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OPILIO CANESTRINII (THORELL, 1876) (ARACHNIDA, OPILIONES, PHALANGIIDAE), THE MOST RECENT HARVESTMAN SPECIES OF THE IBERIAN FAUNA

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Abstract: The Italian species *Opilio canestrinii* (Thorell, 1876) became an invasive species at the beginning of the 20th century and in recent decades has accelerated its expansion, even reaching Norway in the North, Ukraine in the East, as well as North America. Reaching southern France in 2019, the arrival to the Iberian Peninsula was expected and finally happened. Four photographic records for Catalonia obtained since 2019 by citizen scientists are documented and discussed.
Key words: photo-recording, invasive species, Catalonia, citizen science

***Opilio canestrinii* (Thorell, 1876) (Arachnida, Opiliones, Phalangiidae), el más reciente opilión de la fauna ibérica.**
Resumen: La especie italiana *Opilio canestrinii* (Thorell, 1876) se convirtió en una especie invasora ya a comienzos del s.XX y en las últimas décadas ha acelerado su expansión llegando ya incluso hasta Noruega, Ucrania, y Norteamérica. Alcanzado el sur de Francia en 2019, la llegada a la Península Ibérica era esperable, lo que ya ha ocurrido. Se documentan y discuten cuatro registros fotográficos para Cataluña obtenidos desde 2019 por ciencia ciudadana.
Palabras clave: registro fotográfico, especie invasora, Cataluña, ciencia ciudadana

Introduction

Thorell (1876) described *Phalangium Canestrinii* from both ends of the Italian Peninsula, Casella in Liguria and from Calabria, and Simon (1879) described *Phalangium segmentatum* from Corsica. Roewer (1923) considered them to be synonyms of *Opilio parietinus* (De Geer, 1778) despite that both Thorell and Simon expressly differentiated them from *O. parietinus*. Spoek (1962) described *Opilio ravennae* from Ravenna and *Opilio zangherii* from Monte Fumaiolo, both in the northeast of the Apennine Peninsula. Both were considered conspecific by Martens (1978), giving priority to *O. ravennae* and providing the first distribution map of this species, which already included some locations in Switzerland and Germany.

Gruber (1985) unraveled the taxonomy of *O. canestrinii* (downgrading *O. ravennae* and *P. segmentatum* to junior synonymy), with a morphological and faunistic study, including its distribution map (Fig. 1A); following Martens (1978), Gruber established a primary area for Sicily and the Italian peninsula and an expansive secondary area, probably anthropogenic, in the Alpine region (Northern Italy, Switzerland, Tyrol, Lower Austria) and in Central Europe; this expansion would have already begun at the beginning of the 20th century, having documented its presence in Berlin in 1922. Shortly after, Gruber (1988) established its presence in Tunisia and Algeria, considering them to be part of its primary area.

Afterwards, the number of reports describing the expansion process is noticeable. Blick & Komposch (2004) make a partial summary of the invasion process and Rozwałka & Staręga (2012) completed it with subsequent works (references there): Poland in 1979, Denmark in 1987, southern Sweden in 1988, the Netherlands in 1993, the Czech Republic in 1995, Belgium in 1998, Slovakia in 1999, England in 2000, Slovenia in 2002, France in 2009 (with records from 2004 and 2008), and Hungary in 2010. It has been subsequently recorded from Luxembourg (Muster *et al*., 2013). In recent years, citizen science websites, especially iNaturalist.org on a global scale and biodiversidadvirtual.org on an Iberian scale, have emerged as useful tools for detecting and following biological invasion processes, especially for conspicuous species, which often precede scientific publication. For *O. canestrinii*, the first records from iNaturalist for other European countries are (Fig. 1B): Norway in 2017, Ukraine in 2017, Lithuania in 2018, Latvia in 2019, Croatia in 2019, Romania in 2020, Bulgaria in 2020, Albania in 2020, and the process has already started in North America: USA in 2020 and Canada in 2020.

