European Journal of Taxonomy 733: 87–124
https://doi.org/10.5852/ejt.2021.733.1225
ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2021 · Armiach Steinpress I. *et al.*

Research article

urn:lsid:zoobank.org:pub:22EF594A-81C2-4C8B-AF9A-0DC86C3B5BA3

Synopsis of the Evippinae (Araneae, Lycosidae) of Israel, with description of a new species

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Abstract. Evippinae (Araneae, Lycosidae) is a subfamily of old-world lycosids, comprising six genera and 67 species, most of them typically found in xeric habitats. Although Israel is located between the two distribution-centers of the subfamily, Africa and central Asia, only two species of the genus *Evippa* Simon, 1882, namely *E. arenaria* (Audouin, 1826) and *E. praelongipes* (O. Pickard-Cambridge, 1871), and a doubtful record of *Xerolycosa nemoralis* (Westring, 1861) were reported previously. Here we describe a new species: *Evippa amitaii* sp. nov., and re-describe and report a new record for Israel of *E. onager* (Simon, 1895 sensu Šternbergs 1979). Additionally, the genus *Evippomma* Roewer, 1959 is recorded for the first time from the Middle East, with a description of the previously unknown female of *Evippomma simoni* Alderweireldt, 1992. We discuss the possible vicariance of *Evippa arenaria* and *E. praelongipes*. We suggest that the dispersal of *E. arenaria* along the coastal plain is blocked by the Yarqon river valley. We suggest competition with a similar species (*Pardosa subsordidatula* (Strand, 1915)) as a factor affecting the seasonal activity of *E. arenaria*. Additionally, we present a partial molecular phylogeny of Evippinae, to clarify the placement of *E. onager*, a species with an unusual morphology.

Keywords. *Evippa*, *Evippomma*, vicariance, xeric habitat.

Armiach Steinpress I., Alderweireldt M., Cohen M., Chipman A. & Gavish-Regev E. 2021. Synopsis of the Evippinae (Araneae, Lycosidae) of Israel, with description of a new species. *European Journal of Taxonomy* 733: 87–124. https://doi.org/10.5852/ejt.2021.733.1225

Introduction

Lycosidae Sundevall, 1833 is a family of medium-sized to large entelegyne spiders, easily recognized by a combination of characters: three-row eye-arrangement, the lack of a Retrolateral Tibial Apophysis (RTA) (in males) and carrying the egg sac attached to the spinnerets and hatchlings on the body (in females) (Dippenaar-Schoeman & Jocqué 1997). It is the fifth largest family of spiders, with over 2400 described species (World Spider Catalog 2020). Lycosids inhabit most terrestrial habitats, from the Arctic Circle to the tropics and from rainforests to deserts (Bowden & Buddle 2012; Dippenaar-Schoeman & Jocqué 1997; Silva 1996). With some exceptions, lycosids are ground-dwelling, active hunters, either vagrant or burrowing (Dippenaar-Schoeman & Jocqué 1997). The family Lycosidae was traditionally divided into five subfamilies: Allocosinae, Lycosinae, Pardosinae, Sosippinae, and Venoniinae (Dondale 1986). However, recent studies using new techniques are challenging this division (Jiman & Daxiang 1996; Murphy *et al.* 2006; Piacentini 2019). A recent phylogeny suggested nine subfamilies, supported by molecular analysis: Allocosinae, Artoriinae, Hippasinae, Lycosinae, Sosippinae, Tricassinae, Venoniinae, Zoicinae and Evippinae (Piacentini 2019).

The subfamily Evippinae comprises 67 species in six genera (Roewer 1959; World Spider Catalog 2020; Zyuzin 1985), with all six represented in Africa. Little is known about the life histories of most Evippinae species. While three genera (*Proevippa* Purcell, 1903; *Pseudevippa* Simon, 1910; *Zenonina* Simon, 1898) are endemic to sub-Saharan Africa, the other three genera (*Evippa* Simon, 1882; *Evippomma* Roewer, 1959; *Xerolycosa* Dahl, 1908) are distributed across the dry parts of tropical, sub-tropical, temperate and continental regions of the old world (*Xerolycosa* alone can be found in boreal climates (Lyubechanskii 2012)). Evippinae was elevated by Zyuzin (1985) to a subfamily level from the tribe Evippeae, which was first suggested by Roewer (1959). Zyuzin (1985) recognized one synapomorphy for this group: the embolus enters the tegular apophysis (referred to as median apophysis, in Alderweireldt 1991; Alderweireldt 1992; Alderweireldt & Jocqué 2017), forming a single structural complex with it. Roewer (1959) recognized a different distinguishing feature for Evippinae: metatarsus IV shorter than patella IV + tibia IV. However, many somatic characters used by Roewer are given very little value in modern taxonomy (e.g., Alderweireldt & Jocqué 1992). Apart from this character, Evippinae was described by Roewer as similar to the Pardosinae, although today Evippinae is considered more closely related to the Venoniinae, based on molecular data (Murphy *et al.* 2006; Piacentini 2019). According to Zonstein & Marusik (2013), three species of Evippinae have been reported from Israel to date: *Evippa arenaria* (Audouin, 1826); *E. praelongipes* (O. Pickard-Cambridge, 1871) and *Xerolycosa nemoralis* (Westring, 1861). Of these, the report of *X. nemoralis* by Bodenheimer (1937) is considered doubtful (Zonstein & Marusik 2013).

Evippa Simon, 1882, with 38 species, is the most species-rich genus in the subfamily (World Spider Catalog 2020). *Evippa* is highly derived, distinguished easily from other Evippinae by three synapomorphies: elongated tarsal claws, pseudoarticulation of the tarsus and a transverse depression in the carapace, posterior to the ocular area (Alderweireldt 1991). It is found mostly in arid climates, from East Africa to the deserts of Mongolia and China (World Spider Catalog 2020).

Evippomma Roewer, 1959 comprises seven species, distinguished from other Evippinae by two synapomorphies: short leaf-shaped setae covering the body like scales; 4–5 pairs of ventral spines on

tibia I (plus an apical pair) (Alderweireldt 1992). It is found mostly in arid climates in Africa (World Spider Catalog 2020).

Here we studied historical material deposited in collections and collected fresh material, to revise the species of Evippinae in Israel and examine their distributions and seasonal activity.

Material and methods

This synopsis is based on material deposited at the Israel National Arachnid Collection, the National Natural History Collections (NNHC), at the Hebrew University of Jerusalem (HUJ). The samples were preserved in 70% ethanol or absolute ethanol (for DNA extraction) and identified using relevant literature (Šternbergs 1979; Alderweireldt 1991, 1992; Marusik, *et al.* 2003).

Morphological analysis and distribution maps

Measurements are in mm. Epigynes were detached and temporarily cleared with clove oil. Specimens were examined and measured using a Nikon SMZ25 stereo microscope. Digital microscope images were taken using NIS-elements imaging system with a Nikon DS Fi2 digital camera mounted on a Nikon SMZ25 stereo microscope. Habitus images were taken with a Nikon D7100. Images were edited and drawings generated using GIMP ver. 2.6.10. The distribution map was generated with Inkscape ver. 0.48. Transliterated names of the localities in Israel and Palestine follow the 'Israel Touring Map'(1:250 000) and 'List of Settlements', published by the Israel Survey, Ministry of Labor. Coordinates are given in decimal degrees (DD). Coordinates estimated from Google maps by the locality name are in square brackets, coordinates taken in situ with a GPS are without brackets.

Anatomical abbreviations used in text and figures

A	=	atrium
ALE	=	anterior lateral eyes
AME	=	anterior median eyes
C	=	conductor
CY	=	cymbium
E	=	embolus
Fe	=	femur
Mt	=	metatarsus
Pa	=	patella
PME	=	posterior median eyes
RTA	=	retrolateral tibial apophysis
S	=	septum
SA	=	spermatheca
SD	=	sperm duct
SP	=	subapical process
ST	=	subtegulum
T	=	tegulum
TA	=	tegular apophysis
TAT	=	tegular apophysis tip
TER	=	terminal apophysis (as used by Barrientos *et al.* 2015)
Ti	=	tibia
Tr	=	tarsus

Molecular analysis

DNA was extracted from the legs of eight specimens (Table 1) of five species of lycosids, using the BioVision Insect Genomic DNA Kit (Catalog #: K1412), following the protocol provided with the product (except that the samples were incubated in proteinase K overnight, rather than 30 minutes). Two mitochondrial markers were amplified by PCR using general primers (Table 2) and sequenced bidirectionally with Sanger sequencing. We retrieved a ~650 bp long fragment of cytochrome c oxidase I (COI) and a ~600 bp long fragment of NADH dehydrogenase subunit 1 (NADH). All sequences are deposited in GenBank (see Table 1). To these we added the corresponding COI and NADH fragments from six lycosid species retrieved from GenBank (see Table 1). These two markers were selected for their proven utility in lycosid phylogeny (Piacentini & Ramírez 2019). The sequences were edited and aligned using MEGA 10 (Kumar *et al*. 2018). We constructed a maximum likelihood phylogenetic tree, with MEGA 10 (Kumar *et al*. 2018), using the Tamura-Nei substitution model. Nodal support was estimated by running 10 000 non-parametric bootstrap replicates.

Results

Class Arachnida Cuvier, 1812
Order Araneae Clerck, 1757
Family Lycosidae Sundevall,1833

Subfamily **Evippinae** Zyuzin, 1985

Diagnosis

Zyuzin defined this subfamily by the character "The embolus enters the tegular apophysis, forming a single structural complex with it" (Zyuzin 1985: 48). Roewer recognized this distinguishing feature for Evippinae (at the time, tribe Evippeae): Metatarsus IV shorter than patella IV + tibia IV (Roewer 1959). Roewer's character is invalid for identification, as *Evippa amitaii* sp. nov. deviates from these proportions.

Description

Small- to medium-sized lycosids (Figs 1–5), superficially similar to Pardosinae and Lycosinae in somatic appearance, but distinct in genital structure (Figs 6–13). Anterior eye row narrower than second eye row (PME). Tibia I with 2–6 pairs of ventral spines (apart from apical pair). Spinnerets not elongated. Body densely covered with short (often specialized) setae (Alderweireldt 1992) (Figs 1, 14). Sexual dimorphism usually weak (Figs 4–5) (but see section about *Evippomma* (Figs 1–2, 4–5)). Zyuzin (1985) described the Evippinae as having an embolus encased in a sheath of transparent tissue (Figs 6–8); embolus base in mesoapical position, partly flattened, lying against cymbium; bent sharply near tip, inserted into tegular apophysis, forming single structure. Epigyne atria very shallow, pale, conspicuous; septum with narrow base, often covered with setae; spermathecae usually large and conspicuous (Figs 10–11, 13). Coloration variable; carapace often with median band (Figs 1–3). Certain genera (*Evippa, Zenonina*) have a derived habitus, clearly discernible from other lycosid genera (Roewer 1959; Alderweireldt 1991, 1992; Marusik Kovblyuk & Koponen 2011).

Natural history

Most species inhabit deserts, steppes and savannas, but species of open patches in and along forests (*Xerolycosa* spp.) are known. Zyuzin (1985) described *Xerolycosa* as found in dry conifer forests, steppes and arable land, while *Evippa* inhabits flood plains, semideserts and deserts, often as a sole representative of Lycosidae. They are largely presumed vagrant (Alderweireldt & Jocqué 2017), although burrow construction behavior is known from species of *Xerolycosa* (Marusik *et al.* 2011) and *Evippomma* (Bayer *et al.* 2017). Both diurnal and nocturnal activity has been observed (Zyuzin 1985;

Table 1. Specimens used for molecular phylogeny.

Species	Specimen ID	gene	GenBank accession	source
Alopecosa albofasciata (Brullé, 1832)	P6A 7039	COI	MH763780.1	Just *et al.* 2019
***Evippa* sp.**	NIBGE SPD-00947	COI	MK154832.1	Ashfaq *et al.* 2019
Evippa arenaria (Audouin, 1826)	HUJ INV-Ar 20313	COI	MT560596	This study
Evippa arenaria (Audouin, 1826)	HUJ INV-Ar 20313	NADH	MT559069	This study
Evippa arenaria (Audouin, 1826)	HUJ INV-Ar 20319	COI	MT560597	This study
Evippa arenaria (Audouin, 1826)	HUJ INV-Ar 20319	NADH	MT559070	This study
Evippa onager Simon, 1895 sensu Šternbergs	HUJ INV-Ar 20314	COI	MT560593	This study
Evippa onager Simon, 1895 sensu Šternbergs	HUJ INV-Ar 20314	NADH	MT559068	This study
Evippa onager Simon, 1895 sensu Šternbergs	HUJ INV-Ar 20315	COI	MT560592	This study
Evippa onager Simon, 1895 sensu Šternbergs	HUJ INV-Ar 20315	NADH	MT559067	This study
Evippa praelongipes (O. Pickard-Cambridge, 1871)	HUJ INV-Ar 16562	COI	MT560599	This study
Evippa praelongipes (O. Pickard-Cambridge, 1871)	HUJ INV-Ar 16562	NADH	MT559072	This study
Evippa praelongipes (O. Pickard-Cambridge, 1871)	HUJ INV-Ar 20317	COI	MT560598	This study
Evippa praelongipes (O. Pickard-Cambridge, 1871)	HUJ INV-Ar 20317	NADH	MT559071	This study
***Evippomma* sp.**	CAS 9029020	COI	–	Luis Piacentini, pers. com.
***Evippomma* sp.**	CAS 9029020	NADH	MK524650	Piacentini & Ramirez 2019
Evippomma simoni Alderweireldt, 1992	HUJ INV-Ar 16579	COI	MT560594	This study
***Lycosa* sp.**	HUJ INV-Ar 20318	COI	MT560595	This study
Pirata piraticus (Clerck, 1757)	BIOUG06991-A10	COI	KM839375.1	Blagoev *et al*. 2016
Pirata piraticus (Clerck, 1757)	MACN-Ar 35321	NADH	MK524663.1	Piacentini & Ramirez 2019
Xerolycosa miniata (C.L. Koch, 1834)	ZFMK-DNA-100425649	COI	KY270253.1	Astrin *et al.* 2016*
Xerolycosa nemoralis (Westring, 1861)	ZFMK-TIS-2534437	COI	KY270273.1	Astrin *et al.* 2016*
Xerolycosa nemoralis (Westring, 1861)		NADH	DQ019710.1	Murphy *et al.* 2006

* Direct submission to Gen Bank by Astrin J., Hoefer H., Spelda J., Holstein J., Bayer S., Hendrich L., Huber B.A., Kielhorn K.-H., Krammer H.-J., Lemke M., Monje J.C., Moriniere J., Rulik B., Petersen M., Janssen H. and Muster C.

Table 2. Primers used for molecular phylogeny.

Name	Sequence	Gene	Direction	Source
LepF1	ATTCAACCAATCATAAAGATATTGG	COI	F	Hebert *et al.* 2004
LCO1490	GGTCAACAAATCATAAAGATATTGG	COI	R	Folmer *et al.* 1994
LepR1	TAAACTTCTGGATGTCCAAAAAATCA	COI	R	Hebert *et al.* 2004
HCO2198	TAAACTTCAGGGTGACCAAAAAATCA	COI	F	Folmer *et al.* 1994
TL-1-N-12718	TGCATTAGAATTAGAATCTA	NADH	F	Piacentini & Ramirez 2019
M510	ATACTAATTCKGATTCKCCTTC	NADH	R	Piacentini & Ramirez 2019

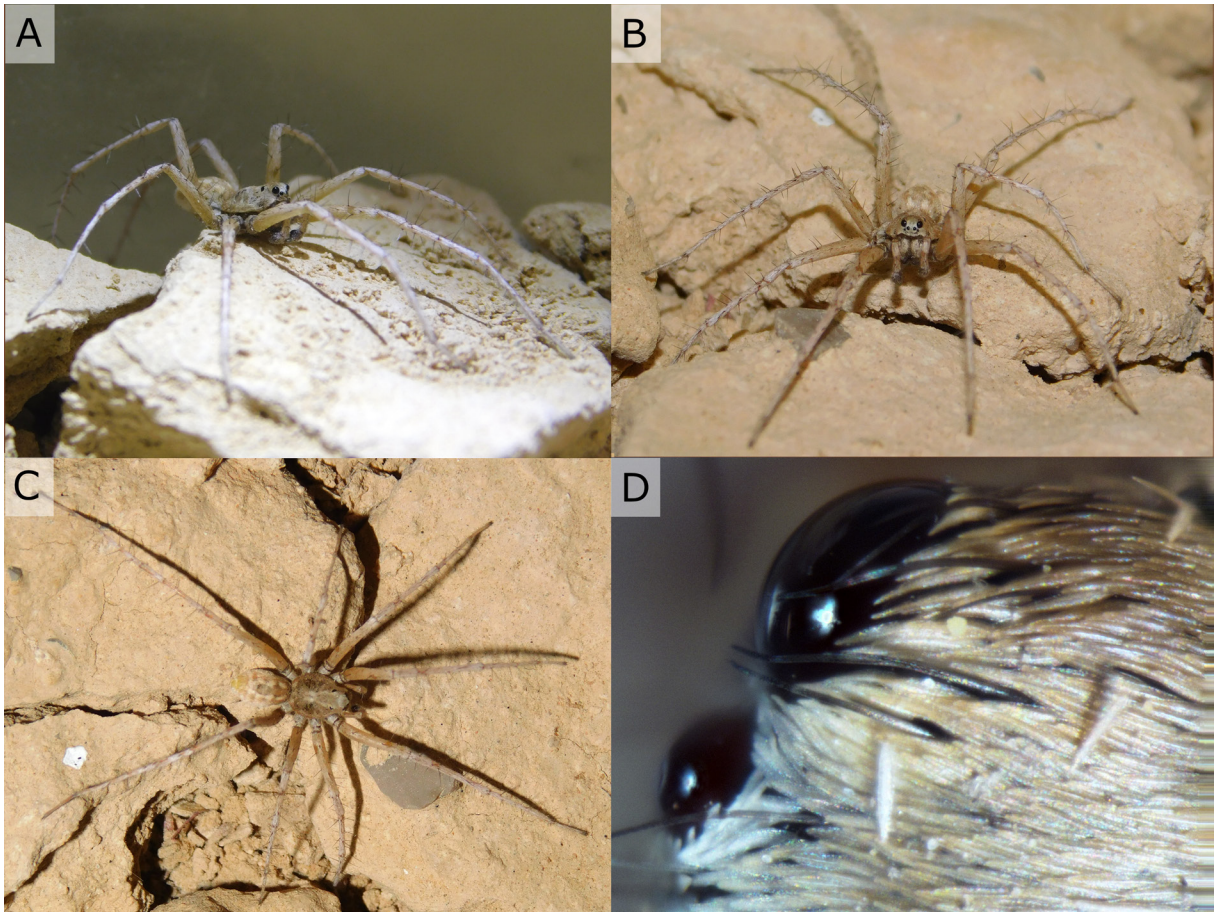

Fig. 1. *Evippomma simoni* Alderweireldt, 1992. Live ♂ (HUJ INV-Ar 16579), Mamshit, Apr. 2018. **A**. Lateral view. **B**. Frontal view. **C**. Dorsal view. **D**. Cephalic region in dorsal view, right side. Leaf-shaped setae discernible. Photos by I. Armiach Steinpress.

