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Special Section: The new Checklist of the Italian Fauna

An updated checklist of Italian false blister beetles (Coleoptera, Oedemeridae) with an open-source interactive website

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SUMMARY

The last checklist of Italian Oedemeridae was published by Bologna in 1995, framed by the first version of the checklist of the Italian metazoans. After 31 years, we provide a revised checklist for the Italian Oedemeridae by adding newly recorded taxa, updating taxonomy and increasing the resolution of the presence data to the regional level. Moreover, we present an open-source interactive website allowing data visualization through table-like format or a map, and the possibility of filtering and exporting the data. The checklist now covers 44 species, 3 of which are represented in Italy by 2 subspecies each, belonging to 11 genera. Overall, 13% of the species and subspecies are endemic to the study area, and our biogeographic analysis highlighted how the diversity increases with region size, with a significant proportion of specific and subspecific taxa restricted to a single region. Finally, we discuss the results in the context of Italian biogeography and species diversity in other European countries, and provide the details on how to use the website for exploring the checklist.

INTRODUCTION

Phylogeny and evolutionary history of Oedemeridae

Oedemeridae is a small family of Tenebrionoidea beetles, characterized by a soft body, long and slender antennae, elongated body and prognathous head. This family comprises about 1500 species and 100 genera distributed in all the continents except Antarctica (Vázquez 2002). The most conspicuous diversity is found in the Palaearctic, Oriental and Australian regions, whereas the Nearctic and Neotropical regions are less diverse. In the Afrotropical region only the Asclerini tribe is represented with a few known species.

Despite being less studied than other beetle families, Oedemeridae have a considerable interest both for evolution and ecology. Many species are saproxylic at the larval stage and feed on dead wood of both conifers and broad-leaved trees, while others develop in shrub and grass stems (Vázquez 2002). During the adult phase, most species are feeding on flowers and are among the earliest insects reported as pollen-feeding, being known from as early as the Cretaceous (Peris 2017). Some of them can be considered as bioindicators since they only live in pristine or well-conserved habitats, such as *Stenostoma rostratum* (Fabricius, 1767), which is a bioindicator of dunes habitat (Bologna 1979). Oedemeridae also contain cantharidin, a toxic terpenoid produced also by Meloidae (blister beetles), which is the reason why they are called "false" blister beetles, and appear in several papers of medical entomology where they have been reported to cause moderate to severe dermatitis (Glatz & Schmid-Grendelmeier 2012).

This family is traditionally included in the superfamily Tenebrionoidea due to the heteromerous tarsi and the morphology of the aedeagus, which is of derived heteromeroid type (Crowson 1955). Based on recent evidence from molecular phylogenetic analyses (Zhang et al. 2016, McKenna et al. 2019, Batelka et al. 2025) Oedemeridae are unanimously considered monophyletic and confirmed in the superfamily Tenebrionoidea, in a clade that is grouping several other families including Salpingidae, Ischaliidae, Meloidae and Anthicidae. According to most authors, the sister clade is composed by Mycteridae, Aderidae and Ischaliidae (McKenna et al. 2019, Batelka et al. 2025) but the placement of Salpingidae is unclear, and according to Zhang et al. (2016) Oedemeridae form a monophyletic clade with Mycteridae. Unfortunately, the authors of these studies never included Stenotrachelidae, which have been considered as the closest family to Oedemeridae according to morphological characters (Crowson 1955, Lawrence 2005). Concerning the hypothesis placing Oedemeridae as sister taxon to Meloidae, based on cantharidin production, it has been rejected based on several molecular and morphological evidence (McKenna et al. 2019, Batelka et al. 2025). Therefore, the cantharidin production may be the result of independent evolution.

The phylogeny at the sub-family level is even more unclear, and not confirmed at all by molecular data. Traditionally, 3 subfamilies are recognized on the basis of adult morphological evidences: Calopodinae, Nacerdinae and Oedemerinae (e.g. Arnett 1951, Švihla 1986, Vázquez 2002). Recently, Lawrence (2005) proposed another subfamily, Polypriinae with only two genera - *Polypria* Chevrolat, 1874 and *Dasytomima* Lawrence, 2005 - and proposed to group the rest of the family in two other subfamilies: Calopodinae and Oedemerinae. In this new Italian checklist, we adopt the latter subdivision of subfamilies and the taxonomy proposed by the Catalogue of Palaearctic Coleoptera (Kubisz, 2020), with minor modifications based on subsequent publications.

