caporiacco, 1928: 91.

Previous records: ALGERIA: Constantine: Region of Constantine (Lucas, 1846). LIBYA: Tubruq: Al Jaghbub (as Giarabub; Caporiacco, 1928). TUNISIA: Djebel Bou Holma (Simon, 1885).
New records: ALGERIA: Batna: Monts de Belezma, col Telmet, S. slope of Kef Islane, 1800m, 1♀, stones in Cedrus atlantica forest, 8.IV.1982 (CRB). TUNISIA: Jendouba: Tabarka, 1♂, stones in humid grassland along Oued Kebir; 7.III.2005 (CJVK).
Distribution: Algeria, Libya, Tunisia, Greece, Israel.

Genus **Heterotheridion** Wunderlich, 2008
A monotypic genus recently described by Wunderlich (2008) for the species Theridion nigrovariegatum.

Heterotheridion nigrovariegatum (Simon, 1873)

Theridion nigrovariegatum; Caporiacco, 1936b: 87; Denis, 1937: 1040; El-Hennawy, 2006b: 75.

Previous records: ALGERIA: Mila: Djebel Daya (Denis, 1937). EGYPT: Alexandria: Alexandria (El-Hennawy, 2006b). Ismailia: Ismailia (El-Hennawy, 2006ba). Matruh: Siwa oasis (El-Hennawy, 2006b). Suez: Suez (El-Hennawy, 2006b). LIBYA: Fezzan (Caporiacco, 1936b).
New records: None.
Distribution: Mediterranean region.

Genus **Kochiura** Archer, 1950
In North Africa, the genus Kochiura counts one, very common species.

Kochiura aulica (C.L. Koch, 1838)

Theridion rufolineatum Lucas, 1846: 260; O.P.-Cambridge, 1876: 569; Simon, 1880a: 56.
Theridion aulicum; Simon, 1874: 106; Simon, 1881: 95; Pavesi, 1884: 461; Simon, 1885: 24; Simon, 1899b: 244; Simon, 1909: 12; Caporiacco, 1928: 91; Caporiacco, 1933: 31; Denis, 1947: 42; Denis, 1964: 121.
Anelosimus aulicus; El-Hennawy, 1990: 36; El-Hennawy, 2006b: 75; Hussein et al., 2003: 131; Abdel-Karim et al., 2006: 36; Ahmad et al., 2009: 103.

Previous records: ALGERIA: Mostagenem: Kaddous (Lucas, 1846). Tizi Ouzou: Bordj Menaël (Simon, 1874). EGYPT: Al Buhayrah: Wadi Natron, Bir Hooker (Simon, 1899b). Alexandria: Alexandria (O.P.-Cambridge, 1876; Simon, 1885); Nile delta (El-Hennawy, 2006b). Giza: Without precise locality (Abdel-Karim et al., 2006; Ahmad et al., 2009). Matruh: Siwa oasis (Denis, 1947). Qalyubia: El Quanatar (Husssein et al., 2003). LIBYA: Ajdabiyah: Gialo (as Djalo; Denis, 1964). Al Kufrah: Al Khufrah (as Cufra; Caporiacco, 1933). Fezzan: Murzuq (as Murzouk; Denis, 1964). Tubruq: Al Jaghbub (as Giarabub; Caporiacco, 1928). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). TUNISIA: Gabes: Gabes (Simon, 1885). Mahdia: El Jem (Simon, 1885). Sidi Bouzid: Bou Hedma (Simon, 1885). Tozeur: Tozeur (Simon, 1885). Tunis: La Goulette (Simon, 1885); Tunis (Pavesi, 1884).

New records: ALGERIA: Alger: E. Bab Ezzouar, 20m, 2♀♀, in marsh around university campus, 8.XII.1986 (CRB). Bejaia: W. of mouth of the Oued Daas, 5m, 1♀, stones on the high shore, 22.V.1988 (CRB). Blida: Arbatache, Djebel Bou Zegza, north slope, 750m, 3♀♀ beating Quercus ilex and Quercus faginea, 6.IV.1982 (CRB); Meftah, 95m, 1♂ 2♀♀ in citrus plantation, 3.IX.1989 (CRB). Boumerdes: Reghaia, 10m, 6♂♂ 1♀, beating of Populus alba branches, 3.V.1988 (CRB). Chleff: 5 km W. Damous, 5m, 1♀, beating branches of Lentisca and Pinus in dunes, 17.IV.1987 (CRB). El Tarf: El Kala, N. Lake Oubeira, N. Bou Merchen, 55m, 1♂, beating herbs in Juncus and Carex marsh, 5.IV.1982 (CRB). Guelma: Hammam Meskoutine, 410m, 1♀, in herbs around big stones, 28.II.1990 (CRB). M'Sila: S. Bou Saada, Aïn-Ograb, 650m, 2♀♀, stones in open Pinus halepensis forest, 12.V.1988 (CRB). W. Skikda: W. Collo, Tamanart, 15m, 2♂♂ 3♀♀, beating branches (Alnus, Quercus, Cystus) near a rivulet, 6.VI.1987 (CRB). Tipasa: Douaouda, 15m, 1♂, beating of Olea branches, 9.III.1987 (CRB). Tizi Ouzou: between Tizi Ghenif and Chabet-el-Ameur, 125m, 1♀, sweeping herbs, 1.V.1984 (CRB); 5 km E. of Tizi Ouzou, 190m, 1♂ 4♀♀, herbs on humid slope, 11.III.1990 (CRB). MOROCCO: Souss-Massa-Drâa: Aït ou Mribete, Oued Massa, 5♂♂ 6♀♀, sweeping Juncus in marshy area, 15.II.2007, 27.IV.2012 (CJVK, CRB); Tamri estuary, 5 m, 2♂♂ 1♀, pitfalls in Tamarisk marsh, 15-28.IV.2012 (CJVK, CRB). TUNISIA: Beja: Ouchtata, plage Zouaraa, 1♀, beating in Pinus plantation, 8.V.2006 (CRB). Jendouba: Hammam Bourguiba, 1♀, beating in Quercus suber forest, 9.V.2006 (CRB); Tabarka, 1♀, herbs on slopes to the castle, 8.V.2006 (CRB). Sousse: S. Hergla, Sebkhet Halk el Menzel, 5m, 1♀, dunes near salt marsh, 24.I.1995 (CJVK).

Distribution: Atlantic Islands, Europe and North Africa to Azerbaijan. Common in the coastal parts.

Genus **Lasaeola** Simon, 1881

The genus Lasaeola was long time considered a junior synonym of Dipoena but was resurrected by Wunderlich (1988). However, most species were unplaced by Wunderlich, and some of the Dipoena species might have to be placed in Lasaeola. The genus actually counts 21 species, only two occur in North Africa.

Lasaeola convexa (Blackwall, 1870)

Lasaeola convexa; Simon, 1885: 26.
Dipoena convexa; Denis, 1937: 1040.

Previous records: ALGERIA: Mila: Djebel Daya (Denis, 1937). MOROCCO: Tanger-Tétaouan: Mdiq (Jocqué, 1977); Tanger (Simon, 1909). TUNISIA: Jendouba: Aïn-Draham (Simon, 1885).
New records: ALGERIA: Batna: Bouhmama, Oued Taga, 1200m, 1♂, stones on border of small degraded Quercus ilex forest and fields, 11.II.1988 (CRB). Blida: Atlas de Blida, Chrea, 1500m, 1♂, stones in open Cedrus forest, 23.IV.1982 (CRB). Tipasa: E. de Cherchel, Oued Hachem, 30m, 1♂, stones in open maquis with some Pinus halepensis, 2.I.1988 (CRB). MOROCCO: Taza-Al Hoceima-Taounate: Djebel Tazeka, 1600m, 1♂, pitfalls in Quercus ilex forest, 8.V.1984 (CRB). TUNISIA: Jendouba: Hammam Bourguiba, 1♀, beating in Quercus forest, 8.V.2006 (CRB). Kasserine: Thala 5 km W., 1♂, beating in open Pinus forest, 19.V.2006 (CRB).
Distribution: Mediterranean region.

Lasaeola testaceomarginata Simon, 1881

Dipoena testaceomarginata; Denis, 1956a: 203.

Previous records: MOROCCO: Grand Casablanca: Aïn Sebaa (Denis, 1956a).
New records: ALGERIA: Boumerdes: Zemmouri, 5m, 1♂, herbs in dunes, 22.III.1985 (CRB).
Distribution: France, Italy, Algeria, Morocco, Portugal.

Genus **Latrodectus** Walckenaer, 1805
This genus includes the large and well-known widow spiders. Five species have been noted in Africa and there has been some confusion in the past. Not all citations might be correct.

Latrodectus cinctus Blackwall, 1865

Latrodectus cinctus; Lotz, 1994: 28.

Previous records: MOROCCO: Souss-Massa-Drâa: Agadir (Lotz, 1994).
New records: None.
Distribution: Tropical Africa, to the north reaching SW Morocco and the Arabian Peninsula.

Latrodectus geometricus C.L. Koch, 1841

Latrodectus geometricus; Caporiacco, 1933: 324.

Previous records: LIBYA: Al Khufrah: Al Khufrah (as Cufra; Caporiacco, 1933).
New records: MOROCCO: Souss-Massa-Drâa: Massa, 1♀, litter in Eucalyptus forest in river bed of Oued Massa, 27.IV.2012 (CJVK).
Distribution: Cosmopolitan.

Latrodectus lilianae Melic, 2000

Latrodectus lilianae Melic, 2000: 21, f. 4A, 6C, 7B-C, 8C, F-I, 9B-C, 11-13.

Previous records: ALGERIA: Laghouat: Laghouat (Melic, 2000).
New records: None.
Distribution: Spain, Algeria.

Latrodectus pallidus O.P.-Cambridge, 1872

Latrodectus pallidus; Simon, 1881: 179; El-Hennawy, 1990: 37; El-Hennawy, 2006a: 32; El-Hennawy, 2006b: 75.

Latrodectus pallidus immaculatus Caporiacco, 1933: 323 (according to Platnick a nomen dubium).

Previous records: EGYPT: South Sinai: Nabq, Kherieza, Wadi Kid (El-Hennawy, 2006a, b). North Sinai: Zaranik (El-Hennawy, 2006a). LIBYA: Al Khufrah: Giallo, Hattia Gur Atta (Caporiacco, 1933).
New records: TUNISIA: Mahdia: between Mahdia and Ksour Essaf, 2♀♀, 6.VIII.1979 (CRB).
Distribution: Cape Verde, Tunisia to Russia and Iran.

Latrodectus tredecimguttatus (Rossi, 1790)

Latrodectus martius; Lucas, 1846: 234.
Latrodectus argus Audouin, 1826: 137; Lucas, 1846: 235.
Latrodectus erebus Audouin, 1826: 137; Cambridge, 1876: 567.
Latrodectus schuchi; Pavesi, 1880: 333; Simon, 1885: 25; Simon, 1899a: 83; Strand, 1908: 94.
Latrodectus tredecimguttatus; Simon, 1880a: 48; Pavesi, 1880: 332; Pavesi, 1884: 451; Simon, 1885: 25; Strand, 1908: 94; Simon, 1914: 308; Caporiacco, 1928: 92; Jocqué, 1977: 332; Lotz, 1994: 52; El-Hennawy, 1990: 37; Melic, 2000: 15; El-Hennawy, 2006b: 75.
Latrodectus tredecimguttatus lugubris; Karsch, 1881: 6; Pavesi, 1884: 451; Simon, 1908: 428; Strand, 1908: 94; Simon, 1909: 22; Caporiacco, 1928: 92; Caporiacco, 1933: 323; Caporiacco, 1934: 131; Caporiacco, 1949: 7.

Previous records: ALGERIA: Alger: Alger (Lucas, 1846). Djelfa: Takersan (Simon, 1907). El Tarf: El Kala, near Lake Tonga and Lake Oubeira (Lucas, 1846). Laghouat: Laghouat (Simon, 1907). *M'sila*: Aïn Baniou (Simon, 1907). Oran: Oran (Lucas, 1846). EGYPT: Alexandria: Alexandria (Audouin, 1826; O.P.-Cambridge, 1872; Simon, 1880a). Ismailia: near Salahyah (Audouin, 1826). Mid Sinai (El-Hennawy, 2006b). South Sinai: Nabq (El-Hennawy, 2006b). LIBYA: Ajdabiyah: Ajdabiya (as Agedabia ; Caporiacco, 1933). Al Jabal: Cyrene, Wadi bel Gadir (Caporiacco, 1949). An Naquat: Sabrata (Lotz, 1994). Benghazi: Benghazi (Simon, 1907); Suluq (as Soluch; Caporiacco, 1947); Tukrah (as Tocra; Caporiacco, 1934). Darnah: Darnah (as Derna; Caporiacco, 1934). Gharyan: Gharyan (Lotz, 1994). Tarhunah: Djebel Tarhuna (Karsch, 1881); Bir Milrha (Karsch, 1881). Tubruq: Al Jaghbub (as Giarabub; Caporiacco, 1928). Unknown locality: wadi Scherschara (Karsch, 1881). MOROCCO: Doukkala-Abda: El-Jadida (as Mazagan; Simon, 1909). Grand Casablanca: Casablanca (Simon, 1909). Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). Rabat-Salé-Zemmour-Zaër: Rabat (Melic, 2000). Souss-Massa Drâa: Agadir (Melic, 2000). Tanger-Tétaouan: Mdiq (Jocqué, 1977); Tanger (Simon, 1909). Taza-Al Hoceima-Taounate: Guercif (Melic, 2000). TUNISIA: Bizerte: Isola Galita (Pavesi, 1880). Gabes: Gabes (Strand, 1908). Gafsa: Djebel Oum Ali (Simon, 1885); Gafsa (Simon, 1885). Kairouan: Kairouan (Pavesi, 1880). Le Kef: Sers (Simon, 1885). Mahdia: El Jem (Simon, 1885); Ksour Essaf (as Ksar-el-Sef; Simon, 1885). Mecheria: Mecheria (Strand, 1908). Medenine: Bou Grara, Sisi Salem (Simon, 1885); Djerba (Pavesi, 1880); Marsa (Strand, 1908); Zarzis (Simon, 1885). Sfax: Kerkena Islands (Simon, 1885); Sfax (Simon, 1885). Sousse: between Sousse and Bir el Buita (Pavesi, 1880). Tunis: sebkha Sedjouni (Strand, 1908); Sidi Messsaoud (Simon, 1885); surroundings of Tunis (Pavesi, 1884). Unknown locality: Oued Batcha (Simon, 1885).
New records: MOROCCO: Fès-Boulemane: W. Fès, Douyet, 1♀, pitfalls in wheat fields, without date, S. Boksch leg. (CRB); Missour, 1♀, 2002 (CRB). Marrakech-Tensift-Al Haouz: Marrakech, 1 juvenile, 9.II.1996 (CRB). Souss-Massa Drâa: Anza, 1 juvenile, stones in Eucalyptus plantation, 3.II.1996 (CRB); Aït ou Mribete, Oued Massa, 1♀, stones

in steppe, 27.IV.2012 (CRB). TUNISIA: Gabes: Arram, 1♀, stones and herbs around irrigation canals, 16.XII.1999 (CRB). Kairouan: Hayeb-el-Ayoun, 2 subadult ♂♂ 2 subadult ♀♀, stones in steppe, 26.I.1995 (CJVK). Kasserine: Feriana S., 1♀ 2 juveniles, stones in alfa steppe, 3.III.2005 (CJVK, CRB); Thelepte, 1♀, stones in ruins, 1.III.2005 (CJVK). Medenine: Djerba, Bordj Jillidj, 1♀, under stones, 2.XII.1999 (CRB).
Distribution: Mediterranean to China. Frequently cited from North Africa, but surprisingly enough no recent captures during the long stay of RB in Algeria.

Genus **Neottiura** Menge, 1868
A small, almost exclusively Mediterranean genus with species formerly placed in the genus Theridion. There are three well-known species in the region.

Neottiura bimaculata (Linnaeus, 1767)

Neottiura bimaculata; Knoflach, 1999: 350.

Previous records: ALGERIA: *M'sila*: Aïn Baniou (Knoflach, 1999).
New records: None.
Distribution: Holarctic.

Neottiura curvimana (Simon, 1914)

Neottiura curvimana; Knoflach, 1999: 352.

Previous records: ALGERIA: Annaba: Djebel Edough (Knoflach, 1999).
New records: ALGERIA: Blida: Atlas Blidéen, Meurdja, 900m, 1♂, sweeping herbs in irrigated garden, 30.V.1987 (CRB).
Distribution: Known from the departments Landes (Simon, 1914), Pyrénées Orientales and Gard (Ledoux et al., 1996; Knoflach, 1999) in France, from the provinces Cadiz, Huesca and Caceres in Spain (Vanuytven et al., 1994), and from the wilaya of Annaba in Algeria (Knoflach, 1999). One new locality in Algeria is added.

Neottiura uncinata (Lucas, 1846)

Theridion uncinatum Lucas, 1846: 267 (descr. female); Simon, 1881: 59; Simon, 1885: 26; Simon, 1914: 295.
Neottiura uncinata; Knoflach, 1999: 358.

Previous records: ALGERIA: Alger: Bouzarea (Lucas, 1846; type locality). MOROCCO: Without precise locality (Simon, 1881). TUNISIA: Tunis: Tunis (Simon, 1885; Knoflach, 1999).
New records: None.
Distribution: North Africa, Mediterranean Europe and Israel, but rare everywhere.

Genus **Nesticodes** Archer, 1950
The genus Nesticodes contains only one pantropical species formerly placed in the genus Theridion.

Nesticodes rufipes (Lucas, 1846)

Theridion rufipes Lucas, 1846: 263 (descr. female); Hubert, 1970: 190.
Theridion bajulans L. Koch, 1875: 21.
Robertus pilosus Denis, 1956a: 203 (descr. male, female).
Nesticodes rufipes; El-Hennawy, 1990: 38; El-Hennawy 2006b: 75.

Previous records: ALGERIA: Oran: Oran (Lucas, 1846; type locality). EGYPT: Cairo: near Cairo (L. Koch, 1875, type locality of Theridion bajulans). MOROCCO: Grand

Casablanca: Aïn Sebaa (Denis, 1956a, type locality of Robertus pilosus). TUNISIA: Nabeul: El Haouaria (Hubert, 1970).
New records: ALGERIA: Alger: Alger, Bab el Oued, 2♂♂ 4♀♀, in house, 13.XI.1987, L. Beladjal leg. (CRB); Bab Ezzouar, 100m, 1♂ 5♀♀, in house, 24.I.1988 (CRB); Beaulieu, 50m, 2♂♂ in garden, 10.X.1989 (CRB). MOROCCO: Souss-Massa-Drâa: Agadir, 2♀♀, in hotel, L. Beladjal leg. (CRB). TUNISIA: Nabeul: Djebel El Haouaria, 1♂ 3♀♀ in cave, 13.IV.1993, K. Desmet leg. (CRB).
Distribution: Cosmopolitan.

Genus **Paidiscura** Archer, 1950

A small Palaearctic genus with two species occurring in the region.

Paidiscura dromedaria (Simon, 1880)

Theridion dromedarius Simon, 1880b: 99 (descr. male); Simon, 1885: 25; Simon, 1890: 95; Simon, 1907: 427; Simon, 1909: 23.
Theridion palustre Pavesi, 1880: 328 (descr. male).
Theridula dromedaria; Caporiacco, 1928: 91; Caporiacco, 1933: 322.
Theridion tuberculatum; Denis, 1947: 41.
Paidiscura dromedaria; El-Hennawy, 1990: 38; Knoflach & Thaler, 2000: 429; El-Hennawy, 2006b: 75; El-Hennawy, 2008: 120.

