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A new pseudoscorpion species in *Amblyolpium* (Pseudoscorpiones: Garypinidae) from a house in Kermanshah Province, Iran

Mahrad Nassirkhani, Reza Vafai Shoushtari & Mahtab Rahmat Abadi

Abstract. *Amblyolpium goldastehae* **spec. nov.**, is described and illustrated on the basis of two males collected from western Iran. Its ability to live in a dry and xerotherme habitat is also discussed.

Keywords: Arachnida, Middle East, morphology, new species, taxonomy, trichobothriotaxy

Zusammenfassung. Eine neue Pseudoskorpionart der Gattung *Amblyolpium* (Pseudoscorpiones: Garypinidae) aus einem Haus in der Kermanshah Provinz, Iran. *Amblyolpium goldastehae* **spec. nov.** wird beschrieben. Die Zeichnungen basieren auf zwei im Westen Irans gesammelten Männchen. Die Präferenz für trockene und warme Habitate wird diskutiert.

The family Garypinidae Daday, 1888, which was considered a subfamily of Olpiidae Banks until it was raised to family level by Judson (2005), currently contains 21 genera and over 78 species (Harvey 2013), of which only two species belonging to two genera have since been reported from Iran: *Garypinus afghanicus afghanicus* Beier, 1959 and *Serianus validus* (Beier, 1971) (Harvey 2013). Also, two species representing a new species of *Garypinus* and *Amblyolpium bellum* J.C. Chamberlin, 1930 have recently been identified from central and southern Iran by Nassirkhani & Harvey (in prep.).

The genus *Amblyolpium* Simon, 1898 was erected on the basis of the type species, *A. dullfusi* Simon, 1898, collected from Collobrières, a commune in the Var department in the Provence-Alpes-Côte d'Azur region in south-eastern France (Harvey 2013). The genus includes 15 known species, of which 13 are found in the Palaearctic, Oriental and Austroasiatic regions and two in the Neotropical region. It is only known from two species, *A. anatolicum* Beier, 1967 and *A. bellum* J.C. Chamberlin, 1930, in the Middle East, Central and South-Eastern Asia (Harvey 2013, Nassirkhani & Harvey in prep.). Recent collecting in western Iran revealed a new *Amblyolpium* species with an important difference in its trichobothriotaxy which is described and illustrated here.

Material and methods

The specimens used in this study are lodged in the collection of the Acarology Laboratory, Islamic Azad University of Arak (IAUA), Iran. The specimens were collected directly by hand, preserved in 70 % ethanol, cleared in 60 % lactic acid and prepared for study using black enameled pins (size 0 to 2). The holotype was permanently mounted on a dished glass microscope slide in Swan's fluid and the paratype was studied as a temporary slide prepared by immersion of the specimen in lactic acid. The prepared specimens were studied using an Olympus CH-2 compound microscope and illustrated with a drawing tube attachment. Measurements were taken by a calibrated ocular micrometer and the photograph was made using a digital camera (Canon PC1468). Chamberlin (1931), Legg (1974, 1975), Harvey (1992), Judson (2007) and Harvey et al. (2012) are the main references for morphological terminology and measurements.

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The following trichobothrial abbreviations were employed:

eb = external basal,
esb = external sub-basal,
est = external sub-terminal,
et = external terminal,
ib = internal basal,
isb = internal sub-basal,
ist = internal sub-terminal,
it = internal terminal,
t = terminal,
st = sub-terminal,
b = basal,
sb = sub-basal.

In addition, the following abbreviations are used in the text: L = length, W = width, D = depth.

Systematics

Family Garypinidae Daday, 1888
Genus *Amblyolpium* Simon, 1898
Amblyolpium goldastehae **spec. nov.** (Figs 1-3)
Etymology. This species epithet is dedicated to Dr. Shila Goldasteh (Markazi, Iran) who has intensively worked on the ecology and biology of insects.
Material examined. IRAN, Kermanshah Province: holotype ♂, Kangavar [34°50'43"N, 47°26'53"E, altitude 1400 m], a wall crevice, into a house, 9 October 2015, leg. M. Rahmat Abadi (IAUA). Paratype ♂, on the external surface of the wall, collected with holotype (IAUA).

Diagnosis

Differs from the other species of the genus by the following combination of characters: trichobothrium *ist* proximad of *it*, *est* at the same level as *t*; the presence of a long and a slightly long seta on the pedipalpal femur; and the pedipalpal size, e.g. femur is 0.42-0.45/0.11-0.12 mm, patella 0.35-0.38/0.13-0.14 mm and chela (with pedicel) 0.68-0.72/0.17-0.19 mm.

Description

Carapace. Reddish brown, pale and weakly sclerotized at posterior margin, entirely smooth; without true transverse furrows, with only anterior distinct transverse stripe related to the musculature (Fig. 1a); 1.65 (1.74) times longer than broad; with two pairs of well-developed corneate eyes, anterior eyes less than one ocular diameter away from the anterior margin, distinctly larger than posterior ones; chaetotaxy 4:5(6):2:4:2:4:4; setae simple and acuminate; 6 pairs of lyrifissures (Fig. 1a).
Tergites. Pale brown, weakly sclerotized, entirely smooth (Fig. 1a); all setae acuminate and relatively long; chaetotaxy 4:4:5:6:6:6:7:7:7:T8T:TT5TT:2(6:4:4:6:6:8:8:8:T6T:TT3TT:2).
Sternites. Weakly sclerotized, entirely smooth; male genital system with paired and enlarged dorsal anterior glands
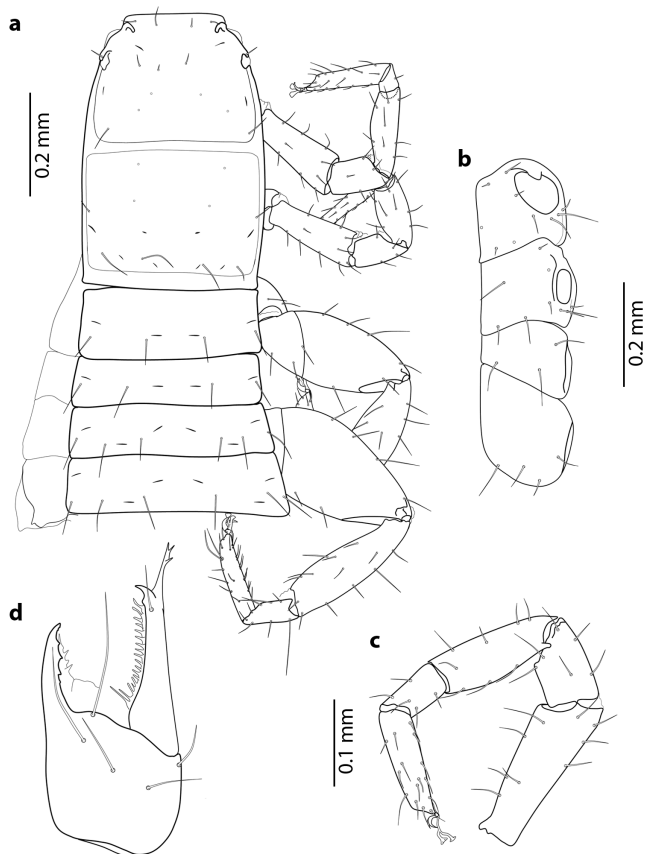
Fig. 1: *Amblyolpium goldastehae* **spec. nov.**, male holotype: **a.** carapace and tergites I-IV, dorsal view (showing chaetotaxy, eyes position, anterior strip and right legs); **b.** left coxae (showing chaetotaxy), ventral view; **c.** leg I (trochanter omitted); **d.** chelicera (showing chaetotaxy, galea, serrula exterior and serrula interior), ventral view

(Fig. 3), genital chamber with two glandular setae on each side; setae on anterior operculum distinctly shorter than those on posterior operculum; anterior operculum with 4 and posterior with 5 lyrifissures; without median suture line; X and XI respectively with 2 lateral long tactile setae; X with 2 medial slightly long setae; chaetotaxy 11:(0)8(0):(0)8(0):8:8:7:7:8:8:8:2.

Pleural membrane. Longitudinally striate.

Chelicera. Brown, hand with 5 acuminate setae (Fig. 1d); rallum with 4 blades, the distal one larger with short lateral denticulations; serrula exterior with 18-19 blades; lamina exterior absent; serrula interior present; fixed finger with 6 (5) teeth; movable finger with one sub-apical lobe and three small teeth; galea with 3 rami (2 short apical and 1 long sub-basal rami) (Fig. 1d).

Pedipalp. Unicoloured (Fig. 2a), reddish brown; entirely smooth; femur with one long seta situated basally and one slightly long seta located sub-medially on retrolateral face (Fig. 2b), L/W 3.81 (3.75); patella with 5 basal lyrifissures (Fig. 2b), L/W 2.69 (2.71); chela (with pedicel) L/W 4.00 (3.79); chela (without pedicel) L/W 3.76 (3.52), hand (with pedicel) L/W 2.00 (2.05); movable finger as long as hand (with pedicel); fixed finger with 8, movable with 4 trichobothria (Fig. 2c, d); fixed finger with trichobothrium *est* situated nearer *it* than *et*, *it* distad of *ist*, *isb* slightly proximad of *ist*, and *ib* slightly proximad of *eb*; movable finger trichobothrium *st* situated at level of *t*, *sb* nearer *b* than *st*; trichobothrium *est* located at level of *t*, *esb* slightly proximad or at same level as *b*;

fixed finger with 9 (10) spine-like short chemosensory setae situated close to trichobothrium *et* on retrolateral face; fixed finger with 35 (37) distinct cusped teeth, 5 (7) basal teeth blunt; movable finger with 25 teeth, apical teeth acute, sub-apical teeth broadened and becoming indistinct towards base of finger; venom ducts unclear (not seen), nodus ramosus situated very close to *est* in fixed finger and slightly distad of *t* in movable finger (Fig. 2d).

Legs. Light brown; entirely smooth; coxal setae arranged (Fig. 1b): 10:9:3:4 (10:10:4:4); sub-terminal setae simple; claws symmetrical, stout and short; arolia divided and distinctly longer than claws (Fig. 1a, c). Leg I: femur L/D 2.33 (2.62); patella L/D 1.57 (2.00); joint between patella and femur mobile (Fig. 1a-c), femur L/patella L 1.91 (1.75); tibia L/D 2.83 (3.60); metatarsus L/D 1.75 (2.66); tarsus L/D 3.50 (2.50). Leg IV: femur L/D 1.20 (1.18); patella L/D 2.20 (2.21); femur + patella L/D 2.71 (2.67); tibia with a slightly long seta situated sub-medially (Fig. 1a), L/D 3.62 (3.33); metatarsus with one tactile seta situated basally (Fig. 1a), L/D 2.20 (2.40); tarsus L/D 4.25 (4.50).

Dimensions (in mm) (paratype in brackets): Body length: 1.92 (2.12). Carapace: 0.53/0.32. Pedipalp: trochanter 0.22/0.11 (0.25/0.12); femur 0.42/0.11 (0.45/0.12); patella 0.35/0.13 (0.38/0.14); chela (with pedicel) 0.68/0.17 (0.72/0.19); chela (without pedicel) L. 0.64 (0.67); hand (with pedicel) L.0.35 (0.38); movable finger L. 0.35 (0.38). Leg I: femur 0.21/0.08 (0.21/0.09); patella 0.11/0.07 (0.12/0.06); tibia 0.17/0.06 (0.18/0.05); metatarsus 0.07/0.04 (0.08-0.03); tarsus 0.14/0.04 (0.11/0.04). Leg IV: femur
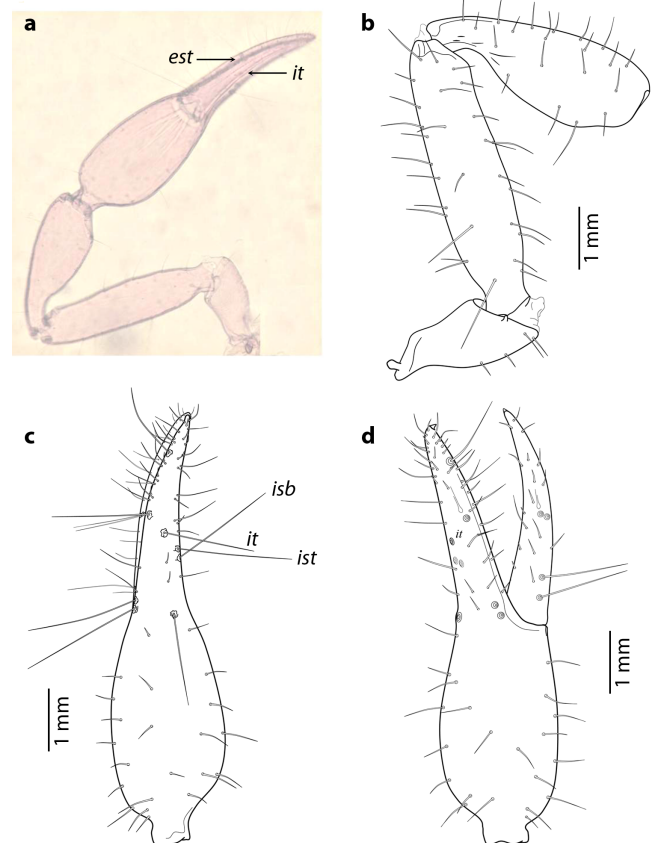
Fig. 2: *Amblyolpium goldastehae* **spec. nov.**, male holotype: **a.** left pedipalp (the positions of trichobothria *it* and *est* shown by arrows), dorsal view; **b.** basal segments of pedipalp, dorsal view; **c.** left chela, dorsal view; **d.** right chela (showing trichobothriotaxy), ventral view
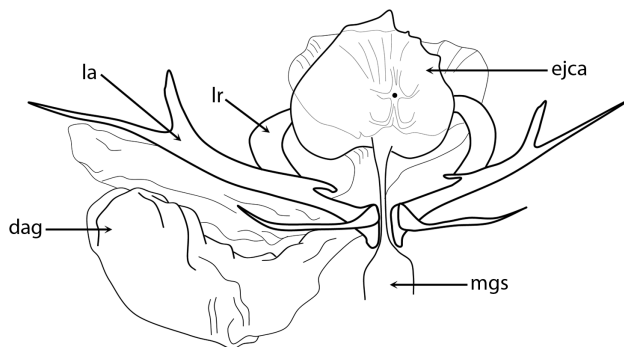
Fig. 3: *Amblyolpium goldastehae* **spec. nov.**, male holotype: genitalia, ventral view (dag = dorsal anterior gland; ejca = ejaculatory canal atrium; la = lateral apodeme; lr = lateral rod; mgs = median genital sac)

0.12/0.11 (0.13/0.09); patella 0.31/0.14 (0.33/0.15); tibia 0.29/0.08 (0.31/0.09); metatarsus 0.11/0.05 (0.12/0.05); tarsus 0.17/0.04 (0.18/0.04).

Remarks

The new species can be distinguished from *Amblyolpium franzi* Beier, 1970, *A. simoni* Heurtault, 1970, *A. japonicum* Morikawa, 1960, *A. bellum* J.C. Chamberlin, 1930, *A. graecum* Mahnert, 1976 and *A. ruficeps* Beier, 1966 by the position of trichobothrium *ist* which is located distinctly proximad of *it* (judging from Beier 1970a: fig. 3, Beier 1966: fig. 5, Harvey 1988: figs 60-61, Heurtault 1970: figs 16-17, Mahnert 1976: figs 7-8, Morikawa 1960: pl.2:9, pl. 7:12, pl. 9:15), and also differentiated from *A. dollfusi* Simon, 1898, *A. ortonedae* (Ellingsen, 1902), *A. novaeguineae* Beier, 1971, *A. biaroliatum* (Tömösváry, 1884) and *A. birmanicum* (With, 1906) on the basis of the position of trichobothrium *est* which is situated at same level as *t* (judging from Beier 1932: figs 233-235, Beier 1971: fig. 1, Lazzeroni 1970: fig. 3).

Amblyolpium salomonense Beier, 1970 and *A. anatolicum* Beier, 1967 can be separated from *A. goldastehae* **spec. nov.** by the position of trichobothrium *it* being located between *ist* and *isb* (judging from Beier 1967: fig. 2, Beier 1970b: fig. 1). The trichobothrial pattern of *A. martinense* Tooren, 2002 is more or less similar to that of *A. goldastehae*, nonetheless in *A. martinense*, trichobothria *est*, *it*, *ist* and *isb* are clustered in the midpoint of the fixed chelal finger, the long seta/e on the pedipalpal femur is lost and the pedipalp is also distinctly larger than that of *A. goldastehae*, e.g. the pedipalpal femur size is 0.72/0.15 mm in *A. martinense* while it is 0.42-0.45/0.11-0.12 mm in *A. goldastehae* (Tooren 2002). Note: Tooren (2002) described the species as *martinensis*, but *Amblyolpium* being neuter, Harvey (2013) corrected it to *martinense*.

Amblyolpium species mostly occur in litter and under the bark of trees (Morikawa 1960, Mahnert 1976, Harvey 1988), or rarely on bat guano (Tooren 2002). The newly collected specimens from western Iran occurred in a crevice on the outside face of a brick wall coated with plaster. In fact, finding only two specimens in a house is not sufficient to characterize the species as synanthropic, and only shows that the species is capable of living and reproducing in dry and warm habitats.

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Crossopriza lyoni new to Germany (Araneae: Pholcidae)

Tobias Bauer, Ingo Wendt, Joachim Holstein & Guido Gabriel

Abstract. The first record of *Crossopriza lyoni* (Blackwall, 1867) from Germany is presented. The species seems to be established at two localities in Stuttgart, Germany. Some information about the biology of the populations is given. The cosmopolitan distribution pattern and a possible route of introduction are discussed.

Keywords: alien, introduced species, new record, spider, synanthropic

Zusammenfassung. Erster Nachweis von *Crossopriza lyoni* in Deutschland (Araneae: Pholcidae). Der erste Nachweis von *Crossopriza lyoni* (Blackwall, 1867) aus Deutschland wird präsentiert. Die Art scheint an den beiden Nachweisorten in Stuttgart inzwischen fest etabliert. Des Weiteren werden Details zur Lebensweise an diesen Fundorten und die kosmopolitische Verbreitung der Art zusammen mit Möglichkeiten der Einschleppung besprochen und diskutiert.

Nearly all members of the spider family Pholcidae recorded in Central Europe are alien species, and their populations are normally associated with buildings (Blick et al. 2004, Heimer & Nentwig 1991, Huber et al. 2015, Nentwig & Kobelt 2010). *Crossopriza lyoni* (Blackwall, 1867), which has only been recorded once in Europe by Van Keer & Van Keer (2001) in the port area of Antwerp, Belgium, was recently (2010) found in Stuttgart, Germany, in a reptile supply shop and a feeder insect breeding room of the Wilhelma, the Zoological-Botanical Garden of Stuttgart. This species has so far been recorded from every continent (except Antarctica), e.g. from the United States (Edwards 1993), several countries of South America (Colmenares-García 2008, Huber et al. 1999), Africa (Huber et al. 1999, Huber & Warui 2012, Millot 1946), Asia (Beatty et al. 2008, Huber et al. 1999, Irie 2001, Kim 1988, Strickman et al. 1997, Yaginuma 1986) and from Australia (Huber et al. 1999). Consequently, *C. lyoni* is listed in the WSC as cosmopolitan (World Spider Catalog 2015). *C. lyoni* was repeatedly described under several junior synonyms, mainly in South America (Huber 2009).

Together with *Pholcus phalangioides* (Fuesslin, 1775), *Pholcus opilionoides* (Schrank, 1781), *Holocnemus pluchei* (Scopoli, 1763), *Psilochorus simoni* (Berland, 1911), *Spermophora kerinci* (Hentz, 1841) and two yet undescribed *Quamtana*-species (Huber et al. 2015), *C. lyoni* is the ninth species of Pholcidae recorded in Germany (Nentwig et al. 2015).

Material and methods

Crossopriza lyoni (Blackwall, 1867)

2♂♂ 2♀♀ (private collection G. Gabriel), 5.III.2010, 2♀♀, 21.IV.2010, 1♂, 24.I.2014 (private collection T. Bauer), 1♂ 2♀♀, 10.XII.2015 (ZFMK), GERMANY, Baden-Württemberg, Stuttgart-Untertürkheim, Lindenfelsstraße, saleroom of a specialized reptile supply shop, 234 m a.s.l, 48°47'9.0"N, 9°14'58.5"E (WGS 84), MTB 7221, T. Bauer leg., T. Bauer & G. Gabriel det., partly vid. B. A. Huber.

4♂♂ 6♀♀ (SMNS 1103–1108), 28.II.2014, 2♂♂ 4♀♀ (SMNS 1205–1206), 18.II.2016, GERMANY, Baden-Württemberg, Stuttgart-Bad Cannstatt, Wilhelma Zoological and Botanical Garden Stuttgart, Greenhouse, 224 m a.s.l, 48°48'17.8"N, 09°12'22.8"E (WGS 84), MTB 7121, I. Wendt leg., J. Holstein det.

Photographs of the epigyne and vulva were taken with a Canon 60D connected to a Novex RZ stereomicroscope, habitus pictures were taken with a Canon 5D and 100 mm macro lens. Micro photographs of the palpus were taken with a Canon 5D SR, 65 mm macro lens and stacked with Zerene Stacker software. Specimens were preserved in 70–80 % ethanol. Systematics and nomenclature follow the World Spider Catalog (2015).

All specimens were identified using Beatty et al. (2008), Irie (2001), Kim (1988), Huber in Nentwig et al. (2015) and Song et al. (1999). Three specimens (1♂ 2♀♀) from Stuttgart-Untertürkheim were deposited in the collection of the Zoological Research Museum Alexander Koenig (ZFMK, Bernhard A. Huber). The specimens from the Wilhelma Zoological-Botanical Garden Stuttgart are deposited at the Stuttgart State Museum of Natural History (SMNS).

Biology

C. lyoni (Figs. 1–7) has been observed at its two Stuttgart localities (a specialized reptile supply shop and a greenhouse of the Zoological-Botanical Garden Stuttgart) for over five years. The average room temperature at the first location is 25–28 °C, exceeding 30 °C on hot summer days only. Due to water spraying in the terraria, the humidity of the air is raised compared to the outside. The spiders build their webs between or in terraria, among natural materials like roots or bamboo and in shelves filled with electrical equipment for sale. Some specimens have even been observed living directly on the ceiling or next to fluorescent tubes. Juveniles and adults can be found in high densities throughout the year. Often spiders live close to each other, without any sign of aggression or cannibalistic behaviour. The species builds a large, irregular tangle web with a vertical diameter of up to 90 cm. Our observations have shown that the spiders prey on different species of dipterans like members of Culicidae or Muscidae (especially in the summer) and small live food (e.g., larvae of the house cricket *Acheta domesticus*), which has escaped from the display terraria. The prey is captured as described in Strickman et al. (1997).

Sporadically, the webs and inhabiting spiders were removed by the shop owner with a vacuum cleaner. In all cases, the

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Figs 1-3: *Crossopriza lyoni* (Blackwall, 1867) from Wilhelma (SMNS 1205), Zoological-Botanical Garden Stuttgart. **1.** Female with egg-sac **2.** Female, ventral side (scale line = 5 mm). **3.** Male (SMNS 1103)

spider population recovered after some months. Other spider species which have been collected together with *C. lyoni* are *Steatoda triangulosa* (Walckenaer, 1802) and *S. bipunctata* (Linnaeus, 1758). In only one case, a single female of *Pholcus phalangioides* was found.

The second locality is a greenhouse in the Wilhelma, the Zoological-Botanical Garden of Stuttgart, which is used to breed insects for feeding the zoo animals. Average room temperature usually is at almost 40 ˚C but can reach 50 ˚C on hot summer days. The spiders predominantly prey on snout moths (Pyralidae) and occasionally on dipterans (Muscidae and Phoridae) and crickets (*Acheta domesticus* and *Gryllus assimilis*).

Currently there is a stable population of *C. lyoni* with some hundred specimens on average. The population was originally discovered by the staff in 2010 due to its high abundance and its strikingly angled opisthosoma. The greenhouse is furthermore inhabited by *Thanatus vulgaris* Simon, 1870, another introduced spider species (Jäger 2002).

Discussion

A possible carrier for the inadvertent introduction of *C. lyoni* to the location in Stuttgart-Untertürkheim could have been bamboo, which, according to the shop owner, was imported from tropical parts of Asia. It is used for decoration in terrariums and is stored loosely in the salesroom for sale to customers. *C. lyoni* is widespread in Asia (Chikuni 1989, Chrysanthus 1967, Huber et al. 1999, Kim 1988, Strickman et al. 1997, Yaginuma 1986) and many spiders in general are known for

their ability to survive long transports even in shipping containers (Kobelt & Nentwig 2008). Thus, it seems possible that some juveniles or even adults were imported together with bamboo and could establish themselves in the permanently heated and regularly moistened salesroom and other heated rooms of the building. Bamboo is also used for decoration in terraria at the second location.

Interestingly, there is another, more conspicuous connection between both locations. Some years ago, both received feeder insects from the same breeder (Meining pers. comm.). If *C. lyoni* could establish itself in a small breeding room of a zoological garden or the salesroom of a reptile supply shop, it seems very possible that the species builds larger populations in industrial breeding stations, from which it could easily spread to new locations with deliveries of feeder insects.

However, populations of this species seem to be extremely resilient, since recovery after clean up only takes a few months. This is in accordance with Strickman et al. (1997), who described a development time of only 80 days for spiderlings from leaving the mother until creating their first egg sac, when fed ad libitum. Although the data represent laboratory results, the ability of the species to mature in less than three months seems to enable the population to compensate for heavy losses in a short time.
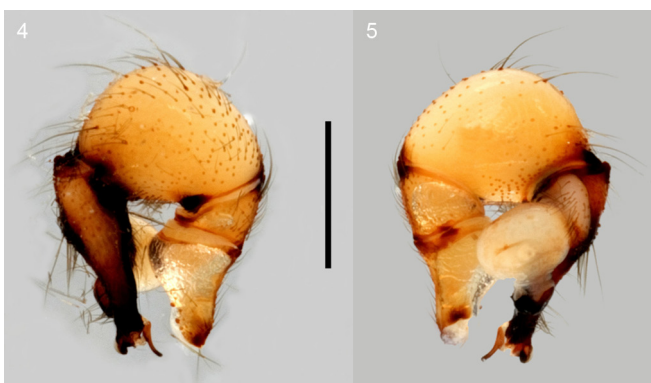
Figs 4-5: *Crossopriza lyoni* (Blackwall, 1867) (SMNS 1205); **4.** Pedipalpus retrolateral; **5.** Pedipalpus prolateral. Scale line = 1 mm
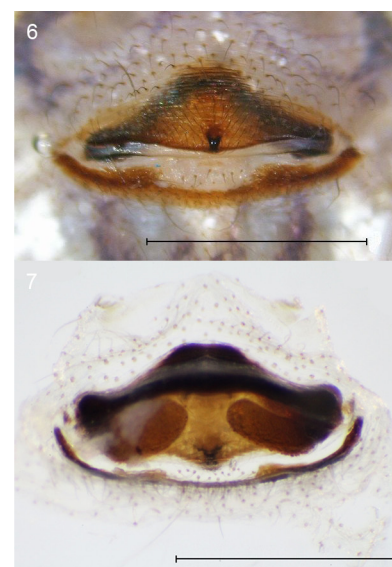
Figs 6-7: *Crossopriza lyoni* (Blackwall, 1867) (in coll. Gabriel); **6.** Epigyne; **7.** Cleared vulva/epigyne dorsal. Scale line = 1 mm

It is possible that *C. lyoni* is more widespread in similar habitats in Central Europe (e.g. greenhouses of other zoological gardens, tropical plant nurseries), but was overlooked in the past. However, at the moment *C. lyoni* cannot be considered established in Germany in the sense of Ludwig et al. (2006), because besides the populations in Stuttgart no further localities have been reported until now.

The type material of *C. lyoni* originates from India (Blackwall 1867), where it was found in synanthropic habitats. Nearly all other records where habitat data were mentioned by the authors (e.g., Beatty et al. 2008, Edwards 1993, Colmenares-Garcia 2008, Huber & Warui 2012) come from buildings and their surroundings. However, the putatively closest relatives of *C. lyoni*, *C. maculipes* (Spassky, 1934), *C. johncloudsleyi* Deeleman-Reinhold & van Harten, 2001 and six yet undescribed species, come from Central Asia and the Middle East, so a tentative assumption about a possible origin of *C. lyoni* from an area ranging from east Africa and the Middle East to north-western India can be made (Huber pers. comm.).

The remaining species currently included in the genus *Crossopriza* are restricted to Africa north of the Equator, the Arabian Peninsula and Central Asia (Huber 2009, Huber et al. 2014, World Spider Catalog 2015). The Malagasy *Crossopriza nigrescens* Millot, 1946, described from a juvenile specimen, is most probably a synonym of *C. lyoni*, since there are no other species known from Madagascar (Huber pers. comm.). In conclusion, *Crossopriza* is clearly a subtropical Old World genus and only *C. lyoni* has spread into the New World and Europe due to human activities in the last centuries and/or decades.

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Epigaeic invertebrate community structure in two subtropical nature reserves, Eastern Cape, South Africa: Implications for conservation management

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Abstract. Epigaeic invertebrates were sampled at non-invaded ('Indigenous Forest' and 'Indigenous Grassland') and alien-invaded ('Eucalyptus' and 'Mixed alien') sub-sites in the Nduli and Luchaba Nature Reserves using pitfall traps. A total of 2054 specimens belonging to three phyla (Arthropoda, Mollusca and Annelida) was caught and sorted into seven orders, 18 families, one tribe, 45 genera (22 identified to species level) and 20 morphospecies. Higher species richness occurred in 'Indigenous Forest' and 'Mixed Alien' sub-sites while higher specimen counts were made in invaded ('Mixed Alien' and 'Eucalyptus') sub-sites during summer months, peaking in January. Canonical Correspondence Analysis results show that some measured site variables, e.g. litter depth, grazing intensity, percentage of alien vegetation cover, and soil chemical properties accounted for invertebrate taxa composition and distribution trends at sub-sites. Although habitat-patch level characteristics (including abiotic factors) were important for determining species distributions, increased levels of infestation by invasive alien vegetation across sub-sites did not necessarily impact on epigaeic invertebrates in a predictable manner. For guiding management decisions, future studies on the effects of invasive alien plants on epigaeic invertebrates should distinguish between ecological effects and adverse impacts on species of conservation concern.

Keywords: alien and indigenous vegetation, environmental variables, epigaeic invertebrates, nature reserves, ordination

Biological invasions are a main component of global change with strong ecological and socio-economic consequences (Simberloff et al. 2013, Schirmel et al. 2016). Such changes can affect resident animal communities by modifying habitats Schirmel et al. 2011), food resources (Wolkovich et al. 2009) or biotic interactions (Schweiger et al. 2010). Effects on local fauna can be negative in terms of abundances and diversity (Hanula & Horn 2011, Holmquist et al. 2011), and functional diversity (Schirmel & Buchholz 2013). Reported effects of invasive species are often biased towards negative consequences (Kumschick & Richardson 2013), but positive effects of invasive plants on animals are also known (Schlaepfer et al. 2011).

Monitoring biodiversity in protected areas (PAs) forms an integral component of assessing their performance and providing the necessary information for effective management. In South Africa, PAs play a significant role as refugia, providing high quality habitat patches for invertebrate biodiversity conservation even though challenges resulting from their size and numbers do arise (Samways 2005, Foxcroft et al. 2011, Samways et al. 2012). Even within these reserves, alien invasive plants impact invertebrate species composition and distribution patterns differently (Richardson & van Wilgen 2004, Halaj et al. 2008, Foxcroft et al. 2010). Invertebrates constitute a significant proportion of terrestrial and freshwater biodiversity (Hamer & Slotow 2002), serve a series of critical ecosystem functions (McGeoch et al. 2011) and, as a consequence, must necessarily be considered in protected area monitoring systems (Vane-Wright 1993).

Little is known about habitat-level impacts of invasive and indigenous vegetation on the richness, abundance and diversity of epigaeic invertebrate taxa within PAs of the Eastern Cape Province of South Africa. Such studies are likely to yield additional insight into how and under which conditions invasive plants alter ecosystem function and biodiversity patterns in such habitats (Samways et al. 2012, Samways & Bohm 2012).

The Nduli and Luchaba Nature Reserves (protected areas), situated in the Eastern Cape Province of South Africa fall within the Albany Centre of Endemism, which has high levels of endemic plant and animal extinctions due to several stressors including invasive alien plants (Smith & Wilson 2002, Preston 2003, Oxborough et al. 2010, Egoh et al. 2011). These reserves are growing in significance as elements of the matrix within which raising public awareness for conserving indigenous biodiversity can be undertaken.

The goal of this preliminary study was to assess habitat characteristics at a priori selected invaded and non-invaded vegetation patches and compare their effects on epigaeic invertebrate assemblages.

Study area, material and methods
The study was carried out in the Nduli and Luchaba Nature Reserves (Fig. 1). These are situated at 31°30'S, 28°42'E and 31°35'S, 28°45'E, respectively, in the King Sabata Dalindyebo (KSD) Municipality. The two reserves are located about 3.5 km apart and fall within the Mthatha moist grassland biome. Nduli Nature Reserve (170 ha) was originally established in 1951 and re-proclaimed in 1972 in terms of the Cape Nature Conservation Ordinance of 1965. Luchaba Nature Reserve (460 ha) is an un-proclaimed protected area on state land, managed as a nature reserve by the Operations Directorate of the Eastern Cape Parks & Tourism Agency (ECPTA). Climate at both reserves is characterized by average winter and summer temperatures of 13 °C and 26 °C respectively, with average annual precipitation of 634 mm (DWAF 2005). Natural forest in the reserve area is made up of indigenous trees, e.g. *Acacia karroo*, *A. sieberiana* , *A. xanthophloea*, *Erythrina caffra* and *Zanthoxylum capense* (Palgraves 2002). Common grass species in the reserves are *Eragrostis curvula*, *E. plana*, *E. racemosa*, *Paspalum dilatatum*, *Themeda triandra* and *Pennisetum* spp., while invasive alien plant species present in Luchaba Nature Reserve comprise *Eucalyptus grandis*, *Acacia mearnsii*, *Lantana camara*, *Solanum mauritianum* and *Cestrum laevigatum* (Olckers & Hulley 1991). The geology of the re-

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serves comprises predominantly shales and sandstones of the Beaufort series of the Karoo system. These land forms are interlaced with dolerite dykes (Acocks 1988).

Sampling site stratification
Site one in the Nduli Nature Reserve (dominated by indigenous vegetation), measuring 130 m², was mapped out and divided into two sub-sites comprising 'Indigenous Forest patch' and 'Indigenous Grassland patch' each measuring 60 m². The second site is in the Luchaba Nature Reserve (comprising predominantly invasive alien plants), measured 250 m² and was also divided into two sub-sites, each measuring 60 m²

for the study. These sub-sites were a 'Eucalyptus patch' and 'Mixed Alien patch' (Tab. 1). Each of the four sub-sites was further stratified into four square grids (sampling units = SU) measuring 10 m² and separated from each other by 8-9 m.

Invertebrate species sampling using pitfall traps
Although the interpretation of pitfall trap data is contentious because the size of catch is not only affected by density, but also the activity of the species being sampled (Saska et al. 2013), this method has been widely used for sampling epigaeic invertebrates because it is less costly, efficient and easy to use (Southwood & Henderson 2000, Parr & Chown 2001, Un-
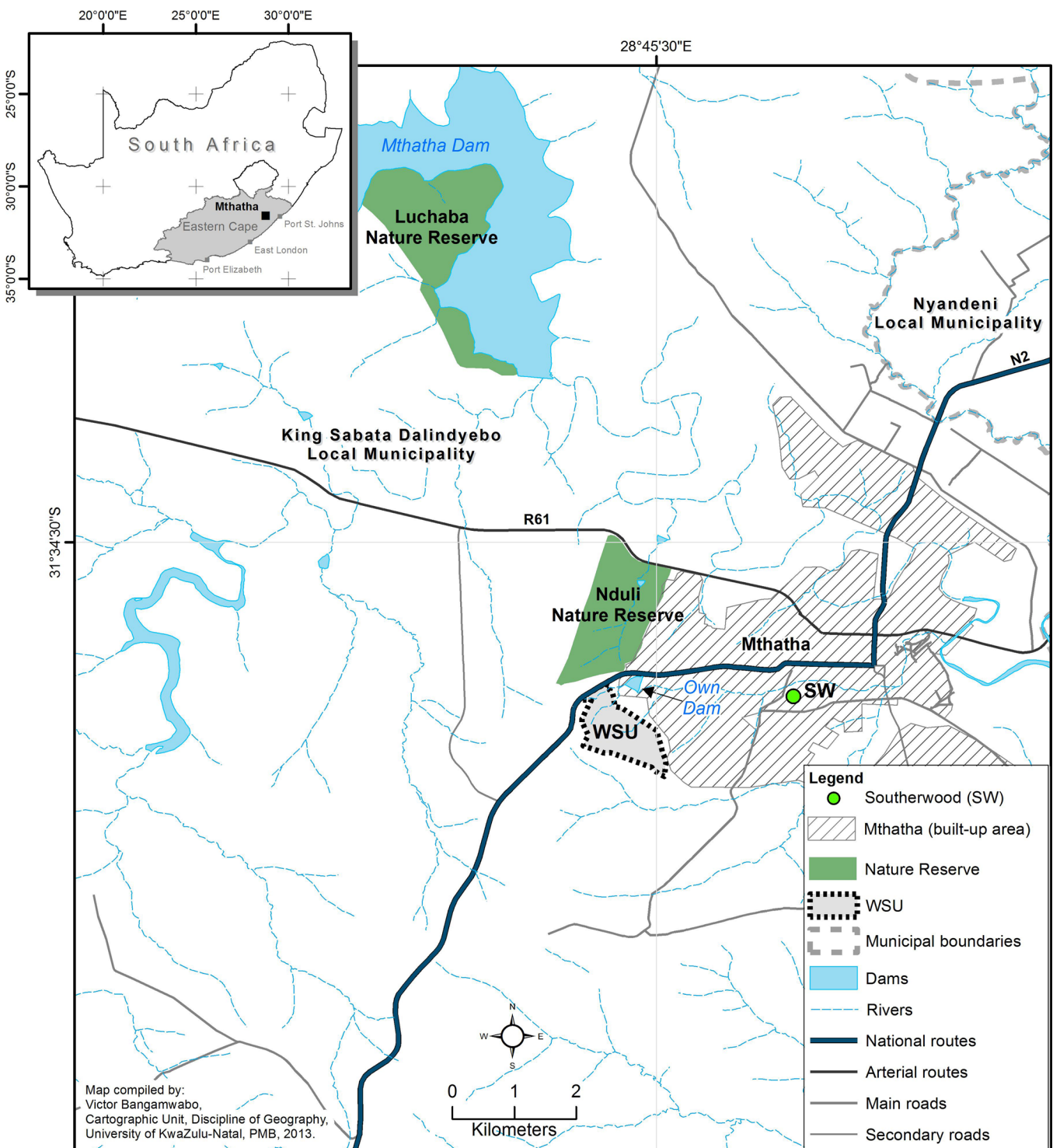

Fig. 1: Map of the study area, King Saba Dalindyebo (KSD) Municipality, Eastern Cape Province, South Africa

Tab. 1: Site description and sampling unit labels at Nduli and Luchaba Nature Reserves

Site Name	Sub-sites	Sampling unit labels	Dominant vegetation /disturbance regime
Site 1: Nduli Nature Reserve	Indigenous Forest patch (IF)	IFA, IFB, IFC, IFD	Native acacias, *Podocarpus* sp., *Erythrina* sp. Minimally grazed
	Indigenous Grassland patch (IG)	IGA, IGB, IGC, IGD	Native grasses e.g. *Eragrostis curvula*, *Paspalum dilatatum*, *Pennisetum* sp. Rich and sedges Moderately grazed
Site 2: Luchaba Nature Reserve	Eucalyptus patch (EU)	EUA, EUB, EUC, EUD	Gum trees (*Eucalyptus grandis*) Highly grazed
	Mixed Alien patch (MA)	MAA, MAB, MAC, MAD	*Lantana camara*, *Acacia mearnsii*, *Solanum mauritianum* Indigenous herbs Highly grazed

derwood & Fisher 2006). In this study, four pitfall traps, each made up of a 250 ml blue plastic cup with a rim diameter of 7.5 cm and 9.5 cm deep were sunk into the ground in square grids within each sampling unit such that the open end of the cup was flush with the ground surface. Traps were filled with soapy water as a trapping medium, and left open in the ground for 24 hours to capture soil-surface dwelling (epigaeic) invertebrate specimens (Forbanka & Niba 2013). Trapped specimens were sorted from flying arthropods, preserved in 70 % alcohol, and transported to the laboratory for preliminary identification. Identification was done using a Zeiss stereo dissecting microscope (Model STEMI DV4) and field guides (Picker et al. 2004). Spider identities were confirmed using reference works by Dippenaar-Schoeman & Jocqué (1997). Ants were identified at the Biosystematics Division of the Agricultural Research Council (ARC) in Pretoria. Unidentified morphospecies were coded and preserved in 70 % alcohol for future identification by taxon specialists. Specimen data was collected in 64 traps per month across all sites during 12 sampling months from May 2010 to April 2011.

Measurement of environmental variables

A number of environmental variables were hypothesized to be important in determining faunal composition and distribution across sampling units at the sites (Avuletey & Niba 2014) and were measured as follows:

i) Soil pH, phosphorus, potassium and zinc contents were determined by collecting (through digging) 200 g of top soil samples to the depth of 10 cm in each SU. The samples were analysed at the Mthatha Dam Soil Analytical Services Laboratory using standardized protocols for measuring soil chemical properties (Soon & Warren 1993)

ii) Litter depth (cm) was measured using a calibrated wooden ruler placed perpendicularly on the soil surface to determine the depth and thickness of the litter

iii) Grazing intensity was assessed by classifying available dung and degree of trampling as 0 (none), 1 (low), 2 (medium) and 3 (high)

iv) Extent of alien plant cover was estimated by determining the percentage of total area of SU surface covered by these plants

v) Percentage (%) shade (insolation) was estimated as amount of sunlight that penetrated the SU during the sampling interval between 11:30 am and 13:30 pm on clear sunny days

Data on soil characteristics were collected once during each of the four seasons of the year while the rest of the measured variables were collected monthly.

Data analysis

Data sets were collated for each sampling unit (SU) for each month and arranged in data matrices as proposed by Clarke & Gorley (2006). The statistical software program DIVERSE in PRIMER V 6 (Clarke & Warwick 2001) was used to determine Shannon diversity index (H') and Pielou's evenness index (J) for species data. Ordination methods attempt to give a broad overview of invertebrate community structure and patterns across site sampling units (Clark & Gorley 2006, Ter Braak & Looman 1995). The computer software package CANOCO (Ter Braak & Šmilauer 2002), which combines into one algorithm Correspondence Analysis (CA) on species data and weighted multiple regressions on environmental variable data, was used. This technique related species composition to known variations in the environment. Canonical Correspondence Analysis (CCA) in CANOCO produced an ordination diagram in which points represented species and sites, and vectors (arrows) represented measured site (environmental) variable gradients. Such a diagram shows patterns of variation in species composition that can be explained best by the measured site variables (Ter Braak & Looman 1995).

Results

A total of 2054 specimens belonging to three phyla (Arthropoda, Mollusca and Annelida) was caught and sorted into seven orders, 18 families, one tribe, 45 genera (22 identified to species level) and 20 morphospecies. The Araneae constituted the richest order with eleven families and 21 genera (10 identified species) followed by the Coleoptera with four families, one tribe (Hopliini), and 13 genera (seven identified to species). Most specimens collected belonged to the order Hymenoptera at 60% (58% Formicidae) while the Stylommatophora was represented by one family and one species. A total of 20 morphospecies collected from traps were sorted into two morphospecies of the Annelida, three of woodlice (Crustacea), two of millipedes and centipedes (Myriapoda) and 13 morphospecies of ticks, mites and scorpions (other Arachnida). Indices of species diversity and evenness trends at across sub-sites are shown in Tab. 2. Only specimens identified to tribe, genus and species levels were included in the multivariate analyses.

Tab. 2: Taxonomic profile and abundance of epigaeic invertebrate taxa sampled at sub-sites in the Nduli and Luchaba Nature Reserves
[a]Order or higher taxonomic level (Phylum/Class), [b]Code names used in analyses

ORDER[a]/Family/Tribe/ Genus/Species	Code[b]	EU	MA	IF	IG	total
ARANEAE						
Araneidae						
Cyclosa sp.	Cycsp	.	.	3	.	3
Clubionidae						
Clubiona sp.	Clusp	.	.	2	.	2
Dysderidae						
Dysdera crocata C.L. Koch, 1838	Dys	3	3	1	2	9
Eutichuridae						
Cheiracanthium furculatum Karsch, 1879	Che	1	.	2	6	9
Eresidae						
Dresserus sp.	Dresp	.	.	1	2	3
Gnaphosidae						
Xerophaeus crustosus Purcell, 1907	Xer	.	.	2	.	2
Zelotes uquathus FitzPatrick, 2007	Zel	3	1	2	.	6
Lycosidae						
Hogna sp.	Hogsp	.	.	2	1	3
Pardosa crassipalpis Purcell, 1903	Par	211	184	10	35	440
Pardosa sp.	Parsp	12	9	2	4	27
Pisauridae						
Afropisaura sp.	Afrsp	2	.	.	.	2
Nilus (*Thalassius*) sp.	Thasp	.	5	19	1	25
Salticidae						
Evarcha sp.	Evasp	2	15	1	5	23
Habrocestum dotatum Peckham & Peckham, 1903	Hab	1	4	2	.	7
Hyllus argyrotoxus Simon, 1902	Hyl	.	5	2	3	10
Langona warchalowskii Wesołowska, 2007	Lan	2	.	1	11	14
Thyene sp.	Thysp	.	.	.	2	2
Thyenula aurantiaca (Simon, 1902)	Thy	2	.	.	3	5
Thyenula juvenca Simon, 1902	Thyj	.	.	.	3	3
Theridiidae						
Theridion sp.	Thesp	.	1	.	.	1
Thomisidae						
Xysticus sp.	Xyssp	10	2	2	5	19
COLEOPTERA						
Chrysomelidae						
Plagiodera sp.	Plasp	.	1	.	.	1
Sagra sp.	Sagsp	.	.	.	1	1
Sonchia sternalis (Fairmaire, 1888)	Son	.	3	1	.	4
Hydrophilidae						
Hydrophilus sp.	Hydsp	.	1	.	3	4

ORDER[a]/Family/Tribe/ Genus/Species	Code[b]	EU	MA	IF	IG	total
Scarabaeidae						
Anachalcos convexus Boheman, 1857	Ana	.	.	2	.	2
Anisonyx editus Péringuey, 1902	Ani	.	4	.	.	4
Aphodius sp.	Aphsp	.	.	2	.	2
Diplognatha gagates Forster, 1771	Dip	1	2	.	.	3
Gymnopleurus sp.	Gymsp	.	.	4	.	4
Hopliini [tribe]	Hoptr	23	.	10	.	33
Kheper nigoaeneus (Boheman, 1857)	Khe	.	1	3	.	4
Sisyphus sp.	Sissp	.	2	.	4	6
Tenebrionidae						
Pachyphaleria capensis Laporte de Castelnau, 1840	Pac	5	1	2	.	8
Psammodes bertolonii Guérin-Méneville, 1844	Psa	.	.	.	5	5
HYMENOPTERA						
Formicidae						
Camponotus sp.	Camsp	71	258	179	112	806
Carebara vidua F. Smith, 1858	Car	1		3	.	4
Messorcapensis (Mayr, 1862)	Mes	.	1	.	.	1
Pheidole sp.	Phesp	117	74	32	16	223
Polyrhachis gagates F. Smith, 1858	Pol	.	3	.	.	3
Streblognathus aethiopicus (F. Smith, 1858)	Stre	.	3	.	2	5
Tetraponera sp.	Tetsp	.	.	2	.	2
Technomyrmex sp.	Tecsp	60	49	67	46	252
BLATTODEA						
Blaberidae						
Bantua sp.	Bansp	.	3	1	.	4
Blattidae						
Deropeltis erythrocephala (Fabricius, 1781)	Der	.	2	2	13	17
STYLOMMATOPHORA						
Valloniidae						
Vallonia sp.	Valsp	2	4	.	.	6
DIPLOPODA						
2 morphospecies						10
ISOPODA						
3 morphospecies						2
ANNELIDA						
2 morphospecies						2
ARACHNIDA (Acari, Scorpiones)						
13 morphospecies						41
Total no. of taxa [only tribe or lower]/sub-site		18	26	29	23	
Total no. of individuals/ sub-site (N)		529	635	447	270	
Margalef's index (d')		3.4	3.6	3.9	4.3	
Shannon diversity index (H')		1.8	1.6	1.3	2.0	
Pielou's evenness Index (J)		0.55	0.52	0.42	0.63	

Spatio-temporal distribution of species across sites

Three invertebrate species (*Pardosa crassipalpis*, *Camponotus* sp. and *Technomyrmex* sp.) occurred throughout the year at all sub-sites, and fourteen taxa (genus and species) were recorded only from indigenous (forest and grassland) vegetation sub-sites while eight were sampled exclusively from invaded (Eucalyptus and Mixed alien) sub-sites. 24 taxa including one tribe (Hopliini) occurred in both invaded and non-invaded sampling units. The Mixed Alien patch had the highest specimen count while the grassland patch had the lowest (Tab. 2). Species richness peaked in summer (January and February) while highest specimen counts occurred in January at the Mixed Alien and Eucalyptus sub-sites. Specimen counts for *Camponotus* sp. accounted for overall high abundance trends in August at the Indigenous Forest sub-site.

Response of epigaeic invertebrates to measured site variables

Results of all measured environmental variables are shown in Tab. 3. The species – sampling units – environmental variable (CCA ordination) tri-plot (Fig. 2) indicated that most species were clumped at the centre of the ordination, and related to certain measured environmental variable gradients. CCA ordination axes one and two (Tab. 4a) suggested that neither axis accounted for much variation in species data. Variance accounted for by measured environmental variables for both axes was 45.1 %. Monte-Carlo permutation tests were not significant for axis one ($F=1.54$, $P>0.05$). However, intra-set correlations extracted gradients of soil chemical properties (e.g. pH and Potassium (K) content), percentage shade (insulation) and grazing intensity that positively correlated with axis one of the ordination tri-plot, and may have determined the occurrence of most taxa at the Indigenous Grassland sampling units, e.g. *Cheiracanthium furculatum* and *Psammodes bertolonii* at SU IGB and *Dresserus* sp. at SU IGA.

Gradients of percentage alien vegetation cover and litter deposition negatively correlated with axis one of the ordination output (Tab. 4b). These variables were mostly important in determining species composition and distribution at the Eucalyptus, Mixed Alien and Indigenous Forest sub-sites. Litter depth explained the distribution of habitat-restricted specific species e.g. *Carebara vidua* at sampling unit EUA.