False blister beetles are scarcely represented in stone fossils, like the majority of insects, due to the small size and absence of shells or other durable structures typical of other invertebrates. The most ancient Oedemeridae dates back to the early Cretaceous (105 Ma) and was found in Spanish amber (Peris, 2017). The species was described as *Darwinylus marcosi* Peris, 2017 and is placed in the Oedemerinae subfamily next to *Dytilus* Fischer von Waldheim, 1817 and *Nacerdes* Dejean, 1834 (Peris 2017). This confirms the hypothesis proposed by Švihla (1986) of a Cretaceous split of the Nacerdini tribe, based on zoogeographical patterns. Mid-Cretaceous Oedemeridae from Burmese amber was discovered by Vitali & Ellenberg (2019) and Vitali and Legalov (2020), while more recent fossil from Baltic amber were described by Szawaryn et al. (2017).

Historical contributions on Oedemeridae

The first wide-range work on Oedemeridae was done by Ganglbauer (1881) who published a key to the West-Palaearctic species. Then Semenov (1894) published a key for the subfamilies for the same region and Seidlitz (1899) considered all the species known at that time. Other more recent and comprehensive works are those of Magistretti (1941) for Europe, Arnett (1951, 1961) for the Nearctic and Neotropical fauna, MacNamara (1969) for Micronesia, Hudson (1975) for New Zealand, Švihla (1986) who, together with several contributions on the Palaearctic and Oriental fauna, published a revision of the Old-World genera, Vázquez (1996) for South Africa, and Vázquez (2002) for Europe.

For the Italian fauna, a comprehensive work has been published by Magistretti (1941), while Schatzmayr (1925, 1926) published two taxonomic

contributions respectively on the tribe Nacerdini and on the genus *Oedemera* Olivier, 1789. Regarding the faunistic data of the Italian Oedemeridae, Magistretti (1967) published a catalogue, now outdated.

The first checklist of the whole Italian fauna was published in 1993-1995 (Minelli et al. 1995), with details on the presence of each species in 4 Italian macro-regions (N: continental regions; S: peninsular regions; Si: Sicily; Sa: Sardinia). For the beetle family Oedemeridae, the checklist was curated by Bologna (1995a) who listed 43 species.

Following this effort the project CKmap was launched, aiming at providing geo-referenced occurrences for the species of the checklist, accessible through a GUI software (Latella et al. 2007). However, this software was including only 10 000 species from selected taxa (Latella et al. 2007) and is now discontinued.

The conservation status of the Italian Oedemeridae was deeply evaluated by Bologna (2014) and Calix et al. (2018).

This contribution aims at updating the previous checklist (Bologna, 1995a) and increasing the geographic resolution of the presence data to the regional level. In addition, we present CKbook: an open-source, interactive, web-based platform to visualize, filter, and export the data of this new checklist, following the FAIR (Findable, Accessible, Interoperable, Reusable) principles for biodiversity data sharing (Wilkinson et al. 2016). This structure can potentially host the whole checklist of the Italian Fauna and facilitates the access and use of its data and aims at unifying the checklist with the CKmap project for spatial visualization of the checklist.

MATERIAL AND METHODS

Dataset

This new checklist of the Italian Oedemeridae follows the guidelines of the New Checklist of the Italian Fauna (Bologna et al. 2022), including the division of Italy in macro-regions and regions (Fig. 1), and adding territories that are geographically but not politically belonging to Italy, namely Corsica, the Maltese islands, Canton Ticino, the Vatican City and the Republic of San Marino.

Therefore, the dataset presented in this contribution is a matrix with presence-only data for the 47 species and subspecies of Oedemeridae found in the study area, which constitutes an update of the previous checklist (Bologna 1995a), up-to-date until December 2025. We screened literature, the authors' collections and two Citizen Science platforms (iNaturalist [5051 records for Italy including Malta, the Vatican City and San Marino, 438 for Corsica and 98 for Canton Ticino] and Forum Entomologi Italiani [206 records]) along with 5 museum collections. The exact query used to retrieve the data from Citizen Science platforms can be found in the Supplementary Methods. For collections and Citizen Science platforms, we included only records for which the species identity could be confirmed by examining the specimens or the pictures. For literature records instead, we didn't perform any check on the original specimens or data. The data sources and the dataset metadata can be found in the Supplementary Materials.

Descriptive statistics

The analyses were performed in R 4.5.1 (R Core Team 2025). The script used is provided as a supplementary file. Plots were drawn with *ggplot2* (Wickham 2016) and the linear regression were performed with *lme4* using the function *lm* (Bates et al. 2015).

