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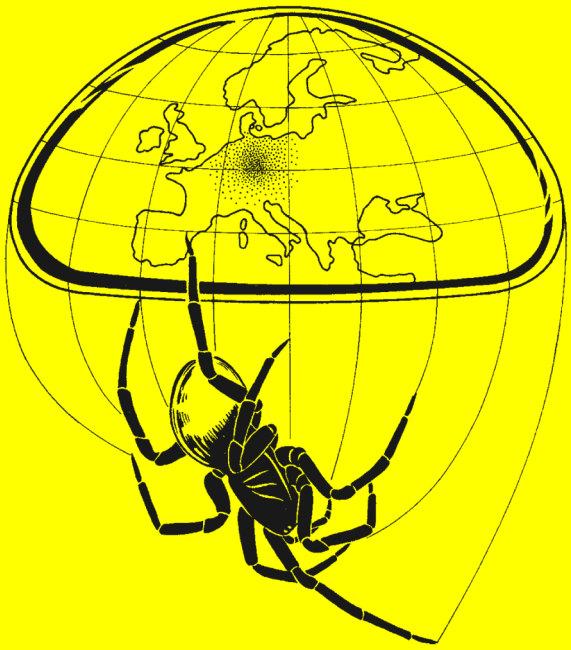

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Ten years after the invasion: *Dicranopalpus ramosus* and *Odiellus spinosus* (Opiliones, Phalangiidae) in Denmark

Søren Toft

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Abstract. The two harvestmen *Dicranopalpus ramosus* and *Odiellus spinosus* were first recorded from Denmark in 2007 and 2006, respectively. Two nation-wide surveys of the species in urban habitats were conducted in 2010 and 2017 providing information on their initial colonization and subsequent establishment and spread. By 2017, *D. ramosus* occurred in all parts of Denmark and was a frequent and abundant species in most of Jutland. On the Danish islands, the species was present but much less frequent. *Odiellus spinosus* occurred sporadically in eastern Jutland and more frequently on the islands. During the early years, new records of both species came from spaced-out locations, indicating arrival by long-distance jump dispersal possibly by independent colonisations from abroad and most probably mediated by human traffic. The range expansion of *D. ramosus* in northern Europe has occurred with a speed of 35–100+ km per year.

Keywords: alien species, colonization, introduced species, invasion routes, speed of range expansion, urban species

Zusammenfassung. Zehn Jahre nach der Invasion: *Dicranopalpus ramosus* und *Odiellus spinosus* (Opiliones, Phalangiidae) in Dänemark. Die beiden Weberknechtarten *Dicranopalpus ramosus* und *Odiellus spinosus* wurden 2007 bzw. 2006 erstmals in Dänemark nachgewiesen. In den Jahren 2010 und 2017 wurden zwei landesweite Kartierungen beider Arten in städtischen Lebensräumen durchgeführt und erbrachten Kenntnisse zur Kolonisierung, Etablierung und Ausbreitung der Arten. Im Jahr 2017 kam *D. ramosus* in allen Teilen Dänmarks vor und war in weiten Teilen Jütlands stetig und zahlreich zu finden. Auf den dänischen Inseln war die Art präsent aber weit weniger häufig. *Odiellus spinosus* kam im Osten Jütlands nur sporadisch vor und war auf den Inseln häufiger. Während der ersten Jahre wurden beide Arten an weit voneinander entfernten Orten gefunden, was auf Ausbreitung aus großen Entfernungen hindeutet, möglicherweise unabhängig voneinander aus dem Ausland mithilfe des menschlichen Fernverkehrs bzw. Gütertransportes. Die Erweiterung des Areals von *D. ramosus* in Nordeuropa fand mit einer Geschwindigkeit von 35–100+ km pro Jahr statt.

During several decennia, Northern Europe has witnessed repeated invasions of harvestman species originating from the Mediterranean region (Wijnhoven et al. 2007, Enghoff et al. 2014). Coming from Italy, *Opilio canestrinii* (Thorell, 1876) expanded through Central Europe during the 1960s, 1970s and 1980s (first records in European countries summarized by Vestbo et al. 2018). In those days, few people paid attention to harvestmen; therefore, observations are generally too haphazard to reflect the true routes and the speed by which the species expanded. For example, when discovered in Denmark in 1987, it was already of nation-wide occurrence and the second most abundant species in urban habitats (Enghoff 1988). It was clear, however, that the species had expanded very fast, but exactly how fast was impossible to tell. When other species followed suit during the 1990s and 2000s, the arachnological community was better prepared and could further take advantage of the creation of national public databases on the internet into which gifted amateur naturalist report their observations. This has tremendously enhanced the ability to follow fast faunistic changes, even if attention is not specifically directed towards harvestmen.

Dicranopalpus ramosus (Simon, 1909) originated from the Iberian Peninsula and Morocco (Wijnhoven & Prieto 2015). It turned up in southern UK in 1957 and slowly widened its distribution along the southern British coast (maps in Sankey & Savory 1974, Rambla 1986). Its northward expansion in western Europe became clear during the 1990s when it was recorded from the Netherlands (1993), Belgium (1994), Ireland (1994) and Scotland (2000) (summarized by Noordijk et al. 2007). In 2002 it was recorded from Germany (Schmidt 2004), in 2007 from Denmark (Toft & Hansen 2011), in 2012 from Sweden (Jonsson 2013) and in 2014 from Poland (Rozwałka & Rutkowski 2016). Noordijk et al. (2007) commented on the speed of spreading as the species was found in most parts of the Netherlands only 14 years after the first record. Based on a nation-wide survey of urban areas in 2010, Toft & Hansen (2011) reported on the early colonization and establishment in Denmark. They found that already within three years after the first discovery of the species it had reached most parts of the country, even locations as far from the presumed sources of immigration as is possible in Denmark. If these observations reflect the process of invasion correctly (see below), they underscore that the species was expanding extremely fast.

The present paper follows up on the previous study (Toft & Hansen 2011). A new nation-wide survey was conducted in 2017, i.e. 10 years after the first Danish record of *D. ramosus* with the purpose of recording the changes that have occurred in the Danish distribution of *D. ramosus* during the intervening seven years. The combined data is then used to deduce the most likely routes and the most likely mechanisms of dispersal by which the species has colonized and established itself in Denmark.

Odiellus spinosus (Bosc, 1792) is another newcomer in Denmark, noticed for the first time in 2006 (Enghoff & Pedersen 2007) and also recorded during the urban surveys. It is native to southern and western Europe (Italy, northern Spain, France, Benelux and southern UK) (Martens 1978). Since the 1970s it has shown expansive tendencies by widening its area eastwards in Germany (Arachnologische Gesellschaft 2018) and adjacently Poland (Rozwałka et al. 2013). The species has spread in Denmark during the same period as *D. ramosus* allowing a direct comparison between the two with respect to area occupied and the speed of colonization and spreading.

The results are discussed in terms of two models of expansion (Hengeveld 1989): wave front expansion or jump dispersal. Either a species enlarges its range as a broad moving front progressing wavelike into the new range. Expansion happens

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by individual short-distance dispersal, induced by a surplus population being produced near the border of the original range. Alternatively, a species' range may expand as a result of long-distance displacements performed by a few individuals that successfully settle and establish themselves at a place far outside the normal range limit. Such pioneer (bridgehead) subpopulations may eventually become incorporated in the species' newly enlarged range by a combination of the two dispersal mechanisms: repeated jump dispersal events from the original range combined with local short-distance dispersal by offspring of the original colonizers. No direct information exists on the mechanisms of migration of these harvestmen; in accordance with Noordijk et al. (2007) and Vestbo et al. (2018) it is assumed that transportation by human traffic (trucks and cars) is the most likely means of long-distance dispersal for these harvestmen. Below I will also discuss the suggestion by Noordijk et al. (2007) that wind dispersal may be involved.

Material and methods

As the immigrant harvestmen were first discovered in urban settings and the animals are most easily observed on house walls, churchyard walls and similar vertical structures, registrations were made as surveys of cities and towns. Each registration was conducted as a one hour walk through (part of) the town, proceeding at a normal walking speed of ca. 3 km per hour, though some of the towns visited were too small to allow a full one-hour survey. Areas with plastered houses painted in light colours (white or yellow) were preferred, as the harvestmen are most easily discovered on such surfaces. In most cases, this means that older parts of the towns (from early 20th century) were included if available. These quarters also had the advantage that the house walls often faced the pedestrian pavement without enclosed gardens in front. All harvestmen seen between ground level and 2 m height were collected in 70 % alcohol and later identified under the binocular microscope.

At some localities these surveys were conducted repeatedly between 2008 and 2017. In the two years 2010 (Toft & Hansen 2011) and 2017, they included a large number of towns covering most of the country (61 and 64 locations, respectively). All records have been submitted to the public database Naturbasen (2018). In the distribution maps, the data from these surveys are supplemented by observations reported by others to the database. The pattern emerging from my own data and from the combined data set are the same, except that the latter provides a more complete geographical coverage.

An attempt, admittedly inaccurate, was made to estimate the rate of expansion of *D. ramosus* in northern Europe, using the locations of the first records of the species in the Netherlands and Germany and the early finds from Denmark. The distance from Ede (Netherlands) and Bochum (Germany) to Årslev (Funen, Denmark) was divided by the number of years between the respective finds (14 and 4 years, respectively). Similar calculations were made between the Ede and Bochum finds and the most remote (i.e. furthest away from assumed places of origin) Danish finds (Copenhagen, easternmost point of Zealand, 2009; Skagen, northernmost tip of Jutland, 2010) (names of main Danish regions/island indicated on Fig. 1A). *Dicranopalpus ramosus* is an extremely characteristic species due to its unique position of the legs during rest (all four legs directed straight to the side). Therefore, it will draw the attention of active field naturalists; they can easily recognize it and documentation by photos is unequivocal. In Denmark, the arrival of the species was anticipated (Toft 2004). It is therefore unlikely that the species had been present, widespread and abundant in Denmark before its first discovery. Similar arguments may refer to the situation in the Netherlands in the 1990s and to the records of *O. spinosus*. Furthermore, several locations in Denmark where *D. ramosus* later turned up were surveyed in 2003 without any trace of the species (Toft & Hansen 2011). Thus, in both countries the species may have first invaded a few years prior to discovery, but the time lag between arrival and discovery may be approximately the same.

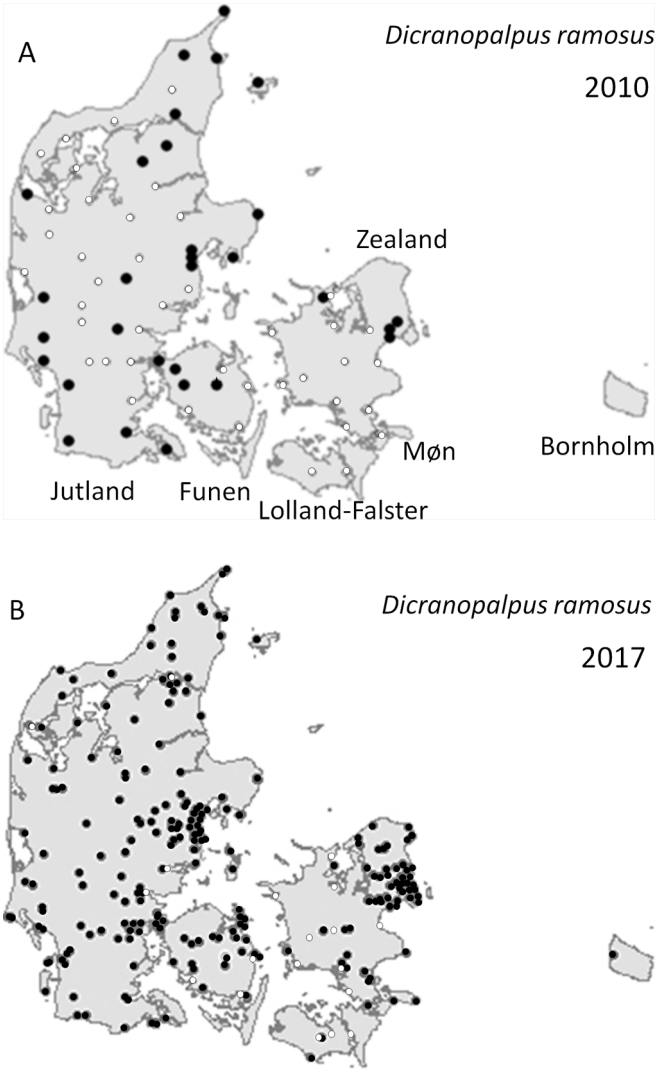

Fig. 1: Known distribution in Denmark of (**A**) *Dicranopalpus ramosus* at the end of 2010 (from Toft & Hansen 2011), (**B**) *D. ramosus* at the end of 2017. Star indicates point of first Danish record (2007). Closed circles: *D. ramosus* present. Open circles: localities searched, but *D. ramosus* was not found

Results

Already in 2010, *D. ramosus* had arrived to many parts of Denmark, but it was also absent from large areas (Fig. 1A; Toft & Hansen 2011). This early distribution can best be characterized as a widely scattered ("patchy") occurrence. At all locations where it was present the species was infrequent,

1-6 specimen (mean 2.4) being found during the one-hour searches. It was absent from central and northwestern Jutland, most of Zealand, as well as Lolland-Falster and Bornholm.

In 2017, *D. ramosus* had arrived to all parts of Denmark (Fig. 1B). In Jutland the species was nearly ubiquitous and was missed in only a very few survey visits (4 of 42 towns), indicating a more or less "continuous" distribution. On southern Funen, most of Zealand and Lolland-Falster, the species was present as indicated by reports to the database, but in any case it was missing in 15 out of 22 of the towns visited during the survey. The relative frequencies in Jutland and the islands are significantly different (Yates' χ^2 = 10.05, df = 1, P = 0.0015). The number of individuals per visit in Jutland was 1-10 (mean 3.6), while on the islands it was 1-2 (mean 1.6) (excluding locations without the species). The first record from the isolated island of Bornholm, situated in the Baltic Sea between Poland and Sweden, is from 2017.

The bee line distance between sites of first records in the Netherland (Ede) and Denmark (Årslev) is 482 km. This was accomplished by *D. ramosus* in 14 years, giving a displacement rate of 34.4 km/year. Records from Copenhagen 2009 and Skagen (northern tip of Jutland) in 2010 give displacement rates of 37.9 and 41.5 km/year, respectively. Similar calculations from the site of the first German record (Schmidt 2004) produce values of 119.5, 97.7 and 104 km/year, respectively. As it is unknown whether the immigrants to Denmark came from Germany or the Netherlands, 35-40 km per year may be considered the cautious estimate. In Sweden, however, *D. ramosus* was recorded from Uppsala only 5 years after the first Swedish record (Artportalen 2018) giving a rate of expansion of 103 km per year. The finding of an established population at Poznań, Poland, 440 km east of the nearest known German locality (Rozwałka & Rutkowski 2016) also indicates the possibility of fast expansion by very long jumps.

Odiellus spinosus (Fig. 2) has spread much less actively than *D. ramosus*. The number of localities and the total distribution area is smaller. It is widely scattered within its area which in 2017 included eastern Jutland and the islands (except Bornholm) with a relatively high concentration on the islands. The distributional pattern (Fig. 2) was as patchy as the early distribution of *D. ramosus*. It has been observed exclusively in or near towns and usually low in numbers (max. 2 individuals per one hour of search).

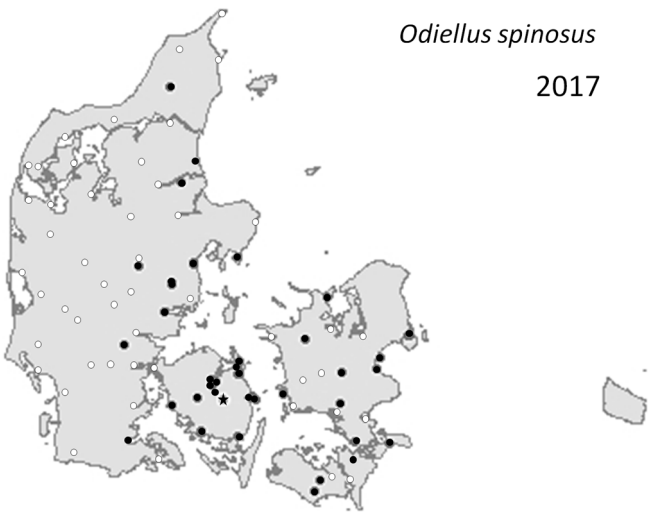

Fig. 2: Known distribution in Denmark of *Odiellus spinosus* at the end of 2017. Star indicates point of first Danish record (2006). Closed circles: *O. spinosus* present. Open circles: localities searched, but *O. spinosus* was not found. For names of Danish regions/islands, see Fig. 1A

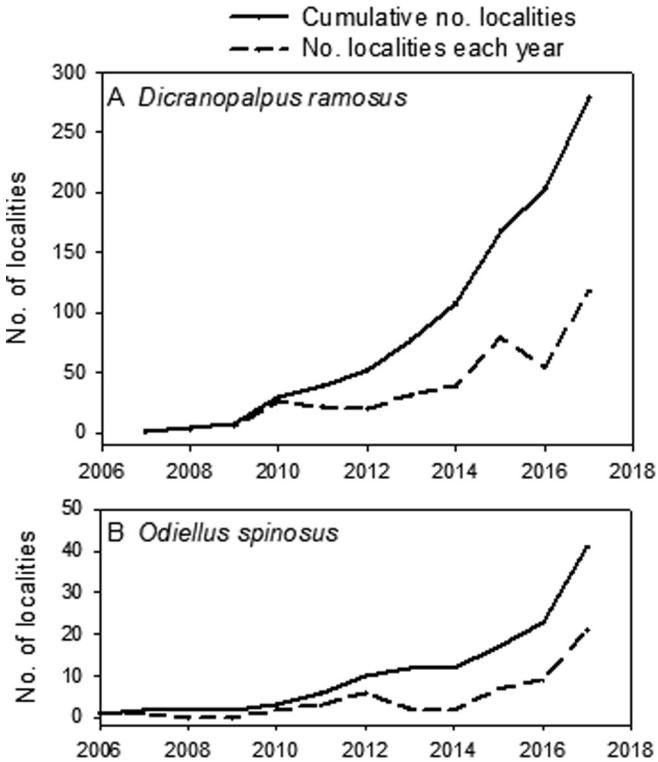

Fig. 3: Increase in the number of localities from which *Dicranopalpus ramosus* (**A**) and *Odiellus spinosus* (**B**) have been reported to Naturbasen (2018)

Discussion

Only since the early 1990s are the data about the occurrence of the two species of sufficient quality to allow analysis of the routes and speed of distributional expansion. According to its distribution before arriving in Denmark, *D. ramosus* must have come from the Benelux/western Germany area. At the subcontinental (north European) scale, there is some evidence of a dispersal front (Netherlands 1993, Germany 2002, Denmark 2007, Sweden 2012), but at the national Danish scale this disappears completely. The map of its occurrence in 2010 (Fig. 1A) indicates that neither distance nor sea water were barriers to dispersal. The species was soon found at locations far apart over most of the country, but at the same time it was missing in large areas. Such a distributional pattern signifies long-distance jump dispersal from the source area(s). Multiple independent immigrations from abroad represent a likely scenario and are compatible with the most probable mode of dispersal, i.e. transportation by human traffic (Noordijk et al. 2007, Vestbo et al. 2018). In fact, Fig. 1A may allow us to hypothesize in more detail about how this transportation took place. The occurrence in eastern Jutland, Funen and Copenhagen fits a pattern of immigration via the Danish highways, which extend the north German highway system northwards along the east coast of Jutland with a branch going east over Funen and Zealand to Copenhagen and Sweden, all of which are connected by bridges. Specifically, the first Danish records of *D. ramosus* (and also *O. spinosus*, Fig. 2) were from Årslev on the island of Funen (Fig. 1A & 2). Vestbo et al. (2018)

argues that this place houses a large horticultural centre that is a target of truck traffic from all of Europe, including not least the Netherlands. Interestingly, the early Swedish records of *D. ramosus* were from the Helsingborg and the Malmö/Lund area (Jonsson 2013, Artportalen 2018), i.e. the part of Sweden adjacent to Copenhagen. Thus, the species probably immigrated to Sweden via Denmark. No highways go up along the west coast of Jutland, but this area attracts high numbers of German tourists during the summer and early autumn. Thus, the areas in which *D. ramosus* became established very early are those which have relatively high traffic rates originating from south of Denmark. In contrast, central Jutland is characterized by east–west traffic and was colonized some years later. The first observation from the island of Bornholm, an isolated island in the Baltic Sea between Poland and Sweden, came in 2017. The late arrival here was expected due to limited traffic connections (ferries from Copenhagen, Germany and Sweden). Considering the Swedish distribution of *D. ramosus* in 2017 (Artportalen 2018), the traffic connections to Bornholm, and the absence of the species in eastern Germany (Arachnologische Gesellschaft 2018), immigration from the north via Sweden may be the most probable route.

Comparison of Fig. 1A and 1B shows that during the years 2010 to 2017, *D. ramosus* in Jutland has filled out much of the space between the locations initially colonized. In 2017 the species was missed in very few of the urban counts and only from one location in which it had been observed in previous years. Fig. 3 witnesses a dramatic increase in the number of new localities reported in precisely this period. Though transportation by cars cannot be excluded as partial explanation for the short-distance dispersal, self-accomplished dispersal may also be partly involved in the local filling of available habitat space. The species' preference for shrubby habitat (Noordijk et al. 2007, own observations) may facilitate corridor spreading e.g. along hedges. Unfortunately, no direct observations exist to evaluate the relative importance of dispersal mechanisms.

The Danish distribution of *O. spinosus* (Fig. 2) differs from that of *D. ramosus* in that it is completely missing in western Jutland, and that it is found considerably more often on the islands (Funen, Zealand, Lolland, Møn) than in Jutland. Apart from showing much slower rates of expansion, this may indicate that the routes of immigration are partly different. The occurrences in eastern Jutland and Funen may have followed the same route as *D. ramosus*, i.e. via highway traffic from Germany. The relatively heavy concentration of the species on south Zealand, Lolland and Møn indicates another immigration route via the ferry from Germany to Rødby (southern coast of Lolland). The immigrants here may have originated from the population that have established in eastern Germany. The possibility of this immigration route is documented by the extreme number of rare southern species (insects, millipedes, centipedes, harvestmen) that have been found at an abandoned railway area near the ferry harbour (Enghoff et al. 2011).

Wind dispersal has been proposed as a possible mechanism of dispersal for the expanding harvestmen (Noordijk et al. 2007). There are neither direct nor indirect evidence for this, however. Firstly, I am unaware of any observations of "flying" harvestmen; in contrast to spiders and mites, harvestmen seem never to have been recorded in samples of aerial plankton whether recorded from planes (Glick 1939), high masts (Freeman 1946) or from boats far at sea (Hardy & Cheng 1986). Secondly, if the air was a main dispersal medium, the direction of spreading is expected to follow the main wind direction. The direction of expansion of most harvestmen has been towards the north, while prevailing winds are westerly (http://www.dmi.dk).

Development of the reports for each of the two species to Naturbasen (2018) (Fig. 3) indicate that the largest increase in the number of locations from which they were reported came in the latter half of the period, after a relatively slow increase in the first half. This picture is consistent with the hypothesis that the early finds were due to independent immigrations from abroad, while the later "filling up" is due to local (and possibly self-mediated) dispersal from each of the primary centres of establishment.

The 2017 distribution of *D. ramosus* on the Danish islands (Fig. 2B) indicates a situation similar to that in Jutland 2010 (Fig. 2A): the species is present, but not abundant enough to turn up at every one-hour observation event. The situation is a logical consequence of the fact that in 2010 the species was completely missing on most of the eastern islands (except in Copenhagen). In another seven years we can expect it to have become firmly established on these islands too.

Dicranopalpus ramosus were estimated to have invaded northern Europe with a speed of 35-100+ km per year. Range expansion rates at such speeds make it hard to imagine that the expansion could take place without human assistance. Though some flying insects (e.g. the harlequin ladybird beetle, *Harmonia axyridis*) may have spread with higher speeds (Brown et al. 2008, Hemptinne et al. 2012), most invasive winged insects have expanded with speeds in the same range as *D. ramosus* or slower (Hemptinne et al. 2012). Indeed, the spread of the harlequin beetle in Denmark has been considerably slower than that of *D. ramosus* (Steenberg & Harding 2009). Human vehicular transportation allows for dispersal by very long jumps also in species incapable of self-mediated long-distance dispersal. It even seems that the speed of expansion has increased as the species moved north. This may be due to increased truck traffic between countries of the European Union during the last decennia. Building of bridges between Funen and Zealand (1998) and between Zealand and Sweden (2000) may have reduced the tendency of the sea belts between these islands (Storebælt and Øresund) to function as dispersal barriers by facilitating terrestrial traffic.

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Electronic Appendix (pdf format): Numbers of *Dicranopalpus ramosus* and *Odiellus spinosus* collected during one-hour surveys of Danish towns during the period 2003 to 2017, with information on geographic position of towns and year/date (Month-Day) of collection.

On the morphological separation of two sibling species: *Pardosa proxima* (*P. vlijmi* syn. nov.) and *P. tenuipes* (Araneae: Lycosidae)

Marco Isaia, Torbjörn Kronestedt, Francesco Ballarin & Alberto Chiarle

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Abstract. Morphological descriptions of *P. proxima* (C. L. Koch, 1847) (= *P. vlijmi* den Hollander & Dijkstra, 1974, **syn. nov.**) and its sister species *P. tenuipes* L. Koch, 1882 (= *P. proxima* auct.), a pair of species hardly distinguishable on a morphological basis but easily separable through behavioural characters, are given. The identification on an ethological basis allowed us to study the morphology of the males and to point out the morphological characteristics that can be used to discriminate the two species. Moreover, the examination of type material of *Pardosa proxima* and *P. tenuipes*, together with details given in the original descriptions, led us to conclude that *P. vlijmi* is a junior synonym of *P. proxima* and that *P. tenuipes* has been long overlooked. However, females remain hard to distinguish due to high intraspecific variability in the shape of the epigyne, vulva and habitus. According to the examination of material from different parts of Europe, *P. proxima* seems to be quite common in Italy and in the south of the Balkan Peninsula (mainly Greece and Bulgaria) while *P. tenuipes* is more widely distributed in western Europe, reaching central Europe. Contact zones between the two species were found in north-western Italy and France. Far from detailing the precise distribution of the two species, we suggest that material previously identified as "*Pardosa proxima*" should be checked for establishing the occurrence of one or both species in different countries.

Keywords: ethospecies, synonymy, taxonomy, wolf spiders

Zusammenfassung. Zur morphologischen Unterscheidung von zwei Schwesterarten: *Pardosa proxima* (*P. vlijmi* syn. nov.) und *P. tenuipes* (Araneae: Lycosidae). Es werden morphologische Beschreibungen von *P. proxima* (C. L. Koch, 1847) (= *P. vlijmi* den Hollander & Dijkstra, 1974, **syn. nov.**) und ihrer Schwesterart *P. tenuipes* L. Koch, 1882 (= *P. proxima* auct.) präsentiert. Es handelt sich um ein Artenpaar, das morphologisch nur schwer, aber durch ihr Verhalten leicht zu unterscheiden ist. Die Bestimmung auf ethologischer Basis ermöglichte uns die Morphologie der Männchen genauer zu untersuchen und morphologische Merkmale zu finden, die es möglich machen die beiden Arten zu trennen. Weiterhin führte die Untersuchung von Typusmaterial von *Pardosa proxima* und *P. tenuipes*, zusammen mit in den Orginalbeschreibungen genannten Details, zu dem Schluss das *P. vlijmi* ein jüngeres Synonym von *P. proxima* ist und dass *P. tenuipes* lange übersehen wurde. Jedoch bleiben die Weibchen, bedingt durch eine hohe intraspezifische Variabilität der Form von Epigyne und Vulva sowie ihrem Habitus, schwer unterscheidbar. Nach Untersuchung von Material aus verschiedenen Teilen Europas scheint *P. proxima* in Italien und dem Süden der Balkanhalbinsel (vor allem in Griechenland und Bulgarien) häufig zu sein, während *P. tenuipes* im westlichen Europa, bis Mitteleuropa, verbreitet ist. Kontaktzonen beider Arten sind aus Nordwest-Italien und Frankreich belegt. Bisherige Nachweise von „*Pardosa proxima*" sollten überprüft werden um die genaue Verbreitung beider Arten in den verschiedenen Ländern zu belegen.

Pardosa C. L. Koch, 1847 is the largest genus within the family Lycosidae with 549 known species and subspecies (WSC 2018) and represents one of the largest spider genera in the world. Most of the species have been placed in informal phenetic species-groups based on similarities in the copulatory organs (Zyuzin 1979, Dondale & Redner 1990, Almquist 2005, Chiarle et al. 2013).

The *proxima*-group includes nine Palaearctic species (Zyuzin 1979): *P. proxima* (C. L. Koch, 1847), *P. hortensis* (Thorell, 1872), *P. morosa* (L. Koch, 1870), *P. tatarica* (Thorell, 1875) [= *P. strigillata* sensu Zyuzin 1979], *P. atomaria* (C. L. Koch, 1847) [= *P. strigillata* sensu Buchar & Thaler 2002], *P. cribrata* Simon, 1876, *P. roscai* (Roewer, 1951), *P. pseudostrigillata* Tongiorgi, 1966 and *P. vlijmi* den Hollander & Dijkstra, 1974. The subspecies *P. proxima poetica* Simon, 1876 was also described from Europe, although Tongiorgi (1966) considered it doubtful since it does not display a well-defined geographical separation from the typical form (see remarks below on *P. proxima poetica*).

Zyuzin (1979) showed clearly outlined characters for the *proxima*-group such as a small, trapezoidal tegular apophysis and, in some cases, a sclerotized lamellar process on the palea in males. Females are characterized by a more or less narrow anterior part of the septum, which is not connected with the anterior margin of the epigyne, and a broadened posterior part usually characterized by a triangular or anchor-like shape.

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Historical background

Carl Ludwig Koch originally described *Pardosa* (sub *Lycosa*) *proxima* on material from unspecified localities in Greece in 1847. According to the original description, specimens were collected by the Bavarian explorer Franz Joseph Schuch (1808-1863). He was a military physician serving in the Bavarian Auxiliary Corps in Greece around 1834-1837. The Corps was stationed in Nauplia (now Nafplio, Ναύπλιο) in the Peloponnese. Supposedly, Dr. Schuch collected the type material of *Pardosa proxima* in the vicinity of Nafplio, as this locality was mentioned for other spiders collected by him and described by C. L. Koch (Koch 1847). The distribution of the species was later considered Euro-Mediterranean (Tongiorgi 1966, Vlijm 1971, den Hollander & Dijkstra 1974), although Dahl (1908) already considered that specimens from south-eastern Europe differed from specimens in south-western Europe. More specifically, Dahl (1908: 507) stated that the south-western specimens showed the same characters that were described by Koch (1882) for *Pardosa tenuipes*, such as the uniform colouration of the male femur of leg I: "Die Exemplare aus Südwesteuropa weichen in ganz bestimmter Weise ab. Beim Männchen von *Lyc. proxima* C. L. Koch sind die Schenkel des ersten Beinpaares stets viel dunkler als die andern, fast einfarbig, bei der südwesteuropäischen Form, welche L. Koch *Pard. tenuipes* genannt hat (vgl. 1881), sind die Vorderschenkel nicht dunkler und meist ähnlich wie die andern geringelt." [The specimens from south-western Eu-

rope differ in a very specific way. Males of *Lyc. proxima* C. L. Koch have the femora of the first leg pair much darker than the others, almost unicolour, while in the form from southwestern Europe, which L. Koch named *Pard. tenuipes* (cf. 1881 [should be 1882]), the first femora are not darker and annulated like the others].

In addition, it is worth noting that in the original description of *P. proxima,* C. L. Koch (1847: 53) mentioned and illustrated the dark femur of leg I of males (see Fig. 24, arrow). The same characteristic was also emphasized by de Lessert (1910: 516, footnote).

Den Hollander et al. (1972) published a paper on the occurrence of wolf spiders of the genus *Pardosa* in southern France. In this work, they observed that specimens previously identified as *P. proxima* showed different courtship behaviour compared to the typical form. They found these "aberrant specimens" in two localities (Pas d'Esculette, near Millau and Le Pin, near Auxerre), occurring together with *P. proxima* auct. and *P. hortensis*. According to den Hollander et al. (1972), the preliminary examination of the external genital structures of the "aberrant specimens" showed intermediate features between *P. proxima* auct. and *P. hortensis*. A few years later, the same material was examined by den Hollander & Dijkstra (1974) who described the "aberrant specimens" as a new ethospecies, *P. vlijmi* den Hollander & Dijkstra, 1974. Ethospecies are defined as pair or complex of species that can be hardly distinguished on a morphological basis, if at all, but are easily separable through behavioural characters (O'Connor et al. 2011, see also Vlijm 1986). The concept of ethospecies was defined by Emerson (1956) to describe species belonging to the genus *Apicotermes* (Isoptera) that could only be distinguished by the different construction of the nests. Among spiders, ethospecies are particularly known in wolf spiders (e. g., Uetz & Denterlein 1979, Cordes & von Helversen 1990, Töpfer-Hofmann et al. 2000, Roberts & Uetz 2004). Chiarle & Isaia (2013) confirmed that courtship behaviour is a valuable tool to discriminate *P. proxima* auct. from *P. vlijmi*. However, it seems likely that the concept of ethospecies only reflects the inability of the researcher to detect useful morphological features.

The fact that the description of *P. vlijmi* as a new species was only based on courtship behaviour created nomenclature problems (see also Vlijm 1986). In particular, den Hollander & Dijkstra (1974) considered *P. proxima* auct. and *P. vlijmi* "morphologically indistinguishable", implying that it was not necessary to see any type material of *P. proxima* C. L. Koch, 1847. In their work, they assigned the new name *vlijmi* to the less common species: "It therefore seems plausible that the widespread *P. "proxima"* refers to *Pardosa proxima* (Koch, 1848) [sic!] and that the aberrant specimens belong to a new species". This kind of conclusion is rather arbitrary, given that there is no evidence that Carl Ludwig Koch had described *P. proxima* on specimens that performs the "normal" or the "aberrant" courtship behaviour observed by den Hollander & Dijkstra (1974). Although the authors provided some preliminary measurements of the body and the external genital structures, the drawings of palps and epigynes are poor and lack details. Moreover, given the apparent lack of documented morphological characters useful to distinguish the new species, it is likely that *P. vlijmi* has been routinely overlooked and often confused with its sibling species, *P. proxima* auct.