In southwestern Europe, the first record for mainland France, ruling out Simon's (1879: 206) statement that it "probably inhabits the Alpes-Maritimes" appeared in a field guide (Bellmann 2000) that mentions it for the Lorraine region, bordering Germany and Belgium. The following records for France also correspond to northern regions (Iorio 2007, Delfosse & Iorio 2009, Iorio & Delfosse 2010). Its progression to the south (Fig. 2C) has been documented by Bal (2018) and Dubois (2018a, 2018b), recording it from the departments of Ardèche in 2013, Côte-d'Or in 2013, Val d'Oise in 2013, Haute-Savoie in 2014, Isère in 2016 and Loire in 2017, and some photographic records from iNaturalist.org: Alpes-Maritimes (Sept 2018), Cantal (Aug 2019), Haute-Loire (Aug 2020), Puy-de-Dôme (Sept 2021), Charente-Maritime (Jul 2021), and the two closest observations to the Iberian Peninsula: Blagnac (June 2019) and Toulouse (July 2020), both in Haute-Garonne. Therefore, given the expansion's speed, its arrival to the Iberian Peninsula could have already occurred.

Observations for the iberian peninsula (Figs. 2, 3)

Four observations by citizen scientists have been tracked for this species:

El Regàs, Arbúcies (Massís del Montseny, Girona, 41.82417º, 2.44717º, 530 m), Javier A. Canteros, 11/viii/2019; a female with reddish-brown opisthosomal areas on a light brown background (Fig. 2A) [https://www.inaturalist.org/observations/71138855].

El Regàs, Arbúcies (Massís del Montseny, Girona, 41.82201º, 2.44750º, 590 m), Javier A. Canteros, 31/viii/2019; a female with an orange-brown back on a yellowish background (Fig. 2B) [https://www.inaturalist.org/observations/71518382].

Av. Josep Crous, Cànoves i Samalús (Barcelona, 41.69345º, 2.35421º, 350 m), Noé Liria, 26/x/2020; a gravid female with grayish-brown opisthosoma and a lighter central stripe (Fig. 2C) [https://www.inaturalist.org/observations/63568301].

"Font d'en Nando", Montesquiu (Barcelona, 42.113688º, 2.205787º, 572 m), Marcel Nadal, 15/viii/2021; a male with a contracted reddish-brown opisthosoma (Fig. 2D) [https://www.biodiversidadvirtual.org/insectarium/Opilio-canestrinii-img1334276.html].

However, an observation loaded by Santiago Serrano from Esteribar (Navarra, 42.9457º, -1.5015º; 13/vi/2021) [https://observation.org/observation/219953201] has been tagged by the observation.org software as *Opilio canestrinii*, but it represents a female of *Phalangium opilio* Linnaeus, 1758.

Other than these, in the Opiliones collection of the Universidad del País Vasco, the first author has tracked a sample ZUPV/4543 which contains a male of *O. canestrinii*; it was provided by Sergio Henriques (Invertebrates Conservation, Indianapolis Zoo) and collected the 06/ix/2006 from "Barcelona (locality uncertain)". The provenance was then considered uncertain because the specimen belonged to an exotic species for the Iberian Peninsula, and the collector was unsure of its origin.

External diagnostic characters of *Opilio canestrinii*

Phalangioids are the most popularly recognizable harvestmen in Europe, those with an ovoid body and long legs. In Europe they are represented by two families, Phalangiidae and Sclerosomatidae, whose most obvious external difference is the absence vs. presence of rows of denticles on the edges of some to all the coxae of the legs, which is only noticeable with a magnifying lens. As some diagnostic characters only occur in adults, such as the rows of coxal denticles, it should be verified that the anterior edge of the genital operculum is separable from the ventral body wall; as this is not the case in juveniles, in which the absence of coxal denticles would not be diagnostic. Given the biological cycle of most European Eupnoi, adults are only found from mid-summer onwards.

Opilioninae is a subfamily of Phalangiidae easily diagnosed by the absence of both, a robust ventral tooth in the basal segment of the chelicerae and denticles in the supracheliceral laminae (a cuticular rim located above the insertion of the chelicerae), characters only visible through a stereomicroscope. If the lack of both features were confirmed, it would be a harvestman of the genus *Opilio*; since there is no native Iberian species of this genus, it would probably be *Opilio canestrinii*.

This species is easily recognizable due to its pattern and coloration: a body with a coloration from rusty-orange to reddish brown, white ocular tubercle, a couple of small white spots on the cephalothorax front edge, and the back part with white-yellowish transverse lines bordering posteriorly (more distinctly on sides) each of the segments of the abdomen; and long, thin dark legs with five rows of denticles.