Previous records: ALGERIA: Annaba: Annaba (as Bône; Simon, 1885). EGYPT: Ismailia: Ismailia (Simon, 1880b; type locality). North Sinai: Zaranik (El-Hennawy, 2006b). Red Sea: Elba protected area, Wadi Sifeira (El-Hennawy, 2008). South Sinai: Nabq (El Hennawy, 2006b). Suez: Suez (Simon, 1890). LIBYA: Ajdabiya: Giallo, Hattia di Gur Atta (Caporiacco, 1933). Matruh: Siwa oasis (Denis, 1947). Tripoli: Tripoli (Simon, 1907). Tubruq: Al Jaghbub (as Giarabub; Caporiacco, 1928). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). TUNISIA: Gabes: Gabes (Simon, 1885). Nabeul: Hammamet (Knoflach & Thaler, 2000). Sfax: Sfax (Simon, 1885). Tunis: Scikli Island in the El Bhira Gulf (Pavesi, 1880; type locality of Theridion palustre). Zaghouan: Ouet-et-Zit (Knoflach & Thaler, 2000).
New records: MOROCCO: Souss-Massa-Drâa: Gourizim, 10m, 5♂♂ 12♀♀, bushes bordering salt marsh, 26.IV.2012 (CJVK); Massa, 20m, 1♀, litter in Eucalyptus forest in river bed of Oued Massa, 27.IV.2012 (CRB); Mirleft, plage Imi n' Tourga, 25m, 1♂ 1♀, litter in valley near the sea, 26.IV.1012 (CJVK); road Tamri-Tamanar, 1♀, pitfalls in dunes, 15-28.IV.2012 (CRB).
Distribution: Atlantic Islands, North Africa, Spain, Israel, Yemen.

Paidiscura pallens (Blackwall, 1834)

Theridion pallens; Denis, 1937: 1040.

Previous records: ALGERIA: Mila: Djebel Daya (Denis, 1937).
New records: ALGERIA: Blida: Chrea, 1100m, 3♂♂ 1♀, beating branches of Quercus ilex and Cedrus atlantica, 28.IV.1987 (CRB); Atlas Blidéen, Meurdja, 950m, 1♂, beating branches of Cedrus atlantica, 28.V.1988 (CRB). Setif: Djebel Babor, 1900m, 1♀, beating branches of Quercus ilex, 24.V.1983 (CRB). Tissemsilt: Theniet el Had, Djebel Meddad, 1550m, 4♂♂, beating branches of Cedrus atlantica, 19.IV-15.V.1988 (CRB). Tlemcen: Forêt d'Hafir, 1350m, 1♂ 1♀, beating in Quercus suber forest, 6.V.1984 (CRB).
Distribution: Europe, Russia and Algeria, where it only occurs in montane forests above 900m.

Genus **Parasteatoda** Archer, 1946

Parasteatoda was for a long time considered a synonym of Achaearanea Strand, 1929. Recently, Saaristo (2006) revised the genus and reinstalled Parasteatoda as a valid genus. It contains 43 species of which only one occurs in North Africa.

Parasteatoda lunata (Clerck, 1757)

Previous records: None.
New records: TUNISIA: Jendouba: Ras Rajel, 1♀, beating in Quercus suber forest, 8.V.2006 (CRB).
Distribution: Palaearctic.

Genus **Pholcomma** Thorell, 1869

A small, easily recognised genus with only one representative in the Palaearctic region.

Pholcomma gibbum (Westring, 1851)

Pholcomma gibbum; Simon, 1914: 308.

Previous records: ALGERIA: Without precise locality (Simon, 1914).
New records: ALGERIA: Alger: Bainem, 200m, 1♀, litter in Quercus fagicola forest, 19.XI.1984 (CRB). Blida: Chiffa, 250m, 1♂, pitfalls in orange orchard, 21.II.1989 (CRB); Atlas Blidéen, Meurdja, 750m, 1♀, herbs around a spring, 23.V.1990 (CRB). Boumerdes: Reghaia, 10m, 1♂, pitfalls in Populus alba forest, 5.IV.1988 (CRB). El Tarf: El Kala, north side of Lake Tonga, 10m, 1♂, pitfalls in Alnus forest, 28.III.1988; idem, 1♂ 1♀, 1.III.1990 (CRB). Tipasa: Bouchaoui, 95m, 3♂♂ 1♀, pitfalls in Ulmus forest, 1.I.1987 (CRB). Tizi Ouzou: Yakouren, 820m, 1♀, pitfalls in Quercus faginea forest, 25.XI.1989 (CRB). TUNISIA: Nabeul: Tazerka, 1♀, litter bordering salt marsh, 26.I.2003 (CRB). Tunis: Gammarth N., 1♀, litter bordering salt marsh, 30.I.2003 (CRB).
Distribution: Europe, Russia, Ukraine, Algeria and here for the first time cited from Tunisia.

Genus **Phoroncidia** Westwood, 1835

A genus of small theridiids mainly occurs in the tropics. One rare species occurs in North Africa.

Phoroncidia paradoxa (Lucas, 1846)

Epeira paradoxa Lucas, 1846: 251.
Ulesanis paradoxus; Simon, 1914: 300.

Previous records: ALGERIA: Alger: Kouba (Lucas, 1846, type locality).
New records: ALGERIA: Tizi Ouzou: Tizi Ouzou: N. Boghni, along Oued Boghni, 150m, 1♀, sweeping herbs along river, 15.IV.1982 (CRB); E. Yakouren, 820m, 1♀, sweeping herbs in Quercus faginea forest, 3.XII.1986 (CRB).
Distribution: A rare species from the Iberian Peninsula to the Balkan. A second and third locality for Algeria is presented here.

Genus **Phylloneta** Archer, 1950

A genus with three species formerly placed in Theridion of which two occur in North Africa.

Phylloneta impressa (L. Koch, 1881)

Theridion impressum; Denis, 1937: 1040; Jocqué, 1977: 332.

Previous records: ALGERIA: Mila: Djebel Daya (Denis, 1937). MOROCCO: Marrakech-Tensift-Al Haouz: Imhil (Jocqué, 1977).
New records: ALGERIA: Bejaia: S. Tichi, 50m, 1♀, in bushes along Oued Djemaa, 20.V.1988 (CRB). TUNISIA: Kasserine: 5 km W. Thala, 2♀♀, beating in Pinus forest, 10.V.2006 (CRB).
Distribution: Palaearctic region.

Phylloneta sisyphia (Clerck, 1757)

Theridium nervosum; Lucas, 1846: 263.
Theridion sisyphium; Simon, 1899a: 83; Caporiacco, 1928: 91.

Previous records: ALGERIA: Constantine: Surroundings of Constantine (Lucas, 1846). Khenchela: Oulad Messelem (Simon, 1899a). LIBYA: Tubruq: Bardiyah (as Porto Bardia; Caporiacco, 1928).
New records: None.
Distribution: Europe, Mediterranean region.

Genus **Platnickina** Koçak & Kemal, 2008
The genus Keijia Yoshida, 2001 includes former Theridion species and received recently the replacement name Platnickina (Koçak & Kemal, 2008) to include ten species, of which one occurs in North Africa.

Platnickina nigropunctata (Lucas, 1846)

Theridion nigropunctatum Lucas, 1846: 266; Simon, 1880a: 56; Simon, 1881: 74; Simon, 1899a: 83; Simon, 1914: 74; Denis, 1956a: 203.

Previous records: ALGERIA: Alger: Surroundings of Alger (Lucas, 1846, type locality; Simon, 1899a). Djelfa: Djebel Sénalba (Simon, 1899a). Tizi Ouzou: Yakouren (Simon, 1899a). EGYPT: Alexandria: Alexandria (Simon, 1880a). MOROCCO: Unknown locality: La Cascade (Denis, 1956a).
New records: ALGERIA: Biskra: Biskra, 120m, 1♂ in garden, 8.III.1987, R. Jocqué leg. (MRAC 167.616). Bordj Bou Arreridj: El Mehir, 900m, 1♀, pitfalls in Pinus halepensis plantation, 15.IV-21.VI.1990 (CRB). Boumerdes: Rhegaia, 25m, 4♀♀, beating in Quercus ilex forest, 3.V.1988 (CRB). El Tarf: El Kala, Lake Tonga, 20m, 1♂ 1♀, beating in Quercus suber forest, 23.XI.1989 (CRB); Lake Tonga, north side, 10m, 2♀♀, beating in Alnus forest, 28.IV.1988 (CRB). Skikda: West of Collo, Tamanart, 15m, 1♂, beating branches near an oued (Alnus, Quercus), 6.VI.1987 (CRB). Tipasa: Sidi Fredj, 10m, 1♀, beating in Pinus halepensis forest, 12.VI.1987 (CRB); Zeralda, 10m, 2♀♀, beating in Eucalyptus forest in dunes, 25.IV.1987 (CRB). MOROCCO: Rabat-Salé-Zemmour-Zaër: Forêt de Mamora, 1♂ 5♀♀, beating of Quercus ilex, 15.IV.1998, K. Reniers leg (CRB). Tetouan: 10 km E. Chechaouen, 500m, 1♀, sweeping herbs in Quercus suber forest, 15.V.1984 (CRB). TUNISIA: Beja: road Ouchtata - plage Zouaraa, 1♀, beating in pinus forest, 8.V.2006 (CRB). Jendouba: Hammam Bourguiba, 1♂, beating in Quercus suber forest, 9.V.2006 (CRB). Kasserine: 5 km W. Thala, 1♀, beating in Pinus forest, 10.V.2006 (CRB).
Distribution: Mediterranean. In North Africa: common in spring and early summer in coastal forests.

Genus **Rhomphaea** L. Koch, 1872

The genus Rhomphaea actually counts 33 species. Most of them are tropical and four occur in different parts of the Mediterranean. Only one occurs in North Africa.

Rhomphaea nasica (Simon, 1873)

Rhomphaea nasica; Simon, 1914: 290.
Rhomphaea argenteola; Simon, 1914: 290.

Previous records: ALGERIA: Without precise locality (Simon, 1914).
New record: TUNISIA: Jendouba: Ras Rajel, 1♀, beating in Quercus suber forest, 8.V.2006 (CRB).
Distribution: Mediterranean, Africa, Atlantic Islands, St. Helena.

Genus **Robertus** O.P.-Cambridge, 1879

The genus Robertus actually counts 42 species. Most of them are Palaearctic but only one occurs in North Africa.

Robertus arundineti (O.P.-Cambridge, 1871)

Previous records: None.
New records: ALGERIA: El Tarf: El Kala, N. Lake Tonga, Necha N'Tonga, 4m, 1♂, pitfalls in Alnus forest, 3-7.IV.1982 (CRB). Saida: Tifrit waterfalls on Oued Tifrit, 825m, 1♀, in herbs near the waterfall, 4.V.1984 (CRB).
Distribution: Palaearctic. New to Africa but rarely collected.

Genus **Rubboridion** Wunderlich, 2011

A monotypic genus recently described by Wunderlich (2011) for the species Theridion musivum.

Ruborridion musivum (Simon, 1873)

Theridion musivum; Pavesi, 1884: 461; Simon, 1909: 23; Simon, 1914: 299; Levy & Amitai, 1982a: 105; El-Hennawy, 1990: 38; El-Hennawy, 2006b: 75; Knoflach et al., 2009: 249, f. 43, 60-64.

Previous records: ALGERIA: The south of Algeria (Simon, 1909). EGYPT: Mid Sinai (El-Hennawy, 2006b). North Sinai: Qadesh Barnea (Levy & Amitai, 1982a). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). TUNISIA: Kairouan: Ouesslatia (Knoflach et al., 2009). Kebili: Zaafrane, 15 km W. Douz (Knoflach et al., 2009). Nabeul: Hammamet (Knoflach et al., 2009). Tunis: Tunis (Pavesi, 1884).
New records: ALGERIA: Alger: El Harrach, 25m, 1♂, garden of Institut National Agronomique, 30.III.1987, and 1♂ 1♀, 16.V.1985 (CRB). Batna: between Arris and Medina, 1♂, along an oued, 11.IV.1987, R. Jocqué leg. (MRAC 167.611). Blida: Meftah, Djebel Zerouela, 400m, 2♀♀, stones in grassland, 7.IV.1987 (CRB). Bouira: Bechloul, 2♂♂ 2♀♀, in tamarisk litter, 28.IV.1988 (CRB); 10 km N. Bouira, 530m, 1♂, stones in grassland, 27.II.1990 (CRB). Guelma: Belkheir, 400m, 1♂ 1♀, stones bordering fields and in Pistacea lentisca litter, 28.II.1990 (CRB). Tipasa: Sidi Fredj, 10m, 2♀♀, beating branches of Pinus halepensis, 12.VI.1987 (CRB). Tizi Ouzou: Beni Yenni, 850m, 2♀♀, mosses in garden, 14.IV.1982 (CRB); N. Boghni, along Oued Boghni, 150m, 1♂ by sweeping herbs, 15.IV.1982 (CRB); Boukhalfa, 1♂ 5♀♀, in Olea litter, 24.XI.1989 (CRB).
Tlemcen: Forêt d'Hafir, S. E. Tlemcen, 1350m, 1♂ 1♀, sweeping herbs in mixed forest, 6.V.1984 (CRB). TUNISIA: Beja: road Ouchtata - plage Zouaraa, 1♀, beating in Pinus forest, 8.V.2006 (CRB). Bizerte: Utique W., trash in Euphorbia hedge, 1 subadult ♂,

29.I.2003 (CRB). Gabes: Arram, 2♀♀, stones and herbs around irrigation channels, 16.XII.1999 (CRB). Gafsa: El Guettar, 1♂ 1♀, stones and litter in oasis, 2.III.2005 (CJVK). Jendouba: Hammam Bourguiba, 1♂ 1♀, beating in Quercus ilex forest, 9.V.2006 (CRB). Tozeur: Nefta oasis, 2♀♀, under stones, 11.V.2006 (CRB); Tozeur oasis, 2♀♀, under stones, 11.V.2006 (CRB).

Distribution: Atlantic Islands, Mediterranean region. In North Africa the species appears to be rather common.

Genus **Sardinidion** Wunderlich, 1995

A monotypic genus recently described by Wunderlich (1995) for the species Sardinidion perplexum Wunderlich, 1995, which appeared to be a junior synonym of Theridion blackwalli.

Sardinidion blackwalli (O.P.-Cambridge, 1871)

Theridion blackwalli; Simon, 1885: 24; Simon, 1899a: 83; Simon, 1914: 298.

Previous records: ALGERIA: Sétif: Bouthaleb (Simon, 1899a). TUNISIA: Jendouba: Aïn-Draham (Simon, 1885). Kasserine: Kasserine (as Kessera; Simon, 1885).

New records: ALGERIA: Tissemsilt: Theniet el Had, Djebel Meddad, 1400m, 2♂♂ 4♀♀, beating branches of Cedrus atlantica, 18.VI.1988 (CRB). TUNISIA: Jendouba: Ras Rajel, 1♂, beating in Quercus suber forest, 8.V.2006 (CRB).

Distribution: Europe, Russia, Ukraine, North Africa.

Genus **Simitidion** Wunderlich, 1992

A small genus includes only three species which were formerly placed in the genus Theridion. Two of them occur in North Africa.

Simitidion agaricographum (Levy & Amitai, 1982)

Previous records: None.

New records: TUNISIA: Jendouba: Hammam Bourguiba, 3♀♀, beating in Quercus suber forest, 9.V.2006 (CRB); idem, 1♂ 2♀♀, 9.V.2006, J. De Graef leg. (CJVK).

Distribution: Israel, Cyprus, Greece (Chios, Lesbos). New to Tunisia.

Simitidion lacuna Wunderlich, 1992

Theridion simile; Simon, 1881: 102; Simon, 1885: 26; Simon, 1899a: 83; Caporiacco, 1933: 11; Denis, 1937: 1040; Levy & Amitai, 1982a: 94 (misidentifications).

Remark: In 1992, Wunderlich described Simitidion lacuna, before then not separated from S. simile. Since all our abundant material from North Africa belongs to S. lacuna we attribute all previous citations from North Africa to that species.

Previous records (all sub Theridion simile)**:** ALGERIA: Without precise locality (Simon, 1881). Alger: surroundings of Alger (Simon, 1899a). Mila: Djebel Daya (Denis, 1937). LIBYA: Al Khufrah: Gialo (Caporiacco, 1933). TUNISIA: Jendouba: Aïn Draham (Simon, 1885). Siliana: Makthar (Simon, 1885).

New records: ALGERIA: Bejaia: Tichi, 10m, 1♂, beating Acacia branches, 21.V.1988 (CRB). Blida: Atlas Blidéen, Meurdja, 900m, 1♀, sweeping herbs along rivulet, 7.IV.1984, 1♀, 21.V.1987 and 1♂ 1♀, 30.V.1987 (CRB); Chrea, 1100m, 1♀, beating Quercus ilex branches, 28.IV.1987 (CRB). Boumerdes: Lakhdaria, Oued Olla, 115m, 1♀, in litter of Olea, 20.IV.1990 (CRB); Reghaia, 25m, 2♂♂ 12♀♀, beating Quercus suber branches, 3.V.1988 (CRB). Skikda: West of Collo, Tamanart, 15m, 3♂♂ 6♀♀, beating Alnus and

Quercus branches, 6.VI.1987 (CRB). Tizi Ouzou: N. Boghni, along Oued Boghni, 150m, 1♀, sweeping herbs, 15.IV.1982 (CRB); between Tizi Ghenif and Chabet-el-Ameur, 125m, 1♂ 1♀, sweeping herbs along an oued, 1.V.1984 (CRB). Tlemcen: S. Col d'Hafir, Oued Tafna, 900m, 3♀♀, sweeping herbs in garden, 5.V.1984 (CRB). MOROCCO: Souss-Massa Drâa: Aoulouz E., 1♀, beating Argania, 6.V.2004 (CRB). Tanger-Tétouan: 10 km east of Chechaouen, 500m, 1♀, sweeping herbs in Quercus suber forest, 15.V.1984 (CRB). TUNISIA: Bizerte: Lake Ichgeul, NW side, 1♀, beating hedges, 9.V.2006 (CRB). El Kef: road Touiret-Le Kef, 3♂♂ 21♀♀, beating in Pinus forest, 9.V.2006 (CRB). Jendouba: Hammam Bourguiba, 1♂ 3♀♀, beating in Quercus suber forest, 9.V.2006 (CRB); Ras Rajel, 6♀♀, beating in Quercus suber forest, 8.V.2006 (CRB). Kasserine: 5 km W. Thala, 1♀♀, beating in Pinus forest, 10.V.2006 (CRB).
Distribution: Canary Islands, Spain, North Africa, Israel.

Genus **Steatoda** Sundevall, 1833
A genus of relatively large, soil-dwelling theridiids with representatives all over the world and of which several have become cosmopolitan. They are well adapted to dry environments and rather common in North Africa. Thirteen species have been recorded. A part of our collected material represents most probably new species, which are not included here.

Steatoda albocincta (Lucas, 1846)

Theridion albocinctum Lucas, 1846: 262 (descr. female).
Lithyphantes albomaculatus; Caporiacco, 1933: 323 (misidentification).
Steatoda albocincta; Ledoux & Raphael, 1999: 6; Ledoux & Emerit, 2010: 6.

Remark: Ledoux & Raphael (1999) revalidated Steatoda albocincta (Lucas), until now considered a synonym of S. albomaculata. They consider Steatoda incomposita Denis, 1957 a junior synonym of S. albocinta Lucas, 1846. Steatoda albomaculata is not present in our material and we follow Ledoux & Raphael (1999) in their claim that S. albomaculata does not occur in the Western Mediterranean and thus cannot be a synonym of S. albocinta.
Previous records: ALGERIA: Setif: Setif (Lucas, 1846; type locality of Theridion albocinctum). LIBYA: Al Khufra: El Hauaria (Caporiacco, 1933, sub Lithyphantes albomaculatus).
New records: MOROCCO: Fès-Boulemane: W. Fès, Douyet, 5♂♂ 3♀♀, pitfalls in wheat fields, S. Boksch leg. (CRB). Meknès-Afilalt: Azrou, 1250m, 1♀, stones in wet grassland along a rivulet south of the town, 11.V.1984 (CRB).
Distribution: Cosmopolitan.

Steatoda ephippiata (Thorell, 1875)

Lithyphantes ephippiatus Thorell, 1875: 63.
Lithyphantes ochraceus Simon, 1908: 428.
Teutana argentea Caporiacco, 1933: 322; Denis, 1966: 121.
Steatoda ephippiata; Levy & Amitai, 1982b: 22; El-Hennawy, 1990: 38; El-Hennawy, 2006b: 75; Van Keer & Bosmans, 2010: 22.

