



Description of *Harpactea sadistica* n. sp. (Araneae: Dysderidae) — a haplogyne spider with reduced female genitalia

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Spiders of the genus *Harpactea* (Araneae: Dysderidae) are non-web building predators that forage on the ground and on tree trunks at night. During the day, they hide in silk retreats under stones or wood, in leaf litter or under tree bark. They occur mainly in xerothermic forests (see Deeleman-Reinhold 1993). *Harpactea* is the second most speciose dysderid genus (after *Dysdera*), with 149 described and valid species (Platnick 2007). Interestingly, almost all species appear to be endemics that are narrowly restricted to parts of the Mediterranean, with only some representatives also found in adjacent areas (Platnick 2007). The contributions to the *Harpactea* fauna of the Middle East were made by Denis (1955), who described the two new species from Lebanon (*Harpactea rugichelis* Denis, 1955 and *H. straba* Denis, 1955), and by Brignoli (1978), who described the species *Harpactea herodis* Brignoli, 1978 from Israel.

Diagnostic characters of *Harpactea* are the body size, colour of prosoma, leg spination and the shape of the copulatory organs (Alicata 1966, Chatzaki & Arnedo 2006, Deeleman-Reinhold 1993). The male copulatory organ of *Harpactea*, the bulbus, is composed of one or two segments connected by a membrane, the hematodocha. The proximal part, the tegulum, is large, smooth and simple, while the distal part is complex and usually composed of two elements: a complex apophysis (conductor) and the tubuliform embolus. *Harpactea* females possess no external copulatory organ. Their copulatory organ, the vulva, is positioned within the opisthosoma. It is relatively complex, holding two types of ‘cul-de-sac’ sperm storage organs. The epigastric furrow is delimited by a sclerotised anterior arc and a posterior transversal bar (see Chatzaki & Arnedo 2006 for figures of *Harpactea* vulvae with these particular structures marked). The anterior arc bears a heavily sclerotised rod-shaped spermatheca, which is usually anteriorly equipped with a sclerotised keel-like projection. This sclerotised anchor-shaped anterior part of the vulva, especially the keel-like projection, also functions as an apodeme for the insertion of muscles associated with the opening of the epigastric furrow. Posterior to the transversal bar, there is a spherical membranous spermatheca called the posterior diverticle. Both sperm storage organs, the spermatheca and the posterior diverticle, are apparently reduced in the species described in the present paper.

Materials and methods. Nomenclature of the copulatory organ structures was adopted from Chatzaki and Arnedo (2006). To investigate the morphology of male copulatory organs, these were separated, dried at room temperature, mounted on a stub, sputter-coated and examined using a scanning electron microscope (JEOL 6380LV). The female genitalia of alcohol preserved specimens were dissected, cleaned using 5% KOH and observed under a light microscope (Olympus BX 51).

Material is deposited in the Hebrew University of Jerusalem, the University of Haifa (both in Israel) and the Crop Research Institute in Prague (Czech Republic).

Harpactea sadistica n. sp.

