

## The first record of *Eurygeophilus multistiliger* (Verhoeff, 1899) (Chilopoda: Geophilomorpha: Geophilidae) in the north west of the Iberian Peninsula: an ecological approach

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### Abstract

The first record of *Eurygeophilus multistiliger* (Verhoeff, 1899) in the north-west of the Iberian Peninsula is presented, thus expanding its known distribution in Spain and confirming its ability of living in temperate climates. A review of the known distribution of *E. multistiliger* is given. Ecological remarks and an identification key for the genus *Eurygeophilus* Verhoeff, 1899 are given.

**Key Words:** Cascadas de Oneta, Villayón, Asturias, oak, distribution.

### Resumen

Se presenta la primera cita de *Eurygeophilus multistiliger* (Verhoeff, 1899) en el noroeste de la península ibérica, ampliando su distribución conocida en España y confirmando su capacidad para desarrollarse en climas templados. Se realiza una revisión sobre la distribución conocida de *E. multistiliger*, se comentan algunas observaciones ecológicas y se proporciona una clave de identificación para el género *Eurygeophilus* Verhoeff, 1899.

**Palabras Clave:** Cascadas de Oneta, Villayón, Asturias, robledal, distribución.

### Introduction

*Eurygeophilus* Verhoeff, 1899 is a genus of chilopod of the order Geophilomorpha, family Geophilidae. Only two species are known in this genus: *Eurygeophilus pinguis* Brölemann, 1898 and *Eurygeophilus multistiliger* Verhoeff, 1899 (Bonato *et al.*, 2006). *E. pinguis* has been recorded from temperate areas of Spain (Barace & Herrera, 1980; Salinas, 1990; Bonato *et al.*, 2006), the French Pyrenees and Corsica (Geoffroy & Iorio, 2009; Zapparoli & Iorio, 2012), Great Britain (Barber, 2009; Barber *et al.*, 2010; BMIG Centipede Recording Scheme, unpub. data), the Austrian, Italian and Swiss Alps (Bonato *et al.*, 2006, 2016) and Slovenia (Vode & Kos, 2014) (Fig. 1A). *E. pinguis* has been rarely reported in Spain, with records from the Cantabrian municipality of Vega de Liébana in the eastern Picos de Europa mountain range (Bonato *et al.*, 2006), from the Quinto Real mountain range and the Irabia reservoir in the Navarre Pyrenees (Barace & Herrera, 1980; Salinas, 1990) and also from the Natural Park of Urbasa-Andía in the north-west of Navarre (S. Gregory, pers. comm.) (Fig. 1B). The species has been found in temperate deciduous forests (Barber, 2009; Bonato & Minelli, 2009), montane and sub-montane woodlands and mixed broadleaved forests, beechwoods and *Larix decidua* Mill. forests (Minelli & Iovane, 1987). On the other hand, *E. multistiliger* is present in Mediterranean countries of southern Europe and it has been recorded from Portugal (Verhoeff, 1988; Attems, 1952), Spain (Machado, 1952; Serra & Ascaso, 1990; Bonato *et al.*, 2006; Vadell & Pons, 2008), the French Pyrenees (Brölemann, 1926; Iorio, 2016), Sardinia (Italy) (Bonato *et al.*, 2006; Zapparoli, 2011) and Greece (Simaiakis *et al.*, 2016) (Fig. 1A). Reports of *E. multistiliger* in Spain are also scarce, with records from the Montseny mountain range in Barcelona (Serra & Ascaso, 1990) and Vidrá in Gerona (Machado,

1952). In addition, *E. multistiliger* has been reported from insular Spain in the Balearic Islands, namely in the Tramuntana mountain range of Mallorca (Vadell & Pons, 2008) (Fig. 1B). This species is only known to inhabit sub-Mediterranean woodlands (Bonato & Minelli, 2009), mountain pastures (Simiakis *et al.*, 2016) and cave systems (Vadell & Pons, 2008). In essence, distribution patterns and the environmental ecology of the *Eurygeophilus* species are poorly known. Hence, the main aim of this work is to enhance our knowledge of the distribution of *E. multistiliger* both in Europe in general and in the Iberian Peninsula and to provide ecological data and identification keys.

