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Some new findings of the genus *Zodarion* (Aranei: Zodariidae) from Turkey

Новые данные по паукам рода *Zodarion* (Aranei: Zodariidae) Турции

İlhan Coşar*[1], Tarık Danışman[2], Kadir Boğaç Kunt[3]
И. Кошар*[1], Т. Данишман[2], К.Б. Кунт[3]

[1] Kırıkkale University, Health Services Vocational School, 71451, Yahşihan, Kırıkkale, Turkey. E-mail: ilhancsr88@gmail.com
[2] Kırıkkale University, Faculty of Science and Arts, Department of Biology, 71451, Yahşihan, Kırıkkale, Turkey.
[3] Cyprus Wildlife Research Institute, Taşkent, Kyrenia, Cyprus.
* Corresponding author

KEY WORDS: Aranei, Anatolia, morphology, new record, new species, *spinibarbe* group.

КЛЮЧЕВЫЕ СЛОВА: Aranei, Анатолоия, морфология, новая находка, новый вид, new, группа видов *spinibarb.*

ABSTRACT. A new species of *Zodarion* similar to *Z. van* Bosmans, 2009, *Z. crewsae* sp.n. (♂♀), from Osmaniye, Turkey is described. *Zodarion spinibarbe* Wunderlich, 1973 (♂) a species previously know from Cyprus found in Turkey for the first time.Three species are are illustrated and their distribution are mapped. This study increases the number of *Zodarion* species in Turkey to 30.

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РЕЗЮМЕ. Описан новый вид *Zodarion crewsae* sp.n. (♂♀, Османие, Турция) близкий к *Z. van* Bosmans, 2009. На территории Турции впервые найден *Zodarion spinibarbe* Wunderlich, 1973, вид ранее известный только из Кипра. Три вида проиллюстрированы, приведена карта находок их находок. Настоящее исследование подняло число известных видов *Zodarion* в Турции до 30.

Introduction

The family Zodariidae is one of the twelve most rich spider families with 1215 species belonging to 87 genera described so far [WSC, 2022]. Within this large family, the genus *Zodarion* Walckenaer, 1826 is represented by 175 species [WSC, 2022], with 149 species in Europe [Nentwig *et al.*, 2022]. *Zodarion* is one of four zodariid genera known in Anatolia and the most speciose one. The genus was never subject of revision in Turkey, while several recent publications have been made on the description of new taxa or the records of spiders new to Turkey [Danışman, Rubio, 2017; Danışman, Coşar, 2020, 2021; Dimitrov, 2020; Coşar 2021; Coşar, Danışman 2021; Coşar *et. al.*, 2021; Danışman *et. al.*, 2022]. While studying recently collected material we found one species new to science and another one new to Turkey. This paper aims to contribute to the knowledge of the Zodariidae of Turkey by describing a new species, and recording a new spider species that not previously mentioned in Turkey.