Previous records: ALGERIA: Naama: Aïn Sefra (Levy & Amitai, 1982b). El Bayadh: El Gatroun; El Abiod (Denis, 1966, sub T. argentea). EGYPT: Without precise locality (Thorell, 1875, type locality of L. ephippiatus; Simon, 1908, type locality of S. ochraceus). El-Omayed (El-Hennawy, 2006b). Mid Sinai (El-Hennawy, 2006b). LIBYA: Ajdabiyah: between Ajdabiyah and Gialo (Caporiacco, 1933, sub T. argentea). Tripoli: Tripoli (Simon, 1908, sub S. ochraceus). TUNISIA: Without precise locality (Simon, 1908, sub S.

ochraceus). Gafsa: Gafsa oasis (Van Keer & Bosmans, 2010). Kebili: S. Douz, Djebil national park (Van Keer & Bosmans, 2010).

New records: Most recent records were given in Van Keer & Bosmans, 2010.

Distribution: Algeria to Israel.

Steatoda erigoniformis (O.P.-Cambridge, 1872)

Steatoda signata O.P.-Cambridge, 1876: 568 (descr. female); Simon, 1880a: 42.
Lithyphantes signatus; Simon, 1885: 25.
Steatoda erigoniformis; Levy & Amitai, 1982b: 26; El-Hennawy, 2006b: 75.

Previous records: EGYPT: Alexandria: Alexandria (O.P.-Cambridge, 1876, sub S. signata; Simon, 1880a, sub S. signata). Nile delta (El-Hennawy, 2006b). TUNISIA: Tunis: La Goulette (Simon, 1885, sub S. signata).

New records: MOROCCO: Souss-Masssa Drâa: Anza, 7 km N. Agadir, 6♀♀, stones in Euphorbia vegetation, 3.II.1996 (CRB). TUNISIA: Sidi Bouzid: Bou Hedma, 1♂, 7.VI.1997, K. De Smet leg. (CRB). Sousse: Sousse, 1♂, under a stone in small city park, 22.I.1995 (CJVK).

Distribution: Originally probably Mediterranean, but also observed in the United States and Japan (Levy & Amitai 1982b).

Steatoda grossa (C.L. Koch, 1838)

Theridion fulvo-lunulatum Lucas, 1846: 267 (descr. female).
Steatoda pulchella; Pavesi, 1880: 330.
Teutana grossa; Simon, 1909: 22.

Previous records: ALGERIA: Oran: Oran (Lucas, 1846; type locality of T. fulvolunulatum). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). TUNISIA: Bizerte: Galitone Island (Pavesi, 1880).

New records: ALGERIA: Alger: Bordj el Bahri, 20m, 1♀, in garden, 10.V.1987 (CRB). MOROCCO: Souss-Masssa Drâa: Agadir, 1♂, 27.X.2003, K. de Smet leg. (CRB); Massa, 20m, 1♂ 2♀♀, litter in Eucalyptus forest in river bed of Oued Massa, 27.IV.2012 (CJVK). Taza-Al Hoceima-Taounate: Al Hoceima, 2♀♀, stones around hotel, 21.IV.1984 (CRB).

Distribution: Cosmopolitan. In North Africa recorded from Algeria and Morocco.

Steatoda latifasciata (Simon, 1873)

Lithyphantes latifasciatus; Simon, 1909: 22.
Steatoda latifasciata; Levy & Amitai, 1982b: 23; El-Hennawy, 2006b: 75.

Previous records: EGYPT: South Sinai: St. Catherine (El-Hennawy, 2006b). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909; Levy & Amitai, 1982b).

New records: ALGERIA: Bordj Bou Arreridj: Portes de Fer, 550m, 1♀, stones in steppe, 13.V.1988 (CRB). Boumerdes: Zemmouri, 5m, 1♀, stones in dunes, 13.V.1983 (CRB); idem, 10m, 1♀, pitfalls in dunes, 5.X.1984 (CRB); idem, 5m, 6♀♀, litter on the high beach, 31.V.1987 (CRB). El Bayadh: Brezina, 1♀, 5.III.2007, K. De Smet leg. (CRB). MOROCCO: Fès-Boulemane: Missour, 2♂♂ 2♀♀, pitfalls in steppe, 22.XI.2001-3.VIII.2002 (CRB). Meknès-Tafilalt: Col de Tagalm, SE Zebzat, 1900m, 1♀, stone field, 19.IV.2012 (CJVK). Souss-Massa-Drâa: Col du Kerdous, 1♂, wall of hotel, 25.IV.2012 (CJVK); Jemâa-Ida-Oussemlal, 1285m, 1♀, stony steppe, 23.IV.2012 (CJVK).

Distribution: Italy, Morocco, Canary Islands, Israel, Niger.

Steatoda maura (Simon, 1909)

Lithyphantes maurus Simon, 1909: 23.
Steatoda maura; Levy & Amitai, 1982b: 21.

Previous records: MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909; Levy & Amitai, 1982b).
New records: None.
Distribution: Morocco, Greece, Turkey and Israel.

Steatoda moerens (Thorell, 1875)

Lithyphantes moerens Thorell, 1875: 64; Simon, 1885: 25.

Remark: Steatoda moerens is an insufficiently known species, since pictures of the male palp or female epigyne were never published. According to Levy & Amitai (1982b) who examined an adult female from the type series from Biskra, it is related to S. latifasciata. A redescription is necessary.
Previous records: ALGERIA: Biskra: Biskra (Thorell, 1875). TUNISIA: Medenine: Zarzis (Simon, 1885). Unknown locality: Mekalta (Simon, 1885).
New records: None.
Distribution: Algeria, Tunisia.

Steatoda nobilis (Thorell, 1875)

Previous records: None.
New records: ALGERIA: Alger: Ben Aknoun, 100m, 1♀, stone in wasteland, 18.V.1988 (CRB); Bab Ezzouar, 25m, 1♂ 1♀, stones in wasteland, 1.XII.1986 (CRB); Bordj-el-Bahri, 1♂, in house, 10.V.1987 (CRB); El Biar, 200m, 1♀, in house, 1988 (CRB); El Harrach, forêt de Beaulieu, 30m, 1♂ 1♀, under Pinus halepensis bark, 18.XI.1987 (CRB); idem, 1♀, in house, 20.VI.1986 (CRB).
Distribution: Madeira, Canary Islands, Portugal, Spain, Corsica, Turkey and introduced in Western Europe. The first records for Africa are presented here. Apparently it is introduced here as well, as all records originate from man-made habitats.

Steatoda paykulliana (Walckenaer, 1805)

Latrodectus ornatus Lucas, 1846: 233 (descr. male, female).
Latrodectus hamatus; O.P.-Cambridge, 1870: 819.
Lithyphantes dispar; Simon, 1874: 66.
Lithyphantes paykullianus; Thorell, 1875: 61; Pavesi, 1880: 331; Simon, 1880a: 36; Karsch, 1881: 6; Pavesi, 1884: 451; Simon, 1885: 25; Simon, 1899a: 83; Simon, 1907: 428; Simon, 1908: 52; Strand, 1908: 96; Simon, 1909: 22; Simon, 1911: 418; Simon, 1914: 305; Caporiacco, 1928: 91; Denis, 1937: 104; Denis, 1956b: 275.
Lithyphantes hamatus; O.P.-Cambridge, 1876: 568.
Steatoda paykulliana; Simon, 1880a: 47; Levy & Amitai, 1982b: 18; El-Hennawy, 1990: 38; El-Hennawy, 2006b: 75.

Previous records: ALGERIA: “Très commune dans l'Est et Ouest de l’Algérie” (Lucas, 1846; type locality of Latrodectus ornatus). Alger: around Alger (Simon, 1874); Cap Matifou (Simon, 1899a). Annaba: Annaba (as Bône; Thorell, 1875). Mila: Djebel Daya (Denis, 1937). Unknown locality: Tuggast (Strand, 1908). EGYPT: Alexandria (O.P.-Cambridge, 1876; Simon, 1880a). El Dakahlia: El Mansourah, Sallant (Sallam, 2004). South Sinai: El-Burullus (El-Hennawy, 2006b); Back of Mount Sinai (O.P.-Cambridge, 1870). LIBYA: Benghazi: Benghazi (Simon, 1907). Darnah: Darnah (as Derna; Caporiacco, 1934). Gharyan: Djebel Gharian (Simon, 1907). Tubruq: Bardiyah (as Porto Bardia; Caporiacco, 1928). Unknown locality: Wadi Scherschara (Karsch, 1881). MOROCCO:

Doukkala-Abda: between Mazagan and Oualidia (Denis, 1956b). Grand Casablanca: Aïn Sebaa (Denis, 1956b). Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909). Tanger-Tétouan: Tanger (Simon, 1909). Oujda-Angad: Oujda (Simon, 1911). Unknown locality: La Cascade (Denis, 1956b). TUNISIA: Bizerte: Galite Island (Pavesi, 1880). Gabes: Gabes (Simon, 1885). Jendouba: Aïn Draham (Simon, 1908). Kasserine: Feriana (Simon, 1885). Le Kef: between Le Kef and Aïn Draham (Simon, 1885). Medenine: Metameur (Simon 1885); Zarzis (Simon, 1885). Siliana: Ras-el-Oued (Simon, 1885). Sousse: Sousse (Simon, 1885). Tunis: Hammam el Lif (Pavesi, 1880); Tunis (Pavesi, 1884, 1885; Simon, 1885); Tunis, along Oued Megerdah (Pavesi, 1880). Zaghouan: Djebel Ressas (Pavesi, 1880). Unknown locality: Mekalta (Simon, 1885).

New records: ALGERIA: Alger: Beaulieu, 50m, 1♂, in garden, 10.X.1989 (CRB); Kouba, 50m, 2♀♀, in house, XI.1987 (CRB). Batna: between Arris and Medina, 1100m, 1♀, stones along a river, 11.IV.1987, R. Jocqué leg. (MRAC 167.620). Biskra: Biskra, 130m, 1♀, in grass tufts in irrigated garden, 10.IV.1982 (CRB). Blida: Meftah, Djebel Zerouela, 400m, 1♀, stones in grassland, 7.IV.1987 (CRB). Bouira: Lakhdaria E., Col des Beni Khalfoun, 700m, 3♂♂, litter in degraded Quercus suber forest, 18.III.1988 (CRB); S. Sour el Ghozlane, Col de Dirah, 900m, 1♀, stones along river, 21.V.1987 (CRB). Chleff: 5 km W. Damous, 5m, 1♀, stones in dunes, 17.IV.1987; idem, 2♀♀, R. Jocqué leg. (MRAC 167.577). Djelfa: Djebel Sénalba, 1450m, 1♂ in pitfall in open Pinus halepensis forest, 24.I.1989 (CRB). Laghouat: 20 km S. Laghouat, 740m, 1♀, pitfalls in Zizyphus bushes in daya, 14.V.1990 (CRB). Msila: Bou Saada, 560m, 1♀, irrigated garden around hotel, 21.V.1987 (CRB). Oran: Hadjadz, 50m, 2♀♀, litter in garden, VII-IX.1988 (CRB). Sétif: Djebel Babor, 1350m, 1♀, stones in Quercus ilex forest, 19.IV.1982 (CRB). MOROCCO: Meknès-Tafilalt: Zouala oasis, 935m, 1♂ 5♀♀, litter in palm yard, 320.IV.2012 (CJVK, CRB). Souss-Massa-Drâa: Agadir, 2♀♀, litter in salt marsh, 16.II.2007 (CRB); Aït ou Mribete, Oued Massa, 1♂ 2♀♀, stones in marshy area, 15.II.2007, 1♀, 27.IV.2012 (CRB); Massa, 20m, 1♀, litter in Eucalyptus forest in river bed of Oued Massa, 27.IV.2012 (CRB); road Nekob-Mellal, 940m, 2♀♀, stones in palm yard, 22.IV.2012 (JVK); between Sguirate and Taroudannt, 1♀, litter in citrus yard, 15.II.2007 (CRB); Sidi Ifni, 3♂♂ 2♀♀, stones and litter in dry river bed, 10.II.2007 (CRB); Timiderte, Oued Drâa, 880m, 2♀♀, stones at sandy river border, 22.IV.2012 (CJVK). TUNISIA: Bizerte: between Aïn Ghellai and Feija, 1 ♀, stones bordering fields, 29.I.2003 (CRB). Gafsa: El Guettar, 1♀, litter in oasis, 2.III.2005 (CJVK); Gafsa oasis, 3♀♀ 1 juvenile, litter in palm orchard, 27.I.1995 (CJVK, CRB). Kasserine: Haidra, 1♂, stones in Roman ruins, 4.III.2005 (CJVK); Thelepte, 2♂♂ 2♀♀, stones in ruins, 1.III.2005 (CJVK). Medenine: Guellala E., 2♂♂ 1♀, stones in upper part of salt marsh, 17.XII.1999 (CRB). Nabeul: Hammamet NE, 1♀, stones in olive yard, 31.I.2003 (CRB); Korba, 2♂♂, stones and litter bordering salt marsh, 21.I.2003 (CRB); Somaa, 1♂ 1 subadult ♀, stones in Pinus plantation, 31.I.2003 (CRB). Siliana: Kesra forest, 820m, 1♀, stones in open grassland, 24.I.1991 (CRB); between Kesra and Siliana, 2♀♀, stones in Pinus forest, 27.I.2003 (CRB). Tozeur: Tamerza, 1♀, 31.II.2001, U. Moldrzyk leg. (CRB). Zaghouan: Zriba Village, 1♀, stones in open grassland, 24.I.1991 (CRB).

Distribution: Mediterranean to Central Asia. In North Africa it is a very common species all over the region.

Steatoda triangulosa (Walckenaer, 1802)

Theridion punicum Lucas, 1846: 256. (descr. female)

Theridion flavo-maculatum Lucas, 1846: 257 (descr. female).

Teutana triangulosa; Simon, 1881: 163; Strand, 1908: 96; Simon, 1914: 303; Caporiacco, 1936a: 100;

Caporiacco, 1936b: 87; Denis, 1937: 1041; Denis, 1951: 315; Denis, 1956a: 203.
Teutana triangulosa punica; Caporiacco, 1928: 91.
Teutana triangulosa concolor Caporiacco, 1933: 322; Caporiacco, 1936a: 100.
Steatoda triangulosa; Pavesi, 1880: 330; Pavesi, 1884: 451; Levy & Amitai, 1981: 62; Levy & Amitai, 1982b: 17; El-Hennawy, 1990: 38; El-Hennawy, 2006b: 75.

Previous records: ALGERIA: "Très commun" (Lucas, 1846, type locality of Theridion punicum). Alger: Alger (Lucas, 1846, type locality of Theridion flavomaculatum). Mila: Djebel Daya (Denis, 1937). EGYPT: Al Buhayrah: Wadi Natron, Bir Hooker (Strand, 1908). Cairo: Cairo (El-Hennawy, 2006b). North Sinai: El-Zaranik (El-Hennawy, 2006b). Unknown locality: Abesto (Denis, 1951). LIBYA: Al Jaghbub: Al Jaghbub (as Giarabub; Caporiacco, 1928). Al Khufrah: Et Tallab (Caporiacco, 1936a); Haret Haffun (Caporiacco, 1936a). Murzuq: Between Ubari and Serdeles (Caporiacco, 1936b). MOROCCO: Chaouia-Ouardigha: Boulhaut, près de la source de l'Aïn Sferdjla (Denis, 1956a). Grand Casablanca: Aïn Sebaa (Denis, 1956a); Casablanca (Denis, 1956a). TUNISIA: Tunis: Tunis (Pavesi, 1884). Zaghouan: Mohammedia (Pavesi, 1880).

New records: ALGERIA: Alger: Bab El Oued, 100m, 1♂ 10♀♀, in house, 24.I.1988 (CRB); Bab Ezzouar, 25m, 1♂, in apartment, 15.X.1984 (CRB); Beaulieu, 50m, 4♀♀, in garden, X.1989 (CRB); Bordj el Kiffan, 25m, 1♀, in apartment, 22.III.1985 (CRB); El Harrach, I.N.A., 25m, 1♂, pitfall in grassland, 31.X.1985 (CRB); Kouba, 1♂, XI.1987 (CRB). Batna: Monts de Belezma, south slope of Kef Islane, Col Telmet, 1800m, 1♀, stones in Cedrus forest, 8.IV.1982 (CRB). Blida: Atlas Blidéen, Djebel Mouzaia, 1300m, 1♀, stones around Lake Mouzaia, 21.XI.1986 (CRB). Bouira: Massif du Djurdjura, Aït Ouabane, 1400m, 1♂, stones in Cedrus forest, 20.X.1987 (CRB). Boumerdes: Zemmouri, 10m, 1♂, pitfalls in maquis in dunes, 5.X.1984 (CRB). Ech Cheliff: S. Tenes, gorges of the Oued Allala, 125m, 1♀, stones, 6.V.1989 (CRB). El Tarf: El Kala, 1♀, in house, 27.V.2008, K. De Smet leg. (CRB). Oran: Hadjadz, 50m, 11♀♀, in garden, VII-IX.1988 (CRB). Setif: Bir el Arche, 900m, 1♀, stones bordering fields, 27.II.1990 (CRB). Tipasa: Ouled Fayed, 265m, 1♀, stones in abandoned grassland, 20.III.1987, R. Bosmans leg. (CRB). Tizi Ouzou: Beni Yenni, 850m, 1♂ 2♀♀, stones in garden, 14.IV.1982 (CRB); T-aguemount Azouz, 800m, 1♀, pitfall in Quercus ilex forest, 1.VIII.1989 (CRB). MOROCCO: Guelmim-Es Smara: Tigmert (Aït Bouka) oasis, 3♀♀, in hotel, 12.II.2007 (CRB). Meknès-Tafilalt: Azrou, 1♂, 18.IV.2012 (CJVK). TUNISIA: Bizerte: Lake Ichgeul, 10m, 1♀, stones along road, 25.I.1995 (CRB).

Distribution: Cosmopolitan. Common in North Africa, living in natural habitats in litter and under stones as well as in man-made habitats.

Steatoda venator (Audouin, 1826)

Latrodectus venator Audouin, 1826: 354, pl. 3, f. 11.
Lithyphantes venator; Caporiacco, 1934: 131.

Remark: For a long time Steatoda venator was considered a synonym of S. paykulliana. Levy & Amitai (1982b) revalidated the species, because the original drawings of Audouin (1826) depict another species. There are no figures of male palp or epigyne available to recognise the species.

Previous records: EGYPT: Alexandria: Near Alexandria (Audouin, 1826; type locality). LIBYA: Darnah: Darnah (as Derna; Caporiacco, 1934); Sidi Garbaa (Caporiacco, 1934); Umm ar Rizam (as Umm Erzem; Caporiacco, 1934).

New records: None.

Distribution: Egypt, Libya.

Genus **Theridion** Walckenaer, 1805

Theridion is the largest theridiid genus including a large number of species from all over the world. Many species have been described in the ancient days of arachnology and are species inquirendae. It is also expected that many will be transferred to new genera in the future. Nineteen species have been observed in North Africa. Some material most probably represents new species which are not included here.

Theridion bicolor Lucas, 1846

Theridion bicolor Lucas, 1846: 268. According to Roewer a nomen dubium.

Previous records: ALGERIA: Alger: Alger (Lucas, 1846). Oran: Oran (Lucas, 1846).
New records: None.
Distribution: Algeria.

Theridion cairoense Wunderlich, 2011

Theridion cairoense Wunderlich, 2011: 248, figs 22-27a (descr. male, female).

Previous records: EGYPT: Cairo: Cairo (type locality; Wunderlich, 2011).
New records: None.
Distribution: Only known from the type locality.

Theridion egyptium Fawzy & El Erksousy, 2002

Theridion egyptium Fawzy & El Erksousy, 2002: 832 figs. 1-4 (descr. male, female).

Previous records: EGYPT: Giza: Giza (type locality; Fawzy & El Erksousy, 2002).
New records: None.
Distribution: Egypt.

