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Notes on the Italian distribution of *Dolomedes plantarius* (Clerck, 1757), species assessed for the IUCN Red List (Araneae: Pisauridae)

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Abstract
The great raft spider, *Dolomedes plantarius*, is a semi-aquatic spider species with an Eurosiberian distribution. As a result of habitat loss and degradation, in 1996 the species was classified as *Vulnerable* in the IUCN Red List of Threatened Species, but since then the status has never been updated. We present the frame of the existing knowledge on the distribution of this rare spider species in Italy, based on literature data and on original records gathered in recent years. Finally, we discuss the conservation value of the Italian populations, in light of their peripheral position within the species range and in light of the future reduction of the bioclimatic range of the species due to climate and land cover changes associated with anthropic disturbance.

Key words: Great raft spider, wetlands, habitat loss, conservation.

Introduction

From the perspective of biological conservation, spiders (Araneae, Arachnida) are among the less explored taxa, although they are one of most important groups in terms of adaptive radiation and its ecological role as top-predators. Among the 1,632 known species in Italy (Pantini & Isaia 2017) - one of the most species-rich countries in Europe - only few species are considered by international and national conservation policies (Milano et al. 2018).

Among them, the great raft spider, *Dolomedes plantarius* (Clerck, 1757) (Araneae, Pisauridae) is a large-sized spider (male body-length: 10-16 mm; female body-length: 13-20 mm; Nentwig et al. 2018) closely associated with lowland wet habitats. Together with the congeneric *D. fimbriatus* (Clerck, 1757), it is the only representative of the genus in Europe. Despite the two species share similar ecological requirements and may be found in syntopy, *D. plantarius* is considered rarer and more stenoecious than *D. fimbriatus*, the former being strictly associated with standing waters such as rushlands, sedgelands and fens, and the latter associated with a variety of swampy areas, including flowing waters, alluvial forests and bog forests.

Due to the high variability of the body coloration and size, the correct identification of the two European species is possible only by means of the examination of sexual characters under the stereomicroscope (van Helsdingen 1993).

As the vernacular name suggests, the great raft spider is closely associated with standing meso-oligotrophic waters, from which many aspects of its life-history depend, from feeding to courtship and reproduction (Duffey 1995; van Helsdingen 1993). Individuals can be found along the edges of marshlands, bogs, canals, turf ponds and swamps, hunting on the water surface or among emergent and marginal vegetation, where females build their typical nursery webs.

Although Bonnet (1930) considered *D. plantarius* widespread all over the Palearctic region, the species is locally rare, suggesting a high vulnerability and a declining trend over much of the range (Duffey 1995; van Helsdingen 1993). In particular, the decline is related to the loss and the degradation of wetland habitats, namely of lowland fens, to the fragmentation of the populations, that are genetically isolated, and to the progressive eutrophication of the water throughout much of its range (Smith 2000).

As the result of its extreme vulnerability, the species is listed in the Regional Red Lists of several European countries (see Milano et al. 2018). In the United Kingdom, the species is classified as *Vulnerable* (Harvey et al. 2017), is

fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 and is the subject of a Species Action Plan (UK Biodiversity Steering Group 1999). In the light of this, a translocation program was initiated in 2010, with the establishment of three new populations at new sites in the Norfolk and Suffolk Broads (Harvey et al. 2017; Smith & Baillie 2011).

The species entered the IUCN Red List of Threatened Species in 1996, being included in the *Vulnerable* category (World Conservation Monitoring Centre 1996). Since then, the assessment has never been updated. New information on the species distribution available at the European level and recent studies demonstrating the dramatic consequences of climate and land cover changes on the range of the species, firmly underline the need of a revision of its conservation status.

In this paper, we present the frame of the existing knowledge on *Dolomedes plantarius* in Italy, based on literature data and on original records gathered in recent years. In light of our results and considering the role of Italian populations in the conservation of the species, we underline the need for long term monitoring programs, aiming to assess the status of the Italian populations and the need of further studies, aiming at deepening the knowledge about the distribution and the ecology of the Italian populations.

Material and Methods

We examined all available literature data referring to the presence of *Dolomedes* spiders in Italy. For the bibliographic survey, we referred to the reference list of the updated version of the Italian checklist of the Italian spiders (Pantini & Isaia 2017).