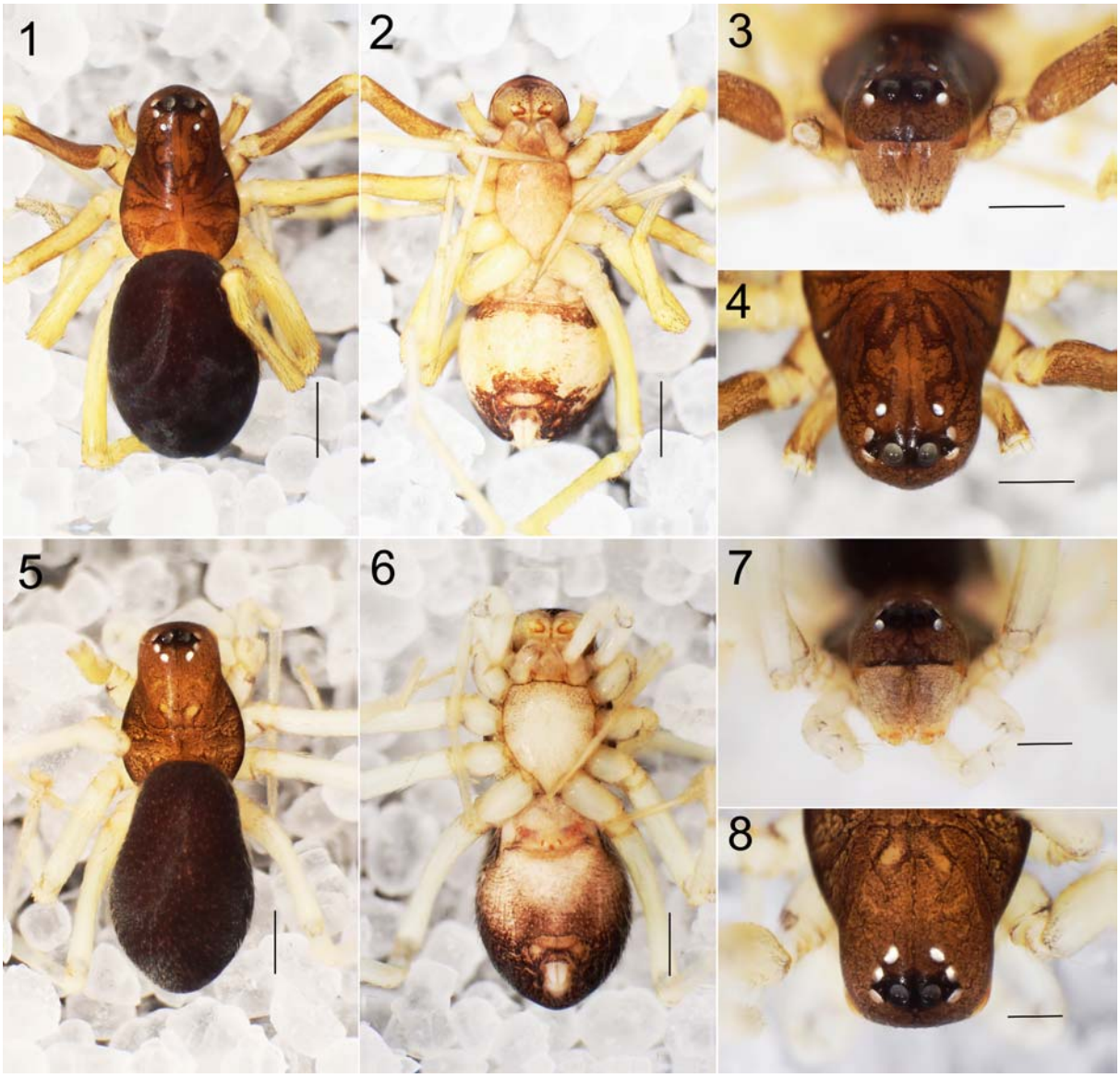
Material and methods

The samples used in this study were collected by hand with an aspirator. Images were taken with a Canon EOS 250D camera connected to a Leica S8Apo stereomicroscope. Multifocus images were montaged using 'Combine ZM' image stacking software and further edited in Photoshop CC 2019. The map of the records was prepared using SimpleMappr- https://www.simplemappr.net [Shorthouse, 2010]. Specimens were preserved in 70% ethanol and are deposited in the collection of the Arachnological Museum of Kırıkkale University (KUAM). Measurements are given in milimetres. Leg measurements are shown as total length (femur, patella, tibia, metatarsus, tarsus). Abbreviations used are: ALE — anterior lateral eyes, AME — anterior median eyes, PLE — posterior lateral eyes, PME — posterior median eyes.

Taxonomy

Zodarion Walckenaer, 1826

Type species *Enyo nitida* Audouin, 1826 from Egypt.
COMMENTS
Zodarion with 172 extant species [WSC, 2022] is the second largest genus of the family. Only *Mallinella* Strand,



Figs 1–8. *Zodarion crewsae* sp.n., male holotype (1–4) and female paratype (5–8). 1, 5 — habitus, dorsal; 2, 6 — habitus, ventral; 3, 7 — prosoma, frontal; 4, 8 — ocular region, dorsal. Scale bars: 1–2, 5–6 — 0.5 mm, 3–4, 7–8 — 0.2 mm.

Рис. 1–8. *Zodarion crewsae* sp.n., голотип самец (1–4) и паратип самка (5–8). 1, 5 — внешний вид; 2, 6 — внешний вид, снизу; 3, 7 — просома, спереди; 4, 8 — глазное поле, сверху. Масштаб: 1–2, 5–6 — 0,5 мм, 3–4, 7–8 — 0,2 мм.

1906, a genus distributed chiefly in South-East Asia is more speciose and comprises over 200 species [WSC, 2022]. Based on the copulatory organs of the species currently considered in this genus, *Zodarion* does not appear to be monophyletic [Zamani, Marusik, 2021]. According to Zamani, Marusik [2021] there are only two species that are morphologically similar to the generotype: *Z. luctuosum* (O. Pickard-Cambridge, 1872) and *Z. lutipes* (O. Pickard-Cambridge, 1872), from the eastern Mediterranean (east of Tunisia to Iran).