Tab. 3: Mean and range (in brackets) of measured environmental variables at sampling units (A-D) during the sampling period in the Nduli and Luchaba Nature Reserves. EUA-EUD (Eucalyptus), MAA-MAD (Mixed Alien), IFA-IFD (Indigenous Forest), IGA-IGD (Indigenous Grassland) sub-sites

Variables (Units)	EUA	EUB	EUC	EUD	MAA	MAB	MAC	MAD	IFA	IFB	IFC	IFD	IGA	IGB	IGC	IGD
Leaf litter depth (cm)	3.6	3.5	4.7	3.9	0.3	0.5	0.5	0.5	1.7	3.8	2.5	2.5	0	0	0	0
	(1.5-5)	(1-7)	(2-8)	(2-5)	(0-2)	(0-3)	(0-2)	(0-2)	(0-3)	(2.5-6.5)	(1-4)	(1-3)	0	0	0	0
Alien veg. (%)	54	54	79	70	70	68	71	72	0.8	0.4	0	0	0	0	0	0
	(30-80)	(30-100)	(50-100)	(20-100)	(40-90)	(60-90)	(50-90)	(50-80)	(0-5)	(0-5)	0	0	0	0	0	0
Shade (%)	50	31	72	68	62	63	67	67	85	81	67	71	87	90	84	91
	(30-70)	(20-40)	(30-80)	(30-90)	(30-90)	(40-90)	(40-90)	(40-90)	(70-100)	(70-90)	(50-80)	(50-100)	(70-100)	(80-100)	(70-100)	(70-100)
Potassium (ppm)	187	169	194	162	231	167	179	164	233	194	232	217	3348	392	381	273
	(90-220)	(80-190)	(75-210)	(100-180)	(200-250)	(120-186)	(144-220)	(98-193)	(210-256)	(200-263)	(183-231)	(184-224)	(250-368)	(320-410)	(340-422)	(210-310)
Phosphorus (ppm)	20	27	15	17	34	23	24	22	12	22	21	19	18	22	17	30
	(14-23)	(11-45)	(11-21)	(14-21)	(24-48)	(12-26)	(14-30)	(15-25)	(9-18)	(10-24)	(13-27)	(15-30)	(8-31)	(11-31)	(12-26)	(11-35)
Zinc (ppm)	0.3	0.4	0.05	0.4	0.4	0.2	0.3	0.2	0.2	1.1	0.8	0.9	0.4	0.3	0.4	0.4
	(0.2-0.5)	(0.1-0.6)	(0.1-0.8)	(0.1-0.8)	(0.2-0.8)	(0.1-0.3)	(0.1-0.6)	(0.1-0.3)	(0.1-0.4)	(0.2-1.7)	(0.4-1.6)	(0.1-0.6)	(0.2-0.5)	(0.2-0.8)	(0.2-0.8)	(0.2-0.6)
Grazing intensity	2	2	3	2	2	2	2	2	1	1	0	0	2	2	1	1
	(1-3)	(1-3)	(0-3)	(2-3)	(1-3)	(1-3)	(1-3)	(1-3)	(0-2)	(0-2)	(0-0)	(0-0)	(0-3)	(1-3)	(0-2)	(0-2)
pH	4.9	4.2	3.9	4	3.5	3.1	3.2	3.9	4.8	5.6	6.5	5.9	4.3	4.7	4.5	4.5
	(4-5.5)	(4-6)	(4-6.6)	(3.8-4.5)	(3.8-5)	(3-4.2)	(3-4)	(4-5.1)	(4.5-6)	(4.3-7)	(5.2-7.5)	(5-6.2)	(4-5)	(4-7.8)	(4-5.5)	(4-5.8)

Tab. 4a: Summary of the first two CCA axes weightings. Variances explained by the two axes are given. Monte-Carlo permutation tests for Axis 1: ($F=1.154$, $P>0.05$) and for all four axes (Global: $F=1.68$, $P<0.05$). *Significant

Axes	1	2	All four axes
Eigen values	0.27	0.20	.
Species-environmental variable correlations	0.97	0.94	.
Cumulative percentage variance of species data	14.7	26	.
Cumulative % variance species/envir. var. relations	25.5	45.1	.
Total inertia	.	.	1.85
F-ratio	1.54	.	1.68
p-value	0.33	.	0.04*

Tab. 4b: Intra-set correlations between each of the measured environmental variables and the first two canonical axes using pooled invertebrate species data recorded at sub-sites in the Nduli and Luchaba Nature Reserves

Variable	Intra-set Correlation CCA1	CCA2	Inter-set Correlation CCA1	CCA2
Litter deposition	-0.40	-0.37	-0.29	-0.39
Grazing Intensity	0.54	0.34	0.41	0.55
pH	0.03	-0.32	0.74	0.03
Potassium K	0.52	0.55	0.51	0.52
Phosphorus P	0.24	-0.26	-0.06	0.24
Zinc Z	-0.26	-0.44	0.43	-0.27
Alien vegetation	-0.34	0.02	-0.67	-0.34
Shade	0.55	0.32	0.38	0.56

Discussion

It is still poorly understood whether general patterns in impacts of invasive plants exist and whether these patterns are related to certain ecosystems or animal traits (Kumschick et al. 2015). Moreover, progress in understanding invasion impacts is challenged in several ways (Schirmel et al. 2016). Impacts are often not or differently defined (Jeschke et al. 2014), controversies about invasion impacts often rely on case studies, but meaningful generalisations based on single cases do not exist (Ricciardi et al. 2013). In this study, the impact of invasive plants on epigaeic invertebrates varied across sub-sites with neutral and decreasing effects on species diversity and abundance. The majority (24 taxa) occurred at both invaded and non-invaded vegetation sub-sites, while 14 taxa occurred exclusively at indigenous (forest and grassland) vegetation sub-sites, possibly due to the fact that these sites had minimal

and moderate grazing intensity respectively, and are more stable ecosystems. Generally, native plants are associated with a higher diversity and abundance of herbivore insects (Schirmel et al. 2016). This is often explained by co-evolutionary adaptations of native insects to leaf structural traits or to chemical compounds of native plants (Harvey & Fortuna 2012). Eight invertebrate species occurred only at the highly grazed invaded (Eucalyptus and Mixed Alien) sub-sites.

High invertebrate species richness and abundance occurred during the rainy summer months of January-February probably as a result of optimal habitat conditions which favoured maturation for various invertebrate taxa. This period is also characterized by high ambient temperatures which may have resulted in higher levels of invertebrate activity and their catch rates in traps. Even though the diversity and abundance patterns of invertebrate taxa (e.g. beetles, ants)
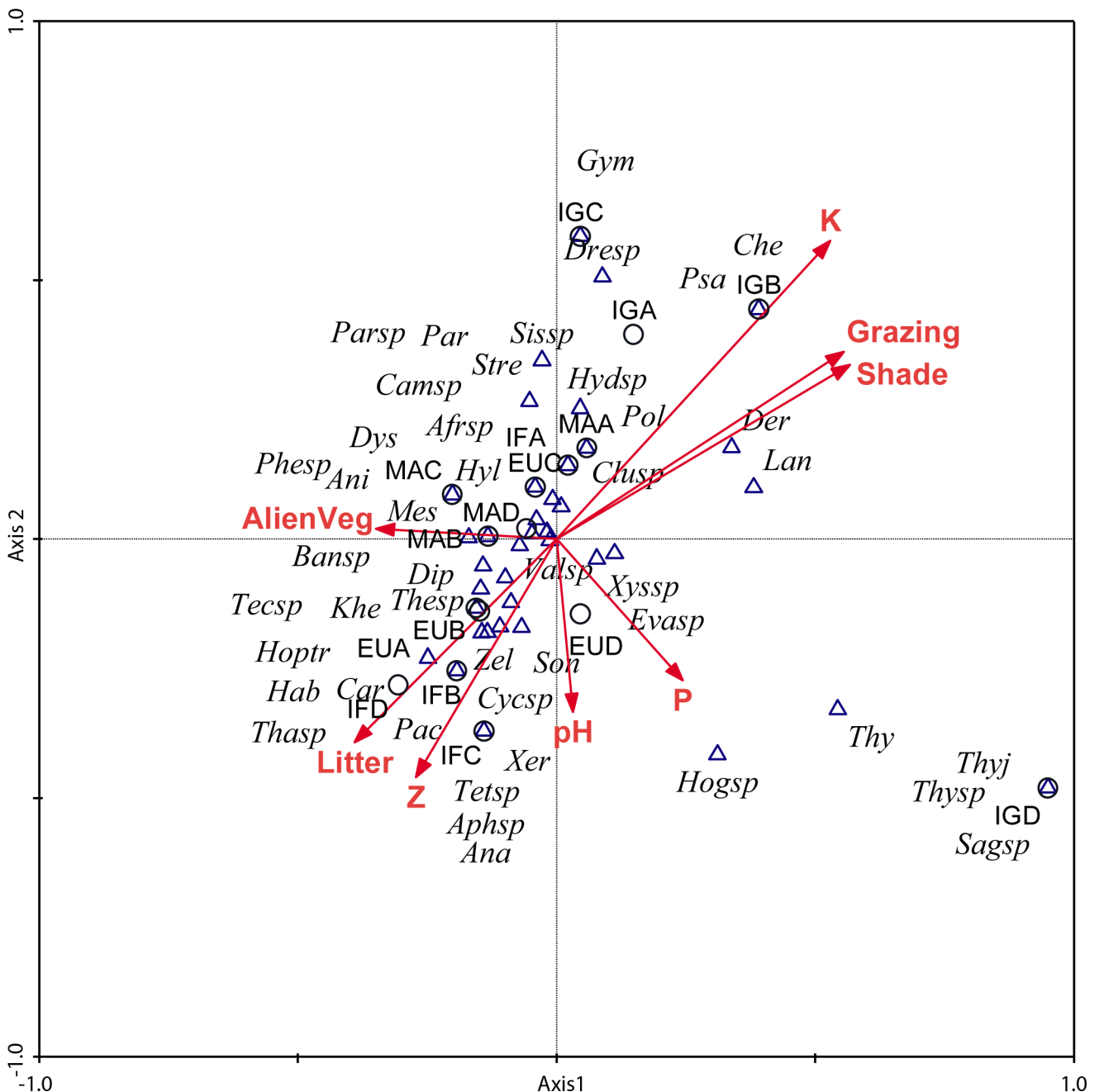
Fig. 2: Canonical Correspondence analysis (CCA) ordination of invertebrate species (Δ), site sampling units (o), and measured environmental variables (↗) using pooled data collected at Nduli and Luchaba Nature Reserves. Site description and sampling unit labels see Tab. 1, species code names see Tab. 2.

have been shown to be influenced significantly by seasonality (rainfall) and temperature (Davis 2002, Hahn & Wheeler 2002), other intrinsic factors could also have influenced the rate at which specimens were caught e.g. thermoregulation, body size, motivation or plasticity in dial rhythms (Atienza & Farinos 1996, Wallin & Ekbom 1994). Extrinsic factors could potentially impact on catch rates e.g. vegetation structure, soil surface litter (Hatten et al. 2007) as well as limitations associated with sampling design or short-term disturbances at sites (Mitchell 1963).

Litter deposition was found to be an important variable gradient influencing the composition and distribution of invertebrates across the Eucalyptus, Mixed Alien and Indigenous Forest sub-sites. High specimen counts at the Eucalyptus dominated sub-site could probably be due to abundant leaf litter deposition used by some taxa e.g. *Pachyphaleria capensis* as growth substrate for egg-laying and shelter from predators and desiccation (Albelho & Graça 1996, Magura et al. 2004, Hills et al. 2008, Tererai et al. 2013).

Grazing intensity can influence the distribution of invertebrate species either positively or negatively depending on grazing pressure (Souminan & Olofsson 2000). Grazing at very high intensities by game can reduce plant diversity leading to a reduction in faunal diversity due to exposure to predators (Allombert et al. 2005, Cheli & Corley 2010).

The composition and distribution patterns of widespread and habitat-restricted taxa e.g. *Langona warchalowskii* and *Cyclosa* sp. respectively were probably influenced by this gradient at the Indigenous Grassland sub-sites.

Soil chemical properties (e.g. pH, zinc and potassium) were also important in determining the occurrence of habitat-restricted invertebrate taxa e.g. *Cyclosa* sp. At Indigenous Forest sub-sites. Agwunobi & Ugwumba (2013) have noted that different faunal species associate with specific soil pH ranges due to their degree of vulnerability and resistance to acidity or alkalinity of the soil. Furthermore, highly acidic soils have fewer nutrients available, thereby providing less suitable environments for epigaeic invertebrates (Magura et al. 2004).

Temperature has a significant effect on the activity of epigaeic arthropods (Honek 1997, Saska et al. 2013) and therefore on their diversity and abundance (Davis 2002). In this study, CCA ordination axis one extracted percentage shade (insulation). This variable gradient may have influenced species composition and distribution patterns of *Clubiona* sp. (Araneae), *Hydrophilus* sp. and *Psammodes bertolonii* (Coleoptera) at the Indigenous Grassland sub-sites (Fig. 2).

Conclusion and management implications

Both direction and magnitude of plant-mediated invasion effects on animals cannot be generalised as universal response patterns but need specification in relation to ecosystem, taxa and functional groups as significant effects (either positive or negative), may thus remain undetected (Schirmel et al. 2016). This preliminary study shows that even though habitat-patch level characteristics (including abiotic factors) were important in determining invertebrate composition and distribution patterns, increased levels of infestation by invasive alien vegetation across sub-sites in the study did not necessarily impact species in a predictable manner.

There is urgent need to monitor and identify species at sub-sites over a much longer period to obtain a complete inventory for comparison with existing regional baseline data for protected areas in South Africa. Although invertebrates remain critically important across a range of protected areas management objectives in the country, they should be explicitly and clearly linked to these objectives (McGeoch et al. 2011). Furthermore, for guiding management decisions, future studies on the effects of invasive alien plants on epigaeic invertebrates should distinguish between ecological effects and adverse impacts on species of conservation concern.

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Activity-density data reveal community structure of Lycosidae at a Mediterranean shrubland

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Abstract. The structure of an ecological community is shaped by diverse factors and processes, including competition for resources between species with similar ecological niches. Species coexistence in the face of competition is achieved by various mechanisms, such as niche partitioning, e.g. division of resources in space and time. We studied the effect of environmental variables on activity-density of the four lycosid species found in a Mediterranean shrubland in Israel, in the spring of 2012. We tested if spatial and temporal niche partitioning enables coexistence among the four ecologically similar lycosid spiders, using multivariate analyses (RDA, Species Response Curves and Trait Analysis (RLQ)) of vegetation structure, habitat characteristics and land use, as well as time in the season. Activity-density was significantly affected by time in the season and the interaction of time and geophyte density. These findings provide first insights into the life cycles of lycosid species in Mediterranean shrublands in Israel, with spider species of the same size-group reaching their activity peaks at different times.

Keywords: *Alopecosa*, coexistence, *Hogna*, Israel, *Lycosa*, niche partitioning, *Pardosa*, seasonality, species assemblage, wolf spiders

Community structure is determined by a combination of factors such as regional species pool, biotic and abiotic environmental variables, and ecological and evolutionary processes (Zobel 1997). Within a community, species that use the same type of resources in a similar way, i.e. – having similar ecological niches, are considered as members of the same guild (Root 1967, Simberloff & Dayan 1991, Wilson 1999). One example of an ecological process, that may occur among species with similar ecological niches (i.e. within guilds), is competition, that can result in either species competitive coexistence or exclusion of species (Wilson 1999, Amarasekare 2003).

In order to coexist, two species' niches have to differ in their position on at least one of the four life-history related axes: resources, predation, space and time (Amarasekare 2003). Identical niches would often result in the exclusion of the species that is less able to maintain positive per capita growth under lowest resource level or highest predation (Amarasekare 2003). Resource partitioning between competitors co-occurring in a given habitat may take place through microhabitat partitioning and prey specialization and define the species' realized niche, i.e. the part of the ecological niche occupied by an organism given pressures from other species (Hutchinson 1957). This way, the abundance of microhabitats and prey types may influence the number of species of a given guild coexisting in a habitat. Temporal partitioning (actual activity time: night/day or seasonality) is another important manner of resource partitioning, which may allow coexistence of species in a given habitat or microhabitat (Kronfeld-Schor & Dayan 2003).

The species-rich spider family Lycosidae comprises over 2000 described species (World Spider Catalog 2016) that are relatively uniform in body structure. Most lycosid species belong to a single ecological guild of cursorial predators (Hatley & MacMahon 1980). Several lycosid species are usually found in a given habitat and cases of resource partitioning

between them at the temporal or spatial scales have previously been documented. For example, two lycosid species, *Hogna carolinensis* (Walckenaer, 1805) and *Rabidosa rabida* (Walckenaer, 1837), native to temperate forests in North America, are generalist predators and avoid competition by habitat partitioning; *Rabidosa rabida* is active on the ground, while *Hogna carolinensis* is mostly active under the surface (Kuenzler 1958). Many spiders have an annual or perennial life cycle, in which adults are only present during part of the year (Enders 1976). There also may be a period of dormancy, in which the species is not active at all, allowing for other species of the same guild to utilize the unused resources, with no direct competition (Framenau & Elgar 2005). This type of species turnover has been demonstrated in the prairies of Colorado, where adults of one species of *Gnaphosa* (Gnaphosidae) were shown to be active during May-June, while adults of a sympatric species are active during July-August (Weeks & Holtzer 2000). It is possible that both species were active during May-June, but in that case, they had different maturation times, leading to possible size-related trophic partitioning.

Developmental-stage-related partitioning may occur if an individual's requirements, including prey preferences, change during its lifetime. These changes may affect the habitat preference, time of activity and additional life-history traits. An example of developmental stage related partitioning can be seen in the lycosid species *Schizocosa mccooki* (Montgomery, 1904), as juveniles were found to prefer habitats of mixed shrubs and grasses, while the adults preferred shrubless grassy patches (Weeks & Holtzer 2000), thus partitioning microhabitats between them.

The habitat preferences of Lycosidae in Israel were studied only as part of spider faunal surveys (Mansour & Whitecomb 1986, Pluess et al. 2008) and as of yet we have very little information about the biology, ecology and taxonomy of Israel's lycosids. In particular, studies of the lycosid fauna of one of Israel's most abundant habitats, the Batha shrubland, were never carried out. The Batha shrubland is a characteristic habitat of the Mediterranean part of Israel, suggested to support a high biodiversity, due to its patchy structure, allowing for a high variation in microhabitats (Naveh & Whittaker 1980, Tews et al. 2004, van der Aart 1972).

A recent study (Bernstein 2014, Gavish-Regev unpubl. data) examined the impact of alternative urban development scenarios on species richness and abundance of plants, beetles and spiders in an ecological corridor, which comprises sub-

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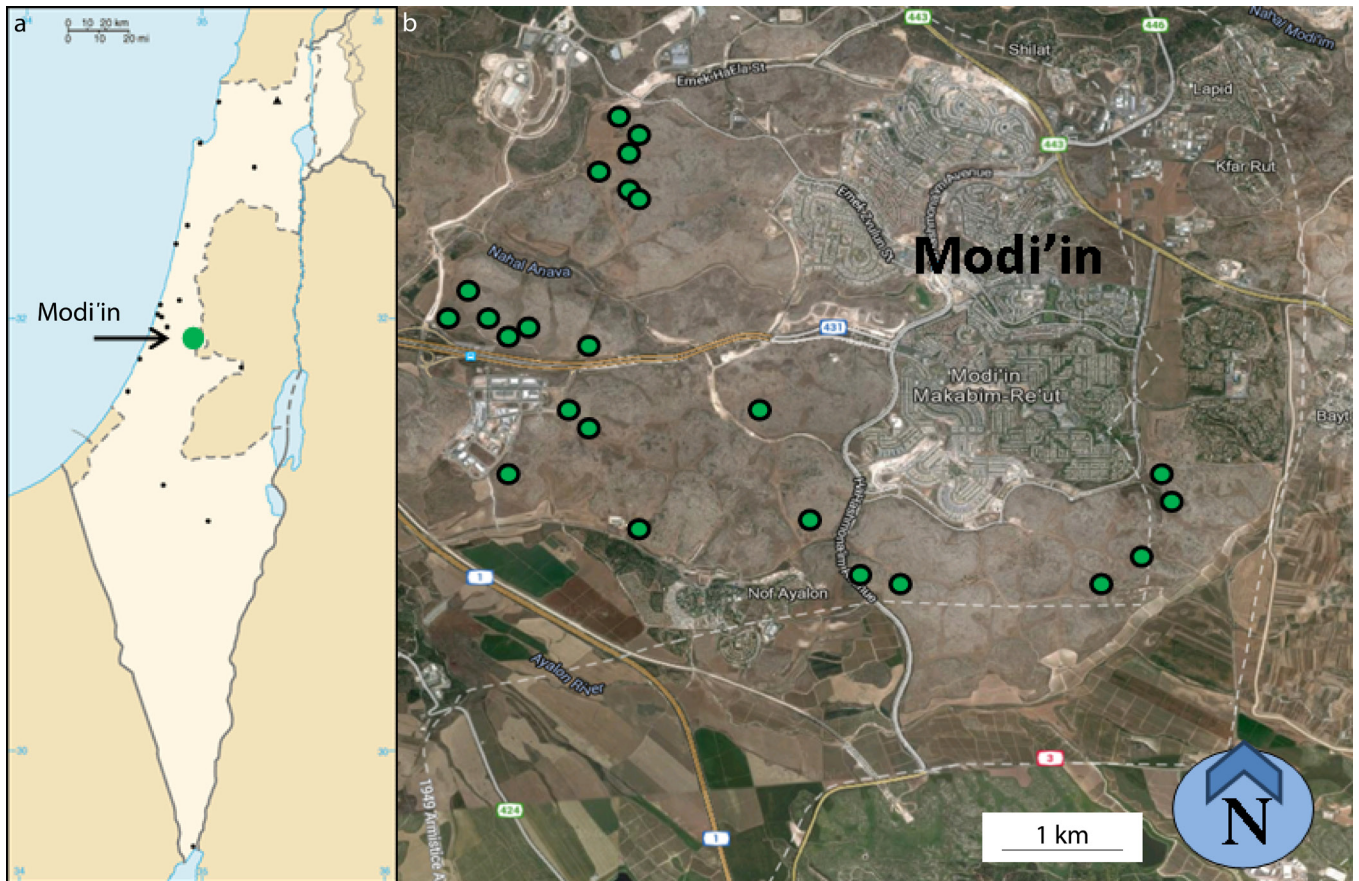
Fig. 1: The study area: **a.** Map of Israel, study area indicated with black arrow (based on Nagy Piroska, 2009); **b.** Map of study area, sampling locations (24 samples) marked with green dots (based on Imagery © 2015 DigitalGlobe, Map data © 2015, Mapa GIsrael)

stantial areas of Batha shrublands. The study found lower activity-densities of lycosids (as a group) in patches with higher shrub densities, and higher activity-densities of lycosids in patches with a higher cover of small stones and in patches at a distance from agriculture (Gavish-Regev unpubl. data).

Using the dataset from Bernstein's study, we studied the effect of environmental variables, such as density of plant life-forms (bushes, dwarf shrubs and grasses), habitat characteristics and land use, as well as time in the season, on the activity-density of lycosid species, sex and developmental stages in spring of 2012. Our hypothesis was that lycosids are represented in the Batha shrubland of the Judean foothills by several species that can coexist due to microhabitat partitioning (spatial resource partitioning), and that coexistence of the different species of lycosids is facilitated by differences in microhabitat preferences that vary between sex and developmental stages. This is the first attempt to look at community structure of Lycosidae (i.e., species distribution in space and time) at the Mediterranean Batha shrubland.

Study area, material and methods
Study area. The study area includes four sites and is located around the city of Modi'in, in the Northern Judean foothills (Figs. 1, 2), at an elevation of 200-300 meters. Each site is an alternative urban development plan for Modi'in (Bernstein 2014). The study area is characterized by a Mediterranean climate (Csa) with average annual rainfall of 550 mm. The rock in the study area is mostly Cretaceous chalk with chert, and the soil is brown rendzina (Sneh 1998). The plant communities are characteristic of disturbed Mediterranean habitats,

and are influenced by grazing and fires. The most common plant community in the study area is the Batha shrubland dominated by dwarf shrubs, in particular Prickly Burnet (*Sarcopoterium spinosum* (L.) Spach). Yet, there are two additional plant communities: the Batha grassland (annual grasses) and bush patches (Garrigue) dominated by *Rhamnus lycioides* L. and *Pistacia lenticus* L. (Alon 1993). The climax community, Maquis of *Rhamnus lycioides* L., *Ceratonia siliqua* L. and *Pistacia lenticus* L. (Alon 1993), is very rare in the study area and therefore was not sampled in this study. The habitats in this study were sorted by General Habitat Category (GHC) (Bernstein 2014), the standard evaluation method in the BIOHAB system, which classifies natural habitats into categories based on the dominant plant life-forms (in this study, bushes, dwarf shrubs and grasses), regardless of local factors.

Fig. 2: Mediterranean Batha shrubland and grassland in the study area, May 2012

Spider sampling, measurements and environmental variables. Spiders were collected using pitfall traps with preservative liquid (20 % ethanol, 20 % acetic acid, 60 % glycerol), and moved to 75 % ethanol after sorting and identifying each specimen to the best taxonomic resolution possible (species or genus level) and sex according to its developmental stage (adult, sub-adult, juvenile). Each pitfall trap was made of two plastic cups (one inside the other; diameter 11.3 cm, height 13 cm) buried in the ground such that the rim was level with the ground surface.

The study area included four sites (the alternative urban development plans), that were sampled using the pitfall traps in three periods: 21-29.iii.2012, 11-20.iv.2012 and 9-17.v.2012. In each site three habitats were sampled (with two repeats per habitat) according to the dominant plant life-form: bushes, dwarf shrubs and grasses, a total of six samples (traps location) per site (Fig.1, samples are marked as green dots). Each sample included 13 pitfall traps, in fixed locations for all three sampling dates, a total of 936 pitfall traps for the entire sampling period (due to trampling by livestock, only 902 traps were retrieved).

Environmental variables, including habitat characteristics (% exposed ground, small stones for one square meter, large stones for one square meter), land use (% monthly grazing, % yearly grazing) and plant life-form (density of annual grasses, density of geophytes, density of dwarf shrubs, density of bushes) were measured once in all locations, prior to the collection period and used to test microhabitat preference (coexistence due to resource partitioning).

In order to test coexistence of size-groups we assigned each spider to one of three size categories: carapace length under 3 mm (juveniles only), 3-4.7 mm (adults and sub-adults of small species and juveniles of large species), over 4.7 mm (juveniles, sub-adults and adults of large species) (see Tab. 1 for the results of size groups). Carapace length was measured in Stereomicroscope Nikon SMZ using NIS-Elements D (Nikon 2015, version 420).

As few or no adult specimens of *H.* cf. *graeca* and *L. piochardi* were collected, all measures of adults of *H.* cf. *graeca* and most adults of *L. piochardi* were taken from material collected in other localities in Israel.

Statistical analysis. We used ordination methods (multivariate analysis - gradient analysis) with the program Canoco (Ter Braak & Šmilauer 2002) to test the effect of the environmental variables on lycosid activity-density, using activity-density as a measure of habitat use. We first performed DCA (detrended correspondence analysis) to determine the length of the gradient. As the first axis gradient was shorter than three

we used linear methods for the rest of the analysis (Leps & Šmilauer 2003). Redundancy analysis (RDA) with unrestricted Monte-Carlo permutations (4999 permutations) was performed testing ten variables (time in the season, and the nine environmental variables listed above). Partial RDA with unrestricted Monte-Carlo permutations (4999 permutations) was performed testing density of geophytes and time as separate main effects while the other variables served as co-variables. We used CanoDraw (Ter Braak & Šmilauer 2002), to create Species Response Curves, in order to examine the response of each species, sex and developmental stage to the significant variables found in the partial RDA. Response curves were fitted using, for the y-axis, the scores of the first axis obtained in the partial RDA plotted against each significant variable or interaction. The response variable is thus a measure of the activity-density of the species, sex and developmental stage that were affected significantly by the variable or interaction (Leps & Šmilauer 2003, Gavish-Regev et al. 2008). The curves were fitted using GAM (Generalised Additive Model: smooth term complexity with 3 d.f.). A Poisson distribution was assumed for the response variable, and Log was used as the link function. Curve selection was based on the Akaike information criterion (AIC) (Leps & Šmilauer 2003). For all ordinations, all spiders collected from the 13 traps of each sample were grouped due to a low number of captures and high variances between individual traps, i.e. a total of six samples per site and 24 samples in the study area each month (overall 72 samples). All analyses were performed at two levels: species level (undivided) and species divided by sex and developmental stage (males, females and, free-roving juveniles\ sub-adults).

In order to investigate the relationship between species traits and environmental variables, we used RLQ analysis (Doledec et al. 1996, Mouillot et al. 2013) with eight environmental variables (habitat characteristics and plant life-forms (as listed above)) (R table) and three species trait attributes (average size, burrow use and month of activity peak) (Q table), and the relative abundance of each sex and developmental stage of the four species (Total of nine species categories in table L). For the RLQ analysis, the R- and Q-tables first underwent principle component analysis (both tables using the Hill and Smith method (Hill & Smith 1976) for mixing quantitative variables and factors) and the L-table underwent correspondence analysis. RLQ analysis was conducted using the ade4 package in R (Chessel et al. 2004).

Results
From the 72 samples, only 67 samples were used for the analyses. Five samples were omitted due to zero catches of lycosid spiders: two from April and three from May.

Tab. 1: Average carapace length of Lycosidae collected around Modi'in in the spring of 2012, by species, sex and developmental stage. Adults of *L. piochardi* and *H.* cf. *graeca* were collected separately, adjacent to the study area

Sex/developmental stage	*Alopecosa albofasciata* (Brullé, 1832)	*Pardosa subsordidatula* (Strand, 1915)	*Hogna* cf. *graeca*	*Lycosa piochardi* Simon, 1876
Males	4.1 mm (n=20) SD=0.238	3.3 mm (n=1)	7 mm (n=3) SD=0.231	9.5 mm (n=7) SD=1.833
Females	4.5 mm (n=23) SD=0.336	4.1 mm (n=22) SD=0.232	7 mm (n=6) SD=0.849	8.5 mm (n=8) SD=1.533
Juveniles	1.1 mm (n=2) SD=0.151	1.9 mm (n=25) SD=0.280	3.3 mm (n=27) SD=0.916 March: 1.9 mm (n=2) SD=0.397 April: 2.6 mm (n=11) SD=0.369 May: 4.1 mm (n=14) SD=0.550	5.4 mm (n=25) SD=1.560 April: 4.9 mm (n=8) SD=1.272 May:5.6 mm (n=17) SD=1.662

Fig. 3: The lycosid species found in the current study (live females): **a.** *Alopecosa albofasciata* (Brullé, 1832); **b.** *Pardosa subsordidatula* (Strand, 1915); **c.** *Hogna* cf. *graeca*; **d.** *Lycosa piochardi* Simon, 1876

From all spiders collected (March, April, May), we identified a total of 385 lycosids, of which 302 were adults and 83 were either sub-adult or free-roving juveniles. Hatchlings were not counted. The lycosids were identified to four species (here listed in decreasing order of relative abundance): *Alopecosa albofasciata* (Brullé, 1832) (201 males, 58 females, 4 subadults; Fig. 3a), *Pardosa subsordidatula* (Strand, 1915) (2 males, 40 females, 27 subadults; Fig. 3b), *Hogna* cf. *graeca* (Roewer, 1951) (28 subadults; Fig. 3c) and *Lycosa piochardi* Simon, 1876 (1 female, 24 subadults; Fig. 3d).

Gradient analyses
Environmental variables and time. Habitat characteristics (exposed ground, small stones and large stones), land use (grazing) and plant life-forms (bushes, dwarf shrubs and grasses) did not affect the activity-density of the four lycosid species in this study, yet time in the season and, to some extent, density of geophytes had a significant effect on the activity-density of the four lycosid species.

The four species (undivided). Ordination analyses indicate that two significant variables: time in the season and geophyte density, explained 41.8 % of the variance of species activity-density (Tab. 2, Figs. 4a, 4b). In Partial RDA only time in the season and the interaction between time and geophyte density were found to affect species activity-density significantly (Tab. 3), while time was the only variable in the study to affect all four species significantly (Tab. 4, Fig. 5a), the interaction

Tab. 2: The effect of variables on the activity- density of Lycosidae species in the Batha shrubland: Ordination results. Monte-Carlo permutation tests (4999 runs) of redundancy analysis (RDA). Out of ten variables, three were included in the model, two were significant (time, Geophytes density), the third (Yearly grazing) was marginally significant.

Environmental variables	% explained variance	F-ratio	P-value
Time	38	40,3	0,0002
Geophyte density	4	3,8	0,04
Yearly grazing	3	3,4	0,055
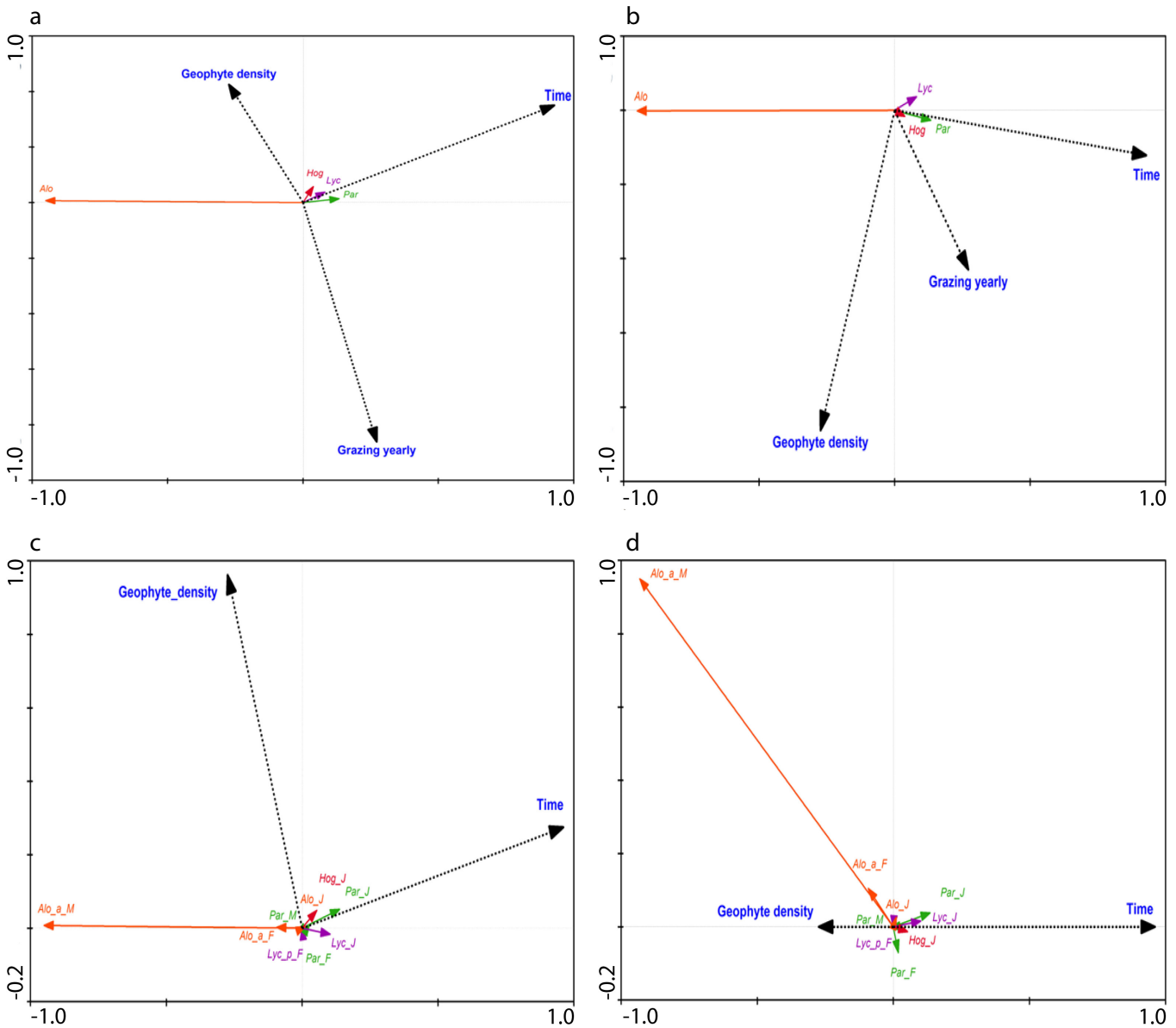
Fig. 4: Lycosid species, sex and developmental stage composition and activity-density based on three sampling dates, in the Mediterranean Batha shrubland, in the spring months of 2012. Ordination diagrams from a redundancy analysis (RDA) of 67 samples from Modi'in area; **a.** biplot (species – environment) of the first and second axes; **b.** biplot (species – environment) of the first and third axes; **c.** biplot (species, sex and developmental stage – environment) of the first and second axes; **d.** biplot (species, sex and developmental stage – environment) of the first and third axes. The quantitative variables are geophyte density, percent of yearly grazing and time; the arrow color of each family (and abbreviated species name) as follows: *Alopecosa albofasciata*: orange (Alo), *Pardosa subsordidatula*: green (Par), *Lycosa piochardi*: violet (Lyc), and *Hogna* cf. *graeca*: red (Hog); Sex and developmental stage are indicated as M: male, F: female, J: juvenile

between time and geophyte density was found to affect only *A. albofasciata* significantly and to affect *H.* cf. *graeca* and *L. piochardi* with marginal significance (Tab. 4, Fig. 5b).

Tab. 3: Partial RDA: The effect of variables on the activity- density of Lycosidae in the Batha shrubland: Ordination results. Monte-Carlo permutation tests (4999 runs). Out of ten variables, two (time and geophyte density) were included in the while the other variables served as co-variables.

Environmental variables	The four species undivided		The four species, divided by sex and developmental stage	
	F-ratio	P-value	F- ratio	P-value
Time	42	0,002	39	0,0002
Interaction between time and geophyte density	2	0,004	2,74	0,05

The four species, divided by sex and developmental stage. Ordination analyses indicate that two significant variables: time in the season and geophyte density, explained 42 % of the variance of species, sex and age groups activity-density (Tab. 5, Figs. 4c, 4d). In Partial RDA only time and the interaction between time and geophyte density, were found to affect species activity-density significantly (Tab. 3), while time was the only variable to affect all species, sex and developmental stages significantly (Tabs. 6a-c, Fig. 5c), the interaction between time and geophyte density was found to affect all groups of *A. albofasciata* significantly (Tab. 6a) and to affect juveniles of *H.* cf. *graeca* with marginal significance (Tab. 6c, Fig. 5d).

Trait analysis

For the four species, divided by sex and developmental stage,

Tab. 4: Partial RDA: The effect of time and the interaction between time and geophyte density on the four species of Lycosidae. Only variables with significant influence are presented.

Environmental variables	*H.* cf. *graeca*		*L. piochardi*		*P. subsordidatula*		*A. albofasciata*	
	F-ratio	**P-value**	**F-ratio**	**P-value**	**F-ratio**	**P-value**	**F-ratio**	**P-value**
Time	5,17	0,003	10,98	0,0001	11,88	0,001	30,95	< 1.0e-6
Interaction between time and geophyte density	3,18	0,031	2,75	0,05	Not significant	Not significant	9,71	0,00003

no significant effects were found in the RLQ analysis for the eight environmental variables and the three traits.

Discussion

We found that time in the season affected significantly the activity-density of all four species, sexes and developmental stages, while the interaction between time and geophyte density affected all species but *P. subsordidatula* . At this early stage of lycosid research in Israel, data is insufficient for any clear-cut conclusion, but we suggest a possible temporal partitioning that may contribute towards separation between similar-sized species in this Batha shrubland. The response in activity to the interaction between time and geophyte density might reflect different microhabitat preferences of males, females and juveniles and changes in their levels of activity over the sampling period.

Gradient analyses

Temporal partitioning. In the absence of habitat spatial segregation, coexistence of competitors can rely on separation in time (Carothers & Jaksić 1984, Kronfeld-Schor & Dayan 2003). Possible evidence for separation in time of the Batha lycosid guild may be differences in the activity-density of the different species along the sampling season. A possible mechanism may be separation by prey sizes, as reflected by the predator sizes. It has been demonstrated in lycosids (*Pardosa*, *Alopecosa*) and other non-web-hunting spiders that the preferred prey size is around 50-80 % of the spider's length (Nentwig & Wissel 1986). Maturation of the species in the guild at different times (see Tab. 1) may create different size-groups of spiders and thus reduce interspecific competition (Fig. 6). For example, in April, the juveniles of *H.* cf. *graeca* were in the lower size group (under 3 mm carapace length). In May they reach the middle size group (3.0-4.7 mm carapace length), when the adults of the smaller species (*P. subsordidatula*, *A. albofasciata*) are at low activity-density. The juveniles of *P. subsordidatula* that were collected in the traps during May all belong to the small size group (under 3 mm), when the juveniles of *H.* cf. *graeca*, collected in the same time, all belong to the larger size group (over 4.7 mm). Temporal

trophic separation has been shown previously between the North American species *Lycosa antelucana* and *Pardosa milvina* and between developmental stages within *Lycosa antelucana* (Hayes & Lockley 1990). For these groups different daily activity times were observed. This mechanism is left unexplored by us. However, *Pardosa subsordidatula, H.* cf. *graeca* and *L. piochardi* were observed by us to be nocturnally active, while *A. albofasciata* was mostly observed to be active in daytime.

Partitioning may also be driven by intraguild predation. Lycosids have been shown to feed on conspecifics and lycosids of other species (Rypstra & Samu 2005). If we assume that the preferred prey size is 50-80 % of the predator's body length, the observed seasonal partitioning may be due to predator avoidance by the smaller species. The activity of juvenile *P. subsordidatula* rises at the time of spring with the lowest activity density of adult *A. albofasciata* and *P. subsordidatula*. The activity of adult *A. albofasciata* and *P. subsordidatula* drops in May, when the large juveniles of *L. piochardi* become active.

Geophyte density. Geophyte density was the only habitat characteristic found to significantly affect activity-density of the lycosid species in this study (see below), but this effect was also related to time in the season. This single significant result is unexpected, as Lycosidae in other studies were found to have habitat and microhabitat preferences related to environmental variables such as vegetation structure (Cady 1983, Eason & Whitcomb 1965, Greenstone 1984, Workman 1977). In a former study (Gavish-Regev unpubl.) ordination analysis of the same dataset, analysed at the family level, revealed three

Tab. 5: The effect of variables on the activity-density of Lycosidae species divided by species, sex and developmental stage in the Batha shrubland. Ordination results Monte-Carlo permutation tests (4999 runs) of redundancy analysis (RDA). Out of ten variables, three were included in the model (time and geophyte density were significant, Yearly grazing, is shown for comparison with Tab. 2).

Environmental variables	% explained variance	F-ratio	P-value
Time	38	40,6	0,0002
Geophyte density	4	3,7	0,032
Yearly grazing	2	2,4	0,085

Tab. 6: Partial RDA: The effect of time and the interaction between time and geophyte density (time x density) on the four species of Lycosidae, divided by sex and developmental stage (n. s. not significant).

Environmental variables	*A. albofasciata* J		*A. albofasciata* F		*A. albofasciata* M	
	F-ratio	**P-value**	**F-ratio**	**P-value**	**F-ratio**	**P-value**
Time	2,8	0,049	5,09	0,0092	49,4	< 1.0e-6
Time x density	7,74	0,00018	4,07	0,0107	7,8	0,00016

Environmental variables	*P. subsordidatula* J		*P. subsordidatula* F		*P. subsordidatula* M	
	F-ratio	**P-value**	**F-ratio**	**P-value**	**F-ratio**	**P-value**
Time	38,67	< 1.0e-6	4,89	0,0042	0,56	0,05
Time x density	n. s.	n. s.	n. s.	n. s.	n. s.	n. s.

Environmental variables	*H.* cf. *graeca* J		*L. piochardi* J		*L. piochardi* F	
	F-ratio	**P-value**	**F-ratio**	**P-value**	**F-ratio**	**P-value**
Time	5,17	0,00319	10,27	0,00017	1,82	0,053
Time x density	3,18	0,031	n. s.	n. s.	3,04	0,0025
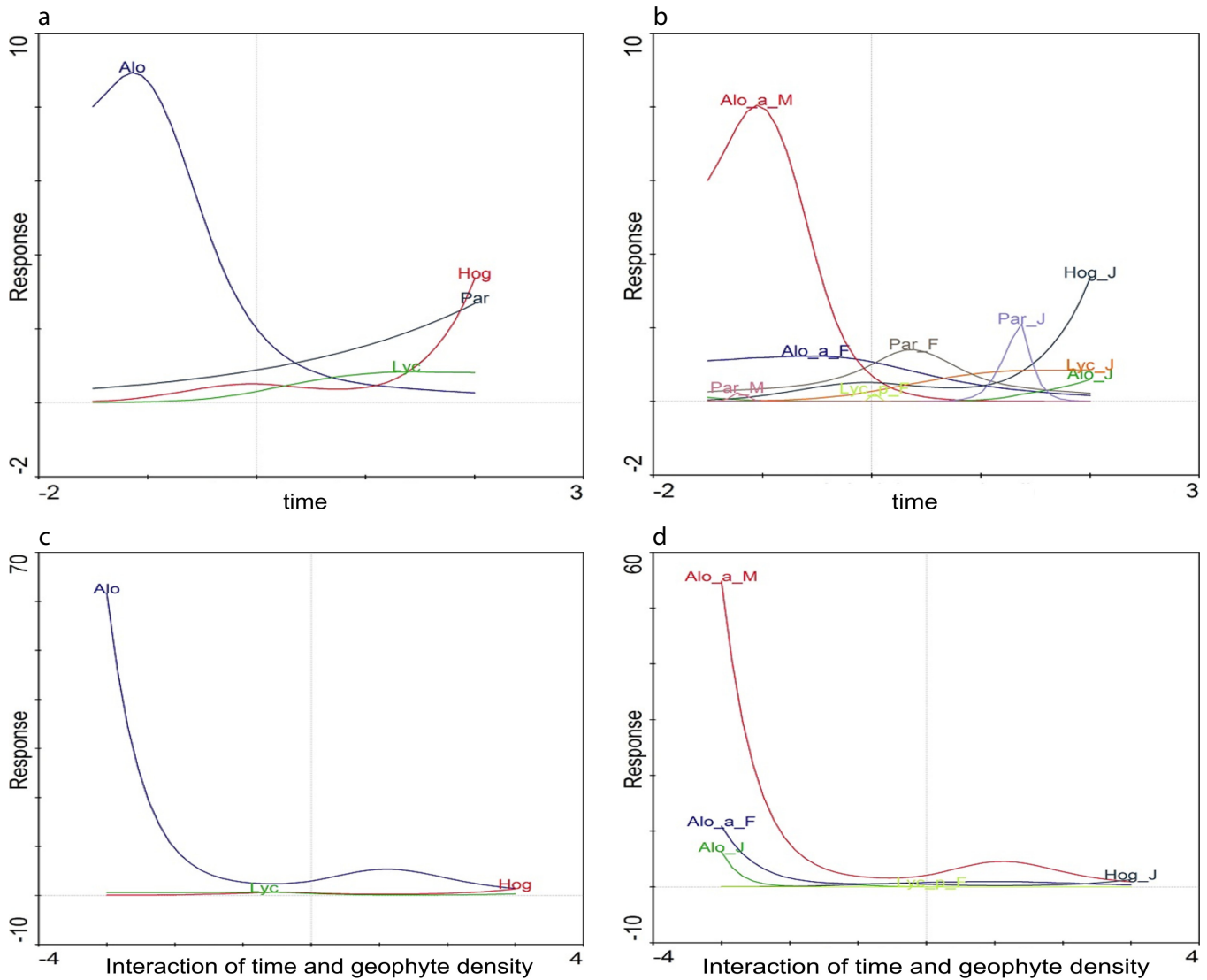
Fig. 5: Species Response Curves of four lycosid species, sex and developmental stage to the first axis of Partial RDA. Only curves of species showing significant response were included and fitted to generalized additive models (GAM). Species abbreviations as follows: *Alopecosa albofasciata*: (Alo/Alo_a); *Pardosa subsordidatula*: (Par); *Lycosa piochardi*: (Lyc/Lyc_p) ; *Hogna* cf. *graeca*: Hog; Sex and developmental stage are indicated as M: male, F: female, J: juvenile. **a.** response curve of species for time; **b.** response curve of species for the interaction of time and geophyte density; **c.** response curve of species, sex and developmental stage for time; **d.** response curve of species, sex and developmental stage for the interaction of time and geophyte density

significant environmental variables affecting activity-density of Lycosidae as a family: Shrub density (negative effect), cover by Small Stones (positive effect) and Distance from Agriculture (positive effect). It is possible that given larger sample sizes, similar effects may yet be found in lycosid species, sexes and developmental stages.

The activity-density *of A. albofasciata* was found to be significantly affected by the interaction between time in the season and geophyte density (Figs. 5b, 5d). The change is negative and implies a magnitude of response diminishing along the season (i.e., spiders respond less to geophyte density as the season progresses). It is possible that the observed trend is due to the seasonal change in vegetation structure (drying up) or a change in the nature of activity of the species along the season.

Geophyte density corresponds with relatively short, grazed vegetation, and with certain rock types (Noy-Meir & Oron 2001). Such conditions may be preferable for lycosid

males' reproductive behaviours, maximizing their visibility during display and courtship (similar to the use of display spaces by *Schizocosa ocreata* (Hentz, 1844), Cady 1983).

Trait analysis. This type of analysis potentially connects discrete traits found in different species to the effect of environmental variables on the species, yet, it failed to find any significant effect in the current study. We suggest that lack of significant results in this analysis stems from the scarcity of data. Moreover, the number of traits examined was low, due to insufficient knowledge of the life histories of the Lycosidae in Israel. Using larger datasets and more traits may improve the analysis.

Lycosidae species assemblage. In this study, a similar number of individuals were collected from two ground-dwelling spider families: Lycosidae (385) and Gnaphosidae (346), however only four species of lycosids were found, while 32 species of
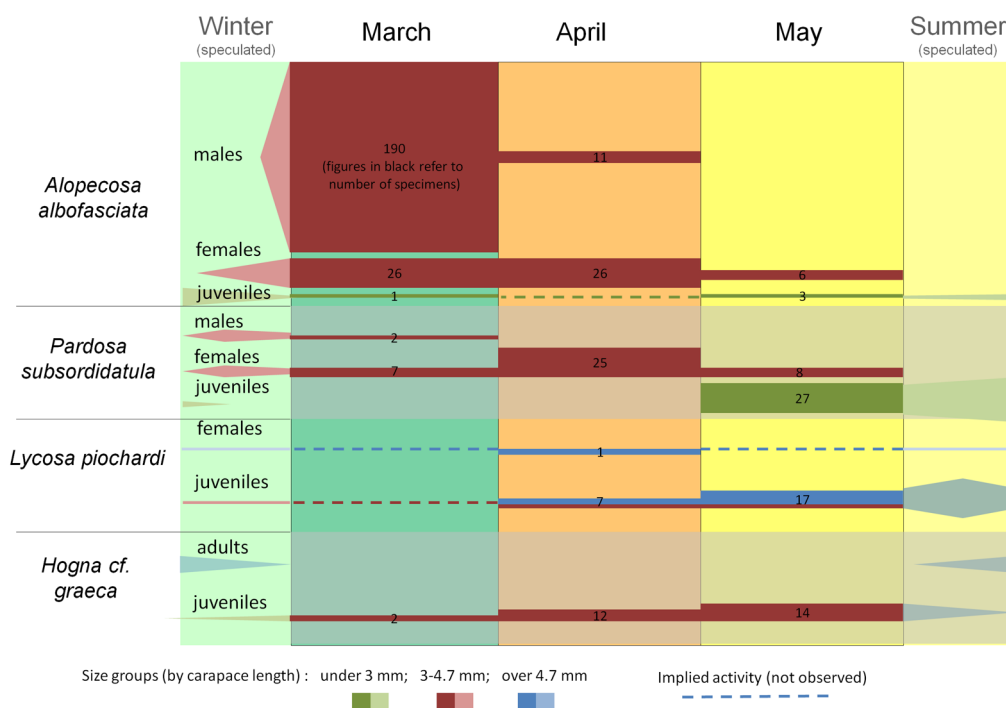
Fig. 6: Observed and implied lycosid activity in the study area (with implied trends in the summer and winter). Figures in black (and line width) denote number of specimens in study.

gnaphosids were found (Gavish-Regev unpubl. data). A possible explanation to the observed low lycosid species richness could be low activity-density of additional species or a poor regional species pool, which would result in lower number of species filtering (Zobel 1997), i.e., less lycosid species that are suitable for living in the Batha: 126 species of gnaphosids are recorded from Israel, compared to 30 species of lycosids (Levy 2009, Zonstein & Marusik 2013). If we assume that for each family's regional pool there is a certain percentage of species that are suitable to colonize the Batha shrubland (filtering), we expect to find more species from the family with a species-rich regional pool in comparison with the family with species-poor regional pool, but a similar magnitude. Indeed, the magnitude of the regional species pool that was found in this study is similar for the two families (25 % of gnaphosid species and 13 % of lycosid species).

It's important to note that all the spiders in this study were collected with pitfall traps and only a few direct observations were made in the field during the spring of 2012 and onwards. Pitfall trapping is a method biased towards more mobile individuals (Lang 2000). Adult males are expected to be more mobile, relative to females and juveniles and are less likely to remain in one habitat (as demonstrated in the North American *Schizocosa ocreata* (Cady 1983)). Indeed, more than half the lycosid specimens were adult males of *A. albofasciata*. Supplementing the collection techniques, enlarging the sample size and lengthening the sampling period to include more than one season will give us a more comprehensive understanding of the biology and ecology of Lycosidae in the Mediterannean Batha shrubland.