Moreover, we checked for the presence of *Dolomedes* spiders in private and Museum collections in Italy, and we conducted a number of field activities in northern Italy (2014-2018) with the help of different contributors (see acknowledgments), with a special focus on the region of Piemonte. The individuals collected were examined and identified using a Leica M80 stereoscopic microscope (up to 60x magnification). Specimens are preserved in 75° ethanol and are stored in Marco Isaia's collection at the Department of Life Sciences and Systems Biology of the University of Torino.

Results

The distribution of *Dolomedes plantarius* in Italy is presented in Fig. 1 and detailed in Tab. 1. The bibliographic survey led us to record the occurrence of this species in Piemonte, Lombardia, Veneto, Emilia-Romagna, Toscana and Sardegna. A number of outdated references documenting the occurrence of this species in Lombardia (Pavesi 1873, 1879), Veneto (Contarini 1843) and Campania (Trani 1902) were considered doubtful due to the high degree of uncertainty of the identifications [the same criteria was adopted by Brignoli (1977) in a first outline of the Italian distribution of this species].

Our field activities led to the discovery of several new records in the rice-growing area of Piemonte (16 localities) and in the wetland of Punta Alberete (Emilia-Romagna). Most of the records fall within natural protected areas.

Material

Piemonte: *Province of Torino*: Candia, shores of Lago di Candia (Reed bed), Parco Naturale del Lago di Candia, 21.VII.2010, Paschetta leg. 1 ♂. *Province of Alessandria*: Valenza, Lanca di San Bernardo (oxbow lake), "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", 10.VIII.2011, Paschetta leg. 1 ♀; Camino, Lanca di Brusaschetto (oxbow lake), "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", 07.V.2018, Cavalcante leg. 1 ♀; Frassineto Po, Lanca Terranova, "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", 24.V.2018, Cavalcante, Isaia & Milano leg. 1 ♀; Lanca Sesia Morto, "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", 24.V.2018, Cavalcante leg. 1 ♂. *Province of Vercelli*: Livorno Ferraris, Fontana Leira, 10.VII.2014, Cavalcante & Evangelista leg. 1 ♂; Castell'apertole, Centro *Emys* Piemonte, 27.V.2018, Cavalcante & Fiore leg. 1 ♂; Tricerro, Fontana Gigante, "Riserva Naturale Speciale di Fontana Gigante", 27.VIII.2015, Cavalcante leg. 1 ♀; VII.2015, Cavalcante leg. 1 ♀; Crescentino, "Palude di San Genuario, Riserva Naturale Speciale e Zona di Salvaguardia della Palude di San Genuario", 10.VI.2015, Cavalcante leg. 1 ♂; 23.V.2018, Cavalcante leg. 1 ♂; Albano Vercellese, "Parco fluviale delle lame del Sesia" (oxbow lake), 25.V.2017, Cavalcante & Fiore leg. 1 ♂; Trino, Madonna delle Vigne (fen), 06.VI.2017, Cavalcante leg. 1 ♂; Ronsecco, Lachelle, Prato Lungo (fen), 21.VII.2017, Fasano leg. 1 ♀; Palazzolo Vercellese, in an irrigation canal, 14.IV.2018, Cavalcante & Fiore leg. 1 ♂; wetland in the nearby of the village, "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", 05.V.2018, Cavalcante leg. 1 ♂. ***Emilia-Romagna***: *Province of Ravenna*, Punta Alberete, "Parco del Delta del Po", VII.2015, Cavalcante leg. 1 ♀.

Discussion

Dolomedes plantarius is closely associated with lowland wetlands, a delicate habitat increasingly subjected to alteration mostly due to changes in the water regime, physical modification, eutrophication and pollution. Just like other wetland species, as a result of habitat degradation and loss (Davidson 2014), populations of *D. plantarius* are

facing a remarkable decline. This has prompted a number of conservation authorities and several European countries to consider *D. plantarius* threatened with extinction (see Milano et al. 2018).