I. Armiach Steinpress, pers. obs.). As in all lycosids, the female carries the egg sac attached to her spinnerets and carries the young on her body for some time after hatching (I. Armiach Steinpress, pers. obs.).

Distribution

The subfamily is restricted to the Old World where it is widely distributed, except in the polar region, wet tropics and wet subtropics. *Xerolycosa* is found across the Palearctic, from Europe to Japan (with a doubtful species from Zanzibar). *Proevippa*, *Pseudevippa* and *Zenonina* are restricted to sub-Saharan Africa. *Evippomma* is found in Africa and India (Indian species might belong to a different genus). *Evippa* is found across arid and semiarid climates throughout Africa and Eurasia, from Tanzania to Siberia (World Spider Catalog 2020).

Relationships

Molecular studies that included *Xerolycosa* tend to place it in a rather basally branching position in Lycosidae, away from the Lycosinae (Park *et al.* 2007; Zehethofer & Sturmbauer 1998). Murphy *et al.* (2006) have placed *Xerolycosa* as a sister taxon of the venoniin genera *Aulonia* (C.L. Koch, 1847) and *Hygrolycosa* (Dahl, 1908) (Venoniinae was not recovered in the study). A recent molecular phylogeny

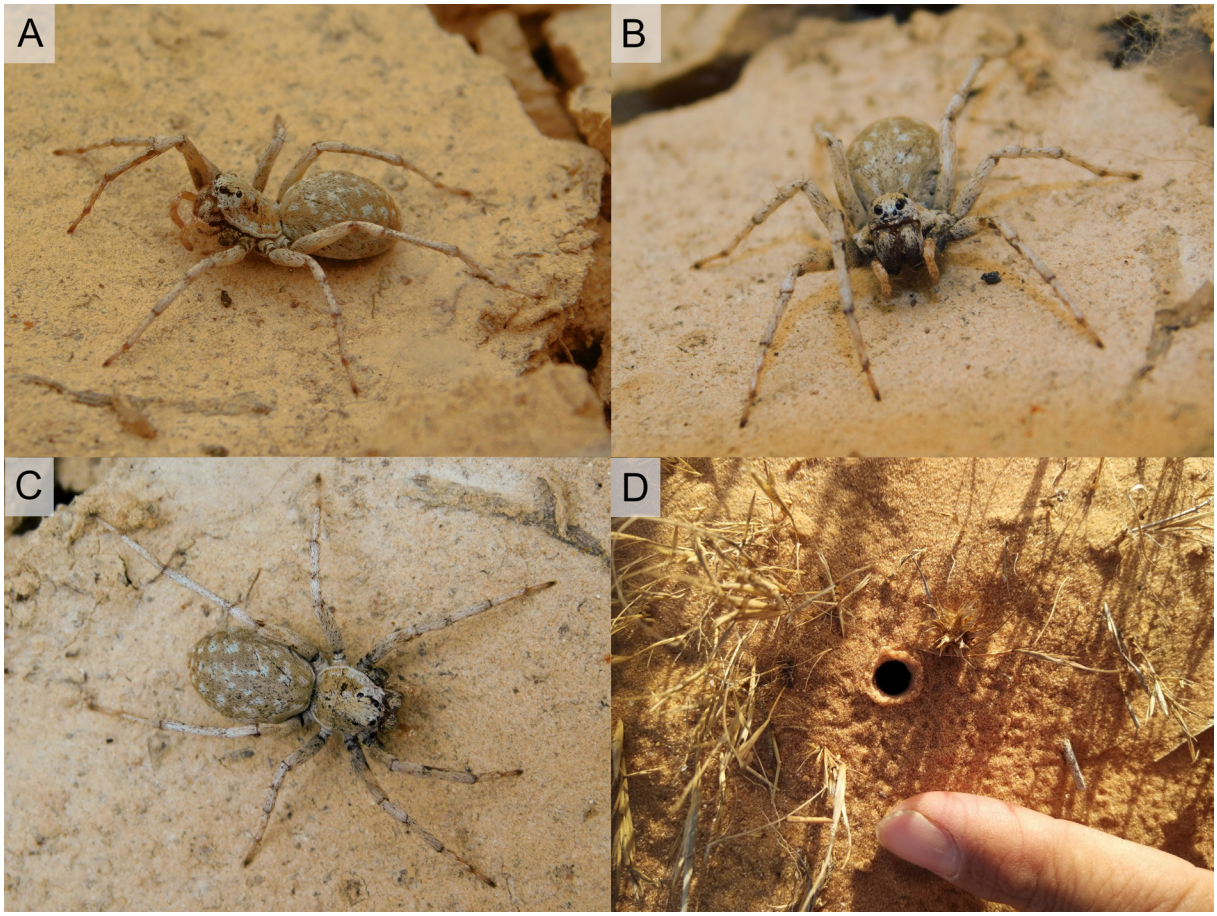

Fig. 2. *Evippomma simoni* Alderweireldt, 1992, a live ♀, (HUJ INV-Ar 20421), Mash'abbim sands, 16 June 2020. **A**. Lateral view. **B**. Frontal view. **C**. Dorsal view. **D**. Burrow in the field. Photos A–C by I. Armiach Steinpress; photo D by S. Aharon.

included for the first time three representatives of Evippinae: *Proevippa*, *Xerolycosa*, and *Evippomma*, and recovered Evippinae as monophyletic (Piacentini 2019).

Composition

Evippinae consists of 67 species in six genera: 38 species in *Evippa* Simon, 1882; seven species in *Evippomma* Roewer, 1959; eleven species in *Proevippa* Purcell, 1903; one species in *Pseudevippa* Simon, 1910; four species in *Xerolycosa* Dahl, 1908; and six species in *Zenonina* Simon, 1898.

Key to the genera of Evippinae (based on: Roewer 1959; Alderweireldt 1991, 1992; Marusik *et al.* 2011). Spines are counted in pairs, as in Alderweireldt 1991.

1. Abdomen triangular, widest distally. Spinnerets ventral, not seen in dorsal view ..... ***Zenonina*** Simon, 1898
– Abdomen oval, widest in the middle. Spinnerets distal, seen in dorsal view 2

2. Body covered with flat, leaf-shaped setae (Figs 1D, 14B) ..... ***Evippomma*** Roewer, 1959
– Body covered with regular (round profile) setae (Fig. 14A) 3

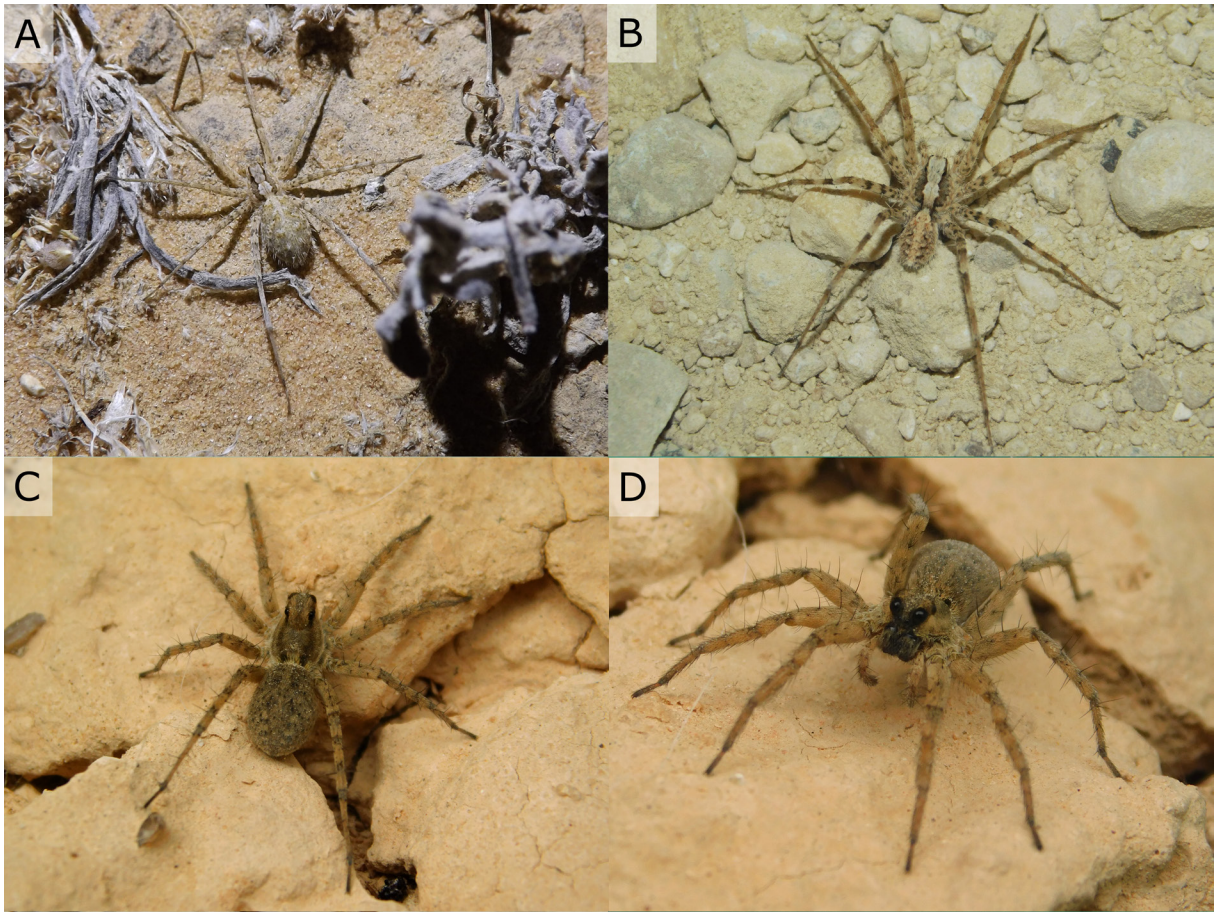

Fig. 3. ♀♀, live specimens. **A**. *Evippa arenaria* (Audouin, 1826) (Ze'elim, 21 Jul. 2015), dorsal view. **B**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (Nahal Ashalim, 13 Apr. 2018), dorsal view. **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 20314, Biq'at 'Uvda ('Uvda valley), 13 Mar. 2018), dorsal view. **D**. *E. onager* (HUJ INV-Ar 20314, Biq'at 'Uvda ('Uvda valley), 13 Mar. 2018), frontal view. Photos by I. Armiach Steinpress.

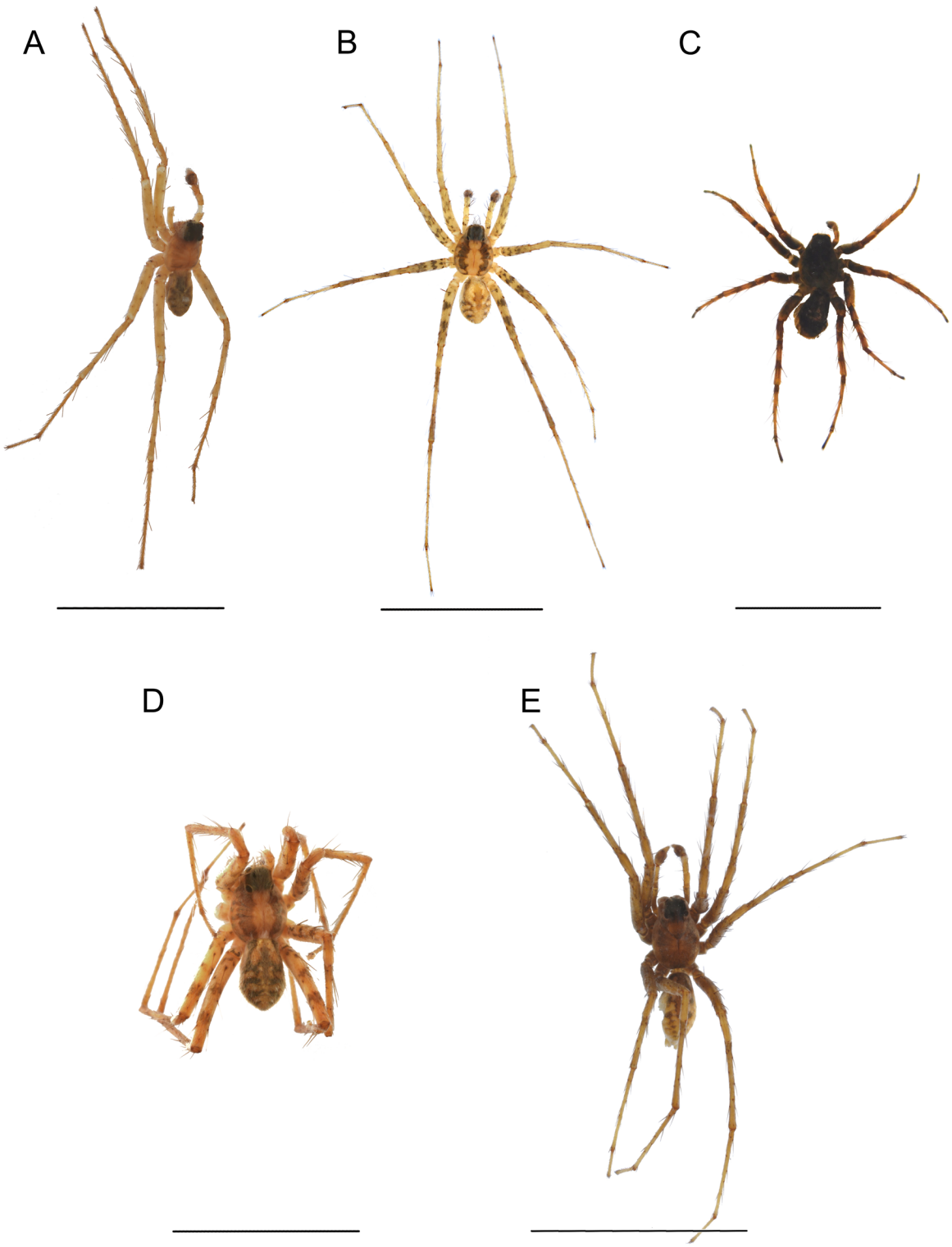

Fig. 4. ♂♂, habitus. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16051). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16508). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 20316). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16041). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16049). Scale bars = 10 mm. Photos by A. Uzan.

