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## Description of previously overlooked specimens of *Nemesia rastellata* (Araneae, Mygalomorphae: Nemesiidae) from the type locality, with notes on functional aspects of male morphology

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**Abstract.** Previously overlooked material of *Nemesia rastellata* Wunderlich, 2011, collected at the type locality and present in the collection of the Senckenberg Museum in Frankfurt am Main, is here described. This description provides important new information for taxonomical recognition of the species and the first observations on intraspecific variations in size and shape in *N. rastellata*. Additionally, aspects of male morphology in *Nemesia* trapdoor spiders are discussed from a functional perspective.

**Keywords:** Greece, intraspecific variation, Karpathos, rastellum, trapdoor spiders

**Zusammenfassung. Beschreibung bisher übersehener Exemplare von *Nemesia rastellata* (Araneae, Mygalomorphae: Nemesiidae) von der Typuslokalität, mit Anmerkungen zu funktionalen Aspekten der männlichen Morphologie.** Bisher übersehenes Material von *Nemesia rastellata* Wunderlich, 2011, gesammelt an der Typuslokalität und Teil der Sammlung des Senckenberg Museums in Frankfurt am Main, wird in dieser Arbeit beschrieben. Die Beschreibung enthält wichtige neue Information für die taxonomische Bestimmung der Art und die ersten Beobachtungen zu intraspezifischen Variationen von Größe und Form innerhalb *N. rastellata*. Zusätzlich werden Aspekte der männlichen Morphologie von Falltürspinnen der Gattung *Nemesia* aus funktionaler Perspektive diskutiert.

Wunderlich (2011) described *Nemesia rastellata* from a male specimen in the collection of the Senckenberg Museum in Frankfurt am Main. The specimen was collected by R. Kinzelbach in September 1963 on the Greek island of Karpathos. Wunderlich (2011) noted that the type specimen was in rather poor condition by stating that “the opisthosoma of the spider and the right pedipalpus have been separated, the opisthosoma is deformed” (sic). The female of the species was, and still is, unknown. At the time of Wunderlich’s description, part of the mygalomorph spider collection was loaned out to the author of the present article and thus absent from the Senckenberg Museum collection. A request from the Senckenberg curator to return the loan in May 2022 triggered renewed attention for the contents of this loan collection and the discovery of three vials (four specimens) that were apparently incorrectly labelled as containing specimens identified as members of the family Atypidae. In fact, these vials appeared to contain four males of *N. rastellata* (fam. Nemesiidae). Moreover, the vial-labels indicated that these specimens, like Wunderlich’s holotype, were collected on Karpathos by R. Kinzelbach. As these four specimens were absent from the Senckenberg collection at the time of Wunderlich’s description of *N. rastellata* (2011), they are likely to have been collected together with the type specimen.

The four retrieved male specimens are here described, providing additional information for taxonomic recognition of the species and a first insight into intraspecific morphological variation in *N. rastellata*.

### Material and methods

The sample consisted of four specimens in three separate vials. Two vials contained single specimens, the third vial contained two specimens (see paragraph ‘Studied material’ below). All

specimens were studied with the aid of a Huvitz HSZ-645TR stereomicroscope equipped with a Lulis HC-20CU camera operating on Panasis software and an Euromex iScoop compact microscope equipped with a Euromex VC-3031 camera. Both systems allow multiple focus photography and precision measurement. Figures were prepared with Adobe Photoshop elements 2022 and Helicon Focus 7. Terminology used and measuring methods follow Cassar et al. (2022). Measurements are given in millimetres. Size measurements (see below) are given as minimal–maximal values found across the sample of four specimens. Ratios (see below) provide an impression of the shape and relative size of different body parts. Ratios are also given as minimal–maximal ranges.

**Terminology.** The following terminology pertaining to male *Nemesia* morphology is used: 1) Clasper-hook (CH), this is the single strong, rigid, curved and sharp-pointed “hook” or “spur” placed on a prominent apophysis in a ventro-distal, prolateral position of tibia I (Fig. 2d–e). 2) Palp-tibia rake (PTR), this is a transverse row of particularly strong, distally directed spines along the dorso-distal margin of the palp-tibia. In some *Nemesia* species, or species groups, the one or more similar strong spines are present just proximal of the apical row (Fig. 2f). 3) Striae are fine, longitudinal ribs on the embolus found in most *Nemesia* species that occur in the eastern Mediterranean Region (Decae 2012).