Theridion familiare O.P.-Cambridge, 1871

Previous records: None.
New records: ALGERIA: Tissemsilt: Theniet el Had, Djebel Meddad, 1400m, 1♂, beating Cedrus atlantica branches, 8.VI.1988 (CRB).
Distribution: Europe. First record in Africa.

Theridion furfuraceum Simon, 1914

Theridion varians; Simon, 1881: 70 (misidentification, male only).
Theridion furfuraceum Simon, 1914: 298; Denis, 1937: 1040.

Previous records: ALGERIA: Without precise locality (Simon, 1881). Mila: Djebel Daya (Denis, 1937).
New records: None.
Distribution: France, Italy, Algeria, Syria.

Theridion genistae Simon, 1873

Theridion genistae; Simon, 1885: 25; Simon, 1914: 297.

Previous records: ALGERIA: Annaba: Massif de l'Edough (Simon, 1914). Tlemcen: Ghazaouet (as Nemours; Simon, 1914). TUNISIA: Jendouba: Aïn-Draham (Simon, 1885).
New records: ALGERIA: Boumerdes: Reghaia, 25m, 4♀♀, beating in Quercus suber forest, 3.V.1988 (CRB). El Tarf: El Kala, Lake Tonga N., 50m, 1♂, beating in Pinus halepensis forest, 28.III.1988 (CRB). TUNISIA: Jendouba: Jendouba: Babouch, 1♂ 1♀, beating in Quercus suber forest, 11.V.2006 (CRB); Hammam Bourguiba, 1♂ 3♀♀, beating

in Quercus suber forest, 9.V.2006 (CRB); Ras Rajel, 1♂ 1♀, beating in Quercus suber forest, 8.V.2006 (CRB).
Distribution: Western Mediterranean to Uzbekistan.

Theridion hannoniae Denis, 1944

Theridion hannoniae Denis, 1944: 116; Bosmans et al., 1994: 238; Knoflach et al., 2009: 244.

Previous records: See Bosmans et al., 1994 and Knoflach et al., 2009. The numerous records in these papers are not repeated here.
New records: MOROCCO: Souss-Massa-Drâa: Anza, 7 km N Agadir, 1♀, stones in Euphorbia vegetation, 3.II.1996 (CRB); medina of Agadir, 1♀, under bark of Eucalyptus, 16.II.2007 (CRB); road Nekob-Mellal, 940m, 1♀, stones in palm yard, 22.IV.2012 (CJVK). TUNISIA: Bizerte: Lake Ichgeul, 1♂ 2♀♀, stones in pasture, 25.I.1995 (CJVK, CRB). Jendouba: Chemtou, 1♂ 2♀♀, stones in Roman ruins, 6.III.2005 (CJVK). Gabes: Zarat, 1♂ 1♀, litter in oasis, 19.XII.2000 (CRB). Gafsa: Gafsa oasis, 1♀, stones and litter in oasis, 2.III.2005 (CJVK). Le Kef: Hammam Mellegue, 1♀, stones in Pinus forest, 4.III.2005 (CJVK); Kalaat es Senam E., 1♀, in rubbish along the road, 10.V.2006 (CRB); between Touiret and Le Kef, 1♀, stones in Pinus forest, 9.V.2006 (CRB). Kasserine: Feriana 10 km S., Oued Soula, 1♀, stones in alfa steppe, 3.IIII.2005 (CJVK); Haidra, 1♀, stones in Roman ruins, 4.III.2005 (CJVK). Jendouba: Hammam Bourguiba, 1♀, stones in Quercus suber forest, 9.V.2006 (CRB). Medenine: Tataouine, 2♀♀, 15.IV.1999, K. De Smet leg. (CRB). Sidi Bouzid: Mazouna E., 1♂ 1♀, stones bordering fields, 12.V.2006 (CRB).
Distribution: Central and S. Europe, North Africa, Atlantic Islands. A common species in North Africa, but not yet recorded in Egypt and Libya.

Theridion hermonense Levy, 1991

Theridion hermonense Levy, 1991: 227, f. 1-2 (descr. female).

Previous records: None.
New records: TUNISIA: Jendouba: Babouch, 1♂ 1♀, beating in Quercus suber forest, 11.V.2006, J. De Graef leg. (CJVK).
Distribution: Until now only recorded from the type locality in Israel.

Theridion luctuosum Lucas, 1846

Theridion luctuosum Lucas, 1846: 263.

Remark: Knoflach et al. (2009, page 244 sub T. hannoniae) cited a female from the MNHNP from Algeria, Souk Arras identified by Simon as Theridion luctinosum. Could this be a lapsus for Lucas' species T. luctuosum? According to Roewer (1955), Theridion luctuosum is a nomen dubium.
Previous records: ALGERIA: Constantine: around Constantine (Lucas, 1846).
New records: None.
Distribution: Algeria. Only type locality.

Theridion melanostictum O.P.-Cambridge, 1876

Theridion melanostictum O.P.-Cambridge, 1876: 570; Caporiacco, 1936a: 101; El-Hennawy, 1990: 39; Knoflach, 1998: 559; El-Hennawy, 2006b: 75.

Previous records: ALGERIA: *M'sila*: Aïn Baniou (Knoflach, 1998). EGYPT: Alexandria: Alexandria (O.P.-Cambridge, 1876). Nile Delta (El Hennawy, 2006b). North Sinia: El Zaranik (El-Hennawy, 2006b). LIBYA: Al Khufrah: Al Jawf (as El Giof; Caporiacco, 1936a).

New records: ALGERIA: Alger: Houssein Dey, Jardin d'Essai, 50m, 2♀♀, litter in park, 29.XII.1987 (CRB). EGYPT: Alexandria: Alexandria, 2♀♀ (CJVK). MOROCCO: Marrakecht-Tensift-Al Haouz: Marrakech, 1♀ in olive yard, 17.X.2007, K. De Smet leg. (CRB). Souss-Massa-Drâa: Mirleft, plage Imi n' Tourga, 25m, 1♀, litter in valley near the sea, 26.IV.1012 (CRB). Tighmert, Aït Bouka oasis, 1♀, litter and stones in palm yard, 12.II.2007 (CRB). TUNISIA: Kebili: Douz W., 1♀, 20.XII.2000 (CRB).
Distribution: Mediterranean, China, Japan, Canary Islands, U.S.A., Aldabra Atol.

Theridion melanurum Hahn, 1831

Theridion denticulatum; Simon, 1881: 79; Simon, 1885: 25; Simon, 1899a: 83; Denis, 1937: 1040.

Previous records: ALGERIA: Alger: Basse Mitidja (Simon, 1899a). Khenchela: Oulad Messelem (Simon, 1899a). Mila: Djebel Daya (Denis, 1937). LIBYA: Al Khufrah: Al Jawf (as El Giof; Caporiacco, 1936a). MOROCCO: Without precise locality (Simon, 1881). TUNISIA: Jendouba: Aïn-Draham (Simon, 1885).
New records: ALGERIA: Blida: Djebel Mouzaia, 1250m, 1♀, stones around the lake, 14.V.1988 (CRB). Bouira: Massif du Djurdjura, Tikjda, 1450m, 3♂♂, beating branches of Cedrus atlantica, 1.VI.1988 (CRB). Chleff: 5 km E. Damous, 5m, 1♂ 1♀, beating branches of Pistacea lentisca and Pinus halepensis in dunes, 17.IV.1987 (CRB). TUNISIA: Jendouba: Hammam Bourguiba, 4♂♂ 4♀♀, beating in Quercus suber forest, J. De Graef leg. (CJVK).
Distribution: Holarctic.

Theridion cfr. mystaceum L. Koch, 1870

Theridion mystaceum; Ledoux, 1979: 283.

Previous records: MOROCCO: Rabat-Salé-Zemmour-Zaër: Environs de Rabat, forêt de Mamora (Ledoux, 1979).
New records: ALGERIA: Bejaia: Tichi, 10m, 2♀♀, beating branches of Acacia in dunes, 21.V.1988 (CRB). Blida: Atlas Blidéen, Meurdja 950m, 1♂ 3♀♀, beating in Cedrus atlantica forest, 7.VII.1987-22.IX.1988 (CRB); Chrea, les Glacières S., 1290m, 1♀, beating in Cedrus atlantica forest, 9.V.1988 (CRB). Boumerdes: Reghaia, 25m, 1♀, beating branches of Quercus suber, 3.V.1988 (CRB). Skikda: West of Collo, Tamanart, 15m, 3♀♀, beating in mixed Alnus, Quercus and Cystus forest, 6.VI.1987 (CRB). Tipasa: Zeralda, 10m, 2♂♂ 3♀♀, beating branches of Eucalyptus in dunes, 25.IV.1987 (CRB). MOROCCO: Meknès-Tafilalt: Ouaoumana, 800m, 1♀, stones in wasteland, 17.IV.2012 (CRB).
Remark: The specimens examined are similar or conspecific with T. mystaceum. Further research is necessary to point out the exact status of our specimens.
Distribution: West Palaearctic.

Theridion patrizii Caporiacco, 1933

Theridion patrizii Caporiacco, 1933: 321.

Previous records: LIBYA: Al Khufrah: Hattia Gur Atta, near Gialo (Caporiacco, 1933).
New records: None.
Distribution: Only cited from the type locality.

Theridion petraeum L. Koch, 1872

Theridion petraeum; Simon, 1909: 22; Simon, 1914: 297.

Remark: Citations of this species are most probably incorrect. We have abundant unidentified material in our collection that is closely related to T. negebense Levy & Amitai, 1982. The material cited by Simon (1909, 1814) most probably belongs to this related species.
Previous records: ALGERIA: Without precise locality (Simon, 1914). MOROCCO: Marrakech-Tensift-Al Haouz: Essaouira (as Mogador; Simon, 1909).
Distribution: Holarctic.

Theridion pictum (Walckenaer, 1802)

Theridion pictum; Caporiacco, 1933: 320.

Previous records: LIBYA: Al Khufrah: Gialo (Caporiacco, 1933); Giallo, Hattia di Gur (Caporiacco, 1933).
New records: None.
Distribution: Europe, Siberia, Libya.

Theridion pinicola Simon, 1873

Theridion pinicola; Knoflach et al., 2009: 251.

Previous records: TUNISIA: Kasserine: Thelepte W. (Knoflach et al., 2009).
New records: ALGERIA: Blida: Atlas Blidéen, Meurdja 950m, 3♂♂ 12♀♀, beating in Cedrus atlantica forest, 28.V.1988 (CRB); Chrea, Djebel Ferroukha, Ghellaï, 1350m, 1♂, seeving litter in Cedrus atlantica forest, 2.VI.1988 (CRB); Chrea, les Glacières S., 1290m, 1♂ 4♀♀, beating in Cedrus atlantica forest, 26.V.1987 (CRB); idem, 1500m, beating in Cedrus atlantica forest, 27.VI.1984 (CRB). Bouira: Massif du Djurdjura, Tala Rana, 1320m, 1♂ 1♀, beating in Cedrus atlantica forest, 1.VI.1988 (CRB); idem, Tigounatine, 1450m, 9♂♂ 5♀♀, beating in Cedrus atlantica forest, 1.VI.1988 (CRB). Sétif: Djebel Babor, 1650m, 3♀♀, beating in Cedrus atlantica forest, 21.X.1988 (CRB). Tissemsilt: Theniet el Had, Djebel Meddad, 1550m, 2♂♂ 2♀♀, beating beating in Cedrus atlantica forest, 18.V.1988 (CRB).; idem, 1400m, 1♂ 4♀♀, 18.VI.1988 (CRB). Tizi Ouzou: Massif du Djurdjura, Ait Ouabane, 1410m, 1♂, beating in Cedrus atlantica forest, 11.VI.1988 (CRB); Massif du Djurdjura, Tala Guilef, 1400m, 1♀, beating in Cedrus atlantica forest, 14.IX.1989 (CRB). MOROCCO: Meknès-Tafilalt: Aguelmame Azigza, 1575m, 1♀, in mixed Cedrus and Quercus forest, 13.V.1984 (CRB). TUNISIA: Kasserine: Thala 5 km W., 950m, 2♂♂ 1♀, beating in Pinus forest, 10.V.2006 (CRB).
Distribution: Previously only known from Corsica and Tunisia, now for the first time cited in Algeria and Morocco where it occurs mainly in Cedrus forests at high altitude.

Theridion spinitarse O.P.-Cambridge, 1876

Theridion spinitarsis O.P.-Cambridge, 1876: 570 (descr. female).
Theridion bifoveolatum Denis, 1945: 48 (descr. female).
Theridion spinitarse; El-Hennawy, 1990: 39; El-Hennawy, 2006b: 75; Knoflach et al., 2009: 257.

Previous records: EGYPT: Aswan: Aswan (as Assuan; Knoflach et al., 2009). Cairo: Cairo (type locality of T. spinitarse; O.P.-Cambridge, 1876). Luxor: Luxor (type locality of T. bifoveolatum; Denis, 1945).
New records: LIBYA: Murzuq: Ghoddna, Traghen, Umm el Aranch, 1♀, 15.VI.1978, J. Mertens leg. (CRB).
Distribution: Egypt, Arabian Peninsula, Ethiopia and a first record from Libya.

Theridion varians Hahn, 1833

Theridion varians; O.P.-Cambridge, 1876: 570; Caporiacco, 1933: 23; El-Hennawy, 1990: 39; El-Hennawy, 2006b: 75.
Theridion varians var. rusticum; Caporiacco, 1933: 320; Caporiacco, 1936a: 101.
Theridion varians var. cyrenaica Caporiacco, 1933: 320; Caporiacco, 1936a: 101.

Remarks: The presence in North Africa of this species from temperate Europe is very doubtful. Levy & Amitai (1982a) pointed out that Cambridge's citation of Theridion varians from Israel was in fact T. hierichonticus. It is possible that Cambridge's citation from Egypt (1876) also represents that species. Caporiacco's abundant citations from Libya almost certainly are misidentifications and must be revised. For completeness, they are included here.
Previous records: EGYPT: Alexandria: Alexandria (O.P.-Cambridge, 1876). LIBYA: Ajdabiyah: Awyila (as Augila; Caporiacco, 1933, sub T. varians rusticum and T. varians cyrenaica; type locality); Gialo, Hattia di Gur Atta (Caporiacco, 1933, sub T. varians rusticum). Al Khufrah: Al Khufrah (Caporiacco, 1933, sub T. varians rusticum); Bir-Al-Ikwan (as Bir el-Akhwan; Caporiacco, 1936a, sub T. varians cyrenaica and T. varians rusticum); El Haueuri near Al Khufrah (Caporiacco, 1933, sub T. varians rusticum); El Talab near Al Khufrah (Caporiacco, 1933, sub T. varians rusticum); Gialo (Caporiacco, 1933, sub T. varians).
New records: None.
Distribution: Holarctic.

Theridion wiehlei Schenkel, 1938

Theridion petraeum; Denis, 1937: 1040 (misidentification).
Theridion wiehlei; Denis, 1944: 113.

Previous records: ALGERIA: Mila: Zouagha forest, Djebel Daya (Denis, 1937, sub T. petraeum; 1944, sub T. wiehlei).
New records: None.
Distribution: Spain, France, Algeria.

Genus **Theridula** Emerton, 1882
A genus including 17 described species, mostly from the tropics, some have become cosmopolitan. There is one rare species in North Africa.

Theridula aelleni Hubert, 1970

Theridion aelleni Hubert, 1970: 190 (descr. male, female).
Theridula aelleni; Knoflach et al., 2009: 257, f. 80-84.

Previous records: TUNISIA: Nabeul: El Haouaria, bat cave (type locality; Hubert, 1970).
New records: None.
Distribution: Only cited from the type locality in Tunisia and from Spain.

Genus **Thwaitesia** O.P.-Cambridge, 1881
A small tropical genus penetrating the Mediterranean region with one species.

Thwaitesia algerica Simon, 1895

Thwaitesia algerica Simon, 1895: 134.

Previous records: ALGERIA: Alger: El Harrach (type locality; Simon, 1895).
New records: None.
Distribution: Only recorded from the type locality.

Conclusion

The number of North African Theridiidae is now as follows:

Actual number of species of Theridiidae in five African countries		
	Literature citations	Literature citations and newly collected material
Algeria	62	74
Egypt	27	27
Libya	19	20
Morocco	38	44
Tunisia	38	49

The following 6 species are new to Morocco:
Anelosimus pulchellus (Walckenaer), Latrodectus geometricus C.L. Koch, Simitidion lacuna Wunderlich, Steatoda albocincta (Lucas), Steatoda erigoniformis (O.P.-Cambridge), Theridion melanostictum O.P.-Cambridge.

The following 12 species are new to Algeria:
Anelosimus pulchellus (Walckenaer), Asagena italica (Knoflach), Dipoena braccata (C.L. Koch), Dipoena leveillei (Simon), Episinus maculipes Cavanna, Lasaeola testaceomarginata Simon, Robertus arundineti (O.P.-Cambridge), Steatoda latifasciata (Simon), Steatoda nobilis (Thorell), Theridion cfr. mystaceum L. Koch, Theridion familiare O.P.-Cambridge, Theridion pinicola Simon.

The following 11 species are new to Tunisia:
Asagena italica (Knoflach), Episinus maculipes Cavanna, Latrodectus pallidus O.P.-Cambridge, Parasteatoda lunata (Clerck), Pholcomma gibbum (Westring), Phylloneta impressa (L. Koch), Platnickina nigropunctata (Lucas), Rhomphaea nasica (Simon), Simitidion agaricographum (Levy & Amitai), Theridion hermonense Levy and Theridion melanostictum O.P.-Cambridge.

The following species is new to Libya: Theridion spinitarse O.P.-Cambridge.

The following table includes all theridiid species recorded from the five studied countries of North Africa depending on "Literature citations" (x) and our "New records" (o).