In relation to the progressive loss of its natural habitat, in 1983, *D. plantarius* was firstly reported in the IUCN Invertebrate Red Data Book as a species in need of conservation (Wells et al. 1983). Some years later, based on similar arguments, Collins & Wells (1987) reported *D. plantarius* among the threatened invertebrates in Europe, and proposed the species as a suitable candidate for inclusion in the Appendix II of the Bern Convention. The first official assessment of the conservation status of the species dates back to 1986, with the inclusion of *D. plantarius* in the *Vulnerable* category (IUCN Conservation Monitoring Center 1986). This status was maintained in the following updates of the Red List (Groombridge 1993; IUCN 1990; Wilcox 1988). After the publication of the 1994 IUCN Red List Categories and Criteria (version 2.3), *D. plantarius* was re-assessed and again placed in the *Vulnerable* category against criterion A (i.e. population size reduction; World Conservation Monitoring Centre 1996). However, being assessed before the publication of the new IUCN standards (version 3.1, 2001), the evaluation of *D. plantarius* remains outdated and hardly comparable with the recent ones.

Regardless of the outdated IUCN assessment, many European countries recognized the importance of the conservation of this spider and listed it on their Regional Red Lists. Currently, *D. plantarius* is cited in the Red List of the following European countries: Finland (Rassi et al. 2010), Norway (Henriksen & Hilmo 2015), Great Britain (Harvey et al. 2017), Flanders (Belgium, Maelfait et al. 1998), Germany (Blick et al. 2016), Austria (Carinthia; Komposch & Steinberger 1999), Czech Republic (Řezáč et al. 2015), Slovenia (Gajdoš & Svatoň 2001), and the region of the Carpathian Mountains (Gajdoš et al. 2014).

Concerning Italy, *D. plantarius* is mentioned as *Vulnerable* on the List of the Threatened Invertebrates of the Italian Fauna (Groppali & Priano 1992) and in the regional legislation of Lombardia, where it is listed in the D.g.r. 8/773 24.07.2008 among invertebrates of regional interest (see Milano et al. 2018).

In Italy, *D. plantarius* seems mostly distributed in the Northern district (Fig. 1), namely in Piemonte (Leroy et al. 2013; this work), Lombardia (Vugdelić, 2006 in Leroy et al. 2013), Veneto (Hansen 2002, 2007) and Emilia-Romagna (this work). However, the species has been formerly reported in central and southern Italy (see Tab. 1 and Fig. 1). Data from Toscana (di Caporiacco 1936) and Sardegna (Kraus 1955) refer to plausible records dating back to the first half of XX century. These isolated localities represent the southernmost records for the species in Italy and figure among the southernmost in Europe.

In accordance with Brignoli (1977) and van Helsdingen (1993), old citations dating back to XIX century are in need of verification, due to the confusion of *D. plantarius* with *D. fimbriatus*. Accordingly, before Bonnet (1930), *D. plantarius* was called *D. fimbriatus*, while *D. fimbriatus* was referred to as *D. limbatus* (Hahn, 1831), making many published records not reliable (van Helsdingen 1993). More specifically, the presence of *D. plantarius* in the province of Naples (Campania) reported by Trani (1902), is uncertain, being more likely based on specimens of *D. fimbriatus*. Similarly, records from the provinces of Pavia (Pavesi 1873) and Varese (Pavesi 1879) in Lombardia also need verification. However, the presence of the species in this region is validated by the records of Bonnet (1930) for Brianza and Vugdelić (2006) for the province of Varese. Similarly, data on the occurrence of *D. plantarius* in Veneto by Contarini (1843), were confirmed by the recent records of Hansen (2002, 2007).

The Italian situation is particularly critical, due to the geographical isolation of the populations at the periphery of the range. Peripheral populations are often genetically and morphologically divergent from central populations, and are particularly important for the evolutionary future of the species (Lesica & Allendorf 1995). In the case of *D. plantarius,* this frame is particularly dramatic in view of the predicted north shift of the species caused by climatic changes (Leroy et al. 2013). Accordingly, species distribution models predict a sharp decrease of the current suitable range, with a remarkable loss in the South and the appearance of newly-suitable areas in the North. In consequence of that, the condition of the Italian populations appears particularly critical: the Alpine barriers blocking the species dispersion northward, will preclude the species from reaching future more suitable areas located North of the Alps. Therefore, the only available option for these peripheral populations will be the unlikely local adaptation to the new environmental conditions.