**Abbreviations.** AME: anterior median eye(s), AR: width anterior eye-row; BuL: length bulb; CL: carapace length; CH: clasper-hook; CW: carapace width; diaALE: diameter anterior lateral eyes; diaAME: diameter anterior median eyes; diaPLE: diameter posterior lateral eyes; disAME: distance between anterior median eyes; EL: length eye-group; EmL: length embolus; Fem4: length femur IV; L1: length leg I; L1TiL: length tibia I; L1TiW: width tibia I; L2: length leg II; L3: length leg III; L4: length leg IV; LL: length labium, LW: width labium; Met4: length metatarsus IV; PL: length palp; PR: width posterior eye-row; PTR: apical rake on dorsal palp tibia; PTiL: length palp tibia; PTiW: with palp tibia; sd: standard deviation; SL: length sternum; SW: width sternum; T1–T4: respective lengths of tibiae I, II, III, IV; TBL: total body length; Tib4: length tibia IV.

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## Taxonomy

### *Nemesia rastellata* Wunderlich, 2011 (Figs 1-2)

**Studied material.** Four male specimens labelled: 87-Atypidae, deposited at the Senckenberg-Museum Frankfurt am Main. Vial labels indicate that the specimens were collected in Greece, on the island of Karpathos, by R. Kinzelbach and bear the collection numbers 11e, 18e and 21e. For purpose of study all specimens were placed in separate vials and re-labelled as: SMF11e, SMF18e, SMF21e1 and SMF21e2.

**Description.** Within the genus *Nemesia*, body sizes of males range from approximately 7.5 to 18.5 millimetres (information from literature available in the World Spider Catalog 2023). With an average body length of 7.4 (sd. 1.14, n = 4) *N. rastellata* is among the smallest species within the genus. Wunderlich's (2011) diagnosis and description are accurate. Detailed observations on measurements and size ratios of body-parts are given below. The following characters, of additional diagnostic value at the species level, not reported on in Wunderlich (2011), are: (1) the black pigmented ring around each AME (Fig. 1d). (2) Patella III has either two or three prolateral spines (Fig. 1f). (3) Spinnerets, although not well preserved in the sample, show spigots spread widely over the ventral surface of the median and proximal segment of the PLS and apically on the knob-shaped PMS (Fig. 1g). (4) The embolus is ornamented with longitudinal, distally converging curved ribs (Fig. 2a-b) relating *N. rastellata* to a large and diverse species-group within the genus *Nemesia* that has its centre of diversity in the eastern Mediterranean (Decae 2012). (5) Contrary to Wunderlich's (2011) observation (fig. 27) the apophysis of the CH is very short (Fig. 2d) in all specimens in

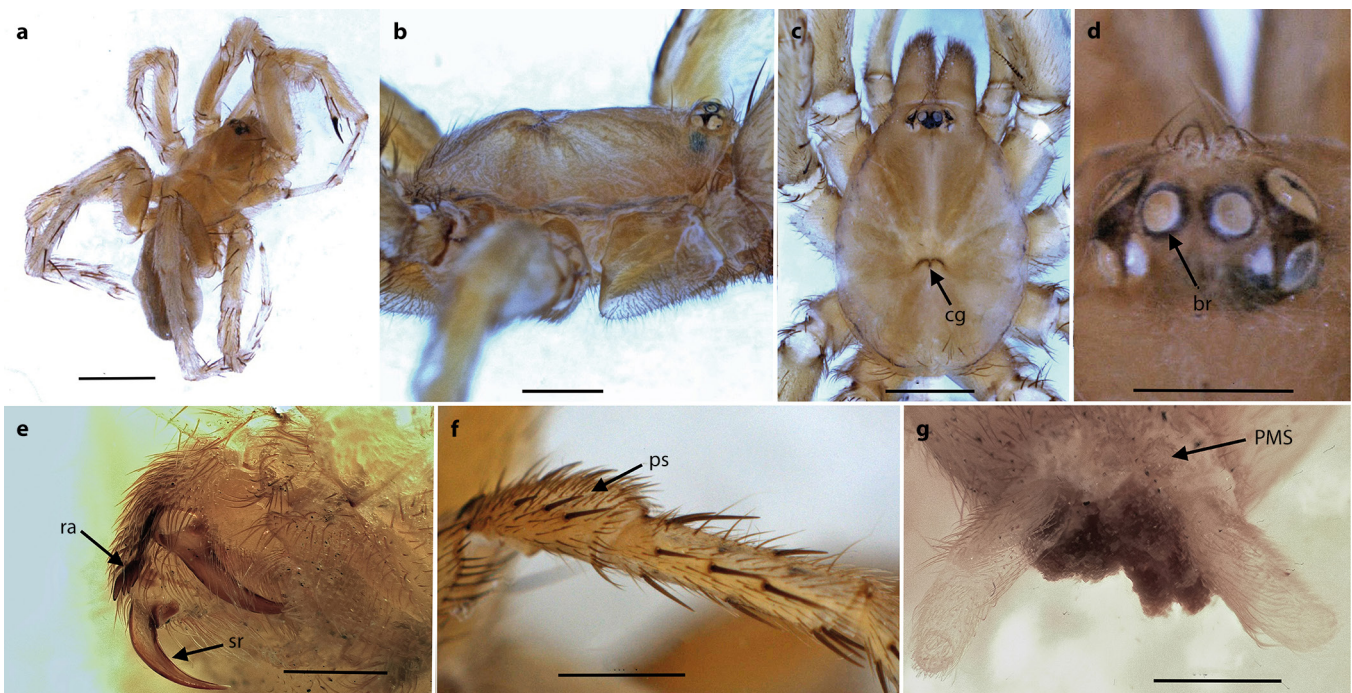
the sample. (6) In ventral view the CH is weakly sigmoid in shape (Fig. 2e). (7) The PTR was found to be very constant in shape and composition with three spines in a transverse apical row and a fourth spine slightly more proximo-retrolateral (Fig. 2f), this is slightly different from Wunderlich's (2011) observation (fig. 29). (8) The fangs have a smooth ventral ridge (Fig. 1e).