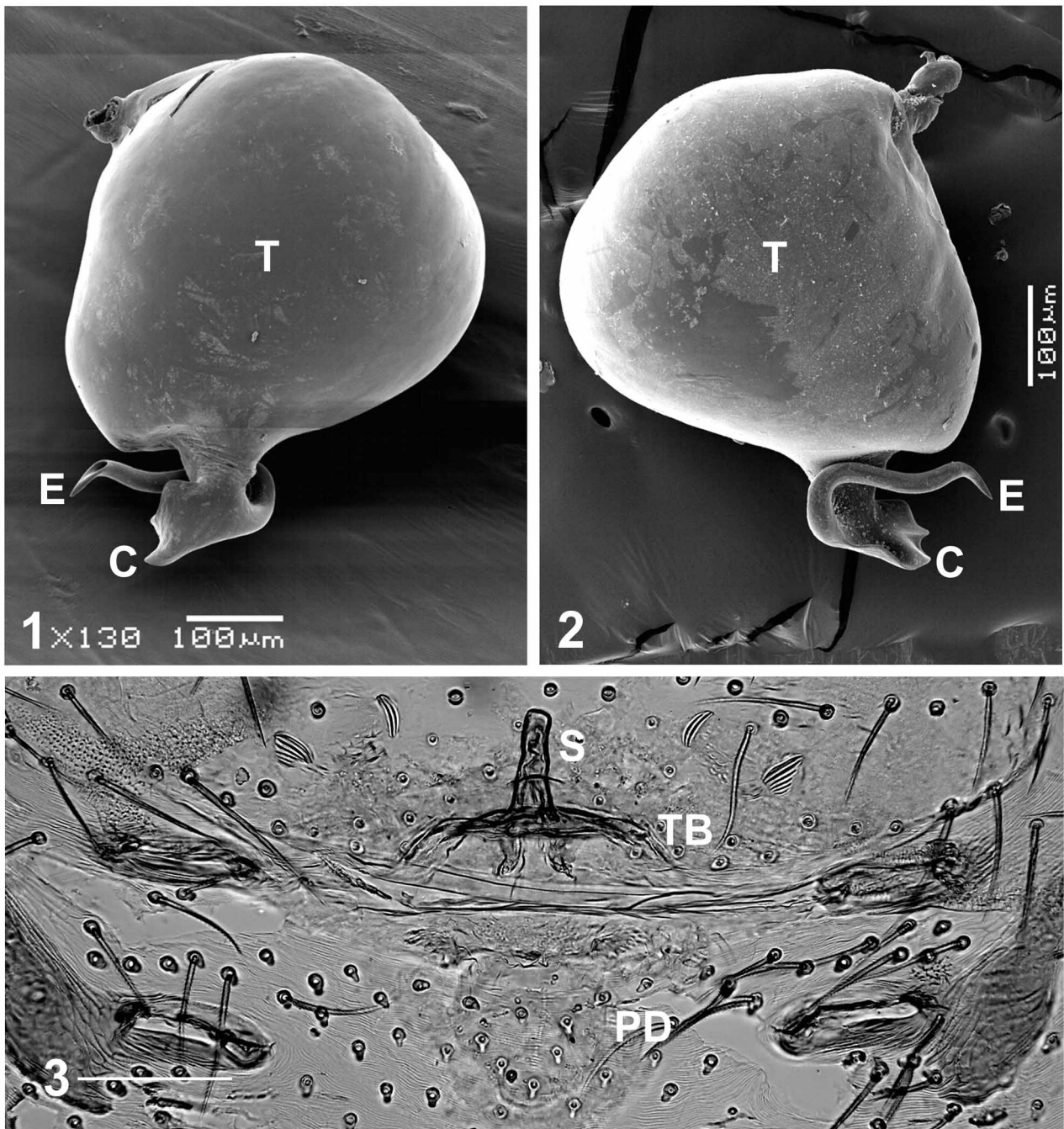
Figs 1–3

Type material. Holotype. 1♂, **Israel: Judean foothills:** Adulam Nature Reserve, village Nehusha near Jerusalem, Israeli mapping grid 144/116 (March 22 2002, pitfall trap, Y. Mandelik leg., coll. Hebrew University of Jerusalem).

Paratypes. Same location (1♂ January 18 2002, 1♂ March 22 2002, Y. Mandelik leg., coll. Hebrew University of Jerusalem; 10♂ April 2003, U. Columbus & T. Levanony leg., coll. University of Haifa; 7♂4♀ March 3–7 2004, Y. Lubin *et al.* leg.; 1♀ April 4 2004, 20♂24♀ March 13 & 18 2007, M. Řezáč, S. Henriquez & S. Pekár leg.; coll. Crop Research Institute in Prague).

Etymology. The species name refers to the mode of copulation in which the males injure the females to promote paternity success (Řezáč, unpubl. data). It is an adjective derived from the word *sadismus*, which means sexual delight while inducing pain to another person. It is derived from the name of the French aristocrat and philosopher Donatien Alphonse François de Sade.