3. Tibia I with 4–5 ventral spines, apart from distal pair ..... ***Xerolycosa*** Sundevall, 1833
– Tibia I with more than 5 ventral spines, apart from distal pair 4

4. Tibia I with 3–4 pairs of ventral spines (apart from distal pair) 5
– Tibia I with 5–6 pairs of ventral spines (apart from distal pair) ..... ***Evippa*** Simon, 1882

5. Metatarsus I with 2 pairs of ventral spines (apart from distal pair) ..... ***Pseudevippa*** Simon, 1910
– Metatarsus I with 3 pairs of ventral spines (apart from distal pair) ..... ***Proevippa*** Purcell, 1903

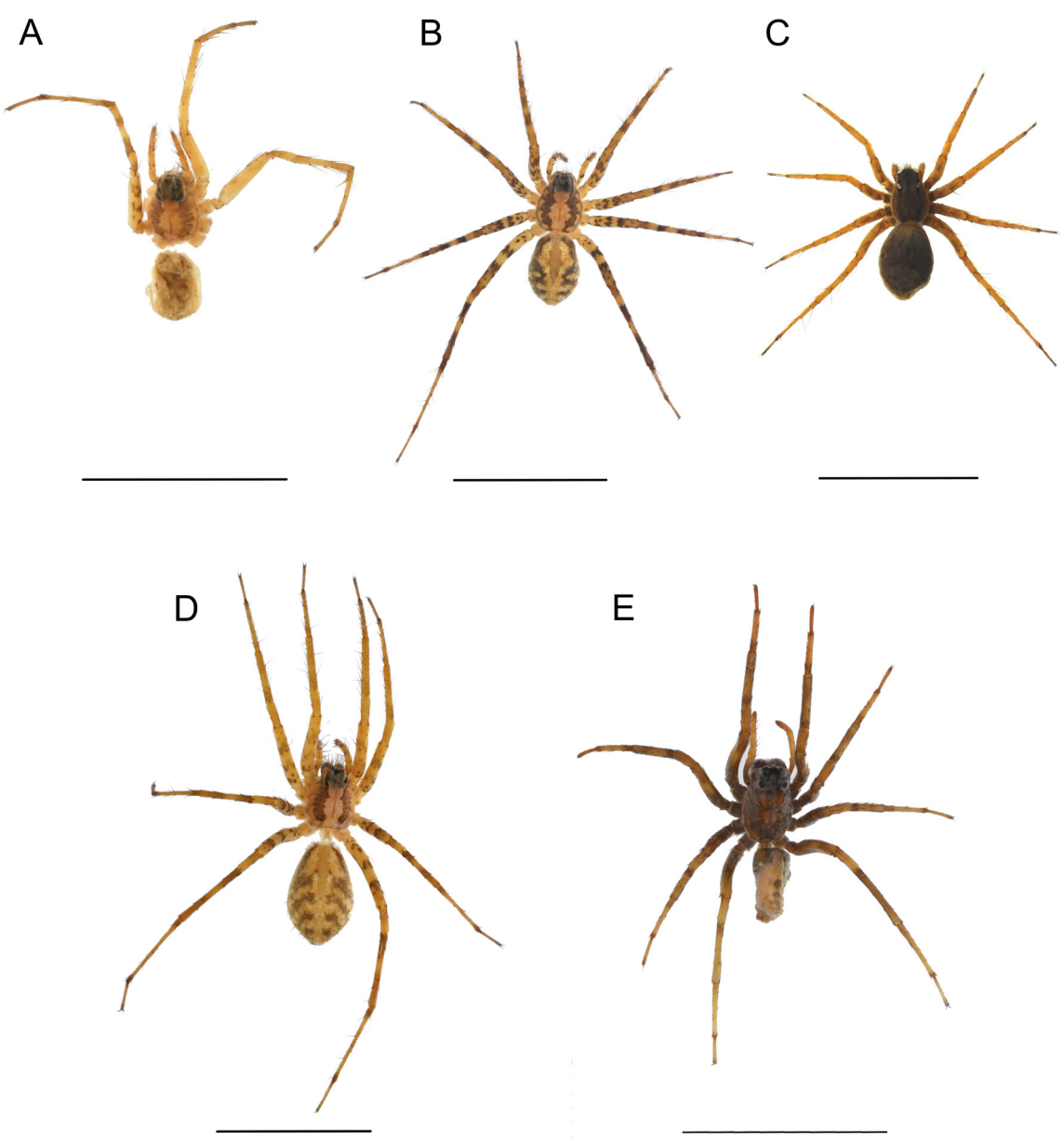

Fig. 5. ♀♀, habitus. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16048). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16507). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 16510). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16044). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16544). Scale bars = 10 mm. Photos by A. Uzan.

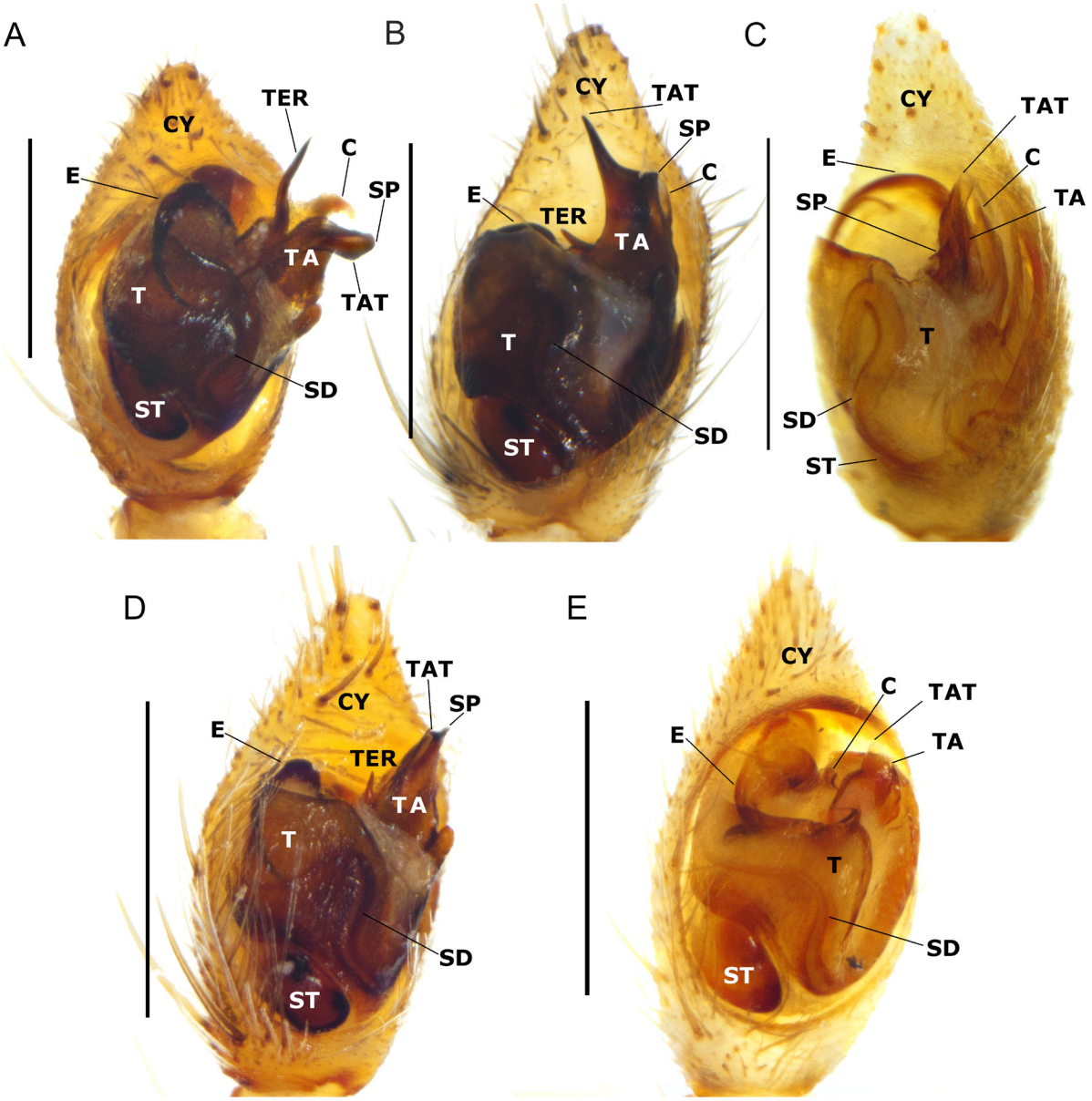

Fig. 6. ♂♂, left palp, ventral view. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16051). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16508). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 *(*HUJ INV-Ar 16510). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16531). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16538). Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

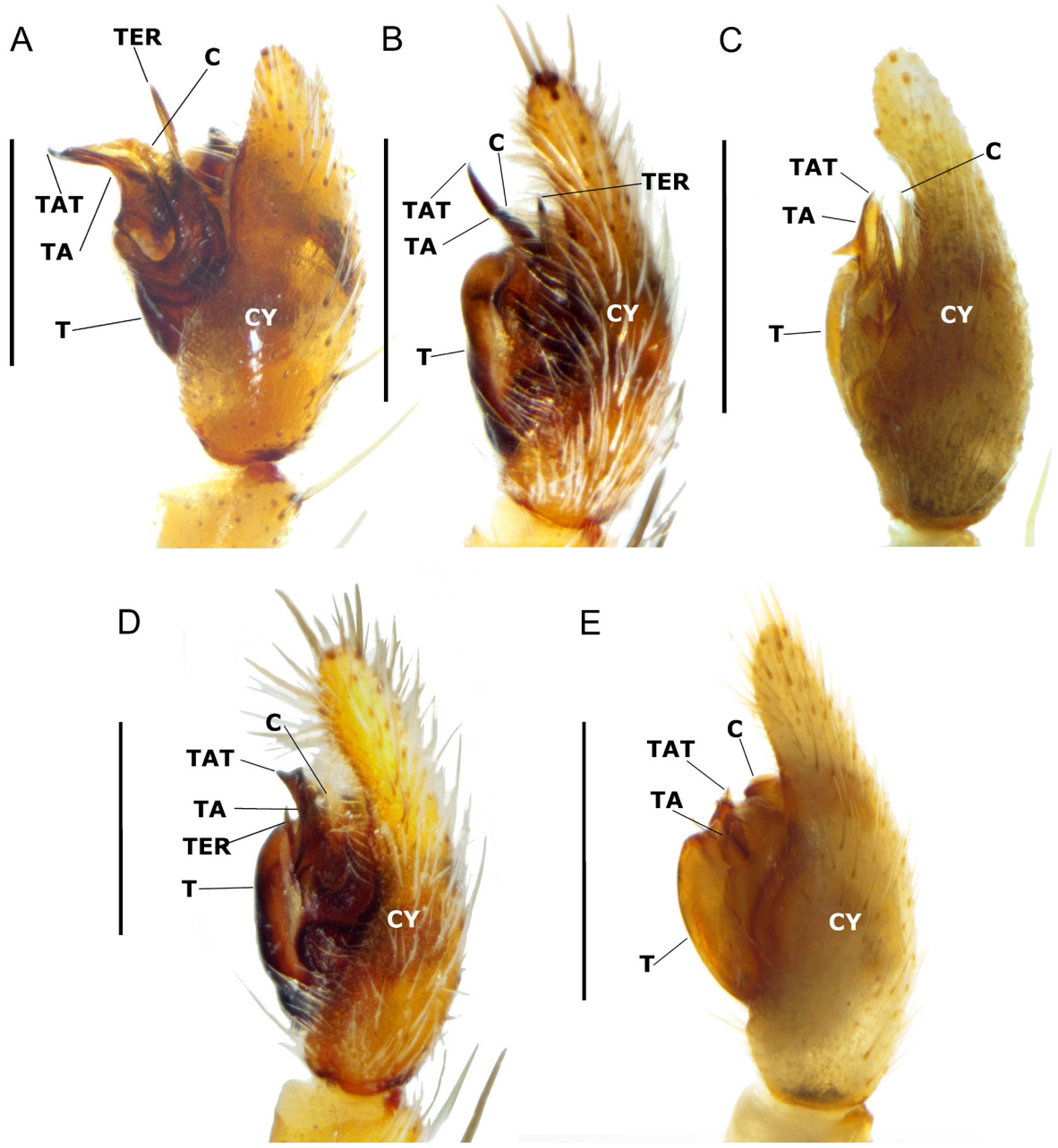

Fig. 7. ♂♂, left palp, retrolateral view. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16051). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16508). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 *(*HUJ INV-Ar 16510). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16531). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16538). Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

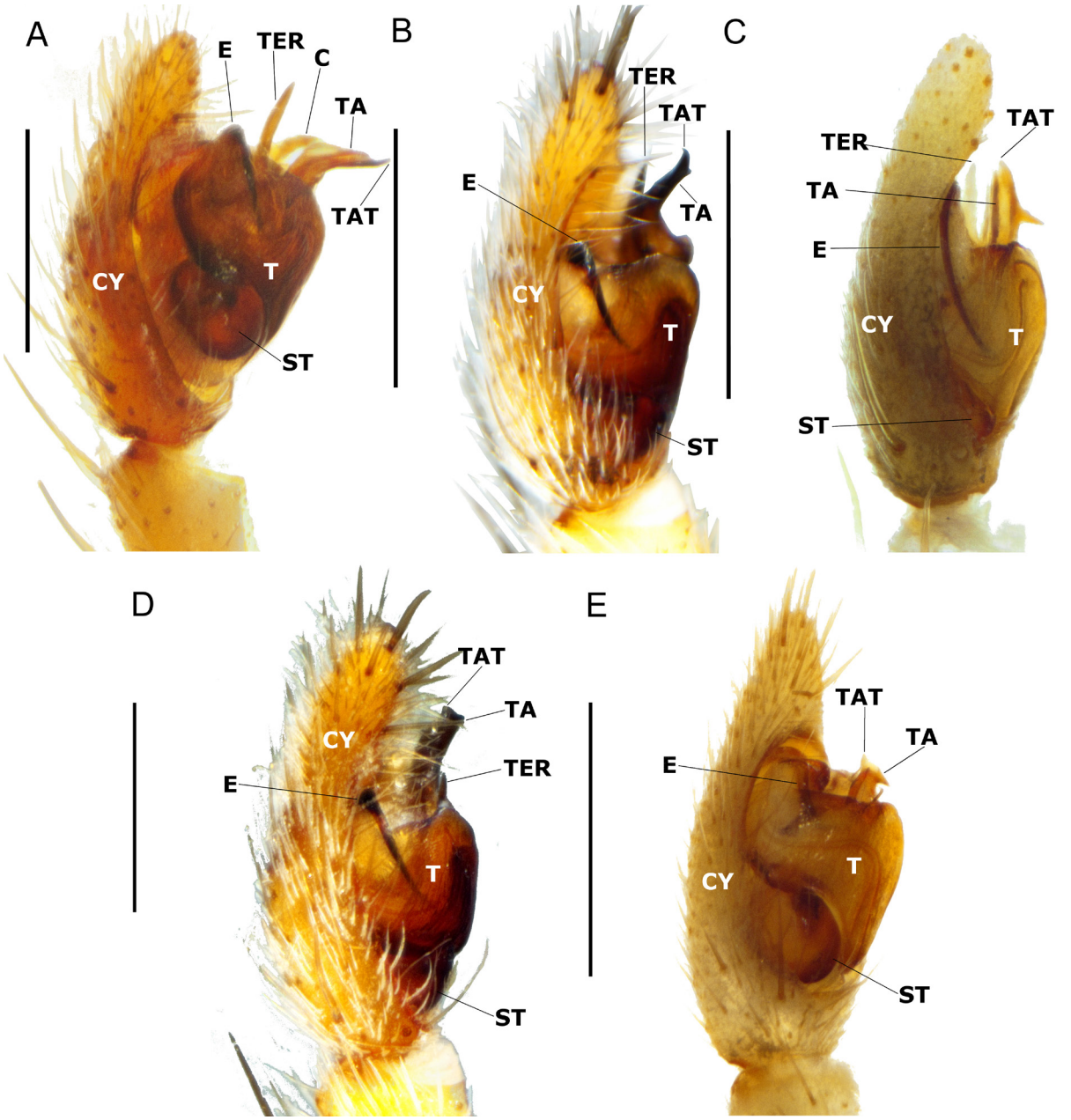

Fig. 8. ♂♂, left palp, prolateral view. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16051). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16508). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 16510). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16531). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16538). Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

Evippa Simon, 1882
Figs 3–13

Evippa Simon, 1882: 367.

Type species

Evippa arenaria (Audouin, 1826)

Diagnosis

Evippa is distinguished easily from all other lycosids by a combination of characters: elongated tarsal claws, 5–6 pairs of ventral spines on tibia I (apart from apical pair), transverse depression in carapace posterior to ocular area (Fig. 3) (Alderweireldt 1991).

Description

Small- to medium-sized lycosids. Cephalic region elevated, separated from thoracic region by transverse depression. Ocular area almost as wide as cephalic region, adorned with long, forward-pointing setae. Clypeus vertical. Anterior row of eyes procurved, narrower than PME. AME larger than ALE. Labium wider than long. Most species with long, slender legs (see *E. onager*; Fig. 3). Claws usually long, toothed near base. Tarsi of many species with pseudoarticulation. Tibia I with 5–6 pairs of spines (apart from apical pair). Coloration cryptic, usually mottled yellow or brown (Fig. 3). Carapace usually with pale median band. Body covered with short setae throughout (Fig. 14A) (Alderweireldt 1992). Male and female of similar appearance. Embolus large; base in meso-apical position (Figs 6–9, 12). Epigyne usually with well-developed, pale atria (Figs 10, 13). Spermathecae large, sperm ducts twisted (Figs 11, 13) (Tikader & Malhotra 1980; Alderweireldt 1991).

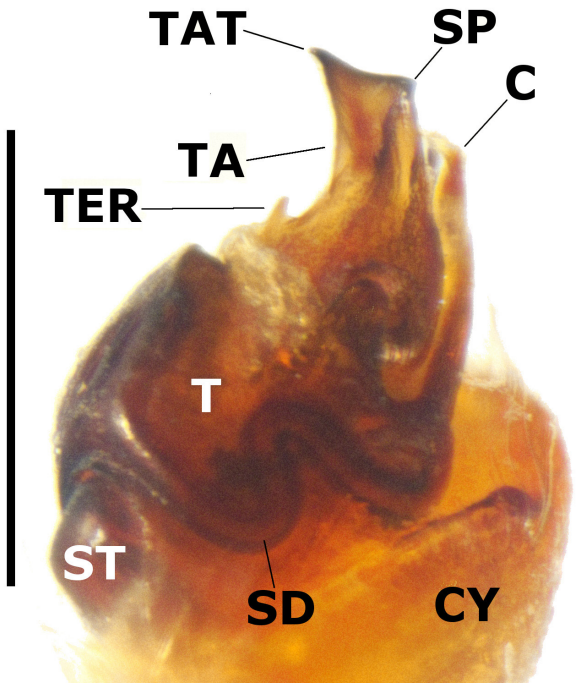

Fig. 9. *Evippa amitaii* sp. nov., ♂ (HUJ INV-Ar 16051), bulb of left palp, proximal view. Photo by I. Armiach Steinpress. Scale bar = 0.3 mm.