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Description of a new *Gibbaranea* (Araneae: Araneidae) from the Western Mediterranean

Jørgen Lissner & Robert Bosmans

Abstract. A new humped orb-weaver, *Gibbaranea bruuni* Lissner **spec. nov.**, is described from specimens collected in Majorca, Spain. The new species is most closely related to two other western Palaearctic species, *Gibbaranea gibbosa* (Walckenaer, 1802) and *Gibbaranea occidentalis* Wunderlich, 1989. *Araneus dromedarius cuculliger* Simon, 1909 (= *Gibbaranea bituberculata cuculliger*) is synonymized with *Gibbaranea bituberculata* (Walckenaer, 1802), **syn. nov.**

Keywords: Algeria, Araneinae, humped orb-weaver, Iberian Peninsula, Majorca, new synonymy, Portugal, Spain, taxonomy, Tunisia

Zusammenfassung. Beschreibung einer neuen Gibbaranea-Art aus der westlichen Mittelmeerregion (Araneae: Araneidae). Eine neue Höcker-Radnetzspinne, *Gibbaranea bruuni* Lissner **spec. nov.**, wird nach Exemplaren beschrieben, die auf Mallorca (Spanien) gesammelt wurden. Die neue Art ist nahe verwandt mit zwei anderen Arten der Westpaläarktis, *Gibbaranea gibbosa* (Walckenaer, 1802) und *Gibbaranea occidentalis* Wunderlich, 1989. *Araneus dromedarius cuculliger* Simon, 1909 (= *Gibbaranea bituberculata cuculliger*) wird mit *Gibbaranea bituberculata* (Walckenaer, 1802) synonymisiert (**syn. nov.**).

Gibbaranea Archer, 1951 is a small genus with ten species (World Spider Catalog 2016). The combined distribution of the species spans the Palaearctic ecozone from the Azores to Japan, extending well into the boreal zones. One species, *G. nanguosa* Yin & Gong, 1996, may extend into the Indomalayan ecozone at Hunan, China (Yin & Gong 1996). Three additional subspecies have been described from Europe and North Africa during 1870-1936 (World Spider Catalog 2016), however these subspecies are only known from the original collectors. In at least one of these subspecies the description was based on a specimen with aberrant colour markings as shown in this study.

    Gibbaranea was separated from *Araneus* Clerck, 1757 by Archer (1951) as a fairly homogenous group of araneid spiders. Previous to that, the majority of the *Gibbaranea* species were grouped within the genus *Araneus* Clerck, 1757 for comfort of identification, as for example in the classic works on the European species (Locket & Millidge 1953, Simon 1929, Wiehle 1931). Simon (1929) operated with a group "No 14" consisting of *Gibbaranea* species, having *G. gibbosa* as the type species. Later Levi (1971, 1973, 1974a, 1974b, 1975, 1977a, 1977b) and Grasshoff (1968, 1976, 1983) reorganized the nomenclature and taxonomy of *Araneus*, based on the structure of the copulatory organs for the North American and Central European species, which is accepted by the rest of the world's authors. An excellent diagnosis of *Gibbaranea* was provided by Helsdingen (2010). All four members of this genus in Europe (Tenerife and the Azores excluded) are widely distributed, and therefore it was a surprise to discover a new species in Majorca. Further specimens of this new species have subsequently been identified among older material from Algeria, Tunisia, Portugal and mainland Spain extending the known distribution to northern Africa and the Iberian Peninsula. The aim of this paper is to describe this new species and briefly discuss its ecology and relationships.

Abbreviations

TL   = total length;
PL   = prosoma length;
PW   = prosoma width;
OL   = opisthosoma length;
CJL   = coll. Jørgen Lissner;
CRB   = coll. Robert Bosmans.

Material and methods

Spiders were collected by shaking vegetation or beating bushes. Illustrations were created from photos of selected features using a Leica Wild M10 stereomicroscope fitted with Leica DFC425 digital camera connected to a computer with Leica Application Suite software v. 4.3.0, Zerene Stacker software v. 1.04 and the vector graphics editor Inkscape v. 0.48.

Results

Gibbaranea bruuni Lissner spec. nov. Figs 1-8

The species described here is assigned to *Gibbaranea*, based on the presence of the following characters: one pair of latero-dorsal tubercles anteriorly on abdomen; a narrow, pale longitudinal dorsal band in front of tubercles; median eyes of the two rows placed in a quadrangle; posterior median eyes larger than anterior medians; all femora of males with blackish apical half in front legs, only apical third in hind legs, blackish area shorter in females; males with a distinct posterior-apical

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Fig. 1: *Gibbaranea bruuni* Lissner spec. nov., male

Fig. 2: *Gibbaranea bruuni* Lissner spec. nov., female

tooth on coxa I and femora I with two rows of ventral spines; leg II of male most heavily spined of all legs; tibia II shorter and slightly thicker than tibia I and with two rows of long and thick ventral to prolateral spines in the apical two-thirds; maxillae with a basal external tooth; male palpal femur with a swelling ventrally and prolaterally; cymbium not spinose, narrow and with straight edges in dorsal view; median apophysis in the male palp in transverse position possessing a narrow spur at proximal end, dilated and blunt at tip; epigyne with short scapus and of similar build as in congeners.

Etymology. The species is named in honour of the outstanding arachnologist, friend and mentor of the first author, Lars Bruun.

Type material. Holotype ♂: SPAIN: Majorca: Gorg Blau, beaten from bushes in open coniferous forest adjoining the reservoir (N39°48'3.5", E2°48'44.5"), 615 m, 29.X.2014 (specimen matured in captivity), leg. Lissner (CJL-10073). Paratypes: subadult ♂, same as holotype, 29.X.2014, 8♂♂ 2♀♀, 7.X.2015 (all matured in captivity), leg. Lissner (CJL-11026). Holotype and paratypes are deposited at the Zoological Museum of Copenhagen.

Other material examined. SPAIN: Majorca: Puig Randa, mixed forest, beaten from branches (N39°31'27.8", E2°55'5"), 380 m, 1♂, 27.X.2014 and 1♂ 5♀♀, 8.IV.2016 (most specimens matured in captivity), leg. Lissner (CJL-10074). Majorca: Cuber, track along reservoir towards Coll de l'Ofre (N39°46'11", E2°46' 5"), 815 m, 1♂, 4.IV.2014 (matured in captivity), leg. Lissner (CJL-1151). Majorca: Gorg Blau, 3♂♂ 1♀, beaten from bushes in open coniferous forest adjoining the reservoir (N39°48'3.5", E2°48'44.5"), 615 m, 7.IV.2016 (specimen matured in captivity). Cadiz: Tari-

fa, (N36°0'53" W5°35'18"), 60m, 2♀♀, IV.1992, leg. P. Poot (CRB). PORTUGAL: Beja: Villa Nova de Milfontes, Rio Mira, on bushes bordering salt marsh (N37°35'54"W8°49'5"), 5m, 2 ♀♀, 16.IV.2013, leg. Bosmans (CRB). ALGERIA: El Tarf: El Kala, Lake Tonga, beating branches in *Quercus suber* forest (N36°52'35" E8°29'28"), 5 m, 1♂, 23.XI.1989, leg. Bosmans (CRB). Tipaza: Zeralda, beating branches of *Pistacia lentisca* in coastal dunes (N36°42'53"E2°50'36"), 10 m, 4♀♀, 25.IV.1987, leg. Bosmans (CRB). TUNISIA: Jendouba: Ras Rajel, beating branches in *Quercus suber* forest (N36°59'9" E 8°51'40"), 200 m, 1♂, 8.V.2006, leg. Bosmans (CRB). *Gibbaranea gibbosa*: SPAIN: Majorca: Gorg Blau, 1♂, beaten from bushes in open coniferous forest adjoining the reservoir (N39°48'3.5", E2°48'44.5"), 615 m, 29.X.2014 (specimen matured in captivity), leg. Lissner (CJL-10072). ALGERIA: Blida: Meurdja, beating in *Cedrus* forest (N36°29'59" E3°8'54"), 1050 m, 1♀, 20.IV.1988, leg. Bosmans (CRB); Bouira, Massif du Djurdjura, Tala Rana, beating in *Cedrus* forest (N36°25'46" E4°13'57"), 1400m, 2♂♂ 1♀, 1.VI.1988, leg. Bosmans (CRB); Tissemsilt, Massif de l'Ouarsenis, beating in *Cedrus* forest (N35°52'15", E1°56'41"), 1550 m, 1♂, 19.IV.1988, 1♀, 13.V.1988, 1♀, 1.VI.1988, leg. Bosmans (CRB). *Gibbaranea occidentalis*: PORTUGAL: Azores: Terceira, Terra Brava (N38°44'7", W27°12'7"), 650 m, 6♂♂ 5♀♀, 4 juv., VI.2012, leg. Paulo Borges (CJL-11309-11311).

Diagnosis

The species is separated from congeners by the genitalia being distinctive in both sexes. Males are most easily separated by the shape of the median apophysis. The epigynes of *G. bruuni* and *G. occidentalis* are quite similar, but the females of the two species do not overlap in size or in distribution, the much larger *G. occidentalis* being endemic to the Azores.

Description
Male
Measurements (n=14, average value with range in parenthesis). TL: 3.4 (2.6-4.2), PL: 1.8 (1.4-2.0), PW: 1.4 (1.1-1.6).
Colour. A well-camouflaged species, habitus of live specimen as in Fig. 1. Carapace dark brown, rather densely covered with light brown and whitish hairs, particularly in cephalic region (Fig. 1). Chelicerae yellow with grey reticulations on anterior surface. Sternum with dark reticulations. Abdomen with dark brown folium and dark spots in anterior part (Figs 1, 4b). Areas to the sides of the folium also brownish, only the median line reaching the fore margin of the abdomen is cream or whitish (white in alcohol conserved specimens). Area between epigastric furrow and spinnerets black. With dense co-
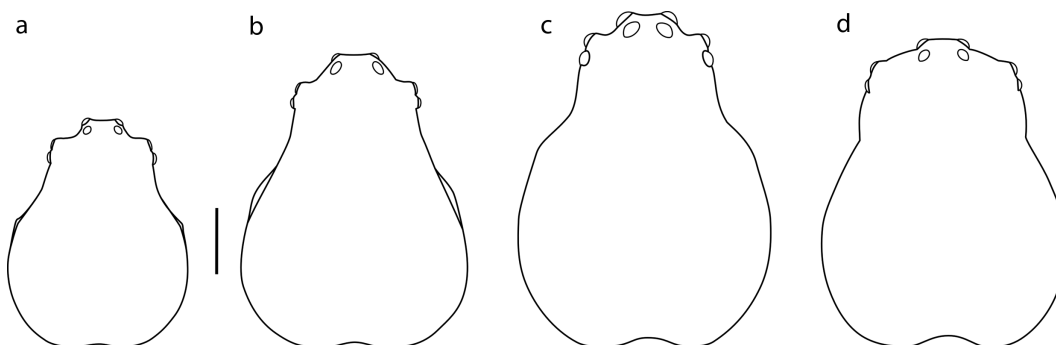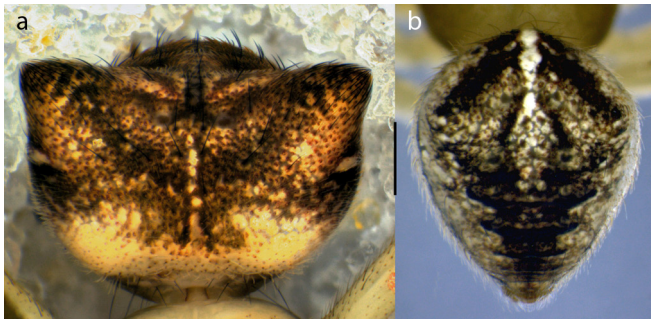

Fig. 3: Outline of prosomas of *Gibbaranea* species: **a.** *G. bruuni* Lissner spec. nov. male from Majorca; **b.** *G. gibbosa* (Walckenaer, 1802), male from Majorca; **c.** *G. occidentalis* Wunderlich, 1989, male from the Azores; **d.** *G. bruuni* Lissner spec. nov., female from Majorca. Only lenses of eyes drawn, sockets omitted. Scale bar 0.5 mm
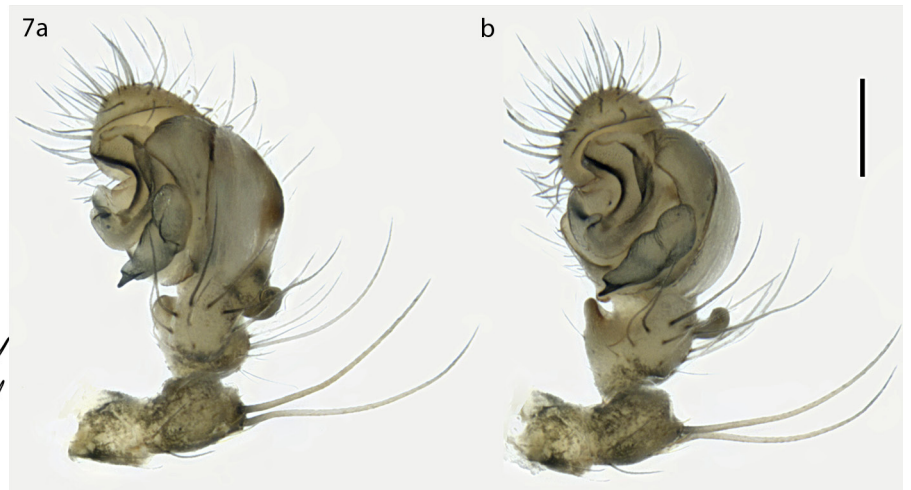
Fig. 4: *Gibbaranea bruuni* Lissner spec. nov., alcohol conserved specimens: **a.** female abdomen in anterior view; **b.** male abdomen in dorsal view. Scale bar 0.5 mm
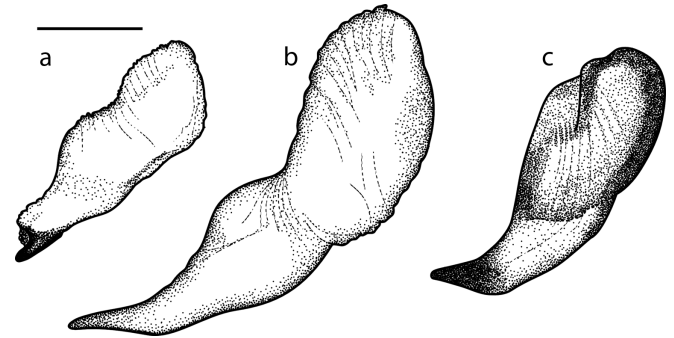
Fig. 5: Median palpal apophysis: **a.** of *Gibbaranea bruuni* spec. nov.; **b.** *G. gibbosa*; **c.** *G. occidentalis*. Scale bar 0.1 mm

Fig. 6: Palp of *G. bruuni* Lissner spec. nov. in ventral view. Scale bar 0.2 mm **Fig. 7:** *Gibbaranea bruuni* Lissner spec. nov., male palp: **a.** retrolateral view; **b.** ventral view. Scale bar 0.2 mm

verage of hairs of same colour as carapace. Trochanters and basal half of femora pale, remaining leg parts annulated with dark brown as in Fig. 1. The many strong spines vary in colour, some whitish with brown bases, some entirely dark, and some dark with pale median part.

Eyes. Median eyes projecting and forming a quadrangle as seen in frontal view (Figs 3a, 3d). All eyes ringed with black, posterior medians with much wider encircling, thus appearing larger than anterior medians (Fig. 3a). Measurements of eyes relate here only to the diameter of lenses or distances between them: anterior median eyes separated by 0.18 (2.4 times the diameter of an anterior median eye), posterior medians separated by 0.16, anterior medians separated by 0.13 from posterior medians. Sockets of anterior and posterior lateral eyes are contiguous, lenses separated by 0.065. Lens diameter of an anterior median eye 0.075, posterior median eye 0.091, anterior lateral eye 0.066 and posterior lateral eye 0.073.

Prosoma. Clypeus as high as the width of an anterior median eye. The lateral edges of carapace rather sharply bent at about midway between the eyes and rear edge (Fig. 3a). Maxillae with a basal external rounded tooth projecting retrolaterally. Cheliceral promargin with four large teeth, three form a group positioned opposite mid position of fang, and a fourth projecting ca. 45° forward, situated near basal position of fang. Cheliceral retromargin with three smaller teeth.

Legs. Coxa I with distinct posterior-apical tooth or hook. All legs with strong spines, tibia II most heavily spined of all segments. Leg formula I-II-IV-III.

Abdomen. Abdominal humps weakly developed (Fig. 4b).

Male palp. Patella of male palp with two strong dorsal spines (Fig. 5c). Paracymbium with distinct hook, gradually bent (Figs 6, 7b). Median apophysis of the male palp transverse with blackish endal spur abruptly narrowed near tip and with a blunt ectal end (Figs 5a, 7b). Conductor spoon-like, narrowed and smoothly bent near tip (Fig.7a). Terminal apophysis barely with dark sclerotization.

Female

Measurements (n=11, average value with range in parenthesis)**.** TL: 4.1 (3.6-4.8), PL: 2.1 (1.9-2.3), PW: 1.8 (1.5-1.9).

Colour (Fig. 2)**.** In drab colours as male and with similar co-
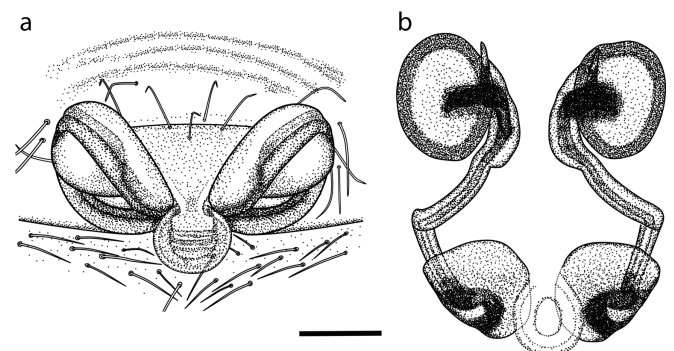
Fig. 8: *Gibbaranea bruuni* Lissner spec. nov., epigyne: **a.** ventral view; **b.** vulva in dorsal/posterior view. Scale bar 0.1 mm
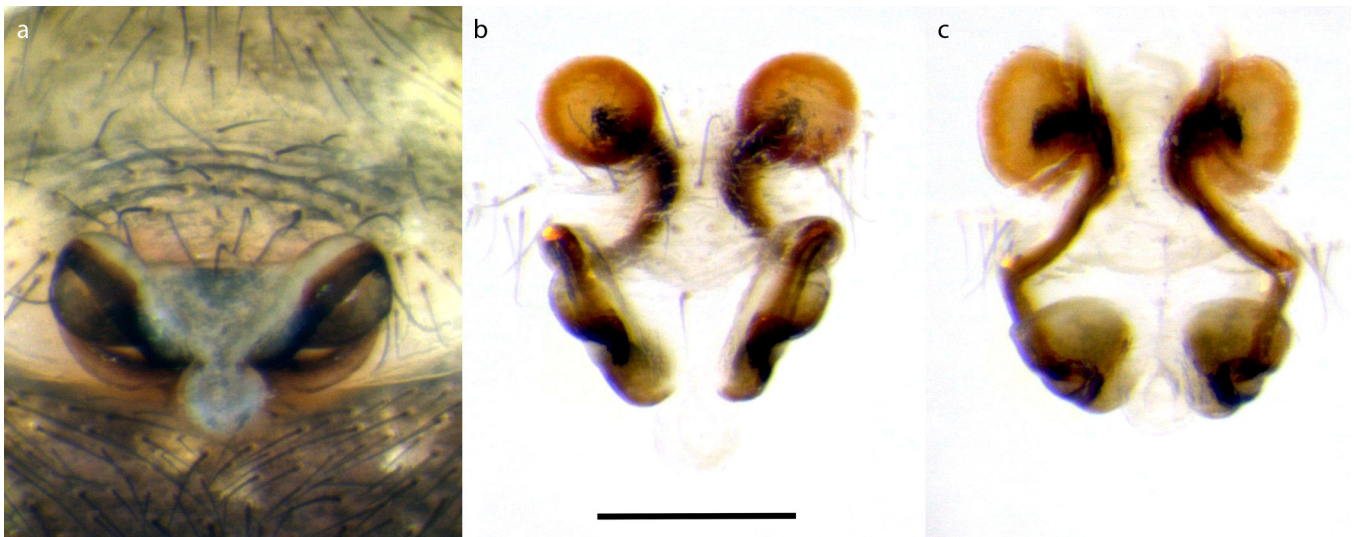
Fig. 9: *Gibbaranea bruuni* Lissner spec. nov.: **a.** epigyne in ventral view; **b.** detached epigyne in ventral-slightly anterior view showing underlying vulva; **c.** vulva in dorsal-posterior view for maximum visibility of structures. Scale bar 0.2 mm

lour of pubescence. Dark annulations of femora I and II less prominent, only apical quarter of segments are dark brown. Chelicerae and sternum coloured as in male. Abdomen with folium. One female out of eleven collected in Majorca has different abdominal markings, possessing a dark triangle spanning the width of the dorsum in area of humps. Females from Tunisia and Portugal have prosoma grey brown, cephalic part with triangular whitish spot, abdomen at level of humps with triangular grey to nearly black spot with median white stripe in anterior part, posterior part white with minute brown speckles contrasting abruptly with grey brown venter.

Eyes. Quadrangle of median eyes situated on a less projecting prominence compared to the male. Eyes of the same size as in male, but spaced more apart due to a wider head in the female. Measurements: anterior median eyes separated by 0.23 (3.1 times the diameter of an anterior median eye), posterior medians separated by 0.22, anterior medians separated by 0.15 from posterior medians. Sockets of anterior and posterior lateral eyes contiguous, lenses separated by 0.075. Lens diameter of an anterior median eye 0.075, posterior median

eye 0.091, anterior lateral eye 0.075 and posterior lateral eye 0.077.

Prosoma. Clypeus 1½ times higher as the width of an anterior median eye. Lateral edges of carapace smoothly narrowed with protruding sides of head convex (Fig. 3d). Cheliceral promargin with four large, equally spaced teeth, retromargin with three smaller teeth as in male.

Legs. As in male but with tooth on coxa I lacking and spination of tibia II not much different from that of other tibiae.

Abdomen. Humps of female much more pronounced than in male (compare Figs 2, 4a, with figs 1, 4b).

Epigyne/vulva. with central structure looping around lateral bulb-like structures all the way to the posterior margin of the epigyne, almost to join opposite loop (Figs 8a, 9a, 9b). Scape circular in ventral view. Ducts of vulva form mirrored "S" (Figs 8b, 9c). Spermathecae circular, separated by slightly less their diameter (Figs 9b, 9c).

Discussion

This is the smallest member of the genus with measured males and females not exceeding 4.2 and 4.8 mm respectively. The species does not overlap in size with any congeners, except males of *G. occidentalis* (TL: 3.2-5.5 according to data in Wunderlich 1989). Measurement data is based mainly on Majorcan specimens, and the size-ranges presented here may not extrapolate to all populations throughout the distributional range of the species. The species resembles *G. gibbosa* with which it may co-occur, but possesses no green markings. The green colours of *G. gibbosa* may be striking in live specimens, but fades in alcohol with time. Southern European specimens of *G. gibbosa* are generally much less greenish than Northern European ones. Accordingly, the Majorcan specimen of *G. gibbosa* has only a green median spot at the anterior border of the abdomen. In *G. bruuni* there is a fairly thin midline in this place, white or cream in all live specimens inspected. A complete lack of green colours may be distinctive for *G. bruuni* and allow separation from *G. gibbosa* in the field. The shape of the male prosoma as seen in dorsal view also differs between the two species. The lateral margin is rather abruptly narrowed in *G. bruuni*,

Fig. 10: *Gibbaranea occidentalis* Wunderlich, 1989, female from Azores. The carapace has a conspicuously dark triangular marking. Abdominal humps vary in size but are generally rather small in this species (photo courtesy of Paulo A. V. Borges)

while tapering smoothly in *G. gibbosa*, and the head is not approximately parallel-sided as in *G. occidentalis*. Abdominal humps as in congeners, largest in females, but with base of humps in non-gravid females less clearly delineated from the abdomen compared to *G. gibbosa* and humps are not directed upwards, but to the side as in *G. bituberculata*. Size and direction of the humps may be different in gravid females. The palp is highly distinctive, particularly the wedge-shaped median apophysis terminating in a blackish spur and with edges undulating (Fig. 5a). The ectal end is blunt in all three species: *G. bruuni*, *G. gibbosa* and *G. occidentalis* (Fig. 5). Paracymbium with distinct hook as in *G. gibbosa*, but more gradually bent. The marginal sclerotized coil of the epigyne is parallel-sided and not widened anteriorly as in *G. gibbosa* (compare Fig. 8a with Fig. 168g in Almquist 2005). The scapus of *G. bruuni* is roughly as long as wide in ventral view, not longer than wide as in *G. occidentalis*, and the spermathecae are situated further apart (compare Figs 8a, 8b with Figs 6, 9 in Wunderlich (1989). Otherwise the epigynes appear very similar in ventral view, that of *G. occidentalis* only slightly larger than that of *G. bruuni* even though the overall size of females differs considerably between these species.

The new species is assumed to be closest to *G. gibbosa* and *G. occidentalis*, based on a similar build of the male palp and epigyne as illustrated by Roberts (1995) and Wunderlich (1989). *G. bruuni* seems to possess relatively little variability in colouration compared to the huge variability in *G. occidentalis*, the markings of the latter species also highly variable among specimens captured at the same locality (Figs 10-11).

Habitat and phenology. In Majorca specimens were beaten from bushes and lower branches of conifers in fairly shaded areas at 380-815 m a.s.l. At Cuber and Gorg Blau it is particularly common in dense stands of thorny, unpalatable shrubs in grazed, open forest. At Gorg Blau it co-occurred with *G. gibbosa*, at Puig Randa with *G. bituberculata*. Subadults were collected in late October and performed their final moult in captivity from late November – early January (males generally earlier than females). In the field males have been encountered in October, April and May and females in April. Subadults of both sexes collected in April matured later in April or in May. In Algeria, one adult male was captured in October, in Tunisia one adult male in May. Adult females were captured in April in Algeria and Portugal. In North Africa, *Gibbaranea bruuni* was only captured at low altitude, from sea level to 200 m, while *G. gibbosa* was only found in forests above 1000 m.
Distribution. Algeria, Portugal, Spain (Majorca, Cadiz), Tunisia.

**New synonymy**
Gibbaranea bituberculata (Walckenaer, 1802)
Araneus dromedarius cuculliger Simon, 1909 **syn. nov.**

Type material
Holotype ♀ MOROCCO: Essaouira (Mogador), MNHNP Coll. Simon 6366; examined.

Comments
Simon (1909) described *Araneus dromedarius cuculliger* Simon, 1909 from Morocco. In the World Spider Catalog (2016) it is mentioned as *Gibbaranea bituberculata cuculliger*. The holotype
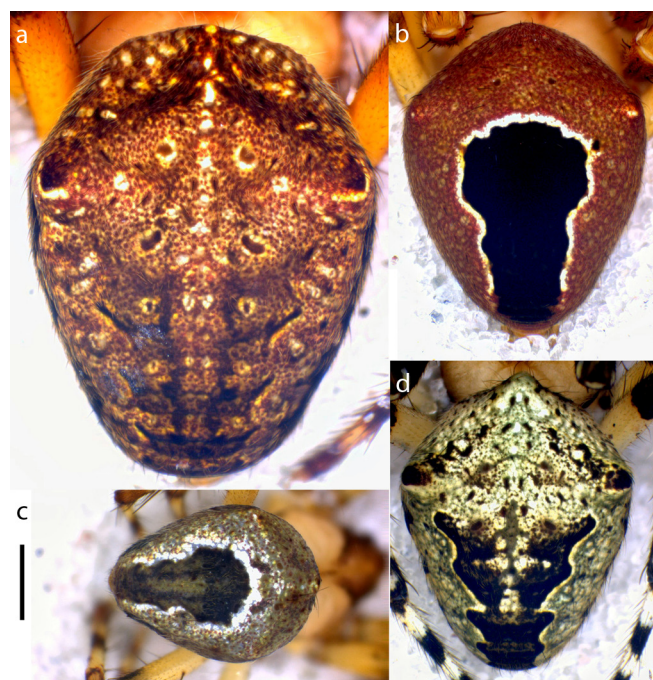
Fig. 11: *Gibbaranea occidentalis* Wunderlich, 1989 (Azores), examples of variation in abdominal colour markings (alcohol conserved specimens): **a.** female; **b.**, **d.** subadult females; **c.** male. Scale bar 1 mm

was examined in order to test its validity and there appears to be no difference between the epigynes of the nominal species and the subspecies. It is just a colour variation and *G. bituberculata cuculliger* is declared here a junior synonym of the nominal species.

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First records of fungi pathogenic on spiders for the Republic of Serbia

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Abstract. During an investigation into parasitic fungi on arthropods in the mixed forests of Mt. Fruška Gora, Republic of Serbia, two pathogenic species were found: *Cordyceps thaxteri* Mains (anamorph: *Akanthomyces aranearum* (Petch) Mains) and *Torrubiella arachnophila* (J.R. Johnst.) Mains (anamorph: *Gibellula leiopus* (Vuill. ex Maubl.) Mains (Hypocreales, Cordycipitaceae). Both specimens were found in the anamorphic (asexual) stage. Previously, there have been no investigations of this group of fungi in this region, thus these are the first records of pathogenic fungi for both Mt. Fruška Gora and the entire territory of the Republic of Serbia. Collected specimens are deposited in the Herbarium of the National Park Fruška Gora, Republic of Serbia.

Keywords: *Akanthomyces,* Araneae, *Cordyceps, Gibellula*, pathogenic fungi*, Torrubiella*

Zusammenfassung. Erstnachweise von arachnophagen Pilzen für Serbien. Im Rahmen einer Untersuchung von Schlauchpilzen (Ascomyceten = Ascomycota), die auf Arthropoden parasitieren, wurden im Untersuchungsgebiet Fruška Gora (Vojvodina, Serbien) zwei spinnen-parasitierende Arten gefunden: *Cordyceps thaxteri* Mains (Anamorph: *Akanthomyces aranearum* (Petch) Mains) und *Torrubiella arachnophila* (J.R. Johnst.) Mains (Anamorph: *Gibellula leiopus* (Vuill. ex Maubl.) Mains (Hypocreales, Cordycipitaceae). Beide Exemplare wurden im anamorphen, ungeschlechtlichen Stadium gefunden. Bisher wurden in dieser Region keine Untersuchungen zu dieser Pilzgruppe gemacht. Die Funde sind somit Erstmeldungen für das Fruška Gora Gebirge und für Serbien. Die gesammelten Individuen sind im Herbar des Nationalparks Fruška Gora, Serbien, hinterlegt.

Fruška Gora is a small mountain (highest peak 539 m) located in the southern region of the Pannonian plain. In the upper parts of this mountain the dominant vegetation type is mixed deciduous forest (*Fagus, Tilia, Quercus*), while the lower parts are covered with meadows, steppe, arable land, orchards, vineyards and settlements (Janković & Mišić 1980). The spider fauna of Mt. Fruška Gora is very diverse and 267 species have been recorded so far (Grbić et al. 2015).

In their natural habitats spiders can be infected with numerous parasitic fungi, exhibiting anamorphic (asexual morph) and teleomorphic (sexual morph) stages. Fungi are named according their teleomorphs, but names of their anamorphic stages (formerly considered separate species) can also be found in the recent literature; even though they represent synonyms (Norvell 2011). The mode of infection and mortality are similar to mechanisms found in numerous entomopathogenic species (Evans & Samson 1987). After contact of the fungal spores with the body of an insect or spider, the spores germinate and grow through the exoskeleton into the haemocoel, gradually occupying the whole body of its host by decomposing soft tissues with digestive enzymes. After a few weeks, the spider dies and fungal structures grow out through the exoskeleton and form sporulating structures (conidiophores) on the surface of the body (Hughes et al. 2016). Arachnophagous fungi can be found in the same habitats as spiders, but they require much humidity and shade for their development (Hajek & Leger 1994).

The anamorphic genus *Akanthomyces* (Cordicipitaceae) consists of 13 species, all parasites of spiders and insects (Lepidoptera and Coleoptera) except one that lives as a saprobe on decaying plant material (Mains 1950, Samson & Evans 1974, White et al. 2003). Species of the genus *Akanthomyces* are characterized by producing white, cream or flesh-coloured cylindrical, attenuated synnemata (large, erect reproductive structures, bearing compact conidiophores) covered with a hymenium (tissue layer on the fungal fruiting body where cells develop reproductive structures) of phialides (flask-shaped projection from the top of the conidiophore).

Anamorphic fungi from the genus *Gibellula* (Cordicipitaceae), with 16 species described so far, are typical pathogens of spiders (White et al. 2003). Most *Gibellula* species are tropical, while there is a small number of species present in the temperate region (Mains 1950). Detailed descriptions of *Gibellula* species can be found in the studies of Petch (1932), Samson and Evans (1977, 1992), Kobayashi & Shimizu (1982), Humber & Rombach (1987), Tzean et al. (1997a, 1998) and Kubátová (2004). Around half of the *Gibellula* species are connected with *Torrubiella* teleomorphs. *Gibellula* usually forms synnemata bearing aspergilloid or penicillate conidiophores with phialidic conidiogenous cells (Kubátová 2004).

The aim of this study was to describe two pathogenic fungi, *Cordyceps thaxteri* Mains and *Torrubiella arachnophila* (J.R. Johnst.) Mains, collected on Mt. Fruška Gora which represent the first records of these species for the Republic of Serbia. We also hope that this paper will draw arachnologist's attention to infected spider specimens, since there is a need for more comprehensive research into this group of fungi.

Material and methods
Sampling
In the period from 2013 to 2015 investigation into fungi of the phylum Ascomycota was conducted in the mixed deciduous forests of Mt. Fruška Gora. Two dead spiders infected with parasitic fungi were collected. The specimens were macro-photographed in situ. Both samples were deposited as dry specimens in the Herbarium of the Fruška Gora National Park, labelled FG266 and FG262 respectively.

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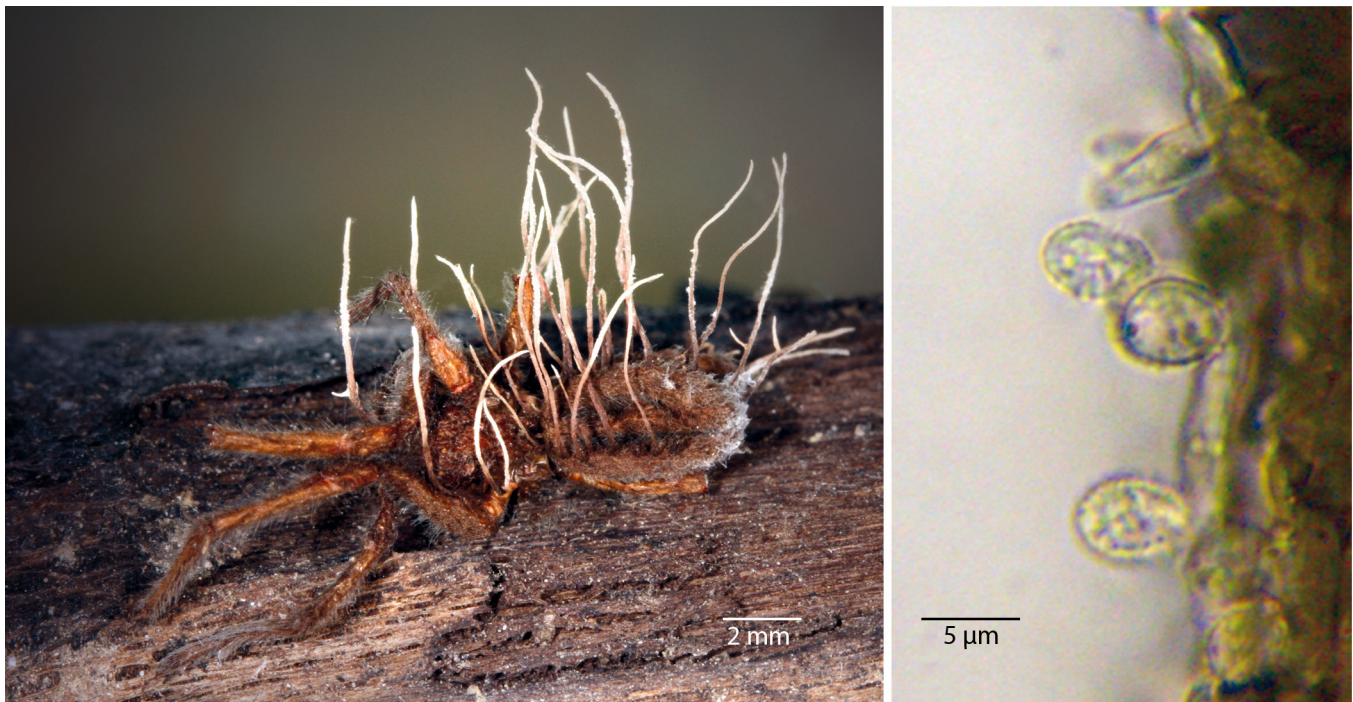
Fig. 1: *Cordyceps thaxteri*: Body of dead spider (Lycosidae) with synnemata, right: Conidiophore and conidiogenous cells

Identification

The collected species were identified on the basis of macroscopic and microscopic morphological characteristics according to specific identification keys published in Samson & Evans (1992) and Hsieh et al. (1997). Microscopic features were observed in water using transmission light microscope and bright-field technique. Spiders were identified according to Loksa (1969), Blauwe (1973), Wang (2002) and Nentwig et al. (2015).

Results

A first sample of a dead spider infected with an anamorphic stage of *C. thaxteri* (Fig. 1) was found on 29 September 2013 on the forest floor of the oak/hornbeam forest (*Aculeato-Querco-Carpinetum*) in the locality Iriški venac (45°8'58.43"N, 19°49'49.67"E). Most of the spider's body was covered with yellowish/white mycelium from which numerous elongated synnemata were growing out. Synnemata were dark brown at the base and yellowish white on the upper part, covered with a thick layer of spherical to ellipsoidal phialides, measuring 6-10 x 4-6 µm. The conidia were hyaline, globular with constrictions at the top, 5-10 x 2.1- 2.4 µm (Fig. 1). A teleomorph was not found.

Macroscopic and microscopic characters of the specimen correspond to the description given by Hsieh et al. (1997). Due to severe damage, identification of the dead spider to species level was not possible, but it was determined that it belongs to the family Lycosidae.

The second sample of a dead spider infected with an anamorphic stage of *T. arachnophila* (Fig. 2) was found on 6 October 2015 under decaying leaves of beech forest (*Tilio-Fagetum submontanum)* in the locality Papratski do (45°8'7.18"N, 19°38'23.62"E). The spider's body was covered with white mycelium and numerous conical to cylindrical synnemata, approximately 1 mm long and 400 µm in diameter (Fig. 2). Conidiophores were short (42-75 x 6-8 µm), septate, at the

tip expanding into vesicles 5-10 µm in diameter with metulae in the upper part. The metulae were wide and globular with numerous cylindrical phialides. The conidia were hyaline, ellipsoid to cylindrical, 4-5 x 1.6-1.9 µm (Fig. 2). A teleomorph was not found.

Macroscopic and microscopic characters of our specimen correspond to the characters of *Gibellula leiopus* described by Tzeanet al. (1997). The spider belongs to the species *Urocoras longispinus* (Kulczyński, 1897), Agelenidae.

Discussion

C. thaxteri has a global distribution, and was recorded e.g., in North America (Mains 1950a), Taiwan (Hsieh et al. 1997), the United Kingdom (NBN Gateway 2015), Ghana (Samson & Evans 1974), The Netherlands (Samson & Evans 1974), Japan (NBRC 2015), Thailand (Hywel-Jones 1996) and New Zealand (GBIF 2015), while this finding represents the first record for Serbia.

G. leiopus is distributed widely and has been recorded e.g., in North America (Mains 1950), Trinidad (Evans & Samson, 1987), the Czech Republic (Fassatiova 1960), Poland (Bałazy 1970), France (in 1975, CBS Fungi database 2015), Sweden (Lundquist 1998), Greece (Kubátová 2004), Austria (Tkaczuket al. 2011), Ghana (Samson & Evans 1973), Russia (Koval 1974) and Taiwan (Tzeanet al. 1997). The finding presented in this paper is the first record for Serbia.

Since the spider fauna is quite diverse in all the types of habitats on Mt. Fruška Gora (Grbić et al. 2015), it can be assumed that other species of arachnophagous fungi may also occur in this region.

There is very little information about the distribution of arachnophagous species of fungi, especially in temperate regions. This is partly because there is a much smaller number of species present in comparison with tropical regions, and fewer investigations have been conducted (Tzean et al. 1997, Kubátová 2004).
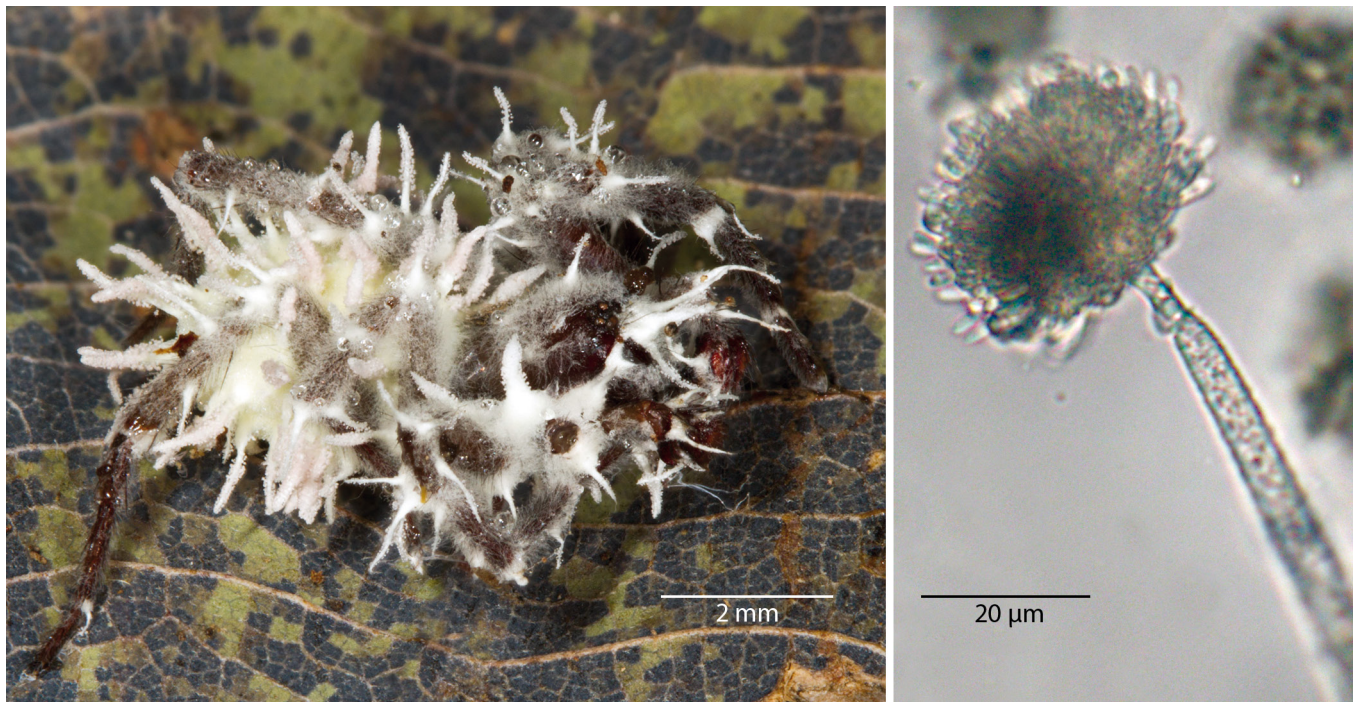
Fig. 2: *Torrubiella arachnophila*: Body of dead spider (*Urocoras longispinus*, Agelenidae) with synnemata, right: Conidiophore and conidiogenous cells

The effect of pathogenic fungi on spider populations is only poorly known (Evans 2013), so it is of great importance for arachnologists to be more involved in the investigations of arachnophagous fungi, since the data they collect during fieldwork can be very valuable.

Also, it is worth mentioning that antimicrobial activity of the species presented in this study was confirmed (Kuephadungphan et al. 2014) and their potential as producers of bioactive compounds should be investigated in the future.

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Web architecture alteration of the orb web weaving spider *Metellina merianae* (Araneae, Tetragnathidae) induced by the parasitoid *Megaetaira madida* (Ichneumonidae, *Polysphincta* group)

Stanislav Korenko

Abstract. The polysphinctine wasp *Megaetaira madida* (Haliday, 1838) is a koinobiont ecto-parasitoid of spiders of the genus *Metellina*. Under the influence of the parasitoid's final instar larva, the spider host *M. merianae* (Scopoli, 1763) built a three-dimensional web architecture, which differed considerably from the capturing orb web. The alteration of spider web behaviour induced by a parasitoid larva in this host-parasitoid pair is described for the first time.

Keywords: behavioural manipulation, host-parasitoid interaction, spider web, wasp

Zusammenfassung. Durch den Parasitoid *Megaetaira madida* (Ichneumonidae, *Polysphincta*-Gruppe) induzierte Veränderungen im Netzbau von *Metellina merianae* (Araneae, Tetragnathidae). Die Schlupfwespe *Megaetaira madida* (Haliday, 1838) aus der *Polysphincta*-Gattungsgruppe ist ein koinobiontischer Ektoparasitoid von Spinnen der Gattung *Metellina*. Unter Einfluss des letzten Larvenstadiums des Parasitoiden baute die Wirtsspinne *M. merianae* (Scopoli, 1763) dreidimensionale Netze, deren Architektur erheblich von der der normalen Fangnetze abweicht. Die Veränderung des Netzbauverhaltens einer Spinne durch die Larve eines Parasitoiden wird erstmals beschrieben.

Koinobiont parasitoid wasps from the *Polysphincta* genus-group sensu Gauld & Dubois (2006) are all exclusively associated with spider hosts and their host range is taxonomically restricted (mostly to genus level) (Fitton et al. 1987). The female wasp temporally paralyses the spider and oviposits on the dorsal side of the spider's opisthosoma/prosoma, where the larva develops while the spider continues foraging. Shortly before pupation, the final stage larva can manipulate the web-spinning activity of the host in order to establish effective protection against enemies and an environment for parasitoid pupation (e.g. Eberhard 2000a, Korenko et al. 2014). This modified web which protects the parasitoid pupa after the spider's death is called the 'cocoon web', a term first introduced by Eberhard (2000a), in which some components of the normal web are reduced (e.g. the web spiral, radii) and others are reinforced (e.g. radii, the central hub, the frame) or multiplied (e.g. threads). These effects of the larva are apparently due to chemical products that are introduced into the spider, but the active compounds involved have not yet been identified (Eberhard 2010).

The polysphinctine parasitoid *Megaetaira madia* (Haliday, 1838) is distributed in several parts of the Palaearctic associated with spiders of the family Tetragnathidae (Yu et al. 2012). Its host range exclusively includes spiders of the genus *Metellina*, which build a typical orb web with a small hole in the hub (e.g. Roberts 1995). The spiders *Metellina mengei* (Blackwall, 1869), *Metellina merianae* (Scopoli, 1863) and *Metellina segmentata* (Clerck, 1757) have already been reported as hosts of *M. madida*, but host utilisation including web architecture modification induced by parasitoid final stage larvae has never been documented (Fitton et al. 1987, 1988). Several specimens of *M. madida* were reared by Nielsen (1923) in small tubes. Unfortunately, the small space in the tubes did not allow the observation of innate web building behaviour or its modi-

fication induced by the parasitoid larva. Nielsen observed that wasp cocoons were surrounded by a tangle of threads which were present in all parts of the tubes. Further, Nielsen collected one cocoon attached to a spruce twig in the field with no silk structure surrounding the cocoon. This resembles the situation in which the parasitized spider falls off the web in the period when the parasitoid larva reaches its final stage and is diverted from building any silk structure. Here, I present new host records and the first note on behavioural manipulation of a spider host by *M. madia* from Italy.

Material and methods

I collected parasitized spiders of the genus *Metellina* from the edge of a deciduous forest in Monterosso Grana (Province of Cuneo, Italy, 44°24'20"N, 7°19'17"E) over a two-day period at the end of October 2014. Spiders were collected by beating tree canopies and undergrowth (30 to 200 cm above the ground) with a square-shaped beating net (1-m^2 area) placed underneath. Each spider was visually inspected for the presence of a parasitoid larva.

The spider hosts were reared in plexiglass experimental arenas (frame 220 × 220 mm, depth 20 mm) with paper tape on four sides of the frame so that the spiders could build webs. The spiders were fed with a surplus of prey (small crickets and *Drosophila* flies). The web building activity of parasitized spiders was observed until the larva killed and consumed the spider and pupated. I used a Canon EOS 500D digital camera with an EF-S 18–55 mm lens to record the architecture of the cocoon web.

Results

Two parasitized *Metellina* spiders, one *M. segmentata* and one *M. merianae*, were collected on 29th October. The parasitoid larva on *M. segmentata* died after ten days in the laboratory and when the spider host moulted the shrivelled dead larva fell out with its exuvia. The parasitoid larva on *M. merianae* pupated on 28th December 2014 and the male wasp emerged on 12th January 2015. In the latter spider host, the architecture of the normal web and the modified cocoon web induced by the final stage larva of *M. madida* were observed.

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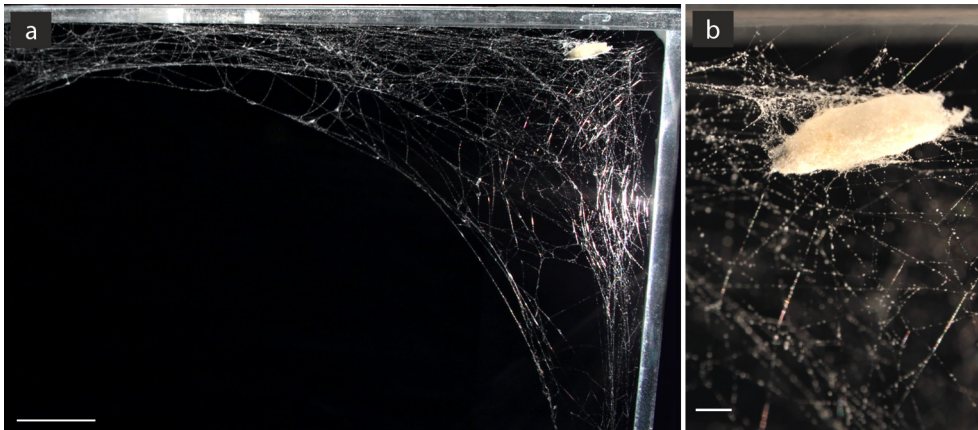
Fig. 1: a. Cocoon web built by a *Metellina merianae* spider host induced by the final stage larva of the parasitoid *Megaetaira madida*; **b.** detail of cocoon. Scale = 20 mm (a) and 2 mm (b)

The parasitized host *M. merianae* rebuilt its orb web several times until the larva reached its final stage, when the spider, under the influence of the parasitoid, built a unique three-dimensional (3D) structure in the upper part of the arena (Fig.1a). This 3D cocoon web had no clear counterpart in the webs of unparasitized spiders. The wasp cocoon was placed in an upper corner of the experimental arena with a high density of threads (Figs 1a, b).

Discussion

Several studies have been devoted to the behavioural manipulation of orb web building spiders from the family Tetragnathidae by polysphinctine wasps. Wasps of the Neotropical genus *Hymenoepimecis* associated with spiders of the genus *Leucauge* were observed to induce the construction of a two-dimensional (2D) cocoon web which consisted of a reduced number of radial threads radiating in a plane from a central hub; the cocoon was suspended from this central hub. This type of cocoon web is documented in *Hymenoepimecis argyraphaga* Gauld, 2000 associated with *Leucauge argyra* (Walckenaer, 1841) (Eberhard 2000a, 2000b, 2001) and *Hymenoepimecis japi* Sobczak, Loffredo, Penteado-Dias & Gonzaga, 2009 associated with *Leucauge roseosignata* Mello-Leitão, 1943 (Sobczak et al. 2009). A cocoon web with a similar 2D architecture, but protected by the 3D structure of a tangle positioned below the hub, was documented in the interaction between *Hymenoepimecis tedfordi* Gauld, 1991 and *Leucauge mariana* (Keyserling, 1881), and *Hymenoepimecis jordanensis* Loffredo & Penteado-Dias, 2009 and *Leucauge volupis* (Keyserling, 1893) (Gonzaga et al. 2015). It is interesting that the larva of the taxonomically distant Costa Rican wasp *Eruga gutfreundi* Gauld, 1991 induced its *Leucauge* host (*L. mariana*) to build a 3D cocoon web (Eberhard 2013). The cocoon web of the orb web weaving spider *Tetragnatha montana* Simon, 1874 induced by the final stage larva of the Palearctic wasp *Acrodactyla carinator* (Aubert, 1965) consisted of one highly reinforced main thread, tensioned mostly by a reinforced side thread (Korenko et al. 2015). *Acrodactyla carinator* was misidentified as Holarctic *Acrodactyla quadrisculpta* (Gravenhorst, 1820) in studies by Korenko et al. (2015) and Belgers et al. (2013) (material revised by K. Holy and K. Zwakhals). Additional investigation revealed that the cocoon web of *T. montana* induced by the larva of *A. quadrisculpta* has the same architecture as that induced by *A. carinator* (Korenko unpubl. data).