Diagnosis. *Harpactea sadistica* n. sp. differs from the vast majority of *Harpactea* species in the male bulbus, which is composed of a single sclerite and possesses a relatively large tegulum and transverse embolus, and in the atrophied female vulva. Furthermore, *H. sadistica* is differentiated from *Harpactea zoiai* Gasparo, 1999 and *Stalagtia kratochvili* Brignoli, 1976 by a lobate conductor and needle-shaped tip of the embolus, from *Stalagtia argus* Brignoli, 1976 by the presence of the conductor, from *Stalagtia thaleriana* Chatzaki & Arnedo, 2006 by transverse embolus, and from the remaining *Stalagtia* species by a bulbus composed of a single sclerite that is equipped with a lobate conductor.



FIGURES 1–3. Copulatory organs of *Harpactea sadistica* n. sp. 1 Left male copulatory organ, lateral view. C: conductor, E: embolus, T: tegulum. 2 Left male copulatory organ, medial view. 3, Atrophied female copulatory organ. PD: posterior diverticle, S: spermatheca, TB: transversal bar. Scale bars, 0.1 mm.

Description. Male. (Holotype). Carapace pale yellow-brown, smooth, 1.7 mm long. Cephalic part narrower than the thoracic part, maximum carapace width 1.26 mm, minimum carapace width 0.63 mm. Fovea apparent, covering almost a third of the thoracic part. Anterior median eye diameter 0.10 mm, posterior lateral eye diameter 0.07 mm, posterior median eye diameter 0.08 mm. Eyes very close to each other, the space between anterior median eyes less than half of their diameter. Sternum pale yellow, slightly shiny. Chelicerae pale yellow-brown, basal segment 0.67 mm long (lateral external view), fang 0.37 mm long. Basal segment with setiferous granulations on the dorsal part, which become more dense on lateral sides. Basal part of chelicerae hairless. Groove of chelicerae 0.18 mm long, covered with hairs arranged in two lines. Retromargin with one tooth on the base of the groove and another, slightly larger one, on its middle part. Promargin with two teeth, the proximal one larger than the distal one, both larger than those at the retromargin. Proximal-most tooth of the retromargin located in the interspace of the two at the promargin. Legs pale yellow, both pairs of forelegs are darker than the two hind pairs. Segment lengths are shown in Table 2. Relative leg length: IV>II=I>III. Spination: patella III dorsally 1–2 spines; femur I proapically 1; femur II proapically 1–2; femur III dorsally 7–9; femur IV dorsally proximally 3 and distally 2; coxa III retrodorsally 0–1; coxa IV retrodorsally 1–2. For spination of tibiae III–IV and metatarsi III–IV see Table 1. Opisthosoma cylindrical, whitish, 2.28 mm long. Palpal segment lengths are shown in Table 2. The bulb is composed of a single sclerite (Fig. 1). The proximal part (tegulum) is spherical, smooth, and relatively large; the distal part is composed of a lobate conductor and a short tubuliform curved embolus, transverse with respect to the tegulum. The tip of the embolus resembles the tip of a hypodermic needle.

TABLE 1. *Harpactea sadistica* n. sp., holotype, spination on leg segments. The numbers in parentheses indicate the different spination on left legs.

	prodorsal	retrodorsal	proventral	ventral	apical ventral
Tibia III	3	2	2(3)	0	2
Tibia IV	3	3	0(1)	3(2)	2
Metatarsus III	3	2	3(2)	0	2
Metatarsus IV	4(3)	3	2(1)	2	2

TABLE 2. *Harpactea sadistica* n. sp., holotype, lengths of pedipalpus and leg segments (mm).

	Coxa	Femur	Patella	Tibia	Metatarsus	Tarsus
Pedipalpus	0.7	0.7	0.5	0.4	–	0.4
I	0.8	1.4	0.4	1.2	1.0	0.4
II	0.7	1.3	0.8	1.1	1.0	0.4
III	0.4	1.1	0.6	0.8	0.9	0.3
IV	0.5	1.5	0.8	1.3	1.4	0.4

Female. All somatic characters as described for the male. Vulva very small, atrophied. The rudiment of the spermatheca slightly sclerotised, visible only by dissection of the genital organ, projected from a slightly sclerotised anterior arc. Anterior arc with curved ventral edge and paddle-shaped dorsal base. The rudiment of the posterior diverticle small, spherical. The posterior transversal bar not developed (Fig. 3).