Natural history

Evippa species inhabit deserts, steppes and savannas, often on sandy, clay or salt-covered plains (Barrientos *et al.* 2015; Ponomarev & Tsvetkov 2004) (Fig. 15), although mountain-dwelling species are known (Tikader & Malhotra 1980). All species are presumed vagrant (Alderweireldt & Jocqué 2017). Diurnal activity has been observed (I. Armiach Steinpress, pers. obs.) but most activity is crepuscular and nocturnal (Alderweireldt & Jocqué 2017). Adults in warm climates are observed active during most of the year (Barrientos *et al.* 2015).

Distribution

The species of *Evippa* are distributed in arid and semiarid environments across Eurasia and Africa. Eight species are reported from Africa, four species are reported from Europe, and 34 are reported from Asia (13 from Central Asia, nine from India, nine from the Middle East, seven from China and one from Siberia) (World Spider Catalog 2020). In Israel four species are found.

Relationships

The genus appears to be closely related to *Pseudevippa* Simon, 1910, from which it is distinguished by the number of ventral spines on tibia I (Alderweireldt 1991).

Key to the genus *Evippa* in Israel

1. Carapace longer than ⅓ length of leg I ..... ***Evippa onager*** Simon, 1895 sensu Šternbergs 1979
– Carapace shorter than ⅓ length of leg I 2

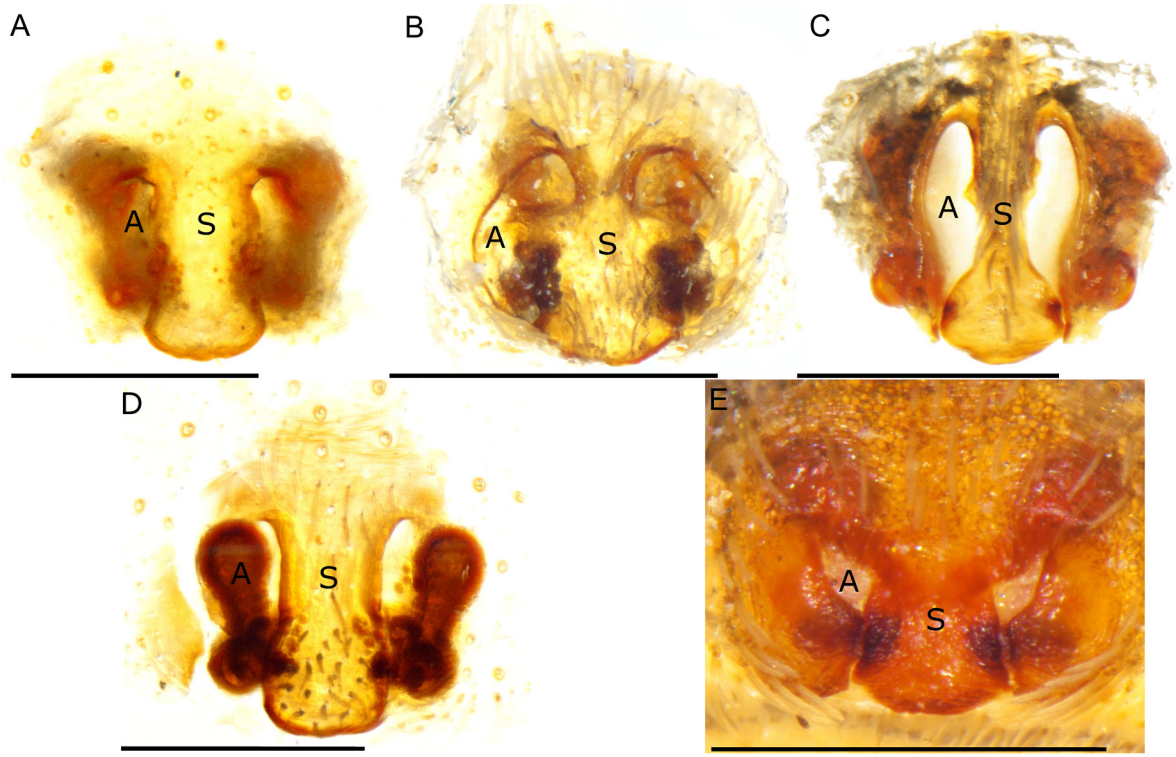

Fig. 10. ♀♀, genitalia, ventral view. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16053). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16058). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 20314). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16521). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16543). Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

2. Females 3
– Males 5

Females

3. Epigynal septum greatly constricted proximally. Epigynal atria curved proximally towards each other (Fig. 10B) ..... ***Evippa arenaria*** (Audouin, 1826)
– Epigynal septum not constricted proximally. Epigynal atria approximately parallel (Figs 10A, D, 13) 4

4. Epigynal septum with smooth edges, widening only towards ends (Fig. 10D) .... ***Evippa praelongipes*** (O. Pickard-Cambridge, 1871)
– Epigynal septum edge with small tooth or terrace (Figs 10A, 13A, C) ..... ***Evippa amitaii*** sp. nov.

Males

5. Terminal apophysis (process between tegular apophysis and cymbium, as used by Barrientos *et al.* 2015) at least at 40° angle to tegular apophysis (Figs 7A, 8A, 12) ..... ***Evippa amitaii*** sp. nov.
– Terminal apophysis approximately parallel to tegular apophysis (Figs 7B–D, 8B–D) 6

6. Subapical process branches off at less than ⅓ of MA length from tegular apophysis tip (Figs 7D, 8D) ..... ***Evippa praelongipes*** (O. Pickard-Cambridge, 1871)
– Subapical process branches off at more than ⅓ of MA length from tegular apophysis tip (Fig. 6B) ..... ***Evippa arenaria*** (Audouin, 1826)

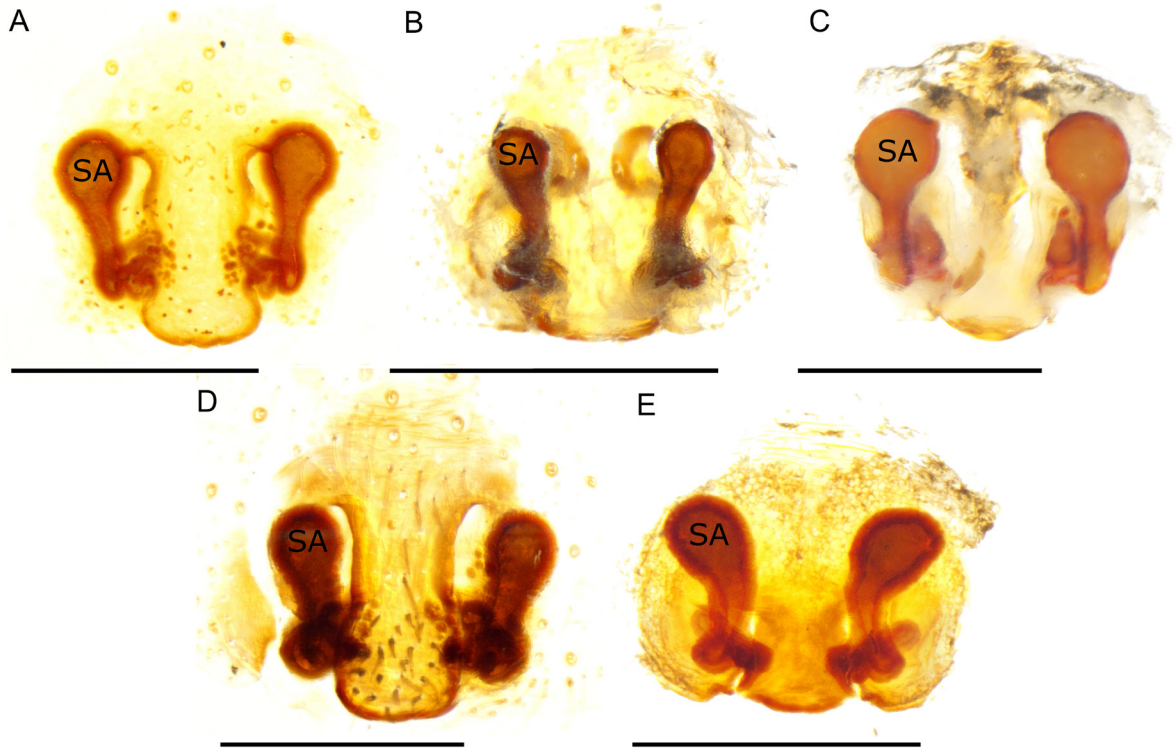

Fig. 11. ♀♀, genitalia, dorsal view. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16053). **B**. *E. arenaria* (Audouin, 1826) (HUJ INV-Ar 16058). **C**. *E. onager* Simon, 1895 sensu Šternbergs 1979 (HUJ INV-Ar 20314). **D**. *E. praelongipes* (O. Pickard-Cambridge, 1871) (HUJ INV-Ar 16521). **E**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16543). Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

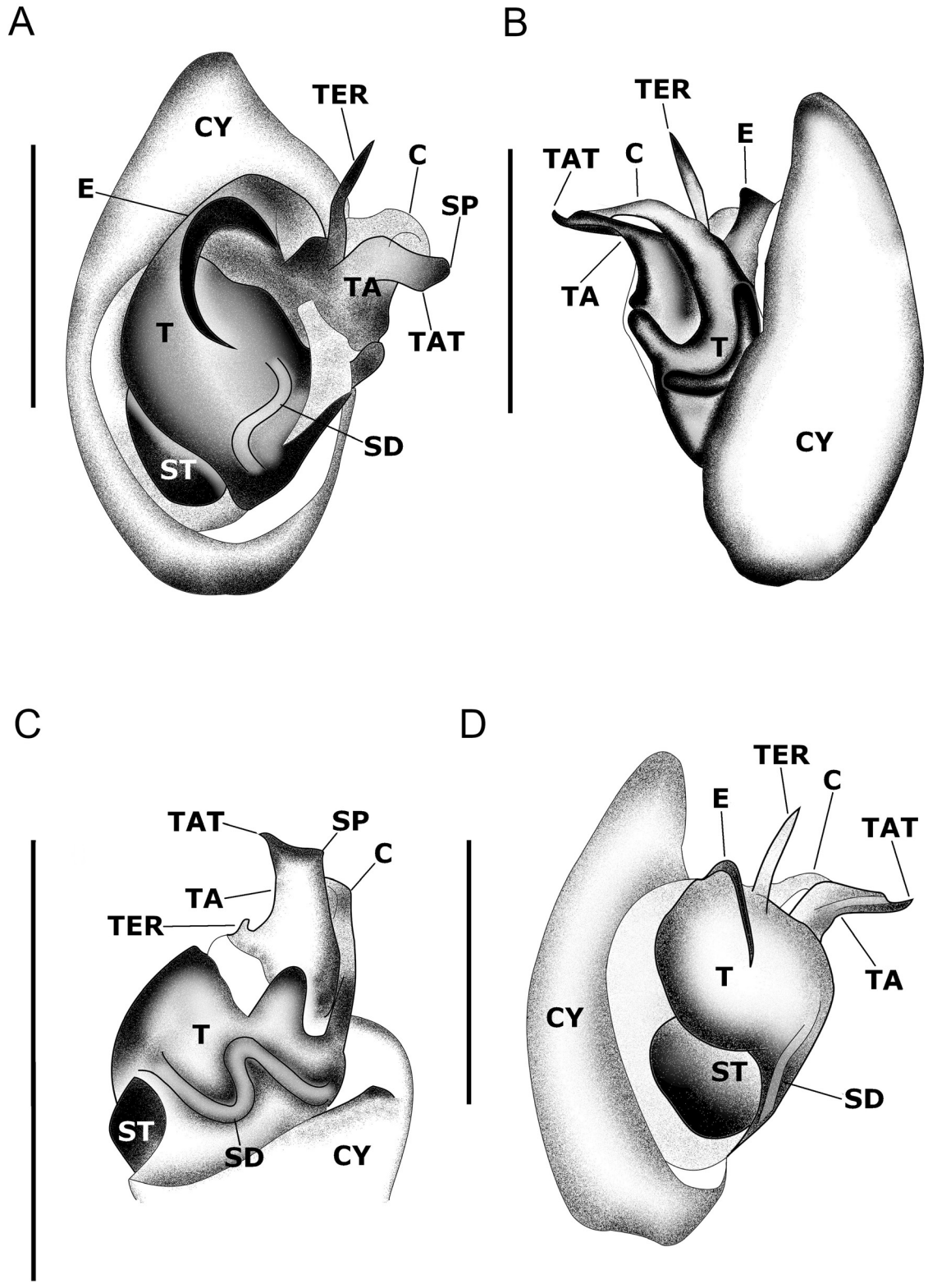

Fig. 12. *Evippa amitaii* sp. nov., ♂ (HUJ INV-Ar 16051), drawings of left palp. **A**. Ventral view. **B**. Retrolateral view. **C**. Proximal view. **D**. Prolateral view. Scale bars = 0.5 mm. Drawings by I. Armiach Steinpress.

Evippa amitaii sp. nov.
urn:lsid:zoobank.org:act:CB6C5814-B74C-4FEC-AD41-27D18232D3FC
Figs 4A, 5A, 6A, 7A, 8A, 9, 10A,11A, 12, 13A, 13C

Diagnosis

Recognized by a combination of genital characters (compare with *Evippa aequalis* Alderweireldt, 1991). Male palp: tegular apophysis tip flat, curved ventrad. Basal process of tegular apophysis long, with sharp tip. Bulb differs from the bulbs of other Evippinae species found in Israel, and from that of *E. aequalis*, by the terminal apophysis (process between tegular apophysis and cymbium) being at least at 40° angle to tegular apophysis and oriented ventrad (in the others the tip of the tegular apophysis is oriented distad) (Figs 6A, 7A, 8A, 12). Epigyne: Atrium borders indistinct. Septum wide, longer than atrium, narrowing

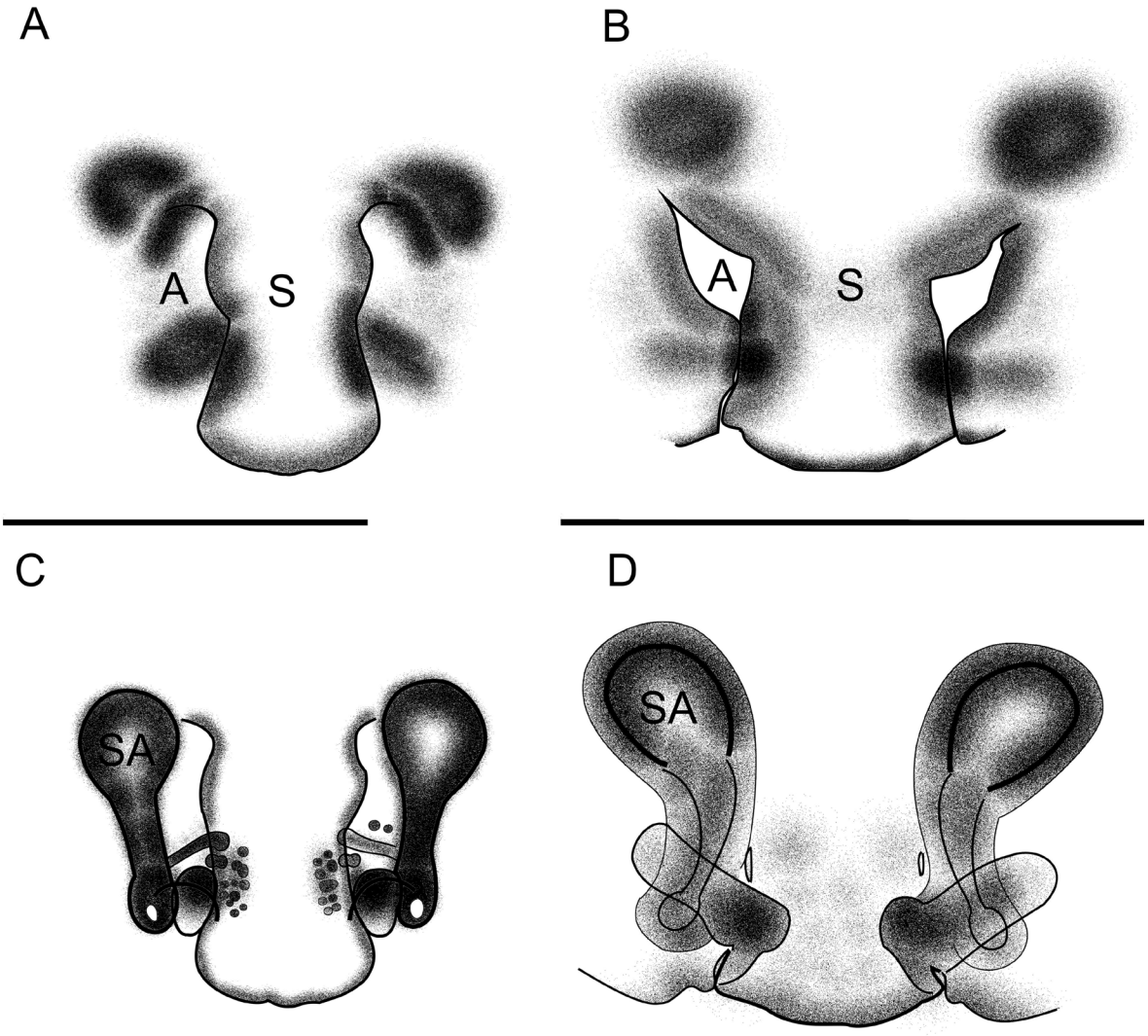

Fig. 13. ♀♀, genitalia, drawings. **A**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16053), ventral view. **B**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16543), ventral view. **C**. *Evippa amitaii* sp. nov. (HUJ INV-Ar 16053), dorsal view. **D**. *Evippomma simoni* Alderweireldt, 1992 (HUJ INV-Ar 16543), dorsal view. Scale bars = 0.5 mm. Drawings by I. Armiach Steinpress.

slightly anteriorly and mesally, creating a small protrusion (Figs 10A, 13A). Spermathecae club-shaped, long, reaching over frontal edge of atria (Figs 11A, 13C). In contrast, the similar *E. praelongipes* lacks the protrusion in the septum (Fig. 10D). The similar *E. aequalis* has a protrusion in the septum, but has short spermathecae, not reaching the frontal edge of the atria (Alderweireldt 1991).