Species	MOR	ALG	TUN	LIB	EGY
Anatolidion gentile (Simon, 1881)	x	x			
Anelosimus pulchellus (Walckenaer, 1802)	o	o	x		
Anelosimus vittatus (C.L. Koch, 1836)		x			
Argyrodes argyrodes (Walckenaer, 1841)	x	x	x		x
Asagena italica (Knoflach, 1996)		o	o		
Asagena phalerata (Panzer, 1801)		x	x		
Coscinida tibialis Simon, 1895		x	x		
Crustulina conspicua (O.P.-Cambridge, 1872)					x
Crustulina erythropus (Lucas, 1846)		x			
Crustulina scabripes Simon, 1881	x	x	x		
Dipoena braccata (C.L. Koch, 1841)		o			
Dipoena lesnei Simon, 1899		x			
Dipoena leveillei (Simon, 1885)		o	x		

Species	MOR	ALG	TUN	LIB	EGY
Dipoena melanogaster (C.L. Koch, 1837)		x	x		
Dipoena sedilloti (Simon, 1885)		x	x		
Dipoena umbratilis (Simon, 1873)		x			
Dipoena xanthopus Simon, 1914		x			
Enoplognatha biskrensis Denis, 1945	x	x	x		
Enoplognatha carinata Bosmans & Van Keer, 1999	x	x			
Enoplognatha deserta (Levy & Amitai, 1981)	x	x	x		x
Enoplognatha diversa (Blackwall, 1859)	x	x	x		
Enoplognatha franzi Wunderlich, 1995	x	x	x		
Enoplognatha gemina Bosmans & Van Keer, 1999					x
Enoplognatha hermani Bosmans & Van Keer, 1999		x			
Enoplognatha latimana Hippa & Oksala, 1982	x	x			
Enoplognatha mandibularis (Lucas, 1846)	x	x	x		
Enoplognatha mordax (Thorell, 1875)	x				
Enoplognatha nigromarginata (Lucas, 1846)	x	x			
Enoplognatha quadripunctata Simon, 1884	x	x			
Enoplognatha verae Bosmans & Van Keer, 1999	x		x		
Episinus algiricus Lucas, 1846		x	x		
Episinus maculipes Cavanna, 1876		o	o		
Episinus maculipes numidicus Kulczyński, 1905		x	x		
Episinus truncatus Latreille, 1809	x	x			
Euryopis albomaculata Denis, 1951					x
Euryopis campestrata Simon, 1907					x
Euryopis episinoides (Walckenaer, 1847)	x	x	x		x
Euryopis laeta (Westring, 1861)			x		
Euryopis quinqueguttata Thorell, 1875					x
Euryopis sexalbomaculata (Lucas, 1846)		x	x	x	
Heterotheridion nigrovariegatum (Simon, 1873)		x		x	x
Kochiura aulica (C.L. Koch, 1838)	x	x	x	x	x
Lasaeola convexa (Blackwall, 1870)	x	x	x		
Lasaeola testaceomarginata Simon, 1881	x	o			
Latrodectus cinctus Blackwall, 1865	x				
Latrodectus geometricus C.L. Koch, 1841	o			x	
Latrodectus lilianae Melic, 2000		x			
Latrodectus pallidus O.P.-Cambridge, 1872			o	x	x
Latrodectus tredecimguttatus (Rossi, 1790)	x	x	x	x	x
Neottiura bimaculata (Linnaeus, 1767)		x			
Neottiura curvimana (Simon, 1914)		x			
Neottiura uncinata (Lucas, 1846)	x	x	x		
Nesticodes rufipes (Lucas, 1846)	x	x	x		x
Paidiscura dromedaria (Simon, 1880)	x	x	x	x	x

Species	MOR	ALG	TUN	LIB	EGY
Paidiscura pallens (Blackwall, 1834)		x			
Parasteatoda lunata (Clerck, 1757)			o		
Pholcomma gibbum (Westring, 1851)		x	o		
Phoroncidia paradoxa (Lucas, 1846)		x			
Phylloneta impressa (L. Koch, 1881)	x	x	o		
Phylloneta sisyphia (Clerck, 1757)		x		x	
Platnickina nigropunctata (Lucas, 1846)	x	x	o		x
Rhomphaea nasica (Simon, 1873)		x	o		
Robertus arundineti (O.P.-Cambridge, 1871)		o			
Ruborridion musivum (Simon, 1873)	x	x	x		x
Sardinidion blackwalli (O.P.-Cambridge, 1871)		x	x		
Simitidion agaricographum (Levy & Amitai, 1982)			o		
Simitidion lacuna Wunderlich, 1992	o	x	x	x	
Steatoda albocincta (Lucas, 1846)	o	x		x	
Steatoda ephippiata (Thorell, 1875)		x	x	x	x
Steatoda erigoniformis (O.P.-Cambridge, 1872)	o		x		x
Steatoda grossa (C.L. Koch, 1838)	x	x	x		
Steatoda latifasciata (Simon, 1873)	x	o			x
Steatoda maura (Simon, 1909)	x				
Steatoda moerens (Thorell, 1875)		x	x		
Steatoda nobilis (Thorell, 1875)		o			
Steatoda paykulliana (Walckenaer, 1805)	x	x	x	x	x
Steatoda triangulosa (Walckenaer, 1802)	x	x	x	x	x
Steatoda venator (Audouin, 1826)				x	x
Theridion bicolor Lucas, 1846		x			
Theridion cairoense Wunderlich, 2011					x
Theridion egyptium Fawzy & El Erksousy, 2002					x
Theridion familiare O.P.-Cambridge, 1871		o			
Theridion furfuraceum Simon, 1914		x			
Theridion genistae Simon, 1873		x	x		
Theridion hannoniae Denis, 1944	x	x	x		
Theridion hermonense Levy, 1991			o		
Theridion luctuosum Lucas, 1846		x			
Theridion melanostictum O.P.-Cambridge, 1876	o	x	o	x	x
Theridion melanurum Hahn, 1831	x	x	x	x	
Theridion cfr. mystaceum L. Koch, 1870	x	o			
Theridion patrizii Caporiacco, 1933				x	
Theridion petraeum L. Koch, 1872	x	x			
Theridion pictum (Walckenaer, 1802)				x	
Theridion pinicola Simon, 1873	o	o	x		
Theridion spinitarse O.P.-Cambridge, 1876				o	x

Species	MOR	ALG	TUN	LIB	EGY
Theridion varians Hahn, 1833				x	x
Theridion wiehlei Schenkel, 1938		x			
Theridula aelleni Hubert, 1970			x		
Thwaitesia algerica Simon, 1895		x			

MOR = Morocco, ALG = Algeria, TUN = Tunisia, LIB = Libya, EGY = Egypt.

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Preliminary study of the spiders inhabiting ornamental plants in Orman garden, Egypt (Arachnida: Araneae)

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Abstract

A survey of spider community composition and diversity associated with foliage of two ornamental plants (Lantana shrubs and Croton trees) was carried out in the Orman garden. Foliage beating, hand collecting and sweep nets were used. Numbers of collected spiders were pooled and analysed for species diversity using Shannon-Wiener Index, evenness, Simpson Index and Sørensen Quotient of Similarity.

A total of 567 spiders grouped in 13 families belonging to 34 genera and more than 34 species. Vegetation type influenced spider abundance. Lantana shrubs received 263 individuals belonged to 25 genera, 27 species of 13 families, while Croton trees received 304 individuals belonged to 21 genera, 22 species of 10 families.

Five families contained 85.17% of the total collected spiders; they are Miturgidae, Philodromidae, Salticidae, Theridiidae and Araneidae. Miturgidae was the most abundant family (20.1%) followed by Philodromidae (19.75%), Salticidae (18.3%), Theridiidae (14.6%) and Araneidae (12.3%). The other remaining families represented 14.6% of the total catch.

Guild structure analysis revealed seven feeding guilds namely, stalker, ground runner, foliage runner, ambusher, orb web spiders, space weaver and wandering sheet spiders. Guild structure varied considerably in relation to the structural quality of vegetation; the foliage runner, stalker and ambusher spider guilds were the dominant feeding guilds on Lantana representing 14.5, 12.3 & 11.5%, respectively of the total collected spiders, while the orb web spiders, the space weavers and the ambushers were the dominant feeding guilds on Croton representing 13.8, 12.8 and 12.7, respectively.

Keywords: Araneae, diversity, foraging guild, Orman garden, Shannon Wiener Index, Simpson Index, similarity, Sørensen Quotient.

Introduction

The Orman Botanical Garden is located west of the River Nile and east of Cairo University in Giza Governorate. It was founded in 1875 by Khedive Ismail who commissioned its landscaping to the French designer Gustave de la Chevalerie who used a collection of great diversity of rare trees and plants imported from other countries: South America, India, Madagascar and Australia. Its area at that time was almost 57 feddans, but later large areas were taken and added to Giza Zoo. The area now is 28 feddans. In 1917, it was put under the Ministry of Agriculture management.

In the garden, there is a rocker garden, 1.5 feddan, where succulents and many rare cactus species, a pond with water and marsh plants among which are found the two most famous aquatic plants in ancient Egypt, Papyrus and Lotus. There is also a rose garden, 2 feddans, and bunches of rare species of Ficus, Palm, Bamboo, conifers and the only red wood tree in Egypt.

Because of the occurrence of water in ponds and the presence of cultivated area with different vegetations and plants all over the year therefore this area provides an excellent field for surviving many living organisms.

Spiders comprise one of the most active groups of predatory species that feed on different sap sucking pests including aphids, whiteflies, jassids and mites as well as other small insects. This group is an interested role as important predators in the biological control of insect pest attacking different plants. Spiders are among the most diverse and abundant invertebrate predators in terrestrial ecosystems (Nyffeler, 2000). They are easily sampled and their assemblages are useful indicators for comparing the biodiversity of various environments and for assessing the effect of disturbances on diversity (Clausen, 1986; Churchill, 1998; Marc et al., 1999). Few studies have compared differences in the abundance of spiders on foliage of different shrubs and tree species (De Souza & Martins, 2005).

Spiders are among the dominant arthropod predators in many terrestrial ecosystems (Muzika & Twery, 1997). Arboreal species spend most of their life in the crowns of trees in close association with herbivorous insects that are frequently their prey (Masson et al., 1997).

Moreover, the study of guild structure implies its quantification. Functional diversity is one of the most important parameters used to explain how ecosystems work and adapt to change. Spider guild composition responds to vegetation diversity and structural complexity (Hatley & Macmahon, 1980; Greenstone, 1984; Uetz, 1991; Rypstra et al., 1999) and local abundance of prey is regarded as one of the major determinants of spider distribution (Moring and Stewart, 1994).

Guild are useful in study of communities, since it is usually impossible to study all species living in an ecosystem at once, guild enables concentration on specific groups with specific functional relationships (Simberloff & Dayan, 1991). Guilds focus attention on all competing species, regardless of their taxonomic relationship. Recently the guild might represent the basic building blocks of communities and the partitioning of communities into guilds might reveal a structure not attributable simply to species numbers and identities. The view that species in communities fill fixed, basic functional roles is one of the most venerable in ecology.

Considering the importance of spiders in the natural suppression of many insect pests and as bio-indicators, urgent efforts are needed to understand their diversity (Sudhikumar et al., 2005). Previous studies demonstrated that spiders inhabiting different strata of habitats may respond differently to changes in environmental factors (Hermann et al., 2010).

In Egypt, researchers have provided descriptions of spider species abundance or composition in a variety of agro-ecosystems (Sallam, 2002; Habashy et al., 2005). Other researchers provided quantitative observations on the abundance and daily activity of spiders (Hussein, 1999; Ragab, 2003) or recorded the spider biology, the predation events and the impact of different insecticides or fertilization on spiders (Hussein et al., 2003; Hendawy & Abul-Fadl, 2004; Sallam et al., 2010; Mahmoud et al., 2011).

This preliminary study throws light to the taxonomic spider assemblages “family guild composition” from two ornamental plants of different structural composition and to the spider communities, concerning relative abundance, species richness, guild composition, Shannon-Wiener index (H’), Simpson index (S), and evenness (e) to quantify the community structures of spiders among the two different vegetation types. These calculations were based upon spider species compositions of the sampling. It is a start point for further investigations.

Material and Methods

Site description and sampling

Survey and seasonal abundance of spiders were studied in the Orman garden, Giza, Egypt for one whole year. Two ornamental plants of different structure and composition were selected. The first is a set of Croton trees (Codiaeum variegatum L.) in a corner of the garden near a lake, composed of 28 trees of 2-3.5m. height, act as woodland habitat. The second is Lantana shrubs (Lantana camara L.) found as hedge nearly of 35m long planted on sandy soil and bordered one side of a small garden of cactus and succulent plants found on the other hand of the garden.

Spiders live on foliage were collected by hand after visual search for spiders found on leaf blades, tree trunks, or running on the ground, in addition to shaking plants on a shake sheet. Samples were taken every two weeks from May 2009 till April 2010. Collected spiders were kept in glass vials containing 70% ethyl alcohol and some droplets of glycerine and examined under a stereo-zoom microscope in the laboratory.

Identification of spiders

Spiders were sorted to adults and juveniles. The adult spiders were identified, as possible, to species. The scientific names of spiders and their classification follows the descriptions, keys, and catalogues of Kaston (1978), Levi (2002), Oger (2002), Ovtsharenko & Tanasevitch (2002a, b, c), Prószyński (2003), Huber (2005), Platnick (2012) and numerous other consulted sources. Juvenile spiders were mostly identified to family or to genus. A few damaged spiders and newly emerged spiderlings were only identified to family. These were designated as undetermined but included in all estimates of total abundance. Voucher specimens were preserved in 70% alcohol and deposited in a reference collection lodged in the Plant Protection Research Institute (P.P.R.I.), Cairo.

Data analysis

Spider community: The community structure of soil spiders was described using the species richness, Shannon-Wiener and Simpson indices "S". The Shannon-Wiener Index "H’" is one of the most common ecological indexes, it may provide an indication of community stability under the balance of nature and it may also respond differently of geographical, developmental, or physical factors. Higher number of H' indicates higher number of species, higher relative abundance and species evenness, so, it means increase in diversity.

Table 1. Species richness of collected spiders inhabiting Lantana, May 2009 - April 2010.

Families & Species	♂	♀	J	Σ	Total	%
Miturgidae					**81**	30.80
Cheiracanthium sp.	5	5	71	81		
Salticidae					**67**	25.47
Thyene imperialis	4	5	27	36		
Hasarius adansoni	2	2	2	6		
Pseudicius spiniger*	2	-	-	2		
Pseudicius sp.	-	2	1	3		
Ballus sp.	-	2	4	6		
Heliophanillus fulgens*	-	1	-	1		
Euophrys sp.*	-	2	1	3		
Euophrys granulata ?*	1	-	-	1		
Plexippus paykulli*	-	1	-	1		
Plexippus sp.	1	-	-	1		
Synageles dalmaticus ?	1	2	-	3		
Heliophanus sp.*	-	1	-	1		
Unidentified species	-	-	3	3		
Philodromidae					**46**	17.49
Philodromus sp.	6	20	18	44		
Thanatus albini	-	2	-	2		
Thomisidae					**19**	7.22
Thomisus spinifer	5	3	4	12		
Thomisus sp.	1	2	4	7		
Theridiidae					**19**	7.22
Kochiura aulica	4	6	9	19		
Lycosidae					**13**	4.94
Allocosa sp.	-	2	-	2		
Trochosa sp.	-	4	-	4		
Pardosa sp.*	1	-	3	4		
Unidentified species	-	-	3	3		
Araneidae					**5**	1.90
Neoscona sp.	-	1	1	2		
Unidentified species	-	1	2	3		
Dysderidae					**4**	1.52
Dysdera crocota	-	3	1	4		
Oxyopidae					**3**	1.14
Oxyopes sp.*	-	1	2	3		
Uloboridae					**2**	0.76
Uloborus walkenaerius	-	1	1	1		
Dictynidae					**2**	0.76
Nigma sp.*	-	1	1	2		
Hersiliidae					**1**	0.38
Hersilia sp.*	-	1	-	1		
Linyphiidae					**1**	0.38
Bathyphantes sp.*	-	-	1	1		
Total	**33**	**71**	**159**	**263**	**263**	

*: species not found in Croton trees.

While Simpson Index "S" is more responsive to changes in the importance of most dominant species, it is a measure of dominance (i.e. the probability of two randomly selected individuals will be of the same species) (Nestle et al., 1993). A community dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance.

The two indices were calculated as described by Ludwig & Reynolds (1988):

$$H' = -\sum (ni / n) \ \ln \ (ni/ n) \quad \text{and} \quad S = \sum (ni/n)^2.$$

Where ni is the number of individuals belonging to the ith of "S" taxa in the sample and "n" is the total number of individuals in the sample."

Sørensen quotient of similarity: To compare guild composition between microhabitats of the two ornamental plants, Sørensen's quotient of similarity (Sørensen 1948) was applied to the number of species and individuals of the two plants. It was used to determine the similarities of spider species composition among the communities. Sørensen's original formula was intended to be applied to presence/absence data, and it is:

$$QS = 2 C / A + B.$$

Where A and B are the number of species in samples A and B, respectively, and C is the number of species shared by the two samples; QS is the quotient of similarity and ranges from 0-1.

Guild composition: Spiders collected during this study were divided into seven guilds according to spider's web-building and prey-catching behaviour as described in the classification system proposed by Uetz et al. (1999).

Results and Discussion

Population study

A total of 567 spiders were collected representing 13 families, 34 genera, and more than 34 species. The 13 families found in Orman garden represent 32.5% of the 40 families recorded in Egypt (El-Hennawy, 2006).

Survey of spiders inhabiting Lantana plants

A total of 263 spiders inhabiting Lantana shrubs were collected; they belonged to 13 families, 25 genera and more than 25 species. Juveniles comprised 60.5% while males and females were 39.5%. The sex ratio was 2.1 ♀: 1 ♂ (Table 1).

Of the most abundant species, 4 ranked in the top, Cheiracanthium sp. (81 individuals), Philodromus sp. (44), Kochiura aulica (19) and Thomisus spinifer (19).

Survey of spiders inhabiting Croton plants

A total of 304 spiders inhabiting Croton trees were collected; they could be classified to 10 families, 21 genera and more than 21 species. Juveniles comprised 46.7% while males and females were 53.3%. The sex ratio was 1.1 ♀: 1 ♂ (Table 2).

The most dominant species was Kochiura aulica (64 individuals) followed by Philodromus sp. (63), Cheiracanthium sp. (33), then Larinioides sp. (20).

Family richness and generic diversity

Out of the 193 genera recorded in Egypt (El-Hennawy, 2006), 34 genera are discovered in Orman garden. Family Salticidae was the dominant family in this biome with maximum generic diversity which is composed of 10 genera, followed by Lycosidae (5), Araneidae (4), Philodromidae (3), and Linyphiidae (2) genera while Thomisidae, Uloboridae and Oxyopidae each with 2 species of one genus.

The 5 remaining families Theridiidae, Dysderidae, Dictynidae, Miturgidae, and Hersiliidae were represented by only a single genus each.

Table 2. Species richness of collected spiders inhabiting Croton, May 2009 - April 2010.

Families & Species	♂	♀	J	Σ	**Total**	%
Philodromidae					**66**	21.71
Thanatus albini	1	1	-	2		
Philodromus sp.	9	14	40	63		
Tibellus sp.*	1	-	-	1		
Araneidae					**65**	21.38
Larinioides cornutus	15	5	-	20		
Agalenatea redii*	1	-	-	1		
Araneus sp.	6	6	1	13		
Neoscona sp.	4	8	-	12		
Unidentified species	-	-	19	19		
Theridiidae					**64**	21.05
Kochiura aulica	17	20	27	64		
Salticidae					**37**	12.17
Thyene imperialis	2	3	8	13		
Hasarius adansoni	2	2	2	6		
Salticus propinquus ?*	-	-	1	1		
Ballus sp.	2	1	3	6		
Unidentified species	-	3	8	11		
Miturgidae					**33**	10.85
Cheiracanthium sp.	4	5	24	33		
Uloboridae					**13**	4.28
Uloborus walckenaerius	1	4	-	5		
Uloborus sp.	3	5	-	8		
Lycosidae					**13**	4.28
Trochosa sp.	1	-	3	4		
Pardosa sp.*	-	1	-	1		
Allocosa sp.	-	3	3	6		
Unidentified species	-	-	2	2		
Thomisidae					**6**	1.97
Thomisus spinifer	1	-	-	1		
Thomisus sp.	2	3	-	5		
Dictynidae					**5**	1.64
Nigma sp.*	3	1	1	5		
Linyphiidae					**2**	0.66
Erigone dentipalpis*	1	1	-	2		
Total	**76**	**86**	**142**	**304**	**304**	

*: species not found in Lantana shrubs.

Species richness

Among the 34 species of spiders collected during the study, 22 species of 10 families were recorded on Croton trees and 27 species of 13 families on Lantana hedges. All families except Oxyopidae, Dysderidae, and Hersiliidae were present on both plants.

A total of 13 species had common occurrence in both plants. The dominant species was Cheiracanthium sp. represented by 33 and 81 individuals in Croton and Lantana respectively, followed by Philodromus sp. (66 & 46), and then Kochiura aulica (64 & 19).

In addition to species composition, foraging guild composition also significantly differed among sampling sites.

Spider guild composition (Functional groups)

The collected spiders can be divided into seven functional guilds (Table 3, Fig. 1) based on their foraging behaviour in the field as described by Uetz et al. (1999):

A. Hunting spiders:
1. Stalkers: Salticidae, Oxyopidae.
2. Ground runners: Lycosidae and Dysderidae.
3. Ambushers: Phillodromidae, and Thomisidae.
4. Foliage runners: Miturgidae and Hersiliidae.

B. Web building spiders (aerial web):
5. Orb web: Araneidae, and Uloboridae.
6. Space weavers: Theridiidae and Dictynidae.
7. Wandering sheet: Linyphiidae.

The foliage runner, stalker and ambusher spider guilds were the dominant feeding guilds on Lantana representing 14.5, 12.3 & 11.5%, respectively of the total collected spiders. While the orb web spiders, the space weavers, and the ambushers were the dominant feeding guilds on Croton representing 13.8, 12.8 & 12.7%, respectively of the total collected spiders and had the highest species richness.