Variation. Prosoma 1.1–1.7 mm (both sexes).

Ecology. *Harpactea sadistica* n. sp. occurs in woodlands (*Quercus calliprinos*, *Pinus* plantations) and steppe habitats dominated by *Asphodellus*. I observed no overlapping generations, therefore it probably exhibits an annual life-cycle. Eggs are laid in March and April.

Discussion. Taxonomy of *Harpactea* is based largely on genital morphology (Deeleman-Reinhold 1993). In *H. sadistica* n. sp., the male copulatory organ, particularly the spherical tegulum and transverse embolus with sub-basal conductor, resemble those of *Harpactea zoiai* and *Stalagtia kratochvili*. The relatively small vulva with inverted V-shaped spermatheca is present in species of the genus *Stalagtia* (as catalogued in Platnick 2007). The taxonomic history, in particular the justification for the placement of the described species' putative closest relatives into two genera, needs a more detailed explanation. Originally, the genus *Stalagtia* was created for large cave-dwelling harpacteinae species with reduced eyes and spony forelegs from the western Balkans (Kratochvíl 1970). Later, two new species from forests in Greece, *S. kratochvili* and *H. argus*, were added to this genus, as their genitalia resembled those of cave-dwelling *Stalagtia* (Brignoli 1976). Nevertheless, Deeleman-Reinhold transferred these two species into the genus *Harpactea*; *S. kratochvili* into the species group *rubicunda* and *S. argus* into the species group *corticalis*, subgroup *auriga* (Deeleman-Reinhold 1993). Gasparo (1999) considered *S. kratochvili*, *S. argus* and a new species from Greece, *H. zoiai*, a mono-

phyletic group belonging to *Harpactea*, species group *rubicunda*. However, recently, Chatzaki & Arnedo (2006) widened the definition of the genus *Stalagtia* and again included *S. kratochvili*, *S. argus* and a new species from Crete, *S. thaleriana*. They did not discuss the generic position of *H. zoiai* and failed to recognize the resemblance of the palpal morphology in *S. thaleriana* and in the species of *Harpactea*, species group *corticalis*, particularly subgroup *auriga* (e.g., *H. oglasana* Gasparo, 1992), to the palp of *S. thaleriana*, from which palp morphology in the former species differs only by the relatively shorter conductor. Moreover, the relatively small vulva with inverted V-shaped spermatheca is present not only in species currently included in the genus *Stalagtia*, but also in *H. catholica* (Chatzaki & Arnedo 2006), some representatives of the group *corticalis* e.g., *H. rucnerorum*; Řezáč, unpublished data) and in some undescribed *Harpactea* species from Portugal. The above seems to cast doubt on the monophyly of *Stalagtia sensu* Chatzaki & Arnedo (2006).

The male copulatory organs, which may be viewed as the arms in the fight for paternity (Arnquist & Danielsson 1999), diverge relatively quickly as new insemination strategies evolve (Eberhard 1985). For example, the conductor has very different functions in particular *Harpactea* species: in some species it opens the female epigastric furrow, in others it anchors inside female genitalia, or, in *H. sadistica*, it hooks the other bulb into position during copulation (Řezáč, unpublished data). On the other hand, similar strategies in sperm competition are expected to result in morphological convergence. Therefore, the male palpal bulb morphology may be misleading for exploration of phylogenetic relationships. The same may hold for the morphology of the vulva. In some obviously unrelated *Harpactea* species, particularly *H. sadistica* n. sp. and a not yet described Portuguese species exhibiting no morphological similarities with *H. sadistica* n. sp., special insemination modes have been observed, where the sperm is no longer stored in the spermatheca or the posterior diverticle (Řezáč, unpublished data). Consequently, the vulva is atrophied in these species. Interestingly, the result of its reduction is very similar: a small vulva with inverted V-shaped spermatheca. Such morphological convergences should be taken into consideration in future taxonomic studies.

For elucidation of the phylogenetic structure of the genus *Harpactea* and allied genera, a comprehensive taxonomic revision of the subfamily Harpacteinae, based on molecular characters, is needed. Until then I propose to follow the narrow definition of the genus *Stalagtia* presented by Deeleman-Reinhold (1993).

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