Discussion

The arrival of *Opilio canestrinii* to the Iberian Peninsula must have occurred several years before it was detected, a common circumstance when the expanding species is not conspicuous. Leaving apart the uncertain record from "Barcelona" (city or province?), which would advance its presence in Spain for 13 years, the first Iberian observations date from August 2019, but J.A. Canteros did not upload them to iNaturalist.org until March 2021, so the first published record would be from October 2020, due to N. Liria. These three observations, correctly determined by **bbinsecte** (=Bernard Bal, who tagged it as " first observation for Spain !!!") and **pdubois** (=Pascal Dubois), went unnoticed by the authors of this note. They were only discovered, after the identification of the observation of M. Nadal, during the corresponding search for information on the range expansion.

Those observations were made in August and October, which would correspond to a univoltine stenochronous cycle (Belozerov, 2012): egg laying in autumn, eggs in winter diapause, birth and growth in spring and maturation in summer, with nymphal phases linked to the ground and the adult phase ascending to the herbaceous-shrub stratum, which makes it more conspicuous.

We hardly know how the process occurs, but surely the range expansion is facilitated by the transport of goods, since there are more than 200 km linear distance between the southernmost French record (Blagnac near Toulouse) and the Catalonian Montseny massif, whose records date from June and August 2019 respectively. Similar or greater distances between the closest records are not uncommon; according to iNaturalist.org records, there are more than 550 km between the areas of Lublin in Poland (first record Aug 2017) and Kyev in Ukraine (first record 26/viii/2017). The crossing of the English Channel and the Irish Sea to reach Great Britain and Ireland respectively, or the arrival at the Baltic islands of Bornholm and Gotland, also according to records in iNaturalist.org, has had to be done by marine transport. In this sense, Vestbo *et al*. (2018) show for Denmark that the proportion of harvestmen of non-native species is higher in areas characterized by more car and truck traffic than in areas where human disturbance was less frequent. Obviously, the first observations in a certain area or locality are not of the individuals that have just arrived, which would be undetectable due to their low number, but of the individuals of the second or following generations; logically, it is impossible to determine how much time elapsed between colonization and first detection. There are no data on the fecundity of *O. canestrinii*, but there are data on *Opilio parietinus* (DeGeer, 1778) which would lay 100-200 eggs/year in several clutches (Machado & Macías-Ordóñez, 2007), nor on mortality during the nymphal phases. Accepting for *O. canestrinii* the minimum value of fertility and a nymphal survival to maturation and reproduction of 10%, from an initial fertilized female there would be 5 egg-laying females in the first year, 25 in the second and

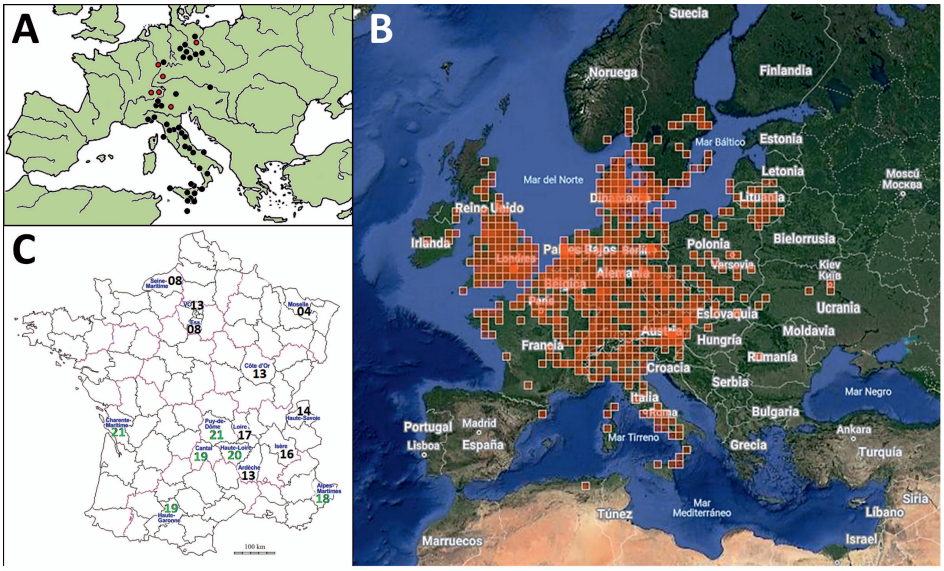


Fig. 1. Geographic distribution of *Opilio canestrinii* (Thorell, 1876). **A**. Known distribution until 1985 (modified from Gruber 1985: fig. 44, spotting in red localities cited by Martens (1978) north of the Po River). **B**. Distribution in Europe based on the 4,487 photographic observations (research grade) uploaded to iNaturalist.org until 22/03/2022. **C**. Departmental data for France from published records (years in black) and photographic observations in iNaturalist.org (years in green, only for southern France).