**Size measurements (n = 4).** Body parts: TBL 6.2–9.2; CL 2.7–4.0; CW 2.0–3.1; SL 1.6–2.1; SW 1.1–1.5; LL 0.3–0.4; LW 0.4–0.6. Eye-group: AR 0.56–0.73; PR 0.54–0.71; EL 0.29–0.47; diaALE 0.17–0.23; diaPLE 0.12–0.19; diaAME 0.12–0.13; disAME 0.06–0.11. Palps and legs: PL 3.3–4.7; L1 8.2–11.6; L2 7.5–10.8; L3 6.9–10.5; L4 10.6–15.6. Blub: BuL 0.6–0.9; EmL 0.3–0.4.

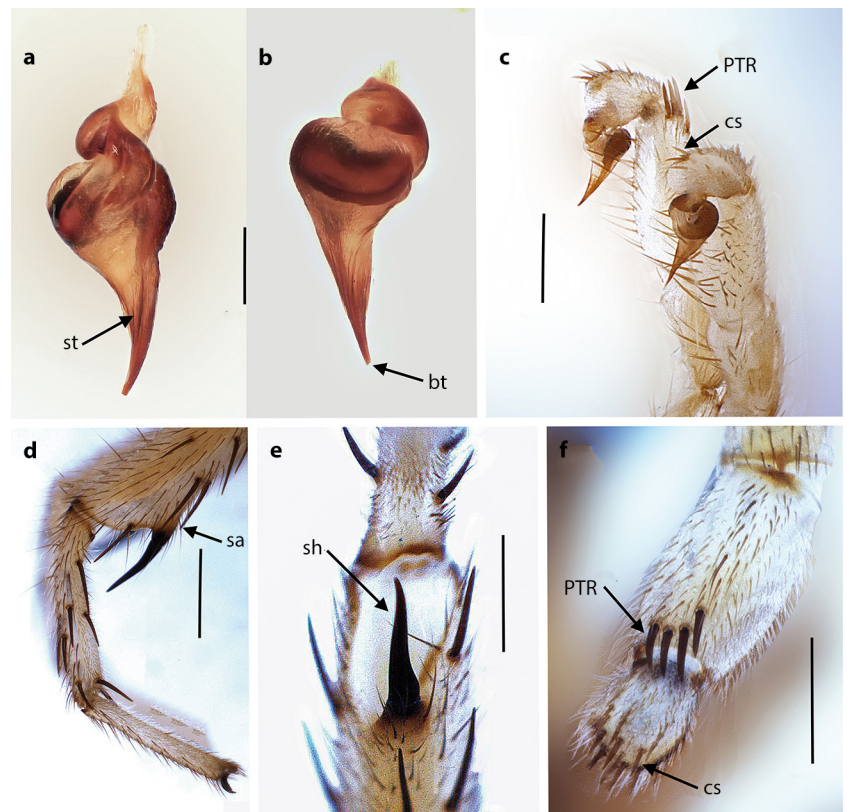
**Ratios (n = 4).** CW/CL 0.63–0.78; EL/PR 0.52–0.56; SW/SL 0.59–0.72; LW/LL 1.38–1.41; PTiW/PTiL 0.48–0.59; L1TiW/L1TiL 0.40–0.45; Fem4/Met4 0.87–0.98; Tib4/Met4 1.05–1.09.

