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Research article

First records of the invasive plant *Carpobrotus edulis* from the Bulgarian Black Sea Coast

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Abstract: First observations in Bulgaria of *Carpobrotus edulis* from both sand dunes and coastal cliffs are presented in the current study. In 2024, first signs of naturalisation of *C. edulis*, a species with high potential for invasiveness, were registered on two locations on the Southern Black Sea Coast: in embryonic shifting dunes, on a small beach west of Chernomorets Town, and on a coastal cliff in the town of Ravda. Images of the most significant morphological characteristics, that distinguish *C. edulis* from *C. acinaciformis*, are presented. In 2025, a field survey, monitoring of invasive plants, was carried out at 23 dune systems from the Southern Bulgarian Black Sea Coast and *Carpobrotus* species were not registered in the sand dune habitats of the studied dune complexes. Nevertheless, collected data shows, that unregulated ornamental planting is a major source of propagules for several invasive species in the dune habitats, and the appearance of *Carpobrotus edulis* as a garden escapee from gardens established around hotels, bungalows, beach bars, etc., is a matter of time, given that the species is widely used for ornamental purposes in the area. Therefore, monitoring of priority areas (coastal dunes and cliffs) and timely action by management authorities is needed to eradicate the recorded populations and raise awareness among the local community about the high invasiveness of the species and the existing ecological risk to coastal habitats – sand dunes and coastal cliffs.

Keywords: alien plant invasion, coastal cliffs, Hottentots-fig, psammo- and hasmophytic vegetation, sand dune habitats, western Pontic coast

Introduction

The genus *Carpobrotus* belongs to *Aizoaceae* – the largest family of leaf succulent plants (Hartmann, 1993, 2002). *Carpobrotus* species are mat-forming trailing succulent perennial herbs, most species in the genus are native to South Africa (Wisura & Glen, 1993), where they commonly occur in coastal habitats among other succulent species (Mucina et al., 2006), and are also part of the Fynbos vegetation – a sclerophyllous shrubland characteristic for the Cape Floral Region (Manning, 2018). *Carpobrotus* spp. have been documented from all five continents and are widely naturalised in coastal habitats outside their native range. In Europe two hybridising taxa, *C.*

edulis and *C. acinaciformis*, are widely distributed along the Mediterranean coast from Spain to Greece and along the Atlantic coast from Gibraltar to the United Kingdom (Campoy et al., 2018).

Coastal habitats provide valuable ecosystem services (Van Dijk, 1989; Petrosillo et al., 2007; Haller et al., 2011; Doody, 2013; Drius et al., 2019a, b), but at the same time they are also among the most threatened (Schlacher et al., 2007; Defeo et al., 2009; Malavasi et al., 2014; Janssen et al., 2016). The structure and functions of coastal ecosystems have been severely modified by constantly growing touristic pressure, habitat loss, land-use change and invasive species (Delbaere, 1998; Alados et al., 2004; Hesp & Martínez, 2007; Malavasi et al., 2013; Šilc et al., 2020). The



Fig. 1. Map of the Southern Bulgarian Black Sea Coast with marked two sites with registration of *Carpobrotus edulis* (in red) and 23 studied dune systems (in green).

introduction of alien invasive plants is one of the most significant threats to local biodiversity and natural ecosystems' preservation, as they produce a decline of native taxa and damage native communities (Mack et al., 2000; Gaertner et al., 2009; Simberloff et al., 2013).

Therefore, studies on their impact on coastal habitats, with an emphasis on sand dunes, have increased recently (Campos et al., 2004; Acosta et al., 2008; Carboni et al., 2010; Asensi et al., 2016; Giulio et al., 2021; etc.).

Carpobrotus has been grown in Europe for ornamental purposes since the late seventeenth century (Preston & Sell, 1988). By the end of the nineteenth century there already are records of naturalised populations (Davey, 1909; Lousley, 1971; McClintock, 1975), most probably as a result of propagule escapes from private botanical gardens and from the horticultural industry (Campoy et al., 2018). Another possible scenario for the establishment of certain populations, apart from gardening, might be the deliberate release of the species for soil and sand dune stabilisation (Preston & Sell, 1988). Due to their intense vegetative clonality and the use of stolons as storage organs, a high phenotypic plasticity, resistance to high concentration of salinity, etc., *Carpobrotus* species show strong adaptability and dispersion ability in a wide range of environmental conditions, with a preferential for coastal habitats, both on rocky and sandy coasts (Roiloa et al., 2010, 2017; Roiloa, 2019; Sarmati et al., 2019). Nowadays, *C. edulis* and *C. acinaciformis* are considered among the most widespread and aggressive invasive plants along the Mediterranean coasts (Vilà et al., 2006; Traveset et al., 2008; Carranza et al., 2010; Jucker et al., 2013; Innangi et al., 2023), and most authors agree on their negative influence on growth, survival, germination and reproduction of native species (Conser & Connor, 2009; Santoro et al., 2012; Novoa et al., 2013, 2014a; Sarmati et al., 2019).

In the current study first observations for Bulgaria of *Carpobrotus edulis* from both sand dunes and coastal cliffs are discussed, along with some taxonomical aspects and identification issues and the species' potential for negative ecological impact as a prominent invasive plant in Europe (Campoy et al., 2018).

Methods

In November 2024, during field work on dune habitats mapping, applying the Standard Dune Mapping Procedure for the Bulgarian Black Sea Coast (Prodanov et al., 2025), first signs of naturalisation of *Carpobrotus edulis* were registered at a couple of locations on the Southern Bulgarian Black Sea Coast: (1). Atia Beach, west of Chernomorets Town, Sozopol Municipality, Burgas District; (2) Scalichkite Beach in Ravda Town, Nesebar Municipality, Burgas District. Subsequently, during May – September 2025, a field survey, monitoring of invasive plants in coastal dune habitats, was carried out using both transect

method (in all present dune habitats) and phytosociological plots (5 m × 5 m). Data were collected from 23 dune systems from the Southern Bulgarian Black Sea Coast (from north to south: Chernomorets, Campsite Gradina and Zlatna Ribka, Sozopol – Harmani, Kavatsi – Smokinya, Alepu, Arkutino, Ropotamo, Primorsko – Perla, Primorsko – South, Atliman, Kiten, Koral and Campsite Yug, Lozenets, Oasis, Arapya, Tsarevo – Popski Plazh, Nestinarka, Ahtopol, Veleka, Butamyata, Lipite, Listi, Silistar; Fig. 1).