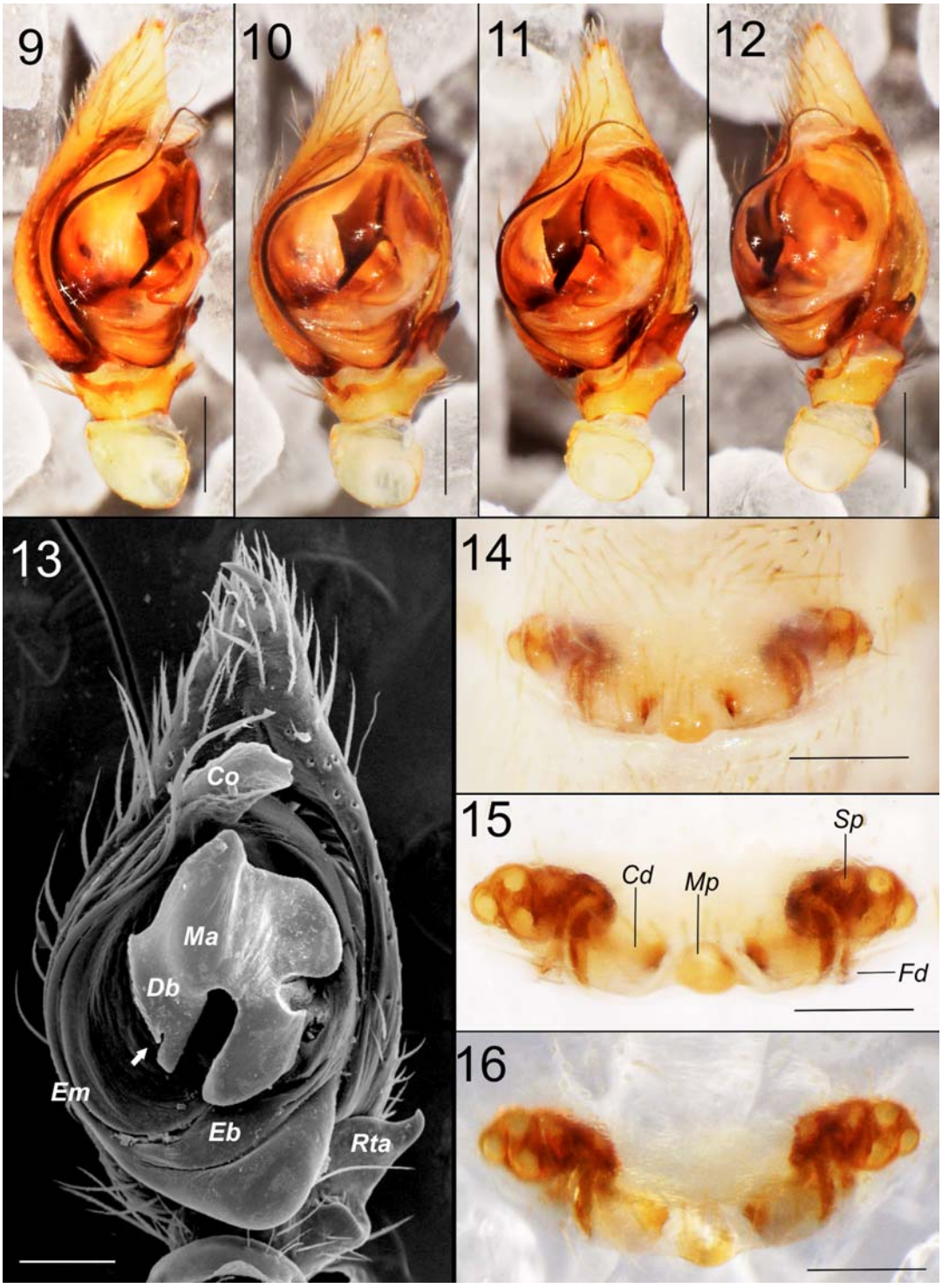
Based on the morphology of copulatory organs *Zodarion* species distributed in the Balkans and Turkey have been classified into nine species groups; *aculeatum, germanicum*, *graecum, lutipes, morosum, pusio*, *rubidum*, *spinibarbe* and *thoni* groups [Bosmans, 2009]. Among these, "*germanicum*" (8 species) and "*spinibarbe*" (7 species) species groups outnumbered by others.

The *spinibarbe* group characterized by flat tegulum without protrusion in lateral view and epigyne the with posteromedian incision represented by 13 species living today [Bosmans, 2009]. Most of these species are distributed in Greece and adjacent regions, including Turkey.

Zodarion crewsae **sp. n.**
Figs 1–16.