The results obtained in our previous studies on the courtship behaviour of these two species (Chiarle et al. 2013, Chiarle & Isaia 2013) concur with those reported by den Hollander & Dijkstra (1974). A closer examination of the specimens used for the behavioural analysis, together with the examination of material from different parts of Europe, revealed that the two species were in fact mostly confused in the past, and that a revision of the current nomenclature was needed. Further support for our assumption, linking morphological and ethological traits, is found in the molecular analysis previously conducted (Chiarle 2013), providing evidence for a clear separation of the two species, and justifying our use of morphological characters for species identification.

Here we present the results obtained from the morphological examination, we point out the characters useful for separating the two species and we revise their nomenclatural status.

Material and methods

Samples were photographed using an Olympus E-520 camera attached on an Olympus SZX16 stereomicroscope at the Zoological Museum, University of Turku and a Leica EC3 camera attached on an Leica MS5 stereomicroscope at the Department of Life Sciences and Systems Biology of the University of Torino. Dishes of different size with paraffin at the bottom were used to photograph the specimens in the correct position. Images have been subsequently fixed using "CombineZP" image stacking software. SEM micrographs were taken with a Hitachi S-4300 scanning electron microscope at the Swedish Museum of Natural History in Stockholm. The digital photo (stacked) in Fig. 26 was taken using an InfinityX camera on an Olympus SZX12 stereomicroscope at the Swedish Museum of Natural History in Stockholm.

Part of the examined material (marked with an asterisk*) has been formerly identified on an ethological basis (see Chiarle et al. 2013, Chiarle & Isaia 2013).

For both species, total body length, prosoma length and width, leg I length is reported (minimum and maximum). For males, we also measured palp tibia length and width. Description and measurements of females are based on presumed "pure" populations (i.e. populations where we only found males of one of the two species). All measurements are given in millimetres.

Apart from types, all studied materials are preserved at: Museo Civico di Storia Naturale di Verona, Italy (MSNVR); Museo Civico di Scienze Naturali "E. Caffi" di Bergamo, Italy (MCSNB); Museo Regionale di Scienze Naturali di Torino, Italy (MRSN); Entomology Department of the Royal Belgian Institute of Natural Science in Brussels, Belgium (RBINS); National Museum in Prague, Czech Republic (NMP), Collezione Isaia stored at Dipartimento di Scienze della Vita e Biologia dei Sistemi, University of Torino, Italy (CI), and Swedish Museum of Natural History of Stockholm, Sweden (NHRS).

Taxonomy

Family Lycosidae Sundevall, 1833

***Pardosa proxima* (C. L. Koch, 1847)**

(Figs 1, 2, 5-10, 19, 21, 22, 24-26)

Lycosa proxima C. L. Koch, 1847: 53, figs 1453-1454 (♂♀)

Pardosa proxima (C. L. Koch): Tongiorgi 1966: 306

Pardosa vlijmi den Hollander & Dijkstra, 1974: 58, fig. 1: 1 (♂♀), courtship behaviour; Chiarle & Isaia 2013: courtship behaviour. Chiarle et al. 2013: 119, courtship behaviour. **Syn. nov.**

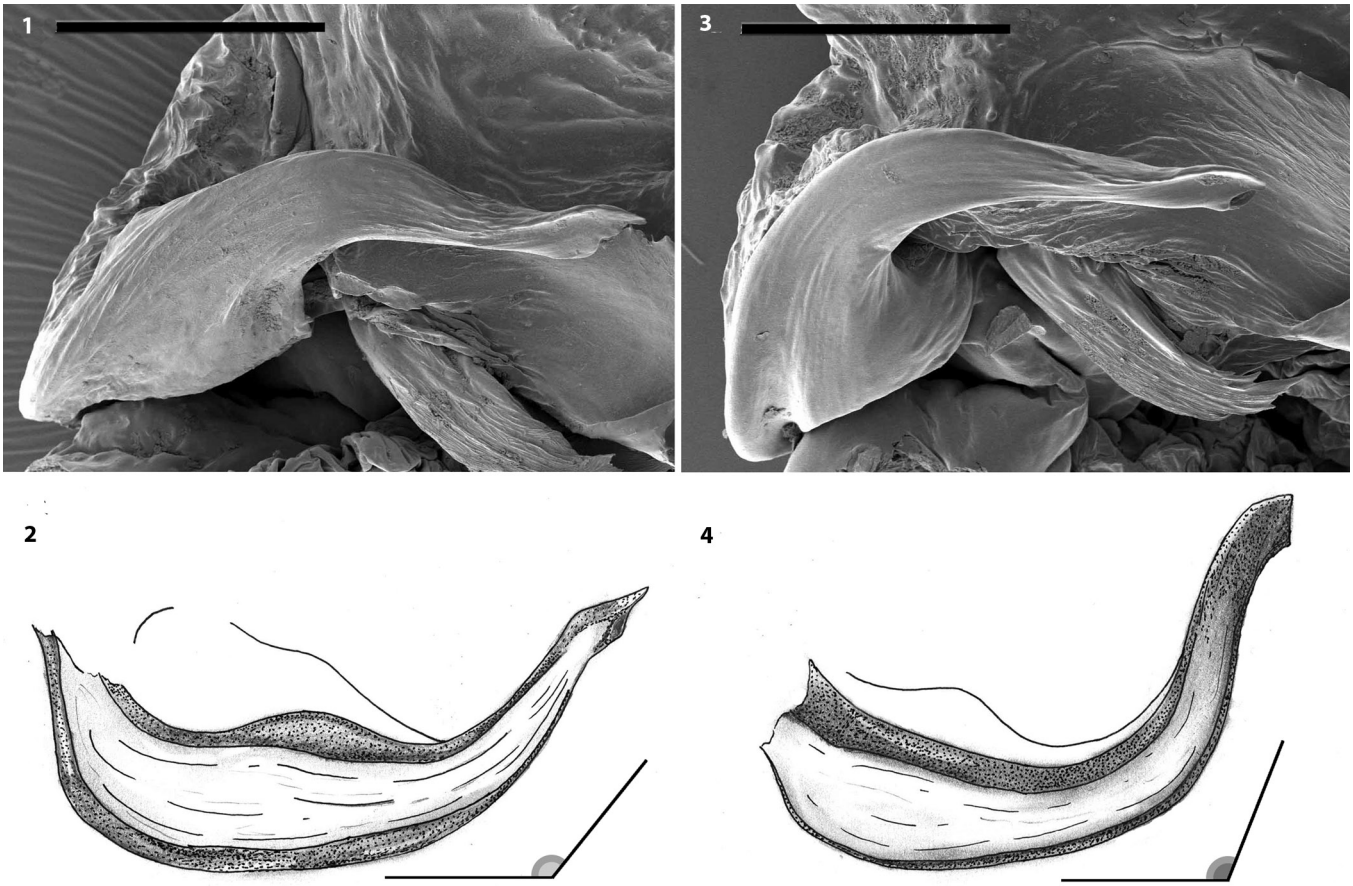
Brief description of the courtship behaviour. The male quickly raises and lowers the whole body on the spot, with a series of small jumps. The vibration turns into a conspicuous hopping, characterized by up and down movements of the whole body toward the female. At the same time, the male performs some very rapid movements of the opisthosoma, kept parallel to the substrate. During hopping, the palps and opisthosoma scrape on the substrate.

Type material. *Pardosa proxima:* Lectotype ♀ with old labels "*Pardosa proxima*" and "Griechenland Type" in Natural History Museum, London, here examined and designated: GREECE, possibly near Nafplio (cf. "Historical background" above). Another female stored in a separate tube labelled "*Lyc. proxima* type" (not old label) turned out to be *P. hortensis*.

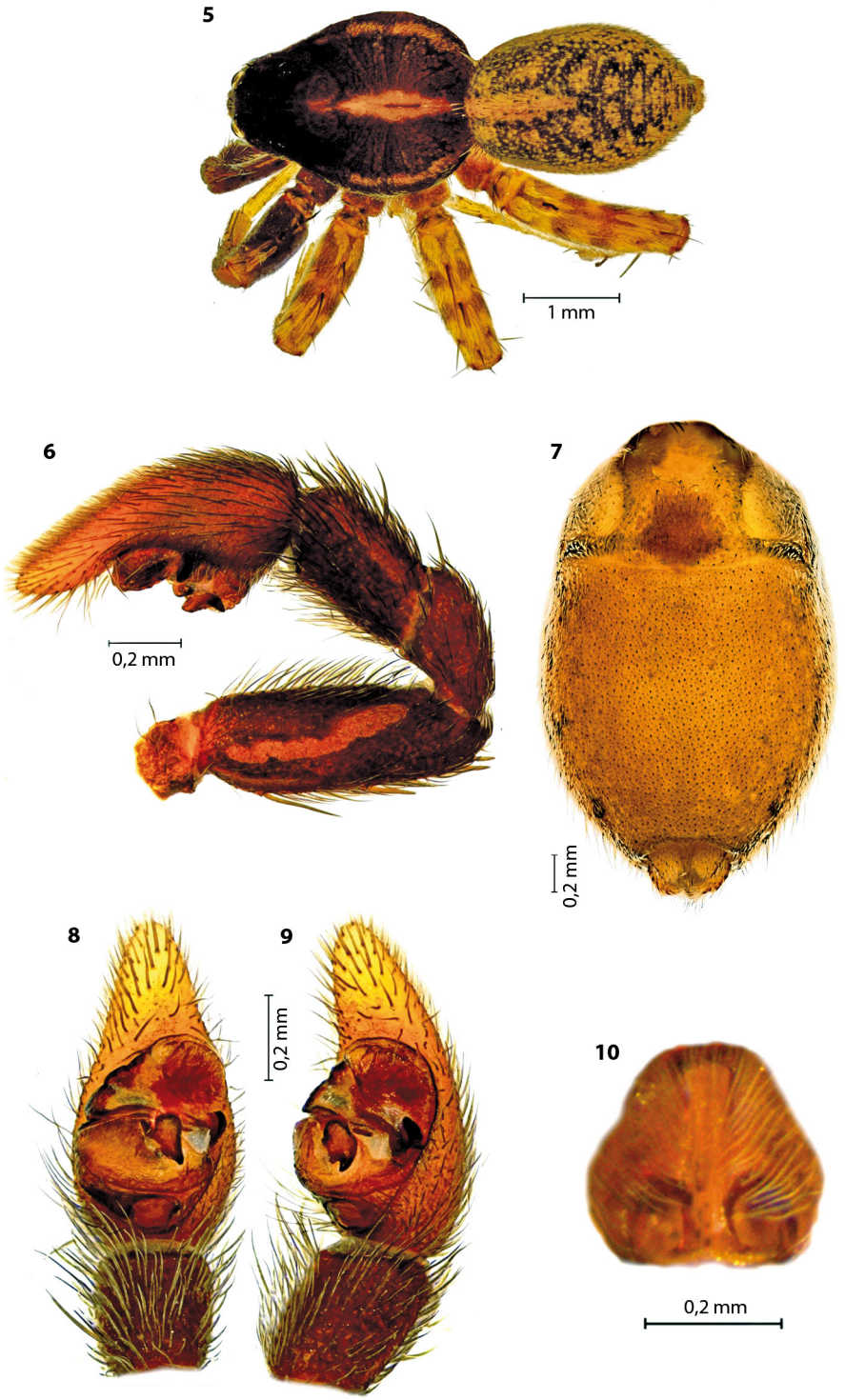
Pardosa vlijmi: Holotype ♂ and allotype ♀ from FRANCE, Lozère, Pas d'Esculette and 2♀ paratypes from FRANCE, Yonne, Le Pin in Naturalis Biodiversity Center, Leiden, examined.

Other material examined. Asterisks (*) indicate specimen used in previous studies for behavioural analysis.

BULGARIA. Blagoevgrad: Sandanski, shore, 20.VI.1963, 16♂ (J. Buchar, NMP). – FRANCE. Corse: Haut-Asco, short grazed grass partly wet from water flow, 24.V.2005, 6♂ 3♀ (T. Kronestedt, NHRS). – GREECE. Eastern Macedonia and Thrace: Lake Mitrikou area, 1.IV.1988, 12♂ 17♀ (D. Cordes, NHRS). Crete: La Canea, Vryses, ashore with stones, 24.VI.1999, 4♂ 1♀ (J. Buchar, NMP); Moni Toplou, small basin, 12.V.2010, 1♂ (J. Buchar, NMP); also material in Bosmans et al. (2013). Peloponnese: Nomia, 16.VI.1974, 1♂ (V. Švihla, NMP); Tolo, drain, 20.VI.2000, 3♂ 3♀ (J. Buchar, NMP); Argos, brook, 22.VI.2000, 3♂ 1♀ (J. Buchar, NMP). – ITALY. Calabria: Cosenza, Cecita lake, 6.VIII.1958, 2♂ (F. Papi, coll. P. Tongiorgi); S. Giovanni in Fiore, Lorica, 24.VIII.1999, 1♂ (E. Ferrario, MSNB). Emilia–Romagna: Ravenna, Cervia, inside the city, IV.1991, 1♂ (P. Tongiorgi, MCSNB); Reggio Emilia, Regnano, meadow with *Medicago sativa*, 23.IV.1978, 4♂ 20♀, lake shore, 1♂ 1♀ (P. Tongiorgi, MCSNB); Viano, 275 m, 30.IV.1978, 1♂ 6♀ (P. Tongiorgi, MCSNB). Lazio: Roma, Campaegli, Cervare di Roma, Monti Simbruini, 18.VIII.2010, 11♂ 1♀ (F. La Casella, CI); Palatino hill, 14.III.1965, 1♂ (P. Brignoli, MCSNB). Liguria: LaSpezia, Bozzi, suburbs, 24.III.1957, 2♂ 2♀; Canaletto, ?.V.1957, 1♂ (G. Mazza, MCSNB). Lombardia: Bergamo, Bariano, Serio river, 120 m, pitfall trap, uncultivated meadow, 8.III.–8.IV.2002, 1♂; 16.VI.–7.VII.2002, 3♂ (S. Ciocca, MCSNB); Bonate Sotto, Brembo river, 175 m, pitfall trap, dry grassland, 11.II.–23.III.2002, 2♂ (S. Ciocca, MCSNB). Zanica, Serio river, 190 m, pitfall trap, grassland with *Artemisia* sp., 8.III.–8.IV.2002, 2♂ (S. Ciocca, MCSNB); river shore, 1.IV.–13.IV.2003, 1♂ (S. Ciocca, MCSNB); Pavia, 20th naviglio, ?.IV.1999, 1♂ (S. Ciocca, MCSNB); Piemonte: Alessandria, Pecetto di Valenza, poplar wood, 06.VII.2006, 1♂ (M. Isaia, CI); Asti, Canelli, vineyard, 4.VII.2009, 3♂ (E. Caprio,

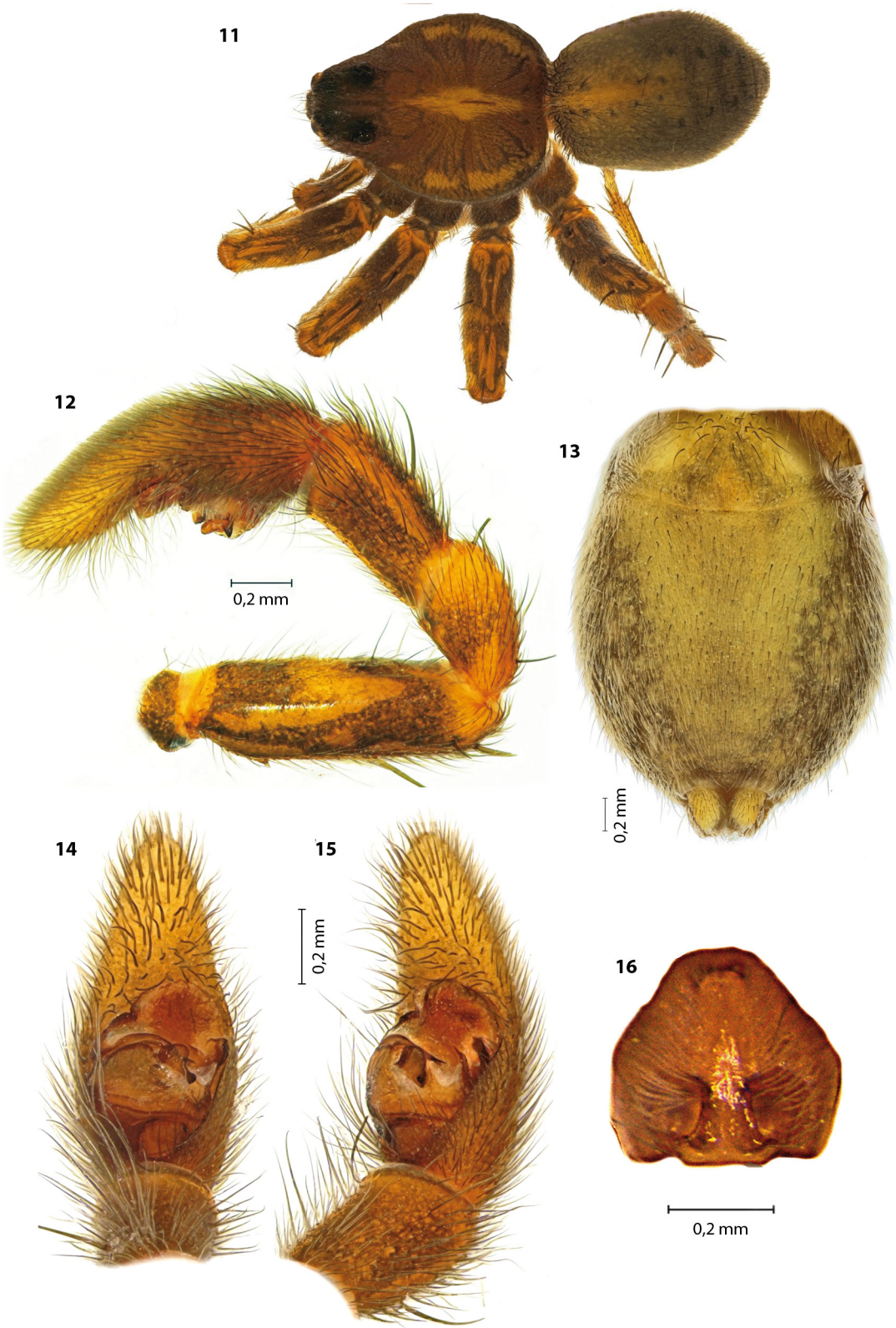


Figs 1-4: 1-2. *Pardosa proxima*, male: **1.** SEM picture of the embolus; **2.** embolus with inclination angle. **3-4.** *P. tenuipes*, male: **3.** SEM picture of the embolus; **4.** embolus with inclination angle. Scale lines = 100 µm. **1-2.** male from Vicoforte Mondovì, Cuneo (IT) **3-4.** male from "La Mandria" natural park, Venaria Reale, Torino (IT)



Figs 5-10: *Pardosa proxima,* male: **5.** habitus; **6.** left palp retrolateral view; **7.** abdomen ventral view; **8.** left palp ventral view; **9.** left palp ventrolateral view; **10.** epigyne. **5-9.** male from Caldiero, (Verona, IT). **10.** female from Belfiore (Verona, IT)

CI); Cuneo, Vicoforte Mondovì, wet meadows, 3.III.2007, 2♂ (MRSN); 22.III.2009, 9♂ (A. Chiarle, CI)*; Guarene, meadows, 7.III.2009, 7♂ (A. Chiarle, CI)*; Torino, Ivrea, Meugliano lake, 30.IV.2010, 1♂ (M. Paschetta, CI). Puglia: Taranto, 6 km from S. Basilio, Lato river shore, 1961, 4♂ 20♀ (P. Tongiorgi, MCSNB). Sardegna: Cagliari, Muravera, Costa Rei bay, 24.VI.1987, 15♂ 14♀ (P. Tongiorgi, MCSNB); Nuoro, Belvì, Enazzu, 550 m, pitfall trap, hazel grove, 13.VII.–27.VII.2006, 1♂ 2♀; 21.II.–19.III.2007, 5♂; 19.III.–26.IV.2007, 1♂; 26.IV.–30.V.2007, 1♂ 3♀ (I.S.E., MCSNB). Toscana: Lucca, Pania della Croce, near the Mosceta lodge, 18.IV.1957, 1♂ (P. Tongiorgi, (MCSNB); Sillano, Capanne di Sillano, swampy area, 4.VII.1965, 1♂ 1♀ (P. Tongiorgi, MCSNB); S. Romano, Orecchiella wildlife reserve, 1200 m, 14.V.1967, 7♂ 22♀ (P. Tongiorgi, MCSNB); Gallicano hill, road to Monterpoli, 3.V.1968, 17♂ 30♀ (P. Tongiorgi, MCSNB); Pisa, humid meadow near the pool, 2.IV.1957, 2♂ (P. Tongiorgi, MCSNB); Caprona, Arno river banks, ?.1962, 11♂ 7♀ (P. Tongiorgi, MCSNB); S. Rossore, field and scrub, 4.IV.1960, 1♂ 4♀ (P. Tongiorgi, MCSNB); meadow near the swampy area, 11.IV.1960, 5♂ 10♀ (P. Tongiorgi, MCSNB); meadows with salted pools, 19.IV.1963, 1♂ 9♀ (P. Tongiorgi, MCSNB); Ponte dei Biacchi, 3.III.1963, 4♂ 2♀ (P. Tongiorgi, MCSNB). Val d'Aosta: Pont-Saint-Martin, Holay, 4.VII.–28.VII.2011, 4♂ (M. Paschetta & D. Giuliano, CI). Veneto: Padova, Vò, Zovon, pitfall trap, 20.X.2010, 5♂ 2♀ (M. Zotti, MSNVR);



Figs 11-16: *Pardosa tenuipes*, male: **11.** habitus; **12.** left palp retrolateral view; **13.** abdomen ventral view; **14.** left palp ventral view; **15.** left palp ventrolateral view; **16.** epigyne. **11-15.** male from Bariano (Bergamo, IT). **16.** female from "La Mandria" Natural Park, Venaria Reale (Torino, IT)

Padova, Colli Euganei, pitfall trap, 10.VII.2010, 30♂ 20♀ (M. G. Paoletti, MSNVR); Verona, Natural History Museum inner court, 1♂ (Boscolo & Zaupa, MSNVR); Belfiore, Porto, uncultivated meadow, 22.III.2008, 3♂ 3♀ (F. Ballarin, MSNVR); Caldiero, Ca' Tantini, pitfall trap, uncultivated meadow, 15.VI.–5.VII.2008, 1♂ (F. Ballarin & D. Fattori, MSNVR); Cologna Veneta, 19.III.1967, 1♂ (Gioco, MSNVR). – MOROCCO. Agadir, lawn in the city, 9.XII.1998, 3♂ (T. Kronestedt, NHRS). – SPAIN. Tenerife: Aguamansa, 1000 m a.s.l., grassland at edge of conifer forest, 11.XII.1999, 10♂ 3♀ (T. Kronestedt, NHRS); Puerto de la Cruz, lawn, 8.XII.1999, 16♂ 4♀ (T. Kronestedt, NHRS). – TURKEY. Mediterranean Region: Side, wet meadows, 1.VI.2002, 14 ♂ (J. Buchar & V. Céza, NMP).

Description. The general description is based on specimens for which we observed courtship behaviour (marked with an asterisk on the material section). Specimens from other localities were considered for comparison.

Male. Total length: 4.50–5.05. Prosoma: 2.18–2.6 long, 1.75–1.92 wide.

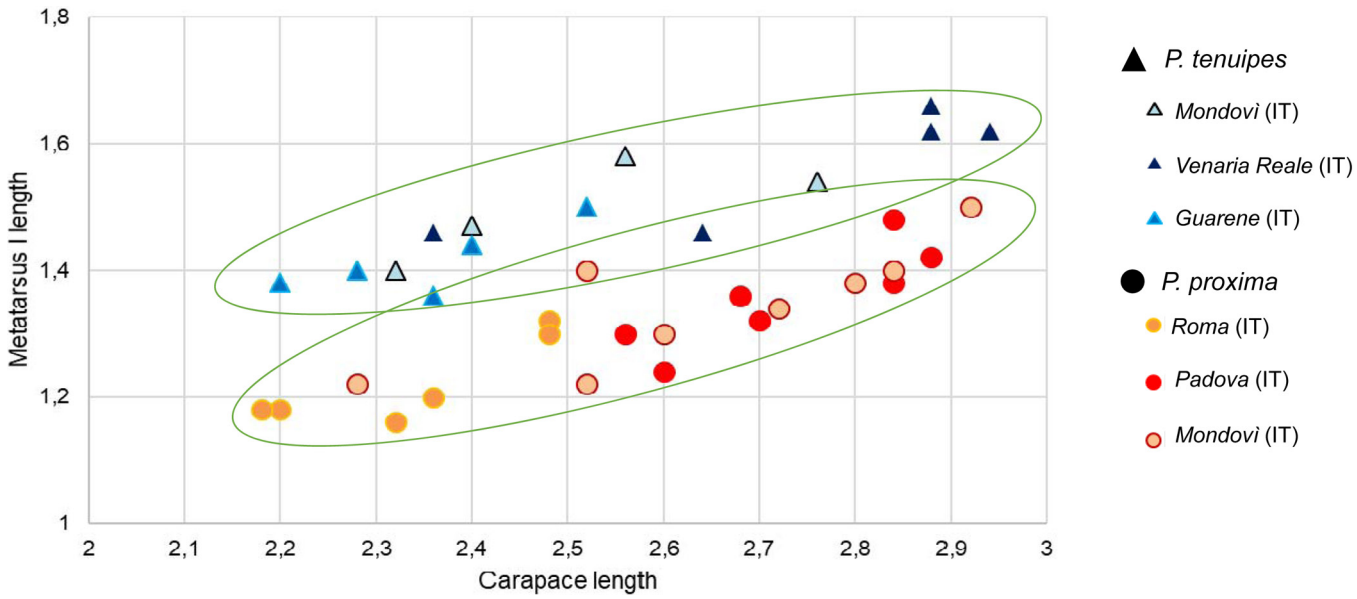


Fig. 17: Clustering of *Pardosa proxima* and *P. tenuipes* based on the carapace (x–axis) and leg I metatarsus length (y-axis).

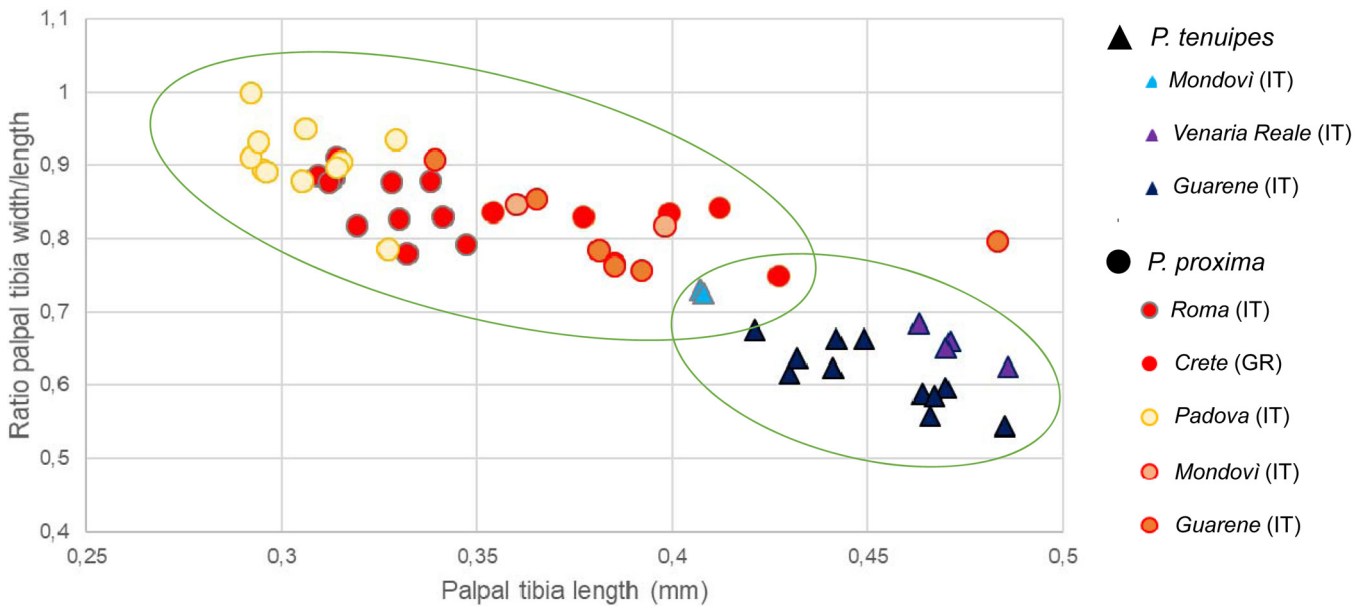


Fig. 18: Clustering of *Pardosa proxima* and *P. tenuipes* based on palpal tibia length (x–axis) and the palpal tibia width/length ratio (y-axis).

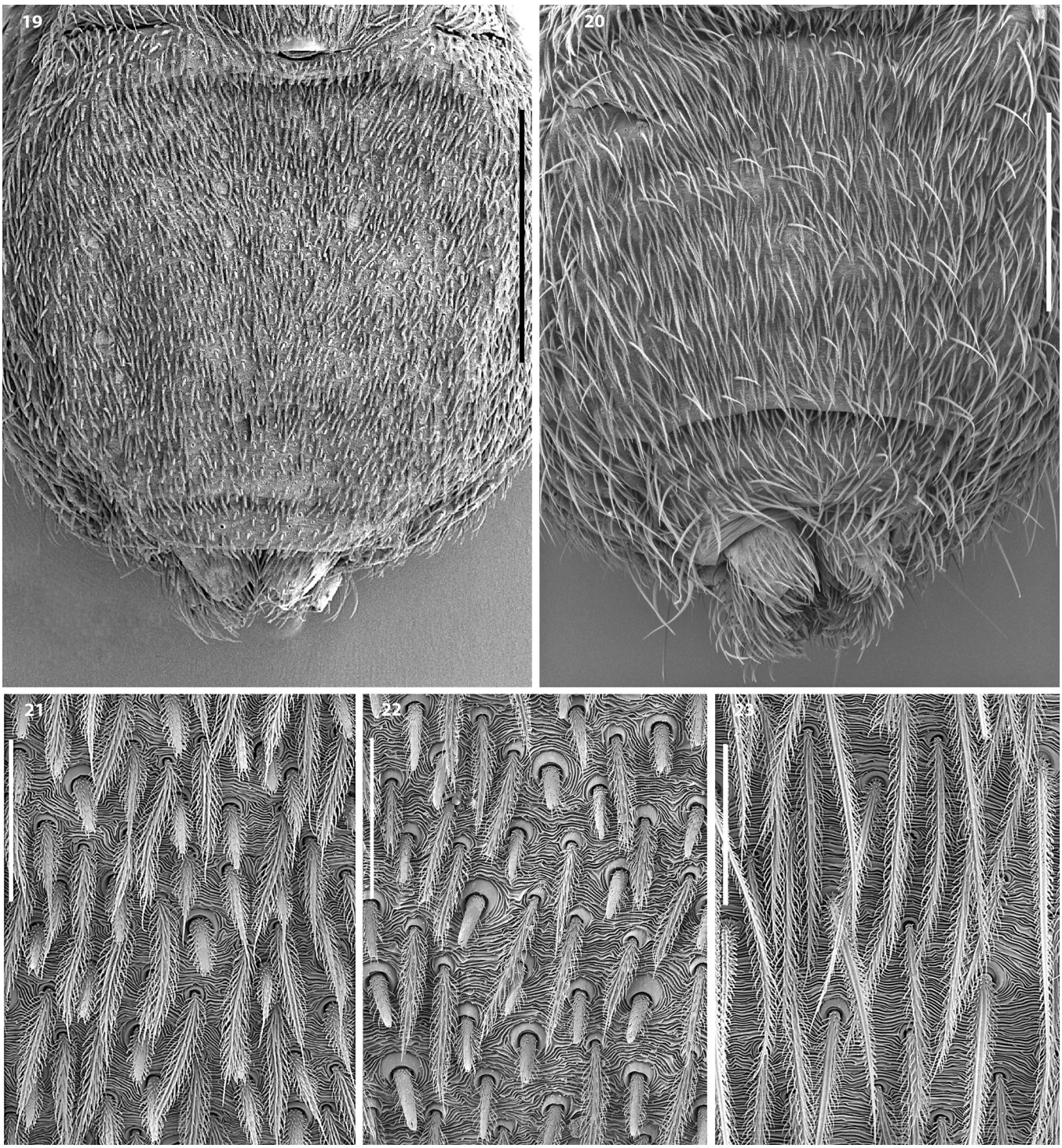
Prosoma dark brown with darker eye region, with a narrow yellowish median band, lateral bands of the same colour, broken into three distinct parts (Fig. 5). Eye region with short hairs. Clypeus brownish, chelicerae brown with yellow internal side. Sternum brown. Opisthosoma dorsally dark brown with a distinct lighter cardiac mark surrounded and followed by a couple of spots of the same colour, spots fused near the spinnerets (Fig. 5). Ventral side of the opisthosoma yellowish with short, stumpy dark hairs (Figs 7, 19, 21–22). Legs uniformly yellowish**,** femora with brown annulations (Fig. 5). Leg I with femur brown (Fig. 5) and with only few long hairs on tibia and metatarsus. Leg I length: Femur 1.5, Patella 0.70, Tibia 1.17, Metatarsus 1.30, Tarsus 0.91. Palp as in Figs 6, 8, 9 dark brown, cymbium brown with yellow distal part. Embolus as in Figs 1–2.

Female. Total length: 5.41–6.25. Prosoma: 2.16–2.40 long, 1.56–1.74 wide.