Due to the importance of land–sea circulation systems, the Bulgarian Black Sea coastline is a separate climatic region within the Continental-Mediterranean climatic zone. Warm summers and mild winters (with positive January temperatures) are typical (700 mm, 4 °C, town of Tsarevo) (Velev, 2002).

Carpobrotus species identification follows Preston & Sell (1988), Gonçalves (1990), Wisura & Glen (1993), Strid & Tan (1997), Cabello (2009), Campoy et al. (2018), Mifsud (2021). Sand dune habitat was defined according to Kavrakova et al. (2009), Interpretation Manual of European Union Habitats – EUR28 (2013), Tzonev (2015a, b).

For the precise species identification, following Mifsud (2021), we prepared representative photographs of: (1) developed leaves (three or more nodes below the flower or apical leaves), (2) cross-sections of leaves, (3) base of leaves with a subhyaline (wax-white) swollen lip, (4) abaxial side of flower with calyx lobes, (5) transversal section of flower with petals, stamens and ovary, (6) fruit, (7) cross-section of ovaries (mature flowers or young fruit). All pictures were taken *ex situ* over a 1 × 1 cm grid mat (Fig. 2A–G). Photographs of the whole plants from both locations were also taken *in situ*. Sample material was collected from the location in Ravda Town.

Results and discussion

Taxonomic complexity and identification of *Carpobrotus edulis*

Carpobrotus edulis (L.) N.E.Br., 1926; Basyonym: *Mesembryanthemum edule* L., 1759; Order *Caryophyllales* Juss. ex Bercht. & J.Presl; Family: *Aizoaceae* Martinov, Subfamily *Ruschioideae*

Mat-forming trailing succulent perennial herb with opposite leaves, straight or slightly curved, more or less

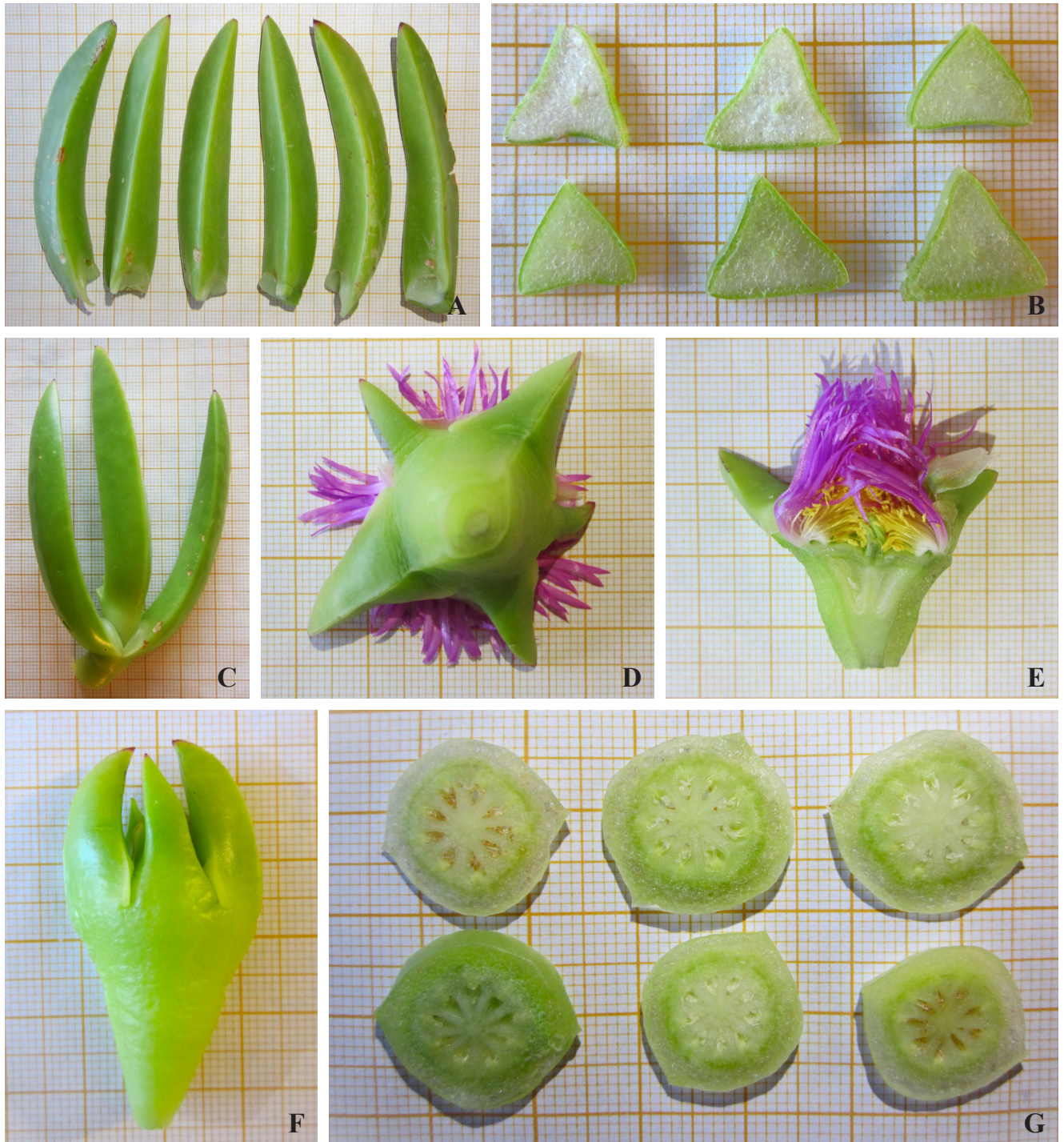


Fig. 2. Images of the most significant morphological characters of *Carpobrotus edulis*: A. leaves, widest part is in the lower (proximal) half of the leaf; B. cross-section of leaf – equilateral; C. leaves, a subhyaline (wax-white) swollen lip is visible at the base of the leaves; D. abaxial side of a mature flower showing unequal calyx lobes; E. transversal section of a mature flower; F. young fruit; G. cross-section of ovaries of young fruit, number of locules 9–10. Photography M. Valcheva.