## Material and Methods

### Study area

The specimen was found near Cascadas de Oneta in the municipality of Villayón, located in northwestern Asturias (NW Iberian Peninsula) (Figs. 1B-C). Although a Mediterranean macrobioclimate is the norm for most of the Iberian Peninsula, more Atlantic macrobioclimates are present in several northern areas (Rivas-Martínez *et al.*, 2017). This is particularly the case for the study area which has a meso-temperate climate with annual temperature variation of between 10 and 14°C and abundant rainfall throughout the year (900-1400mm) (Díaz-González, 2015). Soil substrates are mainly composed of sedimentary and metamorphic rocks. The Oneta river gives rise to hygrophilic wooded areas which are dominated by a mixed forest of common oaks (*Quercus robur* L.) and chestnut trees (*Castanea sativa* L.). Other typical trees near the riverside are hazel (*Corylus avellana* L.), bay (*Laurus nobilis* L.) and ash (*Fraxinus excelsior* L.). Also, grassland and agricultural fields can be found near the village.

### Methodology

The specimen was hand collected and then fixed and preserved in 70% ethanol. A binocular stereomicroscope model NOVEX AP-2 (10-60x) was used for identification. Identification keys and works on the morphology of the *Eurygeophilus* species were consulted in determining the identity of the specimen (Verhoeff, 1899; Brölemann, 1926; Machado 1952, 1953; Bonato *et al.*, 2006, 2014; Vadell & Pons, 2008; Simiakis *et al.*, 2016). *Habitus in vivo* was photographed with a Panasonic Lumix DMC-FZ200 camera equipped with a Raynox DCR-250 macro lens. Maps were generated with QGIS Desktop 3.4.9-Madeira.

## Results

### *Eurygeophilus multistiliger* (Verhoeff, 1899)

#### Material examined

1♀, Spain: Cascadas de Oneta, [Parish of] Oneta, [Municipality of] Villayón – [Principality of] Asturias – 29T 688084 4814623 – 08/12/2019, 271m., D. Cabanillas leg. & det. 2019.

