

Rapid Distribution Updates for Arachnids of Conservation Concern through Citizen Collaboration: the Case of the Spider *Macrothele calpeiana* (Walckenaer, 1805) (Mygalomorphae: Macrothelidae)

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Despite the severe decline that arthropod communities are experiencing worldwide, there are still basic scientific knowledge deficits that are preventing policymakers from implementing optimal decisions for their conservation. Chorological maps, fundamental conservation tools, are not available for most species or are not updated periodically. Limited funding or an unaffordable workforce are some of the impediments to surveying species distribution. To address these challenges in the near term, several solutions have been proposed. One option involves engaging citizens in the collection of data, a method not commonly employed for studying spiders. Here, the distribution of the only spider species protected by EU legislation, the elusive Iberian endemism *Macrothele calpeiana* Walckenaer, 1805 (Macrothelidae) is updated by using traditional sources, but mostly citizen records, both in its native range and for the whole European continent, given that the species has been frequently exported to diverse countries. The native range has been slightly expanded and currently occupies 156 UTM 10x10 grid cells, which means ca. 2.7% of the total area of the Iberian Peninsula. Citizen collaboration proved decisive, especially to generate recent information in a short period of time: over just the last 10 years, data from third parties covered 35 grid cells, 17 of them new to science. On the other hand, *M. calpeiana* has been reported as non-native in eight different countries. In some of them, such as France and Italy, the reports are recurrent. The outcomes of methodology used in the study were highly encouraging, showcasing its

potential for implementation by budget-constrained administrations to effectively monitor this species of conservation concern.

Keywords: Araneae, arthropod conservation, Iberian Peninsula, protected species, Wallacean shortfall

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BACKGROUND

In the current scenario of global change, arthropod communities, which hold key roles in practically all the Earth's ecosystems, are suffering from severe declines worldwide (Hallman et al. 2017; Seibold et al. 2019; Cardoso et al. 2020; Sánchez-Bay and Wyckhuys 2021; Donkersley et al. 2022 among many others). Despite that, the scientific community lacks essential knowledge on arthropods. Their overwhelming diversity and ubiquity, and the underfunding of basic studies on arthropod ecology (Cardoso et al. 2011) are some of the issues that prevent the scientific community from addressing this crisis appropriately. Given the pressing need to generate new information in an agile way, diverse tools, complementary to classic science, have been proposed, such as the collaboration of citizens in data collection (Devictor et al. 2010; Dickinson and Bonney 2012; Theobald et al. 2015; Ratnieks et al. 2016).

In this context, it is worth highlighting that even the species distribution is not known adequately for most arthropods, a deficit termed as “Wallacean shortfall” by Lomolino (2004). Usually, information available for delineating ranges is based on non-representative, very poor data (Diniz-Filho et al. 2010; Cardoso et al. 2011). In this way, a rich and fresh database of distribution records is essential for generating chorological maps, one of the most basic tools in conservation ecology (Margules and Pressey 2005). Among other tasks, chorological maps are fundamental to

identifying those areas of special interest for conservation (Pyle et al. 1981; Armstrong 2002; Bosso et al. 2018), generating potential distribution models (Mammola et al. 2011; Bombi et al. 2019), and inferring population trends and dynamics, if proper time ranges are available (Thomas 2005; Rocha-Ortega et al. 2020).

In spiders, with over 53,000 species described to date and around 800–1,000 newly described every year since the 2000s (WSC 2025), the Wallacean shortfall is especially pronounced compared to other arthropod taxa, owing both to the intrinsic challenges of the group and to the scarce information available for most species (Santos et al. 2017). This context could partly explain why, although there are reasons to think that spiders may be similarly affected as insects in terms of declining, there are very few studies on this issue (Samu et al., 2023), leaving not only newly described but also long-known species in potentially vulnerable position. Limited knowledge of species biology and distribution often goes hand in hand with a lack of understanding of their genetic structure or population boundaries (e.g. Decae et al. 2014). As a result, the risk of overlooking severely impacted species complexes or genetically important populations that are not being properly protected is particularly high in spiders (Su et al. 2016; Mendoza and Francke 2017; Responde et al. 2024); a scenario especially common in groups as mygalomorphs (Hedin et al. 2019). This, combined with the general neglect of spiders in conservation policies (Cardoso et al. 2025 and the literature cited), underscores a pressing conservation issue.