connate at the base, sharply 3-angled, with equilateral triangular cross-section (Fig. 2A–C). Leaf color variable, usually bright green. Widest part of leaves in

the lower (proximal) half. A swollen subhyaline (wax-white) lip, at least 1 mm thick, is present on the adaxial surface at the base of leaves, embracing the stem (Fig.



Fig. 3. *Carpobrotus edulis* in embryonic shifting dunes in Atia Beach (20 November 2024). Photography M. Valcheva.

2C). Each pedicel bears a pair of leaf-like bracts, usually positioned near the midpoint. Calyx consists of five unequal lobes (Fig. 2D), the longest 30–70 (80) mm and the shortest 10–35 mm. Flowers are pedicellate, terminal, solitary, up to 120–150 mm in diameter. *C. edulis* var. *edulis* has yellow petals, fading to pink when aging, and *C. edulis* var. *rubescens* has purple petals (Fig. 2E). The receptacle is turbiniform, 20–40 mm long, tapering linearly towards the pedicel. Fruit is fleshy, pulpy, indehiscent and without valves (Fig. 2F), containing numerous glossy, brown, obovoid and slightly compressed seeds. Ovaries normally with 9–10 (11) locules (Fig. 2G).

According to Campoy et al. (2018), a full review of the genus *Carpobrotus* is needed, due to several taxonomic uncertainties. The taxonomy of the two invasive species from the genus in Europe (*C. edulis* and *C. acinaciformis*) has long been debated: e.g. the primary diagnostic character in the original descriptions – petal colour (yellow in *C. edulis*, purple in *C. acinaciformis*) (Wisura & Glen, 1993), has proven unreliable, since several authors have reported a purple-perianth variety of *C. edulis* (*C. edulis* var. *rubescens*) (Preston & Sell, 1988; Strid & Tan, 1997), which is commonly used in horticulture (Cullen, 2011). Hybridisation between *C. edulis* and *C. acinaciformis*

(Ortiz et al., 2008; Andreu et al., 2010; Suehs et al., 2004a, b) further complicates species identification. In several studies and identification keys (Marloth, 1913; Gonçalves, 1990; Cabello, 2009; Mifsud, 2021), leaf cross-section is considered a diagnostic character (an equilateral triangle for *C. edulis*, isosceles for *C. acinaciformis*). According to Wisura and Glen (1993) the receptacle is also an important character in this genus, turbiniform and tapering into the pedicel in *C. edulis*, while not tapering into the pedicel in *C. acinaciformis*. Mifsud (2021) reports a strong and constant morphological character, which distinguishes both species: the base of most leaves of *C. edulis* is furnished with a subhyaline (wax-white) swollen lip embracing the stem, whereas in *C. acinaciformis* it is flat or very slightly raised above the adaxial surface of the leaf.

Habitat characteristics and site conditions of established locations

Carpobrotus edulis was found in two locations on the Southern Black Sea Coast (Fig 1).

First location is Atia Beach west of Chernomorets Town (coordinates: 42°26'43.78"N, 27°34'26.87"E),



Fig. 4. Atia Beach near the town of Chernomorets, Sozopol Municipality, where *Carpobrotus edulis* was registered (place marked with red arrow). Photography B. Prodanov.

where the species was registered in embryonic shifting dunes as part of a characteristic psammophytic community (Fig. 3). Although the habitat is under strong anthropogenic (touristic) pressures like trampling, building of different infrastructure, maintenance of beach areas for tourism and recreation, etc., a good number of typical psammophytes, such as: *Salsola ruthenica*, *Cakile maritima* subsp. *euxina*, *Lactuca tatarica*, *Polygonum maritimum*, *Leymus racemosus* subsp. *sabulosus*, *Eryngium maritimum*, *Glaucium flavum*, *Medicago marina*, were registered in the phytocoenoses. The total vegetation cover was low (5–10%), and the projective cover of typical species varied between 30–40% of the total vegetation cover. In addition to the typical species for embryonic shifting dunes, some species with wider distribution, that are often found on coastal dunes, were also part of the phytocoenoses: *Suaeda maritima*, *S. altissima*, *Cynanchum acutum*, *Atriplex* spp., as well as some anthropophytes and ruderals like *Cynodon dactylon*

and *Tribulus terrestris*. Except from *Carpobrotus edulis* three other invasive alien plants were registered: *Xanthium italicum*, *Opuntia engelmannii* and *Amorpha fruticosa*, posing a significant threat to the psammophytic vegetation. The most probable reason for the establishment of both *Carpobrotus edulis* and *Opuntia engelmannii* is their use for ornamental purposes in the area right behind the narrow strip of embryonic shifting dunes, where various gardening attempts were visible around the bungalows (Fig. 4).

Second location, where *Carpobrotus edulis* was found, is a coastal cliff in the town of Ravda (coordinates: 42°38'17.99"N, 27°40'42.09"E) (Fig. 5) within a small, pocket-type beach (Scalichkite Beach) bordered by a steep limestone cliff (Fig. 6). The cliff reaches a height of approximately 11 m and forms a pronounced rocky backshore, directly controlling sediment accumulation and limiting beach width. The beach is narrow, with an average width of approximately 18–22 m and a total surface area of about



Fig. 5. *Carpobrotus edulis* on a coastal cliff in Scalichkite Beach in Ravda Town (20 November 2024). Photography M. Valcheva.