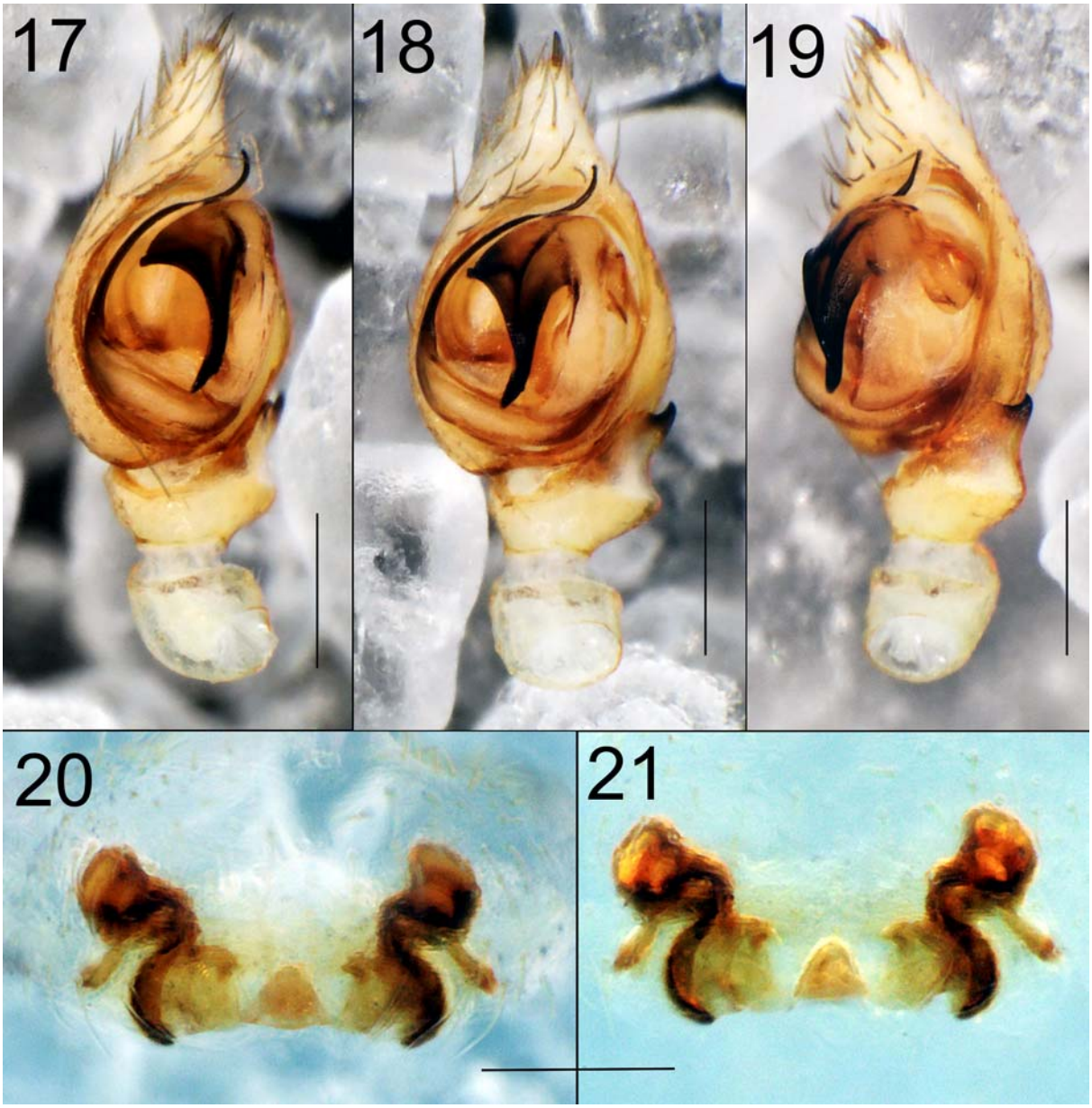
MATERIAL. Holotype ♂ and paratypes 1♂ 3♀♀ (KUAM), TURKEY, Osmaniye Province, Kadirli District, 37°25′53″N 36°13′48″E, 219 m, stony field near scrub, 11.IX.2021, İ. Coşar & T. Danışman leg.

Comparative material: *Zodarion van* Bosmans, 2009 (Figs 17–21), 2♂♂ 4♀♀, TURKEY, Adıyaman Province, Gerger District, Budaklı Village, 38°00′45″N 39°00′22″E, 577 m, 20.V.2021, İ. Coşar & T. Danışman leg.



Figs 9–16. *Zodarion crewsae* sp.n., palp of male holotype (9–13) and epigyne (14–16), 9 — proventral; 10 — ventral; 11 — ventro-retrolateral; 12 — retrolateral; SEM image of right palp 13 — ventral view. 14, 15 — dorsal; 16 — ventral (15 and 16, after maceration). Abbreviations: *Cd* copulatory duct, *Co* — conductor, *Db* — distal branch of median apophysis, *Eb* — embolar base, *Em* — embolus, *Fd* — fertilization duct, *Ma* — median apophysis, *Mp* — median plate, *Rta* — retrolateral tibial apophysis, *Sp* — spermatheca, Arrow: sub-apical notch on distal branch of median apophysis. Scale bars: 0.2 mm.

Рис. 9–16. *Zodarion crewsae* sp.n., пальпа голтипа (9–13) и эпигина (14–16). 9 — провентрально; 10 — вентрально; 11 — вентро-ретролатерально; 12 — ретролатерально; 13 — вентрально; 14, 15 — сверху; 16 — снизу (15 и 16, после мацерации). Сокращения: *Cd* — копулятивный канал, *Co* — кондуктор, *Db* — дистальная ветвь медиального апофиза, *Eb* — основание эмболюса, *Em* — эмболюс, *Fd* — оплодотворительный канал, *Ma* — медиальный апофиз, *Mp* — медиальная пластинка, *Rta* — ретролатеральный отросток голени, *Sp* — сперматека. Стрелка указывает на субапикальную вырезку дистальной ветви медиального отростка. Масштаб: 0,2 мм.