Figure 1. Territory covered by this new checklist of the Italian Fauna, including the political Italian borders divided in 4 macro-regions (North, South, Sicily and Sardinia) and territories outside political borders (here coloured in light blue): Corsica, Maltese Islands, Vatican City, San Marino and Canton Ticino (Switzerland).

RESULTS

The Italian Oedemeridae recorded in this contribution are represented by 11 genera and 44 species, belonging to the subfamilies Calopodinae and Oedemerinae. Three species are represented by two different subspecies: *Nacerdes* (*Xanthochroa*) *carniolica* [ssp. *carniolica* (Gistl, 1834) and ssp. *peloponesiaca* Švihla, 1991], *N.* (*X.*) *gracilis* [ssp. *gracilis* (W. Schmidt, 1846) and ssp. *bellieri* (Reiche, 1861)] and *Anogcodes seladonius* [ssp. *seladonius* (Fabricius, 1792) and ssp. *alpinus* (W. Schmidt, 1846)]. In the previous version of the checklist (Bologna 1995a) the species were 43, one represented by 2 subspecies. The new Checklist updates the previous one (Bologna 1995a) by adding a new species [*Xanthochroina auberti* (Abeille de Perrin, 1876)] recorded from Liguria and Puglia, and a new subspecies (*Nacerdes* (*Xanthochroa*) *carniolica peloponesiaca*) recorded from Calabria. *Ischnomera xanthoderes* is removed, and substituted by *Ischnomera sicula* Bologna, Poloni & Vázquez, 2019 (Bologna et al. 2019). Finally, the undescribed species of *Stenostoma* Latreille, 1810, that was indicated generically as "*Stenostoma* sp." in the previous checklist, is here reported as *Stenostoma cossyrense* Bologna, 1995 following its description (Bologna 1995b). In addition, compared to the previous version, we provide presence-only data of Italian taxa with region-level resolution.

As for many other groups of animals, in the Italian false blister-beetles we can recognize the unique combination of different biogeographic regions that make Italy one of the most biodiverse countries in Europe, together with Spain and Greece (Essl et al. 2013). Most species (Fig. 2) have a broad distribution (e.g. Turano-European or Sibiro-European chorotypes). However, we can distinguish some species that have a narrower Mediterranean distribution [e.g. *Oedemera* (*Oedemera) barbara* (Fabricius, 1792), *Stenostoma rostratum* (Fabricius, 1787)]. Five species are endemic (Fig. 3): *Sparedrus orsinii* Costa, 1852 (Peninsular Italy and Sicily), *Oedemera (O.) melanopyga* W. Schmidt, 1846 (Peninsular Italy), *Ischnomera sicula* (Sicily), *Stenostoma melitense* Cameron, 1907 [Malta and after the online checklist of 2022, recorded from southern Sicily [Poloni et al. 2023]), and *S. cossyrense* (Pantelleria). In addition, *Nacerdes* (*X.*) *gracilis bellieri* is endemic to Corsica. Some taxa are only marginally occurring in Italy, but widely distributed in other Mediterranean regions. It is the case of *Nacerdes* (*X.*) *carniolica peloponesiaca*, which is a Greek subendemic, and also occurs in eastern Calabria, parapatric with the nominate subspecies, or *Oedemera* (*O.*) *algerica* Pic, 1899, which occurs in Northwestern Africa and in Lampedusa Island.