The cocoon web induced by *M. madida* resembled the cocoon web of *E. gutfreundi* from Costa Rica in the sense that both were 3D structures and the cocoons were oriented horizontally; however, the morphologies of the cocoons were considerably different (cocoon circular in cross-section covered by curled structure of *M. madida* vs. square in cross section with paper smooth surface in *E. gutfreundi*). The cocoon of *M. madida* had a densely-woven cocoon wall covered by curled fibres of various lengths and was circular in cross section (Fig. 1b), whereas the cocoon of *E. gutfreundi* had a paper-like smooth surface and was square in cross section (Eberhard 2013).

The wasp *M. madida* was formerly included in the genus *Acrodactyla*, also known as the the *madida* species-complex, but Gauld & Dubois (2006) excluded it because it lacked several features characteristic of the remaining *Acrodactyla* species. *Megaetaira madida* was the only valid species within the genus *Megaetaira*, but two other *Acrodactyla* species have recently been transferred to this genus (Matsumoto in press). Their relatedness to *M. madida* is also supported by the host range of *M. varicarinata* (Uchida & Momoi, 1958) associated with *Meta reticuloides* Yaginuma, 1958, which is related to the genus *Metellina*, the exclusive host of *M. madida* (Takasuka pers. comm.). Although wasps of both *Acrodactyla* and *Megaetaira* are associated with orb web building spiders from the family Tetragnathidae, their manipulation of the spider web architecture differs considerably. *Acrodactyla* wasps induce the production of a strong 2D cocoon web where the wasp cocoon is attached to the strongest main silk line (Korenko et al. 2015). In contrast, the cocoon web induced by *M. madida* is a densely woven 3D structure. However, both strategies are effective for protecting the parasitoid during the pupal stage and both are also used by other polysphinctine parasitoids. More observations of host parasitoid interactions are necessary to reveal further details of the host utilisation of this sparsely occurring spider parasitoid.

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East meets West: on the true identity of *Cheiracanthium rupestre* and *Xysticus albomaculatus* (Arachnida: Araneae: Eutichuridae, Thomisidae)

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Abstract. *Cheiracanthium rupestre* Herman, 1879, and *Xysticus albomaculatus* Kulczyński, 1891, both originally described from Hungary, are among the most rarely reported species of their genera in Europe. Here we report that both of these species have very close relationships to similarly uncommon species originally described from France at about the same time. The specimens currently considered as *Cheiracanthium rupestre* turn out to be very closely related to, but distinct from, *Cheiracanthium striolatum* Simon, 1878. However, the original description of *C. rupestre* does not match these specimens nor any other known species of *Cheiracanthium*. We therefore consider *C. rupestre* a **nomen dubium** and suggest that all previous records of this species after the original description actually refer to *Cheiracanthium macedonicum* Drensky, 1921. *Xysticus albomaculatus,* on the other hand, turns out to be a junior synonym of *Bassaniana baudueri* (Simon, 1877) **syn. nov.**, expanding the range of this species considerably to the East and at the same time confirming that it is a genuine European species, rather than a recent immigrant from North America as previously suspected.

Keywords: *Bassaniana*, *Coriarachne*, doubtful species, new synonyms, nomen dubium, *Ozyptila*, species inquirendae

Zusammenfassung. Anmerkung zur wahren Identität von *Cheiracanthium rupestre* und *Xysticus albomaculatus* (Arachnida: Araneae: Eutichuridae, Thomisidae). Die beiden aus Ungarn beschriebenen Großspinnen *Cheiracanthium rupestre* und *Xysticus albomaculatus* gehören zu den seltensten Vertretern ihrer Gattungen in Europa. Es zeigt sich, dass beide Arten enge Affinitäten zu Arten haben, die etwa zur gleichen Zeit aus Frankreich erstbeschrieben wurden. Die gemeinhin als *C. rupestre* bezeichneten Exemplare sind eng verwandt mit *C. striolatum* Simon, 1878, gehören aber zu einer eigenen Art. Da die Originalbeschreibung von *C. rupestre* jedoch deutliche Unterschiede zu diesen Exemplaren aufweist, und sich auch sonst keiner bekannten *Cheiracanthium*-Art zuordnen lässt, betrachten wir *C. rupestre* als **nomen dubium**; der gültige Name für die bisher zu dieser Art gestellten Exemplare ist *Cheiracanthium macedonicum* Drensky, 1921. *Xysticus albomaculatus* erwies sich bei näherer Untersuchung als jüngeres Synonym von *Bassaniana baudueri* (Simon, 1877) **syn. nov.**, was eine deutliche Ausdehnung des Nachweisareals nach Osten darstellt und bestätigt, dass es sich bei dieser Form um eine autochthone europäische Art handelt, nicht um einen rezenten Import aus Nordamerika, wie zuvor angenommen.

Numerous spider species described from Europe have never been found again after their initial discovery (Breitling et al. 2015, Breitling et al. in press). Others have been found only very rarely and in widely scattered locations. This is particularly surprising when it concerns rather large and noticeable species and when there is no indication of a restriction to rare and unusual habitats. In such cases, there is always the possibility that the rare records are in fact based on misidentifications of more common species (a number of examples are discussed in Breitling et al. 2015). But sometimes it also turns out that the species are actually more common than initially suspected, in which case the lack of records is probably due to a combination of undersampling and insufficient descriptions in the available literature. Here we discuss two such cases, which are especially noteworthy as they reveal unexpected links between rare spider species described from Hungary and similarly uncommon relatives from Western Europe.

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Abbreviations:

CJVK	= Collection J. Van Keer
HNHM	= Hungarian Natural History Museum, Budapest (L. Dányi)
IZ	= Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw (W. Wawer)
LNU	= Ivan Franko National University of Lviv (A. Hirna)
MCSN	= Museo Civico di Scienze Naturali "E. Caffi", Bergamo (P. Pantini)
MMUE	= Manchester Museum of the University of Manchester (D.V. Logunov)
MNHN	= Muséum National d'Histoire Naturelle, Paris (C. Rollard)
NHMW	= Naturhistorisches Museum Wien (C. Hörweg);
NMNHS	= National Museum of Natural History in Sofia (S. Lazarov)
NMP	= National Museum, Prague (P. Dolejš)
PMC	= Pedro M. Cardoso Collectio;
SMF	= Senckenberg Museum, Frankfurt (P. Jäger & J. Altmann)

The case of *Cheiracanthium rupestre*
Material examined

sub *C. rupestre*: BULGARIA: 1♀, 2 juv., Kranevo near Varna, forest edge, ca. 150 m a.s.l., 9.–11.VIII.2005, Dolanský leg. et coll. 1♀, Stranbaka mts., Vitanovo nature reserve, 28.–30.VIII.2000, S. Petrov leg., J. Dolanský coll. 1♂, 10.–14. VII.1977, NMP, J. Buchar leg. et coll. P6d-41/2012/C2331. 3 juv., Bosnek, ca. 1100 m a.s.l., 13. VIII. 2009, J. Dolanský leg. et coll. 6 juv. (1♀, 1♂ kept to adult stage under laboratory conditions), Bosnek, 13. X. 2010, J. Dolanský leg. et coll.

HUNGARY: 1♀, Várpalota, HNHM Araneae-2198, Chyzer coll. 1187. 2♀♀ Várpalota IZ Kulczyński coll. (photographs examined). 1♀, Szentendrei-sziget (Szentendre Island), north of Budapest, under bark on dead wood, end of May 2009, K. Pfeiffer leg., A. Grabolle coll. 1♂, Nadap, Meleghegy, oak forest, 15.VI.1951, HNHM, Kakassné leg. SLOVAKIA: 1♀, Čachtice, 19.VI.1978, J. Svatoň leg. et coll.

sub *C. macedonicum*: BULGARIA: 1♀, between Yakoruda between Yakoruda and Mekhomiya and Mekhomiya, NMN-HS, holotype.

sub *C. striolatum*: ITALY: 2♂♂, Firenze, Marradi, Badia Valle 430 m a.s.l., 25.VI.2003, A. Usvelli leg., MCSN. Sicily 1♀, Ragusa, Giarratana, fiume Irminio, 500 m a.s.l., 19.V.1995, P. Pantini, M. Valle leg., MCSN.

Comparative material

C. striolatum: FRANCE: 4♀♀, 1♂ "Pyr[énnés] Or[ientales] Prats de Mollo", MNHN Simon coll. 1791. 1♂ Bonne Anse dunes, near La Coubre, Charente-Maritime "mainly under rock rose" MMUE Duffey coll. G7512. 1♀, Balcons de la Mescla near Draguignan, bushy area, ca 800 m a.s.l., 25. IV.2009, J. Dolanský leg. et coll. PORTUGAL: 1♀, Picotino, 21.II.2001, P. Cardoso leg. et coll. PMC0390b, pitfall. 1♂, Tó, 21.II.2001, P. Cardoso leg. et coll. PMC0390c, pitfall. 1♀, Fonte d'Aldeia, 7.III.2001, P. Cardoso leg. et coll. PMC0390d, pitfall. 1♀, Fonte d'Aldeia, 13.VI.2001, P. Cardoso leg. et coll. PMC0390g, pitfall. 1♀, Algozinho, 21.III.2001, P. Cardoso leg. et coll. PMC0390e, pitfall. 1♀, Algozinho, 4. IV. 2001, P. Cardoso leg. et coll. PMC0390f, pitfall. 1♂, Mogadouro, 8.II.2001, P. Cardoso leg. et coll. PMC0248B. 1♀, 1♂, Picote, 21.VI.2001, P. Cardoso leg. et coll. PMC0248c, pitfall. 1♂, Bruçó, 3.X.2001, P. Cardoso leg. et coll. PMC0248d, pitfall. 1♂, Picote, 14.XI.2001, P. Cardoso leg. et coll. PMC0248e, pitfall. 1♂, Mértola, 27.V.2003, P. Cardoso leg. et coll. 5358. 1♂, Limas, 18.VI.2003, P. Cardoso leg. et coll. 5475, pitfall. 4♀♀, 2♂♂, 5 juv., Picote, 31.V.2001, P. Cardoso leg. et coll. PMC0390a, swept. 1♀, 1 juv., Praia da Bordeira near Lagos, 12.IV.2005, M. Řezáč leg., J. Dolanský coll. 1♀, Mértola, Corredoura, valley of Guadiana river, 8.XI.2005, M. Řezáč leg., J. Dolanský coll. 1♀ Barca d'Alva near Mogadouro, 10.X.2007, M. Řezáč leg., J. Dolanský coll. 1 juv., Ribeira Limas, 1.VII.2007, S. Pekár leg., J. Dolanský coll. 1 juv., Golega near Torres Novas, 2.X.2007, M. Řezáč leg., J. Dolanský coll. 1♂, Palao near Mogadouro, 4.X.2007, M. Řezáč leg., J. Dolanský coll. 1♂, Fonte de Aldeia near Mogadouro, 5.X.2007, M. Řezáč leg., J. Dolanský coll. 1♀, Faro, Murração, 17.IV.2013, R. Bosmans leg. et coll. 1♀, 1♂, Lagoa de Obidos, in pine litter, 20. IV. 2013, R. Bosmans leg. et coll. 1♀, Belmeque, bushy area, 300 m a.s.l., 38°2'45"N, 7°22'59"W, 28.III.2013, J. Dolanský leg. et coll. 1♀, Mértola, bushy area, 50 m a.s.l., 37°38'5"N, 7°40'13"W, 30.III.2013, J. Dolanský leg. et coll. 1♀, Barranco do Velho, 30.III.2013, J. Dolanský leg. et coll. 15♀♀, southern Portugal, 3.–7.IV.2008, M. Řezáč et S. Korenko leg., J. Dolanský coll. SPAIN 1♂, Fabero, 1.V.2012, F. Šťáhlavský leg., J. Dolanský coll. 1♀, Málaga, Mijas, stones in pine forest, 19.XII.1997, R. Bosmans leg. et coll. Mallorca 14 juv. (3♀♀, 4♂♂ kept to adult stage under laboratory conditions), Badia Gran, bushy area, VI. 2008, J. Dolanský leg. et coll. ITALY 1♀, Livorno, Isola di Capraia, 20.V.1992 C. Berera leg. MCSN. Sardinia 1♀, SMF Roewer coll. RII/13643. FRANCE: Corsica 1♀, Vivario, Col de Sorba (1320m), 26.V.1995, under stones in *Larix* forest, J. & K.

Van Keer leg. et coll. CJVK 1506. 1♀, Solenzara, 28.V.1999, in a *Juncus* field, CJVK. 1♀, Asco, 23.IX.2013, under a stone along rocks, CJVK. 1♂ Zonza, 28.V.1999, under stones in Corsican pine forest, CJVK. 1♂, Mausoleo, rivière Tartagine, 1100 m a.s.l., light trap, 30.V.2000, E. Bertuetti et al. leg., MCSN. 2♀♀, Mausoleo, rivière Tartagine, 1100 m a.s.l., light trap, 1.VIII.2000 Giomi F., Salmini B. leg. MCSN. 3♀♀, Olmi Cappella, affluent rivière Tartagine, 840 m a.s.l., light trap, 30.V.2000, E. Bertuetti et al. leg., MCSN. 5♀♀, 3♂♂, Asco, rivière Stranciacone, 1800 m a.s.l., light trap, 1.VI.2000, E. Bertuetti et al. leg., MCSN. ALGERIA: 1♀, 2♂♂, Wilaya de Tissemsilt, Theniet el Had, clearing in cedar forest, 1750 m a.s.l., 23.III.1988, R. Bosmans leg. et coll. 2♀♀, 1♂, Wilaya de Bouira, Massif du Djurdjura, Tigounatine, 1460 m a.s.l., cedar forest, 6.X.1987–1.IV.1988, R. Bosmans leg. et coll. MOROCCO: 1♀, 1♂, Tiznit, Mirlef, litter and stones, near the sea, 25 m a.s.l., R. Bosmans leg. et coll. Uncertain locality ("gall. m., hisp., alg."= Southern FRANCE, SPAIN, ALGERIA) 28♀♀, 16♂♂, MNHN Simon coll. 1796.1867 (probably including syntypes). No locality. 2♀♀, 1♂ MNHN Simon coll. 1803.13468.

C. sp. near *striolatum:* ALGERIA: 2♀♀ Tlemcen, MNHN Simon coll. 1804.13299. 1♂, Djelfa, Djebel Djellal, 17. VIII. 1990, R. Bosmans leg. et coll. MOROCCO 2♀♀, 1♂ "Mogador, La Escaleza" (= Essaouira, Marrakesh), MNHN Simon coll., 1803.13648. 1♀ "Maroc: entre Mazagan [= El Jadida] et Oualidia (J. Théodoridès leg.)", J. Denis det., MNHN, Simon coll., 1803. TUNISIA: 2♀♀, 1♂ Djerba, MNHN Simon coll. 1804.12462.

Cheiracanthium rupestre was first described by Herman (1879) based on a single female found under a stone in a stony ditch close to Majláth (Diósgyőr, Miskolc, Hungary). It was redescribed by Chyzer & Kulczyński (1897), who not only discussed both sexes in their determination keys, but also provided the first description of the presumptive male of the species, based on a single specimen, the palp of which they illustrated. They considered the species much rarer ("multo rarius") than *C. effossum*, which itself is one of the rarely found species of the genus. Another record, from "Pajsarjeva jama", a cave in central Slovenia, was contributed by Kratochvíl (1934), without further details. The male, but not the female, was later redescribed with detailed illustrations by Cleopatra Oltean (1973), which were later republished (under her married name) in her monograph on the Romanian Clubionidae s. lat. (Sterghiu 1985). The species is said by Sterghiu to be adult in May in Romania, where a single male was found in low vegetation on a roadside in Băneasa, on the northern edge of Bucharest. Since then, the species has been reported very rarely and usually on the basis of single male individuals from a few additional countries: Slovakia (various locations, Gajdoš et al. 1999, 2009), Austria (1 male collected in a xerothermophilic downy oak forest on a south-facing mountainside between 400 and 500 m, Kanzelkogel, Graz, Styria, Horak 1987), Macedonia (4 male specimens collected in July 1998 at elevations between 1300 and 1800 m on Šar Mountain, Komnenov 2002), and Bulgaria (Slavyanka Mountain, Naumova 2009). A female specimen from Bosnek in the Vitosha Mountains, Bulgaria (and now in the Dolanský collection), was illustrated by Kůrka et al. (2015).

Herman's type material could not be found in the collection of the Hungarian Natural History Museum (HNHM)

and is in all probability lost. It was also not found in the Natural History Museum Vienna (NHMW), the Museum & Institute of Zoology, Polish Academy of Sciences, Warsaw (IZ), or the Zoological Museum of the National University of Lviv (LNU), where parts of the Kulczyński collection are held. However, a single female specimen labelled as *C. rupestre* is still available in Chyzer's collection in Budapest and two further females in the Kulczyński collection in Warsaw. Examination of this material showed that *C. rupestre*, as understood by Chyzer, is identical to *C. macedonicum* Drensky, 1921, a species described on the basis of a female specimen collected between Yakoruda and Mekhomiya (= Razlog, Bulgaria), and later also reported as occurring relatively rarely on Babuna Mountain close to Abdi Han and between Resen and Ohrid (Macedonia; Drensky 1929, 1936) (Figs 1-2). However, a specimen from Ohrid labelled as *C. macedonicum* in the Drensky collection in the NMNHS turned out to be a male *C. montanum* (JD vid.). Deltshev & Blagoev (1997) reported *C. macedonicum* from submediterranean to montane coniferous altitudes on Pirin Mountain (Bulgaria) and Deltshev et al. (2013) found it on Galichitsa Mountain in Macedonia. The records of *C. rupestre* from Macedonia (Komnenov 2002) and Bulgaria (Naumova 2009) already imply the synonymy established here. The synonymy between *C. macedonicum* and *C. rupestre* sensu Chyzer & Kulczyński (1897) auct. is further supported by the examination of male and female specimens collected together in Bosnek (100 km north of Razlog, the type locality of *C. macedonicum*). This confirmed that Chyzer's female is indeed correctly matched to the male that was illustrated by Chyzer & Kulczyński (1897), Oltean (1973) and Sterghiu (1985). The genital structures in both sexes are quite distinct and set the species apart from all other *Cheiracanthium* species in Eastern Europe.

One slight complication arises, however, from the fact that Herman's type material of *C. rupestre* could not be traced anywhere, and his original figure of the epigyne shows little similarity to that of *C. rupestre* as it has been understood since the times of Chyzer & Kulczyński (1897), even when we assume that the intraspecific variability is very high (Figs 1-2). The Hungarian text of the original description, but not its German translation in the same work, describes the epigyne as follows: "The epigyne is very characteristic: there is one pinhead-like brown little sphere on each side of a deeply incised leathery arch." This matches the figure very well, so that a printer's or illustrator's error can be excluded. The "pinhead" structures do not seem to be compatible with the epigynal structure of

the specimens that are currently assigned to *C. rupestre*, and the remainder of the illustrated details in the figure also show no resemblance to the distinct patterns seen in, e.g., Chyzer's specimen. There is no indication of the "deeply incised arch" illustrated by Herman in the epigyne of any European *Cheiracanthium* species. The "pinheads" could represent mating plugs, which are known in other *Cheiracanthium* species, such as *C. furculatum* Karsch, 1879 (Bayer 2014) and *C. mildei* L. Koch, 1864 (Bryant 1952), but if Herman's specimen belonged to the same species Chyzer's material, the anterio-lateral position of the plugs would be inexplicable. Moreover, while several females of the closely related *C. striolatum* in Simon's collection had broken emboli lodged in their epigyne, none of the specimens examined had a mating plug. We considered the possibility of assigning a neotype for *C. rupestre*, to stabilize the interpretation of this name, but decided that in view of the major discrepancies between Herman's illustration and the current concept of the species, it would be impossible to select a neotype specimen that fulfils the condition of ICZN art. 75.3.5. "that the neotype is consistent with what is known of the former name-bearing type from the original description and from other sources". Instead, we consider *C. rupestre* as a **nomen dubium**, possibly based on a malformed individual. The valid name for the species described and illustrated in Chyzer & Kulczyński (1897), Oltean (1973) and Sterghiu (1985) thus becomes *Cheiracanthium macedonicum* Drensky 1921, and all records of *C. rupestre* (except that in the original description) should be referred to this species.

Considering the descriptions published after Herman's work and the genitalia of Chyzer's specimen, both male and female *C. macedonicum* appear to be very similar to *C. striolatum*, a species described in 1878 by Simon from a wide range of localities in southern and western mainland France and Corsica, where it was found on low plants. The females were reportedly found with their egg sacs under stones in April. Although the first description already indicated that this species is not rare and can be quite common in suitable habitats, it was relatively rarely reported; and following its inclusion in Simon (1932), which added records from Algeria, Spain and Portugal and also provided the first illustration of the male and female genitalia, the species was not redescribed by modern authors for a long time. Numerous records are known from the Iberian Peninsula, where the species is widespread (Cardoso & Morano 2010). The first illustrated record since Simon (1932) was published only in 2014, based on a female collected under dried leaves along a road margin in Malaga,

Fig. 1: Illustration of the epigyne of **a.** *C. rupestre* in Herman's original description; Herman 1879: Tab. VII, fig. 158); **b.** of *C. macedonicum* in Drensky's original description; Drensky 1921: Tab. I, fig. 14), and **c.** of *C. striolatum* in *Arachnides de France*; Simon 1932: fig. 1361). The epigyne of *C. rupestre* is structurally quite different. In contrast, the epigynes of the other two taxa represent the extremes of a continuum in external appearance, and both forms and their intermediates can be found within a single population.
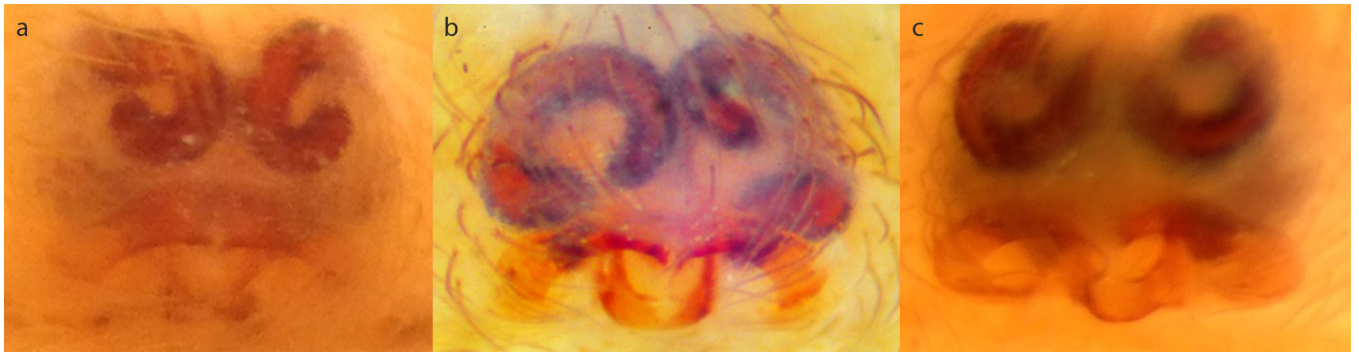
Fig. 2: Epigyne of **a.** *"C. rupestre"* in Chyzer's collection in HMNH, **b.** *C. macedonicum* (holotype, Drensky collection in NMNHS), and **c.** *C. striolatum* (possible syntype, Simon collection in MNHN)

Spain (Lecigne 2014). Lecigne also reported a single female from a dune in Saint-Cyprien, Pyrénées-Orientales, France. Grill et al. (2005) reported the species from Sardinia/Italy and Barrientos et al. (2015) reported and illustrated the species from the Parc Natural del Montseny, Catalonia, Spain, providing the first modern illustrations of both sexes.

The similarity between *C. macedonicum* and *C. striolatum* had already been noted by Deltshev (2003), who had examined the female holotype of *C. macedonicum* in Drensky's collection and concluded that this species is close to *C. striolatum* Simon, 1878, to which it should be thoroughly compared. We have carried out this thorough comparison, based on a large number of specimens from the range of both species (see Material examined, above).

In contrast to the first impression based on published illustrations of the genitalia, *C. macedonicum* and *C. striolatum* cannot be reliably differentiated based on the genitalia in either sex. The female genitalia are extremely variable in morphology, with specimens matching the published illustrations of either *C. striolatum* or *C. macedonicum*, and morphological intermediates between these, even within a single population (Figs 3-4).

In the male, the tegular (median) apophysis is often distinctly bent in specimens of *C. striolatum* (Fig. 5, specimen from mainland France), but this trait is highly variable and specimens with an almost straight apophysis can be found as well, as is typical for *C. macedonicum*.

The hind margin of the cheliceral groove carries 4 teeth in typical *C. striolatum*, compared to 2 teeth in *C. macedonicum*; however, the cheliceral dentition can sometimes vary between the left and right side of the same animal and is difficult to assess reliably. Given that cheliceral dentition has turned out to be unreliable in distinguishing other closely related spiders (e.g., the notorious species pair *Drassodes cupreus/lapidosus*,
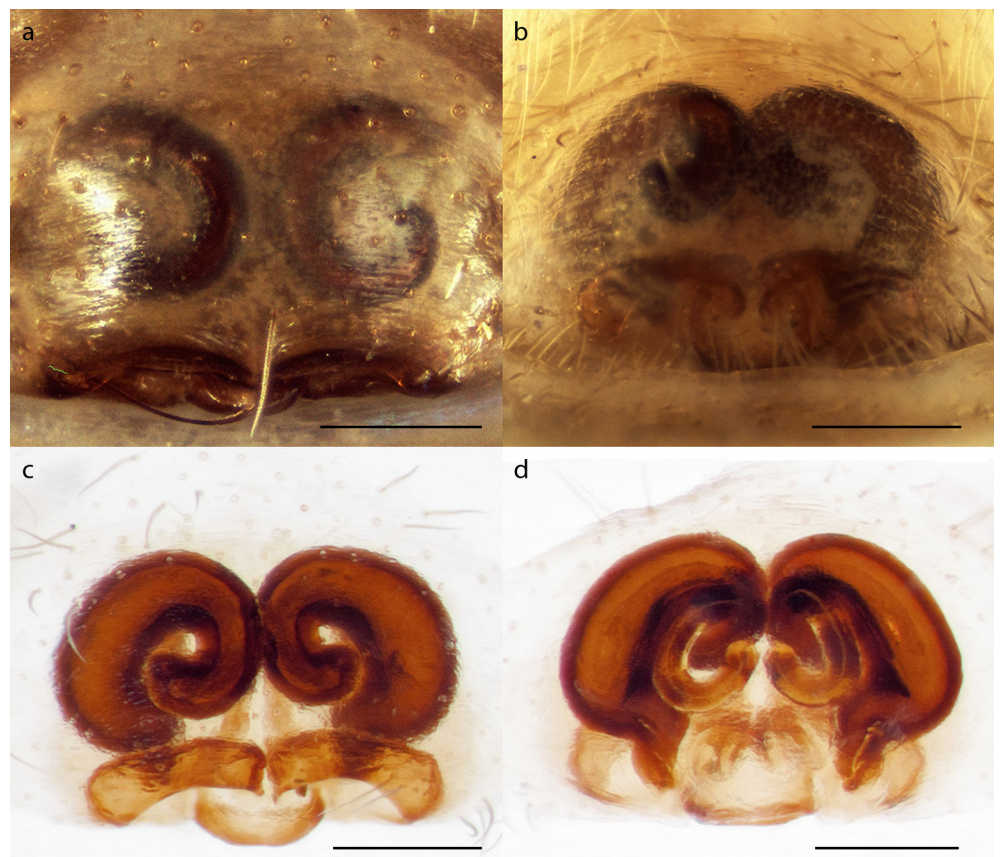
Fig. 3: a., b. External view of the epigyne of two specimens of *C. striolatum* from Corsica representing the *macedonicum* type of external appearance. Cleared epigyne of the latter specimen, in **c.** ventral and **d.** dorsal view. Scale bars = 0.2 mm
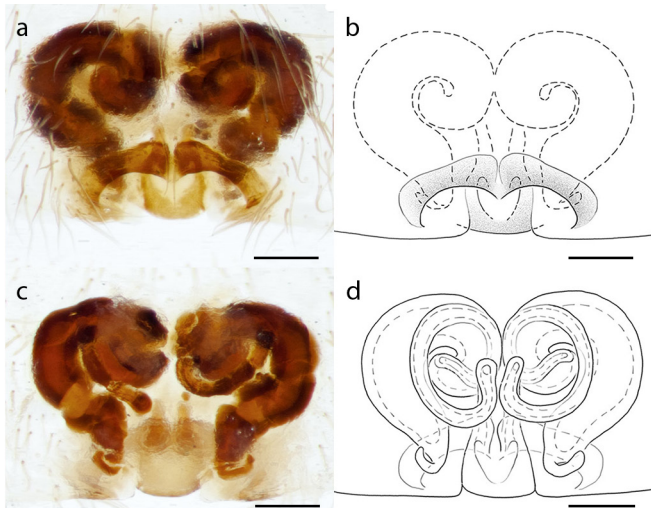
Fig. 4: Cleared epigyne of *C. macedonicum* from Szentendre Island, north of Budapest, Hungary in **a., b.** ventral and **c., d.** dorsal view, photos (a, c.) and schematic drawing (b, d). Scale bars = 0.2 mm

Bolzern & Hänggi 2006), it seems unsuitable to distinguish the two species.

The most reliable feature to distinguish the two species is the opisthosomal pattern: male and female specimens from Western Europe have a distinct reddish heart mark, followed by a series of red chevrons (Figs 6a, 6b). These marks remain distinct and clearly visible even in specimens that have been stored in alcohol for around 100 years in Simon's collection. In specimens from Eastern Europe, any indication of this pattern is usually absent (Figs 6c, 6d). Traces of the chevrons can rarely be seen in male specimens, but the heart mark is always pale and the pattern is never distinct in females. Thus, while some extreme specimens of the two species can be similar in their colouration, there is no overlap in the pattern seen in specimens of the two forms. The difference in opisthosomal pattern is already clearly established in the juveniles, which have distinct markings in *C. striolatum* but not in *C. macedonicum*, as seen in laboratory-reared specimens. Comparable cases of consistent differences in colouration in geographically vicariant populations of widespread spider species seem to be very rare. One example is seen in *Carrhotus xanthogramma* (Latreille, 1819): here, male specimens in the Far East consistently show a black longitudinal line on the opisthosoma, which is missing in European specimens (RB unpubl. observation), while the genitalia are indistinguishable (Prószyński 1973). However, even here, the unusual amphi-Eurasian distribution of the species (Logunov & Marusik 2001) indicates that perhaps the Asian population is a separate species, *Carrhotus crinitus* (Karsch, 1879), which is currently considered a synonym of *C. xanthogramma*. Another relevant case is provided by the sister species *Clubiona vegeta* Simon, 1918, and *C. genevensis* L. Koch, 1866, which are more reliably distinguished based on their abdominal pattern and colouration than based on their genitalia (Helsdingen 1979, Oger unpubl. observation).

Simon (1932) mentioned that the characteristic pattern is sometimes lacking in *C. striolatum*, but this may be due to the inclusion of material from North Africa; examination of the African material in his collection indicates that some populations of *C. striolatum*-like specimens occurring there have a unicolourous opisthosoma. Given the lack of genital diagnostic characters, it is not quite clear if these North African specimens belong to *C. macedonicum* or to a closely related third species, as would be more plausible zoogeographically. Given the apparently highly conservative morphology, it would seem necessary to assess the extent of gene flow between all taxa in this very distinct group using the tools of molecular genetics, with a focus on North Africa and the possible contact areas in the Iberian Peninsula, Italy and Slovenia. For Italy, only *C. striolatum* has been reported in the literature (Caporiacco 1949, Pesarini 2003; another record, from the Laguna Veneta, Caporiacco 1950, is doubtful, according to Hansen 2007, as it is based on a juvenile specimen). However, examination of specimens in the collection of the Museo Civico di Scienze Naturali "E. Caffi", Bergamo, revealed that specimens from the Italian mainland and Sicily lacked the striped opisthosomal pattern and should for now be considered as belonging to *C. macedonicum*. The most recent checklist of Slovenian spiders reports both *C. macedonicum* (sub *C. rupestre*) and *C. striolatum* from that country, based on literature data (Kostanjšek & Kuntner 2015). A molecular genetic analysis would be the most suitable tool to define the precise boundary between *C. macedonicum* and *C. striolatum*, and to determine if sympatric populations or hybrid forms occur in the contact zone.
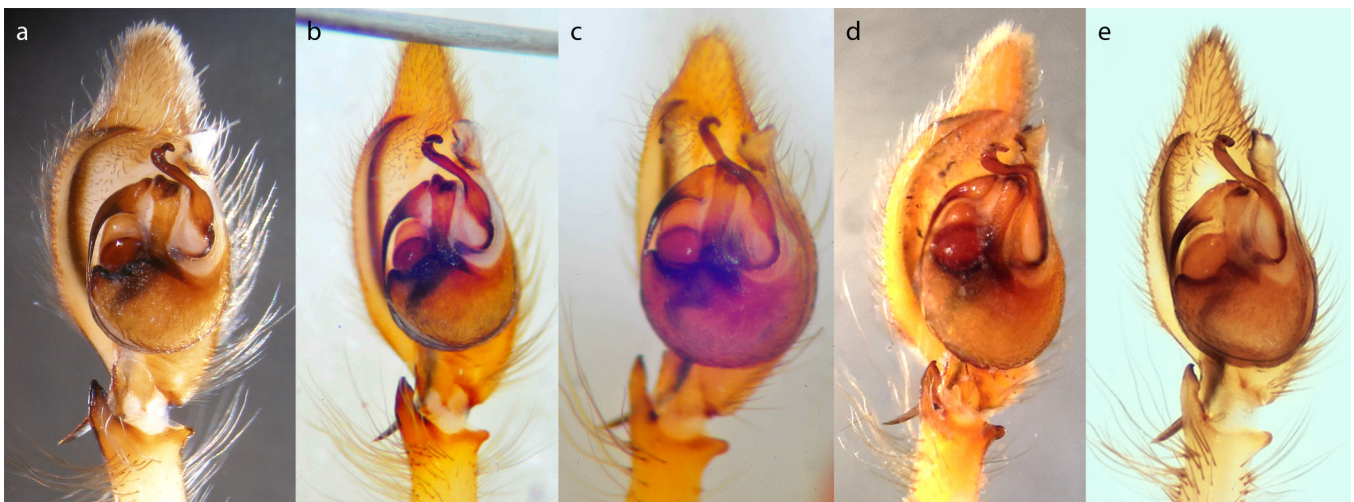
Fig. 5: Ventral view of the pedipalp **a., b.** of two specimens of *C. macedonicum* from Bulgaria and three specimens of *C. striolatum* **c.** from Portugal, **d.** mainland France and **e.** Corsica

Fig. 6: Habitus of **a.** female and **b.** male *C. macedonicum*, and **c.** female and **d.** male *C. striolatum*

For now, we refrain from describing the African specimens as a separate species, but consider *C. striolatum* and *C. macedonicum* as closely related, but distinct species, reliably defined by the differences in opisthosomal pattern only. In view of the stable differences in pattern over a large geographic area (Fig. 7) and long period of time, we consider this hypothesis more likely than the alternative that the two taxa are actually representatives of a single widespread and variable species. Future research may allow a more confident decision in favour of one or the other hypothesis, but for now the treatment as two separate species is not only justified by the available evidence, but is also the more conservative approach, minimizing the number of changes in nomenclature and maximizing the information content of future faunistic records.

Fig 7: Distribution of *Cheiracanthium striolatum* (circles) and *C. macedonicum* (squares), superimposed on a map of climate types according to Köppen (Peel et al. 2007). Black symbols indicate examined specimens, open symbols are based on literature records. For clarity, records from closely adjacent locations are indicated by a single symbol.
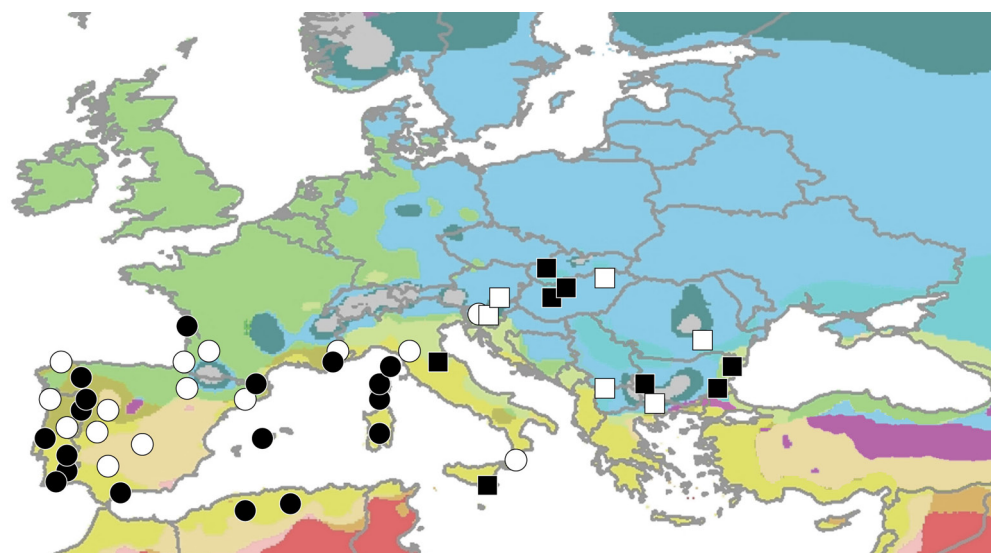
There is no clear indication for an ecological separation of the two species yet, but it is noteworthy that records of *C. macedonicum* come predominantly from montane localities, often in grassy habitats within forests or along forest edges, while there is a reported preference of *C. striolatum* for coastal dune habitats in France. In the Iberian Peninsula, however, records of *C. striolatum* are widespread at altitudes from sea level to 1900 m (Morano et al. 2014).

The case of *Xysticus albomaculatus*
Material examined

sub *X. albomaculatus*: GERMANY: 1♂, Conweiler, Strauben-hardt near Pforzheim, "Birnbaumrinde [pear tree bark]", 19 August 1981, coll. J. Wunderlich. AUSTRIA: 2♀♀ (1 epigyne missing), Lower Austria near Purgstall, Ressl, leg., J. Wunderlich coll. SLOVAKIA: 1♂ 3 juv. Szomotor, HNHM Chyzer coll. 1187 (syntypes). Uncertain locality (HUNGARY?) 1♀ B.-Lellc.(?), Szombathy det., HNHM.

    sub *B. baudueri*: FRANCE: 1♀, 2subad. ♂♂ "Sos [Lot-et-Garonne]" MNHN 1467.2156 (syntypes) [an adult male in the same tube is *B. versicolor* s. str.; it was probably collected in Contis or Mimizan, Landes, as indicated by a second label]. 1♀ "Saint Saud [Dordogne] (aout 1918!) écorce de châtaignier [chestnut bark]", MNHN Simon coll. 1467.25464 (designated as "lectotype" of *B. baudueri* by Déjean & Ledoux 2013, but not a syntype and therefore invalid). 2♂♂ Forêt de Grésigne (Tarn), pitfall traps, 1999, H. Brustel leg., MNHN Ledoux coll. JV.10.898. 1♀ "Berrias (Ardêche) Montchamp, 7/8/04", MNHN Ledoux coll. NQ_10.898-16.921.

Comparative material

Bassaniana decorata (Karsch, 1879): JAPAN 2♀♀, 3♂, 7 juv. Yokohama (syntypes of *Coriarachne japonica* Simon, 1886), MNHN Simon coll. 1467.7346.

    Bassaniana utahensis (Gertsch, 1932): UNITED STATES: 1♀, 1♂ New York, Banks leg., T.A. Bowling det. Nov. 1973, MNHN Simon coll. 1467.4. 9♀♀, 3♂♂, 1subd♂ "Mass. N. Carol. Georg. Colora.", T.A. Bowling det. Nov. 1973, MNHN Simon coll. 1467.688. 2♀♀, 4♂♂ "Am. sept. pacif." (= Pacific North America) T.A. Bowling det. Nov. 1973, MNHN Simon coll. 1467.17106.

    Bassaniana versicolor (Keyserling, 1880): UNITED STATES 16♀♀, 9♂♂ "Mass. N. Carol. Georg. Colora.", T.A. Bowling det. Nov. 1973, MNHN Simon coll. 1467.688.

    Coriarachne brunneipes Banks, 1893: UNITED STATES: 1♀, 1subd♂ "Mass. N. Carol. Georg. Colora.", T.A. Bowling det. Nov. 1973, MNHN Simon coll. 1467.688. 1♀, 1♂ Washington, Banks leg. "Type!", MNHN Simon coll. 1467.3.

Xysticus albomaculatus was first described in 1891 on the basis of very few ("perpauca") male and female specimens from Sátoraljaújhely (Hungary) and the sands at Szomotor (= Somotor, Slovakia) (Kulczyński in Chyzer & Kulczyński 1891). Other specimens were reported in a later volume of the same work from Pozsony (= Bratislava, Slovakia) and Pápa (Hungary) (Chyzer & Kulczyński 1897), and a single male was found a few years later by Bösenberg (1902) on the Großer Feldberg, Taunus, Hesse, Germany; but afterwards it took more than 60 years before the next reliable records were published, from Aiud, Romania (13.V.1962, Fuhn & Niculescu-Burlacu 1969), Pforzheim, Germany (19.VIII.1981)

and Purgstall, Austria (both Wunderlich 1982). Based on this material, Jantscher (2001) re-described the species in detail in her unpublished doctoral thesis.

    Even the original description of *X. albomaculatus* was uncertain about its generic placement, noting an affinity with *Ozyptila*, and Jantscher (2001) cites personal communications by Logunov and Marusik, indicating that the species probably belongs to a new genus, with additional representatives in Siberia. A closer examination shows, however, that *X. albomaculatus* with respect to its cryptic mottled habitus, tree bark habitat and the basic structure of the copulatory organs is very similar to species currently placed in the genus *Bassaniana*, which has commonly found representatives in East Asia and North America.

    In Europe the genus *Bassaniana* is represented by a single species from France, which has been just as rarely reported as *X. albomaculatus*: *Bassaniana baudueri* (Simon, 1877), was first described (as *Oxyptila baudueri*) on the basis of subadult males and a "young female" from Sos, Lot-et-Garonne, France. Another female was found in 1918 in Saint-Saud, Dordogne, together with its egg sac under the bark of a chestnut tree. Simon (1903) transferred the species from *Coriarachne* (where he apparently had placed it in the meantime) to *Xysticus*, together with several other species currently placed in *Bassaniana*. The new records were published in Simon (1932, publ. posthumously). In this work, the taxonomic situation is considerably confounded by the inclusion of an illustration of a supposed *B. baudueri* female from Spain, which actually belongs to *Xysticus cribratus* (Déjean & Ledoux 2013). Moreover, in addition to the records of *B. baudueri* (again sub *Oxyptila baudueri*), the work also contains a single record of a male *B. versicolor* (sub *Coriarachne versicolor*) from Mimizan or Contis, Landes, which is considered an accidental introduction. At a later stage, someone (Simon himself?) considered this specimen to belong to *B. baudueri*, and it is currently found in the same vial in Simon's collection as the original type material of the latter. However, the structure of the pedipalp, with a long, thin, straight embolus indicates that Simon was actually correct in assuming that this male belongs to *B. versicolor* s. str. Mimizan was a major American army base, housing engineering corps members working in the Landes forest around the town (Fenneman 1930), and together with the neighbouring seaside village Contis was a popular tourist location in the interwar years, both of which could explain the introduction, especially as *B. versicolor* is a common spider often found in synanthropic habitats in North America (Kaston 1948).

    Déjean & Ledoux (2013) were the first to report the rediscovery of *B. baudueri* after an interval of almost 80 years, reporting the species to be widespread in forest locations across southern France. They considered *baudueri* a subspecies of the North American *B. versicolor*, and also downgraded *B. utahensis* and (tentatively) *B. decorata* (from Japan) to subspecific status. It is true that all these species are very similar in their (rather variable) habitus, as well as in their genitalia, and difficult to distinguish with confidence. Probable hybrids between *B. versicolor* and *B. utahensis* have been reported as occurring regularly in part of the overlapping range of the two species (Dondale & Redner 1978), and even the material in the Simon collection that was re-identified by T. A. Bowling during his revision of the genus (Bowling & Sauer
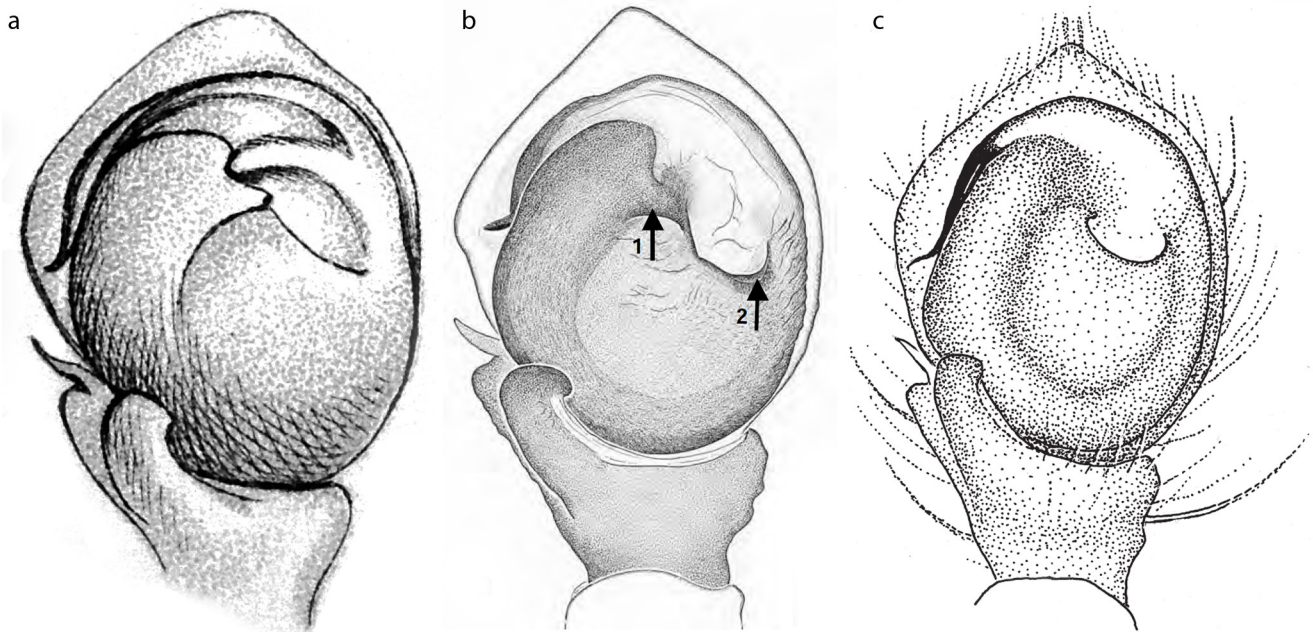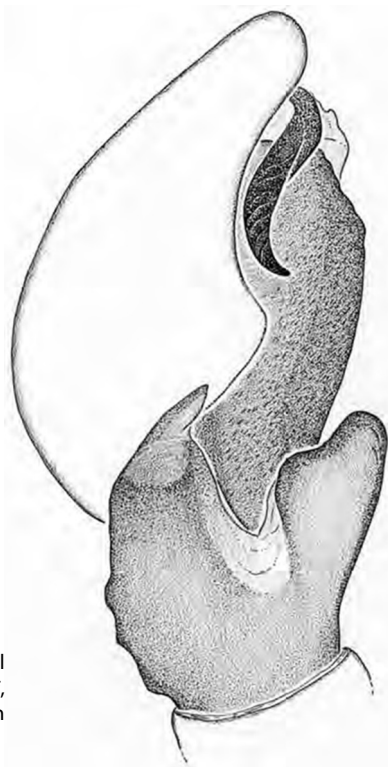
Fig. 8: Pedipalp (ventral view) of *Bassaniana baudueri*: **a.** from the original description of *X. albomaculatus* (Kulczyński in Chyzer & Kulczyński 1891: Tab. III, fig. 33b), **b.** from a German specimen (Jantscher 2001: Tab. 3a), and **c.** a French specimen (figure from Déjean & Ledoux 2013: fig. 10B, by Jean-Claude Ledoux, courtesy of Sylvain Déjean)

1975) seems to contain misidentified specimens. Nevertheless, *B. baudueri* seems to differ consistently in subtle details of the genitalia of both males and females, sufficiently to justify re-elevation to species rank, in addition to the zoogeographical implausibility of spider subspecies occurring on separated continents. In the female, the epigynal septum in *B. baudueri* is broader and less distinct than in the related species, lacking the deeply notched posterior margin, which is particularly prominent in *B. decorata*, but also clearly expressed in the North American species; in the male, the embolus is more


Fig. 9: Pedipalp (retrolateral view) of *Bassaniana baudueri*, based on a German specimen (Jantscher 2001: Tab. 3b). Scale bar = 0.2 mm

robust (not long and thin, as in *B. versicolor*), very gradually tapering towards the tip, which is clearly curved outwards (not straight, as in *B utahensis;* Dondale & Redner 1978: fig. 439). These characters are shared by all European specimens, including the material reported previously as *X. albomaculatus* from Central Europe, and we therefore consider *Xysticus albomaculatus* a junior synonym of *Bassaniana baudueri* (**stat. nov., syn. nov.**).

Both *X. albomaculatus* and its senior synonym *B. baudueri* have been characterized in detail before, both in the original descriptions and in the more recent work of Jantscher (2001) and Déjean & Ledoux (2013). Here we only provide an abbreviated description and illustration of the diagnostic characters. *Bassaniana baudueri* is a typical member of the genus *Bassaniana*, with a variable cryptic mottled pattern of white, brown and black blotches, on legs and body (habitus photos are provided in Wunderlich 1982 and Déjean & Ledoux 2013). It has rather thick, club-shaped spines on the body (but not on the clypeus), in contrast to the thin, pointed spines of *Xysticus* s. str. Total length: ♂♂ 3.8–4.5 mm, ♀♀ 5.0–5.6 mm. Prosoma length: ♂♂ 1.9–2.2 mm, ♀♀ 2.3–2.6 mm. In the male palpus (Figs 8-9), the retrolateral tibial apophysis carries a short straight tooth that is clearly visible in ventral and dorsal view and readily distinguishes the species from similar European spiders in *Xysticus* or *Ozyptila*. The embolus emerges at the distal end of bulbus, is strong and with its tip distally bent outwards retrolaterally in an almost 90° angle, different from *B. versicolor* and other American species in the genus.