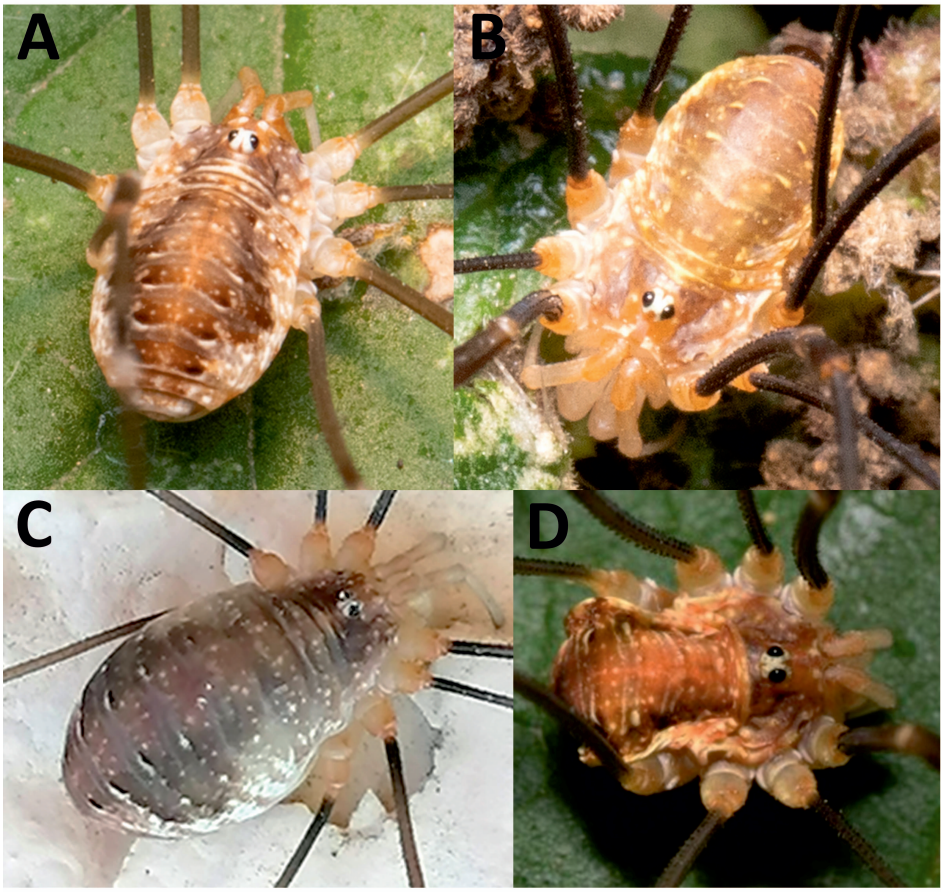


Fig. 2. Clippings from the photographic records of *Opilio canestrinii* (Thorell, 1876) for Catalonia. **A**, **B**: Arbùcies (Girona), by Javier A. Canteros. **C**: Cànoves i Samalús (Barcelona), by Noe Liria. **D**: Montesquiu (Barcelona), by Marcel Nadal.



Fig. 3. Distribution of *Opilio canestrinii* (Thorell, 1876) in the Pyrenean region based on photographic records from iNaturalist.org (red circles) and Biodiversidadvirtual.org (blue circle).

about 3,000 in the fifth year (but up to 10 million with a maturation rate of 50%). The rate of spread after initial colonization can be very high: the citizen science-based study by Enghoff (1988), proposed after its detection in Denmark in 1986 (Enghoff, 1987), documented the presence of *O. canestrinii* in more than 200 localities evenly distributed all over the country. According to Vestbo *et al*. (2018), the arrival in Denmark must have occurred in the early 1980s.