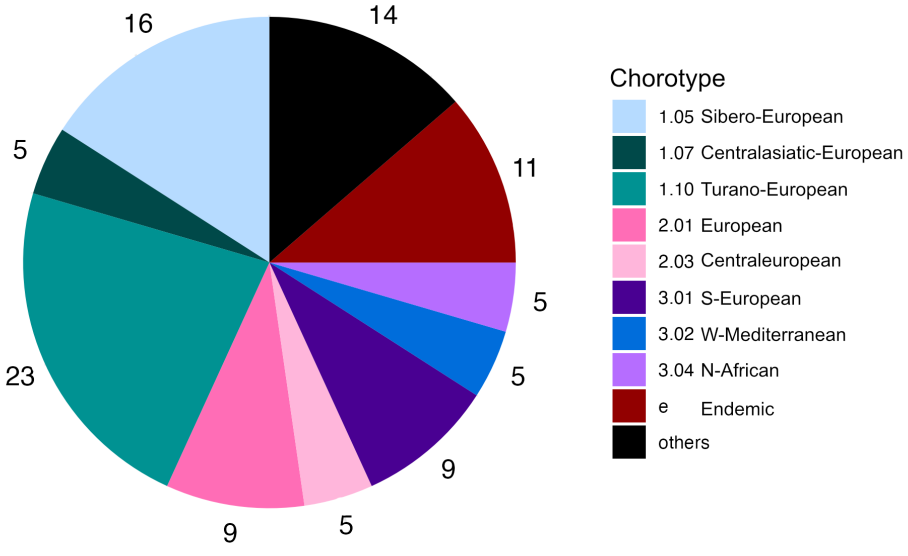

Figure 2. Chorotypes of the Italian Oedemeridae (as defined by Vigna Taglianti el al. 1999). Chorotypes with less than one species associated have been grouped in the "others" category for convenience. The labels represent the contribution of each chorotype to the overall fauna, in percentage.