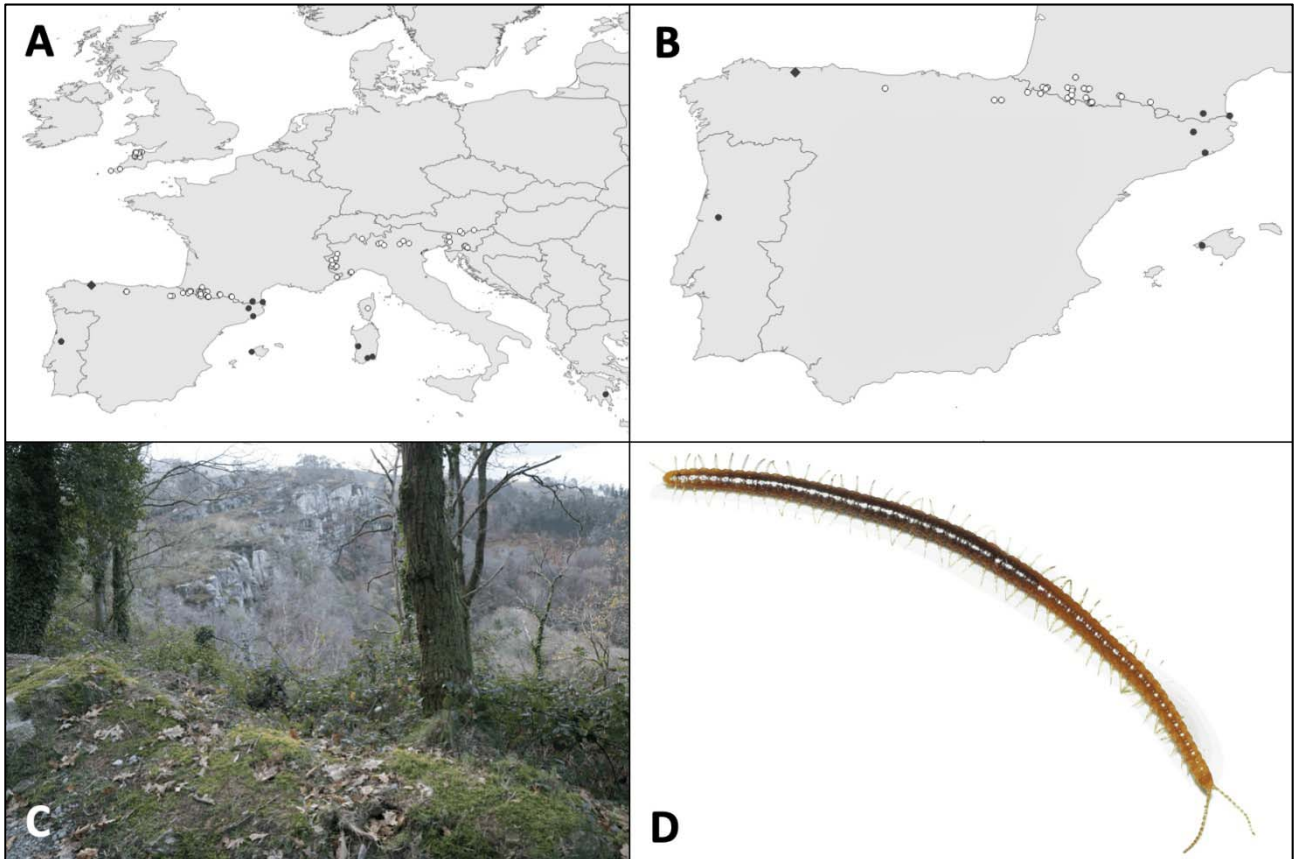
#### Short description

Antennae, head and ultimate leg bearing segment are orange, with a brownish orange trunk but dark grey in the posterior part (*in vivo*) (Fig. 1D). 53 leg pairs. Forcipular tergite short and narrowing anteriorly. Forcipular targunsula slender and flattened, showing a sting-like appearance. Forcipular coxosternite with diverging coxopleural sutures and no visible chitin lines. Short, stout and spine-like setae on the central part of the anterior metasternites (less apparent in the posterior region of the trunk). A transverse band of pores in the posterior part of the metasternites, in both the anterior and the posterior part of the trunk. Central sub-circular depressions close to the anterior edge of metasternites. Ultimate pleuopretergite not divided by sutural sulci. Ultimate leg bearing metasternite sub-rectangular

and 7/8 pores close to the internal margin of the coxopleura. 3/4 coxal pores are visible in dorsal view, close to the anterior margin of the metatergite.

### Ecological remarks

The specimen was found under a stone in the boundaries of an oak and chestnut mixed forest located between arable fields and the Oneta river.



**Figure 1: The genus *Eurygeophilus* in Europe.** A) European records of *Eurygeophilus pinguis* (white circles) and *Eurygeophilus multistiliger* (grey circles); B) Ibero-Balearic records of *Eurygeophilus pinguis* (white circles) and *Eurygeophilus multistiliger* (grey circles, the grey diamond indicates the new record); C) Study area in Cascadas de Oneta (Villayón, Asturias); D) *Habitus in vivo* of *E. multistiliger* (female).

### Identification key

*Eurygeophilus* is readily distinguished from other Spanish geophilomorph genera by having narrowed, slender and sting-like forcipular tarsungula (see Simaiakis *et al.*, 2016). *E. multistiliger* is primarily differentiated from *E. pinguis* by having short and well-marked setae on the metasternites (Bonato *et al.*, 2006). Other criteria useful to determine the species are the pattern of coxal pores, shape of the ultimate leg bearing metasternites and the number of leg pairs (Bonato *et al.*, 2006, 2014). In order to help when determining specimens of the genus *Eurygeophilus*, a simplified dichotomous key is presented (see Appendix 1 for key in Spanish). More detailed data and figures of the morphology are available in Bonato *et al.* (2006), Vadell & Pons (2008) and Simaiakis *et al.* (2016).

33-47 leg pairs. Without short and stout spine-like setae on anterior metasternites, at most several long setae. Ultimate metasternite trapezoidal, with lateral sides sub-parallel. Ultimate coxopleura with scattered ventral pores..... *Eurygeophilus pinguis* (Brölemann, 1898)

49-57 leg pairs. Short and stout spine-like setae on the central part of anterior metasternites. Ultimate metasternite sub-rectangular, with lateral sides converging posteriorly. Ultimate coxopleura with ventral pores close to the lateral margin of the metasternite..... *Eurygeophilus multistiliger* (Verhoeff, 1899)

