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

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

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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

*tartaria* (Thorell, 1875), *P. vlices* sensu Buchar & Thaler 2002], *P. cribrata* Simon, 1876, *P. vesca* (Roewer, 1951), *P. pseudostrigillata* Tongiorgi, 1966 and *P. vlijmi* den Hollander & Dijkstra, 1974. The subspecies *P. proxima poecila* 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 poecila*).

Zyzyn (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.

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, Nafplio) in the Peloponnesse. 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 Dall (1908) already considered that specimens from southeastern Europe differed from specimens in south-western Europe. More specifically, Dall (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 Beinpaars 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-
Two sibling species: *Pardosa proxima* and *P. tenuipes*

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 a 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
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). – ITALY. Calabria: Cosenza, Cecita lake, 6.VIII.1958, 2♂ (F. Papi, coll. P. Tongiorgi); S. Giovanni in Fiore, Loricca, 24.VIII.1999, 1♂ (E. Ferrario, MSNB). Emilia–Romagna: Ravenna, Cervia, inside the city, IV.1991, 1♂ (P. Tongiorgi, MCSVN); Reggio Emilia, Regnano, meadow with Medicago sativa, 23.IV.1978, 4♂ 20♀, lake shore, 1♂ 1♀ (P. Tongiorgi, MCSVN); Viano, 275 m, 30.IV.1978, 1♂ 6♂ (P. Tongiorgi, MCSVN).}

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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, Belvi, 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, Orecchialba wildlife reserve, 1200 m, 14.V.1967, 7♀ 2♂ (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, 7.1962, 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, Vo, Zovon, pitfall trap, 20.X.2010, 5♂ 2♀ (M. Zotti, MSNVR);

Fig 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)
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.

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)
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
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 (♂).

**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).
**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 (Schauffuss) 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) is after Koch (1847): male (24) and female (25); 26. epigyne (lectotype). Scale line = 0.1 mm.

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

**Female.** Total length: 4.32–5.70. Prosoma: 2.20–2.97 long, 1.86–2.32 wide. Prosome blackish brown, eye region with narrow yellowish brown median band, and lateral light brown bands broken into three spots (Fig. 11). Male. Total length: 5.28–5.91. Prosoma: 2.56–2.76 long, 2.02–2.12 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, with numerous scattered long hairs on tibia and metatarsus. Leg 1 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, with some yellowish areas on patella and femur, cymbial yellowish brown median band, and lateral light brown bands (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. Prosome blackish brown, 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, with some yellowish areas on patella and femur, cymbial yellowish 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

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*Figs 24-26: Pardosa proxima. 24-25. after Koch (1847): male (24) and female (25); 26. epigyne (lectotype). Scale line = 0.1 mm.*
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 a lighter V shaped strip is present. Legs uniformly yellow-brownish. Sternum uniformly light brown. Opisthosoma (with numerous short modified hairs in *P. tenuipes* and normally developed in *P. proxima*, 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).

### 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 bulb much shorter than the bulbus. A sample with material fitting Simon’s description was available from Spain, Andalucía, 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.

### 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 north-western 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 (Loks 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).

### 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.

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

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

| WSC entry | Comments about the species attribution |
|-----------|---------------------------------------|
| Lycosa proxima O. Pickard-Cambridge 1878: 125, pl. 11, f. 6 (D). | 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 (D). | Descriptions and drawings does not allow discrimination between P. tenuipes and P. proxima. |
| Lycosa proxima Bösenberg 1902: 383, pl. 36, fig. 561 (D). | Uncertain attribution. |
| Lycosa proxima Nosèk 1905: 140, fig. 19 (D). | 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 (D). | 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 (D). | Uncertain attribution. |
| Pardosa proxima Tyschenko 1971: 175, fig. 509 (D). | Uncertain attribution. |
| Pardosa proxima Miller 1971: 159, pl. XXV, fig. 14 (D). | Uncertain attribution. |
| Pardosa esperanzae Schmidt 1975: 505, fig. 3 (D2). | Described on a single female. Synonymized with proxima by Wunderlich (1992). |
| Pardosa proxima Zvyuzin 1979: 435, fig. 48 (D). | Uncertain attribution. |
| Pardosa canariensis Schmidt 1982: 405, figs. 8–11 (D). | Synonymized with proxima by Wunderlich (1992). |
| Pardosa pseudoproxima Wunderlich 1987: 235, fig. 629 (D5). | Synonymized with proxima by Wunderlich 1992. |
| Pardosa proxima Hu & Wu 1989: 224, fig. 188.3–4 (D). | Uncertain attribution. |
| Pardosa proxima Heimer & Nentwig 1991: 332, fig. 1405 (D2). | 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 (D2). | 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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References
Almqvist S 2005 Swedish Araneae, part 1: families Atypidae to Hahniidae (Linyphiidae excluded) – Insect Systematics & Evolution, Supplement 62: 1-284
Becker L 1882 Les Arachnides de Belgique I. – Annales du Musée Royal d’Histoire Naturelle de Belgique 10: 1-246 – doi: 10.5962/bhl.title.48721
Berland L 1932 Voyage de MM. L. Chopard et A. Méquignon aux Açores (août-septembre 1930). II; Araignées. – Annales de la Société Entomologique de France 101: 69-84
Bösenberg W 1902 Die Spinnen Deutschlands. II-IV. – Annales du Musée Royal d’Histoire Naturelle de Belgique 10: 1-246 – doi: 10.5962/bhl.title.6508
Bosmans R & Van Keer J 2012 On the spider species described by L. Koch in 1882 from the Balearic Islands (Araneae). – Arachnologische Mitteilungen 43: 5–16 – doi: 10.5431/aramit4306