Even so, and despite the current limitations, as many as 301 species are listed as threatened in Europe alone, according to IUCN criteria (Milano et al. 2021). With a much deeper state of knowledge, it is reasonable to suggest that this number would be considerably higher, in line with what has been reported for other well-prospected menaced groups (Hallmann et al. 2017; IPBES 2022; Raghavendra et al. 2022). For the moment, only one species is protected by EU legislation: *Macrothele calpeiana* (Walckenaer, 1805) (Mygalomorphae: Macrothelidae) (Milano et al. 2021). This microendemism restricted to the southwest of the Iberian Peninsula is protected under two legal frameworks: the Bern Convention and the Habitat Directive – Annex IV: Animal and plant species of community interest in need of strict protection –environment.ec.europa.eu/topics/nature-and-biodiversity/habitats-directive_en–. Although the initial motivation to include the species in these legislations is now obsolete, the fragmentation and deep genetic divergence between the

populations obtained in genetic studies, as well as their endemism, supported the preservation of their legally protected status (Arnedo and Ferrández 2007).

However, nor for this protected species are periodic surveys on its status even though its habitat is considered as prone to anthropic pressures (Ferrández 2004 2011; Arnedo and Ferrández 2007; Ferrández et al. 2001 2008) and on the other hand is frequently reported in nonnative areas, an issue mainly caused by accidental introductions due to trade of ornamental trees from Spain and Portugal (Bellvert and Arnedo 2016 and the references cited there). Although the administrative frameworks in which they are included provide for periodic monitoring, the challenges posed by periodically inspecting the distribution of the species –similar to those facing other arthropod monitoring efforts (see Cardoso et al. 2011; Méndez and Cortés-Fossati 2021)– largely hinder such initiatives. As a result, chorology has remained unupdated for more than ten years, since the publication of the *Atlas and Red Book of Threatened Invertebrates of Spain*, where Ferrández (2011) authored the species account.

It is worth noting that there is an online 2013–2018 update under the Habitat Directive on the website of the Ministry of Ecological Transition and the Demographic Challenge (<https://cdn-portal-miteco-stage.adobecqms.net/>), but this update provides no clarification or references for the few new data included—which appear to come from studies published up to that period—. This map version is currently available with references on the website of the Spanish Inventory of Natural Heritage and Biodiversity (<https://iepnb.es/>), although it still cites the 2011 publication as a source, which is inaccurate. Currently, its conservation status in Spain is considered unfavorable based on these data (MITECO, 2020).

To date, few studies focused on spiders and assisted with citizen collaboration or citizen collected-data have been carried out (Campbell and Engelbrecht 2018; Hart et al. 2018; Wang et al. 2018; Jiménez-Valverde et al. 2019; Bauer 2021; Cortés-Fossati et al. 2022; Méndez et al. 2023; Pekár et al. 2025), a fact that could be explained by the difficulty of engaging users in research on animals perceived as harmful (Campbell and Engelbrecht 2018). However, in some, very specific spider taxa, usually large in size, with few species and unequivocal characteristics – such as a structure or pattern unique to the species– photographic identification, that does not imply short distance contact, is reliable (e.g., Jiménez-Valverde et al. 2019). In these cases, citizens should only

send pictures of the monitored species to an intermediary platform, or directly to the researcher, without further interaction with animals. Photo-sharing platforms have demonstrated their ability to increase sample sizes in a determinant manner for rare, threatened species (Fontaine et al. 2022) and for researchers, using these records constitutes a quick, cheap method to maintain monitoring over time. *Macrothele calpeiana* could benefit from this type of citizen-assisted study to generate periodically updated distribution maps. The nocturnal, fossorial lifestyle of the species is a clear handicap for its study, and citizens' opportunistic observations may be a valuable complement to traditional sampling campaigns. On the other hand, the defining features of the species make the probability of misidentification very low (Ferrández 2011).

Here, the chorology of *Macrothele calpeiana* is updated both in the native and non-native areas by exploring potential novel data sources alongside traditional ones, such as published records in literature and de novo field data. The contribution of these sources to generate rapid distribution updates on the species is discussed, as well as the distribution maps obtained and their ecological implications, both for the native and the non-native range.

MATERIALS AND METHODS

A database of records has been compiled without any geographical restriction. The dataset was composed of three different sources: 1) own field records –from 2012 to 2022–; 2) literature records –23 works compiled via repositories, manual searching, or sent by colleagues as of 2022– and 3) records collected from third parties. This last category includes data taken by citizens and sent by mail to the author, observations shared publicly on the Internet –websites, social networks such as Instagram or Twitter– and observations uploaded to Biodiversidad Virtual –until September 2021– and Observation.org, and iNaturalist platforms –until April 2022– with the etiquettes “*Macrothele+calpeiana*”. Only observations with reliably identifiable specimens, georeferenced locations, and recorded dates were considered.

The identification of specimens, both in the field and in photographic resources of the data provided by third parties, was carried out according to Nentwig et al., 2022. Among *Macrothele*

calpeiana's distinctive morphological features, the most notable and useful in photographic identification are its large size –probably the largest species in Europe, reaching a maximum body length of 34.7 mm in females– uniformly black, or dark grey habitus, distinctive eye arrangement, large chelicerae, and especially, the posterior lateral pair of spinnerets, which are long and three-segmented. Within its distribution range, the most similar species could be *Amblyocarenum walckenaeri* (Lucas, 1846) (Cyrtauchenidae), which in fact, is markedly different from the target species (see Nentwig et al. 2022 and the references cited there) .In Europe, only one other species of *Macrothele* is present: *M. cretica* Kulczyński, 1903, markedly small compared to *M. calpeiana* and restricted only to the island of Crete, in Greece. Misidentifications or photographs with insufficient quality found in citizen-collected data were discarded. However, they were counted to calculate accuracy rates in records received.