## Discussion

Wunderlich named the species after three prominent 'rastella' (rows or groups of particularly strong spines) that he found to be present: 1) on the distal chelicerae, just above the base of the fang (Fig. 1e), 2) on the dorso-distal palp-tibia (Fig. 2f) and 3) on the cymbium (Fig. 2f). It should be noted that Wunderlich's three 'rastella' are a general feature of *Nemesia* males (at genus level), and therefore have no practical value in the diagnostics of *Nemesia* species. Furthermore it is customary that only the group of strong and ridged spines at the apex of the basal segment of the chelicerae (Fig. 1e) is referred to as the rastellum (e.g. Main 1967: 9, Ubick et al.



**Fig. 1:** *Nemesia rastellata* male, general somatic characters. **a.** SMF18e, general appearance; **b.** SMF11e, lateral carapace, note flat cephalic part and prominent ocular process (cf. Wunderlich 2011: fig. 25); **c.** SMF21e1, dorsal prosoma, note anterior narrowing carapace and fovea with prominent central groove (cg) (cf. Wunderlich's (2011) median notch on fig. 24); **d.** SMF11e, eye-group, note large anterior eyes and black pigmented ring around AME (br); **e.** SMF18e, ventral chelicerae ventro-lateral view, note rastellum (ra) and smooth fang-ridge (sr); **f.** SMF11e prolateral tibia and patella III, note three spines in line (ps) on the patella, other specimen have either two or three spines in this row; **g.** SMF11e, spinnerets, note knob-shape of PMS. Scale bars = a. 2.0 mm, b, c, f. 1.0 mm, d, e, g. 0.5 mm



**Fig. 2:** *Nemesia rastellata* male, sex related characters. **a-b.** Right-side copulatory organs of two different specimens viewed under different rotation angles; **a.** SMF11e, note longitudinal ribs (striae) on the embolus (st); **b.** SMF18e, note the blunted embolus tip (bt) with apical pore (cf. Wunderlich 2011: fig. 31); **c.** SMF.21e1, general palp morphology, note relatively simple pyriform bulbs with short, distally pointed emboli (cf. Decae 2012: fig. 1); **d.** SMF11e, left distal leg I retrolateral view, note short apophysis clasper-hook (sa) (contra Wunderlich 2011: fig. 27); **e.** clasper-hook (CH) in ventral view, note weakly sigmoid shape (sh); **f.** distal palp in dorsal view, note the four strong spines of the PTR and spine-group on the cymbium (cs) (cf. Wunderlich 2011: fig. 29). Scale bars = a, b. 0.2 mm, c, e, f. 0.5 mm, d. 0.5 mm.

2005: 270, Jocqué & Dippenaar-Schoeman 2006: 24, Foelix 2011: 336). The cheliceral rastellum, that is functional in burrow construction, is a common feature in fossorial mygalomorph spiders of various genera and families. Personal observations indicate that the rastellum is not used for digging-up soil, but rather for compressing soil in the burrow walls and entrance region during burrow construction, and in shaping (molding) the trapdoor. Compressing the soil in the burrow wall and entrance results, probably in combination with a cementing secretion from the mouth (personal observation), in the formation of a sturdy plastered clay lining of the burrow shaft (Nascimento et al. 2021). Burrow construction is exclusively preformed by juvenile and female spiders, which leaves the functionality of the male rastellum an open question. In contrast to the cheliceral rastellum present in juveniles, females and males, rastella on the palp tibia and cymbium described by Wunderlich are exclusively present in adult males. These structures, together with the CH and modified metatarsus I (Fig. 2d-e) are apparently parts of the male defensive equipment which is functional in sexual encounters (personal observation).

The clasper-hook (Fig. 2d-e) is functional in locking the female fangs during copulation. The terminology here used is function-oriented and preferred over ‘megaspine’, the purely structural description of this structure proposed by Raven (1980). The CH is present in all *Nemesia* and *Iberesia* males and is a main diagnostic character to distinguish these two nemesiid genera from two other Mediterranean nemesiid genera: *Brachythele* (forked CH) and *Amblyocarenum* (CH absent).

The dark eye-ring around the AME (Fig. 1d), here proposed as a possibly species level diagnostic character, might be an artefact of preservation in which the cuticle of the carapace has become slightly loose from the deeper lying prosoma.

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