1199,8 m², with a gently sloping profile of a weakly developed accumulative zone. The species was growing at the base of the cliff, within the impact range of the salt spray, which is not surprising given the high tolerance of *Carpobrotus* species to salinity

(Weber & D'Antonio, 1999; Novoa et al., 2014b; Varone et al., 2017). In this micro-beach, along with *Carpobrotus edulis*, there are also *Rosmarinus officinalis*, *Opuntia engelmannii*, *Yucca filamentosa*, as well as other members of the Aizoaceae family, such

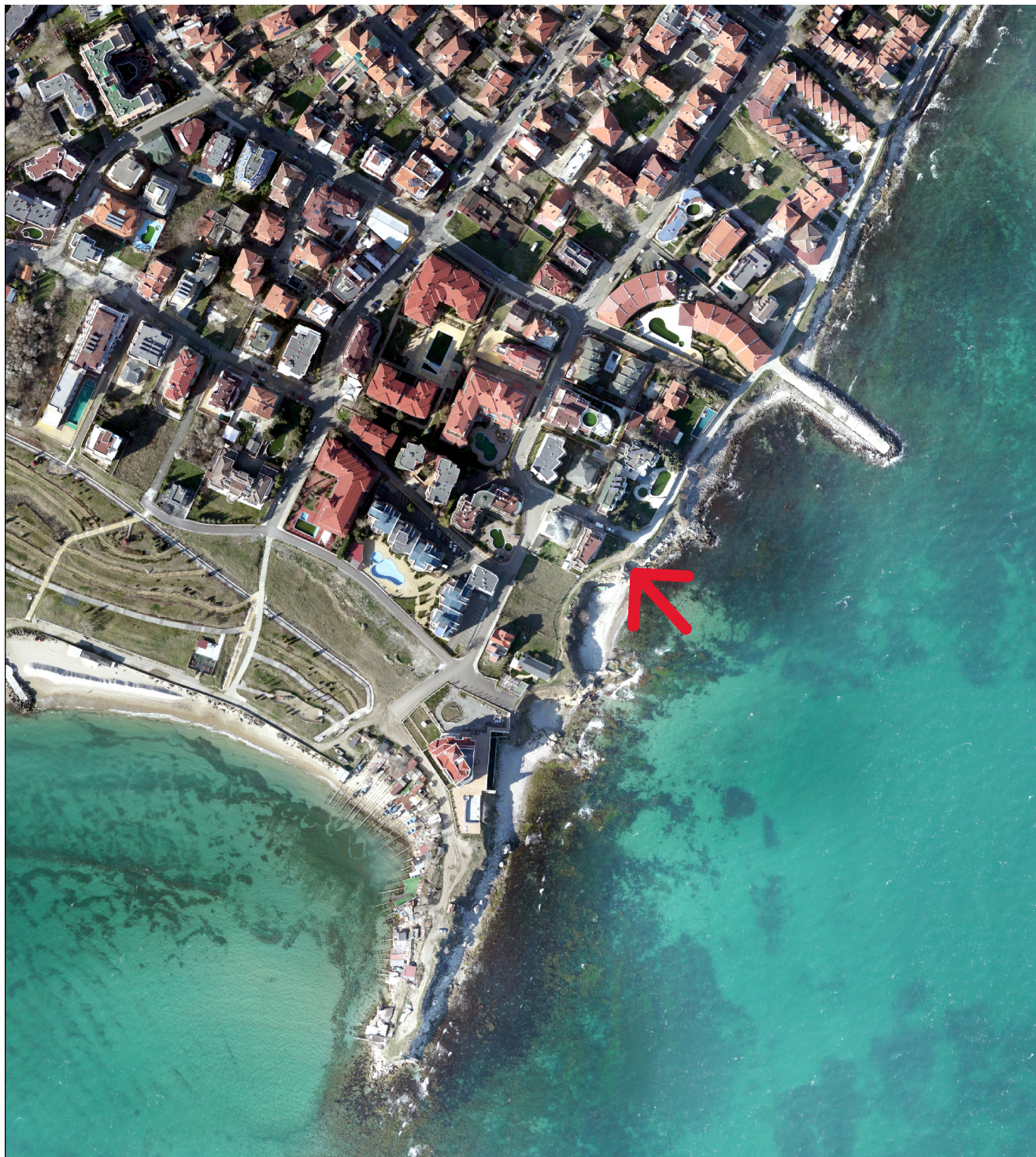


Fig. 6. Scalichkite Beach in Ravda Town, where *Carapobrotus edulis* was registered (place marked with red arrow). Orthophoto mosaic B. Prodanov.

as *Mesenbryanthemum cordifolium* and *Delosperma cooperi*. There are also photographs (Fig. 7) of the creation of this place as an “art garden in situ”, which is a de facto “release into nature” in order to increase

the decorative value of the landscape, without taking into account the invasiveness of the planted species. No natural chasmophyte vegetation has been registered on the rock around the naturalised plant. A