The author constructed three maps: 1) an updated distribution of the species in the native zone, at UTM 10x10 grid resolution, with records from 1932 to 2023, broken down by source of origin; 2) a distribution map based exclusively from records of the last decade –2012 to 2022– to eliminate the effect of historical data on the results also broken down by source of origin at the same UTM 10x10 grid resolution; and 3) a general distribution map for Europe, including non-native records, in georeferenced point format. For map construction, the software used was QGIS ver. 3.24.1 Tisler (QGIS Development Team, 2020) using EPSG25830 coordinate system for native range and EPSG3035 coordinate system for the European range. Shapefile layers used for composition were “Terrestrial 10×10 km grid” from the Ministerio para la Transición Ecológica, “líneas límite provinciales” from the Instituto Geográfico Nacional (centrodedescargas.cnig.es) and “countries 2020” from European Statistical Office (ec.europa.eu/eurostat).

RESULTS

General figures

Overall, the compiled database included 408 georeferenced records from 1849 to 2022. Literature provided 250 records, collected between 1932 and 2022. Observations from third parties provided 148 valid records, compiled between 2002 and 2022 and covered 50 grids, of which 18 were new to science. Own data provided 8 records, compiled between 2014 and 2022 and covered five grids, one of them not previously recorded. The final dataset can be consulted in Table S1.

Within the native range, the records covered 150 grid cells, 145 of them located in Spain (Fig. 1), which represent ca. 2.72% of UTM grid cells of Spanish peninsular territory. The Spanish provinces of Cádiz and Málaga contained most of the total distribution, with ca. 72.66% of grids in their territory – 57.33% for Cádiz – and also the majority of records–168 for Cádiz and 74 for Málaga–. This important concentration coincides with large nature reserves such as the Sierra de Grazalema Natural Park and the Alcornocales Natural Park (province of Cádiz), and the Sierra de las Nieves Natural Park (province of Málaga). *Macrothele calpeiana* records ranged from sea level in Cádiz, Puerto Real, or Málaga, up to 1380 MASL in Granada.