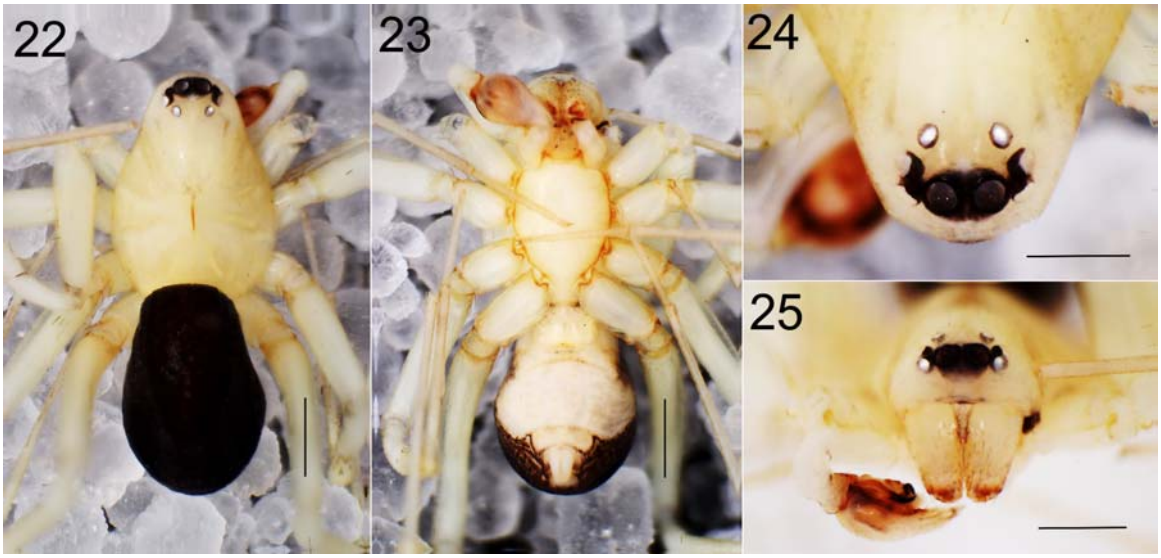
Figs 17–21. *Zodarion van*, male palp (17–19) and epigyne (20, 21), 17 — proventral; 18 — ventral; 19 — retrolateral; 20 — dorsal, 21 — ventral (20 and 21, after maceration). Scale bars: 0.2 mm.

Рис. 17–21. *Zodarion van*, пальпа самца (17–19) и эпигина (20, 21), 17 — провентрально; 18 — вентрально; 19 — ретролатерально; 20 — сверху, 21— снизу (20 и 21, после мацерации). Масштаб: 0,2 мм.

ETYMOLOGY. This species name is in honour of Sarah C. Crews (San Francisco, USA), our colleague and an expert on the Selenopidae, who helps us improve our manuscripts by editing the English and suggesting instrumental comments.

DIAGNOSIS. This new species belongs to the *spinibarbe* group due to having a median apophysis with curled and distally tapered basal branch and toothed distal branches and the epigyne with posteromedian incision, and resembles *Z. van* by the shape of one of the distal branch of median apophysis. However, males of the new species clearly differ from *Z. van* by the shape distal branch of median apophysis, which has a sub-apical notch in the new species, longer embolus and wider embolar base. Females can be differentiated from *Z. van* and other congroupers by the rounded central plate of epigyne which protrudes posteriorly, the streatched almost laterally grape shaped spermathecae.

DESCRIPTION. Male (holotype). Habitus as in Figs 1–4. Measurements: Total length 2.5. Carapace 1.2 long, 0.95 wide, abdomen 1.3 long, 0.85 wide. Ocular area length 0.35. Chelicerae 0.35 long, 0.25 wide. Sternum 0.7 long, 0.6 wide. Clypeus 0.2 high. Eye sizes and inter-distances: AME 0.1, ALE 0.07, PME 0.07, PLE 0.07, AME–AME 0.07, AME–ALE 0.05, AME–PLE 0.07, AME–PME 0.12, PME–PME 0.2, PME–PLE 0.07, PLE–ALE 0.02. Leg lengths: I: 3.8 (1.05, 0.35, 0.85, 0.85, 0.7); II: 3.2 (0.8, 0.3, 0.7, 0.8,



Figs 22–25. *Zodarion spinibarbe*, male, 22 — habitus, dorsal; 23 — habitus, ventral; 24 — ocular region, dorsal; 25 — prosoma, frontal. Scale bars: 0.5 mm.