Prosoma dark brown with darker eye field. Median band yellowish, lateral bands broken into three distinct spots, same colour as median band. Rarely, the lateral bands are unbroken. Clypeus and cephalic flanks yellow-brownish, chelicerae of the same colour. Sternum brownish sometimes with a lighter central area. Dorsal side of the opisthosoma dark brown with a distinct narrow cardiac mark, flanked and followed by 4–5 couples of yellow-brownish spots, which are fused near the spinnerets. The whole pattern is quite variable and, in some specimens, it is faint and not clearly visible. Ventral side of the opisthosoma light brown with two lighter V shaped strips. Legs uniformly yellowish brown with few faint brownish marks on femora and patella. Leg I length: Femur 1.54, Patella 0.76, Tibia 1.22, Metatarsus 1.24, Tarsus 0.89. Epigyne as in Fig. 10.

Habitat. Similar to *P. tenuipes*. The two species may co-occur in the same habitat.

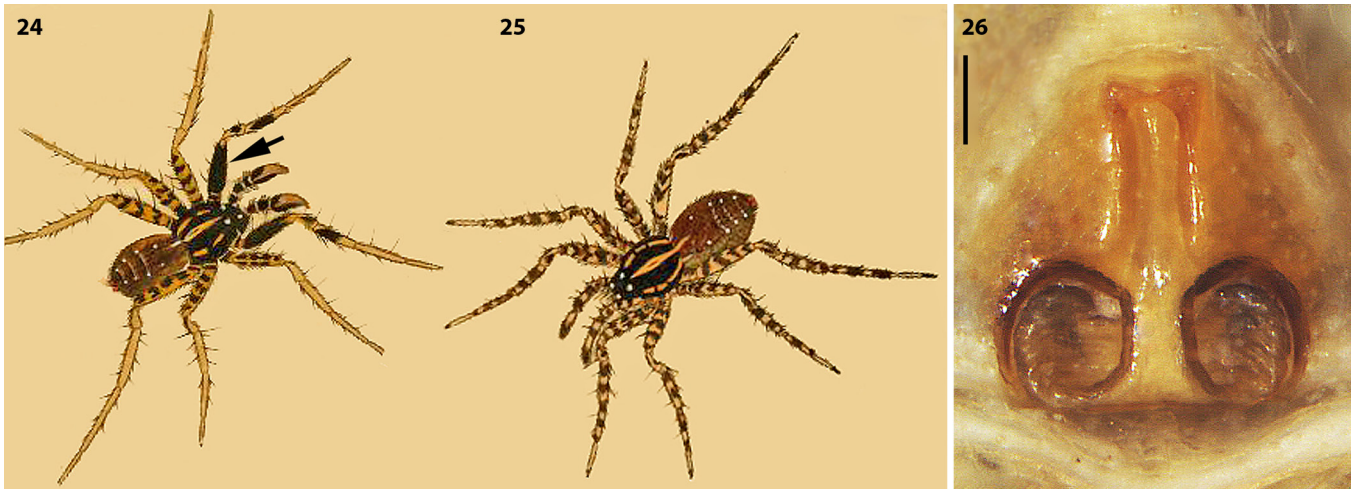
Remarks. The stumpy (peg-like) dark hairs on the venter of the male opisthosoma show some variation in density, being somewhat less dense in males from Morocco and Tenerife in



Figs 19-23: SEM pictures of male abdomens (ventral side): **19.** *Pardosa proxima* showing short (light) and modified (dark) hairs; **20.** *Pardosa tenuipes* showing numerous long and thin (light) hairs, scattered with more erect (dark) hairs; **21.** *P. proxima*, close-up of abdominal hairs; **22.** as in Fig. 21 (note the shabbier modified (dark) hairs); **23.** *P. tenuipes*, close-up of abdominal hairs. Scale line = 500 µm (19, 20), 50 µm (21-23). **19, 22.** male from Campaegli (Roma, IT); **20, 23:** male from "La Mandria" natural Park, Venaria Reale (Torino, IT). **21.** male from Padova (IT)

comparison with males from e.g., Greece, and being slightly longer in some males from Tenerife.

***Pardosa tenuipes* L. Koch, 1882** (Figs 3, 4, 11–16, 20, 23)
Pardosa tenuipes L. Koch, 1882: 649, fig. 24 (♂).
Lycosa proxima tenuipes Dahl 1908: 425, fig. 81 (♂♀). Dahl & Dahl 1927: 33, figs 81–82 (♂♀).
Pardosa proxima tenuipes Lessert 1910: 515.
Lycosa proxima Locket & Millidge 1951: 267, fig. 130C–D, G (♂♀).
Pardosa proxima den Hollander et al. 1972: 79, fig. 1 (♂♀).
Pardosa proxima Loksa 1972: 17, fig. 12F–J, 25A, 26C–D (♂♀, S).
Pardosa proxima den Hollander & Dijkstra 1974: 57, fig. 1.2a–b (♂♀).
Pardosa proxima Roberts 1985: 134, fig. 59d (♂♀).
Pardosa proxima Roberts 1995: 220, fig. (♂♀).
Pardosa proxima Roberts 1998: 235, fig. (♂♀).
Pardosa proxima Chiarle et al. 2013: 119, courtship behaviour.



Figs 24-26: *Pardosa proxima*. **24-25.** after Koch (1847): male (24) and female (25); **26.** epigyne (lectotype). Scale line = 0.1 mm

Brief description of the courtship behaviour. The male moves one step forward with legs I raised, moving the palps up and down and vibrating the opisthosoma. Afterwards, he moves toward the female with hops, hitting the legs and rubbing the cymbia on the substrate.

Type material. *Pardosa tenuipes*: Holotype ♂ from SPAIN, Majorca, Ses Prat de San Jordi, May (Schaufuss) in Museum für Naturkunde, Berlin (ZMB 7921), examined. The male lacks both palps, but one palp and the legs on the right side are mounted on a microslide (ZMB 7921a). The illustration of the palp in Koch (1882: Fig. 24 also Bosmans & Van Keer 2012: Fig. 21) is misleading.

Other material examined. Asterisks (*) indicate specimen identified on ethological basis and used in previous studies (Chiarle & Isaia 2013, Chiarle et al. 2013) for behavioural analysis.

BELGIUM. Flandre: Brabant, Tienen, sugar factory, sandy substrate, 52 m a.s.l., 20.V.2009, 5♂ 13♀ (A. Chiarle, F. Hendrickx & J. Pétillon, RBINS); Antwerpen, 15.V.2009, 5♂ 8♀ (F. Hendrickx, RBINS); Laarne, Damvallei, 30.IV.2009, 1♂ (F. Hendrickx, RBINS). – FRANCE. Languedoc-Roussillon: Pyrénées–Orientales, Mas Larrieu, sandy sea shore among debris of *Arundo donax*, 7.V.2007, 5♂ 10♀ (T. Kronestedt, NHRS). Midi-Pyrénées: Ariège, Fougax-et-Barrineuf, grassland, 1.V.2006, 7♂ 9♀ (T. Kronestedt, NHRS), Lac Mondély, glade with litter and herbs close to lake, 25.IV.2006, 4♂ 2♀ (T. Kronestedt, NHRS), Lac de Montbel, clayey shore with low vegetation, 2.V.2006, 4♂ 4♀ (T. Kronestedt, NHRS). – GREAT BRITAIN. "England (Cambridge)", 1♂ 1♀ (Collectio Thorell No. 246/1546, NHRS). – ITALY, Emilia-Romagna: Reggio Emilia, Viano, Casola Querciola, 30.IV.1978, 1♂ (P. Tongiorgi, MCSNB). Liguria: Imperia, stream Prino slopes, 40 m a.s.l., 3.VI.2006, 1♂ (R. Fabbri, MCSNB). Lombardia: Bergamo, Bariano, Serio river, uncultivated meadows, pitfall trap, 120 m a.s.l., 8.III.–8.IV.2002, 4♂; 16.VI.–7.VII.2002, 6♂; 24.VII.–10.VIII.2002, 11♂; 31.I.–14.III.2003, 1♂, river shore 7.VII.–24.VIII.2002, 1♂ (S. Ciocca, MCSNB, MSNVR); Bonate Sotto, Brembo river, pitfall trap, 175 m a.s.l., 11.II.–23.III.2002, 2♂ (S. Ciocca, MCSNB); Zanica, Serio river, grassland with *Artemisia* sp., pitfall trap, 190 m a.s.l., 8.III.–8.IV.2002, 48♂; 7.VII.–24.VIII.2002, 5♂, 14.IX.–1.XI.2002, 2♂, 14.III.–1.IV.2003, 1♂; grassland with bushes, 14.III.–23.IV.2003, 1♂ (S. Ciocca, MCSNB). Piemonte: Cuneo, Guarene, meadow, 155 m a.s.l., 7.III.2009, 15♂ (A. Chiarle, CI)*; Torino, Venaria, La Mandria natural park, meadow, 09.IV.2010, 9♂ 4♀, (A. Chiarle, MRSN)*; Leini, 10.VII.1967, 1♂ (G. Osella, MSNVR), Ivrea, Meugliano lake, 30.IV.2010, 1♂ (M. Paschetta, CI), Porte, Chisone river pebbly shore, 600 m a.s.l., 06.IV.2008, 2♂ 1♀ (M. Isaia, CI), Verbano-Cusio-Ossola, Fondotoce, meadow, 9.VI-8.VII.2009, 2♂ 1♀ (M. Paschetta, CI). – PORTUGAL. Algarve: Patá, small river, ashore, 4.VII.2001, 4♂ 4♀; Roja Pé, brook, 1.VII.2001, 2♂ 3♀ (J. Buchar, NMP). – SPAIN. Andalusia: Ardales, ashore, 13.VI.1997, 3♂ 3♀; Campo de Golf between Malaga and Torremolinos, 15.V.1977, 13♂ 5♀ (T. Kronestedt, NHRS); San Pedro de Alcántara, among grass at small stream, 12.V.1977, 6♂ 6♀ (T. Kronestedt, NHRS). Majorca: Platja de Muro, Estany d'en Mama, grassland at lake and canal, 21.–23.IV.2013, 3♂ 17♀ (T. Kronestedt, NHRS).

Description. The general description is based on specimens in which we observed courtship behaviour (marked with an asterisk in the material section). Specimens from other localities were considered for comparison.

Male. Total length: 4.32–5.70. Prosoma: 2.20–2.97 long, 1.86–2.32 wide.

Prosoma dark brown, blackish in eye region, with narrow yellowish brown median band, and lateral light brown bands broken into three spots (Fig. 11). Eye region with long hairs. Clypeus yellowish, chelicerae brown with a light longitudinal strip on the internal side. Sternum dark brown. Opisthosoma dorsally grey-brownish with a remarkable brownish cardiac mark followed by 4–5 faint spots of the same colour (Fig. 11). Ventral side greyish with a wide yellow central area covered with hairs, normally developed (Figs 13, 20, 23). Leg I and all other legs uniformly yellow, femora with dark markings (Fig. 11). Leg I with numerous scattered long hairs on tibia and metatarsus. Leg I length: Femur 1.98, Patella 0.94, Tibia 1.61, Metatarsus 1.94, Tarsus 1.23. Palp as in Figs 12, 14, 15, brown with some yellowish areas on patella and femur, cymbium brown with lighter distal part. Embolus bent at approximately 90°, with the distal part almost equal in length to the proximal one (Figs 3–4).

Female. Total length: 5.28–5.91. Prosoma: 2.56–2.76 long, 2.02–2.12 wide.

Prosoma dark brown with darker eye region. Median band light brown, lateral bands of the same colour broken into three different parts, sometimes wide and unbroken with few

small brownish marks. Clypeus, cephalic flanks and chelicerae yellow-brownish. Sternum uniformly light brown. Opisthosoma dorsally dark brown with a distinct lighter cardiac mark usually bordered by black dots. Pairs of light brown spots, often fused, follow the cardiac mark until the spinnerets. Ventral side of the opisthosoma uniformly light brown, sometimes a lighter V shaped strip is present. Legs uniformly yellowish brown with brownish marks clearly visible on femora. Leg I length: Femur 1.74, Patella 0.78, Tibia 1.48, Metatarsus 1.40, Tarsus 0.92. Epigyne as in Fig. 16.

Habitat. Meadows, wet meadows, cultivated fields, swampy areas, edge of ponds and lakes.

Comparative remarks

Males of *P. proxima* and *P. tenuipes* show differences in the shape of the embolus (Figs 1–4), yet other morphological features permit a clear separation of the two species (Tab.1). In addition, the two species can be also well clustered comparing leg I metatarsus length with prosoma length (Fig. 17) and comparing palpal tibia width/length ratio with palpal tibia length (Fig. 18). However, the easiest way to discriminate males of the two species is looking at the hairiness ventrally on the opisthosoma (with numerous short modified hairs in *P. proxima* and normally developed in *P. tenuipes*, Figs 19 and 20, respectively) and at femur of leg I (same as other legs in *P. tenuipes* and darker in *P. proxima*; Figs 5 and 11, respectively). Photos with SEM (Figs 19–23) highlight striking differences in the length and the shape of the ventral hairs. As previously observed (Kronestedt 1996, 2005, Chiarle et al. 2013), modified hairs ventrally on the opisthosoma are found in other lycosid species in which the opisthosoma hits the substrate during courtship. Thus, the modified hairs present in *P. proxima* may be associated with a similar behaviour in this species.

On the other hand, females remain hard to distinguish on a morphological basis due to the high intraspecific variability and high overlap with respect to the shape of epigyne and vulva. Although some slight differences in shape and in the proportion between length and width of the epigyne could be considered, we argue that females of the two species cannot be distinguished on a morphological basis.

Remarks on *Pardosa proxima poetica*. Simon (1876) described *Pardosa proxima poetica* as a small sized ('minima') variety of *P. tenuipes* (sub *P. proxima*). According to the original description, this variety was characterized i.a. by having very clear unbroken lateral bands on the carapace, and the male palp yellowish brown with the cymbium distally of bulbus much shorter than the bulbus. A sample with material fitting Simon's description was available from Spain, Andalucia, Fuengirola, ruderal ground, 18.V.1977 (T. Kronestedt, NHRS), 4♂ 5♀, together with 1♂ and 2♀ of *P. tenuipes*.

We think that the characteristics mentioned by Simon (1876) for *P. proxima poetica* should be further investigated, and we have therefore not placed *Pardosa poetica* as a senior synonym of *P. tenuipes*. It should be mentioned that Simon (1937) regarded *P. proxima poetica* as an "espèce dominante" in Spain and Portugal. Regrettably, a loan of the type material of *P. proxima poetica*, probably present in the Muséum national d'Histoire naturelle in Paris, was not possible.

Remarks on WSC entries for *P. proxima*. In an attempt to assign the correct names to each of the WSC entries referring to *P. proxima*, several cases remained doubtful (Tab. 2). Despite the fact that, in a few cases, descriptions were matching some of the diagnostic features of *P. tenuipes* or *P. proxima*, we could not objectively establish whether they were just reporting Koch's original description or whether they were referring to multiple specimens from different countries.

Tab. 1. Morphological characteristics for separating *Pardosa proxima* and *P. tenuipes* males

	Pardosa proxima	*Pardosa tenuipes*
Prosoma	Eye region with short hairs	Eye region with long hairs
Opisthosoma	Venter covered with short modified (peg-like) dark hairs among short normal white hairs (Figs 7, 19, 21, 22)	Venter covered with recumbent white hairs and scattered more erect dark hairs (Figs 13, 20, 23)
Leg I	Few long hairs on tibia and metatarsus. Femur mostly brown	Numerous scattered long hairs on tibia and metatarsus. Femur yellowish brown with dark markings
Palp	Tibia short and more stumpy, dorsally covered with tuft of thicker hairs	Tibia long and slender

Distribution

According to our data, *P. proxima* seems to be quite common in Italy and in the south of the Balkan Peninsula (including Macedonia: Komnenov pers. comm.). In Greece, only *P. proxima* has been found (e.g. Bosmans et al. 2013, Bosmans pers. comm.). Contact zones with *P. tenuipes* are found in northwestern Italy and in France (original records by den Hollander & Dijkstra 1974). The countries in which the presence of *P. proxima* is certain are: Greece, Macedonia, France, Bulgaria, Italy, Morocco, Turkey, Canary Islands.

Although *P. tenuipes* is considered widespread in Europe, we examined only a few specimens from Western Europe and the Iberian Peninsula. According to our data, *P. tenuipes* occurs in Spain, Belgium, Great Britain, France, Italy and Portugal.

It seems likely that *P. tenuipes* occurs mostly in western Europe, while *P. proxima* seems more common in southern and eastern Europe.

Most illustrations and or descriptions available in literature do not allow a clear understanding about how names were used by previous authors (see Tab. 2). Far from detailing the precise distribution, we suggest that material previously identified as "*Pardosa proxima*" should be checked for establishing the occurrence of one or both species in different countries.

With a certain degree of uncertainty, illustrations and descriptions available in literature seems to confirm the occurrence of *P. proxima* in France (Simon 1876, Tongiorgi 1966), former Yugoslavia, Italy, Macedonia, Albania, Greece and Austria (Tongiorgi 1966).

Concerning *P. tenuipes,* illustrations and descriptions available in literature seems to confirm its occurrence in Germany, Austria, Italy and Spain (Becker 1882), Hungary (Loksa 1972, Dahl 1908, Dahl & Dahl 1927), Switzerland (Lessert 1910, Dahl & Dahl 1927), Great Britain (Dahl & Dahl 1927, Locket & Millidge 1951, Roberts 1985, 1995, 1998), Belgium (Becker 1882, Dahl & Dahl 1927, Roberts 1998), Netherlands (Becker 1882, Roberts 1998) and France (Becker 1882, Dahl & Dahl 1927).

Tab. 2. List of the WSC entries (WSC 2018) for *Pardosa proxima* for which the objective assignation to *P. proxima* or *P. tenuipes* is regarded doubtful.

WSC entry	Comments about the species attribution
Lycosa proxima O. Pickard-Cambridge 1878: 125, pl. 11, f. 6 (♂♀).	Uncertain attribution.
Pardosa furtadoi Simon 1883: 263 (D♂♀).	Only female described. Synonymized by Berland (1932). The description of the female does not allow discrimination between *P. tenuipes* and *P. proxima.* On the other hand, when describing *P. furtadoi* from the Acores, Simon (1883) also mentioned *P. proxima*, thus keeping the species apart. Later, Wunderlich (1992: 32–33) removed *furtadoi* from being a synonym of *proxima,* but still a synonym to *P. acorensis.* which he regarded as the only species of *Pardosa* on the Acores.
Lycosa proxima Chyzer & Kulczyński 1891: 57, pl. 2, fig. 24 (♂♀).	Descriptions and drawings does not allow discrimination between *P. tenuipes* and *P. proxima*
Lycosa proxima Bösenberg 1902: 383, pl. 36, fig. 561 (♂♀).	Uncertain attribution.
Lycosa proxima Nosek 1905: 140, fig. 19 (♀).	Uncertain attribution.
Lycosa proxima Smith 1907: 26, pl. 3, f. 14.	Smith (1907: 27) reports that "…in the male the femora of the first pair are dark, the remaining femora being irregularly annulated". This actually fits *P. proxima* but the description could equally refer to material from other countries or simply refer to Koch's original illustration.
Pardosa proxima Simon 1937: 1068, 1085, 1129, fig. 1657, 1688–1689 (♂ ♀). (in part?)	Possibly Simon had both species in his collection. There is no way to understand which species was illustrated. Descriptions and drawings does not allow discrimination between *P. tenuipes* and *P. proxima*
Pardosa proxima Fuhn & Niculescu-Burlacu 1971: 122, fig. 55a–e (♂♀, S of *P. proxima tenuipes*).	Uncertain attribution.
Pardosa proxima Tyschchenko 1971: 175, fig. 509 (♀).	Uncertain attribution.
Pardosa proxima Miller 1971: 159, pl. XXV, fig. 14 (♀).	Uncertain attribution.
Pardosa esperanzae Schmidt 1975: 505, fig. 3 (D♀).	Described on a single female. Synonymized with *proxima* by Wunderlich (1992).
Pardosa proxima Zyuzin 1979: 435, fig. 48 (♂).	Uncertain attribution.
Pardosa canariensis Schmidt 1982: 405, fig. 8–11 (D♂♀).	Synonymized with *proxima* by Wunderlich (1992).
Pardosa pseudoproxima Wunderlich 1987: 235, fig. 629 (D♂).	Synonymized with *proxima* by Wunderlich 1992.
Pardosa proxima Hu & Wu 1989: 224, fig. 188.3–4 (♀).	Uncertain attribution.
Pardosa proxima Heimer & Nentwig 1991: 332, fig. 1405 (♂♀).	Descriptions and drawings does not allow discrimination between *P. tenuipes* and *P. proxima*
Pardosa proxima Wunderlich 1992: 258, 466 (S).	In comparing *P. proxima* and *P. acorensis* from Macaronesia, Wunderlich (1992: 465) mentions that the male of *proxima* should have few to numerous small bristles ventrally on the opisthosoma "♂-Opisthosoma ventral einige bis zahlreiche Börstchen".
Pardosa proxima Hepner & Paulus 2009: 342, fig. 17–19 (♂♀).	The authors report about the males having: "legs brownish with unclear annulations". This feature is common in *P. tenuipes* but could as well refer to *P. proxima* (not all specimens have distinctly dark femora).

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New data on the spider fauna (Araneae) of Navarre, Spain: results from the 7th EDGG Field Workshop

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Abstract. Multi-taxon investigations are of great importance in biodiversity research. We sampled spiders during the 7th EDGG Field Workshop aimed at studying dry grassland diversity in Navarre, Spain. A total of 99 spider species from 15 families were recorded from 14 localities. Of these, 47 species were new to Navarre. To date, the list of spiders of Navarre accounts for 322 species. During this first dry grassland-specific study of spiders in Spain, 78 species were recorded for the first time in this type of habitat in Navarre, and for 69 species it is a newly recorded habitat in the Iberian Peninsula. The grasslands growing in the submediterranean humid and supramediterranean upper dry territories, belonging to Festuco-Brometea and Festuco-Ononidetea phytosociological classes, were the richest in terms of inhabiting spiders (26 and 23 species respectively) while the communities of mesomediterranean semi-arid area (Lygeo-Stipetea and Salicornietea fruticosae classes) were the poorest (four species each).

Keywords: dry grassland, fauna inventory, habitat distribution, Iberian Peninsula, spiders

Zusammenfassung. Neue Daten zur Spinnenfauna (Araneae) von Navarra, Spanien: Ergebnisse des 7. EDGG Field Workshop. Multi-Taxon-Untersuchungen sind ein wichtiger Teil der Biodiversitätsforschung. Wir haben im Rahmen des 7th EDGG Field Workshop trockenes Grünland in der Provinz Navarra (Spanien) untersucht. Insgesamt wurden in 14 Untersuchungsflächen 99 Spinnenarten aus 15 Familien erfasst, darunter waren 47 neu für Navarra. Damit umfasst die Spinnenliste Navarras nun 322 Arten. In dieser ersten Erfassung von Spinnen speziell in Grünland in Spanien wurden 78 Arten in Navarra und 69 auf der Iberischen Halbinsel erstmals in diesem Habitattyp erfasst. Grünland in den submediterran feuchten und den oberen supramediterran trockenen Regionen gehört zu den pflanzensoziologischen Klassen Festuco-Brometea und Festuco-Ononidetea und war am artenreichsten (26 bzw. 23 Spinnenarten). Dagegen waren die Klassen der mesomediterranen semi-ariden Region (Lygeo-Stipetea und Salicornietea fruticosae) die artenärmsten (jeweils vier Spinnenarten).

The spider fauna of the Iberian Peninsula and of the Balearic Islands is relatively well catalogued. Pedro Cardoso presented a preliminary checklist of Portuguese spiders in 2000 (Cardoso 2000). In 2004, Eduardo Morano published a list of recorded species of Iberian spiders together with a bibliography of available publications on that topic (Morano 2004). This review provided the number of species, Iberian endemics, collecting localities and references for each administrative region of Spain and Portugal. It also revealed the best and worst studied regions of the Iberian Peninsula, and thus outlined promising areas for future investigations.

The next stage of synthesis was the creation of an electronic catalogue of the Iberian spiders (Morano & Cardoso in Cardoso & Morano 2010). An accompanying paper presented an updated checklist of spiders with respect to the provinces and a comparative analysis of the records, species and endemic species in each family and province (Cardoso & Morano 2010). The third (and latest) version of the Iberian spider catalogue provided maps of collecting localities and exhaustive data on the records of 1382 species in 381 genera and 55 families (Morano et al. 2014). Conducting such a huge job, the catalogue authors concluded that the spider fauna of the Iberian Peninsula is still severely incompletely studied. The territory has been unevenly surveyed, there is a shortage in the data on species habitat distribution, and only some families have a sufficient species list (Cardoso & Morano 2010).

The Eurasian Dry Grassland Group EDGG (Vrahnakis et al. 2013) organizes research expeditions (so-called Field Workshops) since 2009, aimed at sampling standardized, high-quality data on species composition and diversity of grasslands and related communities (Dengler et al. 2016). Data collection initially focused on plant diversity; the 7th Field Workshop conducted in the region of Navarre in Spain (Biurrun et al. 2014) was the first example to include invertebrate collection, namely spiders, in the sampling protocol. This opened the opportunity to expand information about spiders in the study region and specify their distribution in various types of grasslands.

The Iberian spider catalogue includes 539 spider records in the region of Navarre, which correspond to 231 species in 141 genera and 35 families; the 79 collecting localities are documented in 37 papers (Morano et al. 2014). Spider habitat distribution in Navarre is known only for 13 cave species (see Morano et al. 2014) and for 149 species from oak and beech-oak forests (Castro & Ferrandez 1998, Castro & Alberdi 2002, Castro & Barriuso 2004, Castro 2009, Morano et al., 2014).

The current paper presents spider records from the 7th EDGG Field Workshop, thus providing a major supplement to the list of spiders of Navarre, and reports the first data on spider species composition in the dry grasslands of the study region.

Material and methods

Study area

Navarre is a Spanish region located in the north-central part of the Iberian Peninsula, ranging from the Pyrenean Moun-

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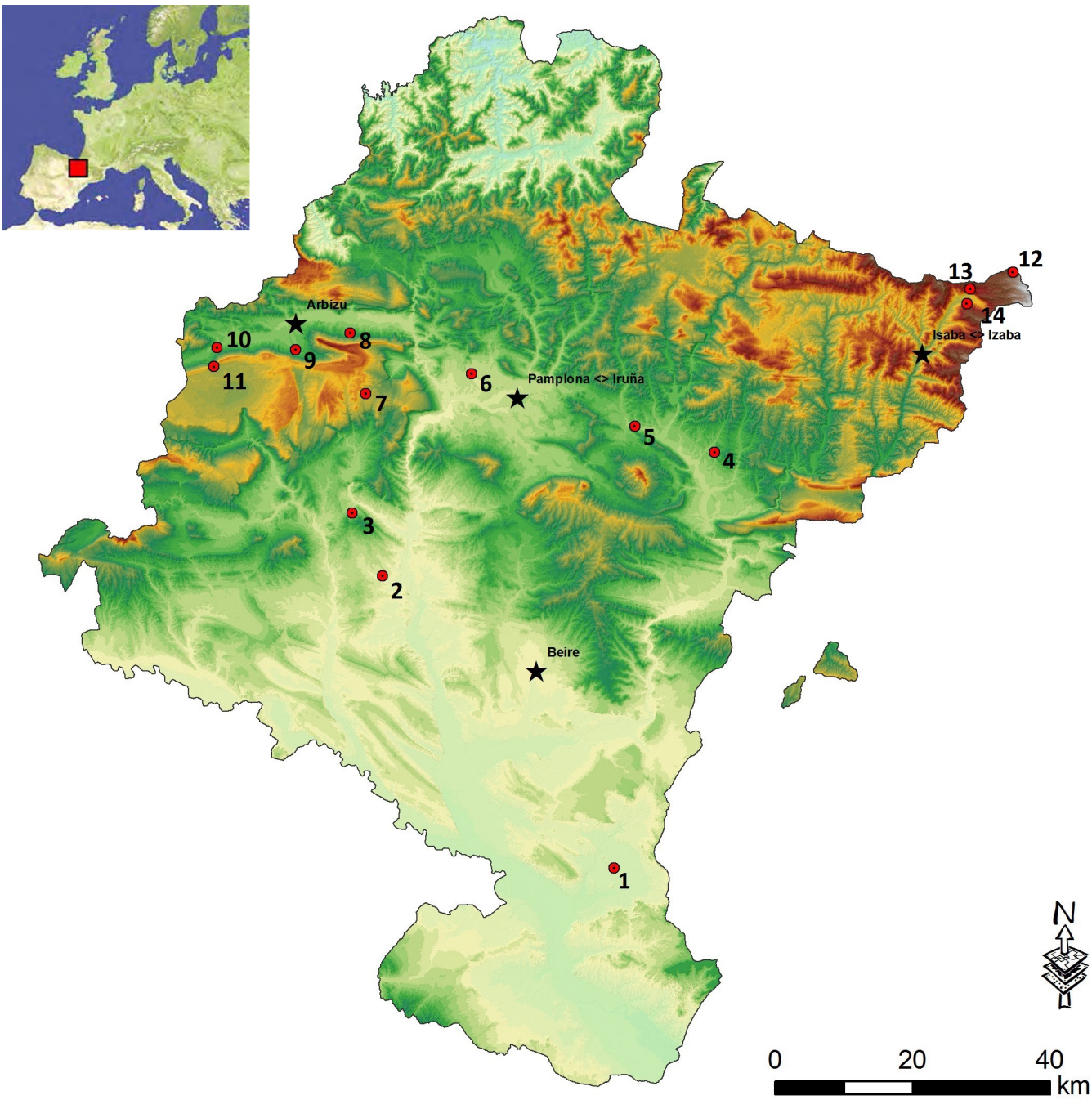

Fig. 1: Collecting localities of the 7th EDGG Field Workshop in Navarre. For locality numbers, see Material and methods.

tains in the northeast to the Ebro depression in the south (Fig. 1). Three biogeographic units are represented in Navarre: Alpine, Atlantic and Mediterranean. The climate changes from Mediterranean in the south of the study area to temperate in the north, with the temperate sub-Mediterranean type in transitional areas. The ombrotype varies from semiarid to subhumid in the Mediterranean Region and from humid to hyperhumid in the Atlantic and Alpine Regions (Peralta et al. 2013). The natural vegetation is highly diverse, given the marked climatic and biogeographic gradient. Deciduous oak and beech forests prevail in the northern areas and Mediterranean evergreen woodlands and scrubs in the south (Loidi & Báscones 2006, Peralta et al. 2013). Sampling was carried out in a great variety of grasslands, ranging from subalpine grasslands, through mesic meadows, dry grasslands to endorheic basins, belonging to ten associations and six phytosociological classes (Berastegi 2013), most of them being semi-natural, i.e. maintained by human activity.

Subalpine grasslands belong to the class Juncetea trifidi, which groups acidophilous swards of the Pyrenees. Basophilous subalpine and supratemperate grasslands in the high mountains are included in the class Elyno-Seslerietea. At middle elevation, in submediterranean territories, the sampled grasslands belong to the classes Festuco-Brometea and Festuco hystricis-Ononidetea striatae. The former occupies deep baso-neutrophilous soils and the latter, rich in dwarf scrubs, grows in shallow and stony soils. The class Lygeo sparti-Stipetea tenacissimae comprises basophilous xerophitic grasslands from dry and semiarid Mesomediterranean areas. Finally, communities growing in endorheic areas with salty soils are included in the class Salicornietea fruticosae (Mucina et al. 2016).

Data collection

Material was collected on 16–23 June 2014 during the 7th EDGG Field Workshop in Navarre (Biurrun et al. 2014). Fourteen localities were chosen for the dry grassland survey along the climatic and biogeographic gradient (Fig. 1). Spiders were sampled using a standard procedure of sweep netting and hand collecting. In addition to grasslands, we collected spiders in adjacent habitats, and the species were included in the general list.

Below, the study localities, grouped by biogeographic regions, are listed with the following information: locality, geographical coordinates in WGS84, elevation, date of collection, ombro- and thermotype of climate, and phytosociological class of grassland vegetation. Different vegetation classes studied in the same locality are marked with a letter (a, b).

Collecting localities

Mediterranean Region

1 – Bardenas Reales, (42.203°N, 1.498°W), 295-318 m a.s.l., 16.06.2014. Mesomediterranean semiarid climate, a – Lygeo-Stipetea, b – Salicornietea fruticosae

2 – Between Oteiza and Larraga, (42.579°N, 1.887°W), 370–390 m a.s.l., 17.06.2014. Mesomediterranean upper dry climate, Lygeo-Stipetea and patched shrub thickets on the slope bottom

3 – Lorca, (42.66°N, 1.94°W), 510–533 m a.s.l., 17.06.2014. Supramediterranean upper dry climate, a – Festuco-Ononidetea, b – Festuco-Brometea

4 – Urraúl Bajo-Sansoain, (42.73°N, 1.29°W), 561–580 m a.s.l., 19.06.2014. Supramediterranean subhumid climate, Festuco-Ononidetea

5 – Liberri, (42.76°N, 1.43°W), 500–523 m a.s.l., 19.06.2014. Supramediterranean subhumid climate, a – Festuco-Brometea, b – Festuco-Ononidetea

Atlantic Region

6 – Iza, (42.84°N, 1.72°W), 427–450 m a.s.l., 18.06.2014. Mesotemperate humid climate, Festuco-Brometea

7 – Munarriz, Sierra de Andia, (42.82°N, 1.90°W), 950–978 m a.s.l., 18.06.2014. Supratemperate humid climate, Festuco-Brometea

8 – Ihabar, (42.90°N, 1.92°W), 569–596 m a.s.l., 22.06.2014. Mesotemperate humid climate, Festuco-Brometea

9 – Unanu, (42.87°N, 2.02°W), 600–610 m a.s.l., 22.06.2014. Mesotemperate humid climate, Festuco-Brometea

10 – Puerto de Urbasa, bottom of the mountain pass, (42.87°N, 2.17°W), 600–615 m a.s.l., 23.06.2014. Mesotemperate humid climate, Festuco-Ononidetea.