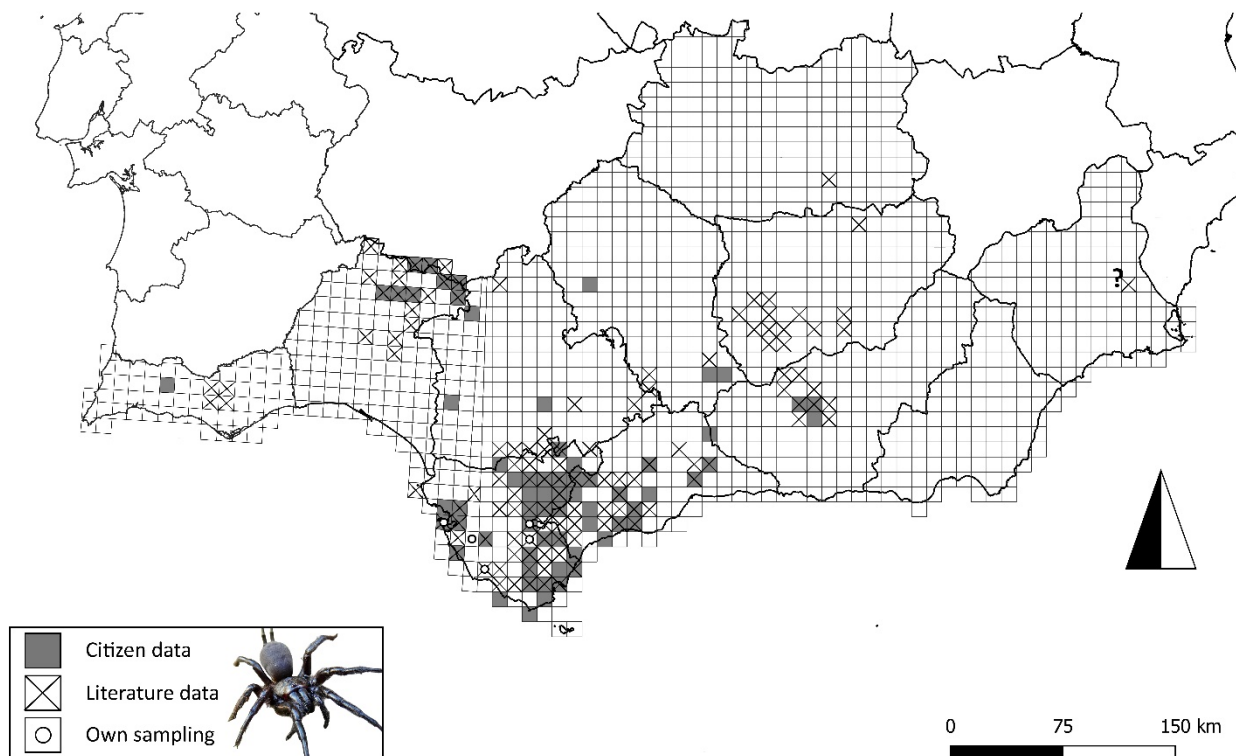


Fig. 1. Updated 10x10 UTM distribution of *Macrothele calpeiana* in its native range. Mapping has been carried out using the total number of records from all sources, from 1932 to 2022. Grey: grids provided by citizen science. Cross: grids provided by literature White dots: own records.

Outside the native range, the species accumulated 45 observations and has been registered in seven European countries (Fig. 2). Most of these observations are recent, dating from 2016 onward. For the moment, there is only a report of an established population, (Bellvert and Arnedo 2016), although no follow-up studies have been carried out in other areas, and consequently, scant information is available on the subject.

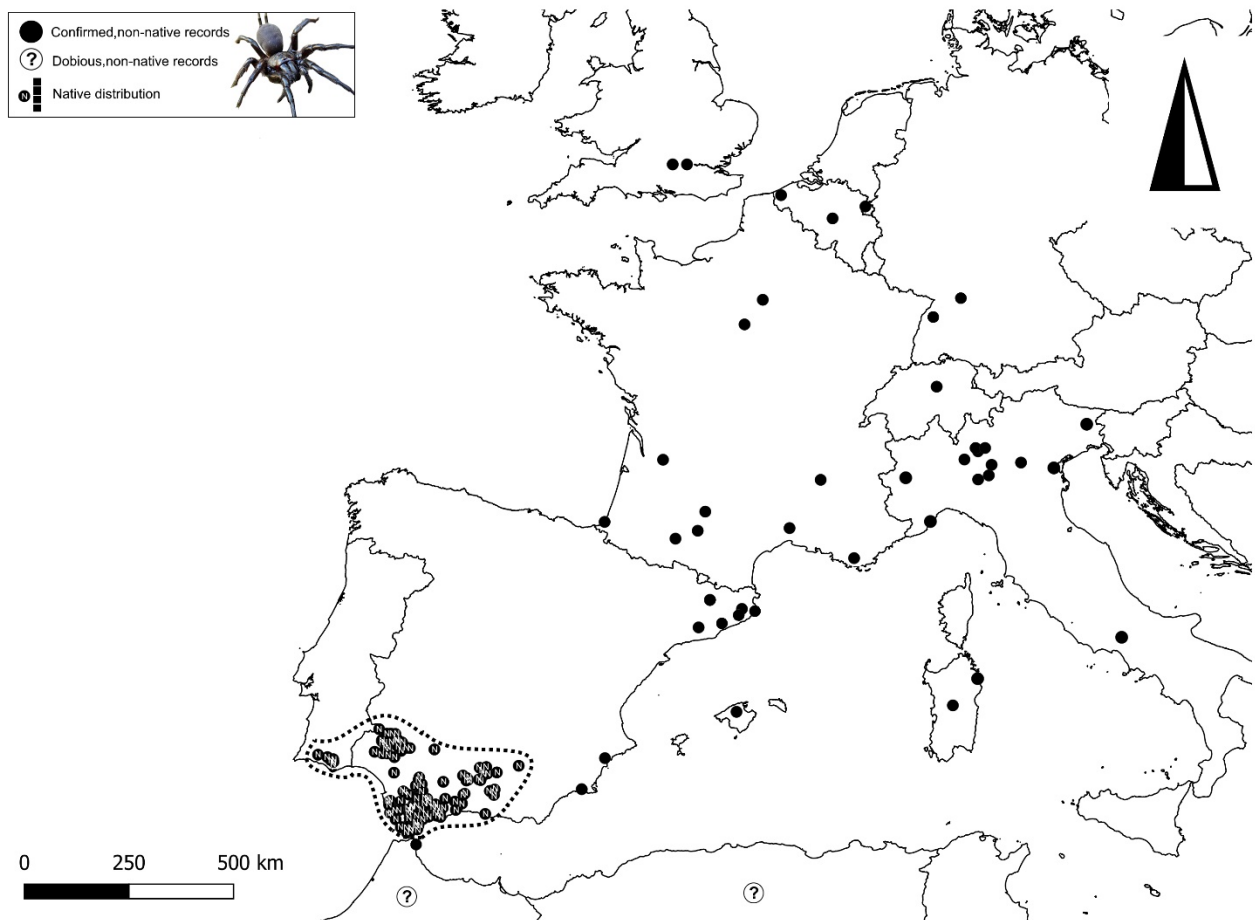


Fig. 2. Total records for *Macrothele calpeiana*. Natural distribution is marked with a dashed line and black dots labelled with an “N”. Doubtful species records marked ‘?’.