Bosmans R, Van Keer J, Russell-Smith A, Kronestedt T, Alderweireldt M, Bosselaers J & De Koninck H 2013 Spiders of Crete (Araneae). A catalogue of all currently known species from the Greek island of Crete. – Nieuwsbrief van de Belgische Arachnologische Vereniging 28, Supplement 1: 1-147

Chiarle A & Isaia M 2013 Signal complexity and modular organization of the courtship behaviours of two sibling species of wolf spiders (Araneae: Lycosidae). – Behavioural Processes 97: 33-40 – doi: 10.1016/j.beproc.2013.04.004

Chiarle A, Kronestedt T & Isaia M 2013 Courtship behavior in European species of the genus Pardosa (Araneae, Lycosidae). – Journal of Arachnology 41: 108-125 – doi: 10.1636/F112-09.1

Chiarle A 2013 The genus Pardosa (Araneae, Lycosidae): an integrative approach. PhD Thesis, University of Torino. 137 pp.

Chyzer C & Kulczyński W 1891 Araneae Hungaricae. Tomus I. Academia Scientarum Hungaricae, Budapest. 170 pp., 4 Pls

Cordes D & Helversen O von 1990 Indications for the existence of Allospeodes barbipes as a sibling species to Allospeodes acutangulus. – Bulletin de la Société européenne d’Arachnologie 1: 70-74

Dahl F 1908 Die Lycosiden oder Wolfspinnen Deutschlands und ihre Stellung im Haushalte der Natur. Nach statistischen Untersuchungen dargestellt. – Nova Acta, Abhandlungen der Kaiserlich Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher 88: 175-678

Dahl F & Dahl M 1927 Spinnentiere oder Arachnoidea. Lycosidae. – Die Tierwelt Deutschlands 5: 1-80

Dondale CD & Redner JH 1990 The insects and arachnids of California. Part. 17. The wolf spiders, nurseryweb spiders, and lynx spiders of Canada and Alaska (Araneae: Lycosidae, Pisauridae, and Oxyopidae). Biosystematics Research Centre, Ottawa, Ontario. 383 pp.

Emerson AE 1956 Regenerative behavior and social homeostasis of termites. – Ecology 37: 248-258 – doi: 10.2307/1933137

Fuhm IE & Niculescu-Burlacu F 1971 Fam. Lycosidae. – Fauna Socec Republicii Socialiste România (Arachnida) 5(3): 1-253

Heimer S & Nentwig W 1991 Spinnen Mitteleuropas: Ein Bestimmungsbuch. Paul Parey, Berlin. 543 pp.

Heuper M & Paulus HF 2009 Contributions on the wolf spider family Pardosidae to Theducosomatidae. Harley Books, Colchester. 229 pp.

Koch CL 1847 Die Arachniden 15. JL Lotzbeck, Nürnberg. 136 pp.

Koch L 1882 Zoologische Ergebnisse von Excursionen auf den Kaiserlichen Königlichen Naturhistorischen Hofmuseums in Wien 20: 114-154

Koch in 1882 from the Balearic Islands (Araneae). – Arachnologische Mitteilungen 1: 1-61

Kochel GH & Millidge AF 1951 British spiders. Vol. I. Ray Society, London. 310 pp.