## Discussion

*Eurygeophilus* is one of the least studied genera due to difficulties in getting significant samples to assess population dynamics or environmental preferences. It has been suggested that *Eurygeophilus* species show low collection rates because they seem to be rare and scarce in biological communities or maybe exhibit unusual habits which still remain unknown to researchers (Bonato *et al.*, 2006). However, the morphology of *Eurygeophilus* species has been studied in depth (Bonato *et al.*, 2006; Vadell & Pons, 2008; Simaiakis *et al.*, 2016), although intraspecific variations studies amongst the European populations are being developed. The female of *E. multistiliger* collected in Asturias agreed with previous descriptions and provided a new datum in regard to the number of leg pairs of a Spanish population (53 LP), which is within the normal range for the species (49-57 LP) (Bonato *et al.*, 2014).

The ecology of *E. multistiliger* is poorly known due to lack of representative data throughout its distribution area, which is currently unclear. The species was known to occur from the western Iberian Peninsula, Pyrenees, Balearic Islands, Sardinia and Greece, all of them classified as Mediterranean regions, although climatological conditions may vary at a smaller scale. This is particularly the case of the Iberian Peninsula and nearby areas. The Portuguese and both the Pyrenean and the pre-Pyrenean records were reported near the ecotone that exists between the Mediterranean and more Atlantic bioclimates. The Asturian record made it possible to confirm the capacity of *E. multistiliger* to survive in a truly temperate region of southwestern Europe. Hence, the Spanish records suggest that the species could occur in temperate regions further north or ecotone areas of southern Europe, so further studies should consider this possibility. It is particularly worth noting that localities where it has been recorded are peripheral areas, often coastal areas or near mountainous systems (Verhoeff, 1899; Brölemann, 1926; Machado, 1952; Bonato *et al.*, 2006; Iorio, 2016; Simiakis *et al.*, 2016). Several ecological factors modified by the nearby sea or mountains, such as moderated temperatures and high moisture levels, may be conditioning the presence of *E. multistiliger* and shedding light on the distribution pattern of this species in Europe. It is difficult to assess whether these environmental conditions are playing a significant role because temperature ranges or precipitation rates are usually not reported when describing the study areas. Nevertheless, environmental conditions of collection areas were checked in order to look for similarities in regard to temperature values and precipitation rates (Source: <https://es.climate-data.org/>). Although these data are not completely accurate and hence only a guide, the annual mean temperature values seem to coincide with *ca.* 16 °C in strictly Mediterranean areas and *ca.* 11 °C in temperate or mountainous areas, apparently not exceeding 25°C in the warmer season. The precipitation range in these areas was between 420-920mm although habitat and microenvironmental conditions could be of utmost importance. In this sense, little is known about the habitat preferences of *E. multistiliger* because records are scarce and niche segregation is actually not apparent. However, the species is expected to be found in humid locations, thus agreeing with the Spanish records in woods, mountainous systems and caves (Machado, 1952; Serra & Ascaso, 1990; Vadell & Pons, 2008). The possibility exists that *E. multistiliger* could live in deeper layers of the soil as Zapparoli (2011) reported, or maybe reach strictly subterranean environments and exhibit an eutroglophilous role, thus hindering its detection in epigeal environments. However, only one specimen has been found in a cave (Vadell & Pons, 2008), so the relation between such environments and the presence of *E. multistiliger* needs clarification.

In summary, the Asturian record of *E. multistiliger* provides new geographical and ecological data and confirmed that this species is able to survive under temperate climatic conditions. Further studies are needed to improve our knowledge of the environmental factors that condition the presence of *E. multistiliger* in southern Europe.

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### Appendix 1: Identification key in Spanish.

- 33-47 pares de patas. Sin sedas cortas y gruesas con forma de espina en los metaesternitos anteriores, a lo sumo algunas sedas largas. Último metaesternito trapezoidal, con los laterales subparalelos. Coxopleuras terminales con poros ventrales de forma dispersa.....  
 ..... *Eurygeophilus pinguis* (Brölemann, 1898)
- 49-57 pares de patas. Sedas cortas y gruesas con forma de espina en la parte central de los metaesternitos anteriores. Último metaesternito subrectangular, con los laterales convergentes posteriormente. Coxopleuras terminales con poros ventrales cerca del margen lateral del metaesternito...  
 ..... *Eurygeophilus multistiliger* (Verhoeff, 1899)