Рис. 22–25. Самец *Zodarion spinibarbe*. 22 — внешний вид, сверху; 23 — внешний вид, вентрально; 24 — глазное поле, сверху; 25 — просома, спереди. Масштаб: 0,5 мм.

0.6); III: 3.25 (0.85, 0.3, 0.65, 0.85, 0.6); IV: 4.75 (1.2 ,0.35, 1.15, 1.35, 0.7). Carapace anteriorly brown, posteriorly yellowish brown with dispersed blackish pattern (Figs 1, 3, 4). Clypeus dark brown, with dark marks medially. Chelicerae light yellow, dorsally with long, dark setae (Fig. 3). Sternum light yellow, darkened anteriorly, edges dark (Fig. 2). Abdomen dorsally dark brown and with tiny yellow spots, covered with short, dark setae (Fig. 1), ventrally light yellow. Spinnerets whitish (Fig. 2). Legs light yellow with short, dark setae. Femora I yellowish brown.

Palp as in Figs 9–13. Femur not modified. Patella 1.4 times longer than wide. Tibia 3 times longer than retrolateral tibial apophysis. Retrolateral tibial apophysis subrectangular, terminally hook shaped, with retrolateral protrusion. Cymbium 2 times longer than wide, about 1.35 times longer than femur, with 2 claws. Bulb elongate, 1.4 times longer than wide. Tegulum flat, not protruding in lateral view. Median apophysis large, 3 times shorter than cymbium, with thick base, protruding anteriorly; distal branch of median apophysis with sub-apical notch. Conductor long, originates at 9 o'clock position and going almost along whole embolus. Embolus thick at base, medially long and curved along its course, originates at 4:30 o'clock position, tapered toward the tip and distally dome shaped, twisted.

Female. Habitus as in Figs 5–8. Measurements. Total length 2.95. Carapace 1.45 long, 0.9 wide; abdomen long 1.5, wide 0.8. Ocular area 0.35 long. Chelicerae 0.4 long, 0.25 wide. Sternum 0.7 long, 0.6 wide. Clypeus 0.2 high. Eye sizes and inter-distances: AME 0.07, ALE 0.05, PME 0.05, PLE 0.05, AME–AME 0.05, AME–ALE 0.02, AME–PLE 0.05, AME–PME 0.1, PME–PME 0.12, PME–PLE 0.02, PLE–ALE 0.02. Leg lengths: I: 3.8 (1.0, 0.4, 0.85, 0.9, 0.65); II: 3.05 (0.65, 0.3, 0.75, 0.8, 0.55); III: 3.2 (0.85, 0.3, 0.65, 0.9, 0.5); IV: 4.65 (1.2,0.4,1.1,1.35,0.6). Carapace yellowish brown, with dispersed blackish pattern. Clypeus brown, with dark pattern medially. Chelicerae light yellow, dorsally with short, dark setae (Fig. 7). Sternum light yellow, darker anteriorly than posteriorly, edges dark (Fig. 6). Abdomen dorsally dark brown with tiny yellow spots, covered with short, dark setae, ventrally yellowish brown, anteriorly lightened. Spinnerets whitish (Fig. 6). Legs light yellow and with long, shiny setae.

Epigyne as in Figs 14–16. Epigyne 0.55 wide, more than 3 times wider than long, with median plate (*Mp*) rounded and protruding posteriorly, 1.5 times longer than wide. Posterior incisions close to each other about 1.5 times the median plate diameter, delimiting 2 arches situated posteriorly. Spermathecae helically twisted, about 1.5 longer than wide, stretched almost laterally.

DISTRIBUTION. Known only from the type locality in Osmaniye Province, mediterranean Turkey (Fig. 33).

Zodarion spinibarbe Wunderlich, 1973
Figs 22–32.