11 – Puerto de Urbasa, top of the mountain pass, (42.858°N, 2.181°W), 903–945 m a.s.l., 23.06.2014. Supratemperate hyperhumid climate, a – Festuco-Brometea, b – Elyno-Seslerietea

Alpine Region

12 – Larra-Arlas, Mtn. La Contienda, (42.96°N, 0.75°W), 1725-1970 m a.s.l., 20.06.2014. Orotemperate hyperhumid climate, slope with patched *Genista occidentalis*,

13 – Larra-Belagua, Lakora, (42.94°N, 0.84W°), 1423–1560 m a.s.l., 21.06.2014. Supratemperate hyperhumid climate, Juncetea trifidi, pasture

14 – Belagua-Arrako, (42.92°N, 0.85°W) 934–968 m a.s.l., 21.06.2014. Supratemperate hyperhumid climate, Festuco-Brometea on the river terrace

Spider species list

Adult individuals of spiders were identified using Heimer & Nentwig (1991) and Nentwig et al. (2018). For the identification of some rare or sibling species we used Bosmans & Abrous (1992), Barriento (1994), Kastrygina & Kovblyuk (2016), Spasojevic et al. (2016), Bosmans et al. (2018) and Isaia et al. (2018).

The annotated checklist of spiders is arranged alphabetically for families and within families following the nomenclature of the World Spider Catalog (WSC 2018). The list is based on the collected adult individuals; we mention juveniles only if adults were absent from a given locality. The number of the locality is provided with a letter if a species was collected in the grassland vegetation of the above-mentioned type. In other cases, we specify both locality and habitat (edge of a beech forest, under stones, etc.). The total number of collected species in a particular family is given in parenthesis after the family name. Species new to Navarre are indicated with an exclamation mark (!).

The bulk of the collected material is deposited in N. Polchaninova's private collection (Kharkiv, Ukraine). Some specimens have been donated to the Museum of Nature of the V.N. Karazin Kharkiv National University, Ukraine (NMKhNU).

Results

Checklist of species

Agelenidae C. L. Koch, 1837 (1)

***Eratigena picta* (Simon, 1870)**

[11], edge of a beech forest, 1♂, 1♀.

Araneidae Clerck, 1757 (9)

!*Aculepeira armida* (Audouin, 1826)

[2], foot slope with dense herbs and shrubs, 2♂♂, 6♀♀.

!*Aculepeira ceropegia* (Walckenaer, 1802)

[10], 1♀ (MNKhNU); [14], 1♀.

***Araniella cucurbitina* (Clerck, 1757)**

[3a], 1♂, 1♀; [7], *Juniperus* shrubland, 3♂♂ (MNKhNU); [8], 3♂♂ 2♀♀; [9], 1♀ (MNKhNU); [10], 1♀; [13], 1♀; [14], 1♂.

!*Araniella opisthographa* (Kulczyński, 1905)

[8], on shrubs, 1♂; [11a], 2♂♂, 1♀; [11b], 3♂♂.

***Cyclosa conica* (Pallas, 1772)**

[8], open woodland, on a tree branch, 1♀ (MNKhNU).

! *Gibbaranea gibbosa* (Walckenaer, 1802)

[8], forest edge, 1♀.

***Mangora acalypha* (Walckenaer, 1802)**

[1], 1♀, bank of a brook; [1a], 1♂, 2♀♀; [1b] 1♂ 2♀♀; [2], 3♀♀; [3a], 3♂♂, 2♀♀; [3b], 2♀♀; [4], 1♂ 1♀; [5a], 3♂, 7♀; [5b] 1♂, 6♀; [6], 2♀♀; [7], 2♀♀; [8], 3♂♂, 6♀♀; [9], 5♀♀; [10] 1♂, 1♀; [11a], 1♂, 4♀♀; [13] 3♀; [14], 1♀.

***Nemoscolus laurae* (Simon, 1868)**

[3a], 1♂, [4], 1♀; [11], forest edge, 1♀.

***Neoscona adianta* (Walckenaer, 1802)**

[1a], 1♂, 1♀; [2], Ligeo-Stipetea, 1♂, 1♀; foot slope with dense grass and shrubs, 3♂♂, 3♀♀ (MNKhNU); [4], 1♀; [5a]

2 ♂♂, 1♀; [5b], 2 ♂♂, 1♀; [6], near the road, 2♀♀; Festuco-Brometea, 3♂♂, 1♀, [8], 3♂♂ 2♀♀; [9], 2♂♂, 3♀♀.

Dictynidae O. Pickard-Cambridge, 1871 (4)
***Brigittea latens* (Fabricus, 1775)**
[8], 1♀.
! *Dictyna arundinacea* (Linnaeus, 1758)
[6], shrubs on the foot slope, 1♂; Festuco-Brometea, 1♀.
***Dictyna uncinata* Thorell, 1856**
[9], forest edge, 1♀.
! *Nigma flavescens* (Walckenaer, 1830)
[3a], 2♀♀; [7], tree branch, 1♀.

Eutichuridae Lehtinen, 1967 (1)
! *Cheiracanthium pennyi* O. Pickard-Cambridge, 1873
[4], 1♂, 1♀; [8], 1♀ (MNKhNU); [9], forest edge, 1♂; Festuco-Brometea, 1♂, 2♀ (MNKhNU).

Gnaphosidae Pocock, 1898 (13)
! *Callilepis nocturna* (Linnaeus, 1758)
[7], 4♀♀; [10], 1♀, all under stones.
! *Civizelotes civicus* (Simon, 1878)
[7], under stones, 1♀.
***Drassodes cupreus* (Blackwall, 1834)**
[7], under stones, 1♀; [11], 1♀.
! *Drassodes fugax* (Simon. 1787)
[12], on the ground under shrubs, 1♂.
***Drassodes lapidosus* (Walckenaer, 1802)**
[7], 2♀♀; [11a], 1♀; [13], 1♂, all under stones.
! *Drassodes pubescens* (Thorell, 1856)
[6], under stones near the road, 1♀.
***Drassyllus praeficus* (L. Koch, 1866)**
[8], under stones, 3♀♀.
***Gnaphosa occidentalis* Simon, 1878**
[7], 4♀♀; [8], 2♀; [11], 1♀, all under stones.
! *Haplodrassus typhon* (Simon, 1878)
[8], in detritus near a path, 1♀.
! *Micaria albovittata* (Lucas, 1846)
[13], on a shrub, 1♀.
***Nomisia exornata* (C. L. Koch, 1839)**
[8], under a stone, 1♀.
***Trachyzelotes pedestris* (C. L. Koch, 1837)**
[9], in detritus, 1♂ (MNKhNU).
! *Zelotes atroceruleus* (Simon, 1878)
[7], under stones near the road, 1♂.

Linyphiidae Blackwall, 1859 (10)
***Agyneta rurestris* (C. L. Koch, 1836)**
[8], 1♀; [11b], 1♂ (MNKhNU); [13], 1♂.
***Erigone dentipalpis* (Wider, 1834)**
[6], on a footslope in shrubs, 1♀.
***Frontinella frutetorum* (C. L. Koch, 1834)**
[3a], 6♀♀; [4], 2♀♀; [6], on a footslope in shrubs, 1♀; Festuco-Brometea, 2♀♀; [7], *Juniperus* shrubland, 1♂, 1♀; [8], 1♀; [11a], 2♀♀; [11b], 1♂,1♀.
***Gonatium rubens* (Blackwall, 1833)**
[13], in detritus on the forest edge, 1♀.
! *Maso sundevalli* (Westring, 1851)
[8], forest edge, 1♀; [11a], 1♀.
! *Microlinyphia impigra* (O. Pickard-Cambridge, 1871)
[14], 1♂.
***Neriene clathrata* (Sundevall, 1830)**
[1], grass near a brook, 1♀; [3a], on the ground, 1♂; [7], *Juniperus* shrubland, 1♀.
! *Pelecopsis bucephala* (O. Pickard-Cambridge, 1875)
[1], bank of a brook, 4♀♀.
! *Prinerigone vagans* (Audouin, 1826)
[8], under the trees near a brook, 1♀; [11a], 1♀.
***Tenuiphantes tenuis* (Blackwall, 1852)**
[3a], 1♀; [8], 1♂; [11], forest edge, 1♀; [11a] 1♀; [11b], 2♀♀; [14], 1♀.

Lycosidae Sundevall, 1833 (9)
***Alopecosa farinosa* (Herman, 1879)**
[8], 2♀♀.
***Alopecosa pulverulenta* (Clerck, 1757)**
[3a], 1♀.
! *Pardosa blanda* (C. L. Koch, 1833)
[12], 5♂♂.
***Pardosa hortensis* (Thorell, 1872)**
8], 1♀; [9], 1♀.
! *Pardosa monticola* (Clerck, 1757)
[8], 2♀; [9], 1♀; [11], pasture, 3♀; [13], 2♂♂, 3♀♀; [14], 2♂♂, 2♀♀.
***Pardosa nigriceps* (Thorell, 1856)**
[12], 1♀.
! *Pardosa tenuipes* L. Koch, 1882
[12], 1♂.
***Pardosa pullata* (Clerck, 1757)**
[13], 3♀♀; [14], 2♂♂, 2♀♀.
***Piratula latitans* (Blackwall, 1841)**
[1], near a brook, 1♂; [14], river bank, 1♀.

Oxyopidae Thorell, 1870 (3)
***Oxyopes heterophthalmus* (Latreille, 1804)**
[2], 1♀ (MNKhNU); [3a] 1♂ 1♀; [3b], 1♀; [4], 3♀♀; [5b] 1♂, 1♀; [7], 1♂; [9], 1♀.
***Oxyopes lineatus* Latreille, 1806**
[4], 1♂, 2♀♀.
***Oxyopes nigripalpis* Kulczyński, 1891**
[1a], 1♂, 1♀ (MNKhNU); [2], stony slope with sparse vegetation, 1♂, 1♀; [3a], 2♂♂ 3♀♀; [4], 1♀; [14], 1♀.

Philodromidae Thorell, 1870 (8)
***Philodromus albidus* Kulczyński, 1911**
[3a], 1♀.
***Philodromus aureolus* (Clerck, 1757)**
[14], tree branch, 1♂.
! *Philodromus cespitum* (Walckenaer, 1802)
[3b], 1♀; [6], 1♂; [8], 1♀.
***Philodromus dispar* Walckenaer, 1826**
[8], 1♀; [14], 1♀, both on tree branches.
***Pulchellodromus navarrus* (Kastrygina, Kovblyuk & Polchaninova, 2016)**
[3a], 1♂, 1♀ (MNKhNU); [6], 1♂, 1♀ (ZMMU) (Kastrygina et al., 2016).
! *Thanatus atratus* Simon, 1885
[2], 1♂; [8], stony place with sparse vegetation, 1♂.
! *Thanatus formicinus* (Clerck, 1757)
[12], 1♂.
! *Tibellus oblongus* (Walckenaer, 1802)
[4], 1♂; [5a], 1♂; [6], 1♂.

Pisauridae Simon, 1890 (1)
***Pisaura mirabilis* (Clerck, 1757)**
[1], near a brook, 1♀; [3a], 1♀; [4] 1♀.

Salticidae Blackwall, 1841 (14)
! ***Asianellus festivus* (C. L. Koch, 1834)**
[2], stony slope with sparse vegetation, 1♀.
! ***Chalcoscirtus infimus* (Simon, 1868)**
[11], stony wall, 1♂.
***Euophrys gambosa* (Simon, 1868)**
[3c], 1♂; [8], 1♀.
! ***Euophrys herbigrada* (Simon, 1871)**
[4], 1♂; [10], 1♀.
! ***Evarcha michailovi* Logunov, 1992**
[3a], 1♂, 1♀; [3b], 1♀; [4], 1♂.
***Macaroeris nidicolens* (Walckenaer, 1802)**
[2], 1♂ on a shrub; [8], 2♂♂ on tree branches.
***Heliophanus cupreus* (Walckenaer, 1802)**
[8], 1♀; [11], forest edge, 2♀♀ (MNKhNU); [11a], 1♂; [11b], 1♂, 2♀♀ (MNKhNU).
! ***Heliophanus dubius* C. L. Koch, 1835**
[14], 1♂, 1♀.
***Heliophanus flavipes* (Hahn, 1832)**
[7], 1♀; [8], 2♀♀, (MNKhNU); [a], 1♀; [10], 1♀; [13], on shrubs, 1♀; on grass, 1♀.
***Heliophanus kochii* Simon, 1868**
[8], 1♂.
! ***Heliophanus tribulosus* Simon, 1868**
[8], 1♂.
***Pellenes tripunctatus* (Walckenaer, 1802)**
[6], 1♀; [7], 3♀♀; [8], 1♂; [14], 3♀♀.
***Phlegra fasciata* (Hahn, 1826)**
[7], 1♀; [12], 2♂♂, 2♀♀ (MNKhNU).
! ***Salticus scenicus* (Clerck, 1757)**
[7], 1♂, 1♀; [12], on a stone, 1♀.

Theridiidae Sundewall, 1833 (12)
***Anelosimus vittatus* (C. L. Koch, 1836)**
[8], single tree, 1♂; [11], forest edge, 1♀.
! ***Dipoena melanogaster* (C. L. Koch, 1837)**
[7], *Juniperus* shrubland, 1♂; [8], under the tree, 1♀ (MNKhNU).
! ***Enoplognatha thoracica* (Hahn, 1833)**
[5], on the ground near the road, 1♀.
! ***Heterotheridion nigrovariegatum* (Simon, 1873)**
[8], 1♀.
***Kochiura aulica* (C. L. Koch, 1838)**
[7], *Juniperus* shrubland, 1♂; [8], forest edge, 1♂.
! ***Lasaeola convexa* (Blackwall, 1870)**
[3a], 1♀; [5a], 1♀; [5b], 1♀; [11a], 1♀.
***Neottiura bimaculata* (Linnaeus, 1767)**
[9], 1♂ (MNKhNU).
! ***Phylloneta impressa* (L. Koch, 1881)**
[1], wheat field, 1♀; [2], footslope, on shrubs, 1♂, 1♀; [3b], 1♀; [6], grass along the road, 1♀, [7], 1♂; [8], 2♂♂, 2♀♀; (MNKhNU), 1♂; [9], 1♂, 1♀; [10], 1♀.
! ***Phylloneta sisyphia* (Clerck, 1757)**
[7], 1♂.
***Simitidion simile* (C. L. Koch, 1836)**
[3b], 1♀; [7], *Juniperus* shrubland, 1♀; shrubs on the hay meadow, 2♀♀; [8], 1♂.
***Steatoda albomaculata* (De Geer, 1778)**
[2], under a shrub on a stony slope, 1♂ juv.
***Theridion pinastri* L. Koch, 1872**
[8], on shrubs, 1♀ (MNKhNU).

Thomisidae (11)
! ***Heriaeus oblongus* Simon, 1918**
[6], grass on the roadside, 2♂♂.
***Misumena vatia* (Clerck, 1757)**
[5a], 1♀; [5b], 2♂♂; [6], 1♂; [8], 1♀.
! ***Ozyptila pauxilla* (Simon, 1870)**
[7], *Juniperus* shrubland, 1♂.
***Runcinia grammica* (C. L. Koch, 1837)**
[1a], 3♂♂; [1b], 2♂♂, 1♀; [2], 2♂♂, 1♀; [3a], 3♂♂ (MNKhNU); [4], 1♂; [6], shrubs on top slope, 1♂, on grass, 1♂; [7], 1♂; [8], 1♂ 1♀.
***Synema globosum* (Fabricius, 1775)**
[3a], 1♂ 4♀♀; [4], 2♀♀; [6], shrubs on the foot slope, 1♀; [8], 2♂♂.
***Thomisus onustus* Walckenaer, 1805**
[2], stony slope with sparse vegetation, 1♂, 1♀; [3a], 2♂♂, 1♀; [5b], 1♂ 1♀; [6], 1♂, 1♀; [8], 1♂.
! ***Xysticus acerbus* Thorell, 1872**
[6], 1♀.
***Xysticus cristatus* (Clerck, 1758)**
[4], 1♀; [5], on the roadside, 1♀; [6], on shrubs, 2♀♀, on grass, 1♂; [8], 1♂; [9], 2♀; [10], 1♀; [11], forest edge, 1♂, 1♀; [11b], 1♂, 1♀ (MNKhNU); [14], 3♂♂ (MNKhNU).
***Xysticus erraticus* (Blackwall, 1834)**
[8], in detrtus, 1♂; [14], 1♂.
! ***Xysticus kempeleni* Thorell, 1872**
[4], 1♀; [5b], 1♀.
! ***Xysticus kochi* Thorell, 1872**
[4], 1♀ (MNKhNU); [8], 2♀♀.

Uloboridae (1)
! ***Uloborus walckenaerius* Latreille, 1806**
[2], sparse vegetation on the foot slope, 1♂; [3a], 1♀; [5a], 2♂♂.

Zodariidae (1)
! ***Zodarion pseudoelegans* Denis, 1933**
[3], in grass between pine trees, 1♀.

A total of 99 spider species from 15 families were recorded during the Field Workshop. The families Salticidae, Gnaphosidae, Theridiidae and Thomisidae were the most species-rich (14, 12, 12 and 11 species, respectively). *Mangora acalypha* was the most widespread species, it occurred in 13 localities out of 14. *Araniella cucurbitina, Xysticus cristatus* and *Phylloneta impressa* were found in eight localities, *Neoscona adianta* and *Runcinia grammica* in seven localities.

Spider species composition was poorest in Bardenas Reales [1], at the bottom of the mountain pass of Puerto de Urbasa [10], and the Larra-Arlas Mountains [12] (7–8 species only), and the richest in Ihabar [8] (43 species) (Tab. 1). If only the spiders collected in grasslands are considered, the same localities were again the poorest, and Ihabar the richest (26 species) followed by the hills in vicinity of Lorca [3] (23 species). Ihabar is located in the Atlantic biogeographic region while Lorca in the Mediterranean one. In the investigated

Tab. 1: Number of spider species recorded from collecting localities (for locality number see Material and methods)

	Localities/Biogeographic regions													
	Mediterranean						Atlantic					Alpine		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Grasslands	4	10	23	18	8	15	14	26	12	7	11	6	9	13
Total	8	11	26	18	10	19	22	43	12	7	19	7	11	16

grasslands, we recorded 51 spider species in the Atlantic region, 36 species in the Mediterranean region, and 18 species in the Alpine region.

Two phytosociological classes, Festuco-Odonidetea and Festuco-Brometea, were the most widespread in the study area. The former hosted 32 spider species and the latter 41 species (Tab. 1).

Discussion

Prior to our study, 275 spider species were known from Navarre, 231 species listed in the Iberian spider catalogue (Morano et al. 2014) and additional 44 species recorded from the oak forest of Orgi (Lizaso) (Castro & Barriuso 2004). We found 99 species from 15 families. Of these, 47 species are new to Navarre including one species described as new to science (Kastrygina et al. 2015). Thus, the total list of spiders has been enlarged to 322 species. By number of species registered, Navarre can now be included in the top six provinces of Spain and Portugal regarding spider species richness: Huesca – 430 species, Barcelona – 356, Coimbra – 321, Madrid – 313 and Salamanca – 300 species (Morano et al. 2014). Nevertheless, considering a large gradient of altitudinal and climatic conditions, the spider species list of Navarre is certainly far from complete.

For *Asianellus festivus* and *Evarcha michailovi*, we provide the second record for the Iberian Peninsula. Both species were previously found in Catalonia (Barrientos et al. 2015, Logunov 2015). Nine species from our collection (*Drassodes cupres*, *Gnaphosa lugubris*, *G. occidentalis*, *Haplodrassus typhoni*, *Zelotes atroceruleus*, *Gonatium rubens*, *Trichoncus affinis*, *Heliophanus dubius*, *Heterotheridion nigrovariegatum*) are also rare in the Peninsula. They have been recorded from a maximum of five localities (Morano et al. 2014).

In all the study localities, arachnological researches were conducted for the first time. In Bardenas Reales, spiders had been previously collected only in Vedado de Eguaras, an 'oasis' of *Pinus halepensis* in the semi-arid area (Romano in Morano et al. 2014). There were no previous specific studies on dry grassland spiders in Spain. The records of 78 species are new for this type of habitat in Navarre; for 69 species, it is a newly recorded habitat in the Iberian Peninsula.

The most widespread species from our collection *(Mangora acalypha, Neoscona adianta*, *Phylloneta impressa*) are grassland generalists. *Mangora acalypha* also occurs in open forests in herb and tree layers. *Xysticus cristatus* is an euryoecious species, *Araniella cucurbitina* inhabits dry and semi-humid biotops in open landscapes (Buchar & Růžička 2002, Polchaninova & Prokopenko 2013, Nentwig et al., 2018). *Runcinia grammica* is a common species in xerothermic grasslands (Polchaninova 2012).

The Festuco-Brometea grasslands in the mesotemperate humid climate (Ihabar) and the Festuco-Ononidetea in the submediterranean subhumid climate (Lorca) hosted the richest spider communities (26 and 23 species, respectively). Interestingly, the grasslands of Ihabar were also the richest in terms of plant diversity (Biurrun et al. 2014). The poorest was the vegetation of Lygeo-Stipetea and Salicornietea fruticosae phytosociological classes in the mesomediterranean semi-arid climate in Bardenas Reales (four spider species each). A higher abundance of spider species collected in the Atlantic grasslands can be explained by a wide variety of altitudes and habitats (from stony pastures to slopes with dense shrubs and herbs) compared with the studied grasslands in the Mediterranean and Alpine regions. Spider communities of the Iberian dry grasslands need further investigation for more detailed analysis.

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Spiders and pseudoscorpions (Arachnida: Araneae, Pseudoscorpiones) in old oaks of a Central European floodplain

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Abstract. Spiders and pseudoscorpions on old pedunculate oaks (*Quercus robur*) with tree cavities were studied in a Central European floodplain (South Moravia, Czech Republic). Altogether 322 specimens from 47 spider taxa and 71 specimens of six pseudoscorpion species were collected during 2010 and 2011 from tree cavities using two methods. More specimens and species of spiders were obtained from flight interception traps and more specimens and species of pseudoscorpions were obtained from pitfall traps. Remarkable records represent typical cavity dwellers, i.e. the spider *Midia midas* (Simon, 1884), the pseudoscorpions *Larca lata* (Hansen, 1884) and *Apocheiridium ferum* (Simon, 1879), the latter occurs mostly under tree bark. Five arachnid species are listed in the Czech red list: *Midia midas*, *Leptorchestes berolinensis* (C. L. Koch, 1846), *Dipoena erythropus* (Simon, 1881), *Larca lata* and *Dendrochernes cyrneus* (L. Koch, 1873).

Keywords: arboreal, Czech Republic, ecology, faunistics, solitary trees, tree cavity

Zusammenfassung. Spinnen und Pseudoskorpione (Arachnida: Araneae, Pseudoscorpiones) in alten Eichen eines mitteleuropäischen Auwalds. Spinnen und Pseudoskorpione alter Stieleichen (*Quercus robur*) mit Baumhöhlen wurden in einer mitteleuropäischen Aue (Südmähren, Tschechische Republik) untersucht. Insgesamt wurden 322 Individuen aus 47 Spinnentaxa und 71 Individuen aus sechs Pseudoskorpionarten in den Jahren 2010 und 2011 mit zwei Methoden erfasst. Spinnen wurden in höhere Individuen- und Artenzahl mit Kreuzfensterfallen und Pseudoskorpione zahl- und artenreicher in Bodenfallen in Baumhöhlen gefangen. Bemerkenswerte Artnachweise betreffen typischer Baumhöhlenbewohner: die Spinne *Midia midas* (Simon, 1884) sowie die Pseudoskorpione *Larca lata* (Hansen, 1884) und *Apocheiridium ferum* (Simon, 1879), letztere kommt vor allem unter Baumrinde vor. Fünf Arten sind in der Tschechischen Roten Liste enthalten: *Midia midas*, *Leptorchestes berolinensis* (C. L. Koch, 1846), *Dipoena erythropus* (Simon, 1881), *Larca lata* und *Dendrochernes cyrneus* (L. Koch, 1873).

Old trees provide important microhabitats for arachnids, such as foliage, branches, trunk and hollows; bark cracks and cavities offer specific microclimatic and structural conditions (e.g. Wunderlich 1982, Nikolai 1986). Some arachnid species live on trees throughout the year, whereas others use trees only for certain periods, mainly for overwintering (e.g. Horváth & Szinetár 2002, Horváth et al. 2004). Some facultative bark-dwelling arachnids that usually live in the canopy are found on trunks and in cavities only from late autumn to early spring, i.e. while deciduous trees are without their leaves (Szinetár & Horváth 2006).

In Europe, spiders living in tree hollows have been studied sporadically (Martínez De Murguía et al. 2007, Niţu et al. 2009), but no detailed study focusing on this topic has been published yet. From Czechia, only a single study dealing specifically with spiders (and some other invertebrate groups) in tree hollows has been published so far (Růžička et al. 1991).

In contrast, pseudoscorpion occurrence in tree hollows is generally known (Beier 1963, Weygoldt 1969, Ranius 2002, Christophoryová et al. 2017b). In Europe, obligate hollow-dwelling pseudoscorpions belong mainly to the families Cheliferidae and Chernetidae (Beier 1963). The first contribution about pseudoscorpions from tree hollows in Czechia was published by Ducháč (1993a); pseudoscorpions were collected using pitfall traps installed in hollow trees in the Třeboňsko Protected Landscape Area. Šťáhlavský (2001) carried out systematic research in Prague and its surroundings, where pseudoscorpions were obtained from the mould of 101 tree hollows of 16 tree species. Šťáhlavský (2001) categorized the species found according to their relationship to tree hollows and defined *Mundochthonius styriacus* Beier, 1971, *Dinocheirus panzeri* (C.L. Koch, 1837), *Allochernes wideri* (C.L. Koch, 1843), and *Anthrenochernes stellae* Lohmander, 1939 as species with a close relationship to this microhabitat. Later several additional records of pseudoscorpions from tree hollows across the country were mentioned in further faunistic publications (Šťáhlavský 2006a, 2006b, 2011, Šťáhlavský & Krásný 2007, Šťáhlavský & Tuf 2009, Šťáhlavský & Chytil 2013).

Various methods have been used to collect arboricolous arachnids. The most popular and effective are arboreal eclectors situated on trunks (e.g. Albrecht 1995, Blick 2011) or on branches (e.g. Koponen 2004). Pocket traps attached to the tree bark represent another effective method (e.g. Bogya et al. 1999, Horváth & Szinetár 2002, Isaia et al. 2006). Pitfall traps have been used to sample arachnids in tree hollows (e.g. Růžička et al. 1991, Ranius & Jansson 2002) and on tree trunks (e.g. Pinzon & Spence 2008, Machač & Tuf 2016). Canopy-dwelling arachnids have been also sampled by canopy fogging (e.g. Otto & Floren 2007). Sweeping and hand collecting were used as a simple method for collecting specimens from branches (Hansen 1992). Flight interception traps have been developed mainly to collect flying insects, those of the window trap type being employed in particular for catching beetles in flight (e.g. Økland 1996). Flight interception traps have not been used primarily for sampling arachnids until now.

The aim of the present paper was to collect original data about spiders and pseudoscorpions of old oaks growing in a Central European floodplain on the northern margin of the Pannonian basin, obtained by pitfall traps installed in tree

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cavities and by flight interception traps installed near their openings. The material was collected within a study primarily focused on saproxylic beetles associated with tree hollows.

Material and methods

Study area

The study was carried out in the Lower Dyje (Thaya) floodplain (48°43'10"N, 16°54'27"E, 150 to 165 m a.s.l.) south to southeast of the Pohansko hunting chateau and archaeological site, which is located ca. 3 km south of the town of Břeclav (South Moravia, CZECH REPUBLIC). This area had been historically used as a wood pasture; during the last two hundred years, the more open areas were partially changed to hay meadows and the rest mostly to high forest for timber production. There is a high number of old trees, particularly pedunculate oaks (*Quercus robur*), both in the meadows and within smaller woods and larger forest stands, that had grown for a long time in open or semi-open conditions (Fig. 1). The study area, sampling design and sampling methods are described in detail in Schlaghamerský (2011) and Miklín et al. (2017).

Sampling design

Sampling was conducted in 2010 and 2011 (leg. J. Budka, J. Schlaghamerský). In 2010, 22 old oaks (*Quercus robur*) with cavities were studied. Ten (five live and five dead) were solitary trees in meadows. Twelve trees (seven live and five dead) were in close-canopy forest stands. All of the dead trees were standing. In 2011, a selection of 11 of these trees was resampled (traps remained on the same positions); only two of them were solitary trees in meadows (one dead), the rest growing in close-canopy forest (six live, three dead). Two sampling methods were used (their primary purpose was the sampling of saproxylic beetles associated with tree hollows). On each tree a flight interception trap (FIT) and a pitfall trap (PT) were installed. FITs hung near the opening of a selected cavity on a tree trunk. Cavity openings had to be at a height between 1.5 and 7 m above ground (Fig. 2a). Cavities with contact to the ground or entirely hollow trees were excluded. The FIT position was thus determined by the position of the opening of the cavity (into which a pitfall trap was also installed) and its distance from the tree crown varied substantially – in some cases it hung within the lowest part of the crown, often substantially below it (due to the primary objective of their installation). FITs were of the vane type, made of two crossing sheets (50 cm × 25 cm) of transparent plastic, with a roof above and a funnel (24 cm in diameter) connected to a collecting bottle attached below. As killing and preserving agent, an aqueous 50% ethylene glycol solution with a drop of detergent was used. Inside each tree cavity a pitfall trap was buried into the wood mould with its opening (6 cm in diameter) level with the mould surface (Fig. 2b). FITs and pitfall traps were exposed simultaneously from the 21th April 2010 to 4th October 2010 and from the 5 May 2011 to 23 August 2011 with three week sampling intervals. Spiders were identified using the key of Nentwig et al. (2018). Pseudoscorpions were identified using the key by Christophoryová et al. (2011c). Nomenclature for all taxa follows the World Spider Catalog (2018) and the catalogue Pseudoscorpions of the World (Harvey 2013). The material of spiders and pseudoscorpions is deposited in the collection of the Department of Botany and Zoology at the Masaryk University in Brno.

Results

Spiders (Araneae)

A total of 322 specimens representing 47 taxa from 15 families were identified (Tab. 1). FITs yielded 165 specimens belonging to 40 taxa and 14 families. None of the species captured by the FITs were particularly abundant, only some species were present in relatively high numbers: *Parasteatoda lunata* (Clerck, 1757) (9 specimens), *Anyphaena accentuata* (Walckenaer, 1802) (8), *Porrhomma oblitum* (O. P.-Cambridge, 1871) (8), *Leptorchestes berolinensis* (C. L. Koch, 1846) (8) and *Platnickina tincta* (Walckenaer, 1802) (8) (Tab. 1). FITs exclusively yielded 27 spider taxa. Most species captured by FITs were Linyphiidae with nine species and a group of species

Fig. 1: Closed-canopy forest with interspersed old oaks at the Pohansko study site (photo J. Schlaghamerský)

Fig. 2: Sampling methods used during the current study. **a.** Flight interception trap (FIT) (photo J. Schlaghamerský); **b.** Pitfall trap (PT) inside a tree hollow (photo J. Budka)

identified only to family level (Tab. 1). Pitfall traps placed in tree hollows yielded 157 specimens belonging to 20 taxa and 11 families (Fig. 4a). The most abundant species trapped in the tree hollows were *Tegenaria ferruginea* (Panzer, 1804) and *Midia midas* (Simon, 1884). The most species-rich family in the pitfall traps was Linyphiidae with six species and a group of species identified only to family level. Most spiders collected in hollows are horizontal web builders. Seven spider taxa were obtained exclusively by pitfall traps. A total of 226 specimens belonging to 41 taxa were obtained from trees in forests and 96 specimens from 27 taxa from solitary trees in meadows. Twenty taxa were obtained exclusively from oak hollows situated in forests, six taxa were obtained exclusively from solitary trees in meadows. Traps installed on dead and live trees yielded 139 specimens belonging to 34 taxa and 183 specimens from 40 taxa, respectively. Seven species were obtained exclusively from dead trees. Exclusively in live trees, 13 taxa were present (Tab. 1).

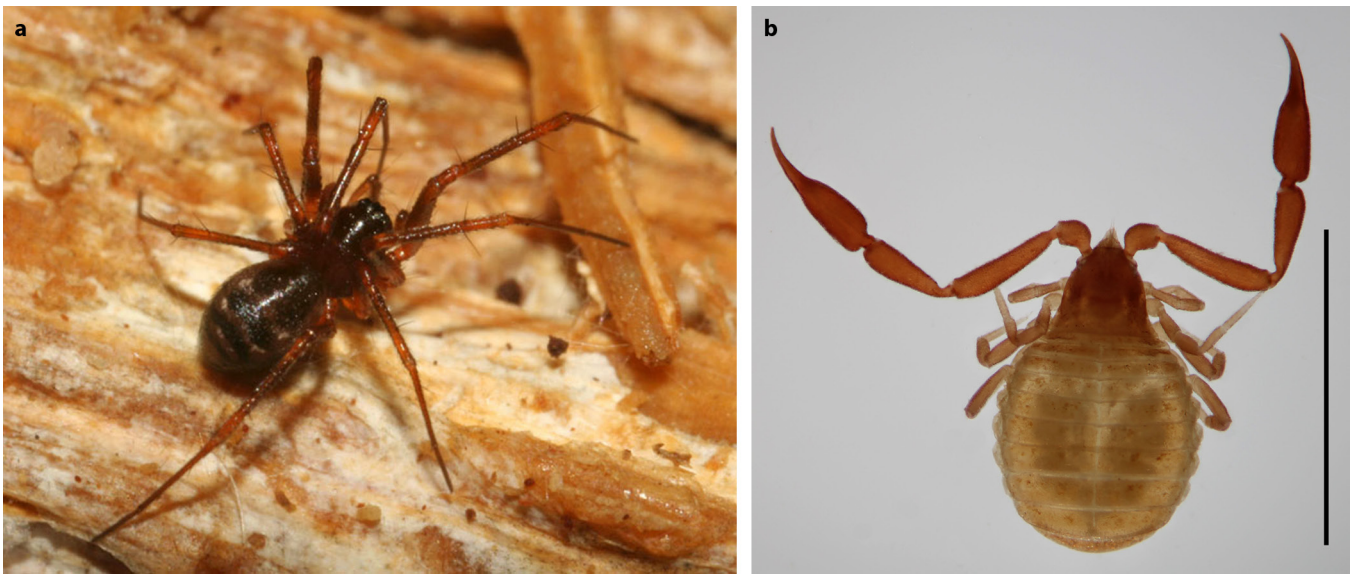

Fig. 3: Typical hollow dwellers. **a.** *Midia midas*, body length 3.5 mm (photo R. Macek); **b.** *Larca lata*, scale bar 2 mm (photo J. Christophoryová)

Remarkable spider species

Linyphiidae

***Midia midas* (Simon, 1884)** (Fig. 3a)

This species is rare and associated with ancient deciduous trees. It lives in tree hollows, where it builds small horizontal webs (Russell-Smith 2002). It is known to occur from the Iberian Peninsula to Turkey, reaching Denmark, Great Britain and Poland in the north (Nentwig et al. 2018). Within Czechia it has been found in eastern Bohemia around Pardubice (Dolanský 1998), South Bohemia (Růžička et al. 1991) and South Moravia near Lednice (Buchar & Růžička 2002, Kubcová & Schlaghamerský 2002). The species is listed in the Czech red list as endangered (Řezáč et al. 2015). Its perceived rarity might be partially due to the lack of arachnological studies focusing on its habitat, although this habitat – old trees with cavities – has definitely become scarce and threatened.