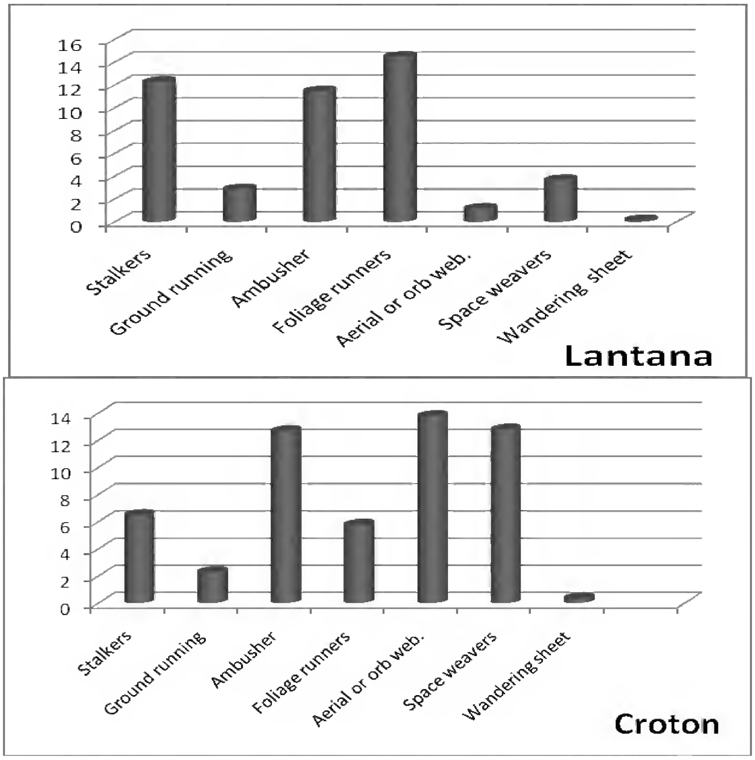

Fig. 1. Foraging guild classification and percentage of spider species per guild in Lantana and Croton plants.

Faunal similarity of spiders

Species richness of spiders collected from Croton (304 individuals) is greater than that of Lantana (263), while the number of spider species greater in Lantana (27 species) than that in Croton (22). Among the 34 genera obtained, 13 were distributed in Lantana only and 7 in Croton, that is to say Lantana and Croton plants had between 7 and 13 unique species, and the common genera were 15 (Table 3). To allow a comparison between the habitats of the two plants, Sørensen's Quotient of similarity (QS) for the two plants was calculated. It is concluded that the two plants are semi-similar as they recorded 60% of similarity.

Table 3. Guild classification of spider taxa in Lantana and Croton plants.

Families and Foraging guild	Lantana			%	Croton			%	Com. sp.	Tot. sp.
	Sp. rich.	No. sp.	Uni. sp.		Sp. rich.	No. sp.	Uni. sp.			
1. Stalkers										
Salticidae	67	12	9	12.3	37	5	1	6.5	3	13
Oxyopidae	3	1	1		-	-	-		0	1
2. Ground running										
Lycosidae	13	3	-	2.9	13	3	-	2.3	3	3
Dysderidae	4	1	1		-	-	-		0	1
3. Ambushers										
Philodromidae	46	2	-	11.5	66	3	1	12.7	2	3
Thomisidae	19	2	-		6	2	-		2	2
4. Foliage runners										
Miturgidae	81	1	-	14.5	33	1	-	5.8	1	1
Hersiliidae	1	1	1		-	-	-		0	1
5. Aerial or orb web										
Araneidae	5	1	-	1.2	65	4	3	13.8	1	4
Uloboridae	2	2	-		13	2	1		1	2
6. Space weavers										
Theridiidae	19	1	-	3.7	64	1	-	12.8	1	1
Dictynidae	2	1	-		5	1	-		1	1
7. Wandering sheet										
Linyphiidae	1	1	1	0.2	2	1	1	0.35	0	2
Total	**263**	28	13		**304**	22	7		15	**35**

Sp. rich. = Species richness, No. sp. = Number of species, Uni. sp. = Unique species, Com. sp. = Common species, Tot. sp. = Total species.

Monthly fluctuation of spider population

Total monthly counts of spiders collected from Croton trees occurred in high abundance in early summer during May (69 individuals, followed by June (51). While the lowest numbers (11 and 10) were recorded during February and March, respectively (Fig. 2). Respective numbers in Lantana plants were 33 and 31 individuals in May and June, while the lowest numbers (11 & 13) were recorded during December, January and February. These results confirmed by Mushtaq et al. (2000) who recorded that maximum number of foliage spider species were recorded in the monthly sample of May with no significant differences among locations. Similar results were reported by Bogya and Markó (2008) who found that spiders showed one population peak in spring time.

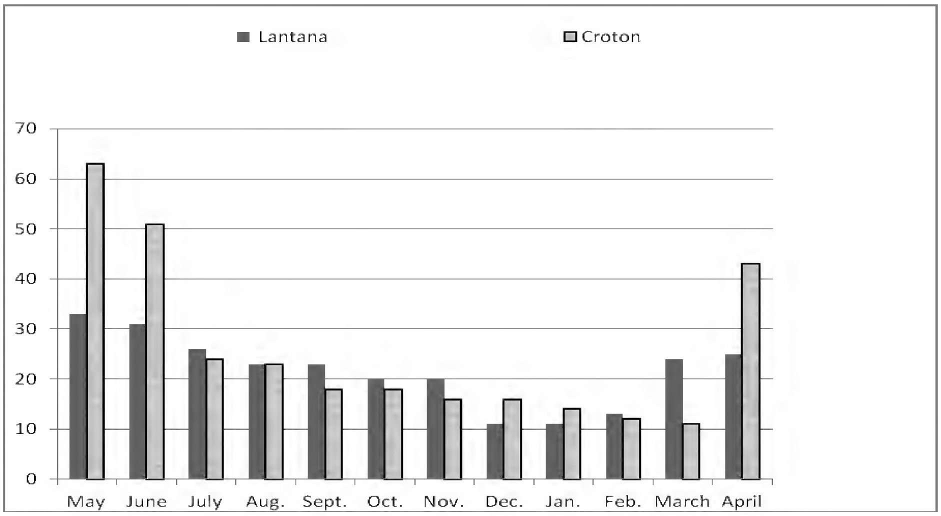

Fig. 2. Total numbers of spiders collected from Lantana and Croton plants in Orman garden in each month between May 2009 and April 2010.

Rank abundance of spider families

The collected spiders were summarized by families in (Table 4) to show their abundance. Five families contained 85.17% of the total collected spiders; they are Miturgidae, Philodromidae, Salticidae, Theridiidae and Araneidae. The greatest number of individuals was found in the Family Miturgidae (114 individuals), then Family Philodromidae (112), and Family Salticidae (104). Families Theridiidae (83 individuals) and Araneidae (70) were ranking the fourth and fifth, respectively.

Table 4. Rank abundance of spider family in Orman garden, May 2009 - April 2010.

Families	Lantana	Croton	Total	%
Miturgidae	81	33	114	20.10
Philodromidae	46	66	112	19.75
Salticidae	67	37	104	18.34
Theridiidae	19	64	83	14.64
Araneidae	5	65	70	12.34
Lycosidae	13	13	26	4.58
Thomisidae	19	6	25	4.41
Uloboridae	2	13	15	2.64
Dictynidae	2	5	7	1.23
Dysderidae	4	0	4	0.70
Oxyopidae	3	0	3	0.53
Linyphiidae	1	2	3	0.53
Hersiliidae	1	0	1	0.18
Total	**263**	**304**	**567**	

Species diversity

The biodiversity of spiders in the two ornamental plants is compared using Shannon Wiener "H'" and Simpson "S" Indices of diversity (Table 5). The cover plantation of croton trees varies in their species richness and recorded the highest population of total number 304 individuals larger than those obtained in the Lantana shrubs. Its ecosystem is made of 10 families, 21 genera and at least 22 species; while the species richness of the Lantana plant were 263 individuals composed of 13 families, 25 genera and at least 27 species.

Using Shannon Wiener Index, the biodiversity index calculation indicates that Croton is the most diverse. The species richness of spiders in different families and their equitability (evenness) were higher in Croton trees than that of Lantana shrubs which might be dependent on type of plant dense vegetation and higher humidity produced from the lake near the plant.

According to Simpson Index which is a measure of dominance (responsive to changes for the most dominant species), it was found that Lantana shrubs included the highest number of dominant species.

Table 5. Comparison of community structure of collected spiders from Lantana and Croton plants.

Families	Lantana				Croton			
	Species richness	H`	Species evenness	S	Species richness	H`	Species evenness	S
Philodromidae	46	0.18	1.197	0.9	66	0.21	1.234	0.9
Salticidae	67	1.73	5.315	0.31	37	1.15	3.158	0.25
Miturgidae	81	1	2.718	1	33	1	2.718	1
Theridiidae	19	1	2.718	1	64	1	2.718	1
Araneidae	5	0.67	1.954	0.52	65	1.4	4.055	0.25
Lycosidae	13	1.34	3.819	0.25	13	1.2	3.32	0.33
Thomisidae	19	0.65	1.915	0.51	6	0.45	1.568	0.7
Uloboridae	2	1	2.718	1	13	0.7	2.014	0.5
Dictynidae	2	1	2.718	1	5	1	2.718	1
Dysderidae	4	1	2.718	1	0	0	0	0
Oxyopidae	3	1	2.718	1	0	0	0	0
Linyphiidae	1	1	2.718	1	2	1	2.718	1
Hersiliidae	1	1	2.718	1	0	0	0	0

H`: Shannon-Wiener Index, S : Simpson Index.

Considering the importance of spiders in the natural suppression of many insect pests and as bio-indicators, urgent efforts are needed to understand their diversity. A diversity index incorporates both species richness and evenness in a single value (Magurran, 1988). The results of this study indicate the influence of vegetation structure on the diversity of resident spider community. Most ecologists believe that an ecosystem with a greater diversity of species and a higher relative abundance is healthier and more stable than an ecosystem with only few species or lower relative abundance.

Lantana shrubs seems to have a higher amount of diversity than Croton trees because it has the greatest number of species, but the evenly spread abundance of species found in Croton trees make it more diverse. The biodiversity index calculation indicates that Croton is the most diverse and contradicts the initial expectation that Lantana shrubs were more diverse. The high species diversity of spiders in Croton trees can be attributed to the dense cover of plants and the marsh near the trees which sustains a high faunal diversity, while the high variety of species in Lantana shrubs might be attributed to the high diversity of cactus and succulent plants extends along the hedge of Lantana, this result is in good agreement with Swarupanandan et al. (2000) who assumed that a high floral diversity sustains a high faunal diversity. Also the structure of Lantana vegetation affect species variety as Uetz (1991) suggested that the structure vegetation of shrubs is more complex and can support a more diverse spider community.

A comparison of guild composition can provide insight into the effect of habitat alteration and disturbance on arthropod biodiversity (Stork, 1987). This observation is in conformity with my result which shows the responses of spider abundances to different structural vegetation. So, foliage runner spiders and stalkers were the dominant guild on Lantana shrubs which had few branches. This is in accordance with De Souza & Martins (2005) who proved that foliage-runners constituted the dominant guild on Desmanthus virgatus and Banksia gardneri, which have few branches; and they suggested that branch architecture is the most important factor determining the abundance of plant-dwelling spiders in the study area independently of branch biomass, leaf surface area or texture. While Croton plants have few ground runners and stalkers but rather high abundance of aerial-orb web and space weavers. This pattern probably resulted because it is a good microhabitat for web construction due to the dense vegetation. Wandering sheet guild was the least frequent in both plants.

Moreover, in the two studied communities, the most common species were Cheiracanthium sp. (20.1%) of the total samples followed by Philodromus sp. represented by (18.9 %), then Kochiura aulica (14.6%). This result is in good agreement with Perez-Guerrero et al. (2009) who recorded the most abundant species in organic cotton crops is Cheiracanthium sp. followed by Philodromus sp.

This work is a first step in understanding the spiders' diversity and their abundance in the Orman garden. Further study will certainly reveal much more species of spiders. However, it is hoped that this study will be helpful to some extent for future workers in Egypt, and will extend research to build upon the checklist and to continue the study of the Egyptian spider fauna.

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The first record of Halodromus patellidens (Levy, 1977) (Araneae: Philodromidae) in Egypt

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Abstract

Halodromus patellidens (Levy, 1977) of family Philodromidae is recorded from Ismailia, Egypt for the first time.

Keywords: Spiders, Philodromidae, Halodromus patellidens, Ismailia, Egypt.

Introduction

Three years ago, Muster (2009) established the new genus Halodromus to include two Old World species of the Ebo-like philodromid spiders with a long patellar apophysis on the male palp (H. patellaris (Wunderlich, 1987) and H. patellidens (Levy, 1977) [Type species], both transferred from Ebo Keyserling, 1884), and described three new species from both sexes, Halodromus barbarae from Egypt (Aswan), Israel, Saudi Arabia and Spain, H. deltshevi from Yemen, and H. gershomi from Eritrea. The name Halodromus refers to the habit of hiding in salt tolerant dwarf shrubs and the relationship to some Philodromus (Rhysodromus) species. Halodromus is presumably an Afro-Syrian element with wide distribution in the Eremial of northern Africa and the Middle East (Muster, 2009).

In addition to these five species, Logunov (2011) described Halodromus vanharteni as new species, from only the male, from United Arab Emirates. He recorded both H. barbarae and H. patellidens from U.A.E. too.

Until now, the small genus Halodromus Muster, 2009 of Family Philodromidae Thorell, 1870 includes six species from northern Africa and the Middle East (Muster, 2009; Platnick, 2012) as follows:

Halodromus barbarae Muster, 2009	Canary Is., Spain, Egypt, Israel, U.A.E., Saudi Arabia
Halodromus deltshevi Muster, 2009	Yemen
Halodromus gershomi Muster, 2009	Eritrea
Halodromus patellaris (Wunderlich, 1987)	Cape Verde Is., Canary Is., Tunisia, Israel
Halodromus patellidens (Levy, 1977)	Cape Verde Is., Algeria, Tunisia, Israel, Kuwait, U.A.E., Saudi Arabia, Yemen
Halodromus vanharteni Logunov, 2011	U.A.E.

Fig. 1. Halodromus patellidens (Levy, 1977) collecting site near the sewage treatment station of Ismailia, Egypt.

Genus Halodromus is mainly diagnosed by:

1. The presence of pro- and retrolateral spines on tibiae and metatarsi of legs (unlike Ebo),
2. Leg II strongly elongated, more than 1.4 times longer than leg I (Fig. 3),
3. Male palp with patellar apophysis and philodromid tegular apophysis (Muster, 2009).

In Egypt, only Halodromus barbarae Muster, 2009 was recorded. There is only one female specimen of this species collected from Aswan on 22 June 1975 and deposited in Muséum d'Histoire Naturelle, Genève (MNHG) as one of the paratypes of H. barbarae (Muster, 2009).

Among 3324 spiders of 26 families, collected by pitfall trapping from Serabium Forest and the open desert near the sewage treatment station of Ismailia during February, May, August and November 2010, only 2♂ specimens of Halodromus were found. They were found among 43 spider specimens, 3 pseudoscorpions, and several insects fallen in two pitfall traps. The collected spiders in both traps belong to 9 families, the majority of them belong to family Gnaphosidae (17 spiders), then Philodromidae (9, including 6 Philodromus sp., 1 Thanatus sp., in addition to the 2♂ H. patellidens), and Salticidae (6). Other spiders belong to families Lycosidae (3), Dictynidae (2), Oxyopidae (2), Pholcidae (2), Araneidae (1), and Liocranidae (1).

The two males were identified as Halodromus patellidens (Levy, 1977). It is a new record in Egypt. This species can be differentiated from H. barbarae by:

– Patellar apophysis longer than tibia of male palp, philodromid tegular apophysis laminate, projecting beyond retrolateral margin of tibia .... H. patellidens

– PatApo barely half as long as tibia of male palp, PTA hooked, not projecting beyond retrolateral margin of tibia. Embolus foxtail-shaped .... H. barbarae

The locality where the two males H. patellidens were collected is from the open desert of Serabium region near the sewage treatment station of Ismailia (30°29'27"N, 32°14'29"E, elevation 10m) (Fig. 1). It is about 12 km from Ismailia city. Only 40% of the land is covered by wild vegetation, almost of Zygophyllum album and Phragmites australis.

Abbreviations used: ALE = anterior lateral eye; AME = anterior median eye; AM-AM = inter-distance between anterior median eyes; CL = cephalothorax length; ClyH = clypeus height; CW = cephalothorax width; CyL = cymbium length; L = length; PatApo = patellar apophysis of male palp; PLE = posterior lateral eye; PME = posterior median eye; PTA = philodromid tegular apophysis; RTA = retrolateral tibial apophysis; TL = total length. All measurements were taken in millimetres.

Halodromus patellidens (Levy, 1977)

(Figs. 2-6, Table 1)

Ebo patellidens Levy, 1977: 210-212, figs. 36-39 (♂♀).
Ebo patellidens Wunderlich, 1992: 504, f. 808f-g [after Levy, 1977] (♂).
Halodromus patellidens Muster, 2009: 66-69, figs. 13, 33-37 (♂♀).

Material examined: 2♂, Egypt, Ismailia governorate, Ismailia (30°29'27"N, 32°14'29"E, elevation 10m). Coll. Doaa M. Medany, 16-22 February 2010.

Description: Male (Figs. 2-6)**:** TL 2.97, CL 1.54, CW 1.54, ClyH 0.21. [Another male: TL 2.70, CL 1.11].

Carapace light brown, with sparse thick setae; cephalic part ends by white crescent shape sign with white longitudinal stripes extending forwards until the ocular area; both sides of thoracic part with blackish patches (Figs. 2-3).

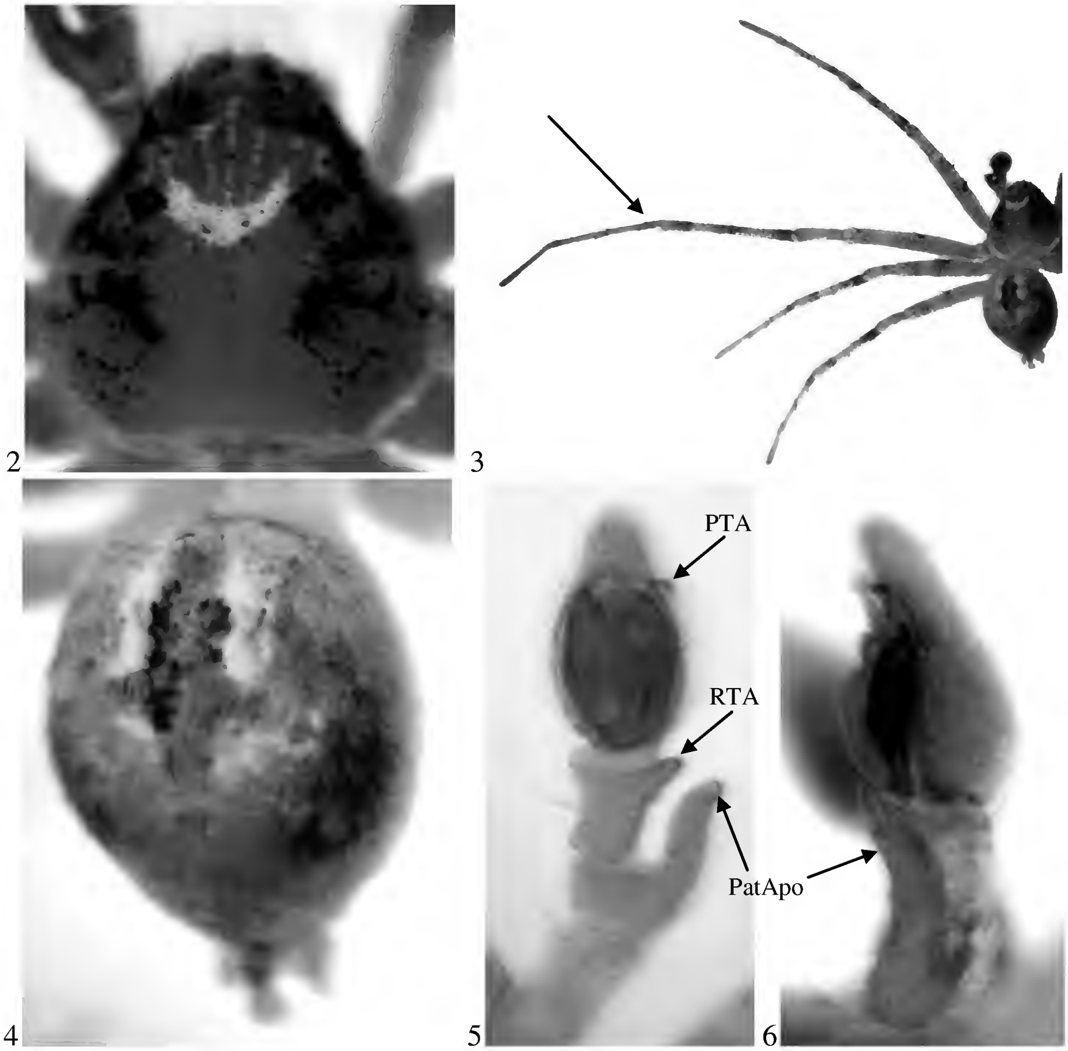
Eye sizes and interdistances: AME 0.11, ALE 0.08, PME 0.08, PLE 0.08, AME–AME 0.13, AME–ALE 0.08, PME–PME 0.24, PME–PLE 0.13, ALE–PME 0.08.