Etymology

Named after Pinchas Amitai, an Israeli entomologist, writer and educator, who coined the Hebrew name for *Evippa*: רצחול (Pronounced: rats'hol, meaning "sand-runner").

Material examined

Holotype

ISRAEL – **Dead Sea Area** • ♂; Ne'ot HaKikkar; [30.94° N, 35.37° E]; Nov. 2014; I. Renan leg.; HUJ INV-Ar 16051.

Paratype

ISRAEL – **Dead Sea Area** • 1 ♀; Ne'ot HaKikkar; [30.94° N, 35.37° E]; 3–27 Aug. 2014; I. Renan leg.; pitfall; HUJ INV-Ar 16048.

Other material

ISRAEL – **Dead Sea Area** • 1 ♂; Ne'ot HaKikkar; [30.94° N, 35.37° E]; 3–27 Aug. 2014; pitfall; I. Renan leg.; HUJ INV-Ar 16047 • 1 ♀; same collection data as for preceding; HUJ INV-Ar 16052 • 1 ♀; Sedom; [31.01° N, 35.35° E]; 21 Apr. 1954; A. Shulov leg.; HUJ INV-Ar 16053.

Description

Male

Male holotype measurements. AME diameter: 0.15; PME diameter: 0.36; carapace length: 2.37; carapace width: 2.2; abdomen length: 2.34; leg I (Fe, Pa, Ti, Mt, Tr): 3.16, 1.21, 2.92, 3.07, 1.48; leg II: 2.95, 1.2, 2.8, 3.07, 1.54; leg III: 2.98, 1.05, 2.87, 3.67, 1.55; leg IV: 3.0, 1.04, 2.88, 3.77, 1.71.

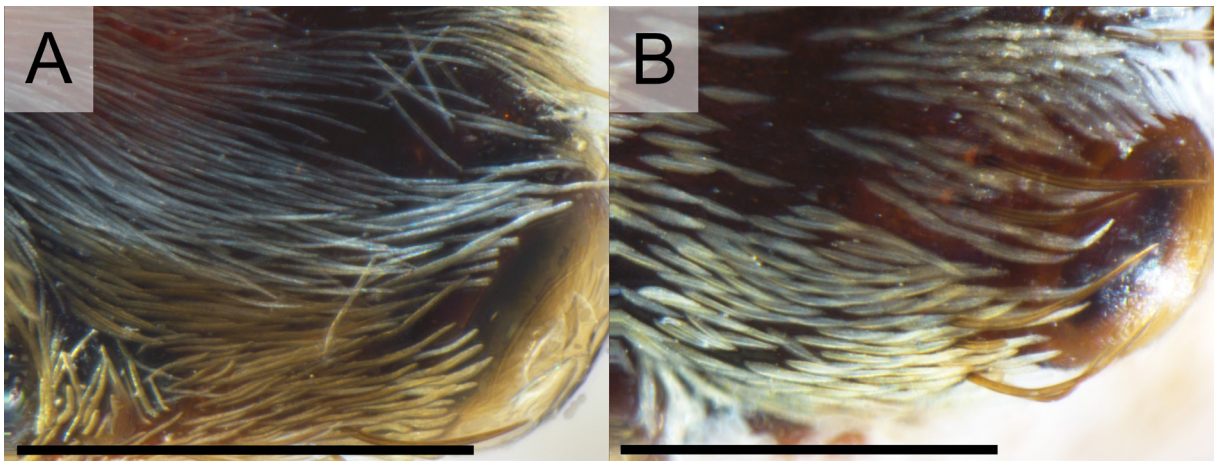

Fig. 14. Cephalic region (right side, dorsal view), showing covering setae. **A**. *Evippa praelongipes* (O. Pickard-Cambridge, 1871), round-profile setae. **B**. *Evippomma simoni* Alderweireldt, 1992, leaf-shaped setae. Scale bars = 0.5 mm. Photos by I. Armiach Steinpress.

Variation in males (n = 2). AME diameter: 0.15–0.16; PME diameter: 0.36–0.39; carapace length: 2.37–2.61; carapace width: 2.2–2.25; abdomen length: 2.1–2.34; legs I, III, IV of male HUJ INV-Ar 16047 are missing. Leg II (Fe, Pa, Ti, Mt, Tr): 2.99, 1.07, 2.9, 3.9, 1.6.

Carapace. Transverse depression posterior to ocular area.

Cheliceral teeth. 3 promarginal, 2 retromarginal.

Color. Carapace yellow, lateral bands faint, brown-grey; margins spotted. Clypeus yellow to brown. Chelicerae yellow, darker retrolaterally. Legs yellow. Femora III–IV with grey dorsal bands. Palps yellow. Sternum yellow. Abdomen dorsum yellow, with dark spots on margins, cardiac mark dark. Abdomen venter yellow to dark yellow, sometimes with longitudinal lines. Spinnerets yellow to orange (Fig. 4A).

Genitalia. Palpal organs strongly sclerotized. Part of sperm duct visible through tegulum as sinuous line. Tegulum bulging. Tegular apophysis large, curved ventrad at about 90°, tip flat (Figs 6A, 7A, 8A, 9, 12), best examined in distal view (Figs 9, 12C). Terminal apophysis long, sharp, slightly curved, oriented distad.

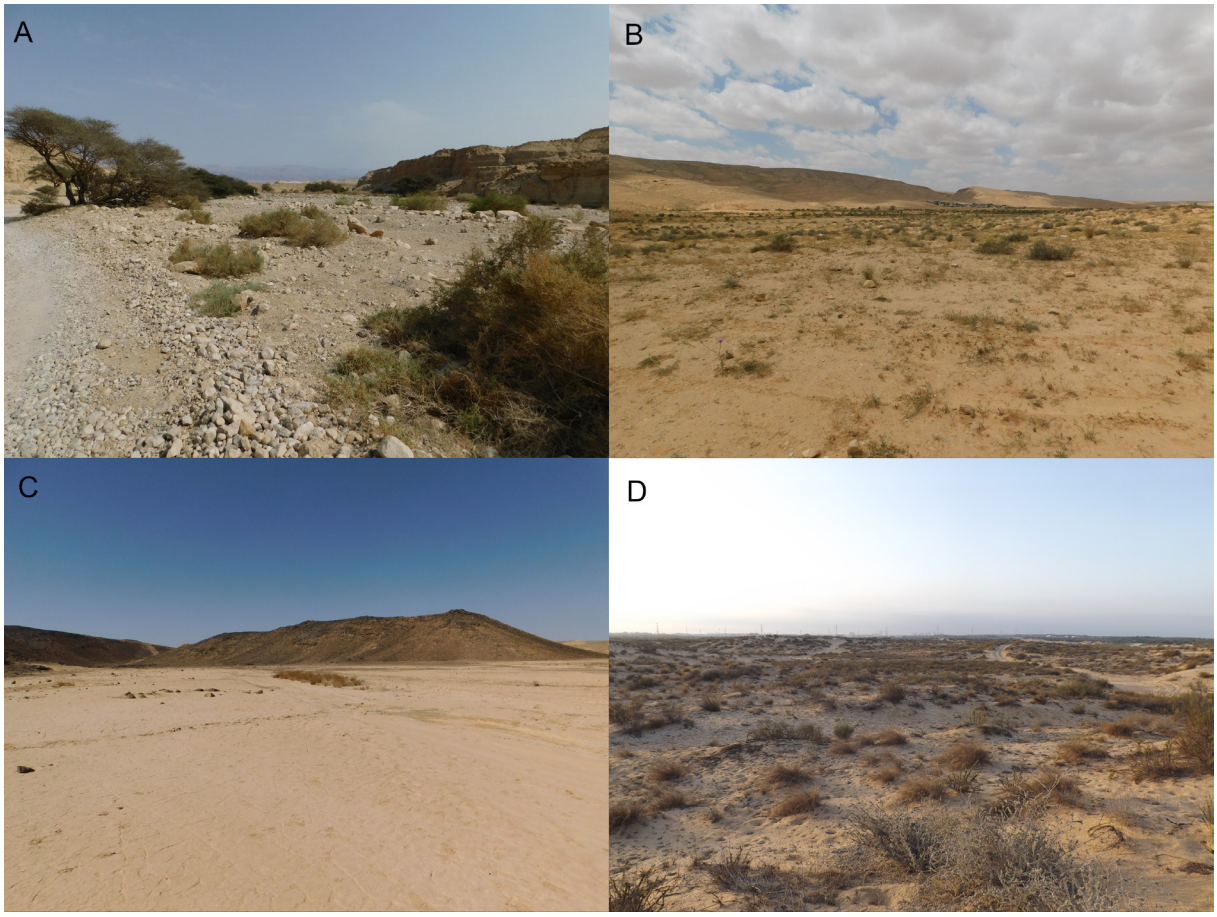

Fig. 15. Typical habitats of Evippinae in Israel. **A**. Nahal Ashalim, Dead Sea area, stream bed in hyperarid climate. **B**. Mamshit, central Negev, sandy loess plain in arid climate. **C**. Biq'at 'Uvda ('Uvda valley), southern Negev, stream bed with cracked soil in hyperarid climate. **D**. Palmahim, Coastal Plain, dunes in Mediterranean climate. Photos by I. Armiach Steinpress.

Legs. Pseudoarticulation of tarsi present. Metatarsus I ventral spination: 3 pairs + apical triplet; tibia I ventral spination: 6 pairs + single weak retrolateral spine + apical pair.

Female

Female paratype measurements. AME diameter: 0.15; PME diameter: 0.37; carapace length: 3.18; carapace width: 2.46; abdomen length: 2.85; leg I (Fe, Pa, Ti, Mt, Tr): 2.6, 1.2, 2.8, 2.77, 1.4; leg II: 2.9, 1.0, 2.85, 2.69, 1.38; leg III: 3.0, 1.2, 2.7, 3.2, 1.5; leg IV: 4.2, 1.2, 3.98, 5.27, 2.0

Variation in females (n = 3). AME diameter: 0.15–0.19; PME diameter: 0.35–0.46; carapace length: 3.14–3. 2; carapace width: 2.46–2.8; abdomen length: 2.85–4.37; leg I (Fe, Pa, Ti, Mt, Tr): 2.6–3.1, 1.2, 2.8–3.09, 2.77–2.8, 1.4–1.5; leg II: 2.9–3.19, 1.0–1.18, 2.85–2.9, 2.69–2.79, 1.35–1.38; leg III: 3.0–3.7, 1.2–1.25, 2.7–2.88, 3.2–3.5, 1.5–1.8; leg IV: 4.2–4.6, 1.2–1.37, 3.98–4.1, 5.6–5.27, 2.0.

Color. Carapace yellow, lateral bands distinct, orange to brown, sometimes radiated. Clypeus yellow to brown. Chelicerae orange. Legs yellow. Legs I–II with faint grey spots. Femora III–IV with three dorsal bands. Palps yellow, darker towards tip, femora with dark stain. Sternum yellow. Abdomen dorsum yellow, with four brown, unfused chevrons (sometimes indistinct); dark cardiac mark. Abdomen venter whitish. Spinnerets whitish yellow with brown setae (Fig. 5A).

Carapace. Transverse depression posterior to ocular area.

Cheliceral teeth. 3 promarginal, 2 retromarginal.

Genitalia. Epigyne as wide as long, septum approximately straight, mildly widening on proximal half, atria indistinct laterally. Spermathecae club-shaped, slightly longer than atria (Figs 10A, 11A, 13C).

Legs. Pseudoarticulation of tarsi present. Metatarsus I ventral spination: 3 pairs + apical triplet; tibia I ventral spination: 6 pairs + apical pair.

Natural history

No live specimens observed. Adults collected in April, August and September (Table 3), from salt pans and oases (Fig. 16).

Distribution

Israel, southern Dead Sea area (Ne'ot HaKikkar, Sedom). (Fig. 16).

Remarks

The species closely resembles the African species *Evippa aequalis* Alderweireldt, 1991. The Dead Sea area is known to be a refugium for tropical species (Yom-Tov & Tchernov 1988), mainly of African origin. We suggest that populations of *E. amitaii* sp. nov., or a closely related species, exist in suitable habitats south of Israel. This species does not conform to Roewer's diagnostic character for Evippinae (metatarsus IV shorter than patella IV + tibia IV), as the females' metatarsus IV (5.27 mm) is slightly longer than its patella and tibia IV (1.2 + 3.98 = 5.18 mm).

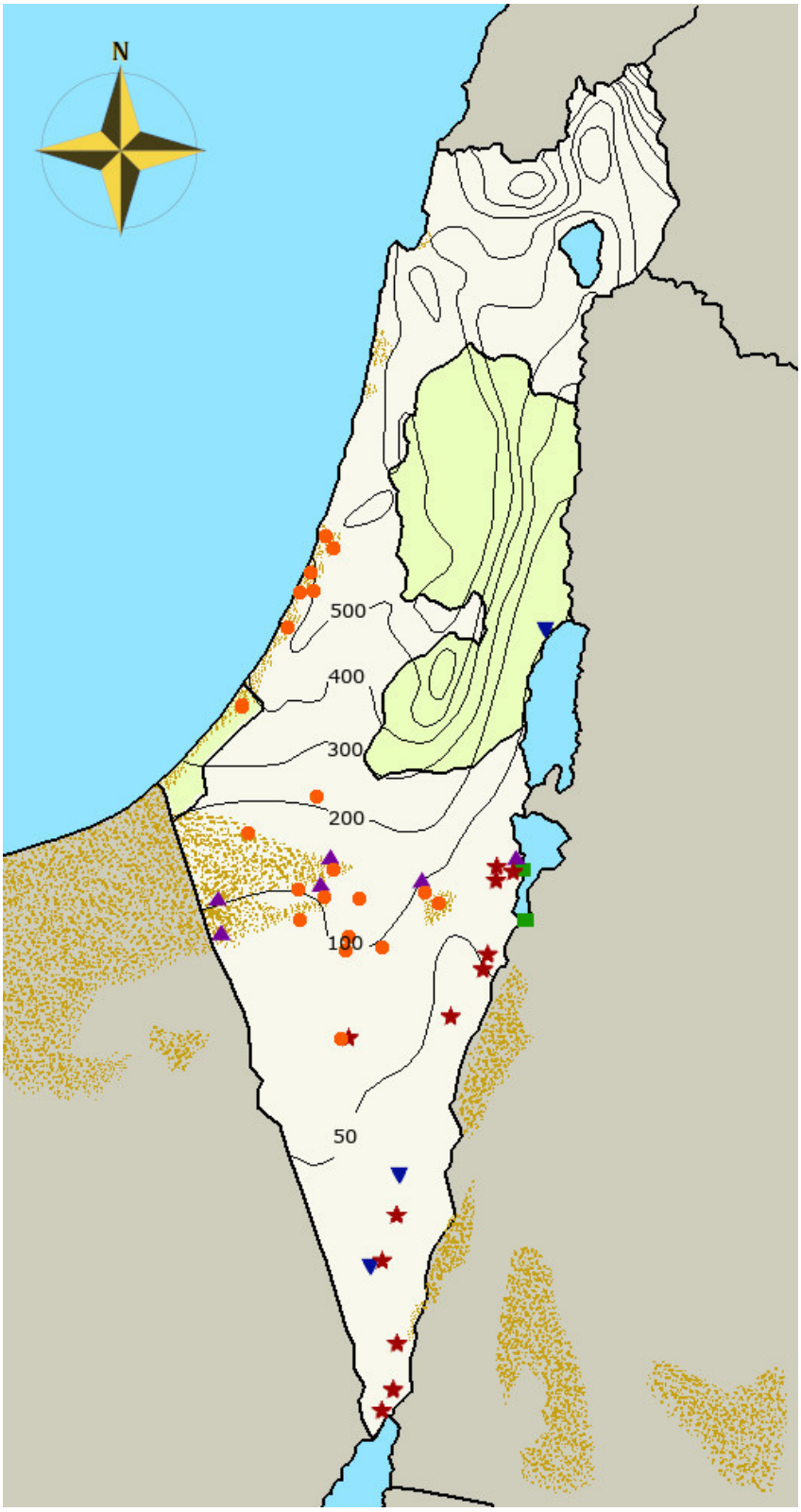

Fig. 16. Recorded distribution of Evippinae in Israel and Palestine: ■ - *Evippa amitaii* sp. nov., ● - *Evippa arenaria* (Audouin, 1826), ▼ - *E. onager* Simon, 1895 sensu Šternbergs 1979, ★ - *E. praelongipes* (O. Pickard-Cambridge, 1871), ▲ - *Evippomma simoni* Alderweireldt, 1992. Dune areas marked by grainy background. Isohyets marking average annual precipitation.