Salticidae

***Leptorchestes berolinensis* (C. L. Koch, 1846)**

Leptorchestes berolinensis is considered as a rare species, living on vegetation on sun-exposed forest edges, on rock outcrops (Buchar & Růžička 2002), as well as on sun-exposed bark of solitary trees and on wooden fences (Bryja et al. 2005, Machač & Niedobová 2015). It is known to occur widely in Europe, except North Europe and Great Britain (Nentwig et al. 2018). The species is listed in the Czech red list as vulnerable (Řezáč et al. 2015).

Theridiidae

***Dipoena erythropus* (Simon, 1881)**

This species is very rare, living on trees and known within Czechia only from South Moravia (Buchar & Růžička 2002), but it might have been overlooked. It lives on branches in the crowns of deciduous trees, mainly oaks. It is known to occur widely in Europe, except the northern part of Europe (Nentwig et al. 2018). Four specimens were obtained from FITs in the present study. This species is listed in the Czech red list as critically endangered (Řezáč et al. 2015).

Pseudoscorpions (Pseudoscorpiones)

In total, 71 specimens belonging to six species from four families were identified (Tab. 1). More specimens were collected in pitfall traps than in FITs (Fig. 4b). The most abundant species, *Larca lata*, was found exclusively in pitfall traps. Also, all specimens of *Allochernes wideri* were found in pitfall traps. On the other hand, *Apocheiridium ferum* (Simon, 1879) and *Dendrochernes cyrneus* (L. Koch, 1873) were collected only in FITs. *Chelifer cancroides* (Linnaeus, 1758) and *Chernes hahnii* (C. L. Koch, 1839) were captured in both trap types. Markedly more specimens were present in hollows in trees situated in forest stands than in those growing in meadows (Tab. 1). Remarkably, all pseudoscorpions were collected on live trees, not a single specimen on a dead one (Tab. 1).

Remarkable pseudoscorpion species

Larcidae

***Larca lata* (Hansen, 1884)** (Fig. 3b)

This species appears to be rare and vulnerable and is a typical cavity dweller (Judson & Legg 1996, Ranius & Wilander 2000). It occurs only in Europe, where it has been found in 13 countries until now (Harvey 2013). Recently it was reported for the first time from Slovakia and Hungary (Christophoryová et al. 2011a, Novák 2013). Within Czechia it has been found in the Třeboňsko Protected Landscape Area (South Bohemia) and in the Lower Morava Biosphere Reserve, which covers also the present study site (Ducháč 1993a, Šťáhlavský 2011, Šťáhlavský & Chytil 2013). In the Czech red list, it is listed as vulnerable (Šťáhlavský 2017).

Cheiridiidae

***Apocheiridium ferum* (Simon, 1879)**

This species is distributed in Europe and has also been found in Asian Turkey, Azerbaijan and Uzbekistan (Harvey 2013). Beier (1963) reported that the species lives under tree bark, especially of fruit trees. According to Weygoldt (1966) it occurs even in the tightest spaces under bark. Ducháč (1997) reported *A. ferum* from South Moravia as new for Czechia, without providing information about its habitat. Later it was found in the same region in the village of Lednice (Šťáhlavský & Ducháč 2001) and also close-by at Valtice and Hlohovec, in both cases under *Platanus* bark (Šťáhlavský & Chytil 2013).

Chernetidae

***Dendrochernes cyrneus* (L. Koch, 1873)**

This species is distributed in Asia and Europe (Harvey 2013). It is one of the pseudoscorpions that regularly occurs in bird nests, but it has also been found under tree bark and

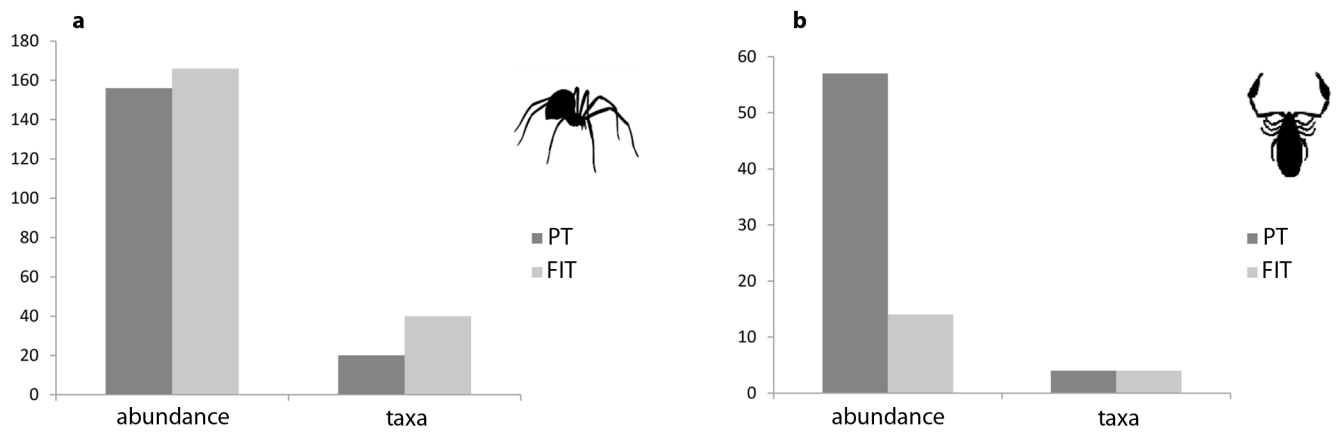

Fig. 4: Abundance and species numbers of spiders (**a**) and pseudoscorpions (**b**) in different types of traps. Abbreviations: FIT – flight interception trap, PT – pitfall trap

Tab. 1: List of taxa collected on old oaks at Pohansko; Abbreviations: FIT– flight interception traps close to cavity openings, PT – pitfall traps in hollows, for – trees in close-canopy forest, sol – solitary trees in meadows, dead – dead trees, live – live trees

Taxa	FIT	PT	for	sol	dead	live
SPIDERS (ARANEAE)						
Agelenidae						
Tegenaria ferruginea (Panzer, 1804)	3	66	42	27	31	38
Anyphaenidae						
Anyphaena accentuata (Walckenaer, 1802)	8	.	8	.	3	5
Araneidae						
Araneus triguttatus (Fabricius, 1775)	1	.	1	.	1	.
Araneus sp.	2	.	.	2	.	2
Clubionidae						
Clubiona comta C. L. Koch, 1839	1	.	1	.	.	1
Clubiona pallidula (Clerck, 1757)	3	.	2	1	1	2
Clubiona sp.	6	2	4	4	5	3
Dictynidae						
Cicurina cicur (Fabricius, 1793)	1	5	5	1	3	3
Dictyna uncinata Thorell, 1856	2	.	1	1	.	2
Lathys humilis (Blackwall, 1855)	7	1	5	3	2	6
Nigma flavescens (Walckenaer, 1830)	2	.	.	2	2	.
Dysderidae						
Harpactea rubicunda (C. L. Koch, 1838)	3	2	5	.	4	1
Gnaphosidae						
Drassodes sp.	1	.	1	.	.	1
Scotophaeus quadripunctatus (Linnaeus, 1758)	.	15	8	7	4	11
Linyphiidae						
Araeoncus humilis (Blackwall, 1841)	2	.	2	.	.	2
Diplocephalus picinus (Blackwall, 1841)	3	.	2	1	1	2
Drapetisca socialis (Sundevall, 1833)	.	1	1	.	.	1
Erigone atra Blackwall, 1833	2	.	1	1	2	.
Hypomma cornutum (Blackwall, 1833)	3	3	3	3	1	5
Lepthyphantes minutus (Blackwall, 1833)	7	7	11	3	7	7
Linyphia triangularis (Clerck, 1757)	5	.	5	.	.	5
Linyphiidae gen. spp.	19	5	18	6	7	17
Midia midas (Simon, 1884)	.	38	31	7	24	14
Neriene montana (Clerck, 1757)	1	1	2	.	1	1
Pelecopsis mengei (Simon, 1884)	1	.	.	1	.	1
Porrhomma oblitum (O. P.-Cambridge, 1871)	8	.	8	.	3	5
Trematocephalus cristatus (Wider, 1834)	.	1	1	.	1	.
Liocranidae						
Agroeca brunnea (Blackwall, 1833)	.	1	.	1	1	.
Lycosidae						
Pardosa sp.	1	.	1	.	.	1
Trochosa robusta (Simon, 1876)	.	1	.	1	.	1
Philodromidae						
Philodromus albidus Kulczyński, 1911	6	.	6	.	.	6
Philodromus spp.	.	1	1	.	.	1
Salticidae						
Ballus chalybeius (Walckenaer, 1802)	1	.	1	.	1	.
Leptorchestes berolinensis (C. L. Koch, 1846)	8	.	1	7	5	3
Salticus zebraneus (C. L. Koch, 1837)	7	.	6	1	2	5
Tetragnathidae						
Metellina segmentata (Clerck, 1757)	1	.	.	1	1	.
Tetragnatha pinicola L. Koch, 1870	3	.	3	.	2	1
Theridiidae						
Dipoena erythropus (Simon, 1881)	2	2	4	.	1	3
Enoplognatha ovata (Clerck, 1757)	3	.	3	.	1	2
Parasteatoda lunata (Clerck, 1757)	9	2	8	3	4	7
Parasteatoda simulans (Thorell, 1875)	3	.	3	.	2	1
Platnickina tincta (Walckenaer, 1802)	8	.	7	1	2	6
Robertus lividus (Blackwall, 1836)	2	.	1	1	1	1
Steatoda bipunctata (Linnaeus, 1758)	2	2	3	1	3	1
Theridion mystaceum L. Koch, 1870	1	.	1	.	.	1
Theridion spp.	11	.	4	7	7	4
Thomisidae						
Ozyptila praticola (C. L. Koch, 1837)	6	1	5	2	3	4
PSEUDOSCORPIONS (PSEUDOSCORPIONES)						
Larcidae						
Larca lata (Hansen, 1884)	.	41	37	4	.	41
Cheiridiidae						
Apocheiridium ferum (Simon, 1879)	7	.	6	1	.	7
Cheliferidae						
Chelifer cancroides (Linnaeus, 1758)	3	7	5	5	.	10
Chernetidae						
Chernes hahnii (C. L. Koch, 1839)	1	1	1	1	.	2
Dendrochernes cyrneus (L. Koch, 1873)	3	.	2	1	.	3
Allochernes wideri (C. L. Koch, 1843)	.	8	8	.	.	8

in tree hollows, though rarely (Christophoryová et al. 2011b, Krajčovičová & Christophoryová 2014). The Lower Morava Biosphere Reserve, which covers also our present study site, represents the only area within Czechia, from where *D. cyrneus* has been recorded; it was found in oak litter, under tree bark and phoretic on a longhorn beetle (Ducháč 1993b; Šťáhlavský & Chytil 2013). Šťáhlavský (2017) listed the species as vulnerable in the Czech red list.

Discussion

Most of the obtained 40 spider species represent arboreal ones (Szinetár & Horváth 2005). Only six taxa were epigeic: *Cicurina cicur* (Fabricius, 1793), *Drassodes* sp., *Harpactea rubicunda* (C. L. Koch, 1838), *Diplocephalus picinus* (Blackwall, 1841), *Pardosa* sp. and *Trochosa robusta* (Simon, 1876). The most abundant species in the FITs were *Anyphaena accentuata*, *Leptorchestes berolinensis* and *Parasteatoda lunata*. *Anyphaena accentuata* lives during the vegetation season on tree branches, *L. berolinensis* and *P. lunata* dwell on tree trunks (Buchar & Růžička 2002). Several small linyphiid spiders were obtained from FITs, including juvenile specimens, which disperse by ballooning. The majority of the species captured by FITs live on tree trunks or branches.

Tegenaria ferruginea and *Midia midas* were most abundant in the pitfall traps. Both species are typical cavity dwellers (Růžička et al. 1991, Buchar & Růžička 2002). The money spider *M. midas* is rare and endangered in the whole of Europe (Russell-Smith 2002, Řezáč et al. 2015). Another typical hollow dweller is *Scotophaeus quadripunctatus* (Linnaeus, 1758), which we obtained only from pitfall traps. The record from Pohansko represents a new locality for Czechia, but not far from its nearest known locality close to Lednice (Kubcová & Schlaghamerský 2002). All specimens were obtained from pitfall traps. The number of spider species and family composition obtained by pitfall trapping was similar to other studies from tree hollows in Spain and Romania (Martínez De Murguía et al. 2007, Niţu et al. 2009), but the species composition differed. Other remarkable spider species were the jumping spider *L. berolinensis* and the theridiid *Dipoena erythropus*, listed in the Czech red list as vulnerable and critically endangered, respectively (Řezáč et al. 2015). Significantly more spiders were obtained from trees in the forest than from solitary trees in meadows. Forests have a high species pool of arboricolous spider species (Samu et al. 2014). More species and specimens were present on live trees than on dead ones.

All of the collected pseudoscorpion species, except *Chelifer cancroides*, represent typical inhabitants of tree microhabitats. *C. cancroides* is considered to be cosmopolitan and synanthropic (Beier 1963), which may be related to its frequent occurrence in the nests of Hirundinidae (Turienzo et al. 2010). Nevertheless, its occurrence under tree bark and in tree cavities is also known (Mahnert 2011, Krajčovičová & Christophoryová 2014). Šťáhlavský & Chytil (2013) recorded the species in tree hollows within Czechia, in the south Moravian floodplains at Lednice and Břeclav. During the present study, *C. cancroides* was found in both trap types. The same numbers of individuals were found in hollows of solitary trees as well as of trees situated in forest stands. Two specimens of *Chernes hahnii* were obtained in the present study, one in FIT one in a pitfall trap. The species shows a strong association with the microhabitat under tree bark (Šťáhlavský 2001, Drogla & Lippold 2004, Krajčovičová & Christophoryová 2014). Its presence in FIT could have been caused by its upwards migration on the tree trunks or by zoophoresy. Krajčovičová & Christophoryová (2014) collected 11 specimens of *Chernes hahnii* in photoeclectors installed on tree trunks which can also be related with upwards migration on the tree trunks. A surprisingly low number of *Allochernes wideri* was found in tree hollows in the present study. In a study conducted in Prague and its surroundings, *A. wideri* represented the second most abundant species found in tree hollows (Šťáhlavský 2001). The species was reported in all of the subsequent faunistic papers dealing with pseudoscorpions from tree microhabitats in Czechia (Šťáhlavský 2006a, 2006b, 2011, Šťáhlavský & Krásný 2007, Šťáhlavský & Tuf 2009, Šťáhlavský & Chytil 2013). Three species *Larca lata*, *Apocheiridium ferum* and *Dendrochernes cyrneus* are presented as remarkable records in the current paper. Two of them, *L. lata* and *D. cyrneus*, are listed in the Czech red list as vulnerable (Šťáhlavský 2017).

In conclusion, looking at the obtained data, one has to bear in mind that whereas the pitfall traps collected specimens living in tree hollows or actively visiting them, the trapping of spiders and pseudoscorpions in free-hanging FITs was a rather accidental process. Both groups do not fly, though some passive air-born transport does occur (ballooning and zoophoresy) (Decae 1987, Christophoryová et al. 2017a). However, other non-flying invertebrates have also been obtained from FITs (own unpublished observation). In the present case one has to assume that many individuals falling down from the canopy, possibly taken by wind, ended up in the traps despite the trap roofs (meant to prevent flooding by rainwater and accumulation of debris in the trap funnel). We also observed spiders building their webs between the panes or between pane and roof.

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Electronic Appendix (pdf format): Supplementary file with detailed collection data of each specimen.

Synanthropic is best: *Nuctenea umbratica* (Araneae: Araneidae) and *Steatoda bipunctata* (Araneae: Theridiidae) are the European Spiders of the Years 2017 and 2018

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Abstract. The European spiders of the year 2017, *Nuctenea umbratica* (Clerck, 1757), and 2018, *Steatoda bipunctata* (Linnaeus, 1758), are presented. Both species were originally bark-dwellers, but became more and more synanthropic. Their appearance and characteristics (e.g., ecology, habitat, phenology) are briefly described. The modality of the voting is given as well as the decisive criteria for the win.

Keywords: bark-dweller, Europe, popular, Rabbit Hutch Spider, synanthropic, Walnut Orb-weaver Spider

Zusammenfassung. Am liebsten im Haus: *Nuctenea umbratica* (Araneae, Araneidae) und *Steatoda bipunctata* (Araneae: Theridiidae) sind die europäischen Spinnen des Jahres 2017 und 2018. Die europäischen Spinnen des Jahres 2017, *Nuctenea umbratica* (Clerck, 1757), und 2018, *Steatoda bipunctata* (Linnaeus, 1758), werden vorgestellt. Beide Arten sind ursprünglich Rindenbewohner, wurden aber mehr und mehr zu Kulturfolgern. Ihre Merkmale und Eigenschaften (z.B. Ökologie, Lebensraum, Phänologie) werden kurz beschrieben. Der Wahlmodus sowie die für die Wahl entscheidenden Kriterien werden genannt.

Synanthropic spiders – sometimes just called 'house spiders' – are feared and loved at the same time. However, this is perfect for a spider of the year! After *Pholcus phalangioides* (Fuesslin, 1775) in 2003, *Salticus scenicus* (Clerck, 1757) in 2005 and *Eratigena atrica* (C.L. Koch, 1843) in 2008 (Kreuels & Jäger 2003, Jäger & Kreuels 2005, Jäger 2007), two more similar species were elected. Both of them took advantage of new microhabitats available in homes and around houses in urbanized areas and were able to settle into human dwellings (Sacher 1983, Reinke 1997, Jocqué et al. 2016). Moreover, they share another habit: they are also bark-dwellers (Wunderlich 1982, Koponen 1996, Horváth & Szinetár 2002, Szinetár & Horváth 2006, Machač & Tuf 2016). This means looking under the bark of trees near houses may reveal a spider of the year!

Election of the European Spider of the Year (ESY)

The European Spider of the Year was chosen by 81 (2017) respectively 83 (2018) arachnologists from 26 European countries (Albania, Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Liechtenstein, Macedonia, The Netherlands, Norway, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland). Co-ordination is via the Natural History Museum Vienna together with the "Arachnologische Gesellschaft" (AraGes) and the European Society of Arachnology (ESA). It is a simple email vote: voting members choose their favourite spider out of six proposed species (partly genera). A majority wins!

Through choosing the Spider of the Year we not only hope that this less popular group of animals will be brought to the fore, but we also hope that researchers can obtain new data about its current distribution. In this context, enjoy the Spider of the Year and help us with your locality records via photographic documentation of this species.

There are many societies supporting the Spider of the Year (see European Society of Arachnology 2018). Furthermore, every arachnologist is asked for support using those spider species as a 'model' to promote spiders in general (for more details see Hörweg et al. 2015).

Nuctenea umbratica (Clerck, 1757)/Walnut Orb-weaver/ Spaltenkreuzspinne/épeire des fissures – Spider of the Year 2017

Nuctenea umbratica belongs to the family of true orb-weavers (Araneidae). This family has 3135 species worldwide, 100 of which are found in Europe (World Spider Catalog 2018, Nentwig et al. 2018). The genus *Nuctenea* is represented by two species in (Central) Europe (Blick et al. 2004, Nentwig et al. 2018).

The orb weaver *N. umbratica* shows a high level of sexual dimorphism: female body length is 13–16 mm, males just 7–10 mm. The body is wide and flattened. The basic colouration is red-brown to black-brown, the legs are dark brown and the opisthosoma shows a dark, leaf-like pattern (foliation) (Figs. 1–2) which can have a light border (Reichholf & Steinbach 1997, Bellmann 2016, Nentwig et al. 2018).

Nuctenea umbratica builds a relatively large orb web (up to 70 cm in diameter) with an eccentric form in which the hub of the web is always displaced towards the spider's retreat (Bellmann 2016). The spider spends the day hidden in this retreat and sits in the middle of the web when it gets dark at night. *Nuctenea umbratica* can be found the whole year round, but mostly from July to October (Wiehle 1931, Sacher 1983, Nentwig et al. 2018). It feeds like other orb weavers mainly on flies, moths, but also winged aphids; many of which are agricultural pests (Nyffeler 1983). The spider itself is regularly preyed upon by the sphecid wasp *Sceliphron curvatum* (Smith, 1870) (Gepp 1995).

Nuctenea umbratica is found throughout Europe (Blick et al. 2004, Nentwig et al. 2018). Its vertical distribution is predominantly from flatlands to low hills (up to about 800 metres above sea level), with only a few records at higher elevations up to 1500 metres in places like Tyrol (Wiehle 1931, Hänggi et al. 1995, Steinberger & Thaler 1990, Thaler & Knoflach 2003). The species occupies various habitats. It was originally a bark-associated species (Wunderlich 1982, Balkenhol & Zucchi 1989, Steinberger & Thaler 1990, Szinetár & Horváth 2006, Machač & Tuf 2016) (Fig. 3), particularly found on dead standing wood with loose bark, but is now also found in urban environments like house walls and fences, especially

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in nooks and crevices (Komposch 1993) (Fig. 4). In some habitats it can be encountered quite frequently and in Central Europe the species is categorised as not threatened (Řezáč et al. 2015, Blick et al. 2016). The known distribution in Europe can be found in specific distribution maps (Helsdingen 2017, Arachnologische Gesellschaft 2018, CSCF 2018, Czech Arachnological Society 2018, European Society of Arachnology 2018, MNHN 2018).

Nuctenea umbratica can be mistaken for dark animals like *Larinioides ixobolus* (Thorell, 1873), but for comparison this species is a metallic black and the foliation is lighter and more prominent. Juveniles of *N. umbratica* resemble the smaller (body length up to 9 mm), but much rarer, *Nuctenea silvicultrix* (C.L. Koch, 1835). This species is distributed more to the east and differs by having lighter sides of the body and a more rounded opisthosoma (Nentwig et al. 2018, Wiki AraGes 2018).

Nuctenea umbratica was chosen as the European Spider of the Year because (1) the species is quite common, (2) despite its hidden way of life it is easy to find close to houses, (3) it is a quite prominent and easy to identify species, and (4) it raises public awareness about its original habitat on the bark of dead wood and/or old trees.

Steatoda bipunctata (Linnaeus, 1758)/Rabbit Hutch Spider/ Fettspinne/stéatode à deux points – Spider of the year 2018

Steatoda bipunctata belongs to the cobweb spider family (= comb-footed spiders, Theridiidae). Worldwide, this family has 2487 species of which 228 live in Europe (Nentwig et al. 2018, World Spider Catalog 2018). The genus *Steatoda* is represented by 13 species in Europe, six of which can be found in Central Europe (Blick et al. 2004, Nentwig et al. 2018).

The body length is 4.5–7 mm in females and 4–5.5 mm in males. The body appears greasy or waxy and shiny, especially the slightly flattened opisthosoma. In German it is called "Fettspinne" (Fat or Greasy Spider). The basic colour of the prosoma is brown to almost black, the opisthosoma is generally light brown becoming dark brown to black towards the edges. A rather indistinct lighter stripe runs down the middle of the opisthosoma, as well as a wide pale band across the front (Fig. 5). Usually four small dark dots can be seen (these mark the points where muscles attach inside the body). The

Fig. 1: *Nuctenea umbratica* – habitus male (photo: Christian Komposch, Ökoteam Graz)
Abb. 1: *Nuctenea umbratica* – Habitus Männchen (Foto: Christian Komposch, Ökoteam Graz)

Fig. 2: *Nuctenea umbratica* within its web (photo: Christian Komposch, Ökoteam Graz)
Abb. 2: *Nuctenea umbratica* im Netz (Foto: Christian Komposch, Ökoteam Graz)

Fig. 3: Natural habitat of *Nuctenea umbratica* on tree bark (photo: Gilbert Loos, ARABEL)
Abb. 3: Natürlicher Lebensraum von *Nuctenea umbratica* auf einer Baumrinde (Foto: Gilbert Loos, ARABEL)

Fig. 4: Artificial habitat of *Nuctenea umbratica* in wall crevices (photo: Johan Van Hoecke, ARABEL)
Abb. 4: Künstlicher Lebensraum von *Nuctenea umbratica* in Mauerspalten (Foto: Johan Van Hoecke, ARABEL)

Fig. 5: *Steatoda bipunctata* – habitus (photo: Pierre Oger, ARABEL)
Abb. 5: *Steatoda bipunctata* – Habitus (Foto: Pierre Oger, ARABEL)

Fig. 6: *Steatoda bipunctata* within the web (photo: Cor Kuijpers, ARABEL)
Abb. 6: *Steatoda bipunctata* im Netz (Foto: Cor Kuijpers, ARABEL)

Fig. 7: *Steatoda bipunctata* with eggs (photo: Stefan Sollfors, eurospiders.com)
Abb. 7: *Steatoda bipunctata* mit Eiern (Foto: Stefan Sollfors, eurospiders.com)

legs are red-brown with darker rings (Reichholf & Steinbach 1997, Bellmann 2016, Bee et al. 2017, Nentwig et al. 2018).

Steatoda bipunctata builds a three-dimensional web – usually in corners or niches – with a more or less thickly spun sheet with upwards and sideward directed threads to fix the net (Fig. 6). The catching threads are directed downwards. Only these have glue droplets, which are located at the bottom of the thread. Prey items become stuck here, and the spider hurries out of its retreat; usually a crevice near the web (Foelix 2015). *Steatoda bipunctata* can overpower not only small insects but even large spiders like the house spider.

Steatoda bipunctata can be found all year round, however males are usually encountered during the mating season from June to October (Schaefer 1976). During mating the male makes chirping noises: the sounds are produced by pulling a sharp ridge at the front of the opisthosoma across a file-like 'stridulatory organ' at the back of the prosoma (Gwinner-Hanke 1970, Foelix 2015). In this way the female is enticed out of her retreat and mating can be completed. The female lays about 50–150 pink coloured eggs in a white egg sac which is hung within the web (Nielsen 1932, Bellmann 2016) (Fig. 7).

Steatoda bipunctata is found in all European countries. Its vertical distribution is mostly from lowlands to low mountain ranges (up to about 800 m above sea level), although there are records up to 2000 m in the Alps (Wiehle 1937, Steiner & Thaler 2004).

As a web-builder the species is mostly found in or on buildings, for example under window ledges or near front doors that stand back a little bit. *Steatoda bipunctata* can even survive in quite dry rooms (Reichholf & Steinbach 1997). As the name implies, rabbit hutches often make a suitable habitat as well. However, they are also found outdoors, mostly in gardens, on bushes and in forests – especially under tree bark – in rock crevices or under stones (Szinetár & Horváth 2006, Machač & Tuf 2016). In places they can be quite common and the species is not regarded as endangered (Řezáč et al. 2015, Blick et al. 2016). The known distribution in Europe can be found in specific distribution maps (Helsdingen 2017, Arachnologische Gesellschaft 2018, CSCF 2018, Czech Arachnological Society 2018, European Society of Arachnology 2018, MNHN 2018).

Steatoda bipunctata can be mistaken for *Steatoda castanea* (Clerck, 1757), a species which lives in similar habitats but which mostly has a lighter colouration and is only found in spring (Nentwig et al. 2018, Wiki AraGes 2018).

Steatoda bipunctata was chosen as the European Spider of the Year because this species is commonly found in houses and is relatively easy to recognize. Furthermore, it is an example of a cobweb spider which is not dangerous, unlike the widow spiders from the Mediterranean which are venomous to people and which are rightly feared and regularly mentioned in the popular media; the chirping of the males is another peculiarity of the species.

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Description of *Histopona kurkai* sp. n. with new data for the genus from the Balkan Peninsula (Arachnida, Araneae: Agelenidae)

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Abstract. *Histopona kurkai* **sp. nov.** (♂♀) is described and illustrated from Albania (Shebenik, Jabllanicë national park) and RN Macedonia (Shar Mountains), where it was collected in beech forest habitats. The new species has somatic characters that correspond well to those of the genus *Histopona* (*torpida* group). Also, *Histopona vignai* Brignoli, 1980 is newly established for the spider fauna of Albania (Hotova national park) and RN Macedonia (Shar Mountains).

Keywords: Albania, faunistics, *Histopona*, Macedonia, taxonomy

Zusammenfassung. Beschreibung von *Histopona kurkai* sp. n. mit neuen Daten der Gattung auf der Balkanhalbinsel (Arachnida, Araneae: Agelenidae). *Histopona kurkai* **sp. nov.** (♂♀) wir aus Albanien (Shebenik, Nationalpark Jabllanicë) und Mazedonien (Shar Mountains), wo sind Buchenwäldern vorkommt, beschrieben und abgebildet. Die neue Art gehört morphologisch eindeutig in die Gattung *Histopona* und gehört zur *torpida*-Gruppe. Weiterhin wird *Histopona vignai* Brignoli, 1980 erstmals für die Spinnenfauna Albaniens (Hotova Nationalpark) und Mazedoniens (Shar Mountains) gemeldet.

Currently, the genus *Histopona* Thorell, 1869 includes 21 valid species (van Helsdingen 2018, WSC 2018). Most of them inhabit south-eastern Europe and 13 species are presently known only from the Balkan Peninsula, primarily in caves (Deeleman-Reinhold 1983, Deltshev 1978, Deltshev & Petrov 2008, Gasparo 2005). In the present paper, *Histopona kurkai* **sp. nov.** is described and illustrated from the Shebenik-Jabllanicë national park of Albania and the Shar Mountains of RN Macedonia, where it was collected in beech forest habitats. The new species has somatic characters that correspond well to those of the genus *Histopona*. The descriptions are based on detailed examination of morphological characters of the genital structures which were found to be discrete, allowing a clear separation of the species. Also, *Histopona vignai* Brignoli, 1980 is newly established for the spider fauna of Albania (Hotova national park) and RN Macedonia (Shar Mountains).

Material and methods

Specimens from Albania were collected by hand and these from RN Macedonia using pitfall traps. Coloration is described from 80% alcohol preserved specimens. Male palps were examined and illustrated after they were dissected from the spiders' bodies. Photos were taken with a Lumix digital camera mounted on a Wild M5A stereomicroscope. Measurements of the legs were taken from the dorsal side. Total length of the body includes the chelicerae. All measurements used in the description are in millimeters.

Abbreviations used in the text and figure legends include:

C = conductor;
CO = copulatory opening;
E = embolus;
RBP = retrolateral basal process;
RTA = retrolateral tibial apophysis;
S = spermatheca.

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The material is deposited in the collection of National Museum – Natural History Museum, Praha (NMP) (holotype, paratypes, Albania), National Museum of Natural History, Sofia (NMNHS) (male and female paratypes, Albania and all three paratypes from RN Macedonia), Museum für Naturkunde, Humboldt-Universität zu Berlin (ZMB) (male and female paratypes, Albania) and Senckenberg Museum, Frankfurt am Main (SMF) (male and female paratypes, Albania), Naturhistorisches Museum Wien (NMW) (male and female paratypes, Albania).

Agelenidae C. L. Koch, 1837
***Histopona* Thorell, 1869**
***Histopona kurkai* sp. n.** (Figs 1–7, 11–17)
Type material. Holotype ♂, ALBANIA, Shebenik – Jabllanicë NP, beech forest (N 41.3166, E 20.4191, 1300 m a.s.l.), 1.07.2017, leg. A. Kůrka (NMP: P6A-6896). Paratypes: 41 ♂, 13 ♀, (NMP: P6A-6897), 1 ♂, 1 ♀ (NMNHS), 1 ♂, 1 ♀ (NMW), 1 ♂, 1 ♀ (SMF), 1 ♂, 1 ♀ (ZMB), same data as holotype; 3 ♂, RN MACEDONIA, Shar Mt., Jelak hut, 1850 m, 10.–19.07.1995 (pitfall traps) (NMNHS); 1 ♂, 1 ♀, Shar Mt., Studena place, 1730 m, 10.–19.07.1995 (pitfall traps) (NMNHS), leg. G. Blagoev.
Etymology. The species is dedicated to the Czech arachnologist Antonín Kůrka, collector of type material from Albania.
Diagnosis. The new species has somatic characters (notched trochanters, patellae with dorsal spines only) that correspond well to those of the genus *Histopona*, and belongs to *torpida* species group according to Deeleman-Reinhold (1983) and Bolzern et al. (2013). Among species of this group, it bears close resemblance to *H. vignai* Brignoli, 1980, but the male of *Histopona kurkai* sp. n. can be easily separated by the thinner conductor, narrowing apically and almost merging with the embolus (Figs 6, 14), while in *H. vignai*, it is rounded and protruding above the embolus (Fig. 9). A significant difference is the presence of a thumb-like process (RBP) retrolaterally-basally on the palpal tibia in *H. kurkai* sp. n. (Figs 6–7, 14–15) which is absent in *Histopona vignai* (Figs 9–10). Also, the distal RTA in both species are different: in *Histopona kurkai* sp. n., the two sclerites of the distal RTA are rectangular and the base of the RTA does not protrude ventrally (Figs 6–7, 14–15), while in *Histopona vignai*, the inner sclerite has

Figs 1–2: *Histopona kurkai* sp. n., male holotype, habitus, dorsal and ventral views, scales: 1.7 mm

Figs 3–4: *Histopona kurkai* sp. n., female paratype, habitus, dorsal and ventral views, scales: 1.6 mm

a convex margin, being distinctly smaller than the outer, and the base of the whole distal RTA-complex protrudes significantly ventrally (Figs 9–10). The female epigyne also resembles that of *H. vignai* (based on Brignoli's drawings) but has a greater distance between the copulatory duct coils (Figs 11–12, 16–17).

