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First description of the male of *Agraecina agadirensis* (Araneae: Liocranidae), an eyeless spider from the Moroccan High Atlas

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Abstract. The female of *Agraecina agadirensis* was discovered during a scientific internship in autumn 2019 in a cave system of the Moroccan High Atlas. Since then, several surveys were needed to find a male of the species, which was finally collected in April 2021. Based on this specimen, a detailed description, an extended taxonomic diagnosis, photos of the habitus, as well as drawings of the male pedipalpus are presented. Furthermore, we draw attention to anthropogenic threats to this endemic troglobionte species and propose the legal protection of the Imi Ougoug cave system.

Keywords: Agadir, cave, conservation, endemic, Ida Outanane Massif, spiny-legged sac spiders, taxonomy, threatened ecosystems, troglobiont species

Zusammenfassung. Erstbeschreibung des Männchens von *Agraecina agadirensis* (Araneae: Liocranidae) – eine augenlose Spinne aus dem marokkanischen Hohen Atlas. Das Weibchen von *Agraecina agadirensis* wurde im Herbst 2019 während eines wissenschaftlichen Praktikums in einem Höhlensystem im marokkanischen Hohen Atlas entdeckt. Um ein Männchen der Art zu finden, waren mehrere weitere Begehungen des Fundortes notwendig. Im April 2021 konnte das Männchen gefangen werden. Anhand dieses Exemplars werden eine detaillierte Beschreibung, eine erweiterte Artdiagnose, Habitusbilder sowie Zeichnungen des Pedipalpus präsentiert. Außerdem wird auf anthropogene Bedrohungen dieses endemischen Höhlenspezialisten hingewiesen und eine vollumfängliche Unterschutzstellung des Höhlensystems vorgeschlagen.

ملخص. تم اكتشاف أنثى *Agraecina agadirensis* في خريف 2019، خلال تدريب علمي وتقني، وذلك داخل كهف واحد من جبال الأطلس الكبير المغربي. منذ ذلك الحين، فشلت العديد من الاستطلاعات بنفس الكهف في العثور على الذكر، حتى تم اكتشافه مؤخرًا. نقدم وصفه بهذا المقال مع التشخيص، الرسومات والصور. علاوة على ذلك، نود أن نلفت الانتباه إلى التهديدات البشرية لهذه الأنواع المستوطنة من ونقترح الحماية القانونية لهذا النظام في كهف Imi Ouhoug.

A large number of specialized (troglobiont) spider species inhabit caves, the majority of them restricted to a single cave system or small areas in mountainous regions (Mammola & Isaia 2017). The eyeless *Agraecina agadirensis* was recently discovered (Lecigne et al. 2020) from one cave in the mountains of the Moroccan High Atlas, albeit without a male being observed at that time. Several further surveys yielded the discovery of a single male. Its morphology clearly confirms relationships with other species of the genus, as already proposed based on features of the female.

Material and methods

During recent surveys (April 2021), a single male was captured from the locus typicus in the Moroccan High Atlas, where we also observed a larger number of females and juveniles in late 2019 (Lecigne et al. 2020). The two-part cave system is known as Imi Ougoug. All specimens were observed in the lower part of the cave system in an area that is termed Ifri Ouado (“Araignées” cave) (Lecigne et al. 2020, fig. 3). The cave system has been known for a long time and was surveyed in 1980 by Josiane and Bernard Lips. The entrance is located near Tizgui, 750 m to the west, in the neighboring parallel valley of the Assif n’Talmat (J. & B. Lips, pers. comm.).

The specimen was collected by hand and preserved in situ in 96% ethanol. Photographs of genitalia were taken under an Olympus CH-2 microscope. For measurements, an ocular micrometer was used; all measurements are in millimetres (mm). Geographical coordinates are presented in the WGS

84 system. For identification we relied on several bibliographical sources (Georgescu 1989, Wunderlich 1992, Weiss & Sárbu 1994, Bosmans 1999, Bosselaers 2009, Deltshv & Wang 2016, Boubakri et al. 2020) and databases (Nentwig et al. 2021, Oger 2021). The taxonomic status follows the World Spider Catalog (2021).