Evippa arenaria (Audouin, 1826)
Figs 3A, 4B, 5B, 6B, 7B, 8B, 10B, 11B

Lycosa arenaria Audouin, 1826: 367, pl. 4, fig. 3 (♀, Egypt).
Lycosa festiva Pavesi, 1880: 369 (♀, Tunisia).

Lycosa arenaria – Walckenaer 1837: 329 (♂, Egypt).
Evippa arenaria – Simon 1885: 12 (North Africa); 1898: 354, figs 346–347, 350 (North Africa). — Reimoser 1919: 158 (North Africa, Syria). — Caporiacco 1933: 337 (Lybia); 1936: 91 (Lybia). — Bodenheimer 1937: 242 (Israel, Palestine). — Roewer 1955: 154 (North Africa, Syria). — Bonnet 1956: 1866. — Alderweireldt 1991: 363, figs 1.3, 2.6 (♂, ♀, Algeria, Tunisia, Libya, Chad and Egypt).

non *Evippa arenaria* – Roewer 1959: 175, figs 90a, 91 (♂♀, Egypt, Tunisia).
non *Evippa arenaria* – Denis 1966: 127, fig. 41 (♀, Lybia).

Diagnosis

Recognized by a combination of genital characters. Male palp: Tegular apophysis parallel to cymbium, tip sharp, distally oriented. Subapical process blunt, located near base of TA. Terminal apophysis between tegular apophysis and cymbium (Figs 6B, 7B, 8B). Epigyne: atria distinct, kidney shaped; septum wide, constricted proximally (Figs 10B, 11B). It is the only Evippinae in Israel to have kidney-shaped atria.

Material examined

ISRAEL – **Coastal Plain** • 1 ♀; Ben Zakkay; [31.86° N, 34.71° E]; 23 May 1973; faunistics course leg.; HUJ INV-Ar 16502 • 1 ♀; Holon; [31.999° N, 34.788° E]; 20 Jul. 2017; I. Armiach Steinpress leg.; HUJ INV-Ar 16509 • 1 ♀; Miqwe Yisra'el; [32.02° N, 34.77° E]; 11 Apr. 1938; A. Shulov leg.; HUJ INV-Ar 16076 • 1 ♀; Nahal Soreq ("Nahr Rubin"); [31.94° N, 34.72° E]; 10 Apr. 1962; P. Amitai leg.; HUJ INV-Ar 16075 • 1 ♀ with eggs; Nizzanim; [31.75° N, 34.62° E]; 29 Sep. 1946; A. Shulov leg.; HUJ INV-Ar 16084 • 2 ♀♀; Nizzanim; [31.75° N, 34.62° E]; 29 Sep. 1946; A. Shulov leg.; HUJ INV-Ar 16085 to 16086 • 1 ♂; Nizzanim; 31.7432° N, 34.6249° E; 14 Jul. 2015; B. Shacham leg.; HUJ INV-Ar 16056 • 1 ♀; Nizzanim sands; 31.7265° N, 34.6059° E; 6 Jul. 2017; B. Shacham leg.; HUJ INV-Ar 16507 • 1 ♂; Nizzanim sands [31.7259° N, 34.6064° E]; 6 Jul. 2017; B. Shacham leg.; HUJ INV-Ar 16548 • 1 juv.; Palmahim; [31.91° N, 34.72° E]; 17 Oct. 2014; B. Shacham leg.; HUJ INV-Ar 16061 • 1 ♀; Ziqim sands; [31.61° N, 34.51° E]; 20 Jul. 2019; B. Shacham leg.; HUJ INV-Ar 20313. – **Negev** • 1 ♀; Ashalim; 30.9856° N, 34.6865° E; 6 Aug. 2015; HUJ INV-Ar 16058 • 1 ♂; Be'er Mash'abbim; [31.01° N, 34.76° E]; 15 Jul. 1990; Y. Ayal leg.; HUJ INV-Ar 16093 • 1 ♀; same locality as for preceding; 18 Sep. 1990; Y. Lubin leg.; HUJ INV-Ar 16095 • 1 ♂; Be'er Mash'abbim; [31.01° N, 34.76° E]; 30 Apr. 1993; Y. Lubin leg.; HUJ INV-Ar 16094 • 1 ♀; Be'er Sheva road to Mizpe Ramon; [31.09° N, 34.82° E]; 24 Mar. 1954; A. Shulov leg.; HUJ INV-Ar 16067 • 1 ♂; Bor Mashash; [31.07° N, 34.84° E]; 5 Feb. 1970; faunistics course leg.; HUJ INV-Ar 16064 • 1 ♂; same locality as for preceding; 5 Feb. 1970; faunistics course leg.; sands; HUJ INV-Ar 16069 • 1 ♀ with eggs; same locality as for preceding; 5 Feb. 1970; faunistics course leg.; sands; HUJ INV-Ar 16073 • 1 ♂; Hatira Ridge; [30.93° N, 35.04° E]; 20 Jun. 1991; Y. Lubin leg.; HUJ INV-Ar 16099 • 1 ♀; same locality as for preceding; 23 Oct. 1991; Y. Lubin leg.; HUJ INV-Ar 16098 • 1 ♀; Holot Agur; [30.97° N, 34.40° E]; 26 Feb. 2013; I. Renan leg.; HUJ INV-Ar 16057 • 1 ♀ with egg; Makhtesh Ramon; [30.59° N, 34.83° E]; 25 Apr. 1954; A. Shulov leg.; HUJ INV-Ar 16079 • 2 ♀♀; Mamshit; [31.02° N, 35.06° E]; 24 Mar. 1954; A. Shulov leg.; HUJ INV-Ar 16065, 16077 • 1 ♀; Mamshit; [31.02° N, 35.06° E]; 15 Jun. 1973; Gershoni leg.; HUJ 16066 • 1 ♂; same collection data as for preceding; 16070 • 1 ♀; Mamshit; [31.02° N, 35.06° E]; 5 Jul. 2015; A. Uzan leg.; HUJ INV-Ar 16506 • 1 ♀; Mishor Yamin; [31.00° N, 35.10° E]; 11 May 2014; Y. Zvik leg.; HUJ INV-Ar 16060 • 1 ♂; Mizpe Ramon; [30.60° N, 34.80° E];

9 Apr. 2015; HUJ INV-Ar 16505 • ♀; Nahal Ashan; [31.28° N, 34.74° E]; 10 May 2016; B. Shacham leg.; HUJ INV-Ar 16062 • 1 ♀, 1 ♂; same locality as for preceding; 30 Apr. 2018; B. Shacham leg.; HUJ INV-Ar 16549 to 16550 • 1 ♀; Nahal Hatira; [30.93° N, 35.03° E]; 21 Aug. 1990; Y. Ayal leg.; HUJ INV-Ar 16097 • 1 ♀; Nahal Sekher; [31.09° N, 34.82° E]; 22 May 1958; A. Shulov leg.; sands; HUJ INV-Ar 16087 • 1 ♂; same locality as for preceding; 15 Apr. 1969; faunistics course leg.; sands; HUJ INV-Ar 16068 • 1 ♀ with eggs; same locality as for preceding; 23 May 1972; M. Pener leg.; sands; HUJ INV-Ar 16072 • 1 ♀; same locality as for preceding; 29 May 1980; M. Pener leg.; sands; HUJ INV-Ar 16092 • 1 ♀; same locality as for preceding; 3 Jun. 1980; faunistics course leg.; sands; HUJ INV-Ar 16096 • 1 ♂; same locality as for preceding; 11 Apr. 1991; Y. Lubin leg.; sands; HUJ INV-Ar 16501 • 1 ♀; Nahal Sekher; 31.091° N, 34.8121° E; 18 Apr. 2015; B. Shacham leg.; Subadult; sands; HUJ INV-Ar 16063 • 1 ♀ with eggs; Nahal Sekher; 31.107° N, 34.8193° E; 6 Apr. 2017; B. Shacham leg.; HUJ INV-Ar 16503 • 1 ♀; Nahal Sekher; 31.1046° N, 34.8228° E; 6 Apr. 2017; B. Shacham leg.; HUJ INV-Ar 16504 • 1 ♀; Nahal Sekher; [31.09° N, 34.82° E]; 24 Mar. 2018; B. Shacham leg.; sands; HUJ INV-Ar 16552 • 1 ♀; Retamim; [31.05° N, 34.68° E]; 22 Mar. 2018; S. Aharon leg.; HUJ INV-Ar 16553 • 1 subadult ♀; Sede Boqer; [30.85° N, 34.78° E]; 14 Mar. 2016; T. Mei–Dan leg.; molted to maturity in lab; HUJ INV-Ar 16089 • 1 ♀, 1 ♂; Sede Zin; [30.85° N, 34.77° E]; 22 Jul. 1993; Y. Lubin leg.; HUJ INV-Ar 16090 to 16091 • 1 ♀; Yeroham; [30.98° N, 34.90° E]; 5 Apr. 1954; A. Shulov leg.; HUJ INV-Ar 16078 • 1 ♀; same locality as for preceding; 30 May 1957; M. Pener leg.; HUJ INV-Ar 16088 • 1 ♂; same locality as for preceding; 24 Apr. 2014; I. Armiach Steinpress leg.; HUJ INV-Ar 16059 • 1 ♀; same locality as for preceding; 10 Apr. 2019; Y. Zvik leg.; HUJ INV-Ar INVAr 20319 • 1 ♀; Ze'elim; [31.17° N, 34.55° E]; 9 Apr. 1967; P. Amitai leg.; HUJ INV-Ar 16071 • 2 ♀♀ with egg-sac; same locality as for preceding; 9 Apr. 1967; P. Amitai leg.; HUJ INV-Ar 16080 to 16081 • 2 ♀♀; same locality as for preceding; 9 Apr. 1967; P. Amitai leg.; HUJ INV-Ar 16082 to 16083 • 2 ♀♀ ; Ze'elim; [31.176° N, 34.556° E]; 21 Jul. 2015; I. Armiach Steinpress leg.; HUJ INV-Ar 16054 to 16055 • 1 ♂, 1 ♀; same locality as for preceding; 23 Jul. 2015; I. Armiach Steinpress leg.; HUJ INV-Ar 16045 to 16046.

PALESTINE – **Gaza strip** • ♀; Jabaliya; [31.52° N, 34.48° E]; 10 Jul. 1972; M. Timtpulson leg.; HUJ INV-Ar 16074.

Natural history

Adults of *Evippa arenaria* were collected from February through October, and egg-sacs are recorded from February to September (Table 3). Both nocturnal and diurnal activity were observed. *Evippa arenaria* is the most mesophilic species of the four *Evippa* species found in Israel. It is found in sand and loess substrate throughout the semi-arid and arid parts of the Negev (Figs 15B, 16). It is also found in the Mediterranean climate zone, along the coastal dune strip (Figs 15D, 16). In the northern edge of its distribution in Israel and Palestine, *E. arenaria* is a strict psammophile, found only on exposed sand, but in the Negev desert it appears to be more generalist in its edaphic preferences, and is even found on somewhat rocky hillsides.

Distribution

Algeria, Tunisia, Lybia, Chad and Egypt (Alderweireldt 1991); Israel, Palestine; the report from Syria (Reimoser, 1919) is doubtful.

Records

Israel: Negev (Ashalim, Be'er Mash'abbim, Bor Mashash Sands, Hatira Ridge, Holot Agur, Makhtesh Ramon, Mamshit, Mishor Yamin, Nahal Ashan, Nahal Sekher (Sands), Sede Boqer, Sede Zin, Yeroham, Ze'elim), Coastal Plain (Ben Zakkay, Miqwe Yisra'el, Nizzanim, Nahal Soreq (Wadi Rubin), Palmahim). Palestine: Gaza (Jabalyia) (Fig. 16).

Remarks

Despite extensive sampling in the Negev in all seasons, no adult *E. arenaria* were collected from November to January. This may be due to seasonal changes in activity (see Discussion).

Evippa onager Simon, 1895 sensu Šternbergs 1979
Figs 3C–D, 4C, 5C, 6C, 7C, 8C, 10C, 11C

Evippa onager Simon, 1895: 341 (♀, China).
Evippa caucasica Zamani *et al.*, 2016: 107, figs 28–30 (♂, Iran). (misidentification corrected by Zamani *et al*. 2017)

Evippa ? onager – Šternbergs 1979: 67, fig. 1 (misidentified fide Marusik *et al.* 2003: 50) (♂ ♀, Turkmenistan).
Evippa ? onager sensu Šternbergs 1979 – Marusik *et al.* 2003: 50, figs 19–22, 28–29 (♂ ♀, Turkmenistan).

Diagnosis

Recognized by short, robust legs (carapace longer than ⅓ of leg I), coloration and its genital morphology. Prosoma of preserved specimens dark brown (other Evippinae in Israel are yellow after preservation). Male palp: tegular apophysis parallel to cymbium, with single, small, subapical process oriented ventrad (Figs 6C, 7C, 8C). It is the only *Evippa* in Israel with a subapical process directed ventrad at 90° to the tegular apophysis. In the similar *Evippa caucasica* Marusik, Guseinov & Koponen, 2003, the base of the subapical process reaches the tip of the tegular apophysis, whereas in *E. onager*, the tip and the process are distinct. Epigyne: atria distinct, widest in middle. Septum narrow, slightly constricted in middle, broadened distally (Figs 10C, 11C).

Material examined

ISRAEL – **Dead Sea Area** • 1 ♂; Qalya; [31.74° N, 35.46° E]; 15 Feb. 1941; A. Shulov leg.; HUJ INV-Ar 16510. – **Negev** • 1 subadult ♀; Nahal Hiyyon; [30.191° N, 35.008° E]; 30 Jul. 2019; HUJ INV-Ar 20315 • 1 ♂; same collection data as for preceding; 30 Jul. 2019; HUJ INV-Ar 20316 • 1 ♀; Biq'at 'Uvda ('Uvda valley); [29.998° N, 34.973° E]; 18 Mar. 2018; E. Gavish-Regev leg.; HUJ INV-Ar 20314.

Description

Male

Measurements (n = 2, specimen HUJ INV-Ar 20316 (the smaller of the two) was raised in the laboratory and might not be representative of sizes found in wild populations). AME diameter: 0.24–0.2; PME diameter: 0.51–0.4; carapace length: 3.97–3.58; carapace width: 2.94–2.67; abdomen length: 2.81–3.4; leg I (Fe, Pa, Ti, Mt, Tr): 2.99–2.74 (rest missing in specimen HUJ INV-Ar 16510), 1.26, 2.38, 2.3, 1.27; leg II: 2.91–2.44, 1.27–1.17, 3.04–2.3, 2.91–2.4 (rest missing in specimen HUJ INV-Ar 16510), 1.19; leg III: 2.29–2.6, 1.38–1.22, 2.59–2.22, 3.51–2.86, 1.51–1.34; leg IV: 3.83–3.34, 1.64–1.37, 3.43–2.9, 5.13–4.13, 1.99–1.61.

Color. Carapace brown, darker on margins and in ocular area, sparsely radiated. Clypeus center dark, margins white. Chelicerae dark yellow, striated brown. Legs yellow, dorsum with wide brown annulations. Palps yellow, tarsus darkest. Sternum brown to black. Abdomen dorsum brown to black with white setae. Abdomen venter black to brown, with sparse white setae. Spinnerets yellow (Fig. 4C). Live specimens dark yellow; legs with faint annulations.

Carapace. Transverse depression posterior to ocular area.

Cheliceral teeth. 2 promarginal, 2 retromarginal.

Genitalia. Palpal organs weakly sclerotized. Tegulum flat. Part of sperm duct visible through tegulum makes two sinoid curves. Tegular apophysis large, somewhat transparent, oriented distad, with subapical process oriented ventrad. Subapical process sharp, distinct from sharp tip of tegular apophysis (Figs 6C, 7C, 8C).

Legs. Pseudoarticulation of tarsi not evident, but tarsi curved. Metatarsus I ventral spination: 3 pairs + apical triplet; tibia I ventral spination: 5 pairs + apical pair.

Female

Measurements. AME diameter: 0.2; PME diameter: 0.56; carapace length: 3.88; carapace width: 2.8; abdomen length: 4.44; leg I (Fe, Pa, Ti, Mt, Tr): 2.54, 1.37, 2.35, 1.94, 1.03; leg II: 2.55, 1.36, 2.26, 1.96, 0.96; leg III: 2.58, 1.31, 2.22, 2.39, 1.1; leg IV: 3.31, 1.47, 2.93, 3.9, 1.41.

Color. Carapace blackish, with some orange setae and orange fringe of setae. Clypeus blackish. Chelicerae reddish brown. Legs yellow, dorsum annulated grey. Palps yellow. Sternum black. Abdomen dorsum dark brown. Abdomen venter grey, spotted yellow. Spinnerets yellow (Fig. 4C). Live specimens yellow, legs mildly annulated (Figs 3C–D).

Carapace. Transverse depression posterior to ocular area.

Cheliceral teeth. 3 promarginal, 2 retromarginal.

Genitalia. Epigyne septum wider posteriorly, margins with small tooth or terrace in middle. Atria distinct (Fig. 10C), width variable (compare Šternbergs 1979). Spermathecae round, unbent, distinct from sperm ducts (Fig. 11C).

Legs. No clear pseudoarticulation on tarsi. Metatarsus I ventral spination: 3 pairs + apical triplet; tibia I ventral spination: 6 pairs + apical pair.