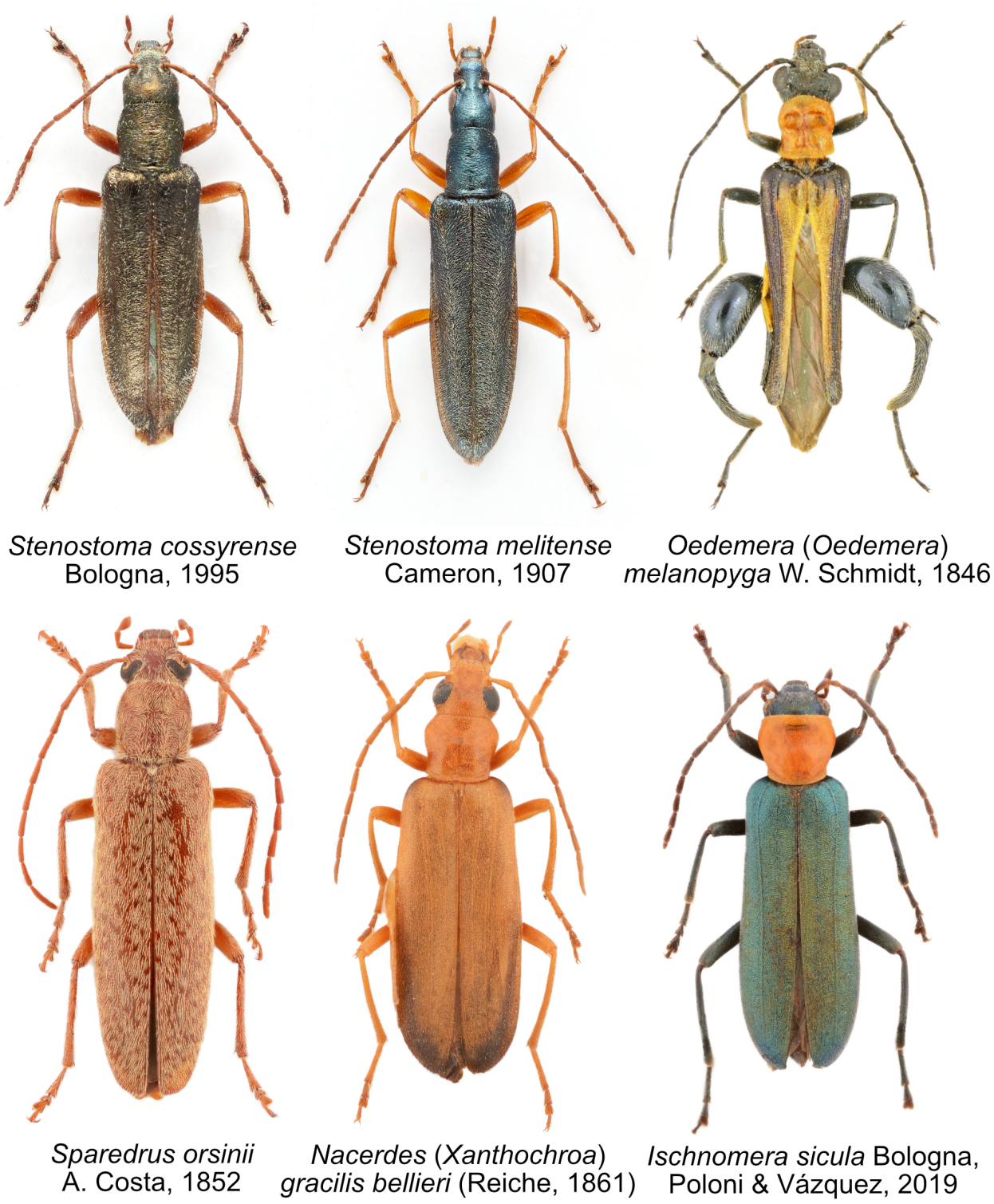

Figure 3. Italian endemic Oedemeridae (habitus, dorsal view). *Stenostoma cossyrense*: Sicily (TP), Pantelleria, Specchio di Venere; *S. melitense*: Malta, Golden Bay; *Oedemera* (*O.*) *melanopyga*: Calabria (RC), San Nicola; *Sparedrus orsinii*: Emilia-Romagna (BO), Castel d'Aiano; *Nacerdes* (*Xanthochroa*) *gracilis bellieri*: Corsica, Ghisonaccia; *Ischnomera sicula* (paratypus): Sicily (PA), Piano Battaglietta.

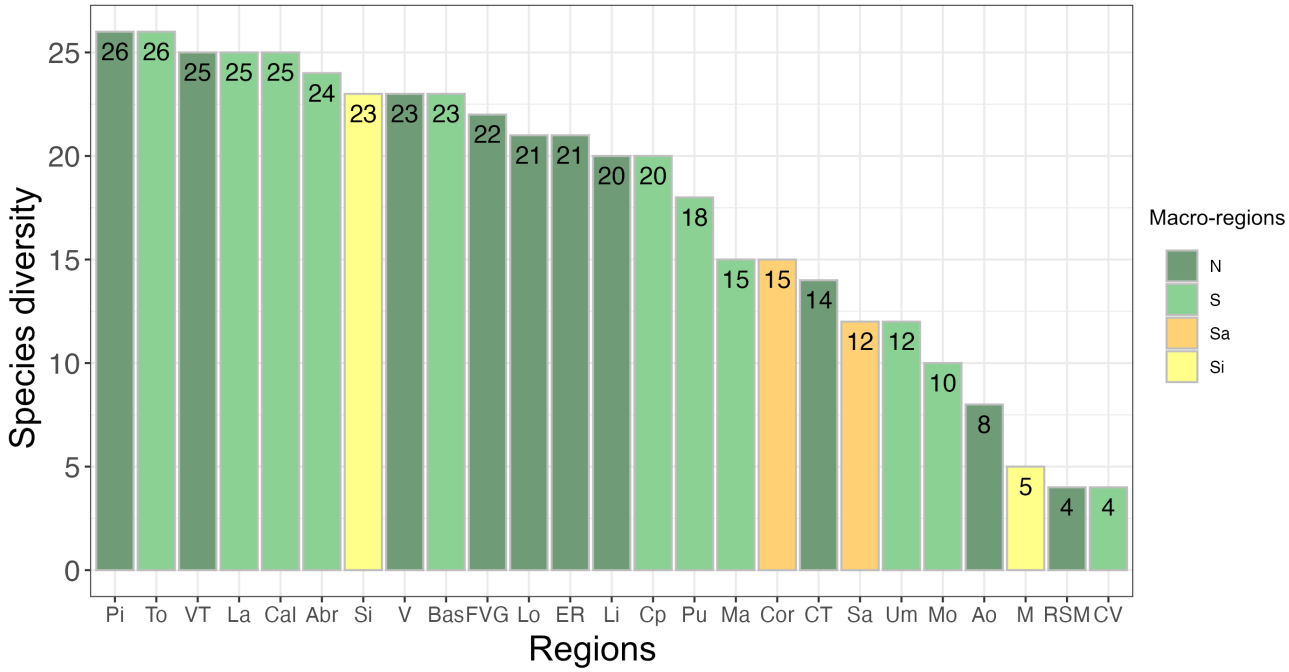

Figure 4. Diversity of Oedemeridae species (and subspecies) in each Italian region. The bar colours indicate the macro-regions. The smaller territories were assigned to the closest macro-region: Malta have been assigned to Sicily, Corsica to Sardinia, Canton Ticino and Republic of San Marino to Northern Italy and the Vatican City to Southern Italy. Pi: Piedmont, To: Tuscany, VT: Trentino-Alto Adige, La: Latium, Cal: Calabria, Abr: Abruzzo, Si: Sicily, V: Veneto, Bas: Basilicata, FVG: Friuli-Venezia Giulia, Lo: Lombardia, ER: Emilia-Romagna, Li: Liguria, Cp: Campania, Pu: Puglia, Ma: Marche, Cor: Corsica, CT: Canton Ticino, Sa: Sardinia, Um: Umbria, Mo: Molise, Ao: Val d'Aosta, M: Maltese islands, RSM: Republic of San Marino, CV: Vatican City.