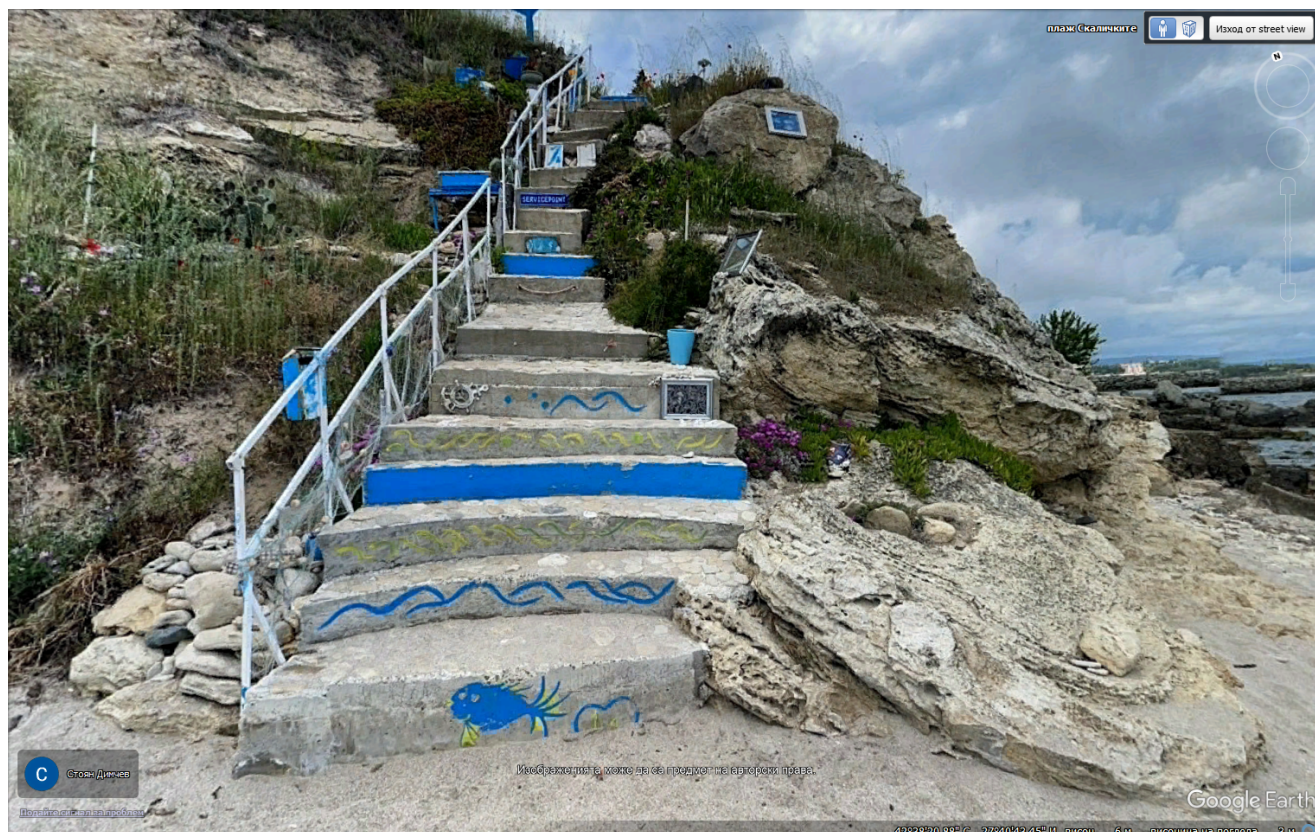


Fig. 7. “Art garden in situ” on a coastal cliff in Scalichkite Beach in Ravda Town (2022). Source: Google Earth.

partial process of “escape” of these species can also be assumed, since in the landscaping of gardens around hotels and private homes in the immediate vicinity, these species are present.

Post-detection monitoring and implications for invasion risk

After the two registrations in 2024 of this highly invasive species, in 2025 a full inventory of 23 dune systems from the Southern Bulgarian Black Sea Coast (Fig. 1) was carried out during a field survey, concerning invasive plants in coastal dune habitats, on the project KP-06-H84/5-16.12.2024 “Mapping and Spatiotemporal Analysis of Beach-Dune Systems on the Southern Bulgarian Black Sea Coast: Evolution, Anthropogenic Pressure, and Ecological Risks to Dune Habitats”. Fortunately, *Carpobrotus* had not yet been found in the sand dune habitats of the studied dune systems. Nevertheless, data collected during the survey shows, that unregulated ornamental planting is a major source of propagules for several

invasive species in the studied sand dune habitats and the appearance of *Carpobrotus edulis* as a garden escapee from gardens, established around hotels, bungalows, beach bars, etc., is a matter of time, given that the species is widely used for ornamental purposes in the area (e.g. the closely related *Delosperma cooperi*, fortunately not an invasive species, was registered in a couple of locations planted in gardens in the immediate vicinity of the dune habitats: Arapya, coordinates: 42°11'23.16"N, 27°50'10.05"E, Sozopol – Harmani, coordinates: 42°24'35.95"N, 27°42'10.62"E). Awareness should be raised among the local community, about the invasive character of the species and its ecological impact on coastal habitats in other parts of the world. Growing some plants with invasive potential, like some species of *Carpobrotus*, *Opuntia*, *Sedum*, *Yucca* etc., in vulnerable coastal areas, would facilitate a potential invasion in the natural habitats, therefore, the use for ornamental purposes of such species should be regulated, particularly when such valuable and endangered habitats are concerned (Valcheva et al., 2021).

Conclusion

The spread of *C. edulis* outside its natural range does not seem to be limited by Mediterranean climatic limits, as it occurs in Northwestern France, Southern Great Britain, Ireland and Northern Germany (Campoy et al., 2018), and given current climate change trends, the potential climatic area suitable for the species could easily increase. These first data on naturalised *C. edulis* in coastal habitats in Bulgaria, discussed in the present study, should focus the attention of responsible institutions for the rapid eradication of invasive populations and trigger monitoring of priority areas (coastal dunes and cliffs) and awareness activities about the presence of this aggressive invasive species, as early detection is essential to prevent plant invasions. Currently, breeding pressure from horticulture near sand dunes and coastal cliffs is the most important problem that needs to be addressed and resolved to prevent the further spread of *C. edulis* in coastal habitats along the Bulgarian Black Sea coast.

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Conflicts of interest

No potential conflict of interest has been reported by the authors, reviewers, or subject editor.