The female epigyne (Figs 10-11) is characterized by a very indistinct light septum, without a distinct posterior margin (different from *B. decorata* and the American species). The poor definition of the epigynal structures might be the reason why Simon (1877) considered his type a "young" (not full sclerotized?) female. The width and shape of the septum are variable, but always broader than in the other species of the genus.
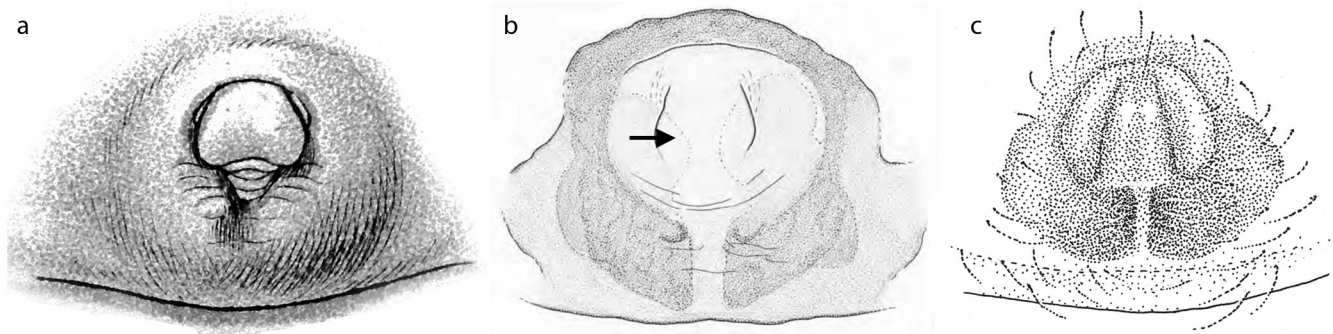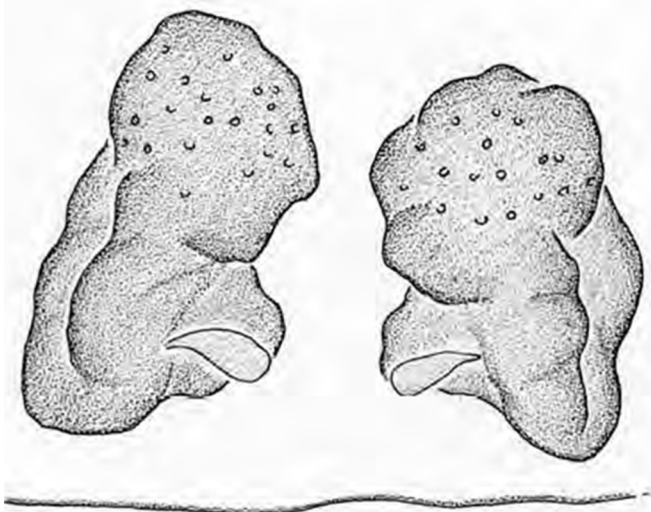
Fig. 10: Epigyne of *Bassaniana baudueri*: **a.** from the original description of *X. albomaculatus* (Kulczyński in Chyzer & Kulczyński 1891: Tab. III, fig. 33a), **b.** from an Austrian specimen (Jantscher 2001: Tab. 3c), and **c.** a French specimen (figure from Déjean & Ledoux 2013: fig. 10A, by Jean-Claude Ledoux, courtesy of Sylvain Déjean)

As discussed above, the generic placement of *B. baudueri* has been unclear since its first description, with suggested affinities to *Ozyptila*, *Xysticus* and *Coriarachne*. The same holds true for the remaining *Bassaniana* species, which were treated as a distinct (unnamed) species group in *Xysticus* by Simon (1903) and partly united in their own genus (*Platyxysticus*) by Gertsch (1932), who later (1939, 1953) synonymized this genus with *Coriarachne* C.L. Koch, 1837, but maintained two distinct species groups, corresponding to the species currently placed in *Coriarachne* (*brunneipes* group) and *Bassaniana* (*versicolor* group). Finally, the species were placed in *Bassaniana* Strand, 1928 (type species: *Bassania aemula* O. Pickard-Cambridge, 1898 = *B. versicolor*) in its current sense by Ono (1985, 1988). Subsequently, Lehtinen proposed downgrading *Bassaniana* to a subgroup "lower than subgenus" of *Coriarachne*, implying (erroneously) that Ono's separation of the two genera was based only on irrelevant differences in body shape (flattened vs. not quite so flattened), and Dondale (2009) suggested that at least the North American species of *Bassaniana* be placed in *Coriarachne*, arguing that the separation was based solely on "equivocal differences in microhabitat". These arguments do not seem particularly convincing: both *Bassaniana* and *Coriarachne* s. str. are very homogenous and probably monophyletic assemblages. Of the two outliers, *C. nigrostriata* Simon, 1886, from Vietnam (holotype subadult

female and additional adult male in MNHN, examined) is probably misplaced in this genus and might possibly belong in or near to *Demogenes* Simon, 1895, an unrevised genus (or group of genera) of coriarachnine-like spiders that includes some of the dominant ground-living thomisids in the Oriental region and Melanesia and resembles *C. nigrostriata* in its habitus and the structure of the pedipalp (Lehtinen 2004, Marusik et al. 2005). And *B. ora* Seo, 1992, from Korea is clearly very close to (and in all probability a junior synonym of) *C. fulvipes* according to the illustrations of the pedipalp provided by Seo and in Namkung (2003) (compare, e.g., figs. 2 and 3 in Seo 1992, to figs. 60 and 61 in Ono 1988). In contrast, the evidence for uniting the two groups in a single *Coriarachne* s. lat. seems to be based entirely on adaptive characters, in particular the flattened body, associated with the shared tree trunk habitat. It is certainly possible that *Xysticus* or *Ozyptila* are paraphyletic with respect to *Bassaniana* and/or *Coriarachne* s. str., but resolving their exact relationships will require a broader study of the entire Coriarachnini (sensu Ono 1988), preferably using a total evidence approach including molecular genetic characters. Until such a study becomes available, we conservatively maintain the generic placement of *baudueri* in *Bassaniana*, following the latest version of the World Spider Catalog (2016).

In a curious twist, Déjean & Ledoux (2013) had suggested that Simon's first description of *O. baudueri* was incomplete, as it did not include information on the genitalia, and that the correct publication date should be 1932. This change was not widely accepted, but if it were correct, *O. baudueri* would be a junior synonym of *X. albomaculatus*. However, even if the 1877 description does not include the details that Déjean & Ledoux would have liked to see, it constitutes a perfectly valid description, providing a plethora of supposedly diagnostic details, and even the type material is still available. The change in publication date is therefore not justified, and the associated assignment of a lectotype collected in 1918 is invalid, as this specimen was not a part of the original type series (ICZN art. 74.2).

The known distribution of *Bassaniana baudueri* as defined here extends from northern Portugal (Cardoso et al. 2008, sub *B. versicolor*, two specimens from a Mediterranean oak forest in Mata da Albergaria, Peneda-Gerês National Park (PNPG), at an altitude of 600 to 700 m) and the western coast of France, via Germany, Austria, Hungary, Slovakia to Central Romania. Considering that its relatives in North America are

Fig. 11: Internal view of the cleared epigyne of *Bassaniana baudueri* (Austrian specimen, Jantscher 2001: Tab. 3d)

widespread, common and often found in rather large numbers in synanthropic habitats (see, e.g., Shinkai 2006 and Kaston 1948), it will be interesting to see if the number of records of *B. baudueri* will increase throughout Europe in the coming years. New records might also fill the apparent gap between the eastern and western populations.

Taxonomic summary

Cheiracanthium rupestre Herman, 1879 nomen dubium
Chiracanthium rupestre Herman, 1879: 157, 356, pl. 7, f. 158 (Description and illustration of female). [Holotype ♀ from HUNGARY: Majláth (Diósgyőr, Miskolc), considered lost].

Cheiracanthium macedonicum Drensky, 1921 (Figs 1a+b, 2a+b, 4, 5a+b, 6a+b)
Chiracanthium rupestre – Chyzer & Kulczyński 1897: 235, pl. 9, figs 42, 62, 78 (description of female, description and illustration of male; three ♀♀ examined, two of them by photographs, considered misidentified)
Chiracanthium macedoinica [sic, lapsus] Drensky, 1921: 49, 77, pl. 1, figs 12-14 (description and illustration of female). [Holotype ♀ from BULGARIA: Yakoruda, Drensky leg., examined].
Chiracanthium macedonica – Drensky 1929: 23 (lapsus corrected)
Cheiracanthium mazedonica – Drensky 1936: 173 (lapsus)
Cheiracanthium macedonicum – Roewer 1955: 480 (correction of gender ending required by ICZN Art. 31.2).
Chiracanthium macedonicum – Bonnet 1956: 1060
Cheiracanthium rupestre – Oltean 1973: 46, figs 1-2 (description and illustration of male; considered misidentified)
Cheiracanthium rupestre – Sterghiu 1985: 110, figs 33a-c (description and illustration of male; considered misidentified)

Cheiracanthium striolatum Simon, 1878 (Figs 1c, 2c, 3, 5c–e, 6c+d)
Cheiracanthium striolatum Simon, 1878: 263 (Description of male and female). [Syntype ♂♂ and ♀♀ from FRANCE: "Basses-Alpes: Castellane (Sédillot) Digne – Var. – Alpes-Maritimes. – Gironde: forêt de la Teste. – Lot-et-Garonne: Sos (Bauduer [leg.]) – Corse – Basses-Pyrénées: St-Jean-de-Luz", probably among the material in MNHN Simon coll. 1796.1867, but not individually identifiable]. Simon 1932: 901, 962, fig. 1360-1361 (description and illustration of male and female). Lecigne 2014: 21, fig. 6 (illustration of female). Barrientos et al. 2015: 62, figs 2a-e (illustration of male and female).

Bassaniana baudueri (Simon, 1877) stat. nov. (Figs 8–11)
Oxyptila baudueri Simon, 1877: 41 (Description of female [considered "jeune"]). [Probable syntype ♀ and 2 juvenile ♂♂ from FRANCE: Lot-et-Garonne: Sos, M. P. Bauduer leg., examined]. Simon 1932: 805, 871 (non fig. 1198, misidentified).
Xysticus albomaculatus Kulczyński, in Chyzer & Kulczyński 1891: 94, tab. 3, figs 33a-b (description and illustration of male & female). [Syntype ♂ and ♀ from HUNGARY: I. S.-a.-Ujhely (Sátoraljaújhely) and SLOVAKIA: Somotor (Szomotor), sandy planes, C. Chyzer leg.; one ♂ syntype examined]. Bösenberg 1902: 352, pl. 33, fig. 520 (description and illustration of male & female). Fuhn & Niculescu-Burlacu 1969: 80, pl. 1, fig. 6 (description & illustration of female). **Syn. nov.**
Psammitis baudueri – Wunderlich 1995: 761 (transfer from *Ozyptila*).

Bassaniana versicolor baudueri – Déjean & Ledoux 2013: 88, figs 9, 10A-C (transfer from *Psammitis*; description and illustration of male & female).

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Phantom spiders 2: More notes on dubious spider species from Europe

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Abstract. A surprisingly large number of European spider species have never been reliably rediscovered since their first description many decades ago. Most of these are probably synonymous with other species or unidentifiable, due to insufficient descriptions or missing type material. In this second part of a series on this topic, we discuss about 100 of these cases, focusing mainly on species described in the early 20th century by Pelegrín Franganillo Balboa and Gabor von Kolosváry, as well as a number of jumping spiders and various miscellaneous species. In most cases, the species turned out to be unidentifiable **nomina dubia**, but for some of them new synonymies could be established as follows: *Alopecosa accentuata* auct., nec (Latreille, 1817) = *Alopecosa farinosa* (Herman, 1879) **syn. nov., comb. nov.**; *Alopecosa barbipes oreophila* Simon, 1937 = *Alopecosa farinosa* (Herman, 1879) **syn. nov., comb. nov.**; *Alopecosa mariae orientalis* (Kolosváry, 1934) = *Alopecosa mariae* (Dahl, 1908) **syn. nov.**; *Araneus angulatus afolius* (Franganillo, 1909) and *Araneus angulatus atricolor* Simon, 1929 = *Araneus angulatus* Clerck, 1757 **syn. nov.**; *Araneus angulatus castaneus* (Franganillo, 1909) = *Araneus pallidus* (Olivier, 1789) **syn. nov.**; *Araneus angulatus levifolius* (Franganillo, 1909), *Araneus angulatus niger* (Franganillo, 1918) and *Araneus angulatus nitidifolius* (Franganillo, 1909) = *Araneus angulatus* Clerck, 1757 **syn. nov.**; *Araneus angulatus pallidus* (Franganillo, 1909), *Araneus angulatus crucinceptus* (Franganillo, 1909), *Araneus angulatus fuscus* (Franganillo, 1909) and *Araneus angulatus iberoi* (Franganillo, 1909) = *Araneus pallidus* (Olivier, 1789) **syn. nov.**; *Araneus circe strandi* (Kolosváry, 1935) = *Araneus circe* (Audouin, 1826) **syn. nov.**; *Araneus diadematus nemorosus* Simon, 1929 and *Araneus diadematus soror* (Simon, 1874) = *Araneus diadematus* Clerck, 1757 **syn. nov.**; *Araneus pyrenaeus* (Simon, 1874) = *Araneus pallidus* (Olivier, 1789) **syn. nov.**; *Araneus sericinus* (Roewer, 1942) = *Aculepeira armida* (Audouin, 1826) **syn. nov.**; *Arctosa brevialva* (Franganillo, 1913) = *Arctosa villica* (Lucas, 1846) **syn. nov.**; *Arctosa cinerea* (Franganillo, 1913) [nec *Arctosa cinerea* (Fabricius, 1777)] = *Arctosa perita* (Latreille, 1799) **syn. nov.**; *Cresmatoneta eleonorae* (Costa, 1883) and *Cresmatoneta mutinensis orientalis* (Strand, 1914) = *Cresmatoneta mutinensis* (Canestrini, 1868) **syn. nov.**; *Cyclosa conica albifoliata* Strand, 1907, *Cyclosa conica defoliata* Strand, 1907, *Cyclosa conica leucomelas* Strand, 1907, *Cyclosa conica pyrenaica* Strand, 1907, *Cyclosa conica dimidiata* Simon, 1929, *Cyclosa conica rubricauda* Simon, 1929 and *Cyclosa conica triangulifera* Simon, 1929 = *Cyclosa conica* (Pallas, 1772) **syn. nov.**; *Dendryphantes lanipes* C.L. Koch, 1846 = *Philaeus chrysops* (Poda, 1761) **syn. nov.**; *Diplocephalus alpinus strandi* Kolosváry, 1937 = *Diplocephalus alpinus* (O. Pickard-Cambridge, 1872) **syn. nov.**; *Entelecara strandi* Kolosváry, 1934 = *Nusoncus nasutus* (Schenkel, 1925) **syn. nov.**; *Euophrys rosenhaueri* L. Koch, 1856 = *Menemerus semilimbatus* (Hahn, 1829) **syn. nov.**; *Evarcha falcata nigrofusca* (Strand, 1900) = *Evarcha falcata* (Clerck, 1757) **syn. nov.**; *Gibbaranea bituberculata strandiana* (Kolosváry, 1936) = *Gibbaranea bituberculata* (Walckenaer, 1802) **syn. nov.**; *Heliophanus auratus mediocinctus* Kulczyński, 1898 = *H. mediocinctus* Kulczyński, 1898 **stat. nov.**; *Larinioides sclopetarius jacobea* (Franganillo, 1910) = *Larinioides sclopetarius* (Clerck, 1757) **syn. conf.**; *Linyphia triangularis juniperina* Kolosváry, 1933 = *Linyphia triangularis* (Clerck, 1757) **syn. nov.**; *Myrmarachne formicaria tyrolensis* (C. L. Koch, 1846) = *Myrmarachne formicaria* (De Geer, 1778) **syn. conf.**; *Nuctenea umbratica obscura* (Franganillo, 1909) = *Nuctenea umbratica* (Clerck, 1757) **syn. nov.**; *Ozyptila strandi* Kolosváry, 1939 = *Ozyptila confluens* (C. L. Koch, 1845) **syn. nov.**; *Panamomops strandi* Kolosváry, 1934 = *Saloca diceros* (O. Pickard-Cambridge, 1871) **syn. nov.**; *Pardosa luctinosa marina* (Kolosváry, 1940) and *Pardosa luctinosa etsinensis* Schenkel, 1963 = *Pardosa luctinosa* Simon, 1876 **syn. nov.**; *Pardosa wagleri atra* (Giebel, 1869) **nomen oblitum** = *Pardosa saturatior* Simon, 1937 **syn. nov.**; *Poecilochroa hungarica* Kolosváry, 1934 = *Aphantaulax trifasciata* (O. Pickard-Cambridge, 1872) **syn. nov.**; *Philaeus albovariegatus* (Simon, 1868) = *Philaeus chrysops* (Poda, 1761) **syn. nov.**; *Philaeus superciliosus* Bertkau, 1883 = *Sandalodes superbus* (Karsch, 1878) **syn. nov.**; *Philaeus varicus* (Simon, 1868) = *Carrhotus xanthogramma* (Latreille, 1819) **syn. conf.**; *Salticus unispinus* (Franganillo, 1910) = *Pellenes nigrociliatus* (Simon, 1875) **syn. nov.**; *Sitticus manni* (Doleschall, 1852) **nomen oblitum** = *Heliophanus melinus* L. Koch, 1867 **syn. nov.**; *Sitticus sexsignatus* (Franganillo, 1910) = *Sitticus floricola* (C. L. Koch, 1837) **syn. nov.**; *Steatoda latrodectoides* (Franganillo, 1913) = *Steatoda paykulliana* (Walckenaer, 1805) **syn. nov.**; *Synema globosum clarum* Franganillo, 1913, *Synema globosum flavum* Franganillo, 1913 and *Synema globosum pulchellum* Franganillo, 1926 = *Synema globosum* (Fabricius, 1775) **syn. nov.**; *Uloborus pseudacanthus* Franganillo, 1910 = *Uloborus walckenaerius* Latreille, 1806 **syn. nov.**; *Zelotes similis hungaricus* Kolosváry, 1944 = *Zelotes similis* (Kulczyński, 1887) **syn. nov.**; *Zilla diodia embrikstrandi* Kolosváry, 1938 = *Zilla diodia* (Walckenaer, 1802) **syn. nov.**; *Zygiella x-notata chelata* (Franganillo, 1909) and *Zygiella x-notata parcechelata* (Franganillo, 1909) = *Zygiella x-notata* (Clerck, 1757) **syn. nov.**; *Teutana grossa obliterata* Franganillo, 1913 = *Steatoda grossa* (C. L. Koch, 1838) **syn. nov**.

Keywords: Araneae, doubtful species, new synonym, nomen dubium, species inquirenda

Zusammenfassung. Phantomspinnen 2: Weitere Bemerkungen zu zweifelhaften Spinnenarten aus Europa. Eine überraschende Anzahl von europäischen Spinnenarten wurde seit ihrer Erstbeschreibung nie wieder zuverlässig wiedergefunden. In den meisten Fällen handelt es sich vermutlich um Synonyme anderer Arten oder die Arten bleiben aufgrund von unzulänglichen Beschreibungen und verlorenem Typusmaterial unidentifizierbar. In diesem zweiten Teil einer Serie zu diesem Thema besprechen wir etwa 100 dieser Fälle, mit einem besonderen Augenmerk auf Arten, die zu Beginn des 20. Jahrhunderts von Pelegrín Franganillo Balboa und Gabor von Kolosváry beschrieben wurden. Ebenso werden einige Springspinnenarten und diverse andere Einzelfälle behandelt. In den meisten Fällen erwiesen sich die untersuchten Arten als unidentifizierbare **nomina dubia**, aber auch einige neue Synonymien konnten festgestellt werden.

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This is the second contribution in a series of publications trying to establish the identity of spider species and subspecies that have been described from Europe, but have never been reliably rediscovered after their initial description. These species are still included in checklists and databases, but many of them are either unidentifiable, due to insufficient descriptions and lost type material, or turn out to be synonymous with common species. Here, as in the case of the first paper (Breitling et al. 2015), we focus mainly on species for which the type material is in all probability lost. In particular, we analyse the work of two arachnologists active in the early 20th century,

who seem to have made a particularly noticeable contribution to the creation of European "phantom spiders", Pelegrín Franganillo Balboa and Gabor von Kolosváry. We also include a discussion of a number of dubious species of jumping spiders, as in this family habitus characters are often diagnostic and it seemed possible that a confident identification could sometimes be achieved even in the absence of genitalic illustrations or type material. In addition, we discuss a number of species from various other families that were encountered during our analysis of the Franganillo and Kolosváry phantoms. For many of the species discussed, we provide a concise summary of the original description, emphasizing potentially diagnostic characters. Literal translations are indicated by quotation marks, and in cases where the original text seemed to be potentially ambiguous or obscure a direct quote is also provided for reference. The nomenclature follows the World Spider Catalog (2016), unless indicated otherwise.

Dubious species described by Franganillo

The Spanish Jesuit padre Pelegrín Franganillo Balboa (1873–1955) published extensively on the arachnid fauna of the Iberian Peninsula from 1909 to 1926, describing numerous new species and forms. After relocating to Cuba in 1918, he also contributed a considerable number of descriptions of new species from this island. Many of the taxa established by Franganillo have long been considered dubious, given that the descriptions are either extremely brief or focus on non-informative or highly variable characters and are rarely illustrated. According to Brignoli (1983), Franganillo's "papers are amongst the worst published since 1870", and to make matters worse, a large part of his collections has been lost or has been inaccessible for many years. Some of Franganillo's Cuban material is presently kept (without identification or collection data labels) in the Instituto de Ecología y Sistematica, La Habana, Cuba (Huber & Pérez González 1998), and part of the collection of Iberian arachnids, including potential type material of several species, was re-discovered in Spain in a considerably damaged state in the early 1970s and is currently housed in the University of Oviedo. A reconstructed catalogue of the latter collection and a revision of the araneid material have been prepared by Lastra (1974, 1975). In this work, Lastra (1974) tried to reconstruct the lost original catalogue of the collection, making an attempt to match the remaining specimens to the species described by Franganillo. It is not clear if this attempt was successful in each case, as Franganillo usually only used numbered labels (Franganillo 1917), adding some uncertainty to any identification even where supposed type material could be examined. In the cases discussed here, unless stated otherwise, the type material is not listed in the catalogue and is considered lost. Even some of the specimens still present when Lastra's catalogue was prepared have not been found again more recently when the material was examined by EM and JAB, and the collection is in need of re-curation. Details on Franganillo's biography are provided by Bonnet (1945) and Perez-Lerena (2001).

Aculepeira carbonaria fulva (Franganillo, 1913) =
nomen dubium (Araneidae)
Franganillo is the only author ever to have reported *Aculepeira carbonaria* from Spain, usually from coastal localities quite

atypical for the species, which is usually found in alpine block-fields ("Blockhalden") (Thaler 1991). It seems likely that his specimens belonged to an *Aculepeira* species, especially as the description of *Epeira triangulata* (= *Neoscona adianta*) compares the pattern of the latter to that of "*A. carbonaria*" sensu Franganillo. However, the short description does not allow an unequivocal identification ("Beige-brown integument; six yellow half-moon-shaped spots (or spots arranged in a half-moon shape?) below the spinnerets [seis manchas amarillas en forma de media luna debajo de las hileras]; found in the mountains together with its blackish egg sacs, around the 20th June"). Both *A. ceropegia* and *A. armida* are missing among Franganillo's records and could be the intended species.

Alopecosa albofasciata rufa (Franganillo, 1918) =
nomen dubium (Lycosidae)
The description of this variant (as *Lycosa albofasciata* var. *rufa*) is extremely short and does not clearly state the diagnostic character(s) that would distinguish it from the nominate form. The animal had red coxae (hence probably the name), and dark, almost bald chelicerae, with a few whitish hairs, but this seems quite normal for typical *L. albofasciata*. With an opisthosoma length of 9 mm (width 5 mm) the described specimen would seem to have been a rather large female of this common species from the Iberian Peninsula. However, as the females of *A. albofasciata* are not as easy to distinguish from other members of *Alopecosa* as the males, it is not sufficiently certain that the specimen indeed belonged to this species.

Alopecosa trabalis albica (Franganillo, 1913) =
nomen dubium (Lycosidae)
The prosoma of this form, from the foothills of the mountains around Gijón, is described as being similar to that of *Lycosa alba* (a nomen dubium, described in the same publication), i.e. it probably had three longitudinal bands of white hairs. The prosoma length of the female specimen described was 5 mm, the fourth pair of legs 19 mm. According to the description, the chelicerae were reddish-brown, with white hairs in particular at the base, the sternum was light beige-brown with white hairs, the epigyne was like that of Simon's *Lycosa pastoralis* (= *Alopecosa alpicola*). As the epigyne of *Alopecosa trabalis* is quite different from that of *A. alpicola*, and as there are multiple species in this genus that could possibly match the vague description, it seems impossible to decide on an unambiguous identification in the absence of type material. The amount of detail is so insufficient that even the generic placement remains uncertain, and new material from the type locality would not help resolving the identity of this taxon.

Araneus angulatus afolius (Franganillo, 1909) =
Araneus angulatus Clerck, 1757 **syn. nov. (Araneidae)**
This variety was characterized only by the lack of a folium and an entirely brown opisthosoma. This would seem to be covered by the wide diversity of colouration in this species. Given that Franganillo tended to over-split his taxa and the absence of any white markings on the opisthosoma, it seems far more likely that this was indeed a variant of *A. angulatus* rather than belonging to another species, even though the large orb-weavers can sometimes be rather difficult to distinguish.

Araneus angulatus castaneus (Franganillo, 1909) =
Araneus pallidus (Olivier, 1789) **syn. nov. (Araneidae)**
This variety was characterized by Franganillo as having brown legs, with dark rings at the end of the femora and an abdomen that is almost as wide as long ("Todo el octópodo es castaño; en las estremidades de los fémures anillos oscuros. Abdomen casi tan ancho como largo."). The supposed type series (3 females and 1 male) is still extant in Franganillo's collection, and the examination of this material by EM surprisingly showed that they are actually *Araneus pallidus,* a species that is not easily confused with *A. angulatus.* However, there is evidence that this is indeed what had happened, when Franganillo described this form in his very first publication on spider taxonomy: when he revisited the case in 1913, he corrected the specific assignment and listed *castanea* as a variety of *Epeira cruciata* (Walckenaer, 1802), rather than of *Epeira angulata,* emphasizing that it lacked any trace of a cross ("sin rastro alguno de cruz"). As Franganillo consistently used *E. cruciata* as the name for specimens belonging to *Araneus pallidus* (Olivier, 1789), as shown by the examples of the varieties *pallida* and *fusca* discussed below, the synonymy seems justified.

Araneus angulatus levifolius (Franganillo, 1909) =
Araneus angulatus Clerck, 1757 **syn. nov. (Araneidae)**
This variety was described as having a folium of the same shape as *nitidifolius,* but indicated only by a brown line, the interior being of the same colour as the rest of the opisthosoma. This falls well within the range of variation seen in this species.

Araneus angulatus niger (Franganillo, 1918) =
Araneus angulatus Clerck, 1757, **syn. nov. (Araneidae)**
This specimen from the Selva de Oza, near Huesca in northern Spain was characterized by its entirely black body, the folium only indicated by a line of white hairs, the legs with brownish-white annuli. *Araneus angulatus* seems sufficiently distinct from any other species to assume that this was indeed a very dark individual of the nominate form, which is common around Huesca (Morano et al. 2014).

Araneus angulatus nitidifolius (Franganillo, 1909) =
Araneus angulatus Clerck, 1757 **syn. nov. (Araneidae)**
Franganillo described this as the typical form of the species in Spain ("el tipo de la *E. angulata* de este país"). There is no indication that he intended to distinguish it from the nominate form. The rather detailed description matches this species very well.

Araneus angulatus pallidus (Franganillo, 1909), *Araneus angulatus crucinceptus* (Franganillo, 1909), *Araneus angulatus fuscus* (Franganillo, 1909), *Araneus angulatus iberoi* (Franganillo, 1909) = *Araneus pallidus* (Olivier, 1789) **syn. nov. (Araneidae)**
The forms *pallida, fusca, iberoi* and *crucincepta* were described by Franganillo as varieties of *Epeira cruciata* Walckenaer, 1802, which was synonymized with *Araneus angulatus* by Simon (1929). They differ only in details of their colour and pattern, but the descriptions of the latter three varieties all state that the majority of the characters correspond to those described in detail for *E. c. pallida.* The type material of *pallida* (3 females and 2 males) and of *fusca* (6 females) is still available in Franganillo's collection, and was examined by EM. To-

gether with the description it allows a confident identification as *Araneus pallidus,* a species well-known for its diversity of colour and pattern (Grasshoff 1968). The description clearly states that the pattern of *E. c. pallidus* forms a cross exactly as in *Araneus diadematus* ("Folium crucem formans, omnino ut apud *E. diadema*"), and that the "clavus" (i.e. scapus) of the epigyne is much shorter than in *Araneus angulatus.* Most importantly, as the illustrations of the type material in Lastra (1974) show, there is an extreme sexual size dimorphism (female total length 13 mm; male 5 mm); a specific feature of *Araneus pallidus* (Grasshoff 1964, 1968), which allows an unambiguous discrimination from *A. diadematus* and related species. The different varieties correspond well to typically observed forms of the species (*fusca* being a dark variety that is otherwise patterned as in *pallidus; crucincepta* a variety where only the upper part of the cross-like pattern is present and consists of [about] three white spots arranged in a trefoil pattern; and *iberoi* a light variety in which all trace of the pattern is absent). In light of this evidence, we consider all four varieties as synonyms of *A. pallidus,* despite the fact that some of the types have been lost, and in the remaining cases the supposed type series contain a mix of species (in the case of *fuscus,* there is not only a vial with six females of *A. pallidus,* but also a vial with a male *Argiope bruennichi* and a female *Aculepeira ceropegia,* and another one with a female *A. ceropegia* only; in the case of *pallidus,* the three females seem to belong to *A. diadematus*).

Araneus angulatus serifolius (Franganillo, 1909) =
nomen dubium (Araneidae)
This form was described together with numerous other varieties of *A. angulatus,* and its legs were described as being patterned as in *levifolius,* the folium like in *nitidifolius.* However, its most striking features according to Franganillo are two yellow lines, a broad transverse one below the shoulder humps, and a second narrow longitudinal one that cuts the first one in half, forming a Greek cross (i.e., a cross with arms of equal length). This does not clearly match any of the forms in the known range of variation of *A. angulatus,* and as there are other similar *Araneus* species in the area, this name is considered a nomen dubium.

Araneus marmoreus trapezius (Franganillo, 1913) =
nomen dubium (Araneidae)
This form supposedly differs from typical *A. marmoreus* by males and females having a trapezoid pattern of four white or whitish-yellow dots in the anterior part of the folium. While this could be within the range of interindividual variation of this polymorphic species, these details do not exclude the possibility that this description refers to one of the colour varieties of *Araneus quadratus* Clerck, 1757.

Araneus sericinus (Roewer, 1942) =
Aculepeira armida (Audouin, 1826) **syn. nov. (Araneidae)**
This species was first described as *Epeira sericea* by Franganillo (1918) (preoccupied by *Epeira sericea* Latreille, 1806 = *Argiope lobata* (Pallas, 1772)), from the dry grasslands around Huesco, and was considered by Franganillo as being very close to *Aculepeira armida.* It had the same pattern as the latter, but was described as differing in its colour, the central band being white, with another, dark band around its margin and con-

taining a yellow-brown oval in the centre. The tibiae of the first three legs carried a dark ring in the middle. The epigyne was shaped quite similar to the upper lip of the spider orchid *Ophrys arachnites* (*O. fuciflora/O. holoserica*), as would be expected in an *A. armida* in which the scapus is raised and probably torn off (see Levi 1977: fig. 209). As the description of this form, especially in the supposedly diagnostic colour characters, perfectly matches typical *A. armida*, but none of the other species of the genus, the synonymy seems justified.

Arctosa brevialva (Franganillo, 1913) =
Arctosa villica (Lucas, 1846) **syn. nov. (Lycosidae)**
This species, living in meadows, was described as medium-sized (female prosoma 5.5 mm, opisthosoma 5.6 mm, leg IV 18 mm). The opisthosoma was dark brown above, with a light line in the middle of the first half. The venter was brown with a dark isosceles triangle in the middle. The epigyne formed two depressions separated by a cutaneous septum. The description states that this species is not Simon's *Lycosa subfasciata* (= *Arctosa fulvolineata*). A damaged specimen putatively assigned to this species is still extant in Franganillo's collection (Lastra 1974) and upon examination was found to be *Arctosa villica* (Lucas, 1846). As this is in good agreement with the original description, the synonymy seems justified.

Arctosa cinerea (Franganillo, 1913)
[nec *Arctosa cinerea* (Fabricius, 1777)] =
Arctosa perita (Latreille, 1799) **syn. nov. (Lycosidae)**
This new species was established as *Lycosa cinerea*, using a preoccupied name and a very limited description. It is clearly a different species than the *Arctosa cinerea* of Fabricius. It was described as a tiny and colourful form similar to *Arctosa perita* ("Se parece á la *Lycosa perita* Latr.; pero no es como élla. […] Es pequeñita y pintorroteada"). The only other descriptive details are the statement of the relative length of the legs ("Patas 4, 1, 2, 3.") and the comment that the species occurs on the sands of the Piles river estuary close to Gijón. Material of *Lycosa cinerea* is apparently still extant in Franganillo's collection. Three specimens are illustrated in Lastra's (1974) catalogue, ranging in size from 7 to 9 mm. The material currently labeled as *A. cinerea* in the collection belongs to *Arctosa perita* (Latreille, 1799) – given that this agrees well with the habitat and the original description, we consider the synonymy to be justified.

Arctosa cinerea obscura (Franganillo, 1913) =
nomen dubium (Lycosidae)
This taxon from the banks of the river Piles was described in rather more detail than the previous one, and while Franganillo considered it a mere variety of *Lycosa cinerea* sensu Franganillo, he also stated that the differences between the two could appear quite large ("La diferencia entre esta especie [*Lycosa cinerea*] y la variedad que á continuación voy á describir [*L. c. obscura*], aunque parece muy grande, no por eso constituye dos distintas naturalezas."). He did not explain, however, which of the specific characters would be diagnostic, and one can only assume that the species was darker and possibly larger (the male prosoma being 5.5 mm long, the opisthosoma 6 mm, the first leg 20 mm; which would not seem to be "pequeñita"). In all probability, this is indeed a second species of *Arctosa*, not a variety or subspecies. The description refers to a dark brown

prosoma, with black spots and white hairs, the femora and patellae were whitish below, and whitish with small black stripes ("comillas negras") above. The pedipalps were also whitish, except the tarsi, which were dark brown at the base and bulb, dark at the tip. The opisthosoma of the male was dark, that of the female light below, dark above, with dark brown regions ("regiones leonado oscuras") and black and white spots. While this description and the river bank habitat conform to the general features of various *Arctosa* species, including the common *Arctosa variana* (C. L. Koch, 1847), it does not allow a confident identification.

Cyclosa conica zamezai Franganillo, 1909 =
nomen dubium (Araneidae)
The description of this variety does not specify the diagnostic characters which supposedly distinguish it from the nominate form. However, considering the diversity of the genus *Cyclosa* in the Iberian Peninsula, it seems impossible to assign this form to *C. conica* with confidence. In particular, no aspect of the description seems to allow the exclusion of *C. algerica* Simon, 1885, which is similarly common and variable, with any confidence, and the description even includes an obscure reference to *Nemoscolus laurae* (Simon, 1868) for comparison. Without type material, the name remains a nomen dubium.

Eresus robustus Franganillo, 1918 =
species inquirenda (Eresidae)
This species was described based on female specimens found under stones and in crevices on Monte Leire, Navarra, Spain. According to the description, the specimens reached a length of 22 mm, the width of the opisthosoma was 10 mm. The thoracic area and the front of the chelicerae was pale red, the opisthosoma dark grey. The leg joints were marked with light rings. The upper part of the first two tibiae was marked by a yellowish longitudinal line, sometimes two. The cribellum was divided into two parts by a transverse gap. The description of the prosomal colouration is similar to that of, e.g., *Eresus ruficapillus* C. L. Koch, 1846 or *E. moravicus* Rezác, 2008. This excludes *E. kollari*, the most common *Eresus* species from Spain according to Morano et al. (2014), but it is quite possible that Franganillo's name refers to the unknown female of either *Eresus solitarius* Simon, 1873 or *Eresus sedilloti* Simon, 1881. Given the importance of prosomal colouration for the identification of female *Eresus* specimens (at least within defined geographical ranges; Řezáč et al. 2008), it seems likely that this species can be confidently identified based on Franganillo's description, once the genus has been revised for the Iberian Peninsula and females of the other two species have been found and described. For the time being, we consider *Eresus robustus* not a *nomen dubium*, but a species inquirenda; a potentially valid species awaiting rediscovery, which should be identifiable once new comparative material becomes available.

Hogna radiata clara (Franganillo, 1913) =
nomen dubium (Lycosidae)
This form was described as being slightly lighter coloured in the female than the typical *Hogna radiata*, with a black colouration of the ventral side of the opisthosoma, forming an isosceles triangle the base of which touches the epigyne, while the rest of the venter, the sternum and legs are dark brown

("Abdomen algo más claro que el de la *L. radiata* común. Vientre negro; pero formando este color un triángulo isósceles, cuya base toca con el epigino. Epigastro, plastra y ancas leonado-oscuras."). The prosoma was 7 mm in length, the opisthosoma 10 mm. Two female specimens, possibly including the type material, are listed in the catalogue of the Franganillo's collection (Lastra 1974), but have not been found. A male labelled as belonging to this species (which cannot be part of the type series that only included females) was identified as belonging to *Hogna radiata* (Latreille, 1817). It is likely that *clara* is just an infrasubspecific form of *H. radiata*, but in the absence of confidently assigned type material, a reliable identification is not possible.

Larinioides sclopetarius jacobea (Franganillo, 1910) =
Larinioides sclopetarius (Clerck, 1757)
syn. conf. (Bonnet 1955: 596) **(Araneidae)**
Despite being one of the most extensively characterized of Franganillo's taxa, this name was not included in Roewer's catalogue (1942: p. 801-802), where *Aranea ovigera* Panzer, 1804 was regarded as the valid name for *L. sclopetarius*, and Franganillo's taxon is therefore also not listed in the World Spider Catalog (2016). But Bonnet (1955: p 596) already listed *jacobea* as a synonym of the nominate form (sub *Araneus sericatus* = *Larinioides sclopetarius*), as he routinely did for the majority of subspecies described at the time. This assessment is confirmed here. The original description only considers *jacobea* a variety of *L. sclopetarius* and does not specify any diagnostic characters. The description of the material also contains no indication that this might be a different species. The unusually lengthy description of the epigyne is unfortunately too obscure to provide much further information. The Franganillo collection contains material of *L. sclopetarius*, but it is not clear if this belongs to the new variety or the typical form.

Lycosa clarissa Roewer, 1951 = **nomen dubium (Lycosidae)**
This species was originally described by Franganillo (1918) as *Lycosa clara* (preoccupied by *Lycosa clara* L. Koch, 1877 = *Knoelle clara*), and the new name was introduced by Roewer during his preparations for the second volume of his catalogue. It was described as a light-coloured lycosid ("Tegumenta clara"), of medium size (total length 12 mm, fourth pair of legs 17 mm). The epigynal groove had chitinized lobed margins and a medium septum in an inverted T-shape ("El epigino es una fosa de bordes quitinosos y festoneados, con un saliente en el medio en forma de T invertida."). The species was found in August in Navarra, Spain. While it is likely that *L. clarissa* is a synonym of *Hogna radiata*, possibly the same form as *Hogna radiata clara* described in 1913, the description seems vague enough to match many other Spanish lycosids as well, and a confident identification seems impossible in the absence of type material.

Nuctenea umbratica nigricans (Franganillo, 1909) =
nomen dubium (Araneidae)
Lastra (1974, 1975) tentatively assigned seven male specimens in Franganillo's collection to this species. The basis for this is unclear, especially as the original description refers to females only. One of the males is still available in the collection and turned out to be *Larinioides sclopetarius* (Clerck, 1757). As the

description explicitly mentions a long and narrow "clavus" (i.e. scapus) of the epigyne, in contrast to *N. umbratica obscura*, this name cannot be referring to *Nuctenea umbratica*. The type was originally described as entirely dark, with a black opisthosoma and almost invisible folium. This would indeed be compatible with being a very dark variant of one of the *Larinioides* species, such as *L. ixobolus*, in agreement with the male specimen in the collection, but as no true type material is available, a confident identification is not possible.

Nuctenea umbratica obscura (Franganillo, 1909) =
Nuctenea umbratica (Clerck, 1757) **syn. nov. (Araneidae)**
This is almost certainly a typical *Nuctenea umbratica*; the description of the dark flattened spider, with its broad folium, black underside with two light spots, and the short, broad scapus of the epigyne, is characteristic enough. The only reason for erecting a new variety seems to have been the presence of a second form (var. *nigricans*) in the sample, which certainly belongs to a different species (see above).

Philaeus stellatus Franganillo, 1910 =
nomen dubium (Salticidae)
The description of this species is very brief ("This species is close to *Philaeus chrysops* Poda. Male: prosoma 3.5 mm, opisthosoma 3 mm. Pedipalpal femur decorated with a white fluff of hairs. Prosoma black, with two white bands at the base. In the middle between the dorsal eyes a little white spot. Opisthosoma grey with brown spots; dorsal eyes further apart from each other than from the anterior lateral eyes.") and does not allow an unambiguous identification of the species. The opisthosomal pattern does not seem to correspond to any of the known variants of male *P. chrysops*, and even the genus affiliation of the species remains unclear.

Pirata albicomaculatus Franganillo, 1913 =
nomen dubium (Lycosidae)
Supposed type material of this species (4 males, 4 females; all subadult) is present in Franganillo's collection, and two specimens are illustrated in Lastra's (1974) catalogue. However, upon examination, these specimens turned out to be *Pardosa hortensis*, which seems to contradict the original description. The original description indicated that *P. albicomaculatus* is indeed a *Pirata* species, in the broad sense ("close to *Piratula knorri*"), with 6 faintly visible transverse rows on the opisthosoma, formed by little tufts of whitish hairs. The specimens were found at the beginning of September in Laviana (close to Oviedo), on the banks of the Nalón river, among half-submerged rubble in quiet waters, where they "ran with lightning speed even on the surface of the water, carrying a little round white egg sac" ("Corrían, como una exalación, aun por la superficie del agua, llevando consigo una ooteca globulosa, blanquecina y pequeña"). In view of the uncertain status of the supposed type material, this species is here considered a nomen dubium.

Pirata subniger Franganillo, 1913 =
nomen dubium (Lycosidae)
As is the case for many of the species established by Franganillo, *Pirata subniger* was described in quite some detail, but none of the mentioned characters seems in any way diagnostic. The female had a prosoma length of 3.2 mm, an opistho-

soma of 5 mm, and the fourth pair of legs is 15 mm long. The tawny brown legs had many black rings on the femora, the sternum was dark but covered in light hairs. The opisthosoma was intensely dark, as was the prosoma, the ventral side lighter. The epigyne was a simple depression covered by the ventral hairs. These details are supplemented by generic descriptions of the eye arrangement, spinnerets and chelicerae, none of which seem to distinguish this species from *Pirata latitans*, to which it is supposedly close, nor from many other *Pirata* species. The habitat ("between the rocks of the sea, at Gíjon") even raises some doubts about the assignment to the correct genus, and Roewer (1955) considered the species as incertae sedis.

Salticus unispinus (Franganillo, 1910) =
Pellenes nigrociliatus (Simon, 1875) **syn. nov. (Salticidae)**
This species was described with some hesitation as a new species and placed in the genus *Calliethera* (= *Salticus*). The prosoma was described as "dark with four white hairy spots in the middle, and a longitudinal one between the anterior median eyes. The margin marked with a white band of hairs"; the "sternum is black with white hairs". The opisthosoma was described as having a characteristic pattern: "the upper anterior part with a white arch, from the middle of which and up to one millimeter from it emerges a white line ["e cujus centro et ad millimetrum distantiae hujus egreditur linea alba"], which extends to the spinnerets. On each side of this line there are two lines and two dots of equally white colour, which with the previously mentioned two lines form an arrow-like shape." This opisthosomal pattern matches *Pellenes nigrociliatus* very well, and the description in places reads like a literal translation from Simon's description of the latter. The unusual "four white spots" on the prosoma, in contrast to the two lines expected for *P. nigrociliatus*, can probably be explained by the wearing off of some of the white hairs.

Sitticus sexsignatus (Franganillo, 1910) =
Sitticus floricola (C. L. Koch, 1837) **syn. nov. (Salticidae)**
This species was originally described as a new species with some hesitation, placing it close to *Euophrys* and *Attus,* from which it was separated by the length of the legs ("Legs 4-1-3-2. Tibia and patella III considerably shorter than tibia and patella IV. Tibia III thicker than tibia IV at the base and in the middle; but of the same thickness towards the end."). The prosoma was described as dark, the ventral side of the opisthosoma pale, its dorsal side yellow-brown with six white dots, the two "lower" [posterior?] ones more distant and more visible, the two anterior ones in fact forming transversal lines. The species "lives in sedges in marshes; in these plants they build their egg sacs from fine silk, where they remain hidden. The egg sacs contain 40 eggs that are non-glutinous, but wrapped in a very fine web. There are usually three or four egg sacs together, protected by dry leaves". The habitus and habitat, together with the distinct egg-sac building behaviour (Bellmann 1997, 2010, Jones 1989, Prószyński 1980, Kůrka et al. 2015), allow the confident identification of this species as *Sitticus floricola*. The related *Sitticus inexpectus*, which also occurs in lowland localities, has not been reported from Spain yet, and can also be excluded because of its preference for stony or sandy habitats (Logunov & Kronestedt 1997). It is also not known to build communal egg sac aggregations in flower heads. This latter character also excludes identification as the rare *Sitticus caricis*, first reported from wetlands in Spain (Galicia) in 2012 (Morano et al. 2012). The type material (7 females and 1 male) was still available in Franganillo's collection when examined by Lastra, but could no longer be found more recently by EM.

Spiroctenus lusitanus Franganillo, 1920 =
nomen dubium (Mygalomorphae incertae sedis)
The genus *Spiroctenus* (Nemesiidae) is currently restricted to South Africa; an occurrence in Portugal would seem unlikely. According to the description, the female holotype was 15 mm in length, had a recurved fovea, tarsal claws with a single row of teeth, the lower claw well developed, save on leg IV (i.e., three claws were present). The maxillae at the base carried numerous cuspules. The spinnerets were similar to those of *Barychelus*, except that the final segment of the superior ones was missing (i.e., four spinnerets were present). Legs and prosoma were pale, the opisthosoma dark yellow-brown. As a very rare supplement to this description, Franganillo also added a sketch of the eye arrangement, which shows well separated lateral eyes, an almost straight anterior eye row, and anterior median eyes that are almost as large as the anterior lateral eyes. This combination of characters does not seem to match any of the mygalomorph species known from the region, and even a confident identification of the family to which this species belongs seems impossible at the moment.

Steatoda latrodectoides (Franganillo, 1913) = *Steatoda paykulliana* (Walckenaer, 1805) **syn. nov. (Theridiidae)**
This species, collected in the Ferreros (close to Oviedo), was first described in the genus "*Lithyfantes*" (= *Steatoda*). It is a large theridiid spider "exactly like *Latrodectus* in size and colour and even the red circles on the opisthosoma." Only the egg sacs, covered in woolly transparent silk revealing a mass of orange-pink eggs, showed that this was a different species. According to Franganillo, the species lives in holes in meadows, from which the webs reach up to two feet into the vegetation. Eggs are laid in early July, and each hole contains multiple egg sacs, in some cases up to five. It seems very likely that this is the common *Steatoda paykulliana*, the only one of the Spanish false widow spiders that regularly shows an orange-red pattern, and the species that most closely resembles the true *Latrodectus*. The habitat and description of the eggs sacs also are in agreement with this species (Bellmann 1997, Hubert 1979, Levy & Amitai 1982). Franganillo (1913) does also mention "*Lithyfantes paykulianus*" (sic!) (and "*Lithyfantes collonatus*" [sic!]) in the same article, both probably referring to different colour morphs of the same rather variable species.

Synema globosum clarum Franganillo, 1913 =
Synema globosum (Fabricius, 1775) **syn. nov. (Thomisidae)**
This variant is not a subspecies, but just part of the broad colour spectrum observed in this species. Here, all the parts of the opisthosoma that are red in the typical form are bright ("Todas las partes rojas del abdomen en la especie común, son aquí de color claro."). The type material (5 females) still exists in Franganillo's collection, and the illustration of one of them in Lastra's (1974) catalogue confirms the specific assignment.

Synema globosum flavum Franganillo, 1913 =
Synema globosum (Fabricius, 1775) **syn. nov. (Thomisidae)**
Franganillo does not describe this form, but only gives a name to a variety mentioned by Simon (1875), who states that in this form all the red parts of the type are light yellow or whitish ("Toutes les parties rouges chez le type, d'un jaune clair ou d'un blânc mat."). This is clearly a mere individual colour variant of the nominate species. Two females in Franganillo's collection are considered by Lastra (1974) as potential types of this form, but as the name was established by bibliographic reference to Simon's description, it is not clear that this is formally correct.

Synema globosum pulchellum Franganillo, 1926 =
Synema globosum (Fabricius, 1775) **syn. nov. (Thomisidae)**
The description of this form from Málaga is slightly more extensive than that of the colour variants of *Synema globosum* established by Franganillo earlier. The prosoma is described as dark red, the opisthosoma of pale golden colour with black markings: two black spots in the anterior half, next to the midline, followed by a transverse line, then a single unpaired spot, which in some specimens is followed by another small transverse line. *S. globosum* specimens with reduced spot-like black markings do occur regularly, especially among juveniles, and could easily be taken for a different species at first glance. As the habitus of the *S. globosum* is quite unique among Spanish thomisids, despite its variability in colour, it seems justified to assume that Franganillo's description refers to such pale specimens, rather than a different species.

Uloborus pseudacanthus Franganillo, 1910 =
Uloborus walckenaerius Latreille, 1806 **syn. nov. (Uloboridae)**
Franganillo listed three characters in which his new species was supposed to differ from *U. walckenaerius*: a) the eyes, b) the length of the calamistrum, c) tibiae I and II. However, the description of the eyes (anterior eyes in an almost straight line, the lateral ones smaller; posterior eyes in a procurved line, the median ones more distant from each other than from the lateral ones; the median area narrower in the front than in the back) matches *U. walckenaerius* very well, and so does the description of the calamistrum (well developed on metatarsus IV, occupying only half of the length of the upper part, which incidentally excludes *Polenecia* as a possible candidate). Tibiae I and II are described as carrying a very prominent single spine in the middle of the upper part ("In superiori parte tibiae I et II ad dimidium unica spina valde visibilis"). It is not quite clear what this statement could refer to, but it seems hardly sufficient evidence to suggest that the species differs from the widespread and common *U. walckenaerius* (and it seems to exclude *U. plumipes*). The type material was still existing in Franganillo's collection when it was rediscovered (one intact male, one specimen separated into prosoma and opisthosoma, and one body without legs, according to Lastra 1974), but could no longer be found by EM more recently.

Zygiella x-notata chelata (Franganillo, 1909) =
Zygiella x-notata (Clerck, 1757) **syn. nov. (Araneidae)**
There is no doubt that this is just a typical *Zygiella x-notata*. This is not only by far the most common species of the genus in the Iberian peninsula, but also the only one that clearly matches the description of the epigyne as being without a scapus, transverse, black and sufficiently visible ("Epigynum feminae sine clavo; scapus transversus, niger et sat visibilis."). The description is preceded by a description of the habits of the species in the genus (including the typical empty sector of the web), so Franganillo's identification can probably be relied on in this case. The description suggests that Franganillo did not intend to distinguish *chelata* from the typical form of the species, but merely from the following form, *parcechelata*, from which it was supposed to differ by having a black, complex male pedipalp and chelicerae that are amply longer than the maxillae, especially in the males.

Zygiella x-notata parcechelata (Franganillo, 1909) =
Zygiella x-notata (Clerck, 1757) **syn. nov. (Araneidae)**
This form is merely the subadult male of the previous species, with the pedipalp whitish and simple, in constrast to *chelata*. The web of this specimen was entire, and a single thread led to the retreat of the spider; this is not uncommonly seen in *Zygiella x-notata*, especially in younger specimens (Witt et al. 1968).

Additional species for which type material is reported to exist in Franganillo's collection

The reconstructed catalogue of Franganillo's collection prepared by Lastra (1974) was never published in its entirety. As a result, while the survival of parts of the collection was widely known, there was considerable uncertainty about which species were potentially represented by type material. In the following section we briefly review the taxonomic status of other taxa described by Franganillo for which material seems to be present in his surviving collection in Oviedo.

Araneus triangulatus (Franganillo, 1913) = *Neoscona adianta* (Roewer 1955: 1490, Méndez 1998: 145) **(Araneidae)**
The type material (4 females, 2 males, one of them subadult; Méndez 1998) is present in the collection and illustrated in the catalogue. The illustration leaves no doubt that the identification by Roewer and Méndez is correct (and Méndez had already examined the material).

Ballus sociabilis Franganillo, 1910 = nomen dubium (Alicata & Cantarella 1988: 54) **(Salticidae)**
A single female of this species is illustrated in Lastra's (1974) catalogue. From the figure, an identification is impossible, but this material should probably be reexamined before confirming its status.

Cyrtophora citricola var. *pallida* Franganillo, 1925 =
nomen nudum
Cyrtophora citricola var. *nigra* Franganillo, 1925 =
nomen nudum
Two females of the former and one supposedly of the latter are present in the collection. However, we have been unable to find a formal description of either of these forms, which are only listed with brief locality data in Franganillo (1925, 1926). While it is very likely that the names referred to different extremes of brightness of this very variable species, they are **nomina nuda**, not nomina dubia as suggested by Roewer (1955), independent of the availability of supposed type material.

Lycosa alba var. *fulva* Franganillo, 1913 =
nomen dubium (Roewer 1955: 267) **(Lycosidae)**
A well-preserved 10 mm-long female specimen supposedly belonging to this form is present in the collection and illustrated in the catalogue. Lastra (1974) expressed doubt about whether this is really the type, as the form was described by contrasting it to typical *L. alba*, which is described in the same article based on a male. However, it is not quite clear from Franganillo's text that he had only male material of *L. alba* before him, and it would be interesting to re-examine this case. The remaining specimen belongs to *Hogna radiata* (Latreille, 1817), but considering the uncertainty of the type status of this material, the consideration as a nomen dubium as suggested by Roewer (1955) seems justified. The collection also contains several unlabelled specimens that Lastra (1974) tentatively suggests as perhaps being the type material of the typical *L. alba* Franganillo, 1913, which also are *H. radiata*.