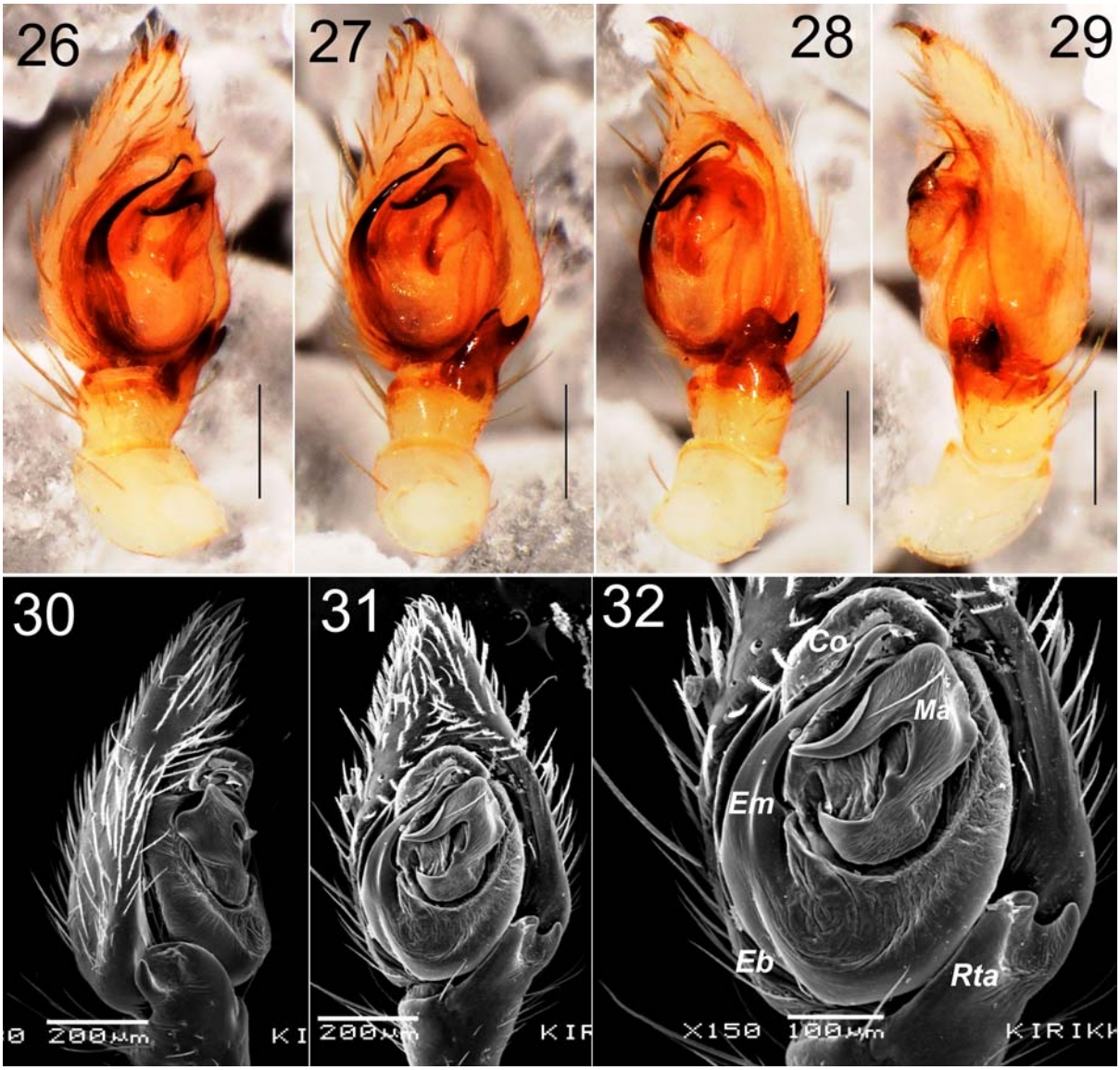
Z. spinibarbis Wunderlich, 1973: 173, f. 4–10 (♂♀).

Z. spinibarbis: Brignoli, 1984: 319, f. 45 (♀, not ♂, f. 43–44, =*Z. barbarae*).

Z. spinibarbe: Bosmans, 2009: 244, f. 72–75, 136–137 (♂♀).

MATERIAL EXAMINED: 2♂♂, TURKEY: Antalya Province, Serik District, Uçansu waterfall, 37°11′52″N 30°54′21″E, 179 m, under stones. 20.02.2015, K.B. Kunt leg.. 1♂, Antalya Province, Gazipaşa District, 36°13′12″N 32°22′36″E, 147 m, under stones. 29.04.2016, K.B. Kunt leg.

DESCRIPTION. Male. Habitus as in Figs 22–23. Total length: 5.1. Carapace 2.6 long, 1.8 wide; abdomen 2.5 long, 1.6 wide. Ocular area 0.7 long. Palp 1.0 long. Sternum 1.8 long, 0.9 wide. Eye sizes and inter-distances: AME: 0.2, ALE: 0.15, PME: 0.1, PLE: 0.1, AME–AME: 0.1, AME–ALE: 0.05, AME–PLE 0.1, AME–PME 0.2, PME–PME: 0.3, PME–PLE: 0.1, PLE–ALE: 0.02. Leg lengths: I: 9.5 (2.5, 0.7, 2.1, 2.6, 1.6); II: 8.6 (2.3, 0.7, 1.9, 2.4, 1.3); III: 8.5 (2.3, 0.7, 1.8, 2.6, 1.1); IV: 10.9 (3.1, 0.7, 2.8, 3.0, 1.3). Carapace light yellow. Clypeus light yellow, with dark markings medially. Chelicerae light yellow, dorsally with long, dark setae (Fig. 25). Sternum light yellow, edges dark (Fig. 23). Abdomen dorsally blackish, with tiny yellow spots, ventrally light yellow (Fig. 22). Spinnerets whitish (Fig. 23). Legs light yellow.