Description. Measurements of male (n = 2, holotype male and paratype male from Albania): total length, 5.63–6.38; carapace: length, 2.65–2.93, width, 1.80–2.10; clypeus: width, 0.15–0.23; chelicerae: length, 1.13–1.50, width, 0.38–0.60; sternum: length, 1.35–1.50, width, 1.20–1.35; opisthosoma, length, 3.00–4.18.

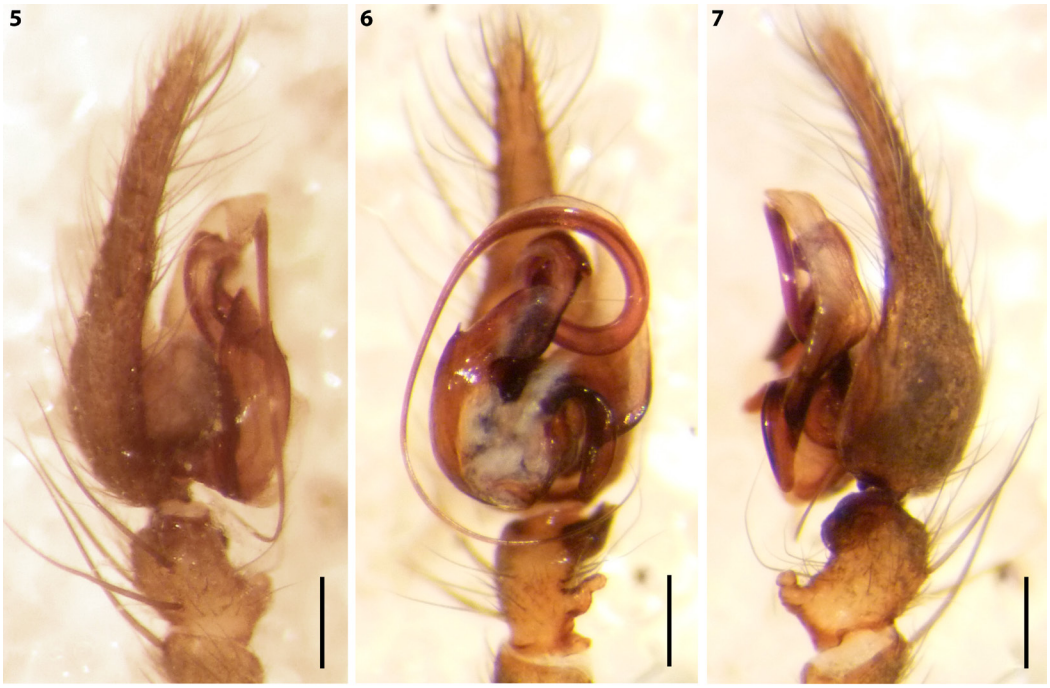
Measurements of female (n = 2, paratypes from Albania): total length, 6.75–9.75; carapace: length, 2.40–2.78, width, 1.73–1.88; clypeus: width, 0.15–0.23; chelicerae: length, 1.13–1.28, width, 0.38–0.60; sternum: length, 1.35–1.65, width, 0.90–1.13; opisthosoma, length, 3.75–4.88.

Eyes: Both eye rows straight in dorsal view. Anterior lateral eyes larger than anterior median eyes. Posterior eyes equal in size.

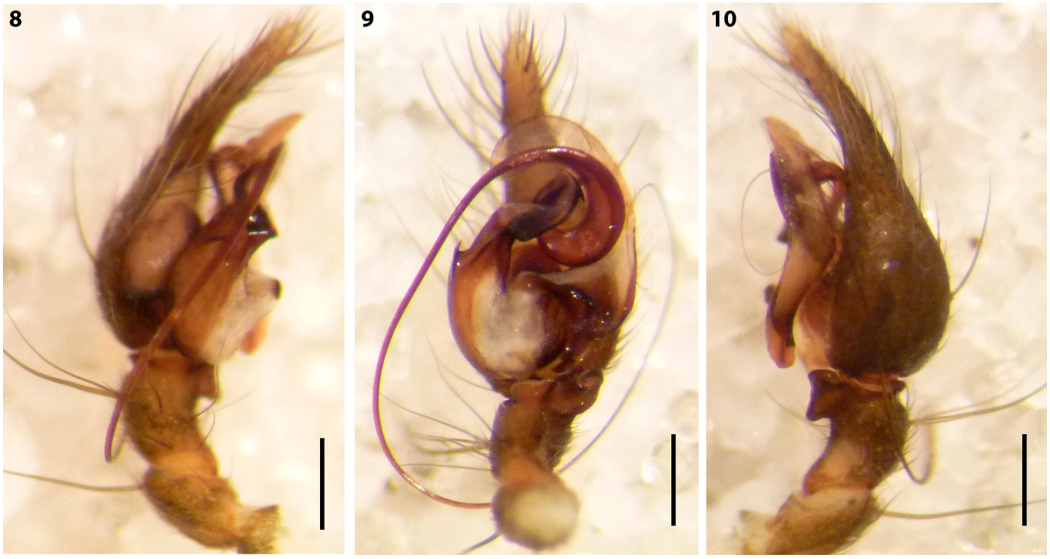
Chelicerae: with three teeth on promargin and four teeth on retromargin.

Legs: All trochanters notched, patellae with dorsal spines only, measurements as in Tabs. 1 and 2. Chaetotaxy see Tab. 3.

Coloration (Figs 1–4): Carapace brown with yellow median band. Sternum brown, without pattern. Abdomen dark-grey, dorsally with lighter stripes, venter grey. Legs: yellow to yellow-brown.



Figs 5–7: *Histopona kurkai* sp. n., holotype, male palp, prolateral, ventral and retrolateral views, scales: 0.25 mm



Figs 8–10: *Histopona vignai* Brignoli, 1980, male palp, prolateral, ventral and retrolateral views, scales: 0.3 mm

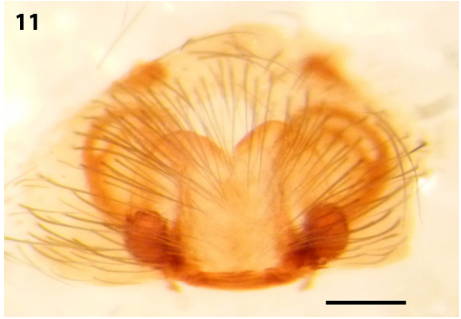
Male palps (holotype) (Figs 5–7, 13–15). Tibia with two retrolateral apophyses. RTA, consisting of two rectangular sclerites, the outer partially covering the inner, situated distally-retrolaterally on the tibia. Retrolaterally-basally, a further thumb-shaped projection (RBP) is present. Bulbus: Embolus very long and connected to the radix by a peculiar knot. Conductor, narrowing apically and almost merging with embolus. Female genitalia (a paratype) (Figs 11–12, 16–17). The

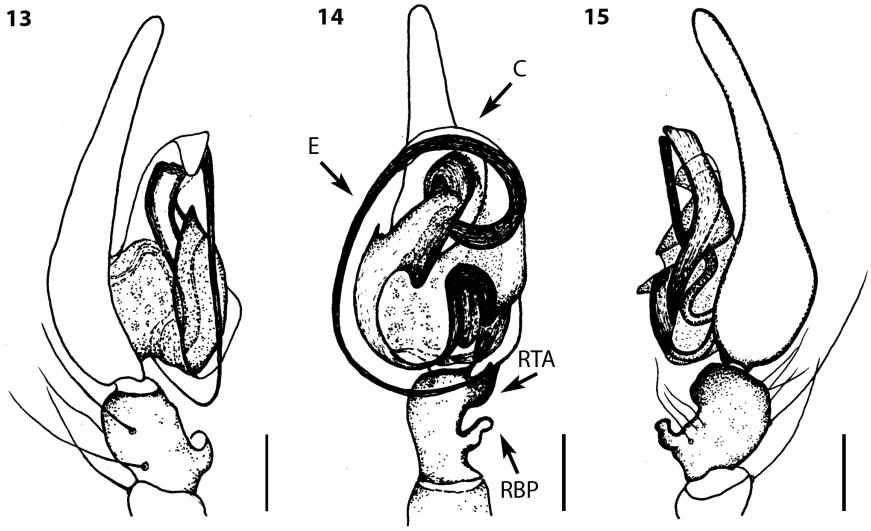
Tab. 1. *Histopona kurkai* sp. n., leg measurements (holotype male and paratype male from Albania)

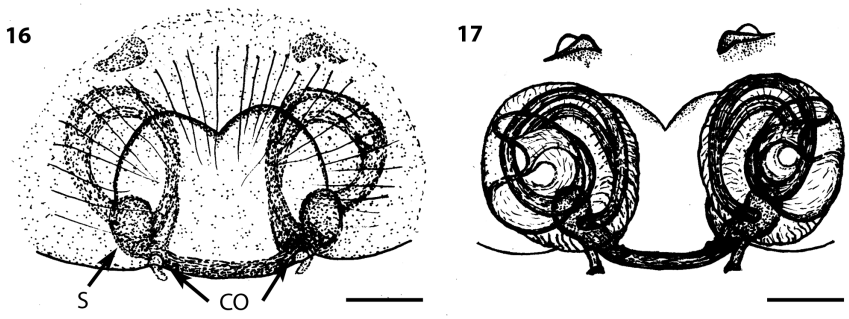
Legs	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.63–3.00	0.90–0.98	2.56–2.85	2.26–2.70	1.73–1.95	10.08–11.48
II	2.40–2.63	0.83–0.90	2.10–2.55	2.10–2.55	1.50–1.65	8.93–10.28
III	2.26–2.63	0.75–0.83	2.03–2.33	2.26–2.63	1.50–1.58	8.80–10.00
IV	2.93–3.38	0.90–0.98	2.85–3.38	3.60–4.13	1.73–1.88	12.01–13.75

Tab. 2. *Histopona kurkai* sp. n., leg measurements (paratype females from Albania)

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.10–2.40	0.83–0.98	1.95–2.40	1.88–2.18	1.35–1.65	8.26–9.61
II	1.88–2.25	0.75–0.90	1.73–2.18	1.73–2.18	1.50–1.73	8.93–9.24
III	1.88–2.25	0.68–0.83	1.65–2.03	1.88–2.25	1.05–1.36	7.29–8.80
IV	2.10–2.50	0.83–0.98	2.20–2.60	1.98–2.38	1.35–1.88	9.46–10.34







Figs 11–12, 16–17: *Histopona kurkai* sp. n., female paratype, epigyne/vulva, dorsal and ventral views, scales: 0.2 mm

Figs 13–15: *Histopona kurkai* sp. n., holotype, male palp, prolateral, ventral and retrolateral views, scales: 0.25 mm

Table 3. *Histopona kurkai* sp. n., chaetotaxy (holotype)

Leg	Femur	Patella	Tibia	Metatarsus
I	3d, 2p, 1r	2d	2d, 2p, 4v	1d, 2p, 2r,3v
II	3d, 1p, 2r	2d	1d, 2p, 5v	1d, 2p, 2r,3v
III	2d, 1p, 1r	2d	2d, 2p, 2r, 3v	3d, 3p, 3r, 3 v
IV	2d, 1p, 1r	2d	1d, 2p, 24, 4v	3d, 3p, 3r, 3v

epigyne has the heart-shaped central sclerite typical for the *torpida* group, with a more strongly sclerotized posterior margin. The copulatory openings are situated just in front of it, well separated. Epigynal plate, nearly hemicircular. Copulatory ducts long, with three large coils, one transparent and two sclerotized. Sclerotized 'heads' situated anteriorly at the transparent entrance coil. Spermathecae small, nearly globular, set apart from each other.

Distribution. Albania, RN Macedonia.

***Histopona vignai* Brignoli, 1980** (Figs 8–10)

ALBANIA, Frashër, Hotova NP, 4.07.2017, 1 ♂, leg. A. Kůrka; RN MACEDONIA, Kozhuf Mt., Michailovo, 1 ♂, 26.05.2003, leg. C. Deltshev, G. Blagoev.

Distribution. Albania, Greece, RN Macedonia.

Acknowledgements

We are much obliged to Antonín Kůrka and Petr Dolejš (National Museum – Natural History Museum, Praha) who provided us with spider material from Albania, to Gergin Blagoev (University of Guelph) for the collection of RN Macedonian material and to Angelo Bolzern (Naturhistorisches Museum Basel) and Fulvio Gasparo (Trieste, Italy) for helpful remarks on the manuscript.

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Allochernes solarii (Pseudoscorpiones: Chernetidae) newly recorded from ant nests in Slovakia

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doi: 10.30963/aramit5607

Abstract. *Allochernes solarii* (Simon, 1898) is recorded for the first time from Slovakia. Six adults and two tritonymphs were found in two nests of *Formica gagates* Latreille, 1798. A description of the species is provided based on Slovakian specimens and the holotype from Italy.

Keywords: Central Europe, faunistics, *Formica gagates*, myrmecophily, taxonomy

Zusammenfassung. *Allochernes solarii* (Pseudoscorpiones: Chernetidae) erstmals in Ameisenbauten in der Slowakei nachgewiesen. *Allochernes solarii* (Simon, 1898) wird das erste Mal für die Slowakei nachgewiesen. Sechs Adulte und drei Tritonyphmen wurden in zwei Ameisenbauten von *Formica gagates* Latreille, 1798 gefunden. Die Art wird auf Basis slowakischer Tiere und des Holotypus aus Italien beschrieben.

The genus *Allochernes* Beier, 1932 includes 33 species and one subspecies distributed mainly in the northern hemisphere. So far, 15 of them have been discovered in Europe (Harvey 2013). *Allochernes solarii* (Simon, 1898) can be considered as a rare species, since it has been found, until the current study, only in the north of Italy, Sardinia and in the south of France (Gestro 1904, Leclerc 1979, Gardini 2000, 2004) (Fig. 1). The species was originally described as *Chelifer solarii* by Simon (1898) from Monte Capraro near Tortona, Piedmont, Italy and subsequently transferred to the genus *Allochernes* by Beier (1932). Gestro (1904) mentioned its occurrence in Sardinia which was questioned by Lazzeroni (1969a). Lazzeroni (1969a) recorded *A. solarii* from Montecchio near Verona, Venetia, under a stone next to a mountain station. Leclerc (1979) published a record from a small cave with colony of bats located in Ruoms à Labeaumem, Ardèche, France. However, Leclerc's (1979) identification of *A. solarii* is doubtful since the author indicated differences in characters between the French specimens and the description in Beier (1932). Records of the species from Riva Valdobbia near Vercelli (Piedmont) and Mt. Pastello near Verona (Venetia), both from ant nests (*Formica* sp., *Lasius* sp.), were mentioned by Gardini (2004). In Slovakia, three *Allochernes* species are known: *A. peregrinus* Lohmander, 1939, *A. powelli* (Kew, 1916) and *A. wideri* (C.L. Koch, 1843) (Christophoryová et al. 2011, 2012). The aim of the present paper is to describe the newly found specimens of *A. solarii* from Slovakia and re-describe the holotype from Italy.

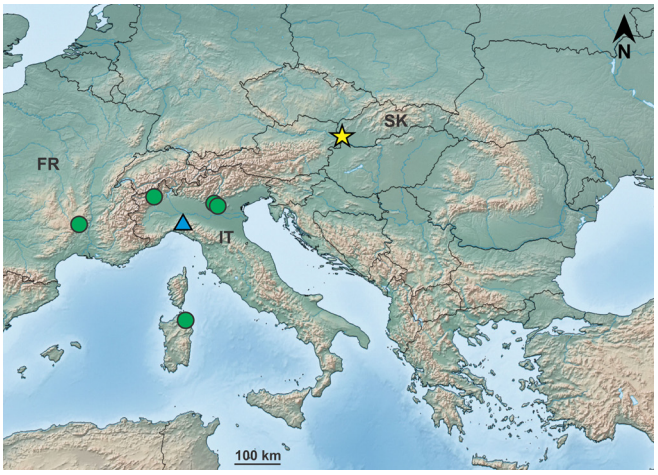

Fig. 1: Distribution of *Allochernes solarii*. Abbreviations: Blue triangle – the type locality of the species in Italy (IT), green circle – localities in Italy, Sardinia and France (FR), yellow star – newly discovered locality in Slovakia (SK)

Fig. 2: One individual of *Allochernes solarii* crawling on a stone in a *Formica gagates* nest in Slovakia (photo: A. Purkart)

Material and methods

Slovakian specimens were collected from two nests of *Formica gagates* Latreille, 1798 (det. Adrián Purkart) (Fig. 2). Both ant nests (distance from each other was at most four meters) were situated under stones and consisted mainly of soil and leaf litter. After rolling the stone, two pseudoscorpions were observed crawling on the stone and on the surface of the ant nest. Two more expeditions were carried out at the study locality. The specimens were collected individually and in addition samples from the centre of ant nests were taken and heat extracted in Tullgren funnels. Collected specimens were studied as temporary slide mounts using lactic acid and photographed using a Canon EOS 1100D camera connected to a Zeiss Stemi 2000-C stereomicroscope. Measurements were taken from the photographs using the AxioVision 40LE application (v. 4.5). Nomenclature follows Harvey (2013). Taken measurements and terminology largely follow Chamberlin (1931). The use of the terms rallum, antiaxial and paraxial fol-

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lows Judson (2007). Figures were drawn using a Leica drawing tube. The species was identified using the keys of Beier (1932, 1963) and was compared with the holotype (MSNG 60888) from Museo Civico di Storia Naturale "Giacomo Doria", Genoa, Italy. The new pseudoscorpion material is deposited in the collection of the Department of Zoology in Faculty of Natural Science, Comenius University in Bratislava.

Faunistic data

Three males, three females and two tritonymphs of *A. solarii* were found in an oak-hornbeam forest, in ant nests of *F. gagates* in Vajnorská Hora (Malé Karpaty Mts., district Bratislava–Vajnory), Slovakia (48.23209°N, 17.17698°E, 280 m a.s.l.) (Fig. 1):

11.IV.2018: 2 ♂♂, individual sampling (ant nest 1), leg. A. Purkart; 3.V.2018: 1 ♂, 3 ♀♀, 1 tritonymph, individual sampling and heat extraction in Tullgren funnels (ant nest 1), leg. M. Červená, K. Krajčovičová, A. Purkart; 26.VI.2018: 1 tritonymph, heat extraction in Tullgren funnels (ant nest 2), leg. J. Christophoryová, M. Červená, A. Purkart.

Holotype female from Italy (Museo Civico di Storia Naturale "Giacomo Doria", Genoa, 60888), Montecapraro near Tortona, Fabbrica Curone, Piemonte, 44.733°N, 9.167°E, ca. 780 m a.s.l. (Simon 1898, Harvey 2013).

Results

***Allochernes solarii* (Simon, 1898)**

Chelifer Solarii Simon 1898: 23–24; Gestro (1904): 14.

Allochernes (*Allochernes*) *solarii* (Simon): Beier (1932): 150, Fig. 160a.

Allochernes solarii (Simon): Roewer (1937): 297; Vachon (1938): Fig. 56g; Beier (1963): 267–268, Fig. 268; Lazzeroni (1969a): 409; Lazzeroni (1969b): 244; Leclerc (1979): 62; Harvey (1991): 538; Gardini (1995): 7; Gardini (2000): 132; Gardini (2004): 131.

Re-description of the holotype from Italy

Female (Tab. 1)

Body and palpal setae short, clavate and dentate. Carapace finely granular with two narrow transverse furrows, eyes absent. Tergite XI without tactile setae. Cheliceral hand with five setae – two acuminate and three dentate, cheliceral movable finger with one seta, rallum with three blades – first two blades denticulate anteriorly. Chelal palps slender, movable chelal finger with venom apparatus, standard number of trichobothria (eight on fixed and four on movable chelal finger), chelal fingers with paraxial and antiaxial teeth on dorsal and ventral side. Tarsus of leg IV without tactile or pseudotactile setae. Claws simple, without dentation. Body measurements as in Tab. 1.

Chaetotaxy of carapace: 57 setae, 29 of which on anterior disk, 17 on medial disk and 11 behind posterior transverse furrow. Chaetotaxy of tergites (right + left hemitergite): I: 5+4, II: 6+4, III: 5+5, IV: 6+6, V: 6+6, VI: 6+6, VII: 6+6, VIII: 8+7, IX: 6+7, X: 6+5, XI: 4+4. Chaetotaxy of sternites (right + left hemisternite): IV: 4+3, V: 10+9, VI: 8+9, VII: 9+10, VIII: 9+9, IX: 7+7, X: 8+7, XI: 3+3.

Anterior genital operculum with 19 acuminate setae. Serrula exterior with 20 blades. Palps: fixed chelal finger with 53 marginal teeth, 7 antiaxial accessory teeth and 3 paraxial accessory teeth; movable chelal finger with 61 marginal teeth, 6 antiaxial accessory teeth and 2 paraxial accessory teeth.

Remarks: Cheliceral galea, chaetotaxy of posterior genital operculum and lyrifissures of anterior and posterior genital operculum not visible.

Description of adults from Slovakia (Figs 3–4): with the same general characters as the holotype. Body measurements as in Tab. 1.

Females (3 specimens; Tab. 1; Fig. 3a)

Chaetotaxy of carapace: 66–75 setae, 32–40 of which on anterior disk, 17–22 on medial disk and 12–16 behind posterior transverse furrow. Chaetotaxy of tergites (right + left hemitergite): I: 4–5 + 4–5, II: 5 + 5–6, III: 5–6 + 5, IV: 6–8 + 6–7, V: 7 + 7–8, VI: 7–8 + 7, VII: 7–9 + 7–10, VIII: 7–8 + 7–8, IX: 6–7 + 6–7, X: 6–7 + 6–7, XI: 4–5 + 4–5. Chaetotaxy of sternites (right + left hemisternite): IV: 3–4 + 3–5, V: 9–12 + 10–11, VI: 10–23 + 11–12, VII: 11–12 + 9–10, VIII: 10–12 + 9–11, IX: 8–9 + 8–9, X: 7–9 + 7–8, XI: 4–5 + 4–5.

Anterior genital operculum with 18–20 acuminate setae and 2 lyrifissures, posterior with 10–14 acuminate setae and 13–15 lyrifissures (Fig. 4a). Cheliceral galea with 6 terminal rami (Fig. 4b); serrula exterior with 18–19 blades. Palps: fixed chelal finger with 59–62 marginal teeth, 6–7 antiaxial accessory teeth and 2–3 paraxial accessory teeth; movable chelal finger with 62–64 marginal teeth, 6 antiaxial accessory teeth and 1–2 paraxial accessory teeth.

Males (3 specimens; Tab. 1; Fig. 3b)

Chaetotaxy of carapace: 72–80 setae, 37–43 of which on anterior disk, 19–22 on medial disk and 15–16 behind posterior transverse furrow. Chaetotaxy of tergites (right + left hemitergite): I: 4–5 + 4–5, II: 5–6 + 5–6, III: 5–7 + 5–6, IV: 7–8 + 7, V: 7–8 + 7–8, VI: 7 + 7–8, VII: 7–8 + 7–8, VIII: 6–8 + 7–8, IX: 6–7 + 7–8, X: 6–7 + 6–7, XI: 5–6 + 5–7. Chaetotaxy of sternites (right + left hemisternite): IV: 3–4 + 4–5, V: 11–12 + 11–12, VI: 10–12 + 10–11, VII: 11 + 10–12, VIII: 9–10 + 9–10, IX: 9 + 8–9, X: 7–9 + 7–8, XI: 5 + 5–6.

Anterior genital operculum with 25–27 acuminate setae, posterior with 12–13 acuminate setae. Cheliceral galea with 4 terminal rami; serrula exterior with 18 blades. Palps: fixed chelal finger with 59–64 marginal teeth, 6 antiaxial accessory teeth and 2 paraxial accessory teeth; movable chelal finger with 62–65 marginal teeth, 6 antiaxial accessory teeth and 1 paraxial accessory tooth (Fig. 4c).

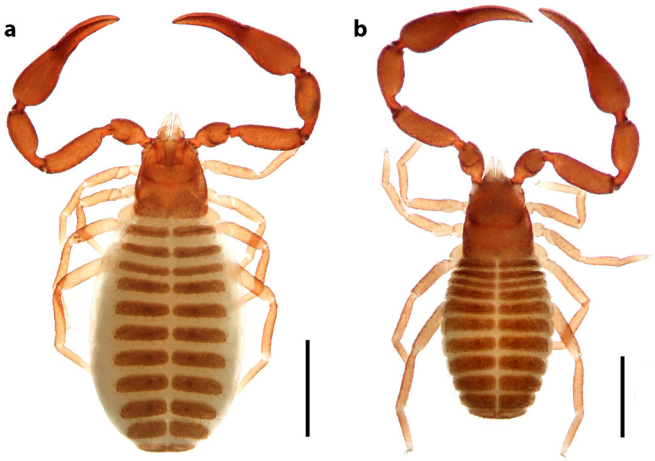

Fig. 3: *Allochernes solarii*, newly discovered specimens from Slovakia. **a.** Female; **b.** Male. Scale lines: 1 mm

Tab. 1: Morphometric data of *Allochernes solarii* for the type specimen from Italy and newly found specimens from Slovakia (in mm). Abbreviations: M – median, Max – maximum, Min – minimum, n – number of measured specimens, x – average

Characteristics	Type, Italy	Newly discovered specimens, Slovakia					
	♀ (n = 1)	♂♂ (n = 3)		♀♀ (n = 3)		Tritonymphs (n = 2)	
		Min–Max	M/x	Min–Max	M/x	Min–Max	M/x
Body, length	2.59	2.68–2.92	2.90/2.83	3.17–3.31	3.22/3.23	2.18–2.47	2.33/2.33
Carapace, length	0.85	0.80–0.82	0.81/0.81	0.82–0.84	0.84/0.83	0.64–0.66	0.65/0.65
Carapace, posterior width	0.82	0.77–0.83	0.81/0.80	0.79–0.80	0.80/0.80	0.60–0.67	0.64/0.64
Carapace, length/posterior width ratio	1.04	0.98–1.04	1.01/1.01	1.03–1.06	1.05/1.05	0.99–1.07	1.03/1.03
Chelicera, length	0.28	0.30–0.33	0.31/0.31	0.28–0.34	0.28/0.30	0.22–0.25	0.24/0.24
Chelicera, width	0.14	0.15–0.15	0.15/0.15	0.14–0.14	0.14/0.14	0.11–0.11	0.11/0.11
Chelicera, length/width ratio	2.00	2.00–2.20	2.07/2.09	2.00–2.43	2.00/2.14	2.00–2.27	2.14/2.14
Cheliceral movable finger, length	0.21	0.23–0.24	0.24/0.24	0.21–0.24	0.24/0.23	0.18–0.19	0.19/0.19
Palpal trochanter, length	0.47	0.42–0.47	0.44/0.44	0.40–0.40	0.40/0.40	0.32–0.35	0.34/0.34
Palpal trochanter, width	0.26	0.23–0.26	0.25/0.25	0.21–0.23	0.23/0.22	0.19–0.19	0.19/0.19
Palpal trochanter, length/width ratio	1.81	1.62–2.04	1.76/1.81	1.74–1.90	1.74/1.79	1.68–1.84	1.76/1.76
Palpal femur, length	0.82	0.78–0.83	0.82/0.81	0.71–0.75	0.71/0.72	0.47–0.50	0.49/0.49
Palpal femur, width	0.24	0.24–0.26	0.26/0.25	0.20–0.23	0.21/0.21	0.20–0.20	0.20/0.20
Palpal femur, length/width ratio	3.42	3.15–3.25	3.19/3.20	3.26–3.55	3.38/3.40	2.35–2.50	2.43/2.43
Palpal patella, length	0.74	0.69–0.76	0.76/0.74	0.63–0.70	0.66/0.66	0.46–0.48	0.47/0.47
Palpal patella, width	0.26	0.28–0.29	0.29/0.29	0.24–0.25	0.25/0.25	0.21–0.21	0.21/0.21
Palpal patella, length/width ratio	2.85	2.46–2.62	2.62/2.57	2.52–2.80	2.75/2.69	2.19–2.29	2.24/2.24
Palpal hand, length with pedicel	0.75	0.72–0.78	0.77/0.76	0.64–0.69	0.67/0.67	0.54–0.56	0.55/0.55
Palpal hand, length without pedicel	0.65	0.64–0.71	0.68/0.68	0.56–0.59	0.59/0.58	0.46–0.50	0.48/0.48
Palpal hand, width	0.35	0.36–0.37	0.36/0.36	0.32–0.36	0.32/0.33	0.27–0.27	0.27/0.27
Palpal hand, length/width ratio	2.14	2.00–2.17	2.08/2.08	1.92–2.09	2.00/2.00	2.00–2.07	2.04/2.04
Palpal finger, length	0.83	0.77–0.84	0.77/0.79	0.69–0.73	0.71/0.71	0.52–0.52	0.52/0.52
Palpal finger, length/palpal hand length	1.11	0.92–1.01	0.94/0.95	0.93–0.95	0.94/0.94	1.04–1.08	1.06/1.06
Palpal chela, length	1.51	1.40–1.52	1.51/1.48	1.27–1.43	1.34/1.35	0.97–1.00	0.99/0.99
Palpal chela, width	0.35	0.36–0.37	0.36/0.36	0.32–0.36	0.32/0.33	0.27–0.27	0.27/0.27
Palpal chela, length/width ratio	4.31	3.89–4.22	4.08/4.06	3.97–4.19	3.97/4.04	3.59–3.70	3.65/3.65
Leg I trochanter, length	0.19	0.19–0.19	0.19/0.19	0.19–0.21	0.20/0.20	0.14–0.14	0.14/0.14
Leg I trochanter, depth	0.14	0.13–0.13	0.13/0.13	0.13–0.14	0.14/0.14	0.11–0.11	0.11/0.11
Leg I trochanter, length/depth ratio	1.36	1.46–1.46	1.46/1.46	1.43–1.50	1.46/1.46	1.27–1.27	1.27/1.27
Leg I femur, length	0.23	0.20–0.21	0.21/0.21	0.19–0.25	0.20/0.21	0.15–0.16	0.16/0.16
Leg I femur, depth	0.14	0.14–0.14	0.14/0.14	0.14–0.16	0.14/0.15	0.11–0.11	0.11/0.11
Leg I femur, length/depth ratio	1.64	1.43–1.50	1.50/1.48	1.36–1.56	1.43/1.45	1.36–1.45	1.41/1.41
Leg I patella, length	0.49	0.42–0.47	0.43/0.44	0.43–0.49	0.45/0.46	0.27–0.27	0.27/0.27
Leg I patella, depth	0.13	0.12–0.12	0.12/0.12	0.11–0.13	0.11/0.12	0.10–0.10	0.10/0.10
Leg I patella, length/depth ratio	3.77	3.50–3.92	3.58/3.67	3.77–4.09	3.91/3.92	2.70–2.70	2.70/2.70
Leg I tibia, length	0.45	0.44–0.46	0.46/0.45	0.44–0.48	0.45/0.46	0.26–0.28	0.27/0.27
Leg I tibia, depth	0.10	0.09–0.09	0.09/0.09	0.09–0.10	0.09/0.09	0.08–0.08	0.08/0.08
Leg I tibia, length/depth ratio	4.50	4.89–5.11	5.11/5.04	4.80–5.00	4.89/4.90	3.25–3.50	3.38/3.38
Leg I tarsus, length	0.46	0.46–0.48	0.46/0.47	0.46–0.48	0.47/0.47	0.30–0.33	0.32/0.32
Leg I tarsus, depth	0.08	0.07–0.07	0.07/0.07	0.07–0.08	0.08/0.08	0.07–0.07	0.07/0.07
Leg I tarsus, length/depth ratio	5.75	6.57–6.86	6.57/6.67	5.75–6.71	6.00/6.15	4.29–4.71	4.50/4.50
Leg IV trochanter, length	0.34	0.28–0.32	0.29/0.30	0.30–0.34	0.30/0.31	0.20–0.23	0.22/0.22
Leg IV trochanter, depth	0.16	0.16–0.16	0.16/0.16	0.14–0.16	0.15/0.15	0.14–0.14	0.14/0.14
Leg IV trochanter, length/depth ratio	2.13	1.75–2.00	1.81/1.85	2.00–2.14	2.13/2.09	1.43–1.64	1.54/1.54
Leg IV femoropatella, length	0.80	0.78–0.78	0.78/0.78	0.63–0.80	0.79/0.74	0.46–0.50	0.48/0.48
Leg IV femoropatella, depth	0.14	0.15–0.15	0.15/0.15	0.12–0.14	0.14/0.13	0.10–0.10	0.10/0.10
Leg IV femoropatella, length/depth ratio	5.71	5.20–5.20	5.20/5.20	5.25–5.71	5.64/5.54	4.60–5.00	4.80/4.80
Leg IV tibia, length	0.68	0.63–0.69	0.69/0.67	0.54–0.65	0.63/0.61	0.38–0.41	0.40/0.40
Leg IV tibia, depth	0.10	0.10–0.10	0.10/0.10	0.10–0.11	0.10/0.10	0.09–0.09	0.09/0.09
Leg IV tibia, length/depth ratio	6.80	6.30–6.90	6.90/6.70	5.40–6.30	5.91/5.87	4.22–4.56	4.39/4.39
Leg IV tarsus, length	0.53	0.52–0.59	0.59/0.57	0.43–0.55	0.51/0.50	0.32–0.35	0.34/0.34
Leg IV tarsus, depth	0.08	0.09–0.09	0.09/0.09	0.08–0.08	0.08/0.08	0.08–0.08	0.08/0.08
Leg IV tarsus, length/depth ratio	6.63	5.78–6.56	6.56/6.30	5.38–6.88	6.38/6.21	4.00–4.38	4.19/4.19

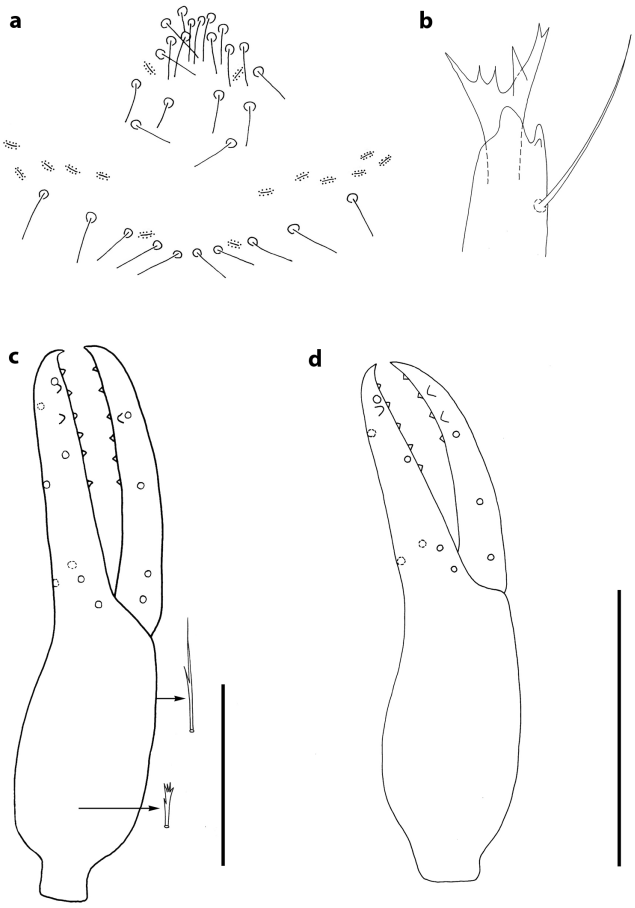

Fig. 4: *Allochernes solarii*, details of newly discovered specimens from Slovakia. **a.** Chaetotaxy of genital operculum, female; **b.** Galea, female; **c.** Palpal chela with trichobothrial pattern, accessory teeth and setae details, male; **d.** Palpal chela with trichobothrial pattern and accessory teeth, tritonymph. Scale lines: 0.5 mm

Description of tritonymphs

Tritonymphs share the following characters with adults: morphology of setae on body and palps, granulation of carapace, absence of a pair of tactile setae on tergite XI, cheliceral hand with five setae, movable cheliceral finger with one seta, cheliceral rallum of three blades, presence of venom apparatus in movable chelal finger, tarsus of leg IV without tactile or pseudotactile setae. Body measurements are given in Tab. 1.