Description of the male of *Agraecina agadirensis* Lecigne, Lips, Moutaouakil & Oger, 2020 (Figs 1, 2a-h, 3a-c)

Agraecina agadirensis Lecigne et al. 2020: p.13, figs 1a, 4a-h, 5a-b (descr. female)



Fig. 1: *Agraecina agadirensis*, male (Morocco, Tizgui, Imi Ougoug, Ifri Ouado cave) (photo: S. Moutaouakil)

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Fig. 2: *Agraecina agadirensis*, male. **a.** Dorsal view; **b.** Ventral view; **c.** Prosoma, dorsal view; **d.** Pedipalp, ventral view; **e.** Idem, retrolateral view; **f.** Idem, prolateral view; **g.** Idem, ventro-prolateral view; **h.** Idem, dorsal view (photos: P. Oger)

Material. 1 ♂, MOROCCO: region of Souss-Massa, prefecture of Agadir Ida-Outanane, caïdat of Taghazout, county of Aqsri, village of Tizgui, Ifri Ouado cave (Imi Ougoug) (30.61229°N, 9.46710°W, 770 m a.s.l.), on rocky soil with presence of pebbles (near a small stream), hand collecting, 22. Apr. 2021, leg. S. Moutaouakil (will be deposited at the Senckenberg Museum Frankfurt). Remark: left pedipalp and right leg II detached; left leg III missing.

Diagnosis. Examination of the male specimen confirms the generic placement proposed for the female. Considering the somatic characteristics, *A. agadirensis* (Fig. 2a-c) most closely resembles the troglobiont *Agraecina cristiani* (Georgescu, 1989) in the lack of eyes and general colouration (light orange to pale yellowish) (Weiss & Sárbu 1994). Considering the genitalia, *A. agadirensis* resembles *Agraecina scupiensis* Deltshv, 2016 from grassland habitats in the Balkans (Del-

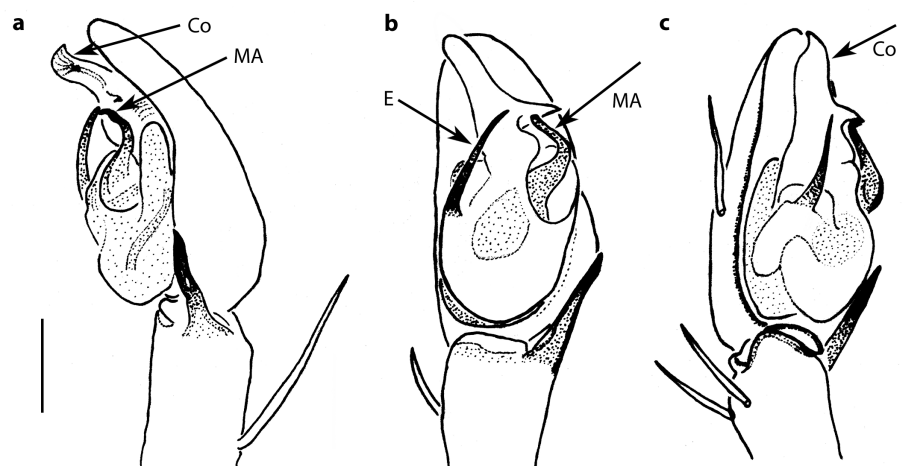


Fig. 3: *Agraecina agadirensis*, male, pedipalp. **a.** Retrolateral view; **b.** Ventral view; **c.** Ventro-prolateral view. Scale line = 0.2 mm. Abbreviations: Co – conductor; E – embolus; MA – median apophysis (drawings: S. Lecigne)

tshev & Wang 2016), but in its distal part, the curved median apophysis of *A. agadirensis* does not narrow abruptly, and the conductor (translucent membrane surrounding the embolus) is not triangle-like. *Agraecina agadirensis* is also very close to *Agraecina canariensis* Wunderlich, 1992, which is mostly found in caves (Wunderlich 1992), but in its proximal part, the conductor of *A. agadirensis* shows an evagination and the median apophysis is distinctly more curved in its middle part. Furthermore, the palpal tibia of *A. agadirensis* is not clearly longer than the cymbium, but it is shorter (1.32 times).