Citizen collaboration

A total of 206 records were collected: 148 met the requirements, and 63 were discarded. Of the discarded records, in 56 cases, the observation lacked photography, and in seven, the species was incorrectly identified, or the image provided had insufficient quality to confirm the

identification. For records that provided a picture, the identification accuracy was 89.64%. In this way, citizen collaboration constituted ca. 36.27% of the dataset. This substantial number of records was gathered in a 20-year timeframe, the records being predominantly concentrated before 2010, leading to a substantial increase in the rate of observation accumulation (Fig.3A).

On the other hand, since the last compilation for the species was published in the 2011 Atlas, citizen collaboration has covered a greater territory and added new grids in a shorter timeframe, compared to literature (Fig. 3B). The native range has been extended ca. 16.66 % thanks to this source. Citizen records covered 66 grids in the overall map. Of these, 25 were new for science: 24 for Spain, and one for Portugal —. This new record, located in the district of Faro and far from any previously known location for the country (Jiménez-Valverde et al. 2007), would represent the furthest east observation known for the species in its native region. With respect to exotic records, citizens contributed nine observations compared to the 36 registered for scientific work, which represents 25% of total exotic records.

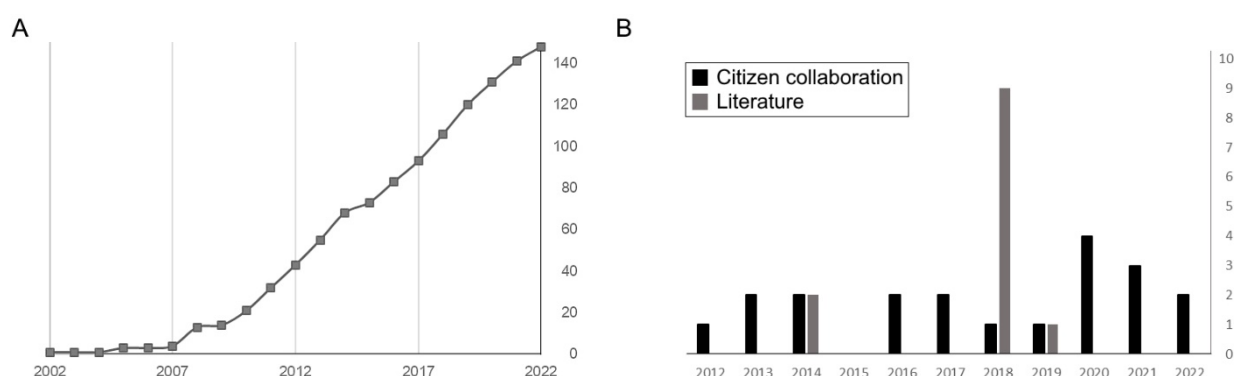


Fig. 3. Performance of citizen science in collecting distribution data for *Macrothele calpeiana*. A. Records accumulation curve from the first data obtained with this source until 2022. B. Number of new grids contributed independently by the two main data sources since the last major compilation work published in 2011. Black. citizen collaboration. Grey: literature.

Finally, regarding the data subset used to construct the distribution map for the native area over the last decade, 2012-2022 (Fig. 4), it was supported by 153 records, 139 provided by citizens. Records from the species in this period occupied 72 grids, of which 62 were covered exclusively by citizen records —ca. 86.11%—, seven exclusively by recent literature —ca.9.72%—, and three covered by both sources —ca. 4.16—.