Micrommmata virescens var. *valvulata* Franganillo, 1913 =
Micrommata virescens (Urones 2004: 48) **(Sparassidae)**
The female type (estimated total length about 7 mm) is present in the collection and illustrated in the catalogue. Urones did not examine the type, but only argued that this name was not intended as a subspecies, just a variety. It would be interesting to re-examine this material, given the diversity of this genus in the Iberian Peninsula and the surprisingly small size of the specimen (assuming that it is indeed an adult female). The original description compares the material to *Micrommata ornata* Th[orell], which might indicate that the specimen was less brightly green than *M. virescens* and could belong, e.g., to *Micrommata aragonensis* Urones, 2004.

Tetragnatha extensa var. *contigua* Franganillo, 1909 =
nomen dubium (Wunderlich 2011: 210) **(Tetragnathidae)**
Wunderlich stated that type material is probably lost, but males of this variety as well as several egg sacs seem to be present in the collection, according to Lastra's catalogue. It might be possible to identify this taxon, which may or may not be an individual variety of *T. extensa* (the description only states that the lateral eyes are contiguous, and the chelicerae a bit weaker and less spread apart; but "one should not consider this a member of *Cyrtognatha* [!]"; Franganillo 1909: 185).

Teutana grossa var. *obliterata* Franganillo, 1913 =
Steatoda grossa (C. L. Koch, 1838) **syn. nov. (Theridiidae)**
Wunderlich (2012) considered this a nomen dubium and erroneously stated that type material does not exist. The variety is described as lacking the opisthosomal pattern and living under floorboards in houses. The presumed type material (two females of about 9 mm total length) is present in the collection and illustrated in the catalogue. Considering the photos and the habitat information, there is little doubt that this is indeed just a dark individual of *Steatoda grossa* (C. L. Koch, 1838) **syn. nov.**

Theridion cellariorum Franganillo, 1917 =
nomen nudum (Theridiidae)
Three females and one egg-sac labelled by Lastra (1975) as *T. cellariorum* are present in the collection. Their examination would only be of historial interest; the name appears to be a **nomen nudum** (or a lapsus), used only without description by Franganillo (1917, 1925).

Zygiella gigans (Franganillo, 1913) =
Zygiella x-notata (Méndez, 1998: 145) **(Araneidae)**
The type, a poorly preserved 8 mm-long female, is present in the collection and illustrated in the catalogue. The material was examined by Méndez and confirmed as belonging to *Zygiella x-notata*.

Dubious species described by Kolosváry
The Hungarian biologist Gábor Kolosváry (Gabriel von Kolosváry) (1901–1968) was one of the most productive European arachnologists of the 1930s and 1940s, publishing a wide range of papers on ecological, behavioural and zoogeographic aspects of arachnology based on material from the National Museum in Hungary, as well as his own collections mostly from Hungary and neighbouring countries, and from the Adriatic region. One special area of interest for Kolosváry was the phenotypic variation of species, an aspect that is central in his first contributions to arachnology (Kolosváry 1931, 1932) and reaches its extreme in the esoteric and obscure 'Generisches System der Lebenserscheinungen' (Generic system of biological phenomena), in the Festschrift for his long-time arachnological mentor, Embrik Strand (Kolosváry 1936). This interest in variations led Kolosváry to describe numerous new spider species, many of which have never been found again. Unfortunately, the majority of his type material is lost (or was never designated), and the descriptions are often exceedingly short and lack the specification of useful diagnostic characters. In contrast to Franganillo, Kolosváry usually provided figures together with the descriptions in the text, but these are of such a highly schematic and abstracted nature that they can only rarely be used for species identification. In the cases discussed here, unless stated otherwise, the type material could not be traced in the Hungarian Natural History Museum, the successor of the National Museum, and is considered lost. Details on Kolosváry's biography are available in Bonnet (1945) and Zullo et al. (1972).

Alopecosa mariae orientalis (Kolosváry, 1934) =
Alopecosa mariae (Dahl, 1908) **syn. nov. (Lycosidae)**
This form was described by Kolosváry (1934b) as being identical in colour and pattern to the typical *A. mariae*, but supposedly differing in the epigyne. The illustration of the latter, however, shows no obvious differences and is in fact very similar to the illustration of an *A. mariae* epigyne in Buchar & Thaler (2004: fig. 5). As the type locality (Nagyenyed = Aiud, Romania) lies 200 km northwest of the type locality of *A. mariae*, in the very centre of the known distribution of the latter (Buchar & Thaler 2004) and far away from the known range of the sister species *A. striatipes*, the new synonymy seems justified.

Alopecosa reimoseri (Kolosváry, 1934) =
nomen dubium (Lycosidae)
The very superficial description in Kolosváry (1934a) ("legs annulated, ocular region black, prosoma with a larger leaf-like patch in the centre, total length 12 mm") and the schematic illustration of the epigyne do not allow a confident identification of this species. Some similarities with *Geolycosa vultuosa* (C. L. Koch, 1838) could be construed, but this seems insufficiently specific to allow an unambiguous identification.

Araneus circe strandi (Kolosváry, 1935) =
Araneus circe (Audouin, 1826) **syn. nov. (Araneidae)**
This form was introduced by Kolosváry (1935a) as a new variety (not a subspecies) of *A. circe* found on juniper trees (*Juniperus communis*) in the Hungarian plains. The text does not specify any diagnostic characters, but the legend to the habitus illustration emphasises a 'thick' white cross on the front part of the light grey opisthosoma that does not continue into the pattern of the darker, brown posterior half of the opisthosoma. This pattern is not unlike that seen in some individuals of *A. circe*, but a similar pattern also occurs in some specimens of *A. angulatus*. However, as the two species are easily distinguished based on their genitalia, which were well illustrated by Chyzer & Kulczynski (1891), it seems reasonable to accept Kolosváry's specific assignment.

Ballus lendli Kolosváry, 1934 = **nomen dubium (Salticidae)**
This species is supposedly similar to *Ballus depressus* (= *B. chalybeius* (Walckenaer, 1802)), but has a different epigyne and characteristic (but not further specified) brown marks on a white background on the opisthosoma. The total length was given as 3.5 mm. The illustration of the epigyne in Kolosváry (1934a) indeed shows some similarity to that of various *Ballus* species, perhaps closest to that of *Ballus rufipes* (Simon, 1868), but the drawing is so schematic that a reliable identification seems impossible.

Cybaeus strandi Kolosváry, 1934 =
species inquirenda (Cybaeidae)
Kolosváry (1934b: 43, fig. 7; see Fig. 1) described this species from Tordaszentlászló (= Săvădisla, Romania) very briefly: prosoma and opisthosoma each 4 mm long; prosoma, legs and pedipalp yellowish; pedipalp long; opisthosoma light grey below, dark grey above. He illustrated the opisthosomal pattern and cleared epigyne, stating that the latter differs from the typical form seen in *Cybaeus*. We have not been able to match the rather distinct drawing of the epigyne to any known species, neither in the Cybaeidae, nor in any of the possibly related families, and it does not seem to be abnormally formed. The closest similarity seems to be seen in some *Amaurobius* species. Instead of declaring *C. strandi* a nomen dubium, we therefore consider this species as a species inquirenda, a po-

Fig. 1: Illustration of the opisthosomal pattern (a) and epigyne (b) of *Cybaeus strandi* from the first description of the species (Kolosváry 1934b: fig. 7)

tentially valid species awaiting rediscovery, which should be easily identifiable based on the information provided by Kolosváry once new material is found.

Cyclosa baloghi Kolosváry, 1934 =
nomen dubium (Araneidae)
Cyclosa strandi Kolosváry, 1934 =
nomen dubium (Araneidae)
These two species were described very superficially in Kolosváry (1934a), based on material collected almost 50 years earlier. The schematic illustrations of the epigynes confirm the generic placement, but do not allow a confident identification of the species. The closest similarity in both cases seems to be to the epigyne of *C. conica*, seen from different angles, but it would seem too drastic to suggest that Kolosváry did not recognize this species correctly. A further record of *C. baloghi* is mentioned by Kolosváry (1938b) from Jasenak, Croatia.

Diplocephalus alpinus strandi Kolosváry, 1937 =
Diplocephalus alpinus (O. Pickard-Cambridge, 1872)
syn. nov. (Linyphiidae)
D. a. strandi was described as a new variety of *D. alpinus* (sub *D. annectens*, lapsus for *D. connectens*) from Hadad (= Hodod, Romania), based on a stronger tibial apophysis of the pedipalp, smaller posterior median eyes, and, in particular, a smaller cephalic pit than the nominate form. As there is no indication of a vicariant distribution, there is no reason to assume that these subtle differences represent more than individual intraspecific variation, or perhaps just an artefact due to slight differences in illumination or viewing angle. We therefore consider *D. a. strandi* as at most an individual infrasubspecific variant, rather than a subspecies in the modern sense.

Entelecara strandi Kolosváry, 1934 =
*Nusoncus nasutus* (Schenkel, 1925) **syn. nov. (Linyphiidae)**
The description of this species in Kolosváry (1934a) is concise to the extreme ("total length 1.5 mm; uniformly grey"), but the illustrations of the epigyne in lateral view and of the cleared epigyne in ventral view are sufficiently characteristic in this case to allow identification of the species. The type locality (Kõrmõcbánya = Kremnica, Slovakia) lies within the known distribution range of *Nusoncus nasutus*, and the forested mountains around the town offer plenty of suitable habitat. The collection date on 25 May 1933 also is in agreement with the known phenology of the species.

Erigone strandi Kolosváry, 1934 =
nomen dubium (Linyphiidae)
According to Kolosváry (1934a), this species is very similar in its epigyne to *Erigone longipalpis* (Sundevall, 1830), but the illustrations provided, showing both the dry and the wet (cleared) epigyne, have no similarity to the corresponding structures in *E. longipalpis*, nor to any other *Erigone* species. The identity of the species seems entirely uncertain.

Euophrys mottli Kolosváry, 1934 =
nomen dubium (Salticidae)
This species, described on the basis of a single immature individual collected almost 50 years earlier, was placed by Kolosváry (1934a) in the *Euophrys difficilis–frontalis* group, from
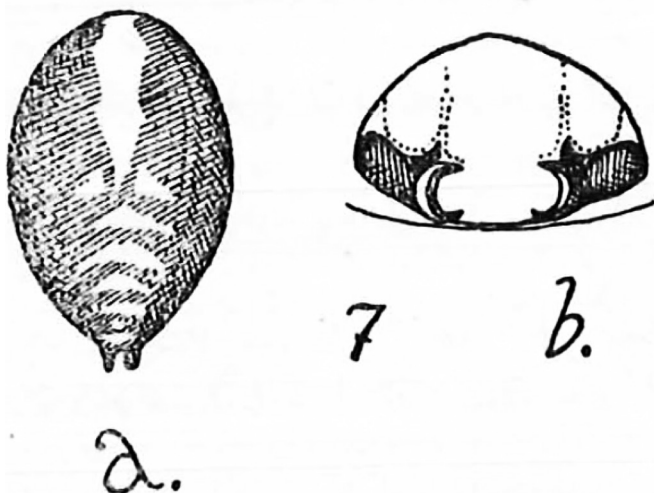
which it was distinguished by having three distinct spines at the anterior margin of the opisthosoma, which were also illustrated. While the illustration by Kolosváry is certainly exaggerated, three prominent setae can sometimes be seen at the front of the opisthosoma in *Euophrys* (see, for example, fig. 463 of a male *E. frontalis* in Zhang & Maddison 2015). However, the complete lack of any further informative details in the description precludes a confident identification at the species level in this case.

Gibbaranea bituberculata strandiana (Kolosváry, 1936) =
Gibbaranea bituberculata (Walckenaer, 1802)
syn. nov. (Araneidae)
This form was described as a new variety of *G. bituberculata* (sub *G. dromaderia* [sic!]), based on its aberrant opisthosomal pattern, which "represents a manifestation of mutant character and also a new variety". There is no further description of the species, except a brief statement that this form is "smaller", and it is not clear which specific features Kolosváry considered to be aberrant, but the illustration of the habitus seems to fall well within the range of intraspecific variation of *G. bituberculata*.

Gongylidium gebhardti Kolosváry, 1934 =
nomen dubium (Linyphiidae)
The description provided for this species by Kolosváry (1934a) is extremely brief: "Male; total length 1 mm; uniformly grey". The accompanying figure of the pedipalp in ventral view is very schematic and seems to show no distinctive characters. An identification, even at the genus level, seems impossible.

Lepthyphantes pannonicus Kolosváry, 1935 =
nomen dubium (Linyphiidae)
This species was described by Kolosváry (1935b) based on a single female specimen without collection data, but assumed to be certainly collected in the area of historical Hungary. The animal was 3 mm long, uniformly grey, with a lighter prosoma and yellowish-light grey legs, pedipalps and chelicera. The description states that the typical *Lepthyphantes* epigyne of the specimen determines its generic affinity without doubt. The illustrations of the epigyne in ventral and lateral view confirm that the species could indeed belong to *Lepthyphantes* s. lat., but is impossible to reconcile with the structure seen in any of the known species of this group and in any case seems too schematic for a confident identification.

Linyphia triangularis juniperina Kolosváry, 1933 =
Linyphia triangularis (Clerck, 1757) **syn. nov. (Linyphiidae)**
This subspecies was described as *Linyphia pinnata* var. *juniperina* in an article on the ecology of the sandy juniper heaths of Hungary, where it was found together with the dominant *Linyphia triangularis*. The "description" consists of a schematic drawing of the epigyne, comparing it to illustrations of the epigyne of *L. tenuipalpis* and *L. triangularis* by Bösenberg (who erroneously considered them genitalically distinct variants of a single species; Kulczyński 1913a), together with a brief remark that "the central area [of the epigyne] is larger than in normal specimens. This variety has a broader red abdominal median stripe than normal animals". Considering the habitat at the type locality, it seems not impossible that Kolosváry's sample contained both *L. tenuipalpis* and *L. tri-

angularis, but the "new variant" would in that case match the latter. It seems, therefore, justified to synonymize *Linyphia triangularis juniperina* with the nominate form.

Nemesia pannonica budensis Kolosváry, 1939 =
Nemesia budensis Kolosváry, 1939 **stat. nov. (Nemesiidae)**
Nemesia pannonica coheni Fuhn & Polenec, 1967 =
Nemesia coheni Fuhn & Polenec, 1967 **stat. nov. (Nemesiidae)**
Nemesia pannonica budensis was first described by Kolosváry (1939a) based on two males collected by Imre Loksa from the Ofner-Gebirge (= Buda Hills), specifically from the Testvérhegy, now covered by a suburb of Budapest. He considered it a northern subspecies of *Nemesia pannonica*, distinguishing it from the typical form and the subspecies *N. p. adriatica* by having "five thoracic spines in rows, radial wrinkling on the prosoma, five spines on the tibia of the pedipalp, and six spines on the tarsus of the pedipalp … body generally lighter than in *N. pannonica* f. *adriatica*". This form differs from the other species discussed here, in that it was found again later, also by other authors. The female was described from the same location (Kolosváry 1939b), again based on material collected by Loksa, then still a 16-year old student. Twenty-five years later, Loksa (1966) summarized his accumulated knowledge on *N. pannonica* in a detailed analysis of the intraspecific patterns of variation in numerous character systems, concluding that the species is monotypic and forms no subspecies, but at most local varieties that are difficult to characterize. A subsequent study by Fuhn & Polenec (1967) came to a different conclusion. While they agree that the characters used by Kolosváry do not allow a reliable separation of the different forms, Fuhn & Polenec did observe geographically consistent allopatric variation in other characters, which supposedly separates the Adriatic populations from those of central Hungary. Most important are differences in the shape of the embolus and the number of prolateral spines on various leg articles. Given the extent of these differences, the poor dispersal ability of *Nemesia* species, and the resulting pattern of small-scale speciation seen in other parts of the range of the genus (Decae 2012), the provisional (!) phylogenetic hypothesis of Fuhn & Polenec (1967) is probably best expressed by raising *N. p. budensis*, as well as the related eastern subspecies *N. p. coheni*, to species rank, consistent with the approach applied in the rest of the genus. The confirmation that these are indeed genetically isolated and independently evolving populations will require a new analysis based on male and female material from the entire range of the species (Fuhn & Polenec only examined a single male of *N. budensis*), and such a study would preferably include morphological as well as molecular characterization.

Ozyptila strandi Kolosváry, 1939 =
Ozyptila confluens (C. L. Koch, 1845) **syn. nov. (Thomisidae)**
This species was first described by Kolosváry (1939b: 174, fig. 2) from Split, Croatia, apparently based on a single specimen, although another record from Dalmatia was mentioned in Kolosváry (1938b). Its thick and broad epigynal scapus was considered unique in the genus *Ozyptila*, while the presence of a small, short, thick spine on femur I was considered as an indication of some affinity with *Ozyptila atomaria* (Panzer, 1801) (sub *O. horticola*). The cephalothorax length is given as

Fig. 2: Illustration of the epigyne of *Ozyptila strandi* from the original description of the species (a; Kolosváry 1939b: fig. 2), and epigyne (b) and habitus (c) of a specimen of *Ozyptila confluens* in the collection of the Hungarian Natural History Museum identified as *O. strandi* by Kolosváry; scale bars: b = 0.2 mm, c = 2 mm

2.5 mm, the opisthosoma is very light, with fine brown dots. The entire body is covered in spatulate hairs, interspersed with small, fine normal hairs. The prosoma is somewhat darker, the legs robust and the femora with 1.1 spines. The type material of this species could no longer be found in the collection of the Hungarian Natural History Museum in Budapest, but a specimen collected by Kálmán Szombathy in Zelenika (Montenegro) and labelled as "*Oxyptila strandi* Kolosváry" is present there (HNMH Araneae-5899). The handwriting on the determination label, and especially several characteristic details of the author name compared to Kolosváry's signature in Zullo et al. (1972), show that this specimen was identified by Kolosváry himself. Its examination showed that it clearly belongs to *Ozyptila confluens*, a widespread species of Southern Europe (Demircan & Topçu 2015, Komnenov 2014, Lecigne 2016) originally described from Greece. The unique broad and hairy scapus of the epigyne of this species is also quite notable in the illustration accompanying the original description, justifying the synonymy (**Fig. 2**).

Panamomops strandi Kolosváry, 1934 = *Saloca diceros* (O. Pickard-Cambridge, 1871) **syn. nov. (Linyphiidae)**
This species, in contrast to most of the other species described in Kolosváry (1934a), can be identified with confidence. The distinct prosomal modifications, as well as the colouration of the eye region, which Kolosváry considered diagnostic (Kolosváry 1934a: 15, fig. 11a-11d), are specific for *Saloca diceros* (O. Pickard-Cambridge, 1871) (**Fig. 3**). The shape of the tibial apophysis confirms this identification. At the same time, this case highlights the extremely schematic nature of Kolosváry's illustrations: even when the identity of the species is known, it is all but impossible to match the structures of the illustrated pedipalp to the structures known in *S. diceros*. This also emphasizes the need for particular caution when trying to identify Kolosváry's species based on details of the illustrations, which may in fact be mere artefacts of his artistic style.

Pardosa kratochvili (Kolosváry, 1934) =
nomen dubium (Lycosidae)
Although the description of this species by Kolosváry (1934a) is very generic ("Legs annulated; prosoma with a broad longitudinal line; sternum black; coxae light; venter light yellow; total length 9 mm"), the illustrations of the wet and dry epigyne suggest that the description refers to a species close to *Pardosa proxima* (C. L. Koch, 1847). However, the schematic nature of the illustrations, as well as the existence of a morphologically indistinguishable sister species of unclear distribution (*Pardosa vlijmi* den Hollander & Dijkstra, 1974), preclude a confident identification at the species level.
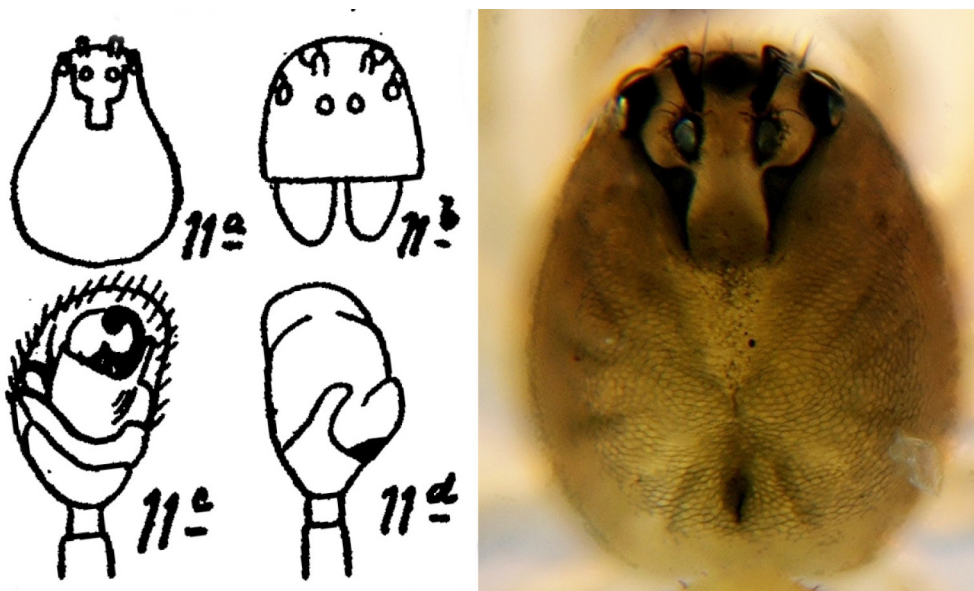
Fig. 3: Kolosváry's (1934a: fig. 11a–11d; left) illustrations of *Panamomops strandi* from Kozárovce (Hungarian: Garamkovácsi) and the prosoma of a *Saloca diceros* male from the Bükk mountains, Hungary (right) (photo Walter Pflieger).

Pardosa luctinosa marina (Kolosváry, 1940) =
Pardosa luctinosa Simon, 1876 **syn. nov. (Lycosidae)**
Pardosa luctinosa etsinensis Schenkel, 1963 =
Pardosa luctinosa Simon, 1876 **syn. nov. (Lycosidae)**
Kolosváry described *Pardosa luctinosa marina* as a new subspecies of the halophilous *Pardosa entzi* (Chyzer, 1891), a species known at that time from Transsylvania (Romania) and Triest (Italy). He argued that the occurrence of his specimens in salt marshes widely separated from the salt lakes of the type locality in Transsylvania supported the idea that they constituted a geographically and genetically isolated subspecies, characterized by subtle differences in the structure of the epigyne. The illustrations, however, both in the original description and in Kolosváry (1942), indicate that the supposed differences fall well within the intraspecific variability of the species, and since Tongiorgi (1964) synonymized *P. entzi* with *P. luctinosa*, a widespread species found in saline locations from Spain to western China, the zoogeographic argument for genetic isolation no longer holds. The easternmost populations of *P. luctinosa* were for some time considered a separate subspecies, *P. l. etsinensis* Schenkel, 1963, for example by Yin et al. (1997). However, this form, described on the basis of specimens from the Chinese province of Gansu (not Inner Mongolia, as stated in the original description), falls within the continuous spectrum of intraspecific variation of *P. luctinosa* just like *P. l. marina* and *P. taxkorgan* Song & Haupt, 1995. A female syntype of *P. l. etsinensis*, Naturhistorisches Museum Basel 2072Ia, "Grenze Chara-Sucha, l. Ufer d. Etsingol" = border of Khara-Sukhay (probably Khara-Sukhe well, in the northeast of Jinta County, Gansu Province), left bank of the river Etsin Gol = Ruo Shui, leg. Potanin, 23.-29.VII.1886, was examined by ThB. The *etsinensis* form was established by Schenkel based on comparison of his material to the original figures of *P. entzi* (Chyzer, 1891) (= *P. luctinosa*). As diagnostic characters he mentioned the larger and more robust ("grösser und plumper") median apophysis of the male pedipalp, and a less regular triangular median septum of the female epigyne with slightly concave sides, a convex baseline, deeper, more rounded lateral pits and without a median groove. For each of these characters one can argue that Schenkel's illustrations more closely match typical *P. luctinosa* than do Chyzer's rather schematic figures. More recent Chinese works no longer list *etsinensis* as a distinct form (Song et al. 1999). Tongiorgi (1964) continued to treat to treat the two subspecies as valid, arguing that perhaps these had evolved in ecologically isolated populations of a species formerly spread around the coasts of the Sarmatian Sea. For *P. l. marina*, this argument seems inconsistent for two reasons: firstly, it is difficult to see how one subspecies (*P. l. luctinosa*) could maintain genetic conherence on a transcontinental scale, while at the same time another subspecies would diverge on the most local scale. Secondly, and perhaps more importantly, there is no indication of an ecological differentiation between *P. l. marina* and the nominate form, both of which occur on Mediterranean salt marshes – if anything, *P. entzi*, from inland saline locations, could be considered ecologically distinct, but this taxon was explicitly synonymized with the nominate form by Tongiorgi (1964). For *P. l. etsinensis*, the case is less clear. The geographic distance and the apparently less halophilic habitat requirements (Hu & Wu 1989, Zhao 1993) could indicate a divergence at the species level. It is also noteworthy that Chinese specimens reported as *P. luctinosa* have come from elevations ranging from 250 to 2400 m (Hu & Wu 1989), while the type locality of *P. taxkorgan* (= *P. luctinosa*, according to Song et al. 1999) is Mingteke, in the Karakorum Mountains, 4200 m above sea level (Song & Haupt 1996). Here, as in analogous cases elsewhere in this article, the suggested synonymy should not be considered the last word on these forms, but merely reflects the latest taxonomic treatment as presented by Song et al. (1999) and other Chinese authors. It is certainly possible that a future comprehensive revision of *P. luctinosa* will reveal that multiple species are involved, especially in the Far East.

Poecilochroa hungarica Kolosváry, 1934 = *Aphantaulax trifasciata* (O. Pickard-Cambridge, 1872) **syn. nov. (Gnaphosidae)**
This species was described in Kolosváry (1934a) as follows: "Female. Total length 7 mm; opisthosoma with four white spots; femora thick and dark; sternum black; coxa I black, coxa II brown, coxa III dark yellow, coxa IV light yellow; venter black." The single specimen was found in a robinia forest in Ágasegyháza (Hungary). Illustrations of the wet and dry epigyne were provided. They indicate that this species is not a *Poecilochroa* species, but *Aphantaulax trifasciata*, which has a similar striking pattern of white spots (in fact, the pattern in this species is more likely to be described as consisting of four spots, than that of *Poecilochroa*, where there are usually two white spots, and an additional white patch in the front and back of the opisthosoma). The black femora and progressively lighter coxae also match this species, but most importantly so does the epigyne, which was illustrated highly schematically, but clearly shows a round epigynal groove (oval in the closely related *A. cincta*) far anterior of the epigastric furrow (much closer to the epigastric furrow in *Poecilochroa* species). In the drawings, the receptacula are visible as two dark structures at the posterior margin of the epigynal groove and further support the identification, as does the characteristic pigmentation in the area anterior of the epigynal groove.

Sintula affinioides Kolosváry, 1934 =
nomen dubium (Linyphiidae)
Judging from the description in Kolosváry (1934b), which compares this species to *Sintula affinis* (= *Agyneta affinis*), and the illustration of the epigyne, there can be no doubt that this name refers to an *Agyneta* species. Given the large number of very similar species in this genus, no identification is possible at the species level.

Sitticus penicillatus adriaticus Kolosváry, 1938 =
nomen dubium (Salticidae)
This subspecies was described by Kolosváry (1938b) on the basis of a single female from Ragusa (= Dubrovnik), Croatia, without description, but with a comparative illustration of the epigyne (both wet and dry), contrasting the shape to that seen in the nominate form, as well as that of *Habrocestum bovaei* (Lucas, 1846) [N.B.: this, rather than *H. bovei*, is the correct spelling of this species, which is named after Nicolas Bové, latinized by Lucas as Bovaeus, possibly in analogy to Linné/Linnaeus. Curiously, the italics font used for the species names in the main text does not distinguish between 'oe' and 'ae' ligatures, but the index in each case clarifies the intended spelling unambiguously. Thus, for instance, *Salticus Ravoisiaei* (= *Neaetha r.;* named after Amable Bonaventure Ravoisié,

Ravoisiaeus), but *S. moestus* (= *Heliophanus m.*) and *S. durioei* (= *Pellenes d.*), the latter being named after Michel Charles Durieu de Maisonneuve, latinized consistently as Durioeus)]. Given the general difficulties of distinguishing the species in this group, even when material is available for microscopic examination (see, e.g., Braun 1963), it seems hopeless trying to identify this form based on the rough sketches of the epigyne provided. It seems clear that *adriaticus* is not conspecific with the species illustrated by Kolosváry as typical *S. penicillatus*, but even the identity of the latter is dubious.

Syedra caporiaccoi Kolosváry, 1938 =
nomen dubium (Linyphiidae)
This species was described by Kolosváry (1938b) based on a single female found in the Igman Mountains west of Sarajevo, Bosnia-Herzegovina. The description is unusually detailed: "Small, body entirely black; eye arrangement as in all species of the genus; the sternum shiny black; total length 1.5 mm; legs and pedipalps light yellow, with sparse hairs; epigyne dark." The epigyne was compared to that of *Diplocephalus helleri* (L. Koch, 1869) (sub *Plaesiocracerus* [sic!] *eborodunensis*), but the illustration of the epigyne shows not the slightest similarity to the structures seen in that species. The species was also stated to be similar to *Syedra nigrotibialis* Simon, 1884, from which it differed by the shape of the scapus of the epigyne, as well as the uniformly coloured legs. Given the inconsistent description and what appears to be an extremely stylized illustration of the epigyne, it seems unlikely that this species will ever be identifiable with any confidence.

Tapinocyba barsica Kolosváry, 1934 =
nomen dubium (Linyphiidae)
The description in Kolosváry (1934a) is extremely concise ("Male. Total length 1 mm; uniformly grey"). The schematic illustration of the pedipalp confirms that this might indeed be a *Tapinocyba* species, but even this is not certain, and no further identification seems possible.

Tapinocyba transsylvanica Kolosváry, 1934 = **nomen dubium (Linyphiidae)**
The description by Kolosváry (1934b) is so superficial, and the illustration of the epigyne so schematic, that even the generic placement of this species is doubtful.

Tiso strandi Kolosváry, 1934 = **nomen dubium (Linyphiidae)**
This species was described by Kolosváry (1934a) as being closely related to *Tiso aestivus* (L. Koch, 1872), but the illustrated wet and dry epigyne does not show any similarity to that of the *Tiso* species. Some similarity seems to exist to the epigynes of *Araeoncus humilis* (Blackwall, 1841) and *Diplocephalus latifrons* (O. Pickard-Cambridge, 1863). The remaining brief description ("Female. Total length 1.5 mm; prosoma yellow; opisthosoma grey"), however, does not allow a confident identification with either of these species.

Xysticus strandi Kolosváry, 1934 =
nomen dubium (Thomisidae)
This species was described as being distinguished from all other *Xysticus* species known to Kolosváry (1934a) by its characteristic epigyne, which was said to be similar to, but certainly not identical to, that of *Xysticus kochi* Thorell, 1872.

The illustration shows some similarity to the epigyne of *X. kochi*, but even more so to that of *X. gallicus* Simon, 1875. Unfortunately, it is too schematic to allow a confident identification.

Zelotes similis hungaricus Kolosváry, 1944 =
Zelotes similis (Kulczyński, 1887) **syn. nov. (Gnaphosidae)**
Unusually for Kolosváry's new taxa, this subspecies was described by Kolosváry (in Kolosváry & Loksa 1944) on the basis of "three entirely identical specimens, thus it is impossible that this is just an aberration or individual variation". Kolosváry instead suggested that the form might be a local modification ("Standortsmodifikation"), specific for the type locality (Kászonfürdő = Iacobeni, Romania) as in other locations the typical form was found. The new form was characterized by an epigyne that has convex rather than concave margins and is "much broader, more robust and shorter" than in the typical form. The comparative figures supplied with the description show that the epigyne of the new form is perfectly within the range of variation seen in *Z. similis* (see, e.g., Grimm 1985); the illustration for the supposedly "typical" form is, however, much narrower than expected. This indicates the possibility that perhaps Kolosváry's *Z. similis* were misidentified and actually belonged to another species. Alternatively, it is possible that Kolosváry exaggerated the distinguishing characters for clarity. In any case, it seems justified to synonymize *Z. s. hungaricus* with the nominate form.

Zilla diodia embrikstrandi Kolosváry, 1938 =
Zilla diodia (Walckenaer, 1802) **syn. nov. (Araneidae)**
This name was introduced by Kolosváry (1938a) for a variety of *Z. diodia* in which the colouration of the prosoma showed an unusual inverted pattern, with a light cephalic area, and a dark thoracic part, rather than the typical dark head region on a lighter background. In addition, the form found in Santa-Eufemia, Calabria, Italy, had a shorter epigynal scapus and a more elongated opisthosoma. The description states that "intermediate forms do not occur", which would imply that a larger number of specimens was examined. While this might indeed be a local variety, it seems very unlikely that a genetically isolated subspecies of such a widely distributed species (found throughout the entire Western Palaearctic, including North Africa) could have evolved in this zoogeographically indistinct area of southern Italy. We therefore consider *embrikstrandi* as an infrasubspecific variety.

Dubious species of jumping spiders (Salticidae)
Attus viridimanus (Doleschall, 1852) = **nomen dubium**
For this species, just as for *Sitticus manni* (see below), the type material (from walls and boarded fences around Vienna and in Upper Hungary) is lost, but a figure is included among a collection of drawings prepared by Doleschall and recently discovered by Thaler & Gruber (2003) in the archives of the Natural History Museum in Vienna. This illustration confirms the impression that the currently accepted synonymy with *Evarcha arcuata* (Clerck, 1757) is certainly wrong. Reimoser (1919), who seems to have first suggested this synonymy, did not provide any arguments in its favour. *A. viridimanus* is obviously a *Heliophanus* species, possibly *H. auratus* or *H. cupreus* (**Fig. 4**). The description confirms this assessment, as it refers to a deeply black species ("nigerrimus"), with shiny purple

Fig. 4: Illustration of *Attus viridimanus* by Doleschall (unpubl.) in the collection of the Natural History Museum Vienna (top) and a female of an unusual variant of *Heliophanus cupreus* showing the green metallic sheen on the surface of the pedipalps that probably gave *A. viridimanus* its name (bottom) (photo Michael Schäfer)

hairs on the opisthosoma and a green surface of the otherwise black palp. Only the patellae and tarsi of all legs, and the tibiae and metatarsi of leg I, are yellowish. A confident assignment to a specific species is, however, not possible.

Dendryphantes lanipes C.L. Koch, 1846 =
Philaeus chrysops (Poda, 1761) **syn. nov.**

The original description of this species (Koch 1846a: 90-91, Tab. CCCCXLVII, Fig. 1152), based on the female only, points out the similarity with *Dendryphantes dorsatus*, which is currently considered a synonym of *Philaeus chrysops*. The type locality is indicated as "Süddeutschland. — Tyrol.", which most likely refers to Tyrol, which at the time was part of the Austrian Empire and is now divided between Austria and Italy. The species was described as a spider of 3.5''' (7.9 mm) total length, with a brown-black prosoma, which shows a white pattern of hairs forming three subtriangular dots between the anterior eyes, and a longitudinal band along the sides, which turns towards the middle in front of the posterior lateral eyes, almost reaching the centre of the head area. The face was covered in white hairs and white bristles, mixed with rusty-red towards the eyes. The chelicerae were black, the sternum black with yellowish-grey hairs, the opisthosoma white, with a broad longitudinal black band, broadest in the middle and barbed towards the back, with two white oblique spots in the middle. The sides, around the white dorsum, were a mixture of white, black and rust-coloured, darker towards the top, while the venter was covered in whitish hairs. The reddish-white legs, with black annulation at the tip of the segments, as well as the pedipalps, were covered densely in white hairs, with some black spines. The accompanying figure differs from this description in that it shows a much more reddish-brown specimen, without the white pattern, but instead with a very noticeable white margin along the prosoma, which is not mentioned in the text.

Simon, in his youthful first edition of the 'Histoire Naturelle des Araignées' (Simon 1864, published at the tender age of 16), listed this species as a synonym of *Dendryphantes semilimbatus* (Hahn, 1829) (= *Menemerus s.*). This seems a reasonable choice, given the figure of the species in Koch's work, but does not match the description in the text. Four years later, in his monographic treatment of the Salticidae, Simon considered *D. lanipes* as a valid species, describing female specimens from southern France and Italy (Simon 1868). However, only four years later he expressed doubt about his

Fig. 5: Illustration of *Dendryphantes lanipes* in the original description (left: Koch 1846a: Fig. 1152) and a juvenile specimen of *Philaeus chrysops* from Turkey, showing several of the important diagnostic characters mentioned in the description of *D. lanipes* (photos Rainer Breitling)

correct identification of these specimens (Simon 1868), noting a remarkable similarity to *Attus bicolor* (= *Carrhotus xanthogramma*), and in his final analysis in 'Les Arachnides de France', he explicitly placed his specimens in the synonymy of the latter species.

Nevertheless, despite the historical confusion, based on the description in the text, and taking into account possible deviations in colour scheme during the manual illumination of the plates in Koch's work, it seems clear that *D. lanipes* is in fact a subadult specimen of *Philaeus chrysops*. This species is highly variable, but all the major features of the pattern, including the very distinct set of bent white lines on the prosoma, which is the main concordant character in text and figure, can be found in *P. chrysops* specimens (**Fig. 5**). The colouration of the dorsum in this species is very variable, but predominantly light grey specimens are known for adult males and females, and the contrast compared to the dark midline might have led to a slight exaggeration of the brightness. The size, distribution and abundance of the species seem to support this identification. It seems therefore justified to consider *Dendryphantes lanipes* a junior synonym of *Philaeus chrysops*.

Euophrys rosenhaueri L. Koch, 1856 =
Menemerus semilimbatus (Hahn, 1829) **syn. nov.**
Immediately following the description of *Dendryphantes jugatus* (= *Philaeus jugatus*; see below), Koch described this slightly larger species based on two males collected from shrubs close to Cádiz, Spain. According to the description, the specimens, which were 3.5" (approx. 8 mm) in length, had a black prosoma with a white triangular spot pointing forward between the eyes and a broad bright white margin. The pedipalps were characterized by bright white scaly hairs on the patella and tibia, while the cymbium was black. The opisthosoma was rusty-brown, with a white dusting and a yellowish-white longitudinal spot in the middle and small white arcs towards the side, which was off-white in colour. The legs were covered in yellowish-white scaly hairs and long black bristle hairs. The femora of the first pair of legs were thicker than the others. There can be no doubt that this description refers to the highly distinct male of the common South-European jumping spider *Menemerus semilimbatus*, despite the fact that the specimens are reported as having been collected on shrubs („auf Gesträuch"), a rather unusual habitat for this species.

Fig. 6: A dark, almost melanistic, specimen of *Evarcha falcata* (photo Mario Freudenschuss)

It is curious that Koch himself did not notice this affinity, in particular as his father had described and illustrated the species (as *Euophrys vigorata*) ten years earlier (Koch 1846b), based on numerous male and female specimens from Greece, but one might want to take into account the fact that the report on Rosenhauer's collection was one of Koch junior's very first arachnological publications.

Evarcha falcata nigrofusca (Strand, 1900) =
Evarcha falcata (Clerck, 1757) **syn. nov.**
Strand introduced the name *nigro-fusca* for a dark variant of *Evarcha falcata* that was "almost uniformly black-brown, so that even the transverse band on the prosoma is indistinct". He explicitly stated that this form, which was first described by Menge (1877), is just an extreme expression of an otherwise continuous spectrum of variation, which links the darker specimens to the more typical lighter form of this highly variable species. It is thus clear that *nigrofusca* is not a subspecies in the modern sense, but a synonym of the nominate form. A specimen of the dark form is shown in **Fig. 6**.

Heliophanus auratus mediocinctus Kulczyński, 1898 =
H. mediocinctus Kulczyński, 1898 **stat. nov.**
This variant was first described on the basis of multiple male and female specimens from the Anninger and Gaisberg mountains north of Vienna, Austria (200–400 m a.s.l.). The type locality is probably contained today within the Naturpark Föhrenberge, which is characterized by limestone woodlands and xerothermic meadows. It was reported to be morphologically identical to the nominate form ("formâ non distinctus"), but differing in its opisthosomal pattern, which not only showed a posterior pair of more or less transverse white spots, but a second pair of spots slightly anterior of the middle, which were arranged as a narrow recurved transverse band across the opisthosoma, widely separated in the middle. This narrow band was almost always present, and only in older specimens was reported as becoming less distinct. Very rarely the narrow band was replaced by a pair of rather thick transverse spots with an elongated external angle.

As Kulczyński was experienced in the genital examination of *Heliophanus* species, as shown for example by his treatment of the group in the 'Araneae Hungariae' (Chyzer & Kulczyński 1891), it seems very unlikely that he misidentified the general affinity of these specimens. As specimens of the typical variety of *H. auratus* were found at one of the type localities of var. *mediocinctus* (Kulczyński 1898: 44), the variety cannot be considered a subspecies in the modern sense. The fact that Kulczyński at that time arranged specimens of *H. auratus* into four full species (*H. auratus, H. varians, H. exsultans* and *H. nigriceps*) indicates that he applied a rather too narrow species concept in this case, and it would seem possible that *mediocinctus* is just another infrasubspecific variant. However, the opisthosomal pattern does not match the typical expectation for *H. auratus*, nor does the xeric locality: in Central and Northwestern Europe, *H. auratus* is usually found close to bodies of water and in mesic to hydric habitats (Harm 1971, Roberts 1998, Almquist 2006). We have seen several specimens identified as *H. auratus* from xeric localities in Southeastern Europe matching Kulczyński's description of the opisthosomal pattern (**Fig. 7**). It seems, therefore, justified to provisionally raise the variety described by Kulczyński to full species status,

as *H. mediocinctus*, to draw attention to the possible existence of a genitally cryptic sister species of *H. auratus* in the Southeast of Europe. A definitive decision of the status of this form will rely on examination of a larger amount of material, preferably in conjunction with genetic analyses and breeding experiments.

Myrmarachne formicaria tyrolensis (C. L. Koch, 1846) = *Myrmarachne formicaria* (De Geer, 1778)
syn. conf. (Simon 1937: 1150)
This form was initially considered a distinct alpine sister species of *M. formicaria*. Lessert (1910) relegated it to the rank of variety, stating that the genitalia (in males and females) are indistinguishable from those of *M. formicaria*, while the colouration (as seen in the original illustrations by Koch 1846a: Fig. 1097) is also very similar. Simon (1937) finally synonymized the two forms, realizing that none of the supposedly distinguishing characters is reliable. Incidentally, a single female specimen in Simon's collection labelled as being *Myrmarachne tyrolensis* (MNHN Boc. 2308 "Var: [Île de] Bagaud") is in fact *Leptorchestes peresi* (Simon, 1868), the female of which was not yet known to Simon and was only described in 2001 by Wesołowska & Szeremeta (2001).

Philaeus albovariegatus (Simon, 1868) = *Philaeus chrysops* (Poda, 1761)
syn. nov. [♂ only; ♀ is *Evarcha falcata* (Clerck, 1757)]
Simon originally assumed this species to be *Dendryphantes fulviventris* (Lucas, 1846), but in an erratum added to his paper recognized his mistake and considered his specimens from Andalusia and Sicily as belonging to a new species. He compared the species to *Dendryphantes bilineatus* (Walckenaer, 1826), which is currently considered a synonym of *Philaeus chrysops*, and confirmed this affinity by the later generic placement of the species. The elevated prosoma was described as being black with light grey hairs on the front of the face and along the sides, as well as in a vague thin line along the middle. The opisthosoma was mottled with grey tufts of hair, and shows two elongated parallel black spots along the middle, which were each decorated with a series of little white spots. The underside was brownish, the pedipalps black, with a reddish cymbium. The front legs were rather thick, the others long (which, if taken literally, would argue against a close relationship to *Philaeus chrysops*); all of them were entirely black with grey rings. Females are only very briefly mentioned in the first description as being very similar, having light yellow pedipalps and all-white facial hair. As Thorell (1873) recognized, Simon had used the presence of an undifferentiated subadult male palp as one of the diagnostic characters of the genus *Dendryphantes*. In his later revision of the species, Simon stated that the female specimens were adult and mentioned that (adult) males have not been found yet. The brief description of the epigyne ("consisting of an arched inferior border and a second, more interior fold following the same curve"). The type material is still available in Simon's collection (MNHN Boc. 2400.753, "Hisp[ania], Sicilia"), and shows that the male specimen is a subadult *Philaeus chrysops* (Poda, 1761), with an already characteristically developed pedipalp, while the female specimen is an adult *Evarcha falcata* (Clerck, 1757). As the original description is almost exclusively based on the male specimen, which also justified the

Fig. 7: A male *Heliophanus* from a wooden fence post in Croatia; the specimen was originally identified as *Heliophanus auratus* and is here provisionally assigned to *H. mediocinctus* on the basis of the locality, habitat and opisthosomal pattern (photo Michael Schäfer)

original and subsequent generic assignments by Simon (first to *Dendryphantes*, then to *Philaeus*), we designate the subadult male as the **lectotype** of the species, with the purpose of stabilizing the future interpretation of this name, in accordance with ICZN Article 74.1.

Philaeus jugatus (L. Koch, 1856) = **nomen dubium**
Like Simon's *P. albovariegatus*, *P. jugatus* was first described based on a specimen from Andalusia (Granada) and initially placed in the genus *Dendryphantes*. The *P. jugatus* female described by Koch has an elevated black prosoma with earth-coloured yellow lines along the sides and above the anterior median eyes. The anterior eyes are surrounded by reddish-brown rings. The pedipalpal femur is dark brown, the other segments yellowish brown. The sternum is black, with yellowish-white hairs. The earthen-yellow legs are annulated in black, the tarsi and metatarsi are reddish with black tips. The opisthosoma is earthen-brown, with black arcs along the sides ("mit schwarzen Bogenstrichchen in den Seiten"), and two black longitudinal lines along the back, which contain little yellow spots. This pattern could possibly match a subadult female *Philaeus chrysops* (compare **Fig. 5** above), especially as the specimen is only 3", i.e. about 6.8 mm in length. However, the description is quite vague, and the type material seems to have been lost (not in the Bavarian State Collection of Zoology, which bought Rosenhauer's collection, where the type was held, after his death). Simon (1876) did not provide a reason for his generic transfer of *D. jugatus* to *Philaeus*, and did not examine material of the species, which he listed as a species invisa in 1868, so even the correct genus of this dubious species remains uncertain in the absence of type material.

Philaeus varicus (Simon, 1868) = *Carrhotus xanthogramma* (Latreille, 1819) **syn. conf.** (Simon 1937: 1270)
In his first description of this species, based on a male specimen that he collected at El Escorial in central Spain, Simon compared this species to *Attus haemorrhoicus*, which is now considered a synonym of *Philaeus chrysops* (Metzner 1999). However, he pointed out that there are some important differences, such as the longer and thinner legs. The opisthosoma was brownish red, with a white margin in front and becoming black towards the centre; the underside was grey. The prosoma was entirely shining black, with a small tuft of brown hairs under each of the posterior eyes. The black-brown legs carried
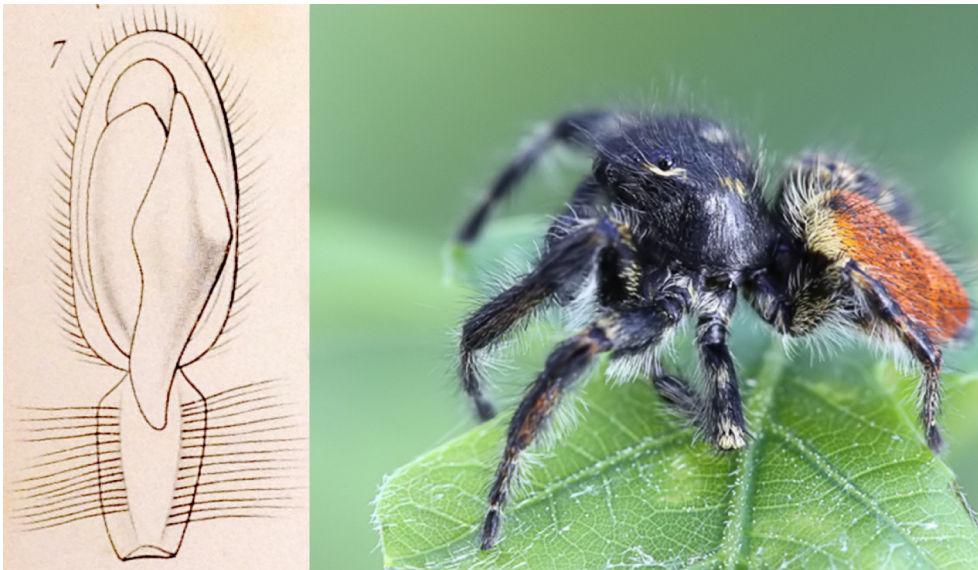
Fig. 8: Illustration of the pedipalp of *Philaeus varicus* in the original description (Simon 1868: pl. 5, f. 7; sub *Attus*), and a habitus photo of a *Carrhotus xanthogramma* male, showing the precise match to the description of *P. varicus*, including the tiny tufts of hairs under the posterior eyes (photo Michael Schäfer)

long, sparsely scattered white hairs. This description perfectly matches *Carrhotus xanthogramma* (Latreille, 1819), which was previously reported from El Escorial (Fernández Galiano 1910), and the illustration of the pedipalp confirms this identification, despite its rather schematic nature (**Fig. 8**). In fact, Simon himself later recognized this synonymy and listed *P. varicus* amongst the many synonyms of *Carrhotus bicolor* (= *C. xanthogramma*) in Simon (1937: 1270); this decision was not followed in the World Spider Catalog (2016) and is reconfirmed here.

Sitticus manni (Doleschall, 1852) **nomen oblitum** = *Heliophanus melinus* L. Koch, 1867 **syn. nov.**
This species was first described as *Attus Mannii,* based on a single male from Dalmatia (Croatia). While Doleschall's type material is lost, original illustrations of many of the species described by Doleschall were discovered by Thaler & Gruber (2003) in the archives of the Natural History Museum in Vienna. In the case of *S. manni*, the figure exactly matches the

textual description and allows a confident identification of the species: *S. manni* is not a *Sitticus* species as assumed by Reimoser (1919). Given the white patchy pattern of hairs on all legs, which is mentioned in the text and also prominent in the figure, it is also not a *Pellenes* species, as suggested by Thaler & Gruber (2003). There can be little doubt that *S. manni* is in fact a senior synonym of *Heliophanus melinus* (L. Koch, 1867) (**Fig. 9**). While Doleschall's name has been mentioned in various catalogues (see also Prószyński 1990, listing the species as a nomen dubium), to our knowledge it seems never to have been used as a valid name since 1899 in the sense of Article 23.9.1. of the International Code of Zoological Nomenclature (ICZN), while the younger synonym has been in widespread use "in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years" (for example, Bellmann 2010, Buchholz 2007a, 2007b, Cantarella 1974, Coşar et al. 2014, Deltshev et al. 2005, Dobroruka 2004, Fuhn & Gherasim 1995, Fuhn & Oltean 1969, Hansen 1985, 1986, Helsdingen 2013, IJland

Fig. 9: Unpublished illustration of *Attus Mannii* by Doleschall in the collection of the Natural History Museum Vienna (left) and a male of *Heliophanus melinus* from Croatia (right) (photo Michael Schäfer)

et al. 2012, Komnenov 2003, 2006, Kovoor & Muñoz-Cuevas 2000, Kranjčev 2012, Locket et al. 1974, Logunov & Chatzaki 2003, Mcheidze 1997, Metzner 1999, Prószyński 1976, 1991, Roberts 1985, 1995, 1998, Sauer & Wunderlich 1997, Tyshchenko 1971, Wesołowska 1986). We therefore suggest, in accordance with Article 23.9.2. ICZN, treating *Attus mannii* Doleschall, 1852, as a **nomen oblitum** and to consider the younger synonym *Heliophanes melinus* L. Koch, 1867, as the valid and protected name of this species.

Philaeus superciliosus Bertkau, 1883 =
Sandalodes superbus (Karsch, 1878) **syn. nov.**
Of all the phantom species amongst the European representatives of *Philaeus*, this one was probably the most challenging to put to rest. *P. superciliosus* was described on the basis of a single male specimen which was dried up and heavily worn. The specimen was collected in the Aachen area (Germany), but detailed collection data were not available, and the original description already speculated that the species was probably introduced, most likely with dyewood for the textile factories of the region (the same volume of the journal in which the description appeared contains a detailed article on introduced species found on imported wood; Stollwerck 1883). Simon, who had seen the specimen, speculated that it might be a Brazilian species (cited in Bertkau & Förster 1883). The holotype could not be found in the Senckenberg Museum Frankfurt, nor in the Museum Koenig Bonn, and is probably lost.