Legs and pedipalps yellowish-brown, mottled with blackish patches; leg formula II-I-IV-III (Table 1); spines few on femora, none on patellae and tarsi, numerous on tibiae and metatarsi. Spination of legs I-IV: femur dorsal 0-1-1, prolateral 0-1-1; tibia ventral 2-2-0, pro- & retrolateral 0-1-1, dorsal 0-0-1; metatarsus ventral 2-2-0, pro- & retrolateral 1-1-1.

Table 1: Legs and pedipalp measurements (mm).

Leg	I	II	III	IV	Palp
Femur	1.80	2.70	1.85	1.85	0.58
Patella	0.69	0.95	0.64	0.69	0.21
Tibia	1.70	2.60	1.43	1.43	0.32
Metatarsus	1.16	2.13	1.22	1.22	---
Tarsus	0.69	1.11	0.69	0.64	0.72
Total length	6.04	9.49	5.83	5.83	1.83

Morphometric indices:
AME size index = diameter AME/CW: 0.07.
PME interdistance index = PME-PME/PME-PLE: 1.85.
Clypeus height index = ClyH/CW: 0.14.
LegII length index = length femur II/femur I: 1.5.



Figs. 2-6: Halodromus patellidens (Levy, 1977) ♂. 2. Cephalothorax, dorsal view. 3. Habitus, dorsal view, left side, showing the strongly elongated leg II. 4. Abdomen, dorsal view. 5-6. Palp (left). 5. ventral view. 6. retrolateral view.

Pedipalp (Figs. 5-6): PatApo 0.48, CyL 0.72. Males are characterized by the exceptionally large patellar apophysis and by the large PTA that projects beyond the retrolateral margin of the cymbium (Muster, 2009). Tibia with almost rectangular processing RTA with rounded tip. Cymbial tip relatively short, less than one fourth of CyL. CyL/CW 0.47. Anterior border of tegulum indistinct, PTA large, laminar, projecting beyond retrolateral margin of cymbium, its tip pointing in ventral direction. Sperm duct forming an elongate, asymmetric loop in retrolateral half of tegulum, opening in 8 o'clock position (Muster, 2009).

Abdomen: L 1.64; grey, densely covered by whitish grey pubescence with sparse dark brown setae; with a conspicuous mid-dorsal dark cardiac mark on anterior part, between two white areas (Fig. 4).

Habitat. This species was collected from sandy area of Serabium desert region where Zygophylum album is covering 40% of the site.

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The first record of Mermessus denticulatus (Banks, 1898) (Araneae: Linyphiidae) in Egypt

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Abstract

Mermessus denticulatus (Banks, 1898) and genus Mermessus O.P.-Cambridge, 1899 of family Linyphiidae are recorded from Egypt for the first time.

Keywords: Spiders, Linyphiidae, Mermessus denticulatus, Cairo, Egypt.

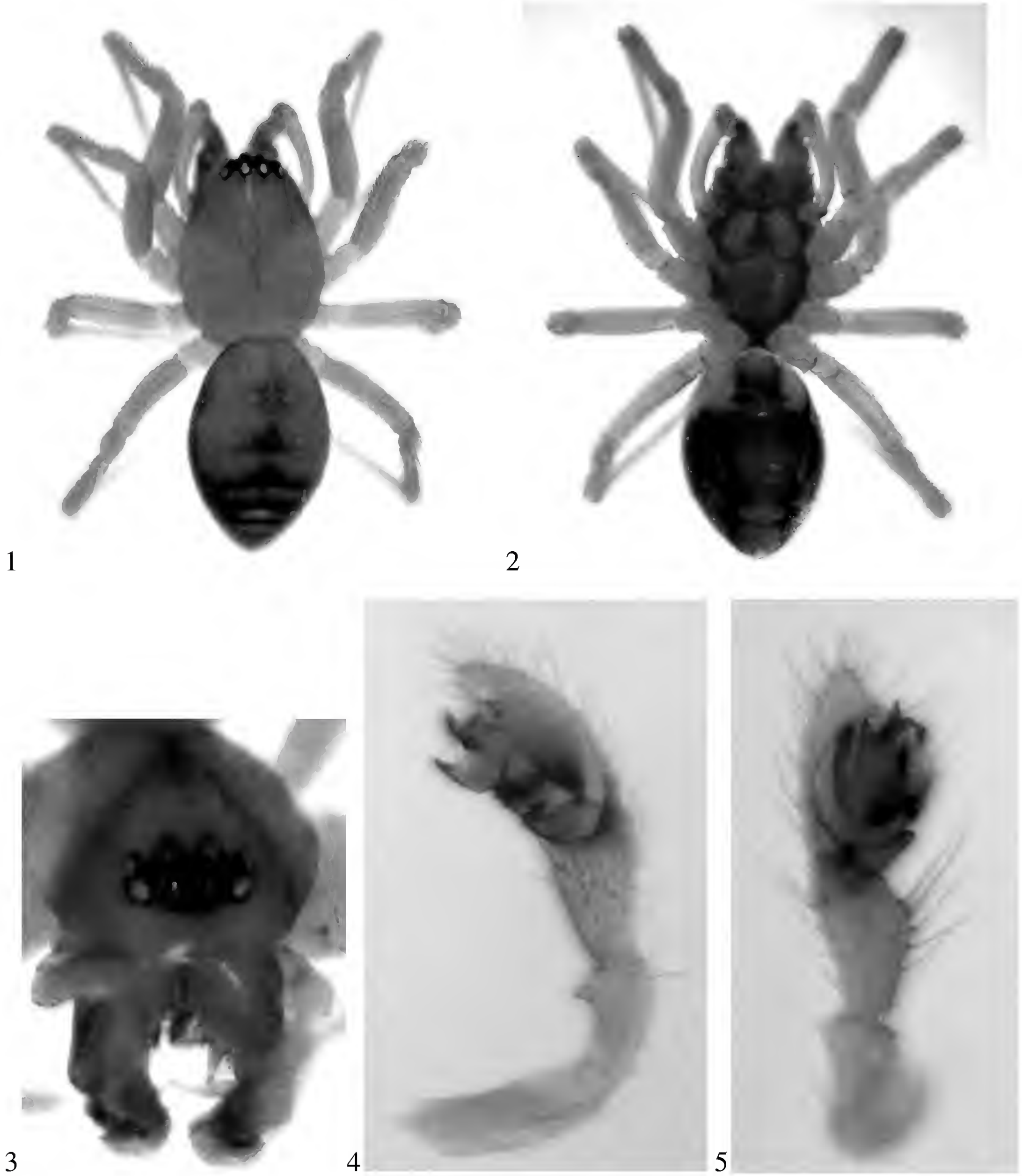
Introduction

Genus Mermessus O.P.-Cambridge, 1899 of Family Linyphiidae Blackwall, 1859 includes 80 species, mainly recorded from North and Central America [Mexico 37 (29 endemic), USA 32 (16 endemic), Canada 12 (1 endemic)], and northern South America with the exception of 6 species recorded from the Old World also [Mermessus bryantae (Ivie & Barrows, 1935) from Azores, M. denticulatus (Banks, 1898) from Europe and North Africa, M. fradeorum (Berland, 1932) from Azores, South Africa, and New Zealand (cosmopolitan), M. maculatus (Banks, 1892) from Russia, M. naniwaensis (Oi, 1960) from China and Japan, and M. trilobatus (Emerton, 1882) from Europe] (Platnick, 2012).

Banks (1898) described the female of Tmeticus denticulatus from Mexico. Crosby, in Chamberlin (1924) described the male and female of the same species as Erigone eschatologica. Crosby & Bishop (1928) described the species again and transferred it to genus Eperigone. Roewer (1942) transferred this species to genus Centromerus. Millidge (1987) redescribed Eperigone eschatologica in his revision of the genus. Klein et al. (1995) recorded Eperigone eschatologica from Germany and discussed its efficiency as a biological control agent of the whitefly Trialeurodes vaporariorum (Homoptera) in ornamental plants in glass houses. Miller (2007) transferred it from Centromerus to Mermessus. Bosmans (2007) redescribed the species from the "Maghreb", North Africa. Helsdingen & Ijland (2007) discussed the records of genus Mermessus from Europe (Spain, Germany, and Netherlands) and its species' modes of distribution. Helsdingen (2009) described in detail the genitalia of both male and female of Mermessus denticulatus as an adventive species in the Netherlands and discussed its spreading potential.

Only one male specimen of Mermessus denticulatus (Banks, 1898) was found in Heliopolis, Cairo, Egypt. It is the first record of both the species and genus Mermessus from Egypt. This new record increases the known linyphiid Egyptian fauna (El-Hennawy, 2006) to 9 species of 9 genera.

Abbreviations used: CL = cephalothorax length; CW = cephalothorax width; L = length; TL = total length. All measurements were taken in millimetres.



Figs. 1-5: Mermessus denticulatus (Banks, 1898) ♂, from Cairo, Egypt.
1-2. Habitus. 1. dorsal view. 2. ventral view. 3. Eyes and chelicerae, frontal view.
4-5. Pedipalp. 4. retrolateral view. 5. mesoventral view.

Mermessus denticulatus (Banks, 1898)
(Figs. 1-5)

Tmeticus denticulatus Banks, 1898: 243, pl. 14, f. 29 (♀).
Erigone eschatologica Crosby, in Chamberlin, 1924: 643, f. 85-88 (♂♀).
Eperigone eschatologica Crosby & Bishop, 1928: 51, f. 113-116 (♂♀).
Centromerus denticulatus Roewer, 1942: 532.
Eperigone eschatologica Millidge, 1987: 37, f. 132-136 (♂♀).
Eperigone eschatologica Klein, Stock & Wunderlich, 1995: 302, f. 4-7 [after Millidge, 1987] (♂♀).
Mermessus denticulatus Miller, 2007: 132, f. 92G-H (T♀ from Centromerus, S♂).
Eperigone eschatologica Bosmans, 2007: 124, f. 25-31 (♂♀).
Mermessus denticulatus van Helsdingen, 2009: 618, f. 1-10 (♂♀).

Material examined: 1♂, Egypt, Cairo governorate, Cairo, Heliopolis (30°05'06"N, 31°19'12"E, elevation 46m). Coll. H.K. El-Hennawy, 7 April 2012.

Description: Male (Figs. 1-2)**:** TL 2.36, CL 1.25, CW 1.01, CL/CW 1.24.

Carapace orange-brown; sides of cephalic part darker. Ocular area, among eyes, mostly blackish. Anterior median eyes smaller than other eyes, nearer to each other than to anterior lateral eyes. Posterior eyes equidistant. Chelicerae (Fig. 3) with meso-frontal tooth and a row of antero-lateral denticles (at base) or hook-shaped teeth (towards tip). Legs slender, light yellowish brown; femur I shorter than the cephalothorax.

Pedipalp (Figs. 4-5): Patella without spines, apically with a small ventral protrusion. Tibia with long hairs; dorsally with a sharply pointed dark-brown apical apophysis; tip of tibia and base of cymbium light-brown, other parts light yellow.

Abdomen (Fig. 1): L 1.17; grey with faint paler chevrons dorsally, darker posteriorly.

Habitat. The single specimen of Mermessus denticulatus from Cairo fell on my hand from a tree (arboreal?).

Acknowledgment

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S E R K E T

Volumes 1-12 (1987-2011)

List of Contents

Contents of Volume 1

Part 1, August 1987

001 - El-Hennawy, H.K. - Preliminary notes on the biology, distribution, and predatory behaviour of Pseudopompilus humboldti (Dhlb.) (Hymenoptera : Pompilidae). - pp. 1-11.
002 - El-Hennawy, H.K. - A list of Egyptian spider genera. - pp. 12-14.
003 - El-Hennawy, H.K. - A simplified key to Egyptian scorpion species (Arachnida : Scorpionida). - pp. 15-17.
004 - El-Hennawy, H.K. - Stegodyphus lineatus (Latreille) 1817 (Araneida : Eresidae) in Jordan. - p. 18.
005- El-Hennawy, H.K. - New records of Stegodyphus dufouri (Audouin) 1825 (Araneida : Eresidae) from Egypt. - p. 19.

Part 2, March 1988

006 - Hassan, A.I. - Feeding and feeding apparatus of Chaetopelma shabati Hassan, 1950. - pp. 1-12.
007 - El-Hennawy, H.K. - Scorpions of Jordan. - pp. 13-20.
008 - El-Hennawy, H.K. - A new record of Compsobuthus werneri (Birula) 1908 (Scorpionida : Buthidae) from Egypt. - p. 21.

Part 3, December 1988

009 - El-Hennawy, H.K. - Key to Pseudoscorpionid families (Arachnida : Pseudoscorpionida). - pp.1-8.
010 - El-Hennawy, H.K. - Pseudoscorpions of Egypt, key and list of species (Arachnida : Pseudoscorpionida). - pp. 9-18.
011 - El-Hennawy, H.K. - Scorpions of Jordan, additional note. - p. 19.
012 - El-Hennawy, H.K. - Hysterochelifer tuberculatus (Lucas, 1846) (Pseudoscorpionida : Cheliferidae) in Jordan. - p. 20.
013 - El-Hennawy, H.K. - Hasarius adansonii (Audouin, 1825) (Araneida : Salticidae) in Egypt. - p. 21.

Part 4-5, March 1990

014 - El-Hennawy, H.K. - Annotated checklist of Egyptian spider species (Arachnida : Araneae). - pp.1-49.

Contents of Volume 2

Part 1, September 1990

015 - El-Hennawy, H.K. - Arachnida in the diet of Acanthodactylus scutellatus (Audouin, 1825) (Reptilia : Lacertidae). - pp. 1-8.
016 - Cokendolpher, J.C. - Harvestmen of Egypt (Arachnida : Opiliones). - pp. 9-13.
017 - El-Hennawy, H.K. - Key to Scorpion families (Arachnida : Scorpionida). - pp. 14-19.
018 - El-Hennawy, H.K. - Key to Solpugid families (Arachnida : Solpugida). - pp. 20-27.

Part 2, October 1990

019 - El-Hennawy, H.K. - Bibliography of Pseudoscorpionida 1980-1989. - pp. 28-61.

Part 3, September 1991

020 - Parker, J.R. - The Revd. O. Pickard-Cambridge in Egypt. - pp. 62-69.
021 - Smith, A.M. - Tarantulas of Egypt (Araneida : Theraphosidae). - pp. 70-80.
022 - El-Hennawy, H.K. - Arachnida of Wadi El-Raiyan (Egypt). - pp. 81-90.
023 - El-Hennawy, H.K. - New locality records of Thomisidae in Egypt (Arachnida : Araneida). - pp.91-92.
024 - El-Hennawy, H.K. - Stegodyphus pacificus Pocock, 1900 (Araneida : Eresidae). A new record from Jordan. - pp. 93-94.

Part 4, January 1992

025 - El-Hennawy, H.K. - A catalogue of the scorpions described from the Arab countries (1758-1990) (Arachnida : Scorpionida). - pp. 95-153.

Contents of Volume 3

Part 1, September 1992
026 - El-Hennawy, H.K. - Distribution of spider genera in Egypt (Arachnida : Araneida). - pp. 1-32.

Part 2, August 1993
027 - Audouin, V. - Description de l'Égypte, Explication sommaire des planches d'Arachnides de l'Égypte et de la Syrie. (Edited by: H.K.El-Hennawy) (1st part). - pp. 33-76.
Part 3, September 1993 028 – Ibid. (2nd part). - pp. 77-121.
Part 4, October 1993 029 - Ibid. (3rd part). - pp. 122-171.

Contents of Volume 4

Part 1, September 1994
030 - El-Hennawy, H.K. - **Index Aranearum**. Part 1 (Liphistiidae, Atypidae, Antrodiaetidae, Cyrtaucheniidae, Idiopidae). - pp. 1-32.

Part 2, December 1994
031 - El-Hennawy, H.K. - **Index Aranearum**. Part 2 (Ctenizidae, Actinopodidae, Migidae, Mecicobothriidae, Microstigmatidae, Hexathelidae, Dipluridae). - pp. 33-62.

Part 3, December 1995
032 - El-Hennawy, H.K. - **Index Aranearum**. Part 3 (Nemesiidae, Barychelidae). - pp. 63-91.

Part 4, March 1996
033 - El-Hennawy, H.K. - **Index Aranearum**. Part 4 (Theraphosidae, Paratropididae). - pp. 92-142.

Contents of Volume 5

Part 1, December 1996
034 - Shereef, G.M., Nawar, M.S., Rakha, M.A. & Sallam, G.M.E. - Ecological studies on spiders in Giza governorate. - pp. 1-31.

Part 2, January 1997
035 - El-Hennawy, H.K. - Notes on Pseudopompilus humboldti (Dahlbom, 1845) [Hymenoptera : Pompilidae] and Stegodyphus lineatus (Latreille, 1817) [Araneida : Eresidae]. - pp. 32-39.
036 - El-Hennawy, H.K. - Bibliography of Pseudoscorpionida 1990-1995. - pp. 40-59.

Part 3, September 1997
037 - El-Hennawy, H.K. - **Index Aranearum**. Part 5 (Hypochilidae, Austrochilidae, Gradungulidae, Filistatidae, Sicariidae, Scytodidae, Drymusidae, Leptonetidae). - pp. 60-89.

Part 4, December 1997
038 - El-Hennawy, H.K. - The Genera of Spiders. - pp. 90-130.

Contents of Volume 6

Part 1, December 1998
039 - El-Hennawy, H.K. - Arachnida of Egypt. I. Order Solpugida. - pp. 1-37.

Part 2, August 1999
040 - Kovařík, F. - Review of European scorpions, with a key to species. - pp. 38-44.
041 - El-Hennawy, H.K. - Catalogue and Bibliography of Family Hersiliidae 1825-1998 (Arachnida: Araneida). - pp. 45-72.

Part 3, December 1999
042 - El-Hennawy, H.K. - Sun-spiders of the Arab countries (Arachnida : Solpugida). - pp. 73-104.

Part 4, February 2000
043 - Bayram, A., Varol, M.İ. & Tozan, İ.H. - The Spider (Araneae) fauna of the cotton fields located in the western part of Turkey. - pp. 105-114.
044 - El-Hennawy, H.K. - The first landmark in the route of Egyptian Arachnology : "Explication Sommaire des Planches d'Arachnides de l'Égypte et de la Syrie" (1825). - pp. 115-128.

SERKET volumes 1-6 (1987-2000) - List of Contents pp. 129-134.

Contents of Volume 7

Part 1, April 2000

045 - Kovařík, F. - Pandinus (Pandinops) pococki sp.n. from Somalia, and Pandinus pugilator, a junior synonym of Pandinus (Pandinops) bellicosus comb.n. (Scorpiones, Scorpionidae). - pp. 1-7.

046 - El-Hennawy, H.K. - Catalogue and Bibliography of Family Oecobiidae 1809-1995 (Arachnida: Araneida). - pp. 8-37.

Part 2, November 2000

047 - Kovařík, F. - Revision of family Chaerilidae (Scorpiones), with descriptions of three new species. - pp. 38-77.