Description

Measurements (n = 1). Total length 4.6; prosoma: length 2.25, width 1.60, 1.40 times longer than wide; fovea length 0.40, fovea length / prosoma length 0.18, anterior part of the fovea 1.27 from front edge of prosoma; sternum length 1.15, sternum width 0.90, sternum length / sternum width 1.28; pedipalp (dorsal): tibia 0.50, tarsus 0.66.

Colour. General colouration pale yellow. Anterior edge of the prosoma darker, fovea brown.

Carapace. Anterior part of the cephalic region with long setae, labium barely wider than long.

Eyes. Completely absent.

Chelicerae. As in female.

Legs. Length of legs order: IV/I/II/III. Femora with three strong dorsal spines; tibiae I–II with three pairs of ventral spines, the third one in a distal position, distinctly shorter; metatarsi I–II with two pairs of ventral spines. Claws, number of teeth in the following order I/II/III/IV: 6/6/4/4. Trochanters notched.

Opisthosoma. As in female.

Pedipalp (Figs 2d–h, 3a–c). Tibial apophysis fairly robust, pointed in the axis of the tarsus, hardly bent in the middle part as seen from retrolateral side; median apophysis with broad base, gradually curved and narrowing towards the tip; embolus nearly straight, long and thin, tip surrounded by the conductor (translucent membrane), long and narrow.

Distribution and habitat. Only known from the type locality (Tizgui, Morocco) (see Lecigne et al. 2020).

Notes on conservation

Currently, *Agraecina agadirensis* is only known from a single cave system. This makes the species highly vulnerable to anthropogenic disturbance and climatic changes, similar to many other troglobiont spider species (Mammola & Isaia 2017).

The example of the scorpion species *Akrav israchanani* Levy, 2007 (Scorpiones: Akravidae) from Levana Cave (Israel) (Fet et al. 2017) demonstrates the sensitivity of underground species to changes in their environment. Since its discovery no living specimens have been found in the caves where it had occurred and the species became potentially extinct simply by a drop of the water level in the cave.

The threat for *A. agadirensis* is all the more real as Imi Ougoug has become the main or even the only destination for local speleological associations and tourist groups, as it is relatively close to the city and easy to access. Extensive tourist visits could predominately affect the first area where the species was observed, which is fairly easy to access from the entrance.

As explained by Mammola et al. (2018), another – indirect – threat is also expected to affect subterranean biocoenosis and ecosystems: changes in temperature. Indeed, specialized

hypogean arthropods are known to have a reduced physiological tolerance to temperature fluctuations, which is especially problematic due to the current anthropogenic climate change.

To date, *Agraecina agadirensis* has only been observed at three different locations in the downstream part of the main gallery of Ifri Ouado. It would be interesting to study the population in order to evaluate its dispersal capacity and thermal tolerance. We do not have temperature records for the three relatively distant sectors of the cave system, which could give an indication of the temperature range of the species' environment. Searching for the species in other parts of the gallery, but also in neighbouring cave systems, should also be considered. To date, seven caves have been surveyed, five of which are in the same locality of Imi Ougoug, without the species being observed. If a study was to be carried out on Ifri Ouado, it could, on the one hand, help assess threats to this species using the International Union for Conservation of Nature (IUCN) Red List criteria (see also recommendations in Mammola et al. 2019). Furthermore, such a study would also contribute to the discussion undertaken by Mammola et al. (2018) on understanding how climate change may impact troglobiont species.

The male of *A. agadirensis* was recorded in a deeper area that is difficult to access (large cavern, about 1500m from the entrance; unmapped, after the last siphon, clayey area and apparently often submerged in water) which suggests that this area may be currently relatively undisturbed by humans.

As discussed by Mammola & Isaia (2017), subterranean habitats support exceptional forms of life and represent critical habitats to be preserved and prioritized in conservation policies. Thus, for these reasons, we propose the legal protection of the Imi Ougoug cave system to conserve the ecosystems of these caves, including *Agraecina agadirensis*.

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