Two other large invasive episodes caused by harvestmen species have been described in Europe. The reconstruction of the expansion process of *Dicranopalpus ramosus* (Simon, 1909), originally described from Morocco, was complex because the first European record (Sankey & Storey 1969) was from England as *Dicranopalpus caudatus* Dresco, 1948, a species described from Portugal. This species was considered a synonym of *D. ramosus* by Staręga (1973) until Wijnhoven & Prieto (2015) revalidated it. Sankey & Storey (1969) also cited it from Biarritz (Pyrénées-Atlantiques) and the southwest of France would be the point of origin of the expansion of *D. ramosus* through Europe. Wijnhoven & Prieto (2015: Fig. 6-7) sum up the colonization process to the west along the Cantabrian Mountains (reaching Galicia in 2014) and to the north across France, reaching Great Britain in 1970, and progressing towards Central Europe (Netherlands in 1993, Germany in 2002, Denmark in 2007, Sweden in 2012), and Austria and Hungary in 2018 based on data from iNaturalist.org.

The other invasive event was by *Leiobunum* "sp. A", an unidentified sclerosomatid species first detected in 2004 in Nijmegen (Netherlands) and characterized by a large blackish body and very long legs that tend to form aggregations reaching hundreds of individuals (Wijnhoven *et al*., 2007). Molecular data (Brown, 2019) suggest that it is related to *L. rotundum* (Latreille, 1798). Already in 2007, the cited authors also point it out from western Germany, northern Switzerland and the extreme east of Austria. Later it has been cited from northeastern France (Noordijk *et al*., 2010), Belgium, Luxembourg, Denmark and finally Poland (references in Rozwałka *et al*. 2017), and also to the UK (Pendleton & Pendleton 2015) and Ireland 2021 (https://www.inaturalist.org/observations/92269502). Towards southern France, Tillier (2015) cites it from Parisian region and subsequent observations in iNaturalist.org record it from the Cantal department (Massif Central) in 2018, where it seems to have arrived from the Alps since it was observed in Haute-Savoie in 2014 (Bal, 2018).

The probability of photo-recording of a species mainly depends on several factors; apart from size, abundance and visibility of individuals, the rate of photographing activity, which is highest around populated areas, where the majority of nature photographers reside, and most of this activity is done in free time; furthermore, as many other synanthropic species, *O. canestrinii* is more abundant in peri-urban areas. Georeferenced photographic detection of fauna and flora has become a popular field of citizen science; although there are many initiatives, we cite only three (cited figures for 22/iii/2022). The global **iNaturalist.org** website houses 92.144 million records by 2.042 million observers determined by consensus of volunteer specialists, of which 4667 are of *O. canestrinii*. The European **observation.org** website, sponsored by Naturalis Biodiversity Center, houses 4.918 million photo-based records by 17924 observers determined by an automatic image recognition application (and posterior validation by human identifier), of which 866 are of *O. canestrinii*. The Spanish **biodiversidadvirtual.org** website, mainly covering the Iberian Peninsula, Balearic Islands and Macaronesian archipelagos, houses 2.285 million photos by 5411 observers (excluding some 52500 extraterritorial photos, but many records include 2 or more photos) to be determined by both amateur and professional volunteer specialists. Such field task force, although mainly composed of volunteers during their free time and surely biased toward more striking and large specimens, is comparable, if no greater, to professional field work for detecting distributional changes and unnoticed new taxa. As an example, the online journal "**BV News Publicaciones Científicas**", hosted at **biodiversidadvirtual.org** website and dedicated to nourishing the scientific literature with new records or description of new taxa discovered by website collaborators, has published 122 contributions until March 2022 when Garrido-García (2022) records 286 invertebrates for a single UTM cell of Granada, including 36 provincial records and 16 Andalusian records. Another significant case of the contribution of citizen science for Opiliones is the range extension of a recently described new genus of Phalangioidea endemic to New Caledonia (Giribet *et al*., 2021).

It is soon to study the ecological changes that will provoke the arrival of an invasive species to the Iberian Peninsula. At the moment, this paper only aims to make official the 136th Iberian species in the order Opiliones and to make a claim to citizen scientists to continue monitoring the geographic progression of this species across Catalonia and the rest of the Iberian Peninsula.

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