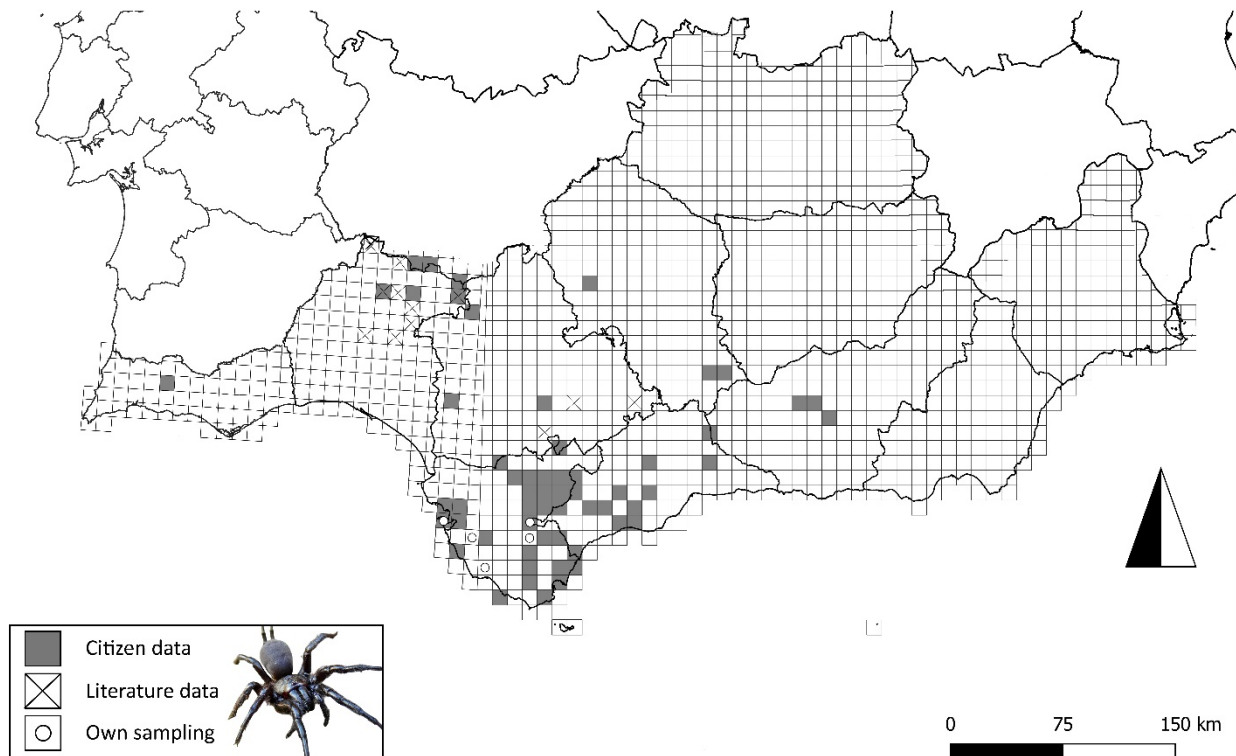


Fig. 4. UTM 10x10 distribution map of *Macrothele calpeiana* in its native distribution range, constructed only using data from the last ten years included in the study (2012-2022). Grey: citizen science. Cross: literature. White dots: own records.

Nonnative records

Outside the native range, observations for *Macrothele calpeiana* occurred in Europe, but also in Africa. In Europe, the species was recorded, from South to North: in the Spanish regions of Valencia, Catalonia and Balearic Islands, France, Italy—including Sardinia—, Switzerland, Belgium, and the Netherlands. While carrying out this work, *M. calpeiana* was reported for the first time in Germany (Bauer and Wendt 2021) and the United Kingdom (Sherwood 2022). France and Italy accumulated the most observations, with 9 and 17 respectively. However, for France, there are frequent notices shared by citizens on the internet who claim they have observed *M. calpeiana* in recent years—not included in the mapping—: Alpes-Maritimes, Gard, Gironde, Haute- Hérault, La Môle (confirmed by photograph), Loire, Lot (confirmed by photograph) and Vaucluse. In accordance with previous literature, new non-native observations gathered in this work occurred near recently transplanted olive trees, in city centres, parks, gardens, and roundabouts, or in

residential pools, where various drowned specimens have been found, probably coming from ornamental trees planted on private land. In the case of an isolated observation in the province of Murcia, in the southwest of Spain, it is not clear whether the specimen was native or not, so it is marked as possibly native but with doubts in the results.

For Africa, there is only a verified report in the autonomous community of Ceuta –Spain– and it is assumed to be an introduction (Ferrández 2001). In Algeria, only one historical, extremely dubious record, treated as native (Lucas 1849) is available. Similarly, in Nentwig et al. 2022 the species appears as present in Morocco, citing an unpublished checklist of African spider species. (Nentwig et al. 2022). Jiménez-Valverde (2009) carried out a detailed and extensive sampling campaign in the country and demonstrated the absence of *M. calpeiana* at 61 different points. For these reasons, and given the lack of recent, contrasting records, data from Algeria and Morocco are considered dubious and were marked as “?” in figure 3.

DISCUSSION

The chorological map of the spider *Macrothele calpeiana*, a species protected by European legislation, has been updated using conventional data sources but also citizen collaboration. This procedure has proved very useful for a rapid updating with few resources needed. Data gathered by citizen collaboration has renewed distribution data for areas not prospected in a decade or more and also has extended the native range by approximately. 12%. New observations have been reported in the non-native range, where the species appears to be observed with more frequency in recent years.