Tritonymphs (2 specimens; Tab. 1)
Chaetotaxy of carapace: 59–60 setae, 31 of which on anterior disk, 18 on medial disk and 10–11 behind posterior transverse furrow. Chaetotaxy of tergites (right + left hemitergite): I: 4–5 + 4, II: 4–5 + 4, III: 5 + 5, IV: 5–6 + 6–7, V: 6–7 + 6–7, VI: 6–7 + 7–8, VII: 6 + 6, VIII: 6–7 + 6–7, IX: 6 + 6–7, X: 6–7 + 6, XI: 4–5 + 4–5. Chaetotaxy of sternites (right + left hemisternite): IV: 2–3 + 4, V: 8 + 9, VI: 8–10 + 10–11, VII: 9 + 7–9, VIII: 8–9 + 7–9, IX: 6–8 + 8, X: 6 + 7, XI: 4 + 4–5. Cheliceral galea with 6 terminal rami; serrula exterior with 15–18 blades. Palps: six trichobothria on fixed and three on movable chelal finger; fixed chelal finger with 46–49 marginal teeth, 5 antiaxial accessory teeth and 1–2 paraxial accessory teeth; movable chelal finger with 47–49 marginal teeth, 4 antiaxial accessory teeth and 1–2 paraxial accessory teeth (Fig. 4d).

Identification key to the *Allochernes* species from Slovakia

1 Tergite XI with a pair of relative long tactile setae . . . . . *Allochernes peregrinus*
– Tergite XI without long tactile setae 2
2 Pedal tarsus IV with subdistal pseudotactile seta . . . . . *Allochernes powelli*
– Pedal tarsus IV without subdistal pseudotactile seta 3
3 Chelal finger shorter than hand with pedicel, palpal chela 1.06–1.23 mm long. . . . . *Allochernes wideri*
– Chelal finger of same length as or longer than hand with pedicel, palpal chela 1.27–1.52 mm long . . . . . *Allochernes solarii*

Discussion

The first proper redescription of *A. solarii* was carried out by Beier (1932, repeated in 1963) based on the holotype specimen from Piedmont, Italy. With respect to the previous descriptions (Simon 1898, Beier 1932, 1963), the following characters are added in the present paper based on the holotype and newly found specimens from Slovakia: chaetotaxy of the carapace, tergites, sternites and genital area, description of galea and complete body measurements.

A few differences are notable between our measurement values of the holotype and that published in Beier (1932, 1963). Beier (1932, 1963) recorded values: "length of palpal hand with pedicel – 0.83 mm" and "length of chelal finger – 0.77 mm". Our measurements showed values of palpal hand with pedicel – 0.75 mm and of chelal finger – 0.83 mm. According to our observations, the measurement values of palpal length hand with pedicel and chelal finger length in Beier (1932, 1963) seem to have been inverted by mistake. The type specimen was to certain extant damaged and lightened; only one chelicera with no evident galea was present.

Specimens of *A. solarii* from Slovakia were compared with the female holotype from Italy reported in Beier (1932, 1963). The main taxonomic characters of the Slovakian specimens correspond with those observed on the holotype, although a few differences were observed. The number of setae on the carapace in the Slovakian specimens was significantly higher than that of the holotype. Only one specimen from Slovakia shows seven antiaxial teeth and the two studied specimens show three paraxial teeth on the fixed chelal fingers as were present on the holotype. Compared to the holotype, the body length of females found in Slovakia was higher. According to our current knowledge it seems that *A. solarii* is a rare species whose ecology is unknown. Gardini (2004) assumed that it could be myrmecophilous, which corresponds to the new findings in nests of *Formica gagates* in Slovakia.

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Erstnachweis von Milde's Dornfinger, *Cheiracanthium mildei* (Araneae: Eutichuridae), in Thüringen sowie Beschreibung eines Bissereignisses

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Abstract. First record of the yellow sac spider *Cheiracanthium mildei* (Araneae: Eutichuridae) for Thuringia and report of a bite event. Until now *Cheiracanthium mildei* L. Koch, 1864 was recorded only from two sites in the eastern part of Germany. Bites of this species are of medical significance, but our knowledge of their effects on humans is often poor. The present paper describes the bite symptoms.

Keywords: area expansion, dispersal, envenomation, invasive species, spider hysteria, venomous spiders, yellow sac spiders

Zusammenfassung. Bisher waren von *Cheiracanthium mildei* L. Koch, 1864, im östlichen Teil Deutschlands nur Vorkommen aus zwei Städten bekannt. Der vorliegende Fund bedeutet den Erstnachweis für Thüringen. Gleichzeitig wird ein damit zusammenhängendes Bissereignis beschrieben. Obwohl in den letzten Jahren eine Reihe seriöser Publikationen zu *Cheiracanthium*-Bissen erschienen, besteht längst keine abschließende Klarheit über deren Wirkung beim Menschen.

Cheiracanthium mildei L. Koch, 1864, wozu das hier beschriebene adulte Weibchen zählt, ist eine Art, die für Deutschland im Gegensatz zu *Cheiracanthium punctorium* (Villers, 1789) noch nicht allzu lange bekannt ist (Knoflach & Horak 2010, Schmitt & Malten 2007). Früher mediterran verbreitet, hat *Cheiracanthium mildei* mittlerweile das europäische Areal deutlich nach Norden ausgeweitet und inzwischen selbst Amerika besiedelt. Muster et al. (2008) und Zimmermann (2015) gehen ausführlich auf diese Thematik ein. Für Thüringen ist es ein Erstnachweis dieser optisch eher unauffälligen Art. Dies vermutete schon Martin (in litt.), der die vom Bissopfer sichergestellte Spinne auch bestimmte. Der Fundort liegt in der bisher recht breiten Lücke zwischen den bereits etablierten Nachweisen von Südwestdeutschland und den jüngeren von Leipzig und Berlin. Außer für Weimar (TK 25 Nr. 5033) sind Nachweise in den neuen Bundesländern ansonsten nur aus den genannten Städten bekannt (Arachnologische Gesellschaft 2018). Die lange zu den Clubionidae und einige Zeit zu den Miturgidae zählende Gattung *Cheiracanthium* steht seit 2014 in der Familie Eutichuridae. Sie umfasst mittlerweile 212 akzeptierte Arten (World Spider Catalog 2018).

Begegnungen mit Spinnen sind zumindest in Mitteleuropa für Menschen meist harmlos, sie werden aber seit jeher trotzdem aufmerksam, meist mit Abscheu, registriert. Kommt es gar zu Bissen, zuweilen nur zu vermuteten, so ist öffentliches Interesse die Regel, das Ereignis wird in den Medien verbreitet. Um das Jahr 2006 erfasste eine Aufregung zu Dornfingerbissen bei Menschen, Synonym Cheiracanthismus, fast ganz Mitteleuropa. Sie ist noch heute in Erinnerung, zumal Bisse von *Cheiracanthium*-Arten durchaus medizinisch bedeutsam sind. Mittlerweile sind Meldungen in den Tagesmedien seltener (Thieme 2016) und zur Thematik auch eine ganze Reihe seriöser Veröffentlichungen erschienen (Foradori et al. 2005, Knoflach 2009, Knoflach & Horak 2010, Muster et al. 2008, Nentwig et al. 2013, Schmitt & Malten 2007, Vetter et al. 2006, Zimmermann 2015). Trotzdem ist hinsichtlich der Symptomatik noch vieles unklar. Nentwig et al. (2013) merken an, dass in der Mehrzahl der Bissfälle weder Patient noch Arzt in der Lage sind, eine Spinne zu unterscheiden, weder von anderen Arthropoden noch gar Arten untereinander. Die offenbar ohnehin seltenen Spinnenbisse erweisen sich beim Hinzuziehen von Experten häufig als zweifelhaft. Die Autoren nennen drei Kriterien, welche derzeit für einen „verified spider bite" international anerkannt sind:

1. Der Spinnenbiss muss beobachtet worden sein.
2. Die Spinne muss während oder unmittelbar nach dem Biss gefangen und zur Bestimmung einem Spezialisten übergeben werden.
3. Der Biss muss Symptome, die gewöhnlich Spinnenbissen zugeschrieben werden, wie Schmerz oder Unwohlsein, hervorrufen.

Die Zahl derart dokumentierter Fälle ist auch in unserer Region überschaubar. Deshalb soll hier ein Fall beschrieben werden, bei dem die genannten Kriterien erfüllt sind.

Bisshergang

Der Biss ereignete sich am 11. Juni 2013, 23.45 Uhr, unweit des Stadtzentrums von Weimar/Thüringen (50°59'N, 11°25'E) in einem Hausgarten. Gebissen wurde eine männliche Person mittleren Alters. Nach Beschreibung des Bissopfers stellte sich der Hergang wie folgt dar:

"Die Spinne saß wahrscheinlich in den herabhängenden Ästen eines ca. 4–5 m hohen *Forsythia*-Strauches (*Forsythia* spec.), der neben dem Garteneingang steht. Beim Öffnen der Zauntür streifte ich kurz mit dem Kopf einen herabhängenden Zweig. Sofort danach verspürte ich mindestens 5–7 Bisse im Kragen- und Nackenbereich, schwerpunktmäßig rechts. Aus dem ersten, unten im Kragen bzw. direkt über dem T-Shirt-Kragenrand (unter der Kapuzen-Trainingsjacke), entwickelte sich die größte Bissstelle. Allerdings kann ich nur vermuten, dass die Spinne in dem *Forsythia*-Zweig saß, von dem sie wohl dann in meinen Kragen bzw. in die Kapuze meiner Trainingsjacke gefallen sein muss. Die Jacke hing zuvor, während eines Trainings, im Umkleideraum einer Sporthalle. Die Heimfahrt mit dem Fahrrad von dort erfolgte unmittelbar danach. Außer dem betreffenden *Forsythia*-Strauch gibt es im Garten um eine kleine Rasenfläche noch zwei große Holunderbäume und eine westseitige flächige Nachbarwandbegrünung mit Efeu (*Hedera helix*) und Wildem Wein (*Par-*

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thenocissus spec.). Besonders warm ist es im oberen besonnten Bereich. Zwischenzeitlich ist mir jedoch in diesem Garten keine Dornfinger-Spinne mehr aufgefallen." Ein verwertbares Foto gibt es leider nicht.

Bissfolgen

Als Bissfolgen werden nachstehende Symptome/Auswirkungen beschrieben:

"1. Sehr starkes Brennen, vergleichbar mit einem Wespenstich bzw. intensivem Brennnesselkontakt, verbunden mit Gänsehaut und Schüttelfrost (ohne Frieren).
2. Das Brennen ließ nach ca. einer viertel bis halben Stunde langsam nach, es stellte sich zunehmendes Taubheitsgefühl auf der Zungenoberseite ein. Ebenso erschien leichtes Kribbeln in Armen und Händen, später in geringerem Umfang auch in den Füßen.
3. Danach immer wieder Gänsehaut- und Schüttelfrost-Attacken in periodischen Abständen; auch ganz unterschwellig leichtes Druckgefühl auf der linken Brusthälfte, das am Folgetag nachließ.
4. Nach ca. 1 Stunde zunehmende (bzw. dann erst bewusst wahrgenommene) Erwärmung der Hände und ganz leichtes Armkribbeln (punktuell auch an Füßen bzw. anderen Stellen).
5. Ca. eineinhalb bis zwei Stunden nach den Bissen Verabreichung einer Tetanus-Schutzimpfung in den rechten Oberarm.
6. Lokale Biss-Schmerzen ließen dann immer mehr nach, so dass nach ca. 4–5 Stunden auch phasenweises Schlafen möglich war.
7. Gänsehaut- und Schüttelfrostattacken traten gelegentlich noch über den ganzen zweiten, am dritten Tag dann in abgeschwächter Form auf.
8. Allerdings traten neben weißfleckiger Nackenrötung in der Biss-Zone auch punktuell ganz leichte fleckige Rötungen (allergische Reaktionen?) an den Händen auf, insbesondere an den Handtelleraußenrändern. Nach wie vor Kribbeln und Taubheitswahrnehmungen an der Zungenoberseite. Gelegentliches, bisweilen etwas zunehmendes Gelenkschmerzempfinden (beidseitig an Schultern, Ellenbogen und Knien, rechtsseitig an Hüfte und Fuß, linker Fußballen bis in den großen Zeh). Leichtes Ziehen in rechter, bissseitiger, Nackenhälfte.
9. Am auffälligsten erschien, dass nach zwei Tagen Zungenkribbeln und leichte Ellenbogengelenkschmerzen immer noch deutlich zu spüren waren."

Verschiedene Symptome klangen erst nach drei Tagen ab. Die Schwellung an der ersten Biss-Stelle und die weißfleckigen Rötungen im rechten Nacken waren auch nach einem Monat noch sichtbar. Außer der Tetanusspritze erfolgten keine weiteren Therapien.

Diskussion

Arealerweiterungen von Tieren, auch von Spinnen, in kühlere Regionen (bei uns nach Norden bzw. in höhere geografische Lagen) werden oft der aktuellen Klimaerwärmung zugeschrieben. Für thermophile und bisher südlich verbreitete Spezies ist diese Ursache zu vermuten, insbesondere, wenn die Ausbreitung entlang wärmebegünstigter Korridore erfolgt (Zimmermann 2015). Auch spricht dafür, dass solche Arten sich zuerst in wärmebegünstigten Habitaten – z. B. in Großstädten und Gebäuden – ansiedeln. Inwieweit wirklich ein kausaler Zusammenhang besteht oder andere Faktoren (Verschleppung, Habitatveränderungen, mangelnde Kenntnis der genauen Verbreitung u. a.) überwiegen, lässt sich nicht immer leicht entscheiden (Lemke 2018, Muster et al. 2008, Schmitt & Malten 2007, Zimmermann 2015). Auch *C. mildei* wurde bisher hauptsächlich in oder nahe von Wohngebäuden gemeldet. Wie nicht nur der vorliegende Fall beweist, ist natürlich hier auch die Begegnung mit Menschen häufiger und intensiver (Knoflach 2009, Muster et al. 2008, Zimmermann 2015). Die Art wird für Mitteleuropa vorwiegend als (hemi) synanthrop beschrieben (Knoflach & Horak 2010, Muster et al. 2008, Schmitt & Malten 2007, Zimmermann 2015). Wo das hier besprochenen Individuum sich vor dem Beißen aufhielt, Gebäudeinneres oder Baum, muss leider ungeklärt bleiben.

Cheiracanthium mildei wird, wie auch *C. punctorium,* allgemein als aggressiv beschrieben, die Tiere beißen zuweilen auch scheinbar ohne Anlass (Muster et al. 2008, Schmitt & Malten 2007, Zimmermann 2015). Bei dem von Schmitt & Malten (2007) geschilderten Biss einer Frau im Landkreis Heilbronn/Neckar durch *C. mildei* hatte sich die Spinne für 15 Sekunden in den großen Zeh verbissen.

Muster et al. (2008) verweisen auf umfängliche Publikationen zur Giftwirkung, die von *C. mildei* ausgeht, schwerpunktmäßig jedoch Nordamerika betreffen. Nentwig et al. (2013) realisierten eine zweijährige Studie über Spinnenbisse, da bis dahin keine zusammenfassende Übersicht für Europa existierte. Es verwunderte, dass, obwohl viele der 4500 Spinnenarten durch die menschliche Haut beißen können, Spinnenbisse allgemein als harmlos für Menschen gelten. Die Fachliteratur beschränkte sich häufig auf das Zitieren historischer Quellen, konkrete artbezogene und modernen Standards genügende Einschätzungen fehlten. Einbezogen wurden in diese Studie 14 Bissfälle, die von Schweizer Notärzten dokumentiert und bei denen Arachnologen das zugehörige Tier determiniert hatten. Als Verursacher gab es fünf Arten, davon vier Fälle mit *Cheiracanthium punctorium, C. mildei* war nicht vertreten. Alle Bisse, vorwiegend von synanthrop lebenden Arten, verursachten nur relativ milde Symptome, bestehend in meist lokalem (mäßigen bis starken) Schmerz, Rötung und Schwellung. Selten traten systemische Wirkungen auf. Beschwerden verschwanden spätestens nach einigen Stunden, immer kam es zu vollständiger Genesung ohne Folgeschäden. Für die Schweiz lässt sich grob eine jährliche Rate von 10–100 Bissen pro eine Million Einwohner abschätzen, eine gewisse Dunkelziffer wird vermutet. Die Autoren prognostizieren eine Erhöhung dieser Rate durch Einwanderung fremder Arten.

Wesentlich erschwert wird die Beurteilung der Sachlage weiterhin durch folgende Fakten: Spinnen geben nicht mit jedem Biss Gift ab. Die jeweilige Menge wird von dem Tier der Situation angepasst, außerdem variiert der Gehalt einzelner toxischer Komponenten. Auch sind Tierversuche aufgrund unterschiedlicher Empfindlichkeiten gegenüber den Giften kaum auf den Menschen übertragbar. Schließlich spielen die Bissstelle sowie Geschlecht, Alter und Verfassung der jeweiligen Person eine Rolle. Diagnosen sind deshalb selbst mit vorliegender verursachender Spinne prinzipiell schwierig, ebenso die Prognose des weiteren Beschwerdeverlaufs (Knoflach & Horak 2010).

Auch Vetter et al. (2006) führen den häufigen und selten zu bestätigenden Verweis in der Literatur auf Nekrosen nach Spinnenbissen auf die unzulässige Verallgemeinerung von Tierversuchen zurück. Sie erwähnen ebenfalls die relativ harmlosen Symptome nach Bissen der Gattung *Cheiracanthium* (*C. mildei* inbegriffen), sowohl in den USA als auch in Australien.

Letztere zusammenfassende Feststellung treffen schließlich ebenso Foradori et al. (2005) in ihrer Studie zur Nekroserelevanz von Spinnengiften. Für ihre Tests nutzten sie die hämolytische (Schaf-Erythrozyten) sowie die nekrotische Wirkung auf Haut von Kaninchen, Meerschweinchen und Hamstern. Untersucht wurden 45 Spinnenarten (einschließlich *C. mildei*) mit sehr differenzierten Ergebnissen.

Die aus Weimar dargelegten Bissumstände, Gebäude bzw. Nähe dazu und Nachtaktivität, passen gut zu bisherigen Schilderungen aus der Literatur. Ebenso fügen sich die Bissfolgen in die Bandbreite der bisher beschriebenen Fälle ein. Starker brennender Schmerz und Rötung der Bissstelle sind die Regel, als Vergleich dient oft ein Bienenstich. Häufig treten auch Schwellungen und Gefühllosigkeit auf. Die Zeitdauer der Beschwerden umfasst je nach Einzelfall und subjektivem Empfinden wenige Minuten bis Stunden, im Einzelfall einige Wochen (Knoflach 2009, Muster et al. 2008, Zimmermann 2015). Im Weimarer Fall kamen noch Gänsehaut, Schüttelfrost und Gelenkschmerzen hinzu. Das mehrfache Beißen hier rührt vermutlich auch daher, dass die Spinne wegen anliegender Kleidung weder flüchten noch sofort abgeschüttelt bzw. -gestreift werden konnte. Mit der damit zumindest denkbaren größeren Giftmenge ließen sich auch die Intensität der Symptome und längere Beschwerdedauer erklären.

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A case of dimorphic males in *Troxochrus scabriculus* (Araneae: Linyphiidae), with notes on synonymy

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Abstract. *Troxochrus cirrifrons* (O. Pickard-Cambridge, 1871) is a **junior synonym** of *Troxochrus scabriculus* (Westring, 1851). Moreover, *Troxochrus scabriculus* is a species with dimorphic males, the nominate form is referred to as *T. scabriculus* forma *scabriculus*, and the second morph as *T. scabriculus* forma *cirrifrons*. No significant differences are present in the male palps or any sexual characters of these two forms. Likewise, the accompanying females of different populations exhibit no significant differences in general appearance or genitalia. We provide data on the taxonomic history, national checklists, habitat and distribution, as well as phenology to support the synonymy and to verify male dimorphism in *Troxochrus scabriculus*.

Keywords: Austria, dimorphism, linyphiid spider, Vienna

Zusammenfassung. Ein Fall von dimorphen Männchen bei *Troxochrus scabriculus* (Araneae: Linyphiidae), mit Anmerkungen zur Synonymie. *Troxochrus cirrifrons* (O. Pickard-Cambridge, 1871) ist ein **jüngeres Synonym** von *Troxochrus scabriculus* (Westring, 1851). Zudem handelt es sich bei *T. scabriculus* um eine Species, bei der es zwei männliche Morphen gibt, die Nominatform *T. scabriculus* forma *scabriculus*, und die zweite Form *Troxochrus scabriculus* forma *cirrifrons*. Es gibt keine erkennbaren Unterschiede in den männlichen Palpen zwischen diesen beiden Formen, und auch die Weibchen aus denselben bzw. aus verschiedenen Population weisen keine erkennbaren Unterschiede im allgemeinen Erscheinungsbild oder in den Genitalien auf. Die Synonymie und der Dimorphismus der Männchen von *Troxochrus scabriculus* wird durch Daten zur taxonomischen Erfassungsgeschichte und in nationalen Checklisten, zum Habitat und zur Verbreitung sowie zur Phänologie untermauert.

Taxonomical history

Westring (1851) first described *Troxochrus scabriculus* (sub *Erigone scabricula*) based on male and female specimens from Sweden. A decade later, Pickard-Cambridge (1860) described *Troxochrus scabriculus* sub *Walckenaera aggeris* from southern England and provided the following information with regard to the record date and locality (on page 174): "Adult males and females of this species were discovered by myself in abundance, during the summer of 1859, at the roots of grass and underneath rubbish on dry bank-sides, near Church Town, Southport, Lancashire". Later, Pickard-Cambridge (1871) described a further new species, sub *Walckenaera cirrifrons*, based on a single male specimen, which clearly came from the same material in which he originally found *T. scabriculus* a decade earlier: "An adult male of this spider was captured, in company with *W. aggeris* (Camb.), at Southport, Lancashire, at the roots of grass &c., in June 1859." It is important to note that (i) *T. scabriculus* and *T. cirrifrons* came from the same material sampled at the roots of grass in the summer of 1859 near Church Town, Southport, Lancashire; and that (ii) the specimens of *T. scabriculus* were present in abundant numbers, while only one male specimen of *T. cirrifrons* was identified in the same samples.

Simon (1884: 645) established the genus *Troxochrus* and was the first to suspect *Troxochrus scabriculus* of being dimorphic in the males, consisting of the typical form *scabriculus* and the second form *cirrifrons*. Simon stated that: "La forme *cirrifrons* se trouve toujours mêlée au type, mais elle est partout plus rare" [The form *cirrifrons* is always mixed with the type, but it is everywhere rarer].

More than a quarter of a century later, Pickard-Cambridge (1911) reopened the case of *T. scabriculus/cirrifrons* and attempted to negate the statement of Simon (1884) that *T. cirrifrons* is a dimorphic male form of *T. scabriculus*. Although Pickard-Cambridge (1911) acknowledged that "the two species remarkably differ in the male sex", he disagreed with the conclusion of Simon (1884), because "Simon relies chiefly, for the identity of *scabriculus* and *cirrifrons*, on the two forms being always found together (i.e., at the same time and place); but this I have by no means myself proved to be the fact".

In the same work, Pickard-Cambridge (1911) described the female of *T. cirrifrons* which he believed to be different from the *T. scabriculus* female by drawing reference to illustrations of the epigynes (*T. scabriculus*, Plate A, Fig. 18 and *T. cirrifrons* Plate A, Fig. 19). Curiously, Pickard-Cambridge (1911) in his description to Plate A, placed a question mark in the figure captions before both species names, perhaps indicating uncertainty about any differences between the females. Nevertheless, Pickard-Cambridge (1911) managed to conclude that "on the whole *T. cirrifrons* still seems to me to be a distinct species from *T. scabriculus*".

Oddly, Simon (1926), in a work which was completed by Lucien Berland and Jean-Louis Fage two years after Simon's death in 1924, recanted the original opinion of Simon (1884). Thus, in the identification key for the genus *Troxochrus*, *T. scabriculus* and *T. cirrifrons* were treated as different species (Simon 1926: 369). Nevertheless in our opinion, the drawings of the epigynes in Simon (1926) (*T. scabriculus*, Fig. 652, *T. cirrifrons*, Fig. 655) are as inconclusive as those in Pickard-Cambridge (1911).

Although *T. scabriculus* and *T. cirrifrons* were henceforth recognized as different species in World Spider Catalogs (see Roewer 1942, Platnick 1989), many arachnologists continued to infer that *T. cirrifrons* is perhaps a subspecies of the typical form *T. scabriculus* (e.g. Bristowe 1939: 75), or that it is a variety (e.g. Wiehle 1960: 466, Locket & Millidge 1953: 264), or indeed a dimorphic form (Thaler 1986: 496) or at least a sibling species (Aakra et al. 2016). With regard to the females, Wiehle (1960: 466) stated that female specimens which were found with the two male forms cannot be distinguished from each other, not even with detailed vulva preparation. Consequently, in one of his following works, Wiehle (1961: 183) di-

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stinguished between the nominate form *Troxochrus scabriculus* and the form *T. scabriculus cirrifrons*.

Almost three decades later, Roberts (1987) briefly summarized the debate surrounding *T. scabriculus/cirrifrons* and pointed out that the male *Troxochrus scabriculus* forma *cirrifrons* (page 74, Fig. 31b) differed from the typical form *Troxochrus scabriculus* (page 74, Fig. 31a) in the size and shape of the cephalic lobe and by the presence of long bristles lateral to each posterior median eye. According to Roberts (1987) there are, however, no significant differences in the male palps between these two forms, and accompanying females exhibit no significant differences in general appearance or genitalia. Concerning the females, there is only slight but insignificant variation in the epigynum of *T. scabriculus*. Roberts (1987) stated in his book on the spiders of Great Britain and Ireland that *T. cirrifrons* is a dimorphic male form of *T. scabriculus*, and he designated it as *T. scabriculus* f. *cirrifrons*. Nonetheless, he declined to synonymize the two species. Instead, he argued that this case would have to be ultimately resolved by breeding experiments.

Recently, Aakra et al. (2016) found two additional differentiating morphological features between the two forms, which they considered as two species with reference to the World Spider Catalog (2018). First, males of *T. scabriculus* possess an extra set of glandular openings on each side of the field of short hairs above the anterior median eyes (Aakra et al. 2016, Figs. 22A–D), while no such structures are visible in *T. cirrifrons*. Second, considerable differences were noted in the invaginations of the sulci, which are much larger in *T. cirrifrons* than in *T. scabriculus* (Aakra et al. 2016, Fig. 22E).

The case of *T. scabriculus/cirrifrons* is not the only taxonomic example within the family Linyphiidae of male morphs having different head forms within one species, without there being differences in genital morphology. Recently, Bosmans & Oger (2018) confirmed *Diplocephalus cristatus* as a dimorphic species, having two male morphs: *cristatus* and *foraminifer*. Other examples are *Diplocephalus conatus/jacksoni* and *Oedothorax gibbosus/tuberosus* (see Roberts 1987). Wunderlich (2008) added further examples of species from the family Linyphiidae, in which the male prosoma has two or more different shapes (i.e. lobes) and/or hairy areas, and he explicitly considered *T. cirrifrons* as a variation (or "form") of *T. scabriculus* ["*Troxochrus scabriculus* (=*cirrifrons*)"].

Thus, the phenomenon of dimorphic males in spiders must be considered as an established fact. As a result of these considerations and based on the examination of our own material, we now follow the original assessment of Simon (1884) and conclude that the *cirrifrons* male is a second male morph of *T. scabriculus*. Since there are no differences in the genital morphology between male specimens of *cirrifrons* and *scabriculus*, and since there are no differences in the females of different populations, we consider *Troxochrus cirrifrons* (O. Pickard-Cambridge, 1871) to be a junior synonym of *Troxochrus scabriculus* (Westring, 1851) and consequently, the male morph *cirrifrons* as a second form of the nominal *T. scabriculus*.

We are not the first to arrive at this conclusion. For example, Müller (1984) clearly regarded *T. scabriculus* and *cirrifrons* as not being distinct species since their male genital morphology is identical, and he also did not consider them as sub-species (as suggested by Heimer 1976) due to their sympatric occurrence.

In several checklists *T. scabriculus* and *T. cirrifrons* have been treated as synonyms. Yet in the checklist of spiders of Germany, Platen et al. (1991) listed *T. scabriculus* and *cirrifrons* as two distinct species. In the checklist four years later, Platen et al. (1995: 36) considered *T. cirrifrons* as a synonym of the typical *T. scabriculus*; and again, in Platen et al. (1999: 25) *T. cirrifrons* is defined as a synonym of *T. scabriculus*. Notwithstanding the fact that *T. cirrifrons* was recorded in Berlin (von Broen 1977), Platen & von Broen (2002) no longer listed *T. cirrifrons* in the checklist of the spiders of Berlin.

Likewise, in the checklists of the spiders of Russia, Mikhailov (1996: 99; 1997: 102; 2013: 96) consistently mentioned *T. cirrifrons* (O. Pickard-Cambridge, 1871) as a (junior) synonym of *T. scabriculus* (Westring, 1851). This is also true in the provisional atlas of the British spiders by Harvey et al. (2002). In the caption to the map of records of *Troxochrus scabriculus*, Harvey et al. (2002: 116) commented that any record submitted to the scheme as *T. cirrifrons* (O. Pickard-Cambridge, 1871) under BRC number 15301, is now considered to be a form of male *T. scabriculus*. Thus, we can summarize that *T. cirrifrons* (O. Pickard-Cambridge, 1871) has been repeatedly considered to be a form of male *T. scabriculus* in several national spider checklists.

However, there are spider checklists of other countries or regions where *T. scabriculus* and *T. cirrifrons* are still listed as separate species, e.g. in the departments "Nord" and "Pas-de-Calais" of northern France (Lecigne 2016: 56), in Flanders (Maelfait et al. 1998: 136), Belgium (Bosmans 2009: 52, Bosmans & van Keer 2017), the Netherlands (van Helsdingen 1999: 156, 2016: 111) and Bulgaria (Blagoev et al. 2002-2018); and of course, in the World Spider Catalog (2018) *T. cirrifrons* and *scabriculus* are still considered two separate species (see also Bosmans & Oger 2018: 52).

Material examined

The epigeic spider fauna of six overgrown gardening plots (study sites A–F) on the rooftop of the "Biozentrum Althanstraße" in Vienna, Austria, was examined from 8 April 2016 to 7 April 2017 by means of one pitfall trap per site (Milasowszky & Hepner 2017).

Troxochrus scabriculus/cirrifrons material: AUSTRIA: 100 ♂♂ (95 *scabriculus*, 5 *cirrifrons*), 34 ♀♀, Vienna, Alsergrund, Biocenter Althanstraße, UZA1, rooftop, overgrown gardening plots, ruderal sites, 176 m a.s.l., M. Hepner & N. Milasowszky leg. & det., M. Hepner collection.

After identifying the material of male *scabriculus* and *cirrifrons* available to us, we completed drawings of the prosomas in lateral and frontal views from both morphs (Figs 1a–d). Additionally, we provide drawings of the female genitalia, i.e. the epigynum and vulva (Figs 2a–b). For views of the identical-looking palps of *scabriculus* and *cirrifrons* males see Figs 3a-b.