In these circumstances, a confident identification might seem close to impossible. However, Bertkau (in Bertkau & Förster 1883) not only provided a detailed description, but also good illustrations of the habitus and pedipalp of his specimen. A number of features were noticeable: the large size, of 12 mm; a dense fringe of stout brown hairs across the entire width of the front of the prosoma; a pit covered by white hairs between the posterior lateral eyes; a strong hook-shaped retrolateral tibial apophysis; a short, straight, distally located embolus, in a deep groove of the truncated cymbium; a prominent white square spot on the opisthosoma, which extends into white lines in the four corners; and thickened femora, patellae and tibiae of the first two pairs of legs. None of these features

is individually diagnostic, but in combination, it appears that they only match one species of jumping spider, the Indo-Australian *Sandalodes superbus* (Salticinae: Mopsini; Maddison 2015; **Fig. 10**). The illustration of the pedipalp seems to be an exact match to figures provided by Hickman (1967; sub *Bavia ludicra*) and Żabka (2000), and none of the characters mentioned in the description contradicts this identification. *S. superbus* shows not only the closest match regarding its genitalia, but is also the largest and most common representative of its genus. The distribution and life history of the species provide further support: the species is widespread from Tasmania to Papua New Guinea (Żabka 2000), where it is arboricole and often found on and under bark (Hickman 1967), making an accidental import with dyewood quite plausible.

Sitticus walckenaeri Roewer, 1951 = **nomen dubium**
This species was originally described as *Aranea nigra* (preoccupied by *Aranea nigra* Petagna, 1787 = *Eresus* sp.) by Walckenaer, in 1802, from the Paris region. The original description was extremely brief: the species was a jumping spider (Walckenaer soon after, in 1805, placed it in the newly created genus *Attus*), and its "prosoma, opisthosoma and palps are black; the petiolus and tips of the legs grey" ("Corcelet, abdomen et palpes noirs; pédicule et extrémité des pattes gris."). Thirty-five years later, Walckenaer (1837) slightly expanded on this description, adding that his female specimen, collected in June, was 2"' (about 4.5mm) in length and "the fourth pair of legs is longer than the first, and the third a bit longer than the second. The femora are black below".

Despite this very generic description, entirely black jumping spiders are sufficiently rare in Europe for several subsequent arachnologists to have felt confident enough to identify Walckenaer's species. The first of these seems to have been Sundevall (1833), who claimed to have observed the same species in Sweden; he provided a slightly more detailed description, stating that his two male specimens, collected in June 1824 in Gotland, were rather close in size and habitus to *Salticus scenicus*, the prosoma being twice as long as broad, the robust legs being similar in length (order 4-1-2-3), with the fourth pair being a quarter longer than the others, twice as long as the prosoma. The total body, except the whitish book

Fig. 10: Habitus of a *Sandalodes superbus* male from North Queensland, Australia, compared to the habitus illustration of *Philaeus superciliosus* provided by Bertkau (photo Greg Anderson)
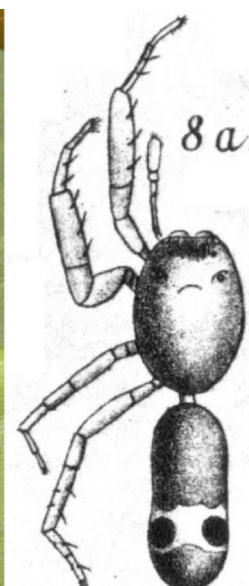
lung covers and the grey venter, is pitch-black, but the face is sparsely covered with yellowish-grey hairs. The joints and tips of the legs are a lighter black ("dilutius picei").

The World Spider Catalog currently lists Sundevall's *Attus niger* as a synonym of *Phlegra fasciata* (Hahn, 1826). However, later arachnologists did not consider this identification self-evident and, most importantly, doubted the identification with Walckenaer's species. Westring (1851) originally considered *Attus niger* as a synonym of *Euophrys aprica* (= *Phlegra fasciata*), but in 1861 listed Sundevall's *A. niger* among the dubious species and put a question mark behind the synonymy with *Aranea nigra* Walckenaer. In this, he was followed by Thorell (1873), who felt that Sundevall's species was probably an *Epiblemum* (= *Salticus*) species, but "dare[d] not offer any further conjecture on this very doubtful species".

In the meantime, Simon (1871), in a supplement to his monograph of the European jumping spiders, had described a single female specimen of what he considered to be *Attus niger* Walckenaer, a "very rare species" from the Paris region, which he places in the *pubescens* group (containing *Sitticus* and *Pseudeuophrys* species, among others), close to *Sitticus pubescens*. He emphasised that the species had previously been confused with the male of *Attus fasciatus* (= *Phlegra fasciata*) by various authors, but is quite distinct. While the described specimen seems to be larger than Walckenaer's material (5.5 mm), the fact that Simon did not have any location data beyond "environs de Paris" suggests that this was indeed part of the type series. Thorell (1873), who also examined Simon's (and thus presumably Walckenaer's) specimen, considered it an *Attus* species in the strict sense (which at the time still included diverse genera such as *Sitticus*, *Pellenes* and *Evarcha*), but did not note any further affinities to known species. In an expanded description Simon (1876) provided further detail, and the specimen became considerably more colourful than before: prosoma and opisthosoma are decorated by a reddish-brown pubescence ("garnis de pubescence fauve-rouge"), sparsely on the prosoma, more densely on the opisthosoma. The clypeus is covered, not very densely, by long, white hairs; the coxae, the base of femur III and IV, and the tarsi and metatarsi, especially of the anterior legs, are olive-brown; the pedipalps are dark brown at the base, reddish-brown towards the tip, with white hairs covering the distal segments. Even the epigyne is described: it is a smooth black plate, marked with a rather large and shallow heart-shaped depression containing two very small rounded projections. Nevertheless, Simon (1937) finally reassessed his views and stated that "it is impossible to know what Walckenaer's *Attus niger* might be". No new evidence seems to have come to light since then, and the name remains dubious, especially as a search for material of this species in Simon's collection turned out unsuccessful.

Miscellaneous other phantom spiders

Alopecosa accentuata (Latreille, 1817) =
nomen dubium (Lycosidae)
Alopecosa accentuata auct., nec (Latreille, 1817) partim =
Alopecosa farinosa (Herman, 1879) **comb. nov. (Lycosidae)**
Alopecosa barbipes oreophila Simon, 1937 = *Alopecosa farinosa* (Herman, 1879) **syn. nov., comb. nov. (Lycosidae)**
The "phantom spider" *Alopecosa barbipes oreophila* was first described by Simon (1876) as an unnamed alpine variant of *A. accentuata*, distinguished from the Parisian variety of the

species by the lack of the characteristic brush of black hairs on the underside of tibia I. The description as a named "local race" in 1937 repeated this lack of a black brush of hairs as the main distinguishing feature, and mentioned that the species was common on high grasslands, in the Alps of the Dauphiné and Provence in southern France. It seems clear that Simon's typical Parisian "*A. accentuata*" is in fact *A. barbipes*, while his *A. a. oreophila* is what is currently referred to as *A. accentuata* (see Cordes [1994] and Cordes & von Helversen [1990] for a discussion of the relationship of these two species). This immediately causes a nomenclatural problem: the type locality of Latreille's *A. accentuata* was stated as "environs de Paris", indicating that this name actually refers to *A. barbipes*. Latreille's brief and vague description does not allow a distinction between the two species, but Simon's collection data would seem sufficiently strong evidence against the occurrence of the species currently known as *A. accentuata* around Paris. To minimize the confusion arising from the resulting necessary name changes, we suggest considering *A. accentuata* as a nomen dubium, rather than a senior synonym of *A. barbipes*, in agreement with Roewer's (1955) assessment of the species as "nicht zu deuten" and supported by Dahl's opinion that it was in fact synonymous with *Alopecosa trabalis* (Clerck, 1757), rather than the *A. accentuata* or *A. barbipes* of later authors.

In this case, the species currently referred to as *Alopecosa barbipes* maintains its established name, but the current *A. accentuata* unfortunately still needs to be renamed. This is a rather radical step, probably the most undesirable of all the name changes suggested in this article, and one might be inclined to argue that a more lenient interpretation of the rules would allow maintaining the use of *A. accentuata* in its present sense, if not in the sense of the original author. We have carefully considered this option, but have concluded that the benefits of a strict application of the rules outweigh any potential disadvantages in the long run. First of all, as *A. accentuata* and *A. barbipes* were considered synonymous for almost a century, and the independent status of the two species was only fully recognized quite recently (Dahlem et al. 1987), the resulting instability should not be too disruptive. More importantly, it might in fact be beneficial if it can stimulate a reassessment of the identity of earlier records of the species. For example, numerous references listed under *A. accentuata* in the World Spider Catalog (Sundevall 1833, Simon 1864, 1937, Ohlert 1867, Menge 1879, Holm 1947, Wiebes 1959) almost certainly refer to *A. barbipes*. The situation had become somewhat more stabilized in recent years, but as important identification guides did not distinguish the two sister species (Bellmann 1997, Heimer & Nentwig 1991), a large number of quite recent records of *A. accentuata* actually refer to *A. barbipes*. As recently as 2013, some influential publications considered *A. accentuata* to be a senior synonym of *A. barbipes* (Mikhailov 2013a, 2013b). Thus, in contrast to *A. barbipes*, which seems to have been used unambiguously and consistently for at least the last 20 years, *A. accentuata* does not have a consistent tradition of prevailing use that needs to be preserved. As the species currently known as *A. accenuata* is not known to occur in the type locality of the species, the designation of a neotype (which is required to come "as nearly as practicable from the original type locality" ICZN Art. 75.3.6) is not an option. The oldest

available name unambiguously referring to the sister species of *A. barbipes* is *Lycosa farinosa* Herman, 1879, described from Hungary. This synonymy is supported by Chyzer & Kulczyński's (1891) examination of a male specimen identified by Herman and by biogeographical arguments: *A. accentuata* in the current sense is considered a Central European species, found in areas with a continental climate, in contrast to *A. barbipes*, which seems to be restricted to areas with an oceanic climate in western Europe (Cordes 1994, Cordes & von Helversen 1990).

Araneus angulatus atricolor Simon, 1929 =
Araneus angulatus Clerck, 1757 **syn. nov. (Araneidae)**
Araneus angulatus personatus Simon, 1929 =
subspecies inquirenda (Araneidae)
These two forms were described by Simon as individual varieties of the highly variable *Araneus angulatus*, the first one applying to melanistic specimens, the second one to specimens with a pattern of black marks on a white-greenish or bluish background. While material of the former variety could not be found in Simon's collection, a single female from the original type series of the latter was still present (MNHN Boc. 2498.2787, "Ht. pyr.[Hautes pyrénées]: Cauterets"). The genitalia of this strikingly coloured specimen show that it belongs to *Araneus angulatus*. The colouration shows a remarkable similarity to that of the black-and-white form of *Araneus nordmanni* (Thorell, 1870), as Simon already had noticed; however, the latter clearly differs in its genitalia and details of the pattern. The *personata* form has apparently also been found in Dorset, Great Britain, as O. Pickard-Cambridge (1896) illustrates a variant specimen (sub *Epeira angulata*) that is closely similar to the type of *personatus*. However, most recent records of *A. angulatus personatus* come from Spain (see documentation at http://www.biodiversidadvirtual.org/insectarium/Araneus-angulatus-personatus-Simon-1929-cat40756.html), suggesting a geographic restriction of this form. Hence, the possibility of *personatus* representing a genitally cryptic sister species in South-Western Europe cannot be excluded with certainty at the present, and further study is required to decide the status of this form. In addition to genetic analyses, it would be interesting to perform breeding experiments to characterize the inheritance of the different colour morphs.

Synonymy with the nominate form can, however, safely be assumed for the *atricolor* variant, the description of which matches the commonly observed dark form of *A. angulatus*.

Araneus diadematus nemorosus Simon, 1929 =
Araneus diadematus Clerck, 1757 **syn. nov. (Araneidae)**
This form, found in "toute la France", was described by Simon with the explicit comment that he did not consider it a subspecies, but rather as a local variety at the extreme of a continuous character gradient. According to the description, it replaced the typical form in forests and under trees, as well as sometimes in marshes. It was described as being characterized in the female by a more slender built and most often a cinnamon-red colouration. Numerous males and females assigned to this form are present in Simon's collection (MNHN Boc. 2483 "forme silvicole, Gallia"). Their genitalia and pattern clearly show that this taxon is synonymous with the nominate form.

Araneus diadematus soror (Simon, 1874) =
Araneus diadematus Clerck, 1757 **syn. nov. (Araneidae)**
This form was originally considered a distinct species, restricted to Corsica, which differs from *Araneus diadematus* only in the constant and remarkable arrangement of the spines on tibia II of the males (which are long and sparse). Later, Simon (1929) considered these specimens as probably just individual, perhaps even accidental variants of *A. diadematus*, as the females were indistinguishable from typical specimens of the latter (the original description being based on subadult female specimens). Material labelled as *Araneus soror* is still available in Simon's collection (MNHN Boc. 2517.158 "Corsica", 16♀♀, 2♂♂). It shows that the tibiae of the males indeed differ from typical specimens of *A. diadematus* in the absence of numerous short, stout spines on the prolateral surface of tibia II, which are replaced by fewer, longer setae. Nevertheless, according to Grasshoff's (1968) careful analysis of the morphological variation in this and related species, this spination pattern falls within the range of intraspecific variability of *A. diadematus*, and in fact Grasshoff already implicitly synonymized *soror* with the nominate form. The examination of the genitalia in Simon's material supports the synonymy.

Araneus pyrenaeus (Simon, 1874) =
Araneus pallidus (Olivier, 1789) **syn. nov.** (♂ only; ♀ is
Araneus diadematus Clerck, 1757) **(Araneidae)**
This species was described by Simon as being very similar to *Araneus diadematus*, but distinct, e.g., in the male genitalia. In 1929, Simon realized that the female had been misidentified and actually belonged to *Araneus diadematus* var. *nemorosa*. This led Roewer (1942) and subsequently the World Spider Catalog to list *A. pyrenaeus* as a synonym of *A. diadematus*. However, this is not correct, as Simon later explicitly stated that the male specimen should be considered as the type of the species ("seul type de l'espèce", Simon 1929: 757, footnote 3), equivalent to a designation of the male specimen as the **lectotype** of the original mixed type series according to ICZN article 74.5. The original types seem to be lost, but Simon's collection contains a number of later specimens, both male and females (MNHN Boc. 2498.670 "R. Castillon, 16.VIII.1915", 1♂; MNHN Boc. 2498.8570 "Portugal", 1♂; MNHN Boc. 2498.21773 "Vendôme, Oct. 1910", 1♀). All of these are *Araneus pallidus*, the male of which was unknown to Simon. This also agrees very well with the original description, which states that the prosoma of the male *A. pyrenaeus* is only 2 mm long (the typical length for *A. pallidus* males, but far too short for *A. diadematus* or other related species [Grasshoff 1968]), and that the tibiae II are not thickened and carry only spines that are longer than their diameter. The distribution of the species – the type was originally considered as coming from Vernet-les-Bains, France, but actually was collected in Spain (Simon 1929) – also agrees with the known Western Mediterranean distribution of *A. pallidus*. Thus, even in the absence of the type material, the synonymy seems strongly supported.

Cheiracanthium cuniculum Herman, 1879 =
nomen dubium according to Chyzer & Kulczyński (1918), cited in Samu & Szinetár (1999) **(Eutichuridae)**
The holotype of this species seems to have been lost and was

possibly destroyed in a fire in the collections of the Hungarian Natural History Museum during the 1956 revolution (Dányi pers. comm. June 2015). The drawing of the female genitalia in the original description shows a very generic *Cheiracanthium* epigyne, and the text is so brief and vague that no identification beyond the generic placement is possible. The epigyne is described as follows in the Hungarian description (but not in the German text): "The epigyne is a brown, slightly domed double plate [?], that has kidney-shaped halves that touch each other only on the upper side enclosing a narrow, light-coloured circle above the respiratory opening [A zár egy barna, kissé domború, kettős tércséből [sic] áll, melynek felei vesealakúak s csak felül érintkeznek, a légzőrés felett pedig keretét képezik egy szűk, világos körnek.]" This could match several species of *Cheiracanthium* known from the region, and Chyzer & Kulczyński (1918) had previously considered the species a nomen dubium.

Cresmatoneta eleonorae (Costa, 1883) = *Cresmatoneta mutinensis* (Canestrini, 1868) **syn. nov. (Linyphiidae)**
Cresmatoneta mutinensis orientalis (Strand, 1914) = *Cresmatoneta mutinensis* (Canestrini, 1868) **syn. nov. (Linyphiidae)**
Costa described *C. eleonorae* based on material from Sardinia. He was obviously aware of Canestrini's *C. mutinensis*, as he placed his specimens in the same genus, but in his four-line description of the new form, he only mentioned generic characters (in particular the strongly attenuated posterior end of the prosoma) and features of the colouration that apply equally well to *C. mutinensis* (three yellow spots on each side of the brown opisthosoma; yellow legs, the femora of the two posterior pairs blackened). Costa's type material is in all probability lost, but Kullmann (1964) who examined topotypical material (now in the collection of the Senckenberg Museum Frankfurt; SMF 59706–124) concluded that the Sardinian specimens undoubtedly belonged to *C. mutinensis* and that it was more than questionable that *C. eleonorae* could be a separate species ("es [ist] inzwischen mehr als fraglich, ob *Cresmatoneta eleonorae* eine echte Art ist"). In view of this, the synonymy of *C. eleonorae* and *C. mutinensis* seems beyond doubt. The same is true for the (non-European) "subspecies" *C. mutinensis orientalis*, described by Strand (1914) based on a single male from Rehovot or Jaffa (Israel). The description leaves no doubt that this name was not suggested for a subspecies in the present sense, but for an individual colour variant. A typical *C. mutinensis* had been found at the same locality five days earlier. Strand compared the colouration of the *orientalis* form to that of *Pachygnatha degeeri*, which is a rather fanciful, but not entirely inappropriate description of the pattern seen in light specimens of *C. mutinensis* (when first describing the species, Canestrini had considered his genus *Formicina* [= *Cresmatoneta*] as closely related to *Pachygnatha*). Given the highly characteristic habitus of *Cresmatoneta*, confusion with another species seems impossible; examination of the type material by ThBl in the Senckenberg Museum Frankfurt (SMF 3092-124) confirmed that the specimen is indistinguishable from the typical form in the details of its pedipalp. Records of *C. mutinensis* from Korea and Japan by Namkung (1986), Yaginuma (1986) and Kim & Kim (2000) are based on misidentified specimens of *C. nipponensis* Saito 1988 (Saito 1988, Namkung 2002); thus, the species is restricted to the Western half of the Palaearctic.

Cyclosa conica albifoliata Strand, 1907, *Cyclosa conica defoliata* Strand, 1907, *Cyclosa conica leucomelas* Strand, 1907, *Cyclosa conica pyrenaica* Strand, 1907, *Cyclosa conica dimidiata* Simon, 1929, *Cyclosa conica rubricauda* Simon, 1929, *Cyclosa conica triangulifera* Simon, 1929 = *Cyclosa conica* (Pallas, 1772) **syn. nov. (Araneidae)**
These seven varieties of *Cyclosa conica* were explicitly considered mere colour variants or local forms by their original authors, not subspecies in the modern sense. The proliferation of names in this case is not only the result of the particularly striking variability of this common species, but also due to a rather comical nomenclatural skirmish between Embrik Strand and Eugène Simon. Originally, Simon (1874) had refrained from formally naming what he obviously considered trivial variants. Instead, he referred to four principal deviations from the typical form as variants β, γ, ε, and ζ. Strand, in his well-known zeal for introducing new names, could not help himself but to name these variants formally. He based his names on literal translations of Simon's brief descriptions of each of the variants, and acknowledged that he was following Simon here, but still did not neglect to append to each name a proud "m." (="mihi", mine). Simon obviously did not appreciate this lack of courtesy and took very subtle (posthumous) revenge, knowing that Strand was on record as being easily offended by any indication that his naming efforts were not properly appreciated. Thus, Simon in 1929 only used one of the four names introduced by Strand (*leucomelas*), and even then he attributed the authorship to Zimmermann, who apparently had first used this name in a letter to Strand. For the other three varieties, he introduced his own names, without acknowledgement of Strand's earlier names, and in the case of *dimidiata* went so far as to suggest that this "might be" *C. c. pyrenaica*, thus making it clear that he was aware of Strand's work, but at the same time intentionally ignoring the fact that this name explicitly referred to the same variety he had described in 1874. The following equivalences hold between the varieties described by Strand and Simon: var. β = *defoliata* Strand = *triangulifera* Simon; var. γ = *pyrenaica* Strand = *dimidiata* Simon; var. ε = *albifoliata* Strand = *rubricauda* Simon; var. ζ = *leucomelas* Strand. No type material for any of these varieties seems to be extant, but there is no doubt that all of them are synonymous with *Cyclosa conica*, especially as Simon was well aware of the diversity of *Cyclosa* in western Europe and is unlikely to have confused this species with its congeners.

Misumena bicolor Simon, 1875 = **species inquirenda** (not *Misumena personata* Simon, 1916) **(Thomisidae)**
Misumena personata Simon, 1916 = *Misumena vatia* (Clerck, 1757) **syn. nov.** contra Lehtinen (2004) **(Thomisidae)**
This characteristically coloured close relative of *Misumena vatia* (Clerck, 1757) was originally described based on a single male from Corsica. It was described as differing from its sister species by having a deeply black prosoma with a beige-brown ocular region (black-brown with a broad light median band in *M. vatia*), a bright light-yellow opisthosoma covered by sparsely distributed short robust hairs (matte white with a darker pattern and without prominent hairs in *M. vatia*), and dark red-brown anterior pairs of legs, almost black on the femora, and white-beige posterior pairs (anterior pairs of legs broadly annulated in *M. vatia*). The pedipalp was beige-

brown, with the cymbium brownish and much narrower than in *M. vatia*. Lehtinen (2004) considered *M. bicolor* a senior synonym of *M. personata* Simon, 1916, but the original descriptions as well as an examination of material of the latter in Simon's collection show that this is unlikely to be correct: all male specimens of *M. personata* show the same colouration as typical *M. vatia*, i.e. a light median band on a brown prosoma, a darkly marked opisthosoma and broadly annulated anterior legs (MNHN Boc. 1488 "Les abeilles, Banyuls, VII-15", 8♀♀, 5♂♂; MNHN Boc. 1488 "Banyuls, VII-09", 1♂; MNHN Boc. 1488.21881 "Banyuls" 1♀, 1♂ [all syntypes?]), and the females are indistinguishable. The supposed subtle differences in the pedipalps, in particular a more strongly coiled embolus, are not clear, even in the electron micrographs provided by Lehtinen. We thus follow the earlier assessment by various authors who considered *M. personata* a synonym of *M. vatia*. Examination of the holotype of *M. bicolor*, in contrast, confirms that this is likely to be a different species. Its embolus is, if anything, *less* strongly coiled than in *M. vatia*, the cymbium is slightly narrower (although this may well be within the range of intraspecific variability), and even in its strongly bleached state the overall habitus of the specimen is distinct. Interestingly, two male thomisid specimens that very closely match the description of *Misumena bicolor* in all its details have recently been observed, but not collected, in Germany (Wiesbaden, 11 August 2012, and Gernsbach, 9 August 2015; both in the Rhine valley; **Fig. 11**). Simon initially suspected that *M. bicolor* might only be a colour morph of *M. vatia*, but the distinctive colouration, which cannot be explained by a general darkening of the pigmentation, makes this unlikely. Microscopic examination of newly collected material will be required to conclusively determine the status of this species, but for now we consider it a species inquirenda, a valid species waiting to be rediscovered.

Pardosa wagleri atra (Giebel, 1869) **nomen oblitum** = *Pardosa saturatior* Simon, 1937 **syn. nov. (Lycosidae)**
Pardosa wagleri atra was described by Giebel as *Lycosa atra*, based on a single female specimen from Gersau, at the banks of the Vierwaldstädter See, Switzerland. He considered the species, which he characterized by its uniformly velvet-black body, with dense grey hair on the prosoma and the sides of the opisthosoma, as a possible close relative of his alpine *Pardosa obscura* Giebel, 1867, which is currently considered a nomen dubium (Roewer 1955). The World Spider Catalog lists three later references to *Pardosa atra*, none of which, however, actually used Giebel's name: *Lycosa wagleri nigra* as used by Dahl (1908) and *Pardosa wagleri nigra* as used by Lessert (1910) are both by definition *Pardosa saturatior* Simon, 1937, as Simon specifically introduced this new name for Dahl's and Lessert's specimens, which are not *Pardosa nigra* (C. L. Koch, 1834). The specimens to which Schenkel (1925) referred as *Pardosa wagleri nigra* are still present in Schenkel's collection in Basel and are also *P. saturatior* (A. Hänggi, pers. comm.). The localities and discussion by Giebel would suggest that his *P. atra* might be *P. wagleri*, and *P. obscura* its alpine sister species *P. saturatior* (see Barthel & von Helversen 1990 for a discussion of the relationship and altitudinal distribution of the two species). However, examination of Giebel's type material of *Lycosa atra*, which is still extant in Halle, showed that this is not the case: the female holotype turns out to be *Pardosa*

Fig. 11. Habitus illustration of the holotype of *Misumena bicolor* from the original description (top left), pedipalp of the holotype in ventral view (top right), and habitus of two possible new specimens of *M. bicolor* from Wiesbaden (middle) and Gernsbach (bottom). (photos Rainer Breitling [top right], Marja Biecker [middle] and Manfred Zapf [bottom])

saturatior as well. The material of *Pardosa obscura* is lost, but possibly belonged either to the same species or to one of the numerous other *Pardosa* species occuring at the type locality on the Furka Pass (A. Hänggi, pers. comm.). This creates the problem that *Pardosa atra* is the older name and has precedence over Simon's *P. saturatior*. However, to our knowledge, *Pardosa atra* Giebel (or *Lycosa atra* Giebel) seems never to have been used as a valid name since 1899 in the sense of Article 23.9.1 of the ICZN. The brief mention of the name by Tongiorgi 1966, when trying to disentangle the confusing treatment in Roewer's catalogue, should not be taken into account in determining usage, according to ICZN art. 23.9.3, and the use of the younger homonym *Pardosa atra* Banks, 1894 (= *P. wyuta* Gertsch, 1934) also cannot be considered as usage of Giebel's name. In contrast, the younger synonym, *P. saturatior*, has been in prevailing use in a broad range of publications, being used "in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years" (for example, Barthel & von Helversen 1990, Blick & Scheidler 2004, Buchar &

Thaler 2002, Cardoso & Morano 2010, Chiarle et al. 2010, 2013, Framenau et al. 2002, Freundenthaler 2004, Gobbi et al. 2006a. 2006b, 2011, Hågvar 2012, Heimer & Nentwig 1991, Jäger 2000, Komposch 2011, Komposch et al. 2015, König et al. 2011, Kostanjšek & Kuntner 2015, Kuntner & Šereg 2002, Le Peru 2007, Manderbach & Framenau 2001, Maurer & Hänggi 1990, Paulus & Paulus 1997, Platen et al. 1995, 1996, Puzin et al. 2014, Raso et al. 2014, Růžička & Thaler 2002, Sint et al. 2012, 2014, 2015, Stratton 2005, Steinberger 1991, 1996, 2008, Thaler & Knoflach 1997, Zulka 2013). We therefore suggest, in accordance with Article 23.9.2. ICZN, treating *Lycosa atra* Giebel, 1869, as a **nomen oblitum** and considering the younger synonym, *Pardosa saturatior* Simon, 1937, as the valid and protected name of this species.

Singa hamata melanocephala C. L. Koch, 1836 =
nomen dubium (Araneidae)

This taxon was first described as a distinct species by Koch, based on a single male from Trieste (Italy), in the same paper that established the genus *Singa*, with *S. hamata* as the type species. According to the figures provided with the original description, the main distinctive characters are a lack of annulation on the orange legs of *S. melanocephala* and the blackened cephalic region of its otherwise reddish-brown prosoma (**Fig. 12**). It is almost certain that later references to this species (e.g., Westring 1861) refer to what is currently known as *Singa nitidula* C. L. Koch, 1844. For example, two females of the *melanocephala* form collected by L. Krohn in Sakkola (= Gromovo), Karelia, Russia, on 17.IX.1857 were determined by Thorell as *S. hamata*, as reported by Nordmann (1863), but later considered to be *S. nitidula* by Palmgren (1974), who examined the material in the Zoological Museum of Helsinki. When Koch described *L. nitidula*, he based the description on specimens with an entirely black prosoma and a darker opisthosomal pattern. Nevertheless, individuals of *S. nitidula* matching the description of *S. melanocephala* are not uncommon, and the unmarked orange legs are characteristic for this species. Simon, however, considered *melanocephala* as a variety

Fig. 12: Illustration of *Singa melanocephala,* accompanying the first description.

of *S. hamata*, following Walckenaer (1841), but the genitalia of his specimens (MNHN Boc. 2509.25698 "[Étang de] La Bonde – Sal[ins] d'Hyères", 11♀♀, 2♂♂) indicate that they belong in fact to *S. nitidula*. Simon's use of the name in 1929 precludes easy suppression of *Singa melanocephala* as a nomen oblitum, without submitting a case to the International Commission on Zoological Nomenclature. Given the overwhelmingly prevailing usage of *S. nitidula*, one of the very few names of a widely distributed spider species that have been uniformly accepted and applied since their first introduction, it might become necessary in the interests of stability to refer this matter to the ICZN for a ruling under the plenary power to suppress *S. melanocephala* for the purposes of priority according to ICZN Articles 23.9.3 and 81.2.3. For the time being, however, we feel that there is sufficient remaining doubt about the actual identity of *S. melanocephala*, as illustrated for instance by the treatment of the taxon by Simon (1929), to consider the name a nomen dubium and thus maintain the prevailing usage, independent of any future referral to the Commission. Moreover, given that cryptic species diversity has recently been reported in the related orbweaver genus *Hypsosinga* (Blagoev et al. 2013), there also remains the possibility that the black-headed morph of *H. nitidula* actually represents a distinct species.

Conclusions

Together with its predecessor (Breitling et al. 2015) this article clarifies the status of about 150 "phantom spiders" from Europe. This confirms our initial estimate that well over 5% of the spider taxa listed for Europe will turn out to be nomina dubia or synonyms of common species. The scale of the problem becomes obvious when imagining a similar situation for more charismatic groups of animals: would 26 species of phantom birds, 24 phantom butterflies or 12 species of phantom mammals be considered acceptable on the European checklists of the 21st century? One would have to go back to medieval times, when unicorns and mermaids roamed the zoologists' bestiaries, to find a comparable level of dubious information about any of these groups. Of course, just as in the case of the imaginary creatures of ancient lore, the experts will know which species are real and which taxa are highly dubious. But even for them, and even more so for beginning arachnologists, the continued presence of unidentifiable and misidentified taxa in standard databases causes an unnecessary burden when trying to identify difficult specimens. Our analysis has also demonstrated that the distinction between dubious and real species is not always trivial and that careful study is necessary to decide each individual case. We therefore renew our appeal to the broader community of arachnologists to join the phantom spider project and help clean up the taxonomic and faunistic records.

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Die Konusspinne *Cyclosa conica* (Araneae: Araneidae) ist die Europäische Spinne des Jahres 2016

Christoph Hörweg

Abstract. *Cyclosa conica* (Araneae: Araneidae) is the European spider of the year 2016. The European spider of the year 2016, *Cyclosa conica* (Pallas, 1772), is presented. Its appearance and characteristics (e.g., ecology, habitat, phenology) are briefly described. The modality of the voting is given as well as numerous links to the supporting societies and to distribution maps.

Keywords: Europe, popular, trash-line spiders

Zusammenfassung. Die europäische Spinne des Jahres 2016, *Cyclosa conica* (Pallas, 1772), wird vorgestellt. Ihre Merkmale und Eigenschaften (z. B. Ökologie, Lebensraum, Phänologie) werden kurz beschrieben. Der Wahlmodus und zahlreiche Links zu den unterstützenden Gesellschaften und Verbreitungskarten werden genannt.

Die Konusspinne oder Konische Kreisspinne *Cyclosa conica* (Pallas, 1772), gehört zur Familie der Echten Radnetzspinnen (Araneidae). Diese Spinnenfamilie zählt weltweit 3114 Arten (World Spider Catalog 2016) und in Europa 130 (Nentwig et al. 2016). Die Gattung *Cyclosa* ist in Mitteleuropa mit zwei Arten vertreten (Blick et al. 2004, Nentwig et al. 2016).

Die Körperlänge beträgt bei Weibchen 6-8 mm, Männchen sind mit 4-4,5 mm um einiges kleiner. Der Vorderkörper ist durchgehend dunkelbraun-schwarz, die Beine dunkelbraun, schwarz geringelt. Der Hinterkörper ist variabel gefärbt, dorsal dunkel rotbraun-schwarz, oft mit weißer Zeichnung, ventral dunkelbraun mit 2 weißen Längsflecken und hinten mit einem dorsalen, konusförmigen Höcker (namensgebend! – siehe Abb. 4), der die Spinnwarzen überragt (Reichholf & Steinbach 1997, Bellmann 2006, Nentwig et al. 2016; Links zu Bildern siehe unten).

Während die Spinne selbst wenig auffällig ist, kann man ihr Netz leicht entdecken. *Cyclosa conica* baut ein kreisförmiges, sehr regelmäßiges und engmaschiges Radnetz, das meist in etwa 1,5 m Höhe über dem Boden angelegt wird (Wiehle 1931, Bellmann 2006, Zschokke & Bolzern 2007) (Abb. 1). Diese Netzform hat der Gattung den Namen „Kreisspinnen" eintragen, und daher auch der deutsche Name Konische Kreisspinne (Buchholz et al. 2010). In der Mitte des Netzes wird meist, aber nicht immer ein dicht gesponnenes senkrechtes Band (Stabiliment) eingebaut (Marples & Marples 1937), auf dem die Spinne sitzt und in das oft Pflanzenteile und Beutereste eingewebt werden (Wiehle 1929, 1931, Tso 1998, Zschokke & Bolzern 2007) (Abb. 2). Daher werden Spinnen dieser Gattung im Englischen oft auch „trash line spiders" genannt.

In dem mit Beuteresten behängten Gespinst ist die Spinne oft nur schwer zu entdecken. Da liegt die Vermutung nahe, dass die Detritus-Stabilimente, wie sie von *Cyclosa* verwendet werden, zur Tarnung der Spinne dienen, sprich als Schutz vor Feinden, und weniger zur Anlockung von Beuteinsekten, wie dies für Stabilimente in anderen Radnetzen oft vermutet wird (Herberstein et al. 2000, Zschokke & Bolzern 2007). Tso (1998) hat bei Freilanduntersuchungen allerdings festgestellt, dass *C. conica* in Netzen mit Stabiliment mehr Insekten fängt

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Abb. 1: Radnetz von *Cyclosa conica* (Foto: Heiko Bellmann/Frank Hecker)
Fig. 1: Orb-web of *Cyclosa conica* (photo: Heiko Bellmann/Frank Hecker)

als in Netzen ohne. Bei Störungen versetzt die Konusspinne das Netz außerdem in Schwingungen, sodass ihre Umrisse fast komplett verschwinden können (Wiehle 1931).

Sowohl Männchen also auch Weibchen der Konusspinnen sind von Frühling bis Herbst (März/April bis September/Oktober) aktiv (Nentwig et al. 2016). Schaefer (1976) nennt einen stenochronen Jahreszyklus mit Fortpflanzungsperiode im Frühjahr und Sommer. Die Eiablage erfolgt im Hochsommer an einem Zweig in der Nähe des Netzes, wobei der Eikokon (mit 50-60 Eiern) von gelblich schimmernden Seidenfäden umwoben wird (Wiehle 1931) (Abb. 3).

Die Konusspinne ist holarktisch verbreitet und kommt in ganz Europa vor. Ihre Vertikalverbreitung reicht bis in die obere Montanstufe auf ca. 1600m Seehöhe (Wiehle 1931, Hänggi et al. 1995, Thaler & Knoflach 2003). Die Art ist generell als arborikol, auf Bäumen lebend, zu bezeichnen und kommt in mäßig trockenen bis trockenen Wäldern vor. Sie bevorzugt lichte Nadelwälder. In Laubwäldern kommt sie seltener vor (Braun & Rabeler 1969, Kreuels & Platen 2000). Man findet sie aber auch an Waldwegen und in Trockenrasen.

Die bekannte Verbreitung im deutschsprachigen Raum bzw. in Europa ist den einzelnen Verbreitungskarten (Helsdingen 2016, CSCF 2016, Staudt 2016, weitere Links siehe unten) zu entnehmen.

Die Schwesterart *Cyclosa oculata* ist viel seltener, in Mitteleuropa nur an warmen Stellen im Juni und Juli zu finden

Abb. 2 links: *Cyclosa conica* gut getarnt im Stabiliment mit eingewebten Beuteresten (Foto: Heiko Bellmann/Frank Hecker)
Fig. 2 left: *Cyclosa conica* hidden in the stabilimentum with wrapped prey-remains (photo: Heiko Bellmann/Frank Hecker)

Abb. 3 rechts: Kokon von *Cyclosa conica* (Foto: Heiko Bellmann/Frank Hecker)
Fig. 3 right: Egg-sac of *Cyclosa conica* (photo: Heiko Bellmann/Frank Hecker)

(Nentwig et al. 2016), das zeigen auch die Frequenzlisten für Deutschland mit nur einem Viertel Meldungen gegenüber der Konusspinne, und einer weitaus geringeren Rasterhäufigkeit (Staudt 2016: http://www.spiderling.de/arages/Frequenzen.php). Sie ist wärmeliebend und kommt an Gräsern auf sonnigen und trockenen Wiesen vor. Das Netz baut sie in unmittelbarer Bodennähe (Wiehle 1929, Reichholf & Steinbach 1997, Zschokke & Bolzern 2007). Die Färbung von *C. oculata* ist ähnlich wie bei *C. conica*, allerdings hat der Hinterkörper dorsal drei Höcker, und ist damit gut von *C. conica* zu unterscheiden (Bellmann 2006).

Abb. 4: *Cyclosa conica* – Frontalansicht zeigt den dorsalen konusartigen Höcker (Foto: Dragiša Savić)
Fig. 4: *Cyclosa conica* – frontal view showing the dorsal conus-like protuberance (photo: Dragiša Savić)

Wahl der Europäischen Spinne des Jahres

Die Spinne des Jahres wurde von 78 Arachnologinnen und Arachnologen aus 26 Ländern gewählt. Der Hauptgrund für die diesjährige Wahl ist die Auffälligkeit dieser Art. Durch den konischen Hinterleib ist sie gut zu erkennen, und auch das sehr regelmäßige engmaschige Netz, das mit einem Stabiliment versehen ist, erleichtert die Erkennbarkeit. Mit der Wahl der Spinne des Jahres soll sicher eine wenig beliebte Tiergruppe ins rechte Licht gerückt werden, aber gleichzeitig erhoffen sich die Wissenschaftler auch, Daten zur aktuellen Verbreitung zu bekommen. In diesem Sinne: erfreuen Sie sich an der Spinne des Jahres und helfen Sie mit ihrer Fundmeldung oder ihrem Foto bei der Dokumentation dieser Art. Diese(s) bitte an den Autor schicken.

Unterstützende Gesellschaften

Arachnologische Gesellschaft e.V. AraGes
http://www.arages.de
Belgische Arachnologische Vereniging/Société Arachnologique de Belgique ARABEL http://www.arabel.ugent.be
The British Arachnological Society (BAS)
http://www.britishspiders.org.uk
Česká arachnologická společnost (CAS)
http://arachnology.cz
European Invertebrate Survey-Nederland, Section SPINED
http://science.naturalis.nl/research/people/cv/eis/helsdingen/spinnen
European Society of Arachnology ESA http://www.european-arachnology.org
Grupo Ibérico de Aracnología (GIA) – Sociedad Entomológica Aragonesa (SEA) http://www.sea-entomologia.org/gia/
Naturdata – Biodiversidade online http://www.naturdata.com

Verbreitungskarten

Der letzte Zugriff auf alle hier genannten Datenseiten erfolgte am 5. Juli 2016.

Benelux
http://www.tuite.nl/iwg/Araneae/SpiBenelux/?species=Cyclosa%20conica

Deutschland
http://spiderling.de/arages/Verbreitungskarten/species.php?name=cyccon

Großbritannien
http://srs.britishspiders.org.uk/portal.php/p/Summary/s/Cyclosa%20conica

Österreich
http://arages.de/wp-content/uploads/2015/12/Cyclosa_conica_Oesterreich.pdf

Schweiz
http://lepus.unine.ch/carto/index.php?nuesp=9102&rivieres=on&lacs=on&hillsh=on&data=on&year=2000

Tschechische Republik
http://www.pavouci-cz.eu/Pavouci.php?str=Cyclosa_conica

Europa
http://spiderling.de/arages/OverviewEurope/euro_species.php?name=cyccon
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http://www.faunaeur.org/Maps/display_map.php?map_name=euro&map_language=en&taxon1=348452

Bilder und weiterführende Informationen

Der letzte Zugriff auf alle hier genannten Datenseiten erfolgte am 5. Juli 2016.

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Das Höhlenlangbein *Amilenus aurantiacus* (Opiliones: Phalangiidae) ist Höhlentier des Jahres 2016 in Deutschland

Stefan Zaenker, Axel L. Schönhofer & Theo Blick

Abstract. *Amilenus aurantiacus* (Opiliones: Phalangiidae) is the Cave Animal of the Year 2016 in Germany. With the nomination of the 'Cave Animal of the Year' the Society of German Cave and Karst Explorers calls public and authorities' attention to the understudied biodiversity of subterranean ecosystems. Here the Cave Animal of the Year 2016, *Amilenus aurantiacus* (Simon, 1881), is presented. It is the first time that a harvestman has been chosen. Its ecology, habitat and morphology are described. New records from Hesse, Bavaria, Baden-Württemberg and North Rhine-Westphalia are listed and discussed.

Keywords: biospeleology, harvestman, new records

Zusammenfassung. Der Verband der deutschen Höhlen- und Karstforscher weist mit der Wahl des ‚Höhlentieres des Jahres' Öffentlichkeit und Behörden auf die kaum bekannte zoologische Artenvielfalt in unterirdischen Lebensräumen hin. Das Höhlentier des Jahres 2016, das Höhlenlangbein *Amilenus aurantiacus* (Simon, 1881), wird vorgestellt. Erstmals ist es ein Weberknecht. Die Merkmale und Eigenschaften (z. B. Ökologie, Lebensraum, Erscheinungsbild) werden kurz beschrieben. Neue Funde aus Hessen, Bayern, Baden-Württemberg und Nordrhein-Westfalen werden aufgelistet und diskutiert.

Seit 2009 kürt der Verband der deutschen Höhlen- und Karstforscher ein Höhlentier des Jahres. Zum zweiten Mal ist dabei die Wahl auf ein Spinnentier gefallen. Nach der Wahl der Großen Höhlenspinne (*Meta menardi*) im Jahr 2012 (Hörweg et al. 2011) ist das aktuelle Höhlentier ein Weberknecht, das Höhlenlangbein *Amilenus aurantiacus* (Simon, 1881) (Abb. 1).

Morphologie und Ökologie

Mit auffallend langen Beinen entspricht das Höhlenlangbein dem generellen Erscheinungsbildes eines mitteleuropäischen Weberknechtes. Auf dem Hinterleib findet sich eine markante lyraförmige Zeichnung (ein gespiegeltes „z"), die beim Männchen wenig kontrastreich (Abb. 2), beim Weibchen (Abb. 3) und den Jungtieren deutlicher auf hellem Untergrund zu erkennen ist. Die Körperlänge (ohne Beine) der Männchen beträgt 2,8 bis 3,3 mm, die der Weibchen 3,5 bis 5,5 mm.

Das Höhlenlangbein lebt in Wäldern aller Art, in den Alpen hauptsächlich in montanen Buchenwald-Gesellschaften und in Nadelwäldern der unteren Subalpinstufe oder in Bachauen (Martens 1978). Hier verbringen die Weberknechte das Sommerhalbjahr in der Bodenschicht unter Steinen und Holz, in Falllaub und Bodenstreu, gelegentlich in der Krautschicht feuchter Pflanzengesellschaften (Martens 1978, Bellmann 2001). Das Höhlenlangbein ist eine subtroglophile Art (Weber 2001, Zaenker 2001, Muster et al. 2013 – zur Einstufung der Höhlenbindung vgl. auch Sket 2008), die in Höhlen- und Spaltensystemen überwintert, in denen die Temperatur nicht oder nur geringfügig unter den Gefrierpunkt sinkt. Die bereits früh im Jahr reifen Tiere legen im Frühjahr oder Frühsommer ihre Eier am Waldboden ab. Die Jungtiere entwickeln sich bis zum Herbst zum Subadultstadium. Ab September beginnen sie in Höhlen und unterirdi-

Abb. 1: Poster zum Höhlentier des Jahres 2016 (Foto: Klaus Bogon)
Fig. 1: Poster advertising the Cave Animal of the Year 2016 (photo: Klaus Bogon)

sche Spaltensysteme vorzudringen. Dort können sich große Gesellschaften von Hunderten oder gar Tausenden von Individuen zusammenfinden, um die Reifehäutung durchzumachen und den Winter zu überdauern. Zur Häutung krallen sich die Tiere an der Höhlendecke fest und ziehen die Beine schleifenförmig aus ihren Hüllen heraus. Mit Eintritt des Frühlings verlassen sie die schützenden Höhlen- und Spaltensysteme. Adulte Tiere treten von Dezember bis Juli auf. Die lokal unterschiedliche Häufigkeit von *A. aurantiacus* wird

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Abb./Fig. 2: Männchen von/Male of *Amilenus aurantiacus* (Foto: Klaus Bogon)

Abb./Fig. 3: Weibchen von/Female of *Amilenus aurantiacus* (Foto: Klaus Bogon)

durch die Existenz von Spalten- und Höhlensystemen mitbestimmt (Martens 1978, Bellmann 2001).

Taxonomie und Verbreitung

Amilenus aurantiacus gehört zur Familie der Phalangiidae (deutsch: Schneider). In Europa sind 142 Phalangiidae-Arten aus 35 Gattungen bekannt (Martens 2013), in Deutschland leben 22 Arten (Muster et al 2016). Das Höhlenlangbein ist die einzige Art der Gattung *Amilenus*.

Das Verbreitungsgebiet des Höhlenlangbeins erstreckt sich von den französischen Westalpen über den gesamten Alpenbogen (Schweiz, Deutschland, Österreich, N-Italien, Slowenien), Belgien, Luxemburg, lokal in Ungarn (Murányi 2005) und auf der westlichen Balkanhalbinsel bis ins nördliche Griechenland (Martens 1969, 1978). In Deutschland war die Art bis Martens (1978) aus dem Alpenraum, aus dem Schwarzwald, der Schwäbischen Alb und mit einem Fundorten aus dem Spessart (Unterfranken, Bayern) bekannt (Abb. 4). Seither hat sich das Wissen um die Verbreitung nördlich der Alpen erheblich erweitert. Nachweise aus dem Saarland, Rheinland-Pfalz, dem Odenwald, Spessart, Thüringen, dem Mittel- und Südharz, dem Kyffhäuser und dem Zittauer Gebirge sind hinzugekommen (Bliss 1982, Eckert & Moritz 1998, Weber 2001, 2012, Zaenker 2001, Staudt 2016) (Abb. 5).

Neue Funde

In Tab. 1 werden neue Nachweise der Art seit Zaenker (2001) aus den Bundesländern Hessen, Bayern, Baden-Württemberg und Nordrhein-Westfalen aufgelistet. Die Funde im hessischen Höhlenkatastergebiet wurden im Rahmen der jährlichen Fledermaus-Winterkontrollen und biospeläologischen Untersuchungen gemacht. Der Erstnachweis für die Fränkische Alb gelang Christa Locke (Höchstadt an der Aisch). Die Fundorte im Hönnetal bei Hemer (Nordrhein-Westfalen) wurden im Rahmen des biospeläologischen Seminars des Verbandes der deutschen Höhlen- und Karstforscher entdeckt. In Tab. 1 ist dem Objektnamen die Katasternummer des jeweiligen Höhlenkatasters vorangestellt. In der Regel ist das die Nummer der TK 25 (Messtischblatt) gefolgt von einer laufenden Katasternummer. In der Fränkischen Alb sind die Höhlengebiete mit Buchstaben gekennzeichnet, denen eine laufende Nummer folgt. Die Nummerierung der Naturhöhlen in den Alpen und im Voralpenland (südlich der Donau) ist an das System in Österreich angegliedert (vgl. http://lhk-

Amilenus aurantiacus
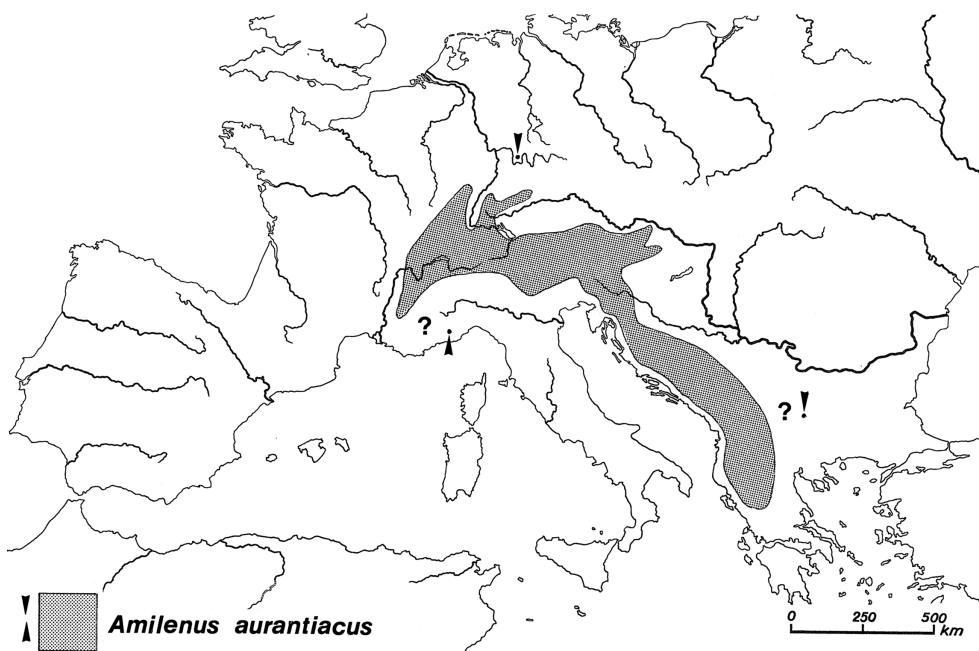
Abb. 4: Verbreitung von *Amilenus aurantiacus* in Europa, Stand 1978 (Martens 1978: S. 374, Abb. 726)
Fig. 4: Distribution of *Amilenus aurantiacus* in Europe, as of 1978 (Martens 1978: p. 374, Fig. 726)
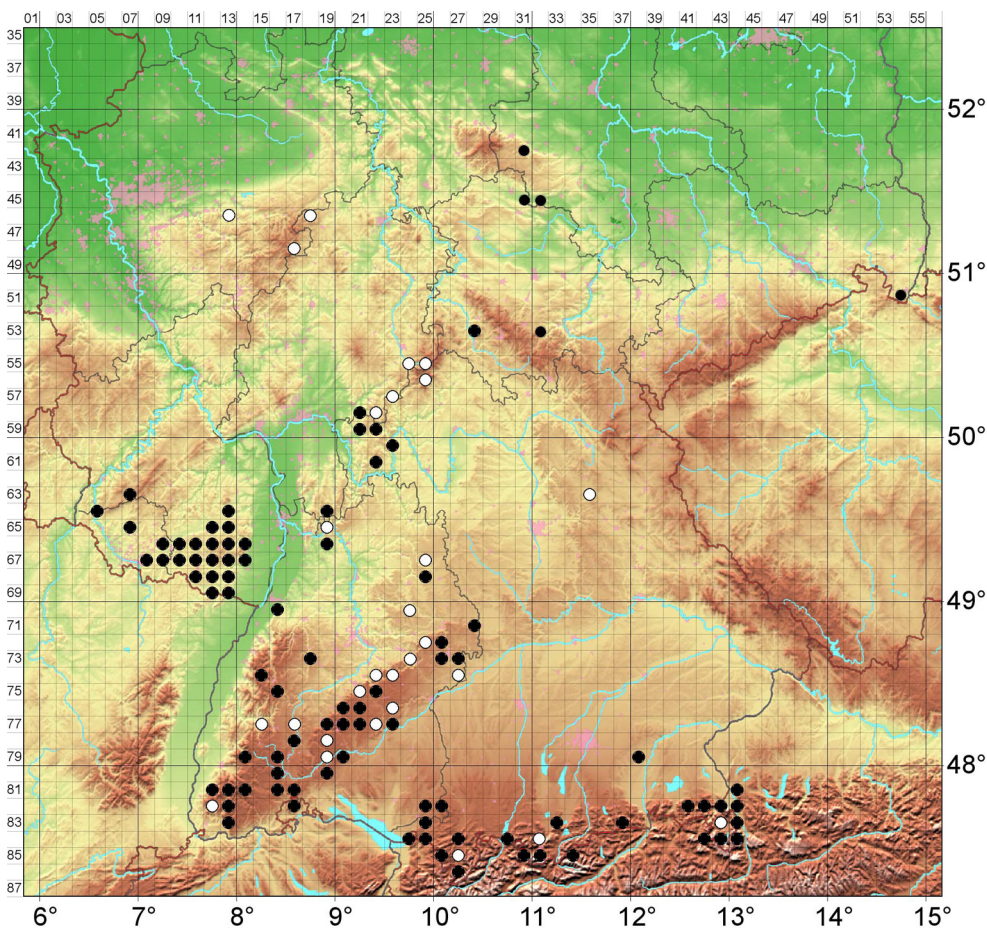
Abb. 5: Karte der Nachweise von *Amilenus aurantiacus* in Deutschland, wo die Verbreitung am Nordrand der Mittelgebirge endet; weiße Punkte: neue Funde (Tab. 1), schwarze Punkte: übrige Nachweise (Staudt 2016)

Fig. 5: Map of records of *Amilenus aurantiacus* in Germany, its distribution ends at the northern border of the low mountain ranges; white dots: new records (Tab. 1), black dots: other records (Staudt 2016)

bayern.de/hkatalpen/index.php); künstliche Objekte werden hier nicht nummeriert. Die TK 25-Nummer ist daher für die Fundorte in der Fränkischen Schweiz und südlich der Donau vor dem Objektnamen beigefügt.