Citizen collaboration

This study has allowed the generation of an up-to-date distribution map for the study species in a relatively simple way, by filling a gap that needed to be covered in a very affordable work time. Within a reasonable period of time –less than a year– a map was built based heavily on citizen collaboration through photographic contributions, for which species identification accuracy by

citizens was 89.64% once corroborated by the author. This positive outcome with large spiders bearing distinctive features aligns with the results of other studies of similar nature, such as the atlas of baboon spiders from the family Theraphosidae in South Africa (Campbell and Engelbrecht 2017), wasp spiders of the genus *Argiope* in Spain (Jiménez-Valverde et al. 2019; Méndez et al. 2023), or studies on the northern black widow *Latrodectus variolus* (Walckenaer, 1837) and the black purse-web spider *Sphodros niger* (Hentz, 1842) (Wang et al. 2018). Unfortunately, no data were found regarding the percentage of validated versus discarded records in those studies, but the nearly 90% accuracy achieved in the present work is considered a remarkably high value.

Data gathered by citizen collaboration in this study accounted more than a third of the overall historical dataset and covered 66 grid cells, 25 of which were new to science, an outstanding figure considering the short trajectory of this tool in its digital format in Spain (Cortés-Fossati 2023). Furthermore, the follow-up map exclusively covering the last 10 years was supported almost entirely by citizen records, meaning that this source can be used to revisit known grid cells far more easily than other sources—many of which have not yielded any additional data from a visited cell after a single publication.

On the other hand, this source also provided better spatial coverage of the entire area and distribution. It should be considered that the significant growth of users in biodiversity observation platforms and personal communications received by the author via the Internet occurred from 2010 onwards, probably linked to the massive access to quality connectivity (Cortés-Fossati 2023). In 2012-2022, 18 new grids were contributed to science by this source, almost doubling the contribution coming from scientific publications. Moreover, while scientific publications deliver new information in concentrated time periods, such as upon article release, data taken by citizens seem to maintain a more or less a continuous information flow and are able to generate maps easily and with valuable data in cases where very little prior information is available, or to complement those that are still poorly represented (Wang et al. 2018; Campbell and Engelbrecht 2017; Jiménez-Valverde et al. 2019). Furthermore, and considering the success in identification by non-expert users, this methodology has demonstrated its potential for implementation by administrations with limited budgets to effectively monitor this species of conservation concern. In any case, citizen collaboration must not replace traditional science but be used as a complement: several regions

within a distribution area are only covered thanks to scientific surveys or data from museums (Wang et al. 2018; MacPhail et al. 2019; Méndez and Cortés-Fossati 2021; Cortés-Fossati 2022), as occurred in this work. This synergy holds great potential for spiders of a similar profile and in fact has even been proposed for other species (Rix et al. 2016). In fact, based on the author's experience, its use not only as a scientific tool but also as an educational one is undeniable helping to bring these essential yet heavily stigmatized animals closer to the public. This is particularly relevant for protected species like *M. calpeiana*, which often coexist with humans near populated or in anthropized areas (Ferrández 2011; pers. obs.), fostering appreciation rather than fear or persecution. In this sense, it could even serve as a flagship species for spiders, given its undeniable spectacular appeal.

Finally, it is worth noting that citizen collaboration contributed more modestly to observations in non-native areas; however, this is to be expected given that the species has only recently begun to be recorded more frequently. If the current trend continues and public awareness and familiarity with the species increase, the number of records is likely to grow in the coming years.

Native distribution

Native distribution suffered a slight enlargement after this work along the area occupied by the main populations, with no substantial changes. This may suggest that the species' range is well surveyed to date, and the actual map is representative enough to delineate the distribution of species. When filtering by records gathered in the last decade, there appear to be significant differences in the distribution limits with respect to the overall map. It is likely that the species is still present in most of the UTM grid cells represented in Fig. 1 and merely that they have not been revisited in the last ten years. However, in some of them, there have been recent, very important urban developments (Garrido Cumbrera and López Lara 2010; Consejería de Medio Ambiente de la Junta de Andalucía 2010; Membrado et al. 2016), so the situation of these grids is uncertain. This disparity shows the importance of periodic follow-up for species of interest for conservation.

Some new grids away from previously known areas have also been detected, reflecting the potential of citizen science to cover large survey areas as stated above. The new record for southwest Portugal stands out, not geographically related to previously known areas. The characteristics of this potentially unidentified population are, at present, unknown. Recently, it was suggested that Portuguese populations may belong to a very restricted, cryptic species (Branco et al 2019). In that case, the new region identified in this work would be worth prospecting for future work on the genetic characterization of Portuguese populations.

Recent studies on this genus have described a surprising number of endemics in recent years, especially in Asia (Lin et al. 2021; Wu et al. 2022) while others have demonstrated the potential presence of cryptic species, such as in the Taiwan–Ryukyu Archipelago (Su et al. 2016), where population isolation may have played a key role in this potential speciation process. This is a commonly proposed explanation for mygalomorph species complexes due to their low dispersal ability (Hedin et al. 2019). Taken together, these findings highlight the importance of accurately understanding the distribution of species like *Macrothele calpeiana*, given their inherent potential to mask cryptic species or genetically unique populations of conservation interest.