Author's contributions

(using [CrediT](#))

Chavdar Gushev: conceptualisation, data curation, formal analysis, investigation, methodology, validation, writing—original draft, writing—review and editing; Magdalena Valcheva: conceptualisation,

data curation, formal analysis, investigation, methodology, visualisation, writing—original draft, writing—review and editing; Bogdan Prodanov: data curation, investigation, validation, visualisation, writing—review and editing.

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Research article

On the identity of the poorly known spider species *Centromerus obscurus* Boesenberg, 1902 and description of a new species (Araneae: Linyphiidae)

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<https://zoobank.org/AE9FA3CE-537D-44C4-B498-1B90C6B6844B> 

Abstract: The taxonomic status and distribution of the poorly known linyphiid species *Centromerus obscurus* Boesenberg, 1902 is discussed on the basis of newly collected material from Bulgaria. Additionally, after a review of the related literature and the newly collected material, a new species of *Centromerus* species, *C. thaleri* **sp. n.**, is described based on both sexes and *Centromerus obscurus* is considered **nomen dubium stat. reconf.**

Keywords: Bulgaria, discussion, new records, taxonomy

Introduction

The identity of *Centromerus obscurus* Bösenberg, 1902, described only based on two females from Germany in the early 20th century, remains unclear. As the type is unfortunately lost (Renner, 1988), the only evidence available to interpret the identity of this taxon is Bösenberg's original description and illustrations, as well as scarce and contradictory follow-up reports (Roewer, 1928 and other sources listed in Braun, 1982), as well as the regional faunal surveys near the locus typicus (Arachnologische Gesellschaft, 2025). This was the reason the species was considered *nomen dubium* by Braun (1982) but was soon revalidated by Thaler (1983) who claimed to have found one female in Austria. Thaler himself was uncertain about the identification, commenting on the morphological differences between his specimen and the original description, thus adding a question mark.

Finding what appears to be Thaler's species in Western Bulgaria by the second author (see Material in the Results section below), including the

previously unknown male, revived the discussion. While morphologically identical to Thaler's species apart from the colouration (see description), this finding prompted a reevaluation of the actual identity of Bösenberg's taxon with the help of the available literature. The aim of the present publication is to clarify the relationship between the new findings and *Centromerus obscurus* using the available literature and to describe the collected species as new.

Material and methods

The studied material was collected by hand. Colouration is described from alcohol preserved specimens. Measurements of the legs were taken from the dorsal side and follow the format total length (femur, patella, tibia, metatarsus, tarsus). Total length of the body includes the chelicerae. All measurements are in mm. Specimens were examined and measured using a Wild M5A stereomicroscope. Digital images were taken with a Canon EOS1100 attached to a Carl Zeiss Amplitval microscope and processed using

Adobe Photoshop CS6 software. The specimens are preserved in 70–95% ethanol and deposited in National Museum of Natural History, Sofia (NMNHS) and the personal collection of S. Indzhov (CSI). The nomenclature follows the World Spider Catalog (World Spider Catalog 2026) and the taxa are listed alphabetically.

Abbreviations follow Ballarin & Pantini (2020): ALE = anterior lateral eyes; AME = anterior median eyes; PLE = posterior lateral eyes; PME = posterior median eyes; PLE = posterior lateral eyes; APP = antero-proximal part of the median membrane; CG = copulatory grooves; CO = copulatory opening; DS = distal part of scapus; E = embolus; P = paracymbium; PMP = posterior median plate; R = radix; RA (I–III) = radical apophyses; S = spermatheca; SA = distal suprategular apophysis; TA = terminal apophysis.

Results

Linyphiidae

Centromerus thaleri sp. nov.

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368F5E72-AD53-4C30-9FCB-D1222177C332 

Material. Holotype: ♂ (NMNHS), Bulgaria, Chepan Mt (Dragoman District), 42.9390°N, 22.9495°E, 24.12.2020 (S. Indzhov leg.). Paratypes: 1 ♀ (NMNHS) same data as the holotype; 1 ♂, 1 ♀ (NMNHS) same location as the holotype, 13.11.2023 (S. Indzhov leg.); 1 ♂, 1 ♀ (CSI) Balsha Village (Sofia District), 42.8598°N, 23.2599°E, 15.03.2024 (S. Indzhov leg.); 3 ♀♀ (CSI) Balsha Village (Sofia District), 42.8598°N, 23.2599°E, 22.12.2024; 2 ♀♀ (CSI) Aldomirovtsi Village (Sofia District) 42.8968°N, 23.0084°E, 19.02.2024 (S. Indzhov leg.).

Material used for comparison: *Centromerus capucinus* (Simon, 1884), 1 ♂, 2 ♀♀ Bulgaria, Chepan Mt (Dragoman District), 13.11.2023 (S. Indzhov leg.).

Diagnosis

The new species is closely related to *C. capucinus* Simon, 1884. The lateral parts of the epigyne are more rounded and broader in *C. thaleri* sp. n., while

being much smaller in *C. capucinus*. The males of *C. capucinus* and *C. thaleri* sp. n. differ mainly by the radical apophyses, being well-separated in *C. thaleri* sp. n. and close together in *C. capucinus* (Figs 1–14).

Etymology

The species name is a patronym dedicated to the well-known arachnologist Konrad Thaler.