Koks I 1972 Araneae II. – Fauna Hungaricae 109: 1-112

Miller F 1971 Pavouci-Araneidae. – Klič zvířeny ČSSR 4: 51-306

Nosek A 1905 Araneiden, Opilionen und Chernetiden. In: Penther A & Zederbauer E (eds.) Ergebnisse einer naturwissenschaftlichen Reise zum Erdchias-Dagh (Kleinasiens). – Annalen des Kaiserlich Königlichen Naturhistorischen Hofmuseums in Wien 20: 114-154

O’Connor T, Starr CK & Cameron SA 2011 The neotropical social wasp Mischocyttarus “alfkenii” Ducke (Hymenoptera: Vespidae) is a pair of ethospecies. – Systematic Entomology 36: 446-452 – doi: 10.1111/j.1365-3113.2011.00575.x

Pickard-Cambridge O 1878 Notes on British spiders with descriptions of new species. – Annals and Magazine of Natural History (5) 1: 105-128

Roberts JA & Uetz GW 2004 Chemical signalling in a wolf spider: a test of ethospecies discrimination. – Journal of Chemical Ecology 30: 1271-1284 – doi: 10.1023/B:JOEC.0000003027.27514.92

Robert E 1883 Études arachnologiques. 14e Mémoire. XXI. Matériaux pour servir à la faune arachnologique des îles de l'Océan Atlantique (Àores, Madère, Salvages, Canaries, Cape Vert, Sainte-Hélène et Bermudes). – Annales de la Société Entomologique de France (6) 3: 259-314

Simon E 1867 Les Arachnides de France. Tome troisième. Roret, Paris. 364 pp.

Simon E 1883 Études arachnologiques. 14e Mémoire. XXI. Matériaux pour servir à la faune arachnologique des îles de l'Océan Atlantique (Àores, Madère, Salvages, Canaries, Cape Vert, Sainte-Hélène et Bermudes). – Annales de la Société Entomologique de France (6) 3: 259-314

Simon E 1937 Les arachnides de France. Synopsis général et catalogue des espèces françaises de l’ordre des Araneae. Tome VI. 5e et dernière partie. Roret, Paris. pp. 979-1298

Smith FP 1907 The British spiders of the genus Lycosa. – Journal of the Quckett Microscopical Club (2) 10: 9-30

Tongiorgi P 1966 Some notes on the occurrence of the genus Pardosa (Araneae, Lycosidae). – Journal of the British arachnological Society 11: 3: 259-314

Tongsirg P 1992 Die Spinnen der Kanarischen Inseln und Bermudes. – Annales de la Société Entomologique de France (6) 3: 259-314

Roberts MJ 1998 Spinnen und Arachniden. – in: Verhees J, Wunderlich J 2000 Die Spinnen Deutschlands und ihrer Lebensräume (Wolfspinnen im weiteren Sinne). – Die Tierwelt Deutschlands 5: 1-80

Dondale CD & Redner JH 1990 Contributions on the wolf spider family Pardosidae (Araneae, Lycosidae) of Gran Canaria (Spain). – Bulletin of the British arachnological Society 14: 339-346 – doi: 10.13156/ arac.2009.14.8.339

Hollander J den & Dijkstra H 1974 Pardosa vlijmi sp. nov., a new ethospecies sibling Pardosa proxima (C. L. Koch, 1948), from France, with description of courtship display (Araneae, Lycosidae). – Beaurotia 22: 57-65

Hollander J den, Vlijm L, Dijkstra H & Verhoef SC 1972 Further notes on the occurrence of the wolf spider genus Pardosa C. L. Koch, 1848 (Araneae, Lycosidae) in southern France. – Beaurotia 20: 77-84

Hu JL & Wu WG 1989 Spiders from agricultural regions of Xinjiang Uygur Autonomous Region, China. Shandong University Publishing House, Jinan. 435 pp.

Koch CL 1847 Die Arachniden 15. JL Lotzbeck, Nürnberg. 136 pp.

Koch L 1882 Zoologische Ergebnisse von Excursionen auf den Balearen. II: Arachniden und Myriapoden. – Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien 31: 625-678

Kronestedt T 1996 Vibratory communication in the wolf spider Pardosa lugubris (Araneae, Lycosidae). – Revue suisse de Zoologie, hors série 1: 341-354

Kronestedt T 2005 Pardosa schenkeli – en för Sverige ny vargspindelart [Pardosa schenkeli Lessert (Araneae, Lycosidae), a wolf spider new to Sweden]. – Fauna och Flora 100(4): 36-41 [In Swedish with English summary]

Lessert R de 1910 Catalogue des invertebres de la Suisse. Fasc. 3, Araignées. Musée d’Histoire naturelle de Genève. 635 pp.