The existence of genetic boundaries and the lack of genetic characterization in populations that may in fact represent distinct species –but have not been properly studied due to data scarcity (Arnedo and Ferrández 2007)– could result in microendemic species being left exposed to threats and lacking specific measures, thus potentially putting their survival at risk. The impacts already clearly outlined by previous work (especially Ferrández 2011), combined with the continued unintentional export of individuals whose genetic identity is unknown –and which potentially may belong to highly restricted cryptic species– represent a clear problem for the conservation of these spiders. In the same way, it is also relevant to make known, that, while carrying out this work, it was easy to find websites with specimens of this protected species available for sale or exchange, which poses another threat factor for origin populations (Ferrández 2011).

Nonnative distribution

Records in nonnative areas seem to have sharply increased in recent years, probably due to the intensification of international merchandise transit, to which the introductions are linked (Bellvert and Arnedo 2016). In 2024, the author was informed on specimens preliminarily identified as *Macrothele calpeiana*—still under analysis—that were collected in Slovakia, where the species had not been reported (Šestáková et al., pers. comm., paper in prep.). In the same way, sightings in non-native areas continue to appear recurrently in the media (e.g., Nicholson, 2025). This suggests that current controls in the transport of fresh produce, ornamental plants, and similar goods may not be efficient in preventing unintentional exports of species with this profile. However, at present, only one nonnative established population is known: Catalonia, in NE Spain, which was not predicted as suitable by various climate models performed (Jiménez-Valverde 2007, 2011), so these tools should be considered with great caution. In this way, Southern France and Italy, regions that accumulate most of the nonnative records, present similar climatological conditions to those of the Iberian Peninsula and may be potential establishment areas. In Italy, there are records of specimens in ornamental olive trees for decades, and it is a likely situation that there are already established populations (Pantini, pers. comm.). For the moment, there is no conclusive evidence to support this, and unfortunately, no follow-up studies have been carried out in the region. Until now, the pressure of propagules necessary to establish new populations also remains unstudied.

Besides accidental introductions, the reiterated withdrawing of individuals from their natural area constitutes per se a problem for conservation and could negatively affect effective population sizes. As already suggested in previous studies and given the large costs generated by the control and management of alien species (Olson 2006), it is necessary to place preventive controls on olive tree exports (Bellvert and Arnedo 2016) or specific protocols to enforce stricter inspections and help prevent biological invasions.

It could be noted that, although in some references it is stated that *Macrothele calpeiana* shall not be listed as alien or invasive inside Europe for being native to the continent (Nentwig et al. 2022), the species could be classified as "Invasive Alien Species native to parts of the EU" in case that some established population causing negative impacts on native fauna is detected. Included in this category, established by the European Commission, are the European rabbit *Oryctolagus*

cuniculus (Solarz 2019) or the North African knapweed *Centaurea diluta* (Brundu 2019) among other species for which there are currently measures for their control and direct eradication, if necessary.

CONCLUSIONS

The species of interest for conservation *Macrothele calpeiana*, difficult to sample, but easy to identify through photographic records, making it a valid taxon for citizen monitoring. The map generated was largely based on citizen records. Despite its protected status and secretive nature, this species is not restricted to core protected areas, as it is relatively common in rural settings, where it coexists with humans and is often perceived as dangerous due to its large size. This highlights the need for greater public understanding, yet another role fulfilled by citizen science programs. In general, based on the distribution maps obtained, the species is found in a very restricted area at the global level but is well represented in the main core of its range, which lies within protected areas. Therefore, the species appears to have a viable short- to medium-term outlook. Despite that perception, there are more vulnerable areas that should be explored to find out if urban pressure is negatively affecting the species on a local scale. On the other hand, an increasing number of nonnative records show the need to focus on accidental introductions into other countries, not only because of the species' introduction in other countries but also due to the repeated removal of population individuals from their native areas, where it is also suspected that there may be cryptic microendemic species still to be described. In view of the results of this study, a citizen monitoring program at the European level over time could be useful in detecting new records and prospecting possible areas of interest. Likewise, and given the concentration of data accumulated in certain areas, it is necessary to carry out follow-up studies especially focused on locations where it is suspected that established populations could exist.

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Consent for publication: I accept the terms and conditions of the journal to publish the work.

Ethics approval consent to participate: not applicable.

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Supplementary materials

Table S1. Complete dataset with georeferenced locations of *Macrothele calpeiana*. Records were divided by source: data from citizen science and third parties (CS), literature data ordered by year (L: YYYY) and own records (OR). The original format of the location provided has been respected and were plotted according to source: for georeferenced position (GEOR. POSITION) coordinates only can present locality name and were considered as NA, or may present X, Y format/UTM grid code. Column G contains the data referring to the observation date for unpublished data or the latest available reference in the case of already published data. Highlighted in light salmon, those locations where the species was introduced. Highlighted in yellow, a historical record considered as dubious. (download)