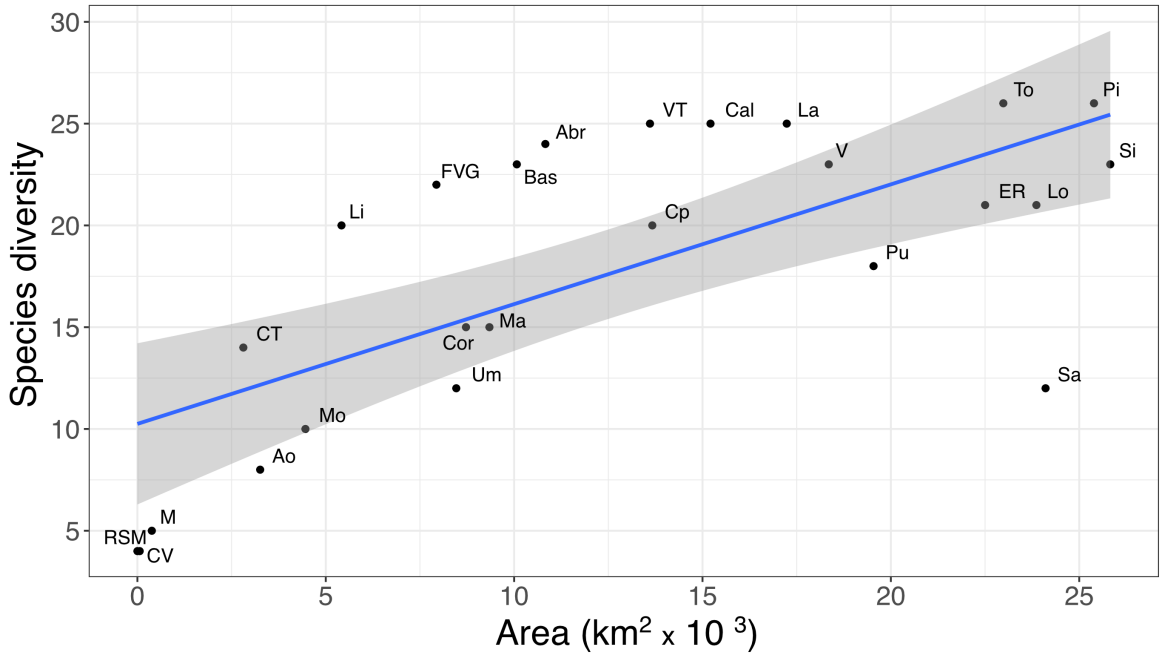

Figure 5. Linear regression between species diversity and surface in Italian regions, showing a significant positive relation between area and species diversity (adjusted R-square = 0.43, p-value (F-statistic) < 0.001). The abbreviations used for Italian regions are the same as Fig. 4.