Description

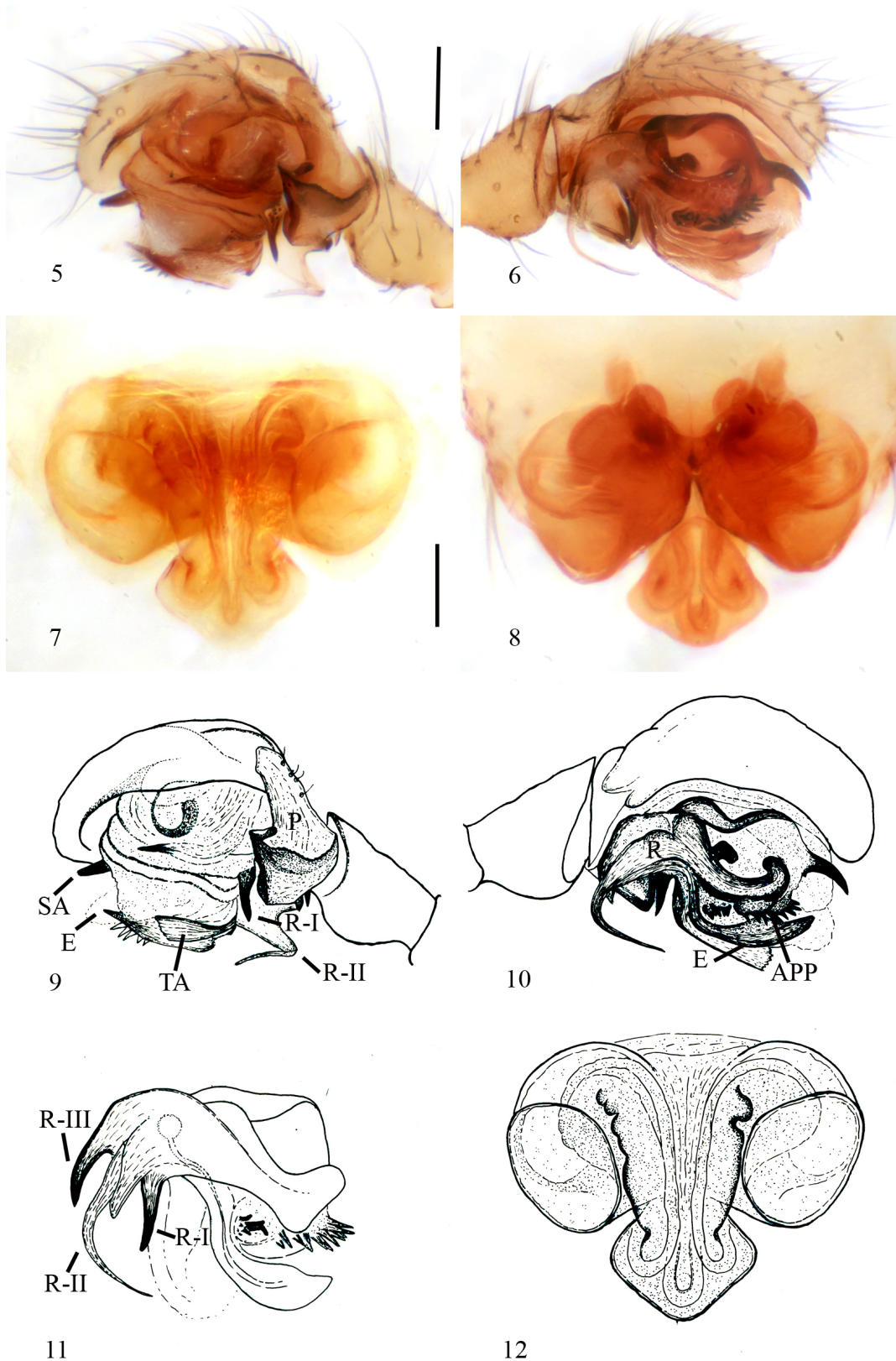
Male holotype. Measurements: Total length 2.34; cephalothorax length 1.15, width 0.90; sternum length 0.54, width 0.46; chelicerae length 0.50, width 0.21; clypeus height 0.07; eye diameters: AME 0.05, ALE 0.07, PME 0.05, PLE 0.05; cymbium 0.32; abdomen length 1.26; legs: I – 4.53 (1.22, 0.28, 1.26, 1.08, 0.68); II – 4.17 (1.15, 0.28, 1.11, 1.00, 0.61); III – 3.60 (1.00, 0.21, 0.86, 1.00, 0.50); IV – 4.35 (1.26, 0.28, 1.26, 1.15, 0.68). Colouration (Figs 1–4): Chelicerae yellow-brown, armed with three teeth on outer row and four denticles on inner row. Carapace and sternum, yellow. Abdomen, pale-grey. Legs yellow to pale yellow, femora I with a dorsal and a prolateral spine; femora II–III with 1 dorsal spine; tibiae III–IV with one dorsal spine; tibia IV with one dorsal spine.

Palp (Figs 5, 6, 9–11): Cymbium without distal tubercle. Paracymbium large with slightly jagged inner margin, four short hairs near proximal end. Three radical apophyses, the first well developed, slightly curved and pointed at the end, the second one step-wise wide at the base, then abruptly thinning out and curved at a right angle, third one also well developed, slightly curved and pointed at the end. Distal suprategular apophysis long, slightly curved and robust. Antero-proximal part of median membrane with two rows of teeth, one with small and stumpy teeth and the other with longer and thin teeth. Terminal apophysis transparent and scarcely visible. Embolus massive, curved, pointed apically.

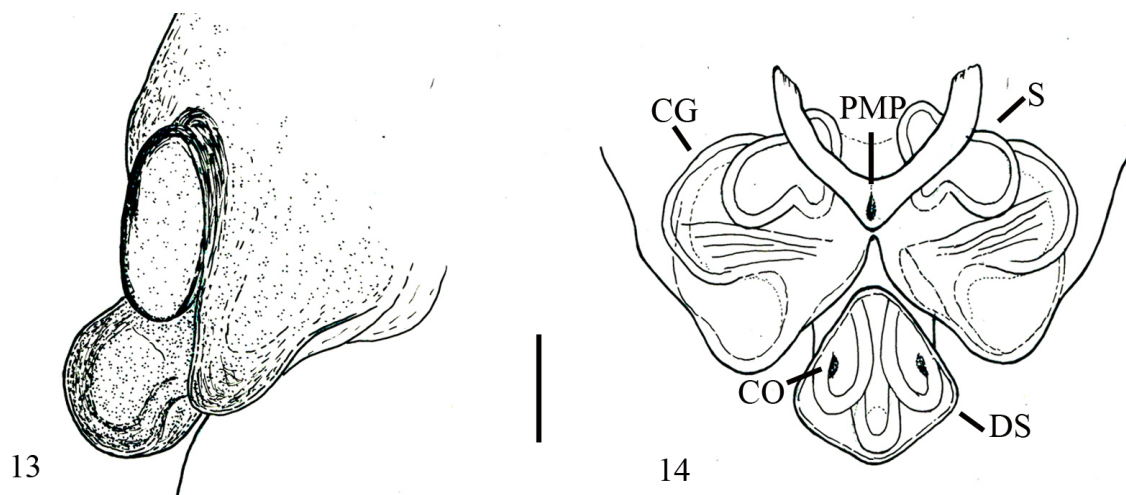
Female (paratype). Measurements: Total length 2.52; cephalothorax length 1.26, width 0.86; sternum length 0.54, width 0.50; chelicerae length 0.50, width 0.22; clypeus 0.07; eye diameters: AME 0.05, ALE 0.07, PME 0.05, PLE 0.05; abdomen 1.51; Legs: I – 4.39 (1.22, 0.28, 1.26, 0.93, 0.68); II – 4.03 (1.15,