Natural history

Outside Israel inhabits steppes. In Israel inhabits hyperarid deserts. Specimens were found at night, on and in the cracks of fine-grained floodplain deposits (Fig. 15C). Adult female collected in March, adult male collected in February, juveniles collected in July (Table 3). The short legs, not typical of Evippinae, may be an adaptation for a somewhat fossorial lifestyle.

Distribution

Turkmenistan (Šternbergs 1979), Iran (Zamani *et al.* 2016), Israel.

Records

Israel: Dead Sea area (Qalya), Negev (Biq'at 'Uvda , Nahal Hiyyon) (Fig. 16).

Remarks

The female of *Evippa onager* was originally described from China by Simon (1895), and redescribed from both sexes by Šternbergs (1979) from Turkmenistan. It is very unlikely that these later specimens are conspecific with the holotype (fide Marusik *et al.* 2003). As we have not examined Simon's type specimen, we avoided describing a new species and instead have chosen to treat the species as *Evippa onager* sensu Šternbergs, following Marusik *et al.* (2003).

The species' population in Israel is by far the southernmost and westernmost of the three known localities, and the only one not in a steppe habitat. Nevertheless, cool steppe habitats are found in Israel and it would be helpfull to search them for *E. onager*.

See Phylogenetic relationships of Evippinae based on COI and NADH for a partial molecular phylogeny and a discussion of the placement of *E. onager*.

Evippa praelongipes (O. Pickard-Cambridge, 1871)
Figs 3B, 4D, 5D, 6D, 7D, 8D, 10D, 11D, 14A

Lycosa praelongipes O. Pickard-Cambridge, 1871: 822, pl. 50, fig. 3 (♂, Egypt).

Pardosa praelongipes – Schmidt 1895: 476 (♀, Turkmenistan. Possibly misidentified *Evippa onager*).
Evippa praelongipes – Simon 1890: 112, 123 (Yemen); 1897: 290 ("Arabia"). — Roewer 1955 (North Africa, Transcaspia, India, Arabia, Sinai, Tripoli); 1959: 182, fig. 93 (♀, North Africa, Transcaspia, India. Misidentified?). — Bonnet 1956: 1866 (Tripoli, Arabia, Russia). — Denis 1966: 127, fig. 44 (sub♀, Lybia). — Alderweireldt 1991: 369, fig. 5.1–5 (♂ ♀, Egypt, Saudi Arabia). — Alderweireldt & Jocqué 2017: 10 (Saudi Arabia, Yemen).

non *Evippa praelongipes* – Tikader & Malhotra 1980: 311, fig. 135–137 (♀, India, Pakistan).

Diagnosis

Recognized by a combination of genital characters. Male palp: tegular apophysis parallel to cymbium, with small, prolaterally oriented subapical process. Short terminal apophysis positioned ventrad to tegular apophysis (Figs 6D, 7D, 8D). Epigyne: straight atria with indistinct retrolateral margins. Septum with smooth margins, without protrusions (compare with similar *E. amitaii* sp. nov. palp, with a small protrusion) (Fig. 10D, 11D) It is the only *Evippa* in Israel to have a septum without protrusions.

Material examined

ISRAEL – **Dead Sea Area** • 1 ♀; Nahal 'Ammi'az; 31.073° N, 35.342° E; 12 Apr. 2018; I. Armiach Steinpress leg.; HUJ INV-Ar 16554 • 1 ♀ with juv.; same collection data as for preceding; HUJ INV-Ar 16555 • 3 ♂♂; same collection data as for preceding; HUJ INV-Ar 16556 to 16558 • 2 ♀♀; Nahal 'Azgad; 31.067° N, 35.335° E; 12 Apr. 2018; I. Armiach Steinpress leg.; HUJ INV-Ar 16559–16560 • 1 ♀; Sedom; [31.01° N, 35.35° E]; 21 Apr. 1954; A. Shulov leg.; HUJ INV-Ar 16518. – **'Arava Valley** • 1 ♂; 'Avrona; [29.67° N, 35.00° E]; 2–8 Sep. 2016; I. Armiach Steinpress leg.; HUJ INV-Ar 16522 • 1 ♀; same collection data as for preceding; 7 Sep. 2016; I. Armiach Steinpress leg.; HUJ INV-Ar 16521 • 1 ♂, 1 ♀; same collection data as for preceding; 11 Sep. 2017; I. Armiach Steinpress leg.; HUJ INV-Ar 16534 to 16535 • 1 ♀; Elat; [29.57° N, 34.96° E]; 15 Apr. 1987; V. and B. Roth leg.; HUJ INV-Ar 16530 • 3 ♀♀; same collection data as for preceding; 18 Aug. 2016; A. Weinstein leg.; HUJ INV-Ar 16519 to 16520, 16044• 1 ♀; 'En Yotvata; [29.879° N, 35.044° E]; 25 Jan. 1958; A. Shulov leg.; HUJ INV-Ar 16517 • 1 ♂; Hazeva; 30.7139° N, 35.1964° E; 14 Jun. 2009; HUJ INV-Ar 16531 • 1 ♂; Hazeva; 30.8121° N, 35.2804° E; 2 Jul. 2010; HUJ INV-Ar 16532 • 1 ♂; Hazeva; 30.7129° N, 35.1964° E; 20 ul. 2010; HUJ INV-Ar 16533 • 1 ♂; Nahal Amazyahu N of 'Iddan; [30.85° N, 35.29° E]; 15 Sep. 1988; B. Shalmon leg.; HUJ INV-Ar 16043 • 1 ♀; same collection data as for preceding; 16 Sep. 1988; B. Shalmon leg.; HUJ INV-Ar 16023 • 1 ♂; Nahal Amazyahu N of 'Iddan; [30.85° N, 35.29° E]; 17 Sep. 1988; J. Koach leg.; HUJ INV-Ar 16524 • 1 ♀; Nahal Amazyahu; [30.85° N, 35.29° E]; 24 Sep. 1988; A. Weinstein leg.; HUJ INV-Ar 16529. – **Negev** • 1 ♀; Nahal Zevira; [30.64° N, 35.20° E]; 24 Feb. 2017; E. Gavish-Regev leg.; HUJ INV-Ar 16560 • 1 ♀; Biq'at 'Uvda ('Uvda valley), Har Shahrur; [29.980° N, 34.953° E]; 13 Mar. 2018; E. Gavish-Regev leg.; HUJ INV-Ar 16562 • 1 ♂; Biq'at 'Uvda ('Uvda valley), Kasuy Sands; [29.964° N, 34.979° E]; 13 Mar. 2018; E. Gavish-Regev leg.; HUJ INV-Ar 16563 • 1 ♂, 1 ♀;

Biq'at 'Uvda ('Uvda valley), Nahal Hiyyon; [29.998° N, 34.973° E]; 13 Mar. 2018; E. Gavish-Regev leg.; HUJ INV-Ar 16564 to 16565 • 1 ♀; Shizzafon; [30.105° N, 35.002° E]; 24 Jul. 2014; I. Armiach Steinpress leg.; HUJ INV-Ar 16511 • 1 ♂, 1 ♀; Makhtesh Ramon; [30.59° N, 34.83° E]; 28 Mar. 1993; Y. Lubin leg.; HUJ INV-Ar 16527 to 16528 • 3 ♂♂; same collection data as for preceding; 21 Feb. 1994; Y. Lubin leg.; HUJ INV-Ar 16041, 16566 to 16567 • 1 ♀; same collection data as for preceding; 21 Feb. 1994; Y. Lubin leg.; HUJ INV-Ar 16042 • 1 ♂, 1 ♀; same collection data as for preceding; 8 Nov. 1992; Y. Lubin leg.; HUJ INV-Ar 16525 to 16526 • 1 ♀; Nahal Shizzafon; [30.042° N, 35.021° E]; 30 Jul. 2019; I. Armiach Steinpress leg.; HUJ INV-Ar 20317.

EGYPT – **Sinai** • ♀; Abu–sela; 13 Aug. 1968; G. Tsabar leg.; HUJ INV-Ar 16512 • ♀; Mt. Catherine; [28.50° N, 33.95° E]; 16 Aug. 1968; G. Tsabar leg.; HUJ INV-Ar 16515 • ♀; Saint Catherine; [28.50° N, 33.95° E]; 15 Jul. 1968; A. Shulov leg.; HUJ INV-Ar 16513 • 2 ♂♂; Wadi Nequra; 21 Jan. 1969; S. Reichenstein leg.; HUJ INV-Ar 16514, 16516.

Natural history

Inhabits hyper-arid deserts. Adults were collected January through April, June through September and in November (Table 3). Egg-sacs were observed in April and September. We suggest that *E. praelongipes* is active and reproducing throughout the year. Specimens were collected at night, mostly in dry stream beds, under and near shrubs (Fig. 15A).

Distribution

Lybia to Saudi Arabia (Bonnet 1956; Alderweireldt & Jocqué 2017), Israel. Reports from Turkmenistan (Schmidt 1895), Pakistan and India (Tikader & Malhotra 1980) might be due to misidentification.

Records

Israel: (Fig. 16) Dead Sea area (Sedom); 'Arava Valley (Elat, 'En Yotvata, 'Avrona, Nahal Amazyahu); Negev (Makhtesh Ramon, Shizzafon). Egypt: Sinai (Mt. Catherine, Wadi Nequra).

Evippomma Roewer, 1959

Figs 1–2, 4E, 5E, 6E, 7E, 8E, 10E, 11E, 13B, D, 14B

Evippomma Roewer, 1959: 187; type species: *Evippomma squamulatum* (Simon, 1898).

Diagnosis

This is the only known genus of Lycosidae in which the body (mainly, the cephalothorax) is densely covered in scale-like, leaf-shaped setae (Figs 1D, 14B).

Description

Small- to medium-sized wolf spiders. Tibia I with 4–5 pairs of ventral spines (apart from apical pair). Body covered in scale-like, leaf-shaped setae. These setae are reflective and give live specimens a pearly shine (Figs 1–2). Coloration of preserved specimens is brown or yellow. Cephalic region elevated. Ocular area with long macrosetae. Genitalia relatively uniform across genus. Embolus large but not conspicuous. Embolic base in meso-apical position. Tegular apophysis hook-shaped (Figs 6E, 7E, 8E). Median septum of epigyne widened posteriorly. Atria narrow (Figs 10E, 13B). Spermathecae large and sperm ducts twisted (Figs 11E, 13D). Anterior row of eyes procurved, narrower than PME. ALE smaller than AME.

Natural history

The species inhabit deserts, grasslands and savannas. *Evippomma rechenbergi* is known to construct silk-lined burrows in sand (Bayer, Foelix & Alderweireldt 2017), as we recorded for *E. simoni* as well (Fig. 2D).

Distribution

Found across Africa, with a new record from Israel (but see the section on Composition).

Relationships

Evippomma is traditionally considered to be related to *Evippa* (Alderweireldt 1992). Our molecular phylogeny supports this placement (see Phylogenetic relationships of Evippinae based on COI and NADH).

Composition

Seven species are included: *Evippomma albomarginatum* Alderweireldt, 1992; *E. evippiforme* (Caporiacco, 1935); *E. evippinum* (Simon, 1897); *E. plumipes* (Lessert, 1936); *E. rechenbergi* Bayer *et al.*, 2017*; E. simoni* Alderweireldt, 1992; and *E. squamulatum* (Simon, 1898). Two representatives of the genus (*E. evippiforme* and *E. evippinum*) that were described from India are not considered here as belonging to *Evippomma*, as they have three pairs of ventral spines on tibia I (Caporiacco 1935), whereas *Evippomma* is defined as having 4–5 pairs. They might form a separate genus. Moreover, *E. evippiforme* appears to have genitalia uncharacteristic of the other known *Evippomma* species.

Evippomma simoni Alderweireldt, 1992
Figs 1–2, 4E, 5E, 6E, 7E, 8E, 10E, 11E, 13B, D, 14B

Evippomma simoni Alderweireldt, 1992: 161, fig. 3a–c (♂, Sudan).

Diagnosis

Recognized by a combination of genital characters. Male palp: tegular apophysis small, translucent, oriented distad, parallel to plane of bulb, laterally barb-shaped (Figs 6E, 7E, 8E). Tegulum presents single sinus shape curve of sperm duct (in *Evippa*: two) (Fig. 6E). Epigyne: rounded or hat-shaped, wider than long, septum wide. Atria narrow, shallow, greatly constricted distally (in *Evippa*: width approximately equal throughout), similar to epigyne of *E. squamulatum*, but proximal portion of atrium wide (in *E. squamulatum* proximal portion of atrium slit-shaped) (Figs 10E, 13B, D). It is the only Evippinae in Israel covered in flat, leaf-shaped setae and without annulations on the legs.

Material examined

ISRAEL – **Dead Sea Area** • 1 ♂; Near Sedom; [31.01° N, 35.35° E]; 10 Apr. 1967; P. Amitai leg.; HUJ INV-Ar 16537. – **Negev** • 1 ♀; Be'er Mash'abbim; [31.01° N, 34.76° E]; 18 Sep. 1990; Y. Lubin leg.; HUJ INV-Ar 16544 • 3 ♂♂; same collection data as for preceding; 11 Apr. 1991; Y. Lubin leg.; HUJ INV-Ar 16541, 16568 to 16569 • 2 ♂♂; same collection data as for preceding; 27 May 1992; Y. Lubin leg.; HUJ INV-Ar 16540, 16570 • 3 ♀♀; same collection data as for preceding; 25 Jun. 1992; Y. Lubin leg.; HUJ INV-Ar 16050, 16571 to 16572 • 4 ♂♂; same collection data as for preceding; 30 Apr. 1993; Y. Lubin leg.; HUJ INV-Ar 16049, 16573 to 16575 • 1 ♀; same collection data as for preceding; 30 Apr. 1993; Y. Lubin leg.; HUJ INV-Ar 16042 • 1 ♂; Holot Agur; [30.97° N, 34.40° E]; 1 Apr. 2012; I. Renan leg.; HUJ INV-Ar 16536 • 1 subadult ♀; same collection data as for preceding; 26 Feb. 2013; I. Renan leg.; HUJ INV-Ar 16576 • 1 juv.; same collection data as for preceding; 14 Mar. 2013; I. Renan leg.; HUJ INV-Ar 16545 • 1 ♀; Mash'abbim sands; 31.002° N, 34.754° E; 16 Jun. 2020; S. Aharon leg.; HUJ INV-Ar 20421 • 1 ♀; Mash'abbim sands; [31.00° N, 34.75° E]; 28 Jun. 2020; S. Aharon leg.; HUJ INV-

Ar 20422 • 4 ♂♂; Nahal Sekher; [31.09° N, 34.82° E]; 5 May 1967; P. Amitai leg.; HUJ INV-Ar 16538 to 16539, 16577 to 16578 • 1 ♀; Nizzana; [30.89° N, 34.41° E]; 29 Aug. 1991; J. Henschel leg.; HUJ INV-Ar 16543 • 1 ♂; Mamshit; [31.02° N, 35.06° E]; 10 Apr. 2018; A. Uzan leg.; HUJ INV-Ar 16579.

Description

Male

Measurements (n = 12). AME diameter: 0.13–0.2; PME diameter: 0.27–0.4; carapace length: 2.8–3.99; carapace width: 2.1–2.8; abdomen length: 2.7–4.17; leg I (Fe, Pa, Ti, Mt, Tr): 2.77–4.7, 0.98–1.6, 2.39–5.96, 2.8–4.86, 1.7–2.3; leg II: 3.38–4.46, 1.2–1.57, 2.8–3.7, 3.57–4.5, 1.7–2.2; leg III: 3.2–4.3, 1.08–1.5, 2.27–2.9, 3.5–4.5, 1.78–2.25; leg IV: 3.8–5.26, 1.3–1.68, 3.9–5.1, 4.6–6.0, 2.14–2.58.

Color. Carapace yellow to orange and brown, lighter around fovea and in patches behind PME; lateral bands brown to grey, radiated, fused posteriorly; ocular area black; cephalic and thoracic regions separated by sharp, black V-shaped line; perimeter with spots of white setae. Clypeus black near AME, light laterally, with white setae on margin. Chelicerae proximally yellow to orange with grey or brown reticulation connecting to oblique brown band in middle, retrolateral margin white. Legs yellow, proximal part of femur and coxa usually grey. Palps yellow to brownish (femur and tarsus darker). Sternum grey to brown, margin black, sometimes with light radiation. Abdomen dorsum yellow to whitish, sometimes with white spots. Cardiac mark yellow to brown, outlined with black spots, surrounded by posteriorly extending broken light band, outlined with dark spots, not reaching spinnerets. Abdominal venter margins yellow to whitish, center irregularly bordered, grey to black with yellow spots. Book lungs white. Spinnerets yellow (Fig. 4E).

Carapace. Ocular area elevated. Fovea area slightly elevated.

Cheliceral teeth. 3 promarginal, 2 retromarginal.

Genitalia. Palpal organs weakly sclerotized. Tegulum keel-shaped. Part of sperm duct visible through tegulum bent at 90°. Tegular apophysis small, translucent, oriented distad, with subapical process oriented ventrad; slightly elevated over tegulum (Figs 6E, 7E, 8E).

Legs. Tarsus without pseudoarticulation, but in some specimens tarsi bent. Metatarsus I ventral spination: 2 pairs of long spines (pair I not reaching pair II) + short apical triplet; tibia I ventral spination: 5 pairs (all long except 5th pair) + short apical pair. Distance between pairs 2–3 greatest.