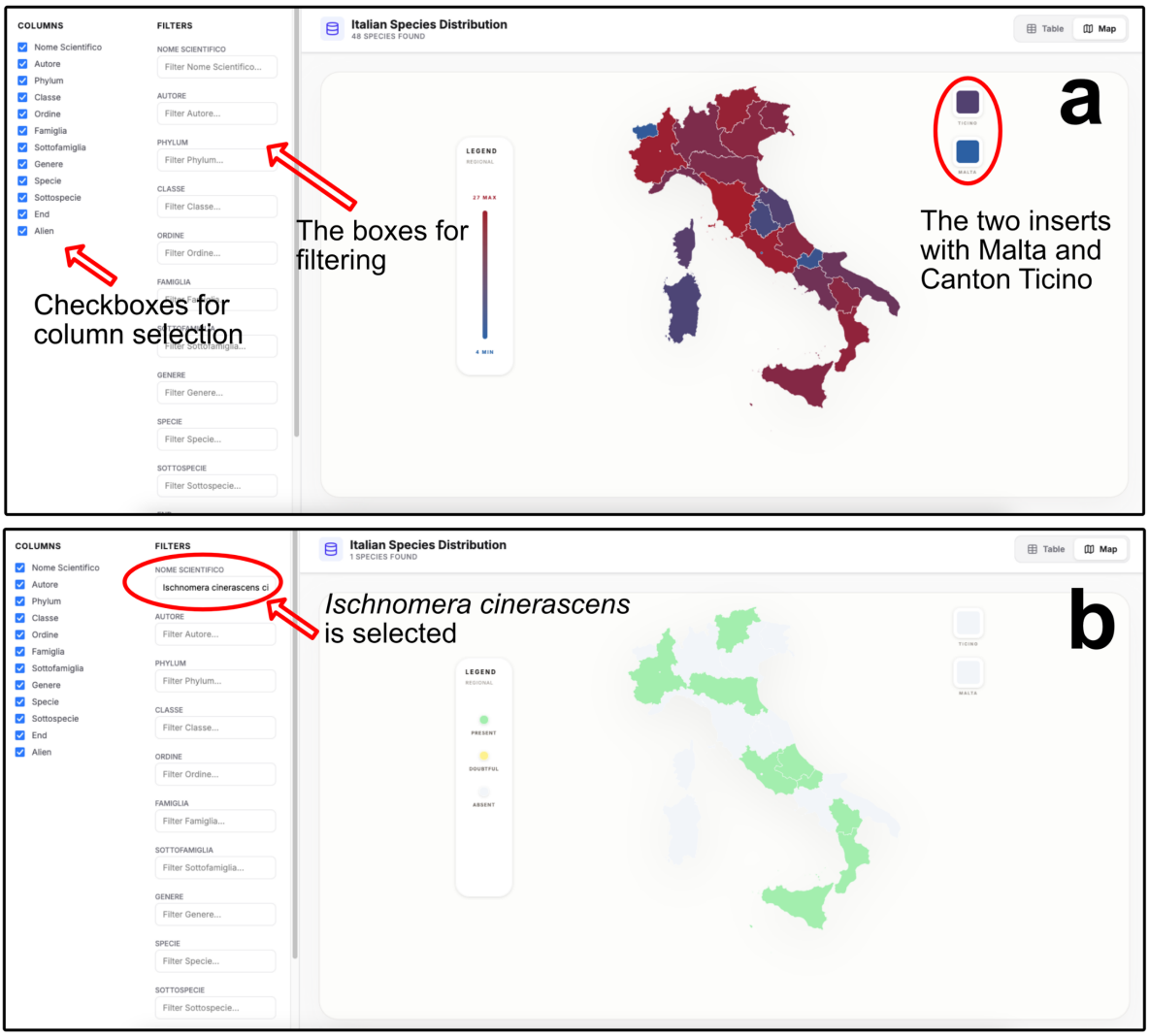

Figure 6. An example of the map tab in the web tool designed to visualize the data of the checklist. The map can show species diversity when multiple species are selected (a) or presence data when one species is selected (b). It is possible to filter different columns of the dataset on the left.

The regions with the highest alpha-diversity are Tuscany and Piedmont (Fig. 4), with 26 species, whereas the one with the lowest is Valle d'Aosta (8). Finally, the Vatican City and Republic of San Marino have the lowest diversity overall (Fig. 4). The most widespread species in Italy are *Oedemera* (*O.*) *flavipes* (Fabricius, 1792), *O.* (*O.*) *nobilis* (Scopoli, 1763) and *O.* (*O.*) *lurida* (Marsham, 1802) (Fig. S1). A considerable proportion of species (21%) is found in only one region, reflecting the relict or marginal presence of some of them in the territory examined in this contribution, or in some case due to lack of sampling or difficulties in identification, as for *Xanthochroina auberti* and *Oedemera* (*O.*) *monticola* Švihla 1978.

Finally, if we observe the taxa richness across Italian regions, we can clearly see that the alpha-diversity is positively correlated with the region surface (Fig. 5) with one clear outlier represented by Sardinia.

CKbook interactive website

With this interactive website we aimed at creating a simple web-based solution allowing both to explore the checklist in text format and the distribution of taxa on a map. In addition, we aimed at increasing the accessibility of the data in the checklist by allowing to seamlessly filter and export useful data for further analysis, aligning to the FAIR principles for biodiversity data sharing (Findable, Accessible,

Interoperable, Reusable). Therefore, the web-site is written in typescript and deployed as a github page, providing an open-source and free solution linked directly to the project repository. Since it is web-based it can be easily implemented in other websites.