Die Belegexemplare wurden von SZ und AS bestimmt und befinden sich in der Sammlung des „Biospeläologischen Katasters von Hessen" des Erstautors. In Klammern sind Angaben zu den beobachteten Tieren beigefügt.

Diskussion

Im Rahmen der systematischen biospeläologischen Erfassung der deutschen Höhlentiere konnte die Art nun erstmals für die Fränkische Alb nachgewiesen weiten. Im Höhlenkatastergebiet Hessen, das das Bundesland Hessen und auch angrenzende Regionen abdeckt, wurden in den letzten Jahren neue Funde im Spessart, Vorkommen in der hessischen und bayerischen Rhön, an der hessisch-nordrhein-westfälischen Grenze im Hochsauerland (Rothaargebirge) und am Ostsauerländer Gebirgsrand sowie nordwestlich davon im Bergisch-Sauerländischen Unterland (Hönnetal bei Hemer) gefunden, wo die Art in großer Anzahl in Bergwerksstollen überwintert.

Martens (1978, Abb. 4) gibt noch das Elsass und die Schwäbische Alb als Nordwestgrenze der alpin-dinarisch verbreiteten Art an. Die Funde von Bliss (1982), Eckert & Moritz (1998), Weber (2001, 2012), Zaenker (2001), Vanhercke (2010), Muster et al. (2013), Muster & Meyer (2014) sowie die vorliegende Arbeit erweiterten das bekannte Areal deutlich nach Norden, einerseits innerhalb Deutschlands und andererseits nach Luxemburg und Belgien. Es ist aber unklar ob eine rezente Arealerweiterung vorliegt oder ob die Art aufgrund der spezifischen Lebensweise in Höhlen und Spalten-

systemen und der Reifezeit im Frühjahr bisher nur übersehen wurde (Muster & Meyer 2014).

Wahl zum Höhlentier des Jahres

Die Abhängigkeit von unterirdischen Habitaten führte dazu, dass das Höhlenlangbein zum ‚Höhlentier 2016' (http://www.hoehlentier.de) gewählt wurde. Die Art steht für eine große Zahl an Tierarten, die auf geschützte und frostfreie Rückzugsorte unter Tage angewiesen sind. Der Verband der deutschen Höhlen- und Karstforscher will mit der Wahl des Höhlentieres darauf hinweisen, dass ganz besonders bei der Erforschung der unterirdischen Ökosysteme und der darin vorkommenden und von ihnen abhängigen Arten noch enormer Handlungsbedarf besteht. Unterstützt wurde die Wahl des Höhlentieres 2016 von der Arachnologischen Gesellschaft, womit die enge und erfolgreiche Zusammenarbeit zwischen den Höhlenbiologen und den Spezialisten für die Höhlentiere zum Ausdruck kommt. Arachnologen sind immer wieder auf die Ortskenntnisse und Techniken der Höhlenforscher (Speläologen) angewiesen, um die Forschungsobjekte aus den unterirdischen Lebensräumen zu erhalten.

Tab. 1: Neue Nachweise von *Amilenus aurantiacus* seit Zaenker (2001) aus Hessen, Bayern, Baden-Württemberg und Nordrhein-Westfalen (vgl. Erläuterungen im Text)
Tab. 1: New records of *Amilenus aurantiacus* since Zaenker (2001) from Hesse, Bavaria, Baden-Württemberg und North Rhine-Westphalia (see also comments in the text)

Objektname	°N	°O	m ü. NN	Objekttyp	Bundesland	Landkreis	Gemeinde	Region	Fangdaten, Material
4613/002 Tunnelhöhle	51,378	7,854	220	Naturhöhle	Nordrhein-Westfalen	Märkischer Kreis	Balve	Bergisch-Sauerländisches Unterland	9.4.2016 1♂/1♀
4613/003 Friedrichshöhle	51,378	7,853	219	Naturhöhle	Nordrhein-Westfalen	Märkischer Kreis	Balve	Bergisch-Sauerländisches Unterland	9.4.2016 1♂/1♀
4618/028 Bismarckstollen	51,386	8,793	355	Bergwerksstollen	Hessen	Waldeck-Frankenberg	Diemelsee	Ostsauerländer Gebirgsrand	16.2.2014 1♀, 28.2.2015 1♂/2♀♀ (zahlreiche Ex. beob.), 14.2.2016 1♀ (mehrere Ex. beob.)
4817/902 Stollen Bromskirchen Hoher Stein	51,103	8,585	620	Bergwerksstollen	Nordrhein-Westfalen	Hochsauerlandkreis	Hallenberg	Hochsauerland (Rothaargebirge)	11.2.2012 1♀, 15.2.2014 2♂♂/2♀♀ (zahlreiche weitere Ex.), 21.2.2015 2♀♀ (zahlreiche weitere Ex.), 13.2.2016 1♂/1♀ (zahlreiche weitere Ex.)
5524/01 Felsenkeller in Hettenhausen	50,450	9,821	390	Felsenkeller	Hessen	Fulda	Gersfeld (Rhön)	Vorder- und Kuppenrhön	13.4.2010 1♂/1♀, 24.1.2011 2♂♂/1♀ (zahlreiche Ex. beob.)
5525/05 Stollen am Großen Nallenberg	50,445	9,885	700	Bergwerksstollen	Hessen	Fulda	Gersfeld (Rhön)	Vorder- und Kuppenrhön	27.3.2013 1♀, 7.3.2016 1♀
5625/902 Grube Marie, Unterer Stollen	50,364	9,888	460	Bergwerksstollen	Bayern	Bad Kissingen	Wildflecken	Hohe Rhön	28.1.2007 1♂/2♀♀ (ca. 50 Ex. beob.)
5723/02 Müllbruchhöhle	50,263	9,531	265	Naturhöhle	Hessen	Main-Kinzig-Kreis	Steinau an der Straße	Sandsteinspessart	18.5.2007 3♂
5723/03 Trümmerhöhle	50,263	9,527	250	Naturhöhle	Hessen	Main-Kinzig-Kreis	Steinau an der Straße	Sandsteinspessart	18.5.2007 1♀
5723/902 Bahnbrücke Jossa	50,238	9,599	200	Brücken-Wartungskammer	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	8.2.2014 1♀ (mehrere Ex. beob.)
5723/904 Eisenbahnüberführung beim Abzweig Zeitlofs	50,266	9,642	240	Gemauerter Tunnel	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	8.2.2014 1♀, 17.1.2015 (zahlreiche Ex. beob.), 1.3.2016 (mehrere Ex. beob.)
5723/906 Eisenbahnüberführung bei Bahnkilometer 26,391	50,279	9,648	280	Betonierter Tunnel	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	9.2.2013 1♂/2♀♀ (zahlreiche Ex. beob.), 8.2.2014 1♀ (zahlreiche Ex. beob.), 17.1.2015 1♀ (zahlreiche Ex. beob.), 25.1.2016 1♀ (zahlreiche Ex. beob.)
5723/907 Wasserdurchlass bei Bahnkilometer 26,65	50,276	9,648	290	Wasserdurchlass	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	8.2.2014 1♀ (mehrere Ex. beob.)
5723/909 Wasserdurchlass Limbach	50,285	9,647	290	Wasserdurchlass	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	8.2.2014 1♀ (mehrere Ex. beob.), 17.1.2015 (zahlreiche Ex. beob.), 25.1.2016 1♀ (zahlreiche Ex. beob.)

Objektname	°N	°O	m ü. NN	Objekttyp	Bundesland	Landkreis	Gemeinde	Region	Fangdaten, Material
5723/910 Wasserdurchlass beim Bahnhof Jossa	50,231	9,609	220	Wasserdurchlass	Hessen	Main-Kinzig-Kreis	Sinntal	Sandsteinspessart	8.2.2014 2♀♀, 1.3.2016 1♀ (mehrere Ex. beob.)
5822/01 Große Höhle im Beilstein	50,170	9,403	460	Naturhöhle	Hessen	Main-Kinzig-Kreis	Jossgrund	Sandsteinspessart	17.3.2001 4♂♂/2♀♀ (ca. 100 Ex. beob.), 12.3.2007 2♂♂ (ca. 50 Ex. beob.), 13.11.2007 (zahlreiche Ex. beob.), 5.2.2011 1♂/1♀, 9.2.2013 (zahlreiche Ex. beob.), 17.1.2015 (zahlreiche Ex.beob.), 1.3.2016 1♂ (zahlreiche Ex. beob.)
5822/02 Kleine Höhle im Beilstein	50,170	9,403	460	Naturhöhle	Hessen	Main-Kinzig-Kreis	Jossgrund	Sandsteinspessart	17.3.2001 1♂, 12.3.2007 1♂/2♀, 18.5.2007 1♂/1♀
5822/03 Casselgrundstollen	50,181	9,346	315	Bergwerksstollen	Hessen	Main-Kinzig-Kreis	Biebergemünd	Sandsteinspessart	30.1.2010 1♂/2♀♀ (zahlreiche Ex. beob.)
A 32 [6335] Breitensteinerbäuerin	49,609	11,592	484	Naturhöhle	Bayern	Amberg-Sulzbach	Königstein	Fränkische Alb	22.4.2012 1♂
6519/01 Leonhardsklause	49,458	8,870	190	Naturhöhle	Hessen	Bergstraße	Hirschhorn (Neckar)	Sandsteinodenwald	10.10.2010 1juv, 4.11.2010 4juv.
6725/01 Heinzengrabenhöhle	49,265	9,993	550	Naturhöhle	Baden-Württemberg	Schwäbisch Hall	Rot am See	Hohenloher Ebene	26.4.2014 1♂/1♀/1juv. (mehrere Ex. beob.), 30.8.2014 1juv. (zahlreiche Ex.beob.)
7024/09a-c Brunnenklingenhöhlen 1-3	48,920	9,672	510	Naturhöhle	Baden-Württemberg	Rems-Murr-Kreis	Kaisersbach	Schwäbisch-Fränkischer Wald	16.3.2014 (mehrere Ex. beob.), 29.8.2014 2juv. (mehrere Ex. in der Höhle)
7225/04 Falkenhöhle	48,744	9,927	710	Naturhöhle	Baden-Württemberg	Ostalbkreis	Bartholomä	Schwäbische Alb	14.9.2013 (mehrere Ex. beob.), 13.4.2014 (zahlreiche Ex. beob.), 20.12.2014 (zahlreiche Ex. beob.)
7225/25 Teufelsklingenbröller	48,770	9,942	617	Naturhöhle	Baden-Württemberg	Ostalbkreis	Heubach	Schwäbische Alb	26.10.2012 2juv. (zahlreiche Ex. beob.)
7225/96 Saalamandern-Höhle	48,781	9,917	705	Naturhöhle	Baden-Württemberg	Ostalbkreis	Heubach	Schwäbische Alb	17.3.2013 1♀
7324/01 Kahlensteinhöhle	48,601	9,809	660	Naturhöhle	Baden-Württemberg	Göppingen	Bad Überkingen	Schwäbische Alb	13.4.2014 (mehrere Ex. beob.), 15.12.2014 1juv. (zahlreiche Ex. beob.)
7422/ Stollen neben der Falkensteiner Höhle	48,515	9,453	580	Bergwerksstollen	Baden-Württemberg	Reutlingen	Grabenstetten	Schwäbische Alb	28.9.2013 1juv.
7422/02 Falkensteiner Höhle	48,515	9,453	620	Naturhöhle	Baden-Württemberg	Reutlingen	Grabenstetten	Schwäbische Alb	28.9.2013 1juv.
7422/03 Veronikahöhle	48,583	9,472	735	Naturhöhle	Baden-Württemberg	Esslingen	Owen	Schwäbische Alb	15.12.2013 (1 Ex. beob.)
7422/10 Sibyllenhöhle	48,680	9,472	763	Naturhöhle	Baden-Württemberg	Esslingen	Owen	Schwäbische Alb	10.3.2013 (zahlreiche Ex. beob.), 27.12.2013 (2 Ex. beob.)

Objektname	°N	°O	m ü. NN	Objekttyp	Bundesland	Landkreis	Gemeinde	Region	Fangdaten, Material
7422/20 Elsachbröller	48,518	9,451	567	Naturhöhle	Baden-Württemberg	Reutlingen	Grabenstetten	Schwäbische Alb	6.12.2014 1juv. (zahlreiche Ex. beob.)
7422/23 Barnberghöhle	48,527	9,404	649	Naturhöhle	Baden-Württemberg	Esslingen	Neuffen	Schwäbische Alb	26.10.2014 (zahlreiche Ex. beob.)
7423/11 Todsburger Höhle	48,566	9,649	748	Naturhöhle	Baden-Württemberg	Göppingen	Mühlhausen im Täle	Schwäbische Alb	13.4.2014 (zahlreiche Ex. beob.), 11.9.2014 3juv. (zahlreiche Ex. beob.)
7427/03 Charlottenhöhle	48,584	10,209	488	Schauhöhle	Baden-Württemberg	Heidenheim	Giengen an der Brenz	Schwäbische Alb	8.10.2013 (mehrere Ex. beob.), 11.1.2014 1♀, 17.2.2014 1♀ (mehrere Ex. beob.)
7521/09 Glemser Höllenloch	48,499	9,322	720	Naturhöhle	Baden-Württemberg	Reutlingen	Metzingen	Schwäbische Alb	7.12.2014 1juv.
7623/06 Bärentalhöhle	48,373	9,639	622	Naturhöhle	Baden-Württemberg	Alb-Donau-Kreis	Schelklingen	Schwäbische Alb	24.10.2014 1juv. (zahlreiche Ex. beob.)
7715/01 Hohler Stein bei Lehengericht	48,259	8,330	790	Naturhöhle	Baden-Württemberg	Rottweil	Schiltach	Schwarzwald	15.9.2013 1juv. (zahlreiche Ex. beob.)
7715/01 Hohler Stein bei Lehengericht	48,259	8,330	790	Naturhöhle	Baden-Württemberg	Rottweil	Schiltach	Schwarzwald	30.11.2014 1juv. (zahlreiche Ex. beob.)
7717/02 Haugenloch	48,293	8,562	480	Naturhöhle	Baden-Württemberg	Rottweil	Oberndorf am Neckar	Oberes Neckartal	30.11.2014 (zahlreiche Ex. beob.)
7722/01 Wimsener Höhle	48,257	9,449	557	Naturhöhle	Baden-Württemberg	Reutlingen	Hayingen	Schwäbische Alb	17.11.2012 (mehrere Ex. beob.), 22.2.2013 1♂/1♀, 9.2.2014 (mehrere Ex. beob.)
7819/02 Dörrhaldenhöhle	48,104	8,864	550	Naturhöhle	Baden-Württemberg	Tuttlingen	Königsheim	Schwäbische Alb	6.4.2014 1♂ (mehrere Ex. beob.)
7919/32 Wulfbachquellhöhle	48,042	8,890	650	Naturhöhle	Baden-Württemberg	Tuttlingen	Mülheim an der Donau	Schwäbische Alb	21.10.2012 2juv. (mehrere Ex. beob.), 6.4.2014 (mehrere Ex. beob.)
8212/01 Schallsinger Höhle	47,768	7,669	552	Naturhöhle	Baden-Württemberg	Lörrach	Schliengen	Schwäbische Alb	1.11.2014 3juv. (zahlreiche Ex. beob.)
1337/01 [8343] Schwarzbachloch	47,639	12,849	775	Naturhöhle	Bayern	Berchtesgadener Land	Ramsau bei Berchtesgaden	Nördliche Kalkalpen	27.2.2010 2♀♀, 1.9.2015 9juv.
1338/03 [8343] Schneiderloch	47,662	12,846	640	Naturhöhle	Bayern	Berchtesgadener Land	Schneizlreuth	Nördliche Kalkalpen	23.2.2008 1♂/1♀, 1.9.2015 3juv.
1338/04 [8343] Schusterloch im Lattengebirge	47,661	12,846	630	Naturhöhle	Bayern	Berchtesgadener Land	Schneizlreuth	Nördliche Kalkalpen	23.2.2008 1♂, 1.9.2015 1 juv.
[8432] Stollen im Laber	47,589	11,080	930	Bergwerksstollen	Bayern	Garmisch-Partenkirchen	Oberammergau	Nördliche Kalkalpen	8.1.2016 1♂/3juv.
1151/08 [8527] Gamsbockloch	47,425	10,169	1347	Naturhöhle	Bayern	Oberallgäu	Obermaiselstein	Nördliche Kalkalpen	21.4.2012 2♂♂/1♀, 20.9.2012 1♂/1♀, 23.2.2014 1♂, 24.7.2015 2♂♂/1♀

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In memoriam Dr. Bodo von Broen 6.1.1933–17.8.2015

Im Sommer des vergangenen Jahres mussten wir Abschied nehmen von Dr. sc. nat. Bodo von Broen, der in seinem 83. Lebensjahr in Berlin verstarb. Die Unterzeichneten, die stellvertretend stehen mögen für viele aus seinem engeren Lebenskreis, die ihn schätzten und verehrten, wollen hiermit ihrem Freunde und Kollegen Bodo ein Zeichen der Verbundenheit und Dankbarkeit widmen.

Bodo wuchs in der Oberlausitzer Kreisstadt Bautzen als Sohn von Erich und Maria von Broen auf. Der Vater, Brückenbauingenieur von Beruf, war ein strenger, ernster, geradliniger Mann. Bodos eigenem Temperament entsprach mehr das der mütterlichen Linie. Insbesondere seine Großmutter, liebevoll „Muddel" genannt, eine kluge und gebildete Frau mit still verhaltenem Humor, war die rechte Inspiration für den lern- und wissbegierigen Jungen. Die Familie besaß ein großes Gartengrundstück am Hang des Spreetals unterhalb der Ortenburg, in dem er schon frühzeitig eigene Naturstudien anstellte. Hier konnte er sich mit großer Geduld in tiefere, ihn immer wieder überraschende Beobachtungen versenken, das war seine Welt, und daraus entstand wohl auch sein Berufswunsch. Einer seiner Deutschlehrer war der Heimatforscher Erich Klausnitzer, der Vater des bekannten Entomologen Bernhard Klausnitzer. Es mag also auch an der Atmosphäre des Ortes, dem genius loci, gelegen haben. Jedenfalls nahm Bodo nach dem Abitur 1951 ein Biologie-Studium an der Ernst-Moritz-Arndt-Universität in Greifswald auf.

Die Biologie besitzt hier eine reiche Tradition in sammlungsbezogenen taxonomischen Forschungen, als bekannte Namen aus langer Geschichte seien nur Gerstaecker (Entomologie), Buchner (Symbiosen), Keilbach (Entomologie) oder Rothmaler (Botanik) herausgehoben. Auf der Ostseeinsel Hiddensee unterhielt die Universität eine Biologische Station und die bekannte Vogelwarte. Hier war jedenfalls gut Studieren, zumal sich in dieser Umgebung eine systemische Denkweise zum Naturganzen entwickelte, welche erst viel später mit den Umweltwissenschaften eine Blüte erreichte, die mit den schon seinerzeit vorrangig geförderten molekularbiologischen Fächern konkurrieren konnte. 1956 erwarb Bodo hier sein Biologie-Diplom mit Untersuchungen an terrestrischen Wirbellosen unter ökologischen und systematischen Gesichtspunkten, eine Thematik, die er danach als Wissenschaftlicher Assistent am Zoologischen Institut weiter verfolgte. Dazu war er in die Ausbildung von Studenten und Doktoranden eng eingebunden. Mit der Dissertation „Untersuchungen über die Makrofauna der Bodenstreu in Greifswalder Universitätsforsten. Ein Beitrag zur Biozönologie" promovierte er im Jahre 1961 zum Dr. rer. nat. In dieser Zeit veröffentlichte er bereits 19 Arbeiten zu Spinnen und anderen Arthropoden. Mehrfach publizierte er gemeinsam mit seinem Kommilitonen Manfred Moritz, dem späteren Kustos der Arachnologischen Abteilung am Museum für Naturkunde in Berlin. Beide verband eine lebenslange Freundschaft. Zum Kreis gehörte ebenso Werner Mohrig, der später sehr erfolgreiche Dipterologe, dem er freundschaftlich verbunden blieb.

In die Greifswalder Zeit fällt auch die Familiengründung mit der Kinderkrankenschwester Margarete Borck. Aus ihrer über 57 Jahre bestehenden Ehe gingen vier Kinder hervor, Beate, Wieland, Eugen und Katharina, und beide durften sich später über sechs Enkel freuen.

Jedoch – Assistentenstellen liefen nach fünf Jahren aus, und Bodo musste eine Entscheidung treffen, in der sowohl fachliche Perspektiven, als auch wirtschaftliche Verpflichtungen seiner Familie gegenüber eine Rolle spielten. So sehr er sein biologisches Fach liebte, die besondere Förderung lag in jenen Zeiten an ganz anderen Stellen. Es spricht für Bodos Mut und Selbstvertrauen, dass er nun, 1965, den scharfen Schnitt nicht scheute. Auch sein Ehrgeiz, sich selbst zu erproben, dürfte beteiligt gewesen sein. Er bewarb sich bei der Berliner Medizin, die geeignete Biologen suchte für Forschungsarbeiten zur aufkommenden Organtransplantation. Er erhielt eine Stelle im Team von Prof. Moritz Mebel, der im Krankenhaus Berlin-Friedrichshain das Nieren-Transplantationszentrum der DDR aufbaute. Eine Zeitlang musste Bodo pendeln, aber er fand sich in seine Situation und vor allem in seine neuen verantwortungsvollen Aufgaben anstandslos hinein. Dieser nicht unbedeutende Teil seines Lebens kann hier abgekürzt wiedergegeben werden mit dem Hinweis auf eine nicht minder erfolgreiche wissenschaftliche Laufbahn. Bodo entwickelte sich zu einem profunden Immunologen, der sich schließlich mit seinen Ergebnissen zur Übernahme in die Akademie der Wissenschaften der DDR (AdW) empfahl. Ab 1967, nunmehr in Berlin-Buch, arbeitete er am Zentralinstitut für Krebsforschung (ZIK) als Tumorimmunologe im Bereich „Experimentelle und Klinische Immunologie" von Günter Pasternak. Mit dem Thema „Äußerungen der zel-

lulären Immunantwort auf fetaltypische Antigenstrukturen maligner und nichtmaligner Gewebe als Ausdruck immunologischer Regelprozesse" habilitierte er sich 1984 (Promotion B, Dr. sc. nat.). Hierzu konnte er mehr als 30 Publikationen und rund 50 Vorträge zu immunbiologischen Themen vorweisen. Als sein Chef Prof. Pasternak zum Leiter des AdW-Forschungszentrums für Molekularbiologie und Medizin aufstieg, nahm er ihn mit in dieses Leitungsgremium. Fortan hatte sich Bodo mit der Koordinierung der medizinischen Forschung der AdW als seiner überwiegenden Dienstaufgabe zu befassen, wozu er fraglos ob seiner Sachkenntnis und Wesensart – Besonnenheit, Verbindlichkeit, Zuverlässigkeit – auserlesen wurde. Er dürfte seinen Chef erheblich entlastet haben. Zuletzt leitete Bodo das Klinische Labor des ZIK. Zum 1. Juli 1991, als aus dem Institut im Rahmen einer Neuformierung das Max-Delbrück-Zentrum für Molekulare Medizin entstand, ging er in den Vorruhestand.

In gewisser Weise muss dieser Schritt für Bodo auch erleichternd gewesen sein. Ihm war es sicher einiges wert, den unvermeidlichen Auseinandersetzungen von Umbruchzeiten zu entkommen. Er konnte schließlich zur „Tier-Zoologie" zurückkehren, was er umgehend in die Wege leitete. Ganz aufgegeben hatte er diese auch zwischenzeitlich nicht (ohnehin unvorstellbar für einen rechten Arachnoentomologen), wie seine angefügte Publikationsliste aufs Beste belegt. Die Erfahrung sagt sogar, dass die Beschäftigung mit kleinen Tieren deutlich hilft, Zeiten großer beruflicher Anspannung besser zu bewältigen. Bodo konnte mit seinen profunden Spezialkenntnissen sofort in eine Reihe von Umwelt-Projekten einsteigen, die damals als boomende Branche aufkamen. Untersuchungen zum Zustand von Natur- und Wirtschaftsräumen wurden in vielfältiger Weise gefördert, und Spinnen sind bekanntlich wertvolle Indikatororganismen. Bodo war einer der Biologen, die Tierarten noch bestimmen konnten. Entlastet von allen dienstlichen Beschränkungen lebte sein Schriftverkehr mit Arachnologen des In- und Auslandes auf. Dabei war er ein ungemein beliebter Team-Partner, der sich immer wieder als ebenso kenntnisreich wie zuverlässig, belastbar, uneitel und folglich überhaupt angenehm erwies. In seinen Projekten untersuchte er vor allem die Berliner und Brandenburger Spinnenfauna; darunter fallen Beiträge zur Inventarisierung der Arthropoden in der Schorfheide, das Monitoring von Brandenburger Großseen und Aufnahmen der Artenspektren im Unteren Odertal sowie in Niederlausitzer Mooren und Feuchtwiesen. Er wirkte an den Roten Listen der Spinnentiere von Berlin und Brandenburg mit, und er war einer der Autoren des Leit- und Zielartenkatalogs wirbelloser Tiere Brandenburgs. Für Institutionen, darunter die Fachhochschule Eberswalde und die Universität Greifswald, war er als Gutachter tätig. Und immer wieder unterstützte er uneigennützig und hilfsbereit junge Kollegen bei der Einarbeitung in diese Tiergruppe. Bis in seine letzten Lebensjahre war er solcherart arachnologisch engagiert, zu seiner und zur Freude derer, die mit ihm arbeiteten. Gelegentlich weniger zur Freude seiner Familie, die ihn nicht selten eher als versunkenabwesend am Mikroskop sitzend wahrnahm (was einigen von uns nicht ganz fremd sein dürfte). Seine Spinnensammlung gab Bodo 2007 an das Museum für Naturkunde Berlin, wo sie als Sondersammlung zugänglich ist.

Mit Bodo von Broen verliert die arachnologische Gemeinschaft einen begeisterten Spinnenkundler mit reichem Erfahrungsschatz und einen hilfsbereiten und herzlichen Kollegen.

So schmerzlich richtig dieser letzte Satz ist, so formal klingt er freilich auch. Im Falle Bodo von Broens kann man ihn so nicht stehen lassen, es würde etwas Entscheidendes fehlen. Wir möchten deshalb in Abwandlung aller Gepflogenheiten persönliche Worte einiger Freunde anhängen, die bei der Erarbeitung dieses Textes eingegangen sind. Wir sind sicher, es würden gern noch mehr sein, die sich aber in ihrer Aussage zur Verbundenheit mit Bodo von Broen und ihrer Wertschätzung kaum unterscheiden dürften.

Wir bedanken uns bei dem Kollegenkreis, der sich nachdrücklich die Würdigung Bodos wünschte (wir wissen, dass wir ihn hier bei seinem Vornamen nennen durften), und der selbst half, diese Aufgabe umzusetzen. Besonders herzlicher Dank gilt Frau Margarete von Broen und Frau Dr. med. Beate von Broen für ihre wertvolle Unterstützung.

Ralph Platen (Berlin) – Ich traf Bodo von Broen das erste Mal 1984, ohne dass er persönlich anwesend war. Ich arbeitete seinerzeit am Museum für Naturkunde in Berlin beim Kustos der Arachnologischen Abteilung Manfred Moritz, um die dortige Spinnensammlung auf Berliner und Brandenburger Funde durchzusehen. Manfred Moritz erzählte mir von seiner gemeinsamen Studienzeit mit Bodo in Greifswald, dass er inzwischen am Zentralinstitut für Krebsforschung in Berlin-Buch arbeitete und dass Bodo ihn anfangs oft im Museum besucht hatte. Bei diesen Treffen hatte Bodo die Angewohnheit, sich morgens in einem Becherglas Tee aufzubrühen und ihn dann auf eine Heizplatte zu stellen. Die Teeflöhe tanzten dann, der Konvektionsströmung folgend, den ganzen Tag im Kreise herum. Das hat mich sehr beeindruckt, und ich wollte diesen Mann unbedingt kennen lernen. Leider hat es sich nie ergeben, dass wir drei uns einmal im Museum getroffen haben. Erst 1988, als wir gemeinsam an der Liste der Webspinnen und Weberknechte des Berliner Raumes arbeiteten, besuchte ich ihn an seiner Arbeitsstelle in Berlin-Buch. Als ich eintraf, war er gerade damit beschäftigt, zerquetschte Spinnen und Weberknechte aus den Fugen der Fensterrahmen herauszukratzen. Er erzählte mir, dass er zerdrückte und auf den Wegen zertretene Weberknechte sammle und sie einem Kollegen zur Bestimmung übergeben würde. Da ich kurz zuvor im Rahmen eines entomologischen Colloquiums an der Universität Greifswald von einem Diplomanden von Herrn Müller-Motzfeld einen Vortrag über die zertretene Käferfauna auf Wegen und Straßen hörte, dachte ich: ‚Hm, eine neue Forschungsrichtung, faszinierend.'

In den Jahren danach lernte ich Bodo als einen gutmütigen und geselligen Menschen kennen, mit dem ich auf Tagungen bei einem Glas Wein viel geplaudert und gefachsimpelt habe oder privat in einer Berliner Kneipe ein Bier gezischt habe. Ich habe Bodo sowohl als Mensch als auch als hochkompetenten Fachkollegen stets sehr geschätzt.
Mach's gut, Bodo!
Wir sehen uns.

Christian Kropf (Bern) – Bodo von Broen zeichnete sich auch durch seine Hilfsbereitschaft aus. Als CK vor 20 Jahren seine Stelle als Konservator am Naturhistorischen Mu-

seum der Burgergemeinde Bern (NMBE) in der Schweiz antrat, erwähnte dieser kurz, dass in Bern keine aufgearbeitete Spinnensammlung vorhanden sei. Sofort erklärte sich Bodo bereit, Belegtiere aus seiner Privatsammlung – alle hervorragend dokumentiert – dem NMBE zur Verfügung zu stellen. Damit war in Bern innerhalb kurzer Zeit eine Arbeitssammlung aus dem Sammelgebiet von Hermann Wiehle etabliert, die zur Basis der Berner Spinnensammlung wurde.

Seine kritische Distanz zur Kultur- und Wissenschaftsfinanzierung in seiner preußischen Heimat drückte er einmal so aus: „Ich wollte, es wäre Nacht, oder der Alte Fritz käme" (in Abwandlung des legendären Ausspruchs des Herzogs von Wellington während der Schlacht bei Waterloo). Bodos Schreiben waren stets in einem herzlichen und sehr persönlichen Stil gehalten. Gerne pflegte er sie mit der Unterschrift „Bodo berolinensis" abzuschließen.

Jens Jakobitz (Dresden) – Dr. von Broen lernte ich als Student kennen. Er hielt damals als Projektmitarbeiter am Deutschen Entomologischen Institut (DEI) an der Fachhochschule Eberswalde Vorlesungen und Seminare, unter anderem zu den Webspinnen. Unter seiner Anleitung konnte ich mich damals im Praktikumssemester am DEI in diese Tiergruppe einarbeiten.

Bemerkenswert war sein fundierter Unterricht und wie er auf die Studenten eingegangen ist. Wenn etwas nicht verstanden wurde, hinterfragte er zuerst sich, ob er es besser oder anders erklären könnte, um den Stoff zu vermitteln. Das habe ich in der Form nur zweimal in meinen Schul-, Ausbildungs- und Studienzeiten erlebt.

Ich verdanke ihm, dass ich mich in die Webspinnen und Weberknechte einarbeiten konnte sowie in die wissenschaftliche Publikationsarbeit. Er war mir ein sehr guter Freund, sehr kameradschaftlich, und ich bin ihm für seine Hilfe sehr dankbar, die er mir angedeihen ließ.

Holger Dathe (Müncheberg) – Mit Bodo von Broen kam ich 1984 in Berlin-Buch zusammen, als ich für zweieinhalb Jahre abgestellt war, um in einer übergeordneten Leitung der biowissenschaftlich-medizinischen Institute der AdW (siehe oben) die Praxis der Wissenschaftsorganisation zu erlernen. Ihm war es ähnlich ergangen, ebenfalls aus seiner Forschungstätigkeit heraus. Wir saßen in einem Zimmer beisammen, das heißt, er holte mich dahin, als er sah, wie ich unter den Rauchschwaden meines Zimmerkollegen litt. Von da an rauchte er selbst nicht mehr am Schreibtisch, was ich ihm hoch anrechne. Von Vertrauen zeugte sein Geständnis, dass er richtiger Zoologe sei und außer Proteinen auch Tiere kannte (wovon man in Buch besser nichts verlauten

ließ). Bodo geriet für mich zur Lichtgestalt, die mich das, was ich als eine Art Fremdenlegion empfand, ertragen ließ. Er verfügte über Stil und eine unnachahmliche Technik, mit dem unerquicklichen Alltag zurechtzukommen, der aus Berichten bestand, aus Analysen, Projektkontrollen, Planzahlen und ähnlichem Bürokram, wie das jeder Forscher gerne hat: Bodo war kauzig und in dieser Rolle unangreifbar. Er liebte vor allem seinen Schwejk und wusste ihn trefflich zu zitieren (Tucholsky hatte ihn den „weisesten Mann des Jahrhunderts" genannt, den Schwejk). Nichts war erlösender als eine der ruhigen Bemerkungen von Bodo in ausweisloser Lage: „nur eine Hetz". Vieles Ungemach hat eine komische Komponente, und Bodo fand diese unfehlbar heraus, ohne zu verletzen. Er galt in diesem AdW-Gremium als seriöser, zuverlässiger, kompetenter und lösungsorientierter Sachwalter, obwohl er – ungewöhnlich für so eine Leitung – keiner Partei angehörte und im Grunde zu nichts zu bewegen war, was er in seinem Herzen ablehnte. Das musste gekonnt sein, aber Bodo hatte diese Aura.

Ihm verdanke ich, dass ich einmal am Ekhof-Theater in Gotha auftreten durfte. Vor allem wegen dieser Bühne und diesem Auftritt meldete ich einen Tagungsvortrag an (SIEEC IX), den ich damals, 1986, schließlich erst mit Bodos Hilfe fertig ausarbeiten konnte

Wir begegneten einander wieder häufiger, als ich Ende 1993 an das Deutsche Entomologische Institut in Eberswalde ging, wo er uns bei zahlreichen Umweltprojekten äußerst nützlich wurde. Leider ist er nicht mehr nach Müncheberg gekommen, als das Institut dorthin umzog, er war wohl nicht mehr sehr gut zu Fuß. Ich hatte ihn damals schon vermisst; man sah ihn stets gern kommen, und nach seinem Besuch war auch der mieseste Tag wie verwandelt.

Elisabeth Bauchhenß (Wien) – Mein erster Kontakt mit Bodo von Broen fand 1985 statt – eine triviale Bitte von ihm um Schriftentausch. Nicht trivial hingegen war, dass wir

beide die Papers nicht nur lasen, sondern Kommentare und Meinungen dazu abgaben. So entwickelte sich binnen kürzester Zeit ein reger Schriftwechsel, wobei wir bald merkten, dass wir in sehr vielen Punkten gleiche Meinungen vertraten – nicht nur in der Arachnologie (aus Halb- und Nebensätzen konnte man ja auch auf andere Lebensgebiete schließen). Was dann folgte, kann man im buchstäblichen Sinn des Wortes als Brieffreundschaft bezeichnen, denn wir wurden Freunde, ohne uns persönlich begegnet zu sein. Unsere Briefthemen gingen bald weit über die Spinnen hinaus. Und Jahr für Jahr hatten wir Pläne, wann und wo wir uns treffen wollten, immer wieder verhindert durch Krankheiten, Termine und und und … So dauerte es 10 Jahre, bis wir uns endlich Aug' in Auge gegenüber standen. Ich hatte meine Rückreise von Prag, wo ich Buchar besucht hatte, nach Schweinfurt mit einem „kleinen Schlenkerer" über Eberswalde verbunden. Nie werde ich den Augenblick vergessen, wo wir unter all den Wartenden und Ankommenden zielsicher aufeinander zugingen und uns erkannten, ohne uns je gesehen zu haben: „Sie sind sicher …". Ich hatte drei Stunden Zeit, und in diesen Stunden wurde eine Brieffreundschaft zu einer echten persönlichen Freundschaft. In der Folgezeit trafen wir uns häufiger, immer wenn ich in Berlin war, tranken wir 1, 2, … Biere in seiner Eckkneipe und diskutierten uns die Köpfe heiß.

In den letzten 10 bis 15 Jahren ging es in unseren Briefen zunehmend um körperliche Einschränkungen, Krankheiten, Tod. Bodo war keiner, der jammerte oder in Selbstmitleid versank. Auf einen Satz: „Mein Befinden hat sich wieder dramatisch verschlechtert" folgte ein zweiter, in dem er von neuen Plänen sprach. Aber es wurde mühsamer. Seinen letzten Brief 2012 schrieb er am PC und entschuldigte sich, dass seine Hände keinen handschriftlichen Brief mehr erlaubten. Seither hielten wir nur noch telefonisch Kontakt. Bei meinem letzten Telefongespräch mit ihm im Sommer 2015 versprach ich ihm fest, ihn im Winter im Haus Weidenweg zu besuchen. Er hat sich diesem Termin entzogen!

Bodo war mein wichtigster Gesprächspartner, was Ökologie der Spinnen anlangt. Seitenlang, nächtelang diskutierten wir über Habitatpräferenzen, die sich (vielleicht) im Norden und Süden unterscheiden und tauschten Tiere aus verschiedenen Gegenden aus.

Ich habe Bodo als liebenswerten Menschen kennen gelernt: intelligent, kritisch, hoch gebildet ohne jegliche Allüren und Arroganz, hoch sensibel, mit unglaublichem Witz, der sich häufig zwischen den Zeilen versteckte, menschlich zugewandt, ein Gentleman der alten Schule, kurz – er war einer meiner liebsten Kollegen.

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Buchbesprechung/Book review

John A Murphy & Michael J Roberts 2015 Spider families of the world and their spinnerets. British arachnological Society, York. 553 pp. ISBN 978 0 9500093 7 7

John Murphy and Michael Roberts have both made very significant contributions to arachnology. Michael Roberts is widely known for his excellent illustrations and much appreciated for his impressive trilogy "The spiders of Great Britain and Ireland" (Roberts 1985a, 1985b, 1987, 1993), later followed by the equally useful "Spiders of Britain and Northern Europe" (Roberts 1995). Both works laid the foundation for a lifelong interest in the faunistics of Northern European spiders for many of us and the books turned out to be, in fact, indispensable. On top of that, Roberts published several papers on, among others, Theridiidae, Tetragnathidae, Araneidae, Gnaphosidae and Linyphiidae. John Murphy, arguably the Nestor of arachnology at present, is best known for his many key papers on Gnaphosidae, many of them executed in collaboration with Norman Platnick or Anthony Russell-Smith. Both authors also undertook some excellent collaborations in the past: the wonderful "An introduction to the spiders of South East Asia" (Murphy & Murphy 2000) gained much from the illustrations of Michael Roberts and his magnum opus "Gnaphosid genera of the world" (Murphy 2007) derives much of its splendour from the amazing artwork of the same Roberts.

When it was announced that both authors were about to publish "Spider families of the world and their spinnerets" (Murphy & Roberts 2015), expectations were high.

As it turns out, this bulky, two-volume work is again excellently illustrated by Roberts, although most figures focus on details of spinnerets, tarsal claws and setae. Genitalic structures are generally ignored, except for the 25 page appendix, where the palps, epigynes and vulvae of a number of puzzling specimens are illustrated in full splendour reminiscent of Roberts's best work. There is good reason to suppose that the text was also mainly under the responsibility of Michael Roberts, reflecting his views on high level spider taxonomy.

For the first time, we have a book that gives a comprehensive overview of spinneret characters for all spider families. Moreover, a few new and taxonomically interesting spinneret characters are described and illustrated. The book is also well edited, the only flaw being that illustrations 31 and 44 occur twice and 32 and 45 are missing. These two plates were later sent to all owners in digital format. The authors modestly describe their book, which took them ten years to complete,

SPIDER FAMILIES OF THE WORLD
AND THEIR SPINNERETS

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and
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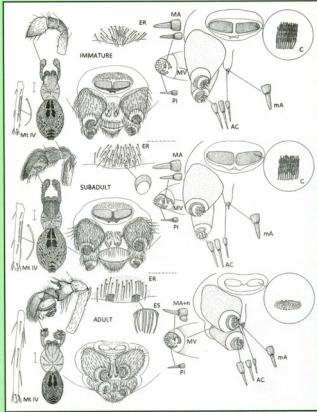
PART I: Text

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as a "preliminary work" and rightly hope that it will be an incentive for many to devote renewed attention to high level spider taxonomy.

In spite of these undeniable positive elements, "Spider families of the world" disappoints in several respects.

The work not only duly presents an overview of all the spider families of the world, but also sets out to propose a new taxonomic framework for the entire order. For such a large, megadiverse group, this seems a task that simply cannot be brought to a good end by two authors in a single book.

Writing a family overview of a megadiverse taxonomic group like spiders is indeed a daunting task, one of us can vow for that. Not only is the amount of information to be gathered enormous, the task is also frustrating as it is never finished. Although some scholars complain about a dip in taxonomic research, there have never been as many taxonomists active at the same time as nowadays. This fact is reflected in the enormous stream of data at all levels of spider taxonomy, including at the family level. There is no ideal time to write a book on spider families: the subject is constantly changing.

Murphy & Roberts were admittedly not very lucky in this respect, as during the period in which they prepared their book, dramatic changes at family level have taken place. Since the previous overview by Jocqué & Dippenaar-Schoeman (2006), six families were added before their book was published. Of these, only Euctenizidae and Trogloraptoridae are discussed. Eutichuridae, Phrurolithidae, Sinopimoidae and Trachelidae are not mentioned.

The authors state that "...the form of the spinnerets and their spigots within any given family remain remarkably constant, even though somatic and genitalic structures may vary considerably...". This may sound plausible, but by the same token, an important and remarkably constant character such as spore bearing gills, for example, has evolved independently eight times in eight major orders of fungi (Wright 2014)! Based on their firm belief in, and their very personal interpretation of, the importance of spinneret characters for high level spider taxonomy, Murphy & Roberts, contra Lehtinen (1967), reinstall Cribellatae and divide the Araneomorphae into cribellates and colulates. Cribellates are considered those that have a cribellum (lost in some instances) instead of the ancestral anterior median spinnerets, colulates have a non-functional bump called a colulus instead, a structure which may be reduced to a few setae or be entirely lost. This rejection of the repeatedly corroborated hypothesis that the cribellum is the plesiomorphic state within Araneomorphae leads to a plethora of proposed nomenclatural changes and transfers. These are listed on pages viii and ix, arguably the most objectionable pages of the book. First of all, no arguments are given for the many changes, apart from the fact, in some instances, that species with a cribellum and species with a colulus are not allowed to be placed in the same family. On top of that, these two pages reveal an incomplete survey and a selective interpretation of the arachnological literature. Three transfers to Agelenidae had already been published by Miller et al.

(2010). The transfer of *Poaka* to Amaurobiidae was already made by Raven & Stumkat (2003). The transfers of *Perilla* and *Phonognatha* to Araneidae date back to Kuntner (2002) and Kuntner et al. (2008). The influential work of Ramirez (2014) is completely ignored.

Another disappointing, if not irritating, aspect of the text are the negative comments on valuable and established techniques in spider taxonomy. Cladistics is called "a kind of lie" and "not science". Millidge (1995) is quoted in this respect, and it has to be admitted that twenty years ago spider cladistics still had a long way to go. Nevertheless, quite a few relationships established in that period still stand. Nowadays, cladistics has become an accurate, carefully executed discipline and not just "crunch the numbers". Cladistics takes into account all important characters without engaging in preconceived ideas, while "Spider families of the world and their spinnerets" virtually ignores valuable characters such as tenent hairs, the retrolateral tibial apophysis, tapetum, chilum, mouthparts, legs and more. Scanning electron microscopy is called a "quick fix" and "woefully inadequate". It is true that a good light microscopist can study matters in surprising detail and that SEM is maybe used too often, but anybody who has tried to obtain good, clean SEM images of a tiny part of a rare spider can confirm that the technique is far from a quick fix.

Unfortunately, the book also contains a number of errors which have led to false conclusions. *Eutichurus* females, for example, do have cylindrical gland spigots and as such would not belong in Clubionidae. However, only careful comparison between males and females can make this clear, and the book only illustrates a female. Invisible under the light microscope, the nubbins on the anterior lateral spinnerets of *Penestomus* and *Cryptothele*, an important character, are not shown or mentioned. The major ampullate spigots of *Selamia* are not recognised as such. *Tamgrinia* has a cribellum (Miller et al. 2010) and also the fact that *Archoleptoneta* has a cribellum (Ledford & Griswold 2010) has escaped the authors' attention – it is happily left in Leptonetidae, where it belongs. Somewhat embarrassing is the fact that *Drassodes hypocrita* (fig. 3, p. 5) should be *Drassodex hypocrita*, the type species of the genus (Murphy 2007).

On page 6, the authors state: "We feel certain that studies in molecular biology will eventually confirm most of our work in progress...". The course of events has decided otherwise. Garrison et al. (2016), in the largest assessment of spider phylogeny to date using genomic data only, recovered many of the well-supported monophyletic groups that Murphy & Roberts reject: Entelegynae, Dionycha, and the RTA clade. Dimitrov et al. (in press), in a molecular analysis based on six genes, find further evidence for a single origin and multiple independent losses of the cribellum within Araneomorphae, not the existence of two independent lineages, as Murphy & Roberts propose.

Notwithstanding the serious drawbacks outlined above, the two-volume book is worth having. When critically studied and compared with the literature, the contents encourage us to question the prevailing views on high level spider taxonomy, stimulating a renewed interest in this fascinating subject. After all, John Murphy and Michael Roberts have contributed widely to arachnology in the past and their legacy has been of great use to all of us.

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Buchbesprechung/Book review

Étienne Iorio & Emmanuel Delfosse 2016 Les opilions de la moitié nord de la France (Arachnida: Opiliones). Toutes les bases pour étudier ce groupe et identifier aisément les espèces. – Mémoires de la Société Linnéenne de Bordeaux 17: 1-72

Faunenwerke über europäische Weberknechte können immer mit Aufmerksamkeit rechnen. Jetzt legen Iorio und Delfosse eine Arbeit über die Opiliones Nordfrankreichs vor, von den südlicheren Regionen Pays-de-la-Loire, Centre, Bourgogne und Franche-Comté nördlich bis zum Atlantik und den Grenzen Deutschlands, Luxemburgs und Belgiens. Damit sind die noch immer „schwierigen" Faunen der Südwestalpen und der Pyrenäen ausgespart. Es werden weniger genaue Daten zur Verbreitung und Ökologie vorgelegt, sondern es handelt sich um einen (nicht immer) dichotomen Schlüssel für die Arten des Gebietes mit Ausblick auf wenige Arten aus Nachbargebieten, die noch in Nordfrankreich gefunden werden könnten. Der Schwerpunkt liegt auf einem überreichen Angebot an meist großformatigen Abbildungen, zumeist Fotografien von konservierten Tieren in unterschiedlichen Maßstäben, bisweilen eine halbe Seite füllend. Kongenerische Arten sind oftmals einander gegenübergestellt und erlauben einen unmittelbaren Vergleich. Leider fehlen überall Maßstäbe, so dass für den Anfänger die tatsächliche Größe der Tiere nicht erkennbar ist, umso weniger, als große und kleine Arten oft in gleich großen Fotos dargestellt sind. Es ist anzumerken, dass die Fotos nicht dem aktuellen Stand der Makrofotografie entsprechen. Viele sind unscharf und zudem in den Farben deutlich verfälscht, meist hin zu krassen Gelb- und Grüntönen. Auf eigene Zeichnungen als Bestimmungshilfen wurde gänzlich verzichtet und die wenigen Übernahmen aus anderen Werken wurden so verändert, dass deren Qualität zumeist deutlich gelitten hat. Zehn häufige Arten wurden für den Anfänger herausgegriffen und mit jeweils drei wichtigen fotografierten Merkmalen charakterisiert, um die Schnellbestimmung zu ermöglichen. Man stellt sich die Frage, warum einzelne Abbildungen mehrfach reproduziert wurden, so der Penis von *Leiobunum tisciae* und der Palpus von *Platybunus bucephalus*.

Für alle Arten werden knappe Verbreitungsangaben geliefert, für das behandelte Gebiet und für das Gesamtareal. Für Frankreich beziehen sich die Angaben zumeist auf große Gebiete und sind somit kaum geeignet, bereits bestehende Verbreitungskarten für außerfranzösische Nachbargebiete sinnvoll zu ergänzen. Einige Angaben machen stutzig. Für *Platybunus bucephalus* werden große Gebiete Nordfrankreichs zum Areal gezogen und dabei auf eigene Arbeiten verwiesen. Das widerspricht der bisher bekannten eher alpinen Verbreitung mit Ausläufern in den nördlichen Mittelgebirgen. *Platybunus pinetorum* wird für das Gebiet ebenfalls abgehandelt, aber nicht abgebildet. Für diese und andere Arten wird auf die AraGes-Punktkarten von Staudt („2014") verwiesen, doch geben allenfalls grenznahe deutsche Vorkommen Hinweise auf potentielle französische Arealpunkte. Nennung von *Megabunus diadema* für das Département Moselle bedarf dringend der Bestätigung. *Nemastoma bimaculatum* ist auch östlich des Rheins bekannt.

Die moderne Fototechnik erlaubt heute, hochwertige Fotos für Schlüssel und Faunenwerke einzusetzen. Dadurch nimmt die Tendenz zu, auf Zeichnungen der taxonomisch wichtigen Merkmale zu verzichten. Aber solche genauen Zeichnungen erzwingen die intensive Auseinandersetzung mit dem Objekt und den oft subtilen Unterschieden von Art zu Art. An diese Selbstdisziplin sollten Anfänger unbedingt herangeführt und Fortgeschrittene weiterhin dazu angehalten werden. Nur so lassen sich neue und/oder gebietsfremde Arten erkennen, und sinnvolle Systematik und Taxonomie wird nur auf diesem Wege ermöglicht.

Generell ist diese Arbeit eine brauchbare Einführung in die Weberknechtfauna Nordfrankreichs, wobei kaum Arten behandelt werden, die nicht auch in den neueren Faunen der Niederlande (Wijnhoven 2009) und Luxemburgs (Muster & Meyer 2014) dargestellt sind. Für gute Farbabbildungen und Zeichnungen sollte man Wijnhoven und Muster & Meyer zusätzlich konsultieren.

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The journal "Arachnologische Mitteilungen" publishes scientific papers about Western Palaearctic arachnids (excluding mites and ticks) in German or British English.

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Examples:

Broen B von 1993 Nachweise selten gefundener oder gefährdeter Spinnen (Araneae) in der Mark Brandenburg. – Arachnologische Mitteilungen 6: 12-25

Chatzaki M 2008 A critical review of the spider family Gnaphosidae in Greece. In: Makarov SE & Dimitrijevic RN (eds.) Advances in arachnology and developmental biology. Pensoft, Sofia. pp. 355-374

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Kovblyuk MM & Marusik YM 2012 First description of the female of the theridiid spider Robertus golovatchi (Araneae: Theridii-dae). – Arachnologische Mitteilungen 44: 17-19 – doi: 10.5431/aramit4405

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