Figs 1–4. *Centromerus thaleri* sp. n.: male habitus, dorsal and ventral view (1–2); female body, dorsal and ventral view (3–4). Scale bars – 0.3 mm.



Figs 5–12. *Centromerus thaleri* sp. n.: (5, 6, 9, 10) left male palp, retrolateral/prolateral view; (11) embolic division, prolateral view; (7, 8) Epigyne/vulva, ventral/dorsal view; (12) epigyne. Scale bars – figures 5, 6, 9, 10 – 0.05 mm; figures 7, 8, 12 – 0.06 mm.



Figs 13, 14. *Centromerus thaleri* sp. n.: (13) epigyne, lateral view; (14) vulva, dorsal view. Scale bars – 0.06 mm.

0.28, 1.11, 0.90, 0.57); III – 3.34 (1.00, 0.21, 0.86, 0.79, 0.46); IV – 4.28 (1.26, 0.28, 1.26, 1.08, 0.68).

Colouration as in male.

Epigyne/vulva (Fig. 7, 8, 12–14): Anterior wall triangular, lateral sides rounded and broad. Distal part of scapus wide and rhomboid. Posterior median plate small, curved and rectangular, with a triangular extension in the middle, pointed to distal part. Spermathecae elongated and kidney-shaped. Copulatory ducts turning arcuate posteriorly and outward before returning to the middle part of vulva, ending in copulatory openings in distal part of scapus.

Ecology

The species matures in winter. It inhabits the soil of open, xerothermic habitats and is occasionally found in or near ant nests.

Distribution

Known only from Bulgaria and Austria.

Discussion

Braun (1982) thoroughly examined the available evidence for all species described by Bösenberg and gave his interpretations, although he expressed uncertainty on many of them. Regarding *Centromerus obscurus*, he stated that ‘the epigyne shows with

[some] probability a species which belongs to a member of Microneteae (sensu Wiehle [1956]), with the genera *Agyneta* and *Meioneta* most likely coming in question’. This careful formulation shows that Braun was convinced that the original description of the species did not allow an unambiguous identification, and even expressed doubts about Bösenberg’s generic placement. Braun also discussed Roewer (1928)’s interpretation of *Centromerus obscurus*. According to him, it was ‘surprising that Roewer [1928] this time did not copy the drawing by Bösenberg’, and speculated that Roewer could have examined one of the syntype females. ‘If so,’ he continued, ‘Roewer’s drawing could only originate from a strongly forwards (ventrally) turned epigyne, or the depicted epigyne belongs to a *Centromerus* from the *sylvaticus* group (compare to [...] *C. alnicola* Schenkel [,] 1936, one however much smaller-sized species!).’ *Centromerus alnicola* Schenkel, 1936 is currently considered a synonym of *Centromerus semiater* (L. Koch, 1879) (WSC, 2026). Again, Braun (1982) formulated his interpretation very carefully, in conditionals, in an attempt to explain the discrepancies between the early works. His comments on later findings from the Netherlands and Poland also showed two distinct misidentifications – as *Agyneta saxatilis* (Blackwall, 1844) and as *Centromerus brevipalpus* (Menge, 1866), respectively. These three contradictory interpretations of the identity of *Centromerus obscurus* in the subsequent literature only highlight the inadequacy of this description.

Thaler (1983) added an additional putative species to the list, herein identified as *Centromerus thaleri* sp.

nov. He himself was not convinced of the identification, adding a question mark to the name and mentioning morphological differences between his material and the original description (larger lateral parts of the epigyne than in the description at Bösenberg 1902). We also think we should comment on one other possible candidate for the true identity of *Centromerus obscurus*: *Centromerus capucinus* (Simon, 1884), a species which Bösenberg treated as a member of another genus and knew only from the male sex (Bösenberg, 1901). Specimens of both taxa were collected from the same area of Southwestern Germany, where Bösenberg was active. In present-day Germany, *Centromerus capucinus* has many records from this area (Arachnologische Gesellschaft, 2025), while the species reported by Thaler is yet to be found in this well-surveyed region – its current distribution ranging from Eastern Austria (East of the Alps) to the Balkans. While it is not automatically excluded that our species is found west of the Alps (*Centromerus capucinus* is found across a large part of Europe), it is dubious that German surveying efforts for the last 125 years have failed to find any individuals. Both the morphological discrepancies and the distribution make Thaler (1983)’s interpretation of the taxon likely also incorrect.

Acknowledgements

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Conflicts of interest

No potential conflict of interest has been reported by the authors, reviewers, or subject editor.

Author’ contributions

(using [CrediT](#))

Christo Deltshev: conceptualisation, methodology, resources, supervision, visualisation, writing—

original draft, writing—review and editing; Simeon Indzhov: conceptualisation, data curation, investigation, resources, writing—original draft, writing—review and editing.

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