The interface is composed of two tabs: the first shows the table as it is, and allows to filter the data and export them. This is particularly useful if data for a particular region are required or if the user wants to view a single taxonomic group. The second tab is a map of the territory included in the checklist, showing the presence of the different taxa on the left and a series of boxes allowing to select the data to be displayed on the left. The map shows the distribution across regions (Fig. 6a) or, if not available, the macro-regions (N, S, Si, Sa), with a colour scale that depends on the number of species present in the region. In addition, two inserts represent Malta and Canton Ticino, which would otherwise be outside of the map. If only one species is selected, the regions where the species is present are coloured in green (Fig. 6b).

The web page can be accessed at: https://r-poloni.github.io/CKbook/.

DISCUSSION

Compared to the previous checklist (Bologna 1995a), the number of species and subspecies of this new Checklist did not increase significantly (47 vs 44). In particular, *Xanthochroina auberti* and *Nacerdes* (*X.*) *carniolica peloponesiaca* were added as new for the Italian fauna, and *Ischnomera xanthoderes* was removed, because the Sicilian population was described as a separate species, *I. sicula*. Finally, *N.* (*X.*) *gracilis bellieri* was added as a consequence of including Corsica in the territories considered by the checklist.

The overall taxa richness (species and subspecies) is comparable to other countries in Europe (Table 1) with similar geographic latitude and surface (e.g. France: 41), but higher than countries in Central or Northern Europe (e.g. Denmark: 11, Finland: 10) and lower than other Southern European countries (e.g. Spain: 50, Greece: 56).

The regional species richness is also positively correlated with region area, as it is well-known in many study systems from the theory of Island biogeography (MacArthur & Wilson 2001, Storch et al. 2012). However, the species-area relationship has been observed to follow a power low across most spatial scales (Connor et al. 1979, Storch et al. 2012), or more complex ones like triphasic curves (O'Dwyer et al. 2010). Instead, we observe a linear relationship with area. This is probably due to the spatial scale or to the low number of species considered. Nonetheless, Sardinia appears as a clear outlier in the model. This could be explained by the distance to the continent, which is known to be negatively correlated with species richness (MacArthur & Wilson 2001), but also to the lack of endemic species, which is generally high for large islands and counter balance the island effect (Lomolino & Weiser 2001).

Moreover, as described in the results section, a significant portion of taxa (21%) is occurring in just one region, and another quite consistent proportion (13%) is endemic to the Italian territory. This highlights a potential conservation concern for several taxa. However, there is currently no

Table 1. Species and subspecies richness in different European countries according to Kubisz (2020).

Country	Species / subspecies richness	Country	Species / subspecies richness
Greece	56	Slovenia	27
Spain	50	Bosnia-Herzegovina	26
Italy	47	Albania	23
France	41	Poland	23
Hungary	39	Sweden	19
Croatia	38	Portugal	19
Bulgaria	34	Lituania	16
Austria	32	Belgium	14
Romania	31	Estonia	13
Switzerland	31	Denmark	11
Czech Republic	28	Finland	10
Germany	27	Ireland	3

Oedemeridae assigned to one of the IUCN risk categories (VU, EN, CR). Nonetheless, not all species were assessed and, among the assessed ones, two were assigned to the NT (Near Threatened) category, namely *Stenostoma rostratrum* and *S. cossyrense* (Bologna 2014). Four species were assessed as "data deficient". Information on the conservation status and risks of other Italian species are pointed out by Calix et al. (2018).

Overall, the Oedemeridae in Italy have been extensively collected during the past 25 years, but this checklist is probably still incomplete. A few species could be found with more extensive research: an example is *Ischnomera xanthoderes*, occurring in the French coastal regions not far from the Italian border. Moreover, the faunistic records can be raised by more specialized research, as in the case of species with nocturnal habits such as *Xanthochroina auberti,* or the *Nacerdes* (*Xanthochroa*) species, or species difficult to identify such as *Oedemera* (*O.*) *monticola*. It is also likely that careful taxonomic reassessment using both morphological and molecular data, will reveal cryptic species in the Italian fauna, that is rich of endemics.

We also presented CKbook: an interactive web-based platform for exploring the data of the checklist. This platform unifies two formats: the checklist *sensu stricto* as a list of species, and the CKmap project, providing georeferenced records on a map, like the books of the "Fauna d'Italia" series. In addition, our platform harnesses the power of an interactive website allowing users to filter the data and export them. It is accessible to both researchers and nature enthusiasts, because it provides both a simple, interactive view and advanced filtering and export features. This will increase both the accessibility to biodiversity data and their use. In the future, this structure could