Part 3, February 2001

048 - Kovařík, F. - Catalog of the Scorpions of the World (1758-1998) by V. Fet, W.D. Sissom, G. Lowe & M. Braunwalder (New York Entomological Society, 2000: 690 pp.) Discussion and supplement for 1999 and part of 2000. - pp. 78-93.

049 - Ali, M.O., Saber, S.A., El Menshawy, O.M., El Bakary, Z. & Sarhan, M. - A Comparative Morphological Study of the Pectines of three Scorpion species (Scorpionida, Buthidae) from Assiut, Egypt. - pp. 94-105.

050 - El-Hennawy, H.K. - Photography of Arachnids, A simple technique. - pp. 106-107.

Part 4, November 2001

051 - Metwally, A.M., Mowafi, M.H. & Mohafez, M.A. - Biological aspects of Hersilia caudata Savigny, 1825 (Arachnida: Araneida: Hersiliidae). - pp. 108-113.

052 - El-Hennawy, H.K. - Catalogue and Bibliography of Genus Cheiracanthium C. L. Koch, 1839 (Arachnida: Araneida: Miturgidae). - pp. 114-155.

Contents of Volume 8

Part 1, April 2002

053 - Kovařík, F. - A checklist of scorpions (Arachnida) in the collection of the Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany. - pp. 1-23.

054 - Metwally, A.M., El-Naggar, M.E., Mowafi, M.H. & Mohafez, M.A. - Spiders associated with economic plants in Sohag, Egypt. - pp. 24-28.

055 - El-Hennawy, H.K. - Spiders of Sinai (Egypt), a list of species (Arachnida: Araneida). - pp. 29-34.

056 - Sallam, G.M.E. - Survey and ecological studies on spiders in four governorates of Egypt. - pp. 35-42.

Part 2, October 2002

057 - McVean, A., Omran, M.A.A. & El-Nagar, M.H. - The demography of scorpion envenomation in Bedouin from St. Catherine, Sinai (Egypt), native remedies and precautions, a review on the efficacy of scorpion antivenom and a testable proposal for preventative treatment. - pp. 43-56.

058 - El-Hennawy, H.K. - Revision of the North African spider genus Dorceus C.L.Koch, 1846 (Araneida: Eresidae). - pp. 57-72.

059 - El-Hennawy, H.K. - A list of Egyptian spiders (revised in 2002). - pp. 73-83.

060 - El-Hennawy, H.K. - A seven-legged araneid spider from Egypt (Araneida: Araneidae). - pp. 84-85.

Part 3, April 2003

061 - Kovařík, F. - Eight new species of Compsobuthus Vachon, 1949 from Africa and Asia (Scorpiones: Buthidae). - pp. 87-112.

062 - El-Hennawy, H.K. & Mohafez, M.A. - Life history of Stegodyphus dufouri (Audouin, 1825) (Arachnida: Araneida: Eresidae) in Egypt, A step on the way from asocial to social. - pp. 113-124.

063 - Kovařík, F. - Butheoloides cimrmani sp. n. from Ghana (Scorpiones: Buthidae). - pp. 125-127.

Part 4, October, 2003

064 - Hussein, A.M., Hassan, M.F. & Ahmad, N. - Biological aspects of Anelosimus aulicus (C.L. Koch, 1838) (Arachnida: Araneida: Theridiidae) in Egypt. - pp. 129-134.

065 - Abo-Taka, S.M., Hussein, A.M., Osman, A.A., Zohdi, G.I. & Hamada, E.G. - Ecological studies on spider families associated with some vegetable crops (Arachnida: Araneida) in Egypt. - pp. 135-141.

066 - Abo-Taka, S.M., Hussein, A.M., Osman, A.A., Zohdi, G.I. & Hamada, E.G. - Studies on some biological aspects of Erigone dentipalpis (Wider, 1834) (Arachnida: Araneida: Linyphiidae). - pp. 142-145.

067 - Sallam, G.M. & El-Hennawy, H.K. - Biological aspects of Nurscia albomaculata (Lucas, 1846) (Arachnida: Araneida: Titanoecidae) in Egypt. - pp. 147-150.
068 - El-Hennawy, H.K. - Arachnids in three Egyptian coastal protected areas on Aqaba gulf (Red Sea). - pp. 151-163.

Contents of Volume 9

Part 1, May 2004

069 - El-Hennawy, H.K. - A new species of genus Eresus from Algeria (Araneida : Eresidae). - pp. 1-4.
070 - Abo-Taka, S.M., Hussein, A.M., Osman, A.A., Zohdi, G.I. & Hamada, E.G. - Studies on some biological aspects of Theridion melanostictum O.P.-Cambridge, 1876 (Arachnida: Araneida : Theridiidae). - pp. 5-9.
071 - El-Hennawy, H.K. - Spider studies in Egypt, A review. - pp. 10-24.
072 - El-Hennawy, H.K. - Review of spiders of genus Eresus in Egypt (Araneida : Eresidae). - pp. 25-35.

Part 2, October 2004

073 - Sallam, G.M.E. - Life Cycle of Steatoda paykulliana (Walckenaer, 1805) in Egypt (Araneida : Theridiidae). - pp. 37-40.
074 - Abdel-Nabi, I., McVean, A., Abdel-Rahman, M. & Omran, M.A. - Intraspecific diversity of morphological characters of the burrowing scorpion Scorpio maurus palmatus (Ehrenberg, 1828) in Egypt (Arachnida: Scorpionida: Scorpionidae). - pp. 41-67.
075 - El-Hennawy, H.K. - Oecobius amboseli Shear & Benoit, 1974, a new record from Egypt (Araneida : Oecobiidae). - pp. 68-71.

Part 3, May 2005

076 - El-Hennawy, H.K. - Arachnids in Mediterranean protected areas of Egypt. - pp. 73-84.
077 - Topçu, A., Seyyar, O., Demir, H. & Kunt, K.B. - Anagraphis pallens Simon, 1893, a new record from Turkey (Araneae : Prodidomidae). - pp. 85-86.
078 - El-Hennawy, H.K. - A new species of genus Eresus from Algeria and Tunisia (Araneida : Eresidae). - pp. 87-90.
079 - Zaher, M.A., El-Hennawy, H.K., Hassan, M.F., Hussein, A.M. & Ahmad, N.F.R. - Survey and populations of spiders and other arthropods in cucurbit and legume fields in Al-Kanater (Egypt). - pp. 91-100.
080 - Habashy, N.H., Ghallab, M.M. & Rizk, M.A. - Spider populations associated with different types of cultivation and different vegetable crops in Fayoum Governorate (Egypt). - pp. 101-107.

Part 4, October 2005

081 - Topçu, A., Demir, H. & Seyyar, O. - A Checklist of the spiders of Turkey. - pp. 109-140.
082 - El-Hennawy, H.K. - Redescription of Pardosa iniqua (O.P.-Cambridge, 1876) (Araneida : Lycosidae) from Egypt. - pp. 141-144.

Contents of Volume 10

Part 1, May 2006

083 - Karataş, A. - Distribution of the “Euscorpius carpathicus” complex (Scorpiones: Euscorpiidae) in Turkey. - pp. 1-8.
084 - Karataş, A. - Distribution and Systematic Status of Euscorpius italicus (Herbst, 1800) (Scorpiones: Euscorpiidae) in Turkey. - pp. 9-17.
085 - Topçu, A., Demir, H. & Seyyar, O. - Cave dwelling spiders (Araneae) of Turkey. - pp. 18-24.
086 - Kaya, R.S., Uğurtaş, İ.H. & Bayram, A. - A new record for the Turkish spider fauna: Oecobius cellariorum (Dugès, 1836) (Araneae: Oecobiidae). - pp. 25-28.
087 - El-Hennawy, H.K. - White widow, Latrodectus pallidus (Araneida: Theridiidae), in Jordan and Egypt. - pp. 29-34.
088 - Abdel-Karim, E.H., Rady, G.H.H., Ibrahim, G.A. & Ahmad, N.F.R. - Biology, mass rearing and observations on the behaviour of Kochiura aulica (C. L. Koch, 1838) (Arachnida: Araneida: Theridiidae). - pp. 35-43.
089 - Mohafez, M.A. - Life history of Cheiracanthium isiacum O.P.-Cambridge, 1874 (Arachnida: Araneida: Miturgidae) in Egypt. - pp. 44-47.

Part 2, October 2006

090 - Seyyar, O., Demir, H. & Topçu, A. - A contribution to the gnaphosid spider fauna of Turkey (Araneae: Gnaphosidae). - pp. 49-52.
091 - Stewart, A.K. - Mitigating scorpion-sting syndrome in the Middle East: understanding the substratum preferences of Androctonus crassicauda (Olivier, 1807) (Scorpiones: Buthidae). - pp. 53-64.
092 - El-Hennawy, H.K. - A list of Egyptian spiders (revised in 2006). - pp. 65-76.

Part 3, April 2007

093 - Bayram, A., Danışman, T., Sancak, Z., Yiğit, N. & Çorak, İ. - Contributions to the spider fauna of Turkey: Arctosa lutetiana (Simon, 1876), Aulonia albimana (Walckenaer, 1805), Lycosa singoriensis (Laxmann, 1770) and Pirata latitans (Blackwall, 1841) (Araneae: Lycosidae). - pp. 77-81.
094 - Bayram, A., Danışman, T., Yiğit, N., Çorak, İ. & Sancak, Z. - Three linyphiid species new to the Turkish araneo-fauna: Cresmatoneta mutinensis (Canestrini, 1868), Ostearius melanopygius (O.P.-Cambridge, 1879) and Trematocephalus cristatus (Wider, 1834) (Araneae: Linyphiidae). - pp. 82-85.
095 - Demir, H., Aktaş, M., Topçu, A. & Seyyar, O. - A contribution to the crab spider fauna of Turkey (Araneae: Thomisidae). - pp.86-90.
096 - Yağmur, E.A., Koç, H., Kesmezoğlu, S. & Yalçın, M. - Scorpions of Kilis Province, Turkey (Arachnida: Scorpiones). - pp. 91-105.
097 - El-Hennawy, H.K. - A seven-legged pholcid spider from Egypt (Araneida: Pholcidae). - pp. 106-107.

Part 4, November 2007

098 - Seyyar, O. & Demir, H. - A new locality for Charinus ioanniticus (Kritscher, 1959) (Amblypygi: Charinidae) in Turkey. – pp. 109-111.
099 - Türkeş, T. & Mergen, O. - The comb-footed spiders fauna of the Central Anatolia Region and new records of theridiid spiders (Araneae: Theridiidae) for the Turkish fauna. – pp. 112-119.
100 - Demir, H., Aktaş, M. & Topçu, A. - A review of the genus Synema Simon, 1864 (Araneae: Thomisidae) in Turkey with a new record, Synema utotchkini Marusik & Logunov, 1995. - pp. 120-122.
101 - Seyyar, O., Demir, H. & Topçu, A. - Three new ground spider records for the Turkish spider fauna (Araneae: Gnaphosidae). – pp. 123-124.
102 – Kaya, R.S., Uğurtaş, İ.H. & Akkaya, A. - Oecobius maculatus Simon, 1870 (Araneae: Oecobiidae) a new record for the Turkish spider fauna. – pp. 125-129.
103 - El-Hennawy, H.K. - Sun-spiders of Turkey (Arachnida: Solpugida), list of species and key to genera. – pp. 130-134.

SERKET volumes 1-10 (1987-2007) - List of Contents pp. 135-141.

Contents of Volume 11

Part 1, May 2008

* El-Hennawy, H.K. - *Between sorrow and happiness.* – p. 1.
104 - Kurt, K., Demir, H., Seyyar, O. & Topçu, A. - Some harvestmen records (Arachnida: Opiliones) from Niğde Province of Turkey. – pp. 2-6.
105 - Demir, H. - An updated checklist of the Philodromidae (Araneae) of Turkey with zoogeographical remarks. – pp. 7-12.
106 - Yağmur, E.A., Yalçın, M. & Çalışır, G. - Distribution of Androctonus crassicauda (Olivier, 1807) and Buthacus macrocentrus (Ehrenberg, 1828) (Scorpiones: Buthidae) in Turkey. – pp. 13-18.
107 - Kunt, K.B., Yağmur, E.A. & Ülgezer, V. - Antistea elegans (Blackwall, 1841) (Araneae: Hahniidae), a new record of a comb-tailed spider from Turkey. – pp. 19-22.
108 - El-Hennawy, H.K. - Review of the Oonopidae of Egypt (Arachnida: Araneae). – pp. 23-36.

Part 2, November 2008

109 - Demir, H. - An updated checklist of the Thomisidae (Araneae) of Turkey with zoogeographical remarks. – pp. 37-50.
110 - Seyyar, O., El-Hennawy, H.K., Demir, H. & Türkeş,T. - The first record of genus Pax (Araneae: Zodariidae) in Turkey. - pp. 51-54.
111 - Kunt, K.B., Yağmur, E.A. & Tezcan, E. - Three new records for the spider fauna of Turkey (Araneae: Araneidae, Palpimanidae, Theridiidae). – pp. 55-61.
112 - Yağmur, E.A., Kunt, K.B. & Yalçın, M. - The first record of family Hersiliidae from Turkey (Arachnida: Araneae). – pp. 62-64.

113 - El-Hennawy, H.K. - Sun-spiders of Sudan (Arachnida: Solpugida), [Introductory study]. – pp. 65-77.

Part 3/4, December 2009

114 - Özşen, Ö. & Türkeş, T. - The first record of genus Phintella (Araneae: Salticidae) in the Turkish spider fauna. – pp. 79-81.

115 – Marusik, Y.M. & Kunt, K.B. - Spiders (Araneae) new to the fauna of Turkey. 7. New species and genera records of Linyphiidae. – pp. 82-86.

116 - Kaya, R.S., Yağmur, E.A. & Kunt, K.B. - The first record of genus Neospintharus Exline, 1950 (Araneae: Theridiidae) from Turkey. – pp. 87-92.

117 - Kunt, K.B., Yağmur, E.A., Danışman, T., Bayram, A. & Kaya, R.S. - Genus Uroctea Dufour, 1820 (Araneae: Oecobiidae) in Turkey. – pp. 93-101.

118 - Ahmad, N.F.R., Ibrahim, G.A., El-Sherbeny, A.H. & Rady, G.H.H. - Kochiura aulica (C. L. Koch, 1838) (Araneida: Theridiidae) against greenhouse pests. – pp. 102-109.

119 - El-Hennawy, H.K. - Arachnida of Ain Gudeirat (Sinai), with notes on family Titanoecidae in Egypt. – pp. 110-118.

120 - El-Hennawy, H.K. - Scorpions of Saudi Arabia (List of species, their distribution, and identification key). – pp. 119-128.

121 - El-Hennawy, H.K. - Eresidae of Sudan (Araneida: Eresidae).- pp. 129-137.

Contents of Volume 12

Part 1, May 2010

122 - Khalil, N. & Yağmur, E.A. - Leiurus abdullahbayrami (Scorpiones: Buthidae), a new species for the scorpion fauna of Syria. pp. 1-6.

123 - Kaya, R.S., Kunt, K.B., Marusik, Y.M. & Yağmur, E.A. - The first record of genus Argyrodes Simon, 1864 (Araneae: Theridiidae) from Turkey. – pp. 7-12.

124 - Seyyar, O. & Demir, H. - New records of ground spiders from Turkey (Araneae: Gnaphosidae). – pp. 13-16.

125 - Demir, H., Aktaş, M. & Topçu, A. - Additional notes on crab spider fauna of Turkey (Araneae: Thomisidae and Philodromidae). – pp. 17-22.

126 - El-Hennawy, H.K. - Hersiliidae of Sudan (Araneida: Hersiliidae). – pp. 23-31.

Part 2, November 2010

127 - Kurt, K., Eman, Ö.K., Demir, H. & Seyyar, O. - The Turkish Harvestmen (Opiliones) with zoogeographical remarks. – pp. 33-44.

128 - Özdikmen, H., Kurt, K. & Demir, H. - A new name for a preoccupied specific epithet in the genus Metaphalangium Roewer, 1911 (Opiliones: Phalangiidae). – pp. 45-46.

129 - Uyar, Z., Kaya, R.S. & Uğurtaş, İ.H. - Systematics of the philodromid spider fauna of Uludağ Mountain region (Araneae: Philodromidae) with a review of the Philodromidae in Turkey. - pp. 47-60.

130 - El-Hennawy, H.K. - Notes on Spiders of Africa – I.– pp. 61-75.

Part 3, April 2011

131 - Kielhorn, K.H. - First record of Eresus algericus El-Hennawy, 2004 from Israel (Arachnida: Araneae). – pp. 77-79.

132 - Uyar, Z. & Uğurtaş, İ.H. - New record species of Diaea Thorell, 1869 (Araneae: Thomisidae) for the Turkish spider fauna, with a review of the Thomisidae of Turkey. – pp. 80-86.

133 - Danışman, T., Öztürk. N. & Ulusoy, M.R. - Two new theridiid records from Turkey (Theridiidae: Araneae). – pp. 87-90.

134 - El-Hennawy, H.K. - Notes on Spiders of Africa – II (Madagascar, Seychelles, Aldabra, Comoro Is., Réunion, Mauritius, and Rodriguez). – pp. 91-112.

Part 4, December 2011

135 - El-Hennawy, H.K. - The first record of Cheiracanthium molle in Saudi Arabia. – pp. 113-116.

136 - Karabulut, H. & Türkeş, T. - New records of Linyphiidae (Araneae) for Turkish araneo-fauna. – pp. 117-123.

137 - Türkeş, T. & Demir, H. - Thomisidae and Philodromidae (Araneae) of the Central Anatolia Region, with a new record for Turkey. – pp. 124-134.

138 - Demircan, N. & Topçu, A. - New records of family Lycosidae (Araneae) in Turkey. – pp. 135-140.

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List of Contents - Systematic

Arachnida – Amblypygida - Araneida - Opilionida - Pseudoscorpionida - Scorpionida – Solpugida & Hymenoptera (Pompilidae)

Hymenoptera - Family Pompilidae (Spider wasps)

Opilionida (Opiliones, Harvestmen)

Pseudoscorpionida (Pseudoscorpiones, False Scorpions)

Scorpionida (Scorpiones)

* The superscript number = 1st, 2nd, 3rd, … author.

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New Species, New Names

Araneida, Araneae

Cheiracanthium siwi El-Hennawy, 2001 from Egypt	(Serket, 7(4): 114-155).
(A new name of C. tenue Denis, 1947, a primary junior homonym of C. tenue L. Koch, 1873).	
Eresus algericus El-Hennawy, 2004 from Algeria	(Serket, 9(1): 1-4).
Eresus jerbae El-Hennawy, 2005 from Tunisia & Algeria	(Serket, 9(3): 87-90).
Hersiliola eltigani El-Hennawy, 2010 from Sudan	(Serket, 12(1): 23-31).

Scorpionida, Scorpiones

Pandinus (Pandinops) pococki Kovařík, 2000 from Somalia	(Serket, 7(1): 1-7).
Chaerilus petrzelkai Kovařík, 2000 from Vietnam	(Serket, 7(2): 38-77).
Chaerilus tichyi Kovařík, 2000 from Malaysia	
Chaerilus tryznai Kovařík, 2000 from China (Tibet),	
Compsobuthus becvari Kovařík, 2003 from Pakistan	(Serket, 8(3): 87-112).
Compsobuthus jakesi Kovařík, 2003 from Iraq	
Compsobuthus kabateki Kovařík, 2003 from Egypt	
Compsobuthus kafkai Kovařík, 2003 from Iran	
Compsobuthus kaftani Kovařík, 2003 from Iran	
Compsobuthus plutenkoi Kovařík, 2003 from Iran	
Compsobuthus seicherti Kovařík, 2003 from Sudan	
Compsobuthus sobotniki Kovařík, 2003 from Iran	
Butheoloides cimrmani Kovařík, 2003 from Ghana	(Serket, 8(3): 125-127).

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12 volumes, 47 parts, 1676 pages, 141 papers, 80 authors of 9 countries [1 from: Czech Republic, France, Germany, Russia, Syria; 2 U.S.A.; 3 U.K.; 34 from Egypt; and 36 from Turkey]
New species names: 4 spiders and 13 scorpions

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