Moreover, it seems likely that in the Italian northern districts, the progressive loss of wetlands resulting from agricultural exploitation have fragmented and jeopardized natural populations, which are now restricted to natural protected areas. This seems particularly remarkable in the provinces of Vercelli and Alessandria (Piemonte), where natural lowland wetlands are widely replaced by rice fields. Intensive agricultural use in these renowned rice-growing areas, associated with changes in the hydrological regime and water pollution due to agricultural products, resulted in a severe alteration of the natural ecosystems, with dramatic consequences on the survival of populations of *D. plantarius*. Accordingly, it seems likely that most of the populations currently survive in unexploited protected wetlands, i.e. "Parco fluviale del Po tratto vercellese/alessandrino e Riserva Naturale del torrente Orba", S.I.C. Fontana Gigante and S.I.C. Palude di San Genuario. Despite additional studies which may further support this hypothesis, we argue that the preservation of the wetland habitat is crucial for the conservation of the species. It seems clear that, in lack of specific conservation measures and

Table 1 – List of the Italian records of *Dolomedes plantarius* (Clerck, 1757).

Region	Municipality	Locality	Reserve	Author	Year of collection
Emilia-Romagna	Ravenna (RA)	Punta Alberete	Parco del Delta del Po	This work	2018
Lombardia	Pavia (PV)	Unspecified locality	–	Pavesi, 1873	1873
Lombardia	Varese (VA)	Isolino di Varese	Riserva Naturale Palude Brabbia	Pavesi 1879	1878
Lombardia	–	Unspecified locality in Brianza (MB)	–	Bonnet 1930	1930
Lombardia	Corgeno (VA)	Lago di Comabbio	–	Vugdelić 2006 in Leroy et al. 2013	2002
Piemonte	Verbania (VB)	Lake margin near Camping Isolino (Reed bed)	Riserva Naturale Speciale del Fondo Toce	Leroy et al. 2013	2009
Piemonte	Verbania (VB)	Lake margin near Camping Isolino (Reed bed)	Riserva Naturale Speciale del Fondo Toce	Leroy et al. 2013	2009
Piemonte	Candia (TO)	Shores of Lago di Candia (Reed bed)	Parco Naturale del Lago di Candia	Leroy et al. 2013	2010
Piemonte	Candia (TO)	Shores of Lago di Candia (Reed bed)	Parco Naturale del Lago di Candia	Leroy et al. 2013	2010
Piemonte	Candia (TO)	Shores of Lago di Candia (Reed bed)	Parco Naturale del Lago di Candia	Leroy et al. 2013	2010
Piemonte	Candia (TO)	Shores of Lago di Candia (Reed bed)	Parco Naturale del Lago di Candia	Leroy et al. 2013	2010
Piemonte	Candia (TO)	Shores of Lago di Candia (Reed bed)	Parco Naturale del Lago di Candia	This work	2010
Piemonte	Valenza (AL)	Lanca di San Bernardo (oxbow lake)	Parco fluviale del Po tratto vercellese/ alessandrino e Riserva Naturale del torrente Orba	This work	2011
Piemonte	Livorno Ferraris (VC)	Fontana Leira	–	This work	2014
Piemonte	Tricerro (VC)	Fontana Gigante	Riserva Naturale Speciale di Fontana Gigante	This work	2015
Piemonte	Crescentino (VC)	Palude San Genuario	Riserva Naturale Speciale e Zona di Salvaguardia della Palude di San Genuario	This work	2015
Piemonte	Palazzolo Vercellese (VC)	Nearby of Palazzolo Vercellese (irrigation canal)	–	This work	2018
Piemonte	Trino (VC)	Madonna delle Vigne (fen)	–	This work	2017
Piemonte	Albano Vercellese (VC)	Parco fluviale delle lame del Sesia (oxbow lake)	Parco fluviale delle lame del Sesia	This work	2017
Piemonte	Crescentino (VC)	Palude San Genuario	Riserva Naturale Speciale e Zona di Salvaguardia della Palude di San Genuario	This work	2018
Piemonte	Camino (AL)	Lanca di Brusaschetto (oxbow lake)	Parco fluviale del Po tratto vercellese/ alessandrino e Riserva Naturale del torrente Orba	This work	2018
Piemonte	Frassineto Po (AL)	Lanca Terranova	Parco fluviale del Po tratto vercellese/ alessandrino e Riserva Naturale del torrente Orba	This work	2018
Piemonte	Palazzolo Vercellese (VC)	Wetland in the nearby of the village	Parco fluviale del Po tratto vercellese/ alessandrino e Riserva Naturale del torrente Orba	This work	2018
Piemonte	Frassineto Po (AL)	Lanca Sesia Morto	Parco fluviale del Po tratto vercellese/ alessandrino e Riserva Naturale del torrente Orba	This work	2018
Piemonte	Livorno Ferraris (VC)	Castell'apertole. Centro Emys Piemonte	–	This work	2018
Piemonte	Tricerro (VC)	Fontana Gigante	Riserva Naturale Speciale di Fontana Gigante	This work	2015
Piemonte	Ronsecco (VC)	Lachelle, Prato Lungo	–	This work	2017
Sardegna	Sassari (SS)	Unspecified locality	–	Kraus 1955	1952
Toscana	Monterchi (AR)	Unspecified locality	–	Di Caporiacco 1936	1925
Toscana	Arezzo (AR)	Alluvial deposits of Tevere	–	Di Caporiacco 1936	1926
Veneto	Padova (PD) and Venezia (VE)	Padova and Venezia (unspecified locality)	–	Contarini 1843	1843
Veneto	Quarto d'Altino (VE)	San Michele Vecchio (oxbow lake of Sile)	–	Hansen 2002	1992
Veneto	Venezia (VE)	Laguna di Venezia, Valle Averto	–	Hansen 2007	1992