Habitat and distribution

Platen et al. (1991) listed *T. scabriculus* and *T. cirrifrons* as two distinct species, however, the information provided for both with regard to habitat was identical, i.e., plant formation: subatlantic broom-heathland, sand dry grassland, couch grass-meadows and persistent ruderal areas. Furthermore, both species or forms were characterized as xerophilic inhabitants of the soil-surface with a peak of activity in the summer

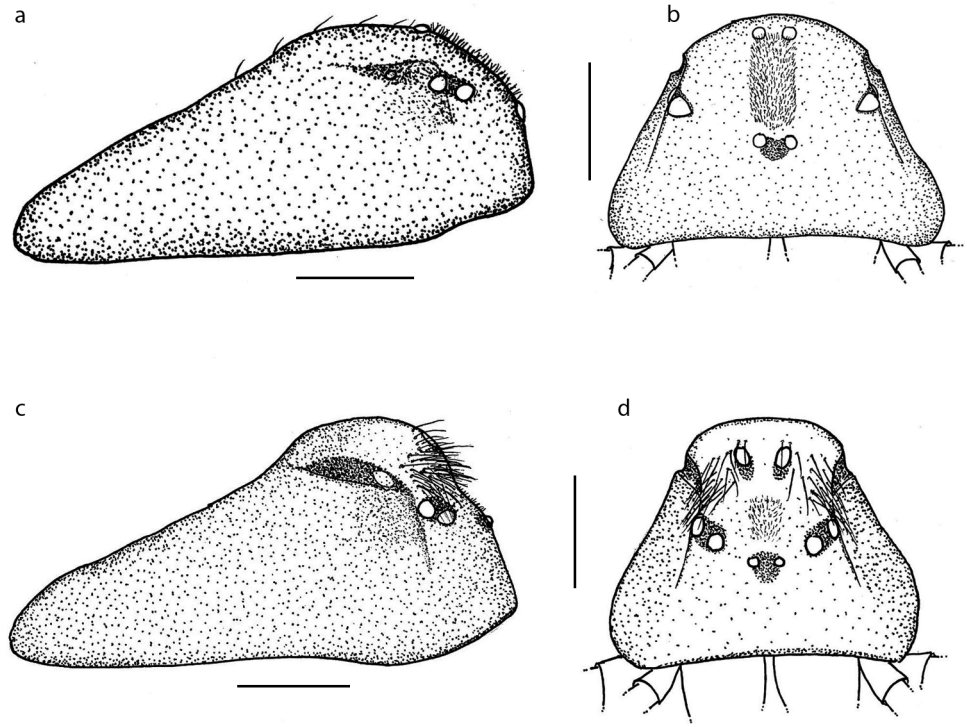

Fig. 1: *Troxochrus scabriculus* (Westring, 1851), male prosoma: **a.** forma *scabriculus*, lateral view, **b.** frontal view, **c.** forma *cirrifrons*, lateral view, **d.** frontal view. Scale bar 0.2 mm

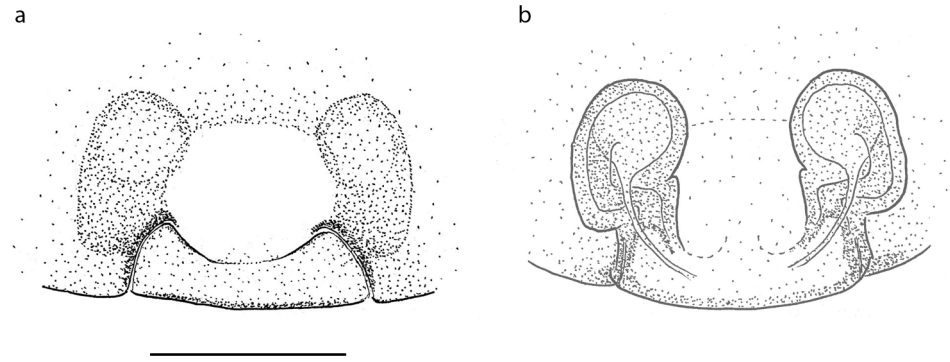

Fig. 2: *Troxochrus scabriculus* (Westring, 1851), female genitalia: **a.** epigynum, ventral view, **b.** vulva, dorsal view. Scale bar 0.1 mm

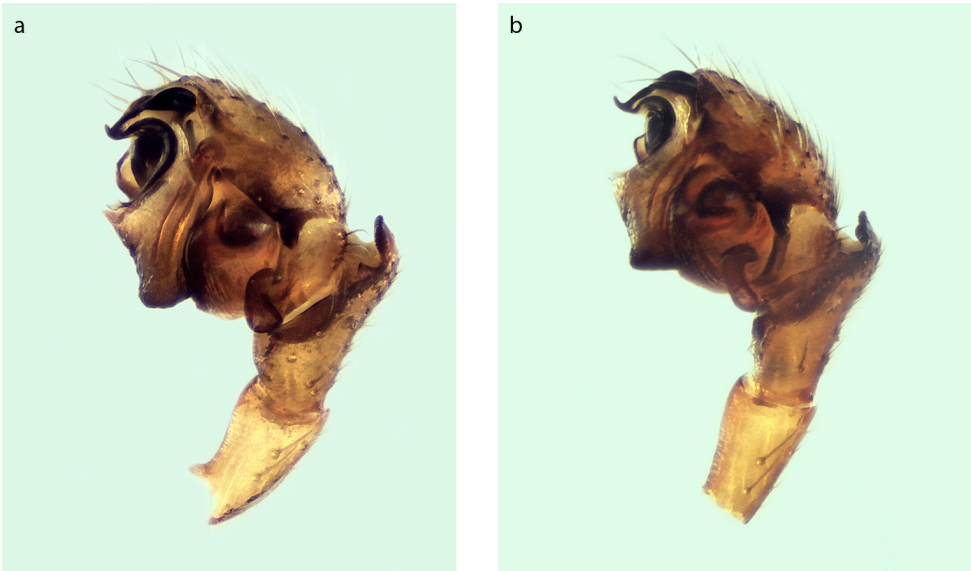

Fig. 3: *Troxochrus scabriculus* (Westring, 1851), male palps: **a.** forma *scabriculus*, lateral view, **b.** forma *cirrifrons*, lateral view (photos taken from Oger 2018)

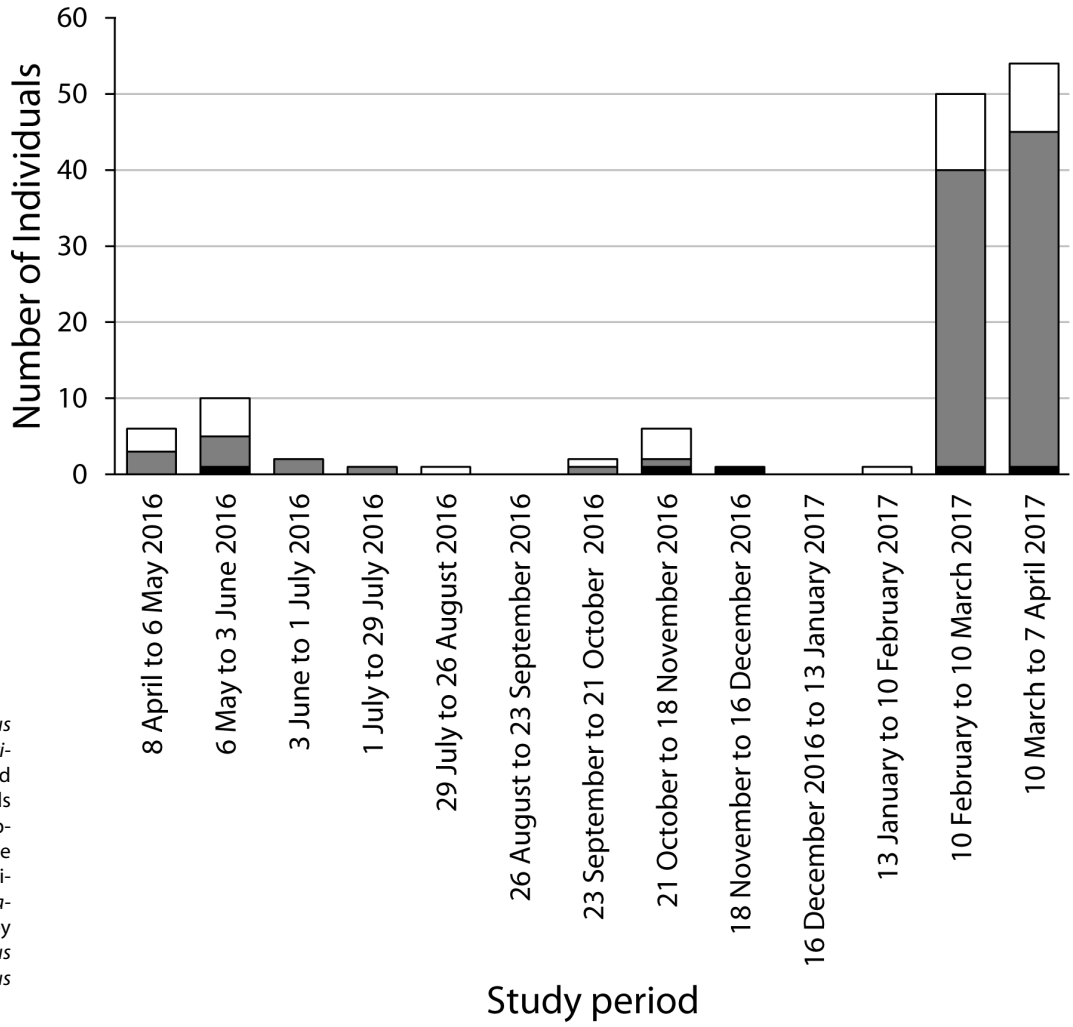

Fig. 4: Phenology of *Troxochrus scabriculus* males (forma *scabriculus* and forma *cirrifrons*) and females in 13 study periods between 8 April 2016 and 7 April 2017 on the rooftop of the "Biozentrum Althanstraße" in Vienna (Austria). Black bars: *T. scabriculus* f. *cirrifrons* males; Grey bars: *T. scabriculus* f. *scabriculus* males; White bars: *T. scabriculus* females.

months (mid-June to mid-September). Müller & Schenkel (1895) reported *T. scabriculus* and *T. scabriculus cirrifrons* adult male forms under the taxon *T. scabriculus*; both forms were collected from October to December in an alder forest along a meadow riverbank in Switzerland. Also, Thaler (1986) documented that both forms occurred together in a black alder forest near Vienna (Austria), where, 69 males of the form *scabriculus* and two males of the form *cirrifrons* were collected. Steinberger & Thaler (1990) collected one *cirrifrons* male in a small relictual floodplain forest strip on the left riverbank of the river Inn in Tyrol (Austria). Interestingly, *T. scabriculus* males were present in the same area, but not in the same study sites, in contrast to Thaler (1999), who considered the records in the two study sites as evidence of sympatric occurrence.

In Denmark, Larsen & Bøggild (1970) noted sympatric occurrences of *T. scabriculus* and *T. cirrifrons* from sand dunes and marram grass. Wiehle (1960) related that one male of the form *cirrifrons* was on the southern slope of the "Kyffhäuser" mountains in Germany, 4 October 1958, and another male in a salt meadow (Salicornietum) near Hecklingen-Anhalt, 12 June 1958. Von Broen (1977) reported *T. scabriculus/cirrifrons* from a "Ligusterhecke" [privet hedge] in Berlin, Germany. In the "Niederrhein"-Lowland, Otrembnik (1978) secured one *T. scabriculus* f. *cirrifrons* male and one female in a riparian grassland and seven *T. scabriculus* f. *cirrifrons* males and one female in a fertilized nutrient-rich meadow; however, no records were made of the typical male form. In Aldenhoven, Germany, Esser (1997) collected two *cirrifrons* males together with 64 *T. scabriculus* specimens (probably mostly males) in a small ryegrass-plantain field margin strip (300 m length, 3 m width) situated between an arable field and an asphalt road. In Renkum, a town in the eastern Netherlands near Arnhem, van Helsdingen & IJland (2008) discovered a single male in a former arable grassland field between 1 April and 31 October 2008. Dekkers-Scheutjens (2010) obtained 31 *T. scabriculus* males in a study site within a nature reserve southwest of Tilburg, together with three *cirrifrons* forms.

According to Harvey et al. (2002), *T. scabriculus* is restricted to dry habitats in the British Isles, such as calcareous grassland, quarries, river shingle, haystacks and bare ground. The spider is a typical inhabitant of sand dunes where it prefers dense clumps of marram grass; in gardens the species can be encountered on gravel paths (Harvey et al. 2002). Mikhailov & Trishina (2013) observed one *T. cirrifrons* male form co-occurring with one male and two females of *T. scabriculus* in a birch and lime tree plantation in the vicinity of Pushta (Mordovian Republic, Russia) on 19 August 2011. In Norway, *T. cirrifrons* inhabited the same type of habitat as *T. scabriculus*, i.e. open sand and shingle (= gravel) dominated localities near rivers, streams and the seashore (Aakra et al. 2016). Entling et al. (2007) compared 224 Central European spider communities along two major environmental gradients, i.e. shading and moisture. Within the shading gradient from open habitats to forests, *T. scabriculus* and *T. cirrifrons* had very similar

average niche positions in open habitats (Entling et al. 2007, Appendix S2), while within the moisture gradient their niche positions slightly differed; *T. scabriculus* could thus be considered as an inhabitant of mesic moist habitats, while *T. cirrifrons* as one of mesic dry habitats. However, niche width values indicate a wide niche range in both species/forms, i.e. a great niche overlap within the moisture gradient.

In the distribution maps of the "Nord" and "Pas-de-Calais" departments of northern France, six records exist of *T. cirrifrons* that overlap with the records of *T. scabriculus* to 100 % (Lecigne 2016). Of interest here is that fact that 26 of the overall 33 records of *T. scabriculus* were located on the coast (Lecigne 2016: 212). Furthermore, in Bulgaria, where *T. scabriculus* also occur, the first record of *T. cirrifrons* was made by Deltshev (2004) in a pine forest near Sandansky, where he uncovered three *cirrifrons* and no *scabriculus* males. Perhaps this exclusive occurrence of the form *cirrifrons* is the reason for its entry in the spider checklist of Bulgaria. Deltshev (2004) commented that the locality in Bulgaria is at the southeastern border of its range. However, Mikhailov (1996, 1997) previously documented *T. cirrifrons* [as a junior synonym of *T. scabriculus*] from Russia (e.g. Russian Plains, Urals, and Middle Siberia) and the Ukraine. Mikhailov & Trishina (2013) noticed one *T. cirrifrons* male form co-occurring with one male and two females of *T. scabriculus* in a birch and lime tree plantation in the vicinity of Pushta (Mordovian Republic, Russia) on 19 August 2011. According to Roberts (1987), *T. scabriculus* and *T. scabriculus* f. *cirrifrons* have a similar distribution throughout the British Isles. However, both forms do not always occur together, rather they are locally common in dry habitats. Thus, *T. scabriculus* and its form *cirrifrons* have a widespread but patchy distribution in much of Britain. In summary, both forms are extensive in western and central Europe, and their distribution range extends east to Russia and the Far East.

Phenology

Simon (1884) stated that the form *cirrifrons* is "commun au premier printemps dans les détritus humides" [common in early spring in moist litter]. Wiehle (1960) reported one male of the form *cirrifrons* from Germany, 4 October 1958, and another male, 12 June 1958. Larsen & Bøggild (1970) registered *T. scabriculus* males in June, July, August and October, and *T. cirrifrons* in June and August. Females were present in April, May, June, July, August and October. Thaler (1986) recorded one *cirrifrons* male in the period from 24 April to 5 May, and one *cirrifrons* male in the period from 5 to 19 May. Von Broen (1977) reported *T. scabriculus*/*cirrifrons* from urban ruderal areas in Berlin, Germany, and presented the phenology data of both forms over one calendar year. According to this data, *T. scabriculus* males occurred from the beginning of March until the end of November. Nine specimens of *T. cirrifrons* were collected in April, May and June. According to von Broen (1977), the activity peak of adult males was in April. Since the species could be found nearly all year round, von Broen characterized it as eurychronus. Adult females may be present throughout the year but there is a peak in recorded number of adults of both sexes in late spring and early summer, and again in the autumn (Harvey et al. 2002). Mikhailov & Trishina (2013) discovered one *T. cirrifrons* male form co-occurring with one male and two females of *T. scabriculus* on 19 August 2011. In our study, we noted that the highest peak of activity of *T. scabriculus* was in the months February and March (Fig. 3), which is about a month earlier than in the study from Berlin where the maximum lies between March and April (von Broen 1977). According to the phenology figure in Harvey et al. (2002), the activity peak in the United Kingdom seems to be in May.

Male morph ratio within populations

Simon (1884: 645) stated: "La forme *cirrifrons* se trouve toujours mêlée au type, mais elle est partout plus rare" [the form *cirrifrons* is always mixed with the type, but it is everywhere rarer]. Based on their findings, von Broen & Moritz (1965) arrived at the same conclusion that the variety *T. scabriculus cirrifrons* occurs in all populations of *T. scabriculus*. In general, this is true, although there are many exceptions (e.g. see the *T. scabriculus*/*cirrifrons* maps of Lecigne 2016). Roberts (1987) summarized the up-to-date data and concluded that *T. scabriculus* f. *cirrifrons* was rather less common than the typical form *T. scabriculus*. In general, this is true, but there are exceptions or even populations of *T. scabriculus* that consist purely of *cirrifrons* males. To give an example, Deltshev (2004) documented three *cirrifrons* males in a pine forest in Bulgaria without any *scabriculus* morphs.

Pickard-Cambridge (1860, 1871) was the first to quantify the ratio between the male form of *T. scabriculus* and *cirrifrons* as "abundant" to "one". In our data set we obtained a ratio of 95:5 = 19:1. Thaler (1986) documented 69 males of the form *scabriculus* and two males of the form *cirrifrons* in a floodplain area near Vienna, Austria; hence, the ratio between the typical form and "*cirrifrons*" was about 35:1. Interestingly, in two relictual floodplain forests along the Inn River in Tyrol, Austria, Steinberger & Thaler (1990) counted about 45 *T. scabriculus* males in the study site "Kufstein" (large floodplain forest on the right river bank) and one "*cirrifrons*" male in the study site "Langkampfen" (small floodplain forest strip on the left river bank), i.e. both forms seemed co-occur in the same study area, but not in the same study sites. In Aldenhoven, Germany, Esser (1997) identified two *cirrifrons* males together with 64 T. *scabriculus* specimens (probably mostly males) in a small ryegrass-plantain field margin strip (300 m length, 3 m width) situated between an arable field and an asphalt road; hence the ratio of *scabriculus* and *cirrifrons* was at a maximum of 32:1, but probably a little lower due to the unknown number of females. Von Broen (1977) accounted for both *T. scabriculus* and *cirrifrons* from three urban ruderal areas in Berlin, Germany, (i) a "Ligusterhecke" [privet hedge], (ii) an "Erdbeerbeet" [strawberry patch] and (iii) a "Holzmehlfläche zwischen Ziegelbau und Holzschuppen" [an area covered with saw dust between a brick building and a woodshed]. In the privet hedge, the ratio between *T. scabriculus* and *T. cirrifrons* males was about 14:1 (164 *T. scabriculus*, 12 *T. cirrifrons*), while in the strawberry patch and the sawdust site only *T. scabriculus* specimens were captured. Von Broen (1977) also provided unpublished data on the ratio of the two forms from Greifswald, where he captured 10 *T. scabriculus* males and two *T. cirrifrons* males; hence, there the ratio was 5:1. Dekkers-Scheutjens (2010) collected 31 *T. scabriculus* males in a study site within a nature reserve southwest of Tilburg (Netherlands) together with three *cirrifrons* forms, i.e. the ratio was about 10:1.

Conclusion

It is evident that the synonymy of T. *scabriculus/cirrifrons* is not a taxonomically problematic case to resolve. Since both males and females from populations with co-occurring male forms are identical in their genital morphology, it is highly plausible that the different male morphs must represent two forms of the same species. It is also apparent that *Troxochrus scabriculus* (Westring 1851) is the typical form, while the later described form *cirrifrons* is a second male morph that must be designated *Troxochrus scabriculus* forma *cirrifrons* (O. Pickard-Cambridge, 1871). Based on further evidence from distribution maps, habitat preferences, phenology and appearance in populations (see above), it is obvious that Simon (1884) made the correct judgement from the very start.

Although breeding experiments would be desirable to clarify the status of the two forms of the male spider, as once recommended, we consider the taxonomic case of the dimorphic males in *T. scabriculus* to be closed and quote the famous fictional figure Sherlock Holmes: "We must fall back upon the old axiom that when all other contingencies fail, whatever remains, however improbable, must be the truth" (Doyle 1908).

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Nachruf / Obituary

Farewell to RNDr. Zdeněk Majkus, CSc.

Sad information reached Czech arachnologists in spring of this year – Zdeněk Majkus (Fig. 1), an important Czech arachnologist, an outstanding university teacher and – namely – a good friend, passed away.

Zdeněk was born on 1 June 1943 in Ostrava – Přívoz. He was interested in nature since his studies at secondary school. In the years 1960–1965 he studied didactics of biology and chemistry at the Faculty of Natural History, Palacký University in Olomouc. From the same faculty Zdeněk graduated in biology and chemistry in 1967–1970, and in 1981 he passed the state doctoral exam. Eight years later, Zdeněk defended his dissertation entitled "The composition of arachnocoenoses of selected pit heaps in Ostrava town". Furthermore, he acquired valuable experience during his stays abroad, specifically in laboratory of P. M. Brignoli (Istituto di Zoologia, L'Aquila, Italy, 1983) and visits to Cambodia and Vietnam (1988). However, Zdeněk began his scientific and pedagogical career in his place of birth.

Zdeněk's pedagogical activities were diverse. He started his career at the secondary school in Ostrava – Vítkovice, where he taught biology and chemistry from 1965–1973. At the Faculty of Education (where he arrived in 1973), later (since 1991) the Faculty of Science, he taught many biological subjects (Biology, General Zoology, Developmental Biology, Ethology, Invertebrates of the Czech Republic, Field courses on Biology), and led seminars on pedagogy and arachnology. Zdeněk worked there for 45 years and stayed at this institution until the end of his life. He supervised over a hundred theses (only after the year 2005, 62 bachelor and 35 diploma theses). He was also a referee for theses from various universities (e.g. Palacký University in Olomouc, Technical University of Ostrava) as well as a member of the boards of a Ph.D. study at the Department of Zoology of the Slovak Academy of Science (Bratislava) and the Faculty of Natural History of the Palacký University (Olomouc).

Beside his demanding pedagogical work, Zdeněk also carried out research activities. These resulted in many publications; most of them focused on faunistics of his beloved Moravian and Silesian regions. He studied, for example, spiders of Moravian karstic areas (Hranický kras Karst, Jesenický kras Karst, Moravský kras Karst). Together with Jaroslav Svatoň, he focused on spiders of the Pavlovské vrchy Hills, the corridor of the Upper Odra River, Osoblaha Region, the Hostýnské vrchy Hills, the Beskydy Mts., the Jeseníky Mts. and other many areas in Moravia and Silesia. He found for the first time five spider species new for the Czech Republic, namely: *Alopecosa pinetorum* and *Pardosa agricola* (Lycosidae), *Araniella inconspicua* (Araneidae), *Heliophanus patagiatus* and *Talavera aperta* (Salticidae). Zdeněk also participated in four European Colloquia of Arachnology: in České Budějovice (1994), Siedlce (1996), Stará Lesná (1999) and Blagoevgrad (2005). Furthermore, Zdeněk organized the Czechoslovakian-Polish arachnological meeting in Ostrava (1986), in cooperation with Polish arachnologists.

Zdeněk is known among arachnologists (Fig. 2) mainly through his unique research on slag heaps in Ostrava. We therefore call him "The Slag Heap Expert". Zdeněk proved that slag heaps are a unique biotope where surprising succession occurs. Due to his interest in the ecology of slag heaps, Zdeněk began to cooperate with Polish zoologists from the Upper Silesian Basin. Together, they studied the impact of heavy metals on spiders and other arthropods in industrial agglomerations. The studies on spiders from black coal slag heaps, their physiology, as well as research on the arachnofauna of Moravia and Silesia belong to his most cited works.

Fig. 1: Dr. Zdeněk Majkus in 2012 (photo M. Dominik)

Zdeněk Majkus was a member of many scientific societies, editorial boards and committees: Czech and Slovak colleagues never forget his active participation in the Czech and the Slovak Arachnological Societies. He was also a member of the Czech Zoological Society, Czech Entomological Society, Arachnologische Gesellschaft (Germany) and C.I.D.A. (Centre international de documentation arachnologique) in Paris. Zdeněk also worked as member of the departmental committee for development of universities and as an editor of the journal Acta Facultatis Rerum Naturalium Universitatis Ostraviensis. He belonged to long-lasting organisers of scientific competitions of Czech students (Secondary-School Scientific Activity, Biological Olympiad). As an enthusiastic biologist, Zdeněk took part for many years in the popularization of biology, especially in organisation of the international film festival Ekofilm.

Fig. 2: Dr. Zdeněk Majkus (second from left) among Czech and Slovak colleagues (Jaroslav Svatoň, Vladimír Šilhavý, Pavel Kasal and Miroslav Krumpál) at the arachnological meeting in Ostrava, 1978 (courtesy of P. Gajdoš)

We always enjoyed meeting Zdeněk. He passed away suddenly and unexpectedly, literally during his work, namely on a student field trip on 22 May 2018 into one of his beloved regions, the Beskydy Mts…

We would like to thank Jiří Král (Prague) for valuable comments to the manuscript and Aneta Dominiková (Lelekovice) and Peter Gajdoš (Nitra) for the photos of Dr. Majkus.

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Buchbesprechung / Book Review

Kůrka A, Řezáč M, Macek R & Dolanský J 2015 Pavouci České republiky [Spiders of the Czech Republic]. Academia, Praha. 623 pp., ISBN: 978-80-200-2384-1

130 × 200 mm, hardback, 360 CZK (14 EUR) & postage; Order: Nakladatelství Academia, Vodičkova 40, 110 00 Praha 1, Czech Republic; E-mail: eshop@academia.cz or expedice@academia.cz;
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Spiders are a very popular group in the Czech Republic. This fact is confirmed by public interest in arachnological books like "V říši pavouků" [In the realm of spiders] (Baum 1938, Baum & Buchar 1973) or "Naši pavouci" [Our spiders] (Buchar & Kůrka 1998, 2001) which are completely sold out today. Now, we have a further book contributing to this series – the atlas "Pavouci České republiky" [Spiders of the Czech Republic]. The author team consists of two excellent Czech arachnologists, a well-known scientist and a professional photographer. Such an author constellation promises a high-quality result. During four years of preparation, this ambitious project arose aiming to bring a complex book covering the biology – and specifically an atlas – of all spider species living in the Czech Republic, including photographs of most of them.

The book is divided into general and systematic parts. In the former, readers are provided with information over 64 pages about spider morphology and biology. The morphology part comprises descriptions of the spider body and each organ system. Further chapters deal with spider venom and the most characteristic organs for spiders – the spinning apparatus. All are accompanied by original illustrations and as yet unpublished photographs. The next chapter describe ethology, from mating and moving to prey tactics. The authors also remembered to describe how spiders avoid their predators. The following chapter summarizes the ecology of spiders and their importance for bioindication – a topic that was established in the Czech Republic by Jan Buchar. The atlas thus contains a list of threatened biotopes and the spider species inhabiting them. Furthermore, each spider species is characterised by the degree of vulnerability based on the current Czech Red List (Řezáč et al. 2015). The last chapter focuses on collecting and identifying spiders and contains an identification key for the families. It is worth mentioning that the key uses different morphological characters as compared to other keys commonly used today. It is thus not surprising that the effectiveness of the new key was almost immediately tested by students (Krištofová 2015, Krištofová et al. 2015).

The information mentioned in the general part of the atlas is precise and up to date. In addition, the text is easily readable and the chapter headings are often unusual, drawing the reader's attention, e.g. "Pavoučí kámasútra" [Spider Kama Sutra]. Only relevant data are provided so the reader is not overwhelmed by unnecessary facts. I can recommend the entire general part of the atlas not only as suitable reading material for amateurs, but also as a textbook for university students studying invertebrate zoology and/or arachnology.

The systematic part of the atlas is the bedrock of the book. At the beginning, the position of spiders in zoological systematics is introduced, followed by a chart with typical representatives of all 39 Czech families. Descriptions of families, genera and species occurring in the Czech Republic are then provided. The arrangement of the families more or less reflects the traditional system. Each family (except the Phrurolithidae that was established shortly before the book was printed) is characterised morphologically and basic biological data are provided. The number of species and their

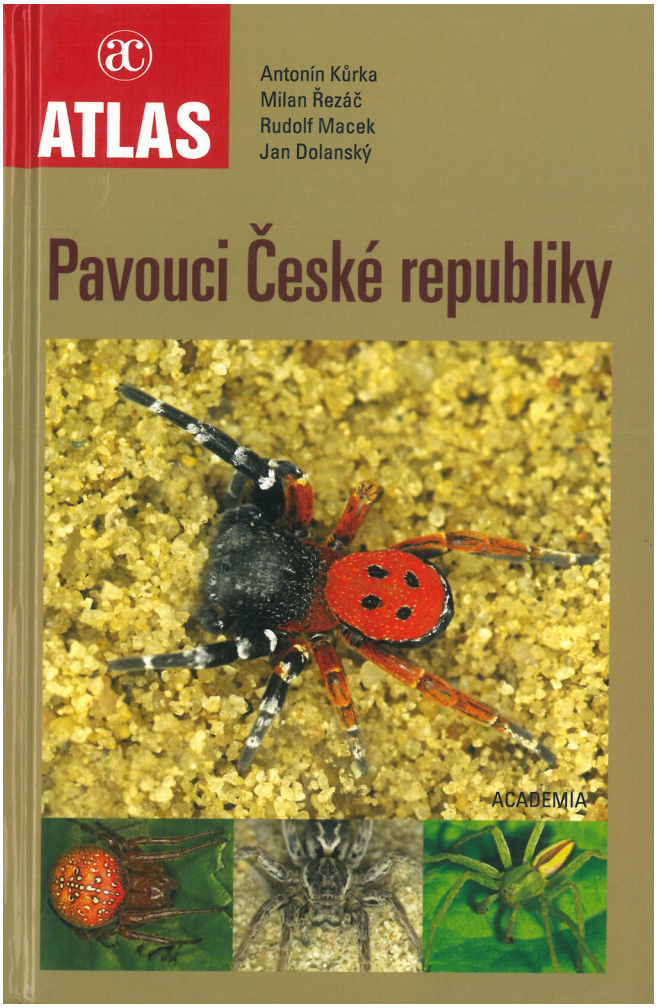
distribution are also provided. The species are sorted alphabetically according to their Latin names; the Czech name, as well as a brief morphological characterisation, is also included. I remember how the authors were checking the true state of morphological characters on museum specimens, in those cases when other literature had provided contradictory data. Similarly, they were checking the body lengths of spiders (some publications give the body length whereas other only the length of prosoma). Furthermore, the biology and ecology of each species is described as well as the period of adult activity. This information was also being checked and consolidated, because some publications provide the entire period of adult occurrence (including resting or hibernating adults), whereas other sources give only the period of reproduction when the adults reach the highest activity and it is thus likely to encounter them in nature. The distribution of the species both in the Czech Republic and in the rest of the world is summarized.

The atlas was prepared to be as up to date as possible. We can find all species occurring in the territory of the Czech Republic. Those species that were found after the editorial deadline are mentioned in an addendum. In some cases, the atlas even foresaw changes – the authors also included those species whose description was "in press" at that time. However, as arachnology is a very dynamic branch, several changes occurred while the atlas was being printed, e.g. several *Hahnia* species (p. 358) were transferred into other genera and the eresid mentioned on p. 112 as *E.* cf. *illustris* was described shortly after as a new species: *E. hermani* Kovács et al., 2015.

Nice photographs of living Czech spiders (despite their smaller size) are very valuable. In comparison with other similar monographs published all over the world, the Czech atlas is unique as it is the only national atlas showing photographs of almost all species living in a given area. Only after having a look at the Czech alas, can the reader imagine the species proportion and richness of central European spider families. Only a few people know that more than two thirds of the species are represented by tiny, 1–2 mm long, money spiders (Linyphiidae). When comparing the photos in the atlas, we also see that it is almost impossible to identify spider species based only on the image. An experienced arachnologist can identify more than 60 species from photographs – in the case of Czech araneofauna this still corresponds to only 7% of the spider species.

A subjective disadvantage of the atlas is that it is written in Czech and thus only easily understandable for Czech and Slovak people, with more difficulties also for those people speaking other Slavic languages. On objective disadvantage is a lack of literature sources. The references include, at most, only books and it is a pity that original scientific papers (that surely served as sources of information for the general part of the book) were omitted. The list of references is printed on one page and on four lines of the other page, so there would have been enough room to include more literature. The indexes of Czech and Latin names follow. Unfortunately, they are sorted according to the generic names – this may complicate searching for a species after it was transferred to another genus. A terminological index is not included.

Attractive photos, reliable information, excellent graphics (I would only have chosen a different colour for the cover) and a high quality print on glossy paper surpassed my expectations. It is thus not surprising that the atlas "Spiders of the Czech Republic" became a bestseller shortly after being published. Also thanks to its suitable format it is a practical and highly recommendable field book for all naturalists, students and professional arachnologists.



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Generic and **species names** must be italicised! All **personal names** in normal text, also in literature citations and the literature list. Country names in material lists in capitals. Please do not use symbols to separate numbers in the thousands.
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Literature citations: In the text, if there are three or more authors only the first author is cited (Schulze et al. 1969), citations are separated by comma (Koponen 2000, 2008, Huber 2010). In the literature cited the citations are arranged alphabetically by author and journal names are not abbreviated. Papers with the same author(s) and years are identified by a, b, c, etc.

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

Clayhills T, Rinne V & Koponen S 2008 On insect and spider fauna of Jungfruskär in Houtskär, 2007. Unpublished report to the Finnish Forest and Park Service, Turku. 80 pp. (in Finnish)

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