Female

Measurements (n = 6). AME diameter: 0.1–0.19; PME diameter: 0.33–0.42; carapace length: 3.28–4; carapace width: 2.3–3.07; abdomen length: 3.57–5.1; leg I (Fe, Pa, Ti, Mt, Tr): 2.95–3.6, 1.24–1.56, 2.5–3.09, 1.84–2.31, 1.22–1.5; leg II: 2.64–3.18, 1.22–1.3, 2.15–2.47, 1.69–2.2, 1.1–1.3; leg III: 2.46–3.14, 1.1–1.26, 1.5–2.9, 1.9–3.1, 1.37–1.6; leg IV: 2.99–3.86, 1.28–1.58, 2.79–3.8, 2.69–3.25, 1.48–1.78.

Color. Carapace yellow to brownish-orange, covered with white setae, lighter around fovea and in patches behind PME; lateral bands grey, radiated, fused posteriorly; cephalic and thoracic regions separated by sharp, black V-shaped line. Clypeus yellow to brown, covered with leaf-like setae, with dark lateral bar. Chelicerae orange, with leaf-like setae on proximal half, sometimes with grey reticulation and oblique grey band. Legs yellow, usually, greyish on proximal side of segment, sometimes with grey line on dorsal side. Palps yellow, with some grey on femur and tarsus. Sternum brown. Abdomen dorsum yellow to whitish. Cardiac mark grey, usually with two lines of gray spots, connecting above spinnerets. Abdomen venter yellow, grey or white, darker on center. Book lungs white. Spinnerets yellow (Fig. 5E).

Carapace. Ocular area elevated. Due to the females' strongly raised cephalic region and short legs they resemble a juvenile *Lycosa* rather than an *Evippa*.

Cheliceral teeth. 3 promarginal, 2 retromarginal.

Genitalia. Epigyne wider than long, septum wide, atria distinct, shallow, narrow, widening proximally. Spermathecae longer than atria, bent retrolaterally, shaped like a crookneck squash (Figs 10E, 11E, 13B, D).

Legs. No pseudoarticulation of the tarsus. Metatarsus I ventral spination: 2 long pairs (pair I reaching base of pair II); tibia I ventral spination: 5 pairs (long, except 5th) + short apical pair.

Natural history

Adult *Evippomma simoni* were collected April through June, August and September (Table 3) and may have a yearly cycle similar to what was suggested for *E. arenaria*, with a period of lowered activity in the colder months of the year (see Discussion). A female with eggs (HUJ INV-Ar 20422) was collected in June. The species mostly inhabits sandy desert habitats (Fig. 15B). An anecdotal report raises the possibility that the species also exists along the coastal dune strip, similar to *Evippa arenaria* (Y. Salaviz, pers. com.). Specimen HUJ INV-Ar 20421 was found by S. Aharon in a silk-lined burrow (Fig. 2), similar to what has been reported for *E. rechenbergi* (Bayer *et al.* 2017).

Distribution

Sudan (Alderweireldt 1992), Israel.

Israel: Negev (Be'er Mash'abbim, Holot Agur, Nahal Sekher, Mamshit), Dead Sea area (Near Sedom) (Fig. 16).

Remarks

This is the first record of *Evippomma* in Israel, and may also be the first record outside of Africa (depending on the dubious report of the species from India (Roewer 1955)). If there is a continuous distribution with the type locality at the northern Sudanese border, this species is to be present in the sandy desert of northern Sinai and in eastern Egypt. It may be distributed in other hot desert environments in the region, such as the sandy deserts of Jordan.

Most of the specimens were collected in dune areas, but a specimen from the Sedom area, with a clay-rich substrate, suggests that this species is not an obligate psammophile.

Phylogenetic relationships of Evippinae based on COI and NADH

The ML tree topology recovered the genus *Evippa* as monophyletic (bootstrap support [BS] = 89%). Evippinae was only moderately supported in our tree (Fig. 17; BS = 63%), yet the topology in our tree accords with the tree topology for Lycosidae in Piacentini & Ramírez 2019 and with the composition of Evippinae sensu Alderweireldt 1991.

Discussion

Habitat use and distribution

The Evippinae are among the most desert-adapted lycosids, often being the only representatives of Lycosidae in desert habitats. Even though mesophilic Evippinae are known (*Xerolycosa*, *Proevippa*), the Evippinae of Israel are largely excluded from mesic habitats. The only exception to this rule is *E. arenaria.* It is found along the southern and central coastal dunes of Israel. The southernmost record is from the coastal dunes of Gaza, where the dunes come in contact with the Negev desert. The northernmost record is from Miqwe Yisra'el, south of Tel-Aviv (Fig. 16). Miqwe Yisra'el was historically located near

the northern edge of a large area of dunes, where the coastal sands are interrupted by the alluvial plain of the Yarqon river system. Two major dune areas exist on the Israeli coast north of this point (Qesarya sands and Zevulun valley sands). Visual searches by the authors were performed in both areas. A 2015 study in Qesarya sands, using pitfall traps, did not find *E. arenaria* (A. Avisar, pers. com.). North of Israel, on the Lebanese coasts, there are no significant dune areas (Kasparek 2004). The Yarqon river is known to be a northern limit for several desert-dwelling species. Examples of this biogeographic limit can be found among mammals (*Meriones sacramenti* Thomas, 1922; *Jaculus jaculus* Linnaeus, 1758); reptiles (*Trapelus savignii* (A.M.C. Duméril & Bibron, 1837); *Varanus griseus* (Daudin, 1803); *Mesalina olivieri* (Audouin, 1829)) (Yom-Tov & Tchernov 1988) and insects (*Adesmia dilatata* (Klug, 1830), *Cataglyphis sabulosa* J. Kugler, 1981) (Alon 1991). The accepted hypothesis is that these species have colonized the dunes from the area of the present-day Negev desert, during the Holocene, with subsequent range expansion and their spread was impeded by physical barriers, such as rivers. *Evippa arenaria* may have followed the same route of expansion, and if so, the Yarqon may be the northernmost distribution edge of *E. arenaria* in the Levantine coastal region.

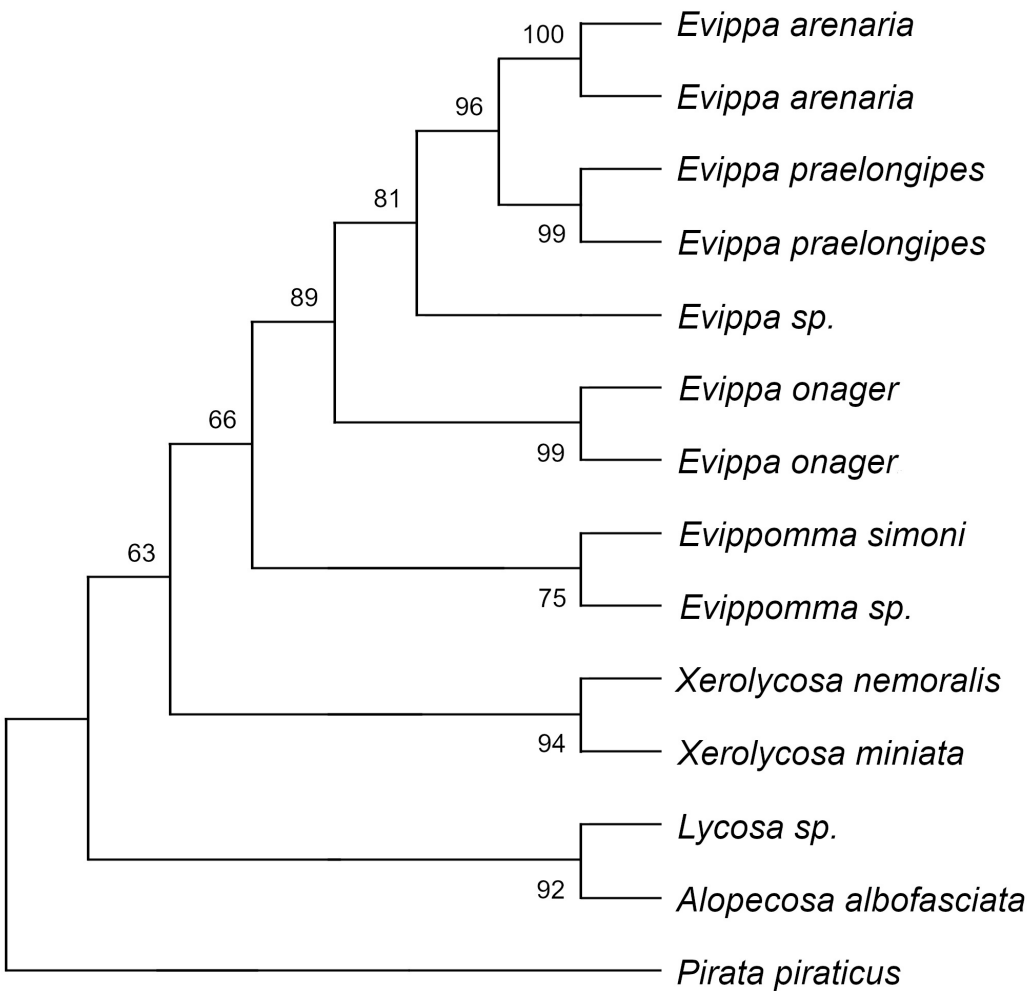

Fig. 17. Maximum likelihood cladogram, showing the topology of Evippinae, with *Lycosa* sp., *Alopecosa albofasciata* (Brullé, 1832) and *Pirata piraticus* (Clerck, 1757) as outgroups. Bootstrap supports provided on the nodes. Species appearing twice represent different specimens, as detailed in Table 1.

The xeric habitats populated by the Evippinae are not uniform, differing greatly in annual rainfall, temperatures and substrate. The species assemblage also differs, including occurrence of other lycosids. Many vicariant species of different taxa are known from the Negev, and they replace each other along the climatic gradient and across different edaphic conditions (Yom-Tov & Tchernov 1988). From this it is to be expected that the distributions and activity patterns of the local Evippinae species are not uniform.

Evippa arenaria is the best sampled species in our study, with 62 specimens, collected at 23 localities (Fig. 16). It is found on loess and sandy substrates, in semi-arid steppes and arid deserts in the range of 80–300 mm average annual rainfall (Fig. 15B). It is also found in coastal dunes, in higher rainfall areas (Fig. 15D). Throughout most of its range, *E. arenaria* co-occurs with other lycosids (*Alopecosa* spp., *Hogna* spp., *Pardosa* spp., *Lycosa* spp.), including a partial overlap with the range of *Evippomma simoni*. It is usually less abundant than *Pardosa subsordidatula*. Of the 23 localities at which *E. arenaria* was collected, it co-occurs with another *Evippa* species (*E. praelongipes*) only in one, at the southern edge of its distribution (Fig. 16). The second most sampled species, *E. praelongipes*, is largely restricted to the hyper-arid region (<80mm average annual rainfall), mostly in stream beds (Fig. 15A). It is the most common, and often only, lycosid species in its habitat (I. Armiach Steinpress., pers. obs.), rarely co-occurring with *E. onager*, *Lycosa* sp., *Hogna ferox* and *Evippomma simoni*, as well as *E. amitaii* and the aforementioned *E. arenaria*. It is not yet known whether the apparent vicariance between *E. arenaria* and *E. praelongipes* is mainly due to habitat requirements, species interactions or other variables.

In our study area, the Dead Sea area (Fig.15A) is the richest in Evippinae species (*E. amitaii*, *E. onager*, *E. praelongipes and Evippomma simoni*) (Fig. 16). The biogeographic mechanism underlying this trend is not known. One possibility is that the different species are specializing in different habitats of the region: mountains, plains, stream beds, salt pans and oases. In recent fieldwork, we found *E. praelongipes* to be common along stream beds, but could not find the other species. *Evippa onager* was found in other localities on and under cracked mud crusts. *Evippa amitaii* is possibly endemic to the Dead Sea region, and may be restricted to a habitat discontinuous with the surrounding desert, such as salt pans or hot oases. The habitat preferences of *Evippomma simoni* are unknown. Further collecting and in-situ observations need to be done to clarify these questions.

Activity patterns

No *Evippa arenaria* or *Evippomma simoni* were collected during the winter months. The lack of adult Evippinae specimens from the winter months in collections (Table 3) might reflect an annual period of lowered activity. A study of arachnids in the northern Negev, that was conducted between 1990 and 1993, using pitfall traps (Lubin, unpublished data) found *Evippa arenaria* from April through October, and *Evippomma simoni* in April through September. This area is rich in other lycosid species, including the very common *Pardosa subsordidatula* (Strand, 1915), which is similar in size to *Evippa arenaria* and co-occurs throughout its range. In the same study *P. subsordidatula* was collected in November through April, complementing the activity period of *Evippa arenaria* and *Evippomma simoni*. These data are congruent with collection dates of other specimens deposited in The Arachnid National Natural History Collection (HUJ).

These activity patterns contrast with those of *E. praelongipes*, which is evidently active all year round (Table 3). One notable difference between *Evippa arenaria*, *Evippomma simoni* and *E. praelongipes* is that *E. praelongipes* is the dominant lycosid species in its habitat. Therefore, we postulate that a contributing factor to the activity patterns of *E. arenaria* and *Evippomma simoni* may be temporal habitat partitioning with a winter-active species, possibly *P. subsordidatula*. Further research is to be done to address this suggestion.

Table 3. Documented activity of adult Evippinae in Israel (by month). Females with egg-sacs marked by 'o'.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Evippa amitaii sp. nov.				♀				♂♀	♂			
Evippa arenaria (Audouin, 1826)		♂♀o	♀o	♂♀o	♀o	♂♀o	♂♀	♀o	♀o	♀		
Evippa onager Simon, 1895 sensu Šternbergs		♂	♀									
Evippa praelongipes (O. Pickard-Cambridge, 1871)	♂♀	♂♀	♂♀	♂♀o		♂	♂♀	♀	♂♀o		♂♀	
Evippomma simoni Alderweireldt, 1992				♂♀	♂	♀o		♀	♀			

Molecular phylogeny

Evippa onager is an unusually short-legged species (Figs 4C, 5C), unlike most *Evippa* species, and unlike the type species, *E. arenaria*. This feature is shared with at least two other species: *E. kirchshoferae* Roewer, 1959 (Barrientos *et al.* 2015) and *E. caucasica* Guseinov & Koponen, 2003. The three species also share similarity in their male genital morphology: a subapical, ventrad oriented process on the TA. *Evippa onager* and *E. kirchshoferae* are also known to have preferences for cracked soil (Barrientos *et al.* 2015). We hypothesized that these species may belong to a separate genus, as was already suggested for *E. kirchshoferae* by Alderweireldt (1991). To test this hypothesis and examine the relatedness of *E. onager* to the other Evippinae a thorough phylogeny is needed, yet we could not find material of *E. kirchshoferae* and *E. caucasica* for molecular analysis. Nevertheless, we created a molecular phylogeny of the Evippinae available to us, including *E. onager*. The resulting cladogram (Fig. 17) does not support the placement of *E. onager* in a separate genus, but does not reject it altogether. It does imply, though, that *E. onager* is more closely related to *Evippa arenaria* (the type species of *Evippa*) than it is to *Evippomma* or *Xerolycosa*. This species may belong to a separate species-group within *Evippa*, along with other short-legged species, possibly conforming to the *eltonica* group suggested by Marusik *et al.* (2003). To test both hypotheses more material is needed.

To conclude, five Evippinae species are found along the xeric habitats of Israel, with some species in sympatry: four species occurring in different parts of the Negev (*Evippa arenaria, E. onager, E. praelongipes* and *Evippomma simoni*), four species co-occurring in the southern Dead Sea area (*Evippa amitaii* sp. nov., *E. onager*, *E. praelongipes* and *Evippomma simoni*) and one species occurring in the southern 'Arava valley (*E. praelongipes*). In addition, one species (*E. arenaria*) is found along the mesic, but edaphically suitable coastal dunes. These distribution patterns may manifest either adaptations to specific habitats or micro-habitats (such as salt pans, sand or clay), competitive exclusion or a combination of both. Which ecological and/or evolutionary mechanisms are responsible for these distribution patterns is beyond the scope of this study, yet the distributions and relationships we present here suggest a higher complexity in a putatively "simple" desert ecosystem. At present, sampling has been scarce, even within the boundaries of Israel and Palestine. The southern Negev and northern rift valley are undersampled for Evippinae specifically, and generally for arachnids and other arthropods. Neighboring countries (Jordan, Lebanon, Syria and to a lesser extent, Egypt) have very little to no data concerning the diversity and distribution of Evippinae. We hope that in the future local researchers in the other Levantine countries will complete our knowledge about the Evippinae species of the region, their biogeography and life history.

Acknowledgements

We would like to thank all the people that provided us with specimens. Among others, Shlomi Aharon, Pinchas Amitai, Aviv Avisar, Yael Lubin, Tal Mei-Dan, Ittai Renan, Yakov Salaviz, Boaz Shacham, Benny Shalmon and Amir Weinstein. Special thanks to Assaf Uzan for making the habitus photographs and collecting the first live specimen of *E. simoni*; to Luis Piacentini, for sharing DNA sequences and advice on sequencing; to Miquel Arnedo, Ivan Magalhaes and Prashant Sharma for useful discussions; and to Prof. Dany Cohen for endowing IAS with a student-stipend.

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Manuscript received: 4 June 2020
Manuscript accepted: 20 October 2020
Published on: 4 February 2021
Topic editor: Rudy CAM Jocqué
Desk editor: Jeroen Venderickx