Figs 26–32. Male palp of *Zodarion spinibarbe*. 26 — proventral; 27 — ventral; 28 — retroventral; 29 — retrolateral; 30–32 — SEM images, 30 — prolateral, 31 — ventral 32 — ventral, closer angle. Abbreviations: *Co* — conductor, *Eb* — embolar base, *Em* — embolus, *Ma* — median apophysis, *Rta* — retrolateral tibial apophysis. Scale bars: 26–31 — 0.2 mm, 32 — 0.1 mm.

Рис. 26–32. Пальпа самца *Zodarion spinibarbe*. 26 — провентрально; 27 — вентрально; 28 — ретровентрально; 29 — ретролатерально; 30 — пролатерально, 31–32 — вентрально Abbreviations: *Co* — кондуктор, *Eb* — основание эмболюса, *Em* — embolus, *Ma* — медиальный апофиз, *Rta* — ретролатеральный отросток голени. Масштаб: 26–31 — 0,2 мм, 32 — 0,1 мм.

Palp as in Figs 26–32. Femur not modified. Tibia 2 times longer than retrolateral tibial apophysis. Retrolateral tibial apophysis almost subrectangular, terminally hook shaped. Cymbium 2 times longer than wide, about as long as femur. Patella 1.35 times longer than wide. Bulb elongate, about 1.9 times longer than wide. Tegulum flat, not protruding in lateral view. Median apophysis large 3 times shorter than cymbium, base thick, tapering distally toward tip, protruding anterolaterally. Distal branch of median apophysis like seahorse head. Conductor long, originates at 9 o'clock position and going almost along whole of the embolus. Embolus thick at base, medially long and curved along its course, originates at 9 o'clock position, tapered toward the tip and distally slightly curved.

DISTRIBUTION: Crete and Southern Anatolia.

Discussion

With this study, the total number of *Zodarion* species recorded from Turkey increases to 30. This number is fewer in comparison to Greece with 43 species, but higher than in other adjacent countries Azerbaijan (6), Bulgaria (14), Cyprus (8), Iran (23) and Israel (23) [Zonstein, Marusik, 2013; Bosmans *et al*., 2019; Otto, 2020; Nentwig *et al*., 2022; Zamani *et al*., 2022]. The spider diversity in some regions of Turkey has not been

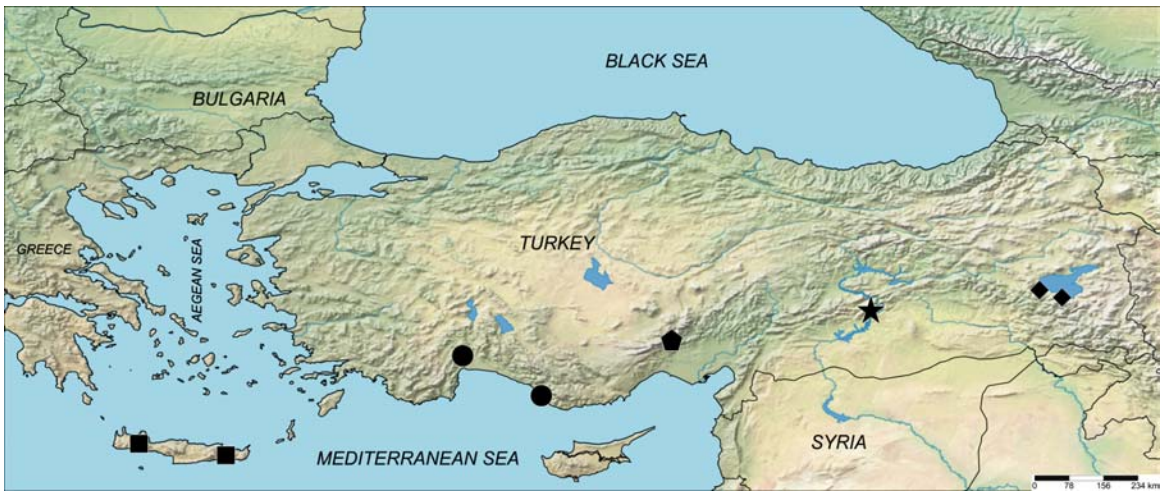


Fig. 33. Distribution records of *Zodarion crewsae* sp. n. (pentagon), *Z. spinibarbe* (square:type locality, new records) and *Z. van* (diamond: type localities, star: present record).

Fig. 33. Точки находок *Zodarion crewsae* sp.n. (пятиугольник), *Z. spinibarbe* (квадрат: типовые местонахождения, круг: новые находки) и *Z. van* (ромб: типовые местонахождения, звезда: новая находка.

completely studied and the species number of Turkish zodariid is supposed to be much higher. Thus, it is necessary to conduct more faunistic studies, but also detailed taxonomic research, especially in, eastern Anatolian, southeastern Anatolian and Black Sea Region, which have hitherto been neglected by most arachnologists.

Disclosure statement. No potential conflict of interest was reported by the authors.

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