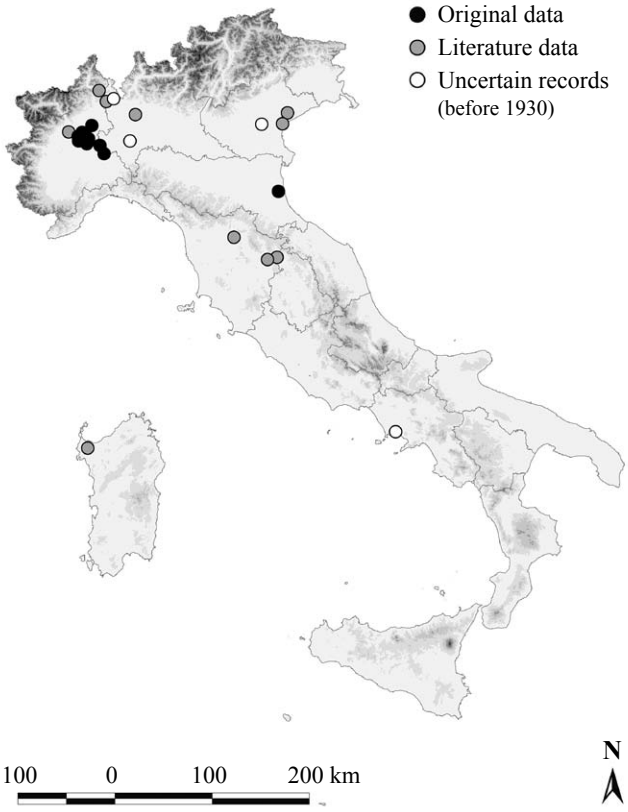

Fig. 1 – Distribution map of *Dolomedes plantarius* (Clerck, 1757) in Italy. Black dots refer to original data published in this work. Grey dots refer to literature data. Records before Bonnet (1930) are considered doubtful (white dots).

national legislation, the preservation of natural population of *D. plantarius* highly depends from the protection of other wetland species targets of conservation (i.e. amphibians and birds), with similar ecological requirements.

Therefore, if from one side we emphasize the importance of umbrella species in the preservation of *D. plantarius* in Italy, from the other we underline the need of a detailed understanding of the ecological requirements of this species in order to optimize conservation efforts. Moreover, we advocate specific monitoring of the Italian populations, aiming to assess their conservation status and to deepen the knowledge on the distribution in Italy of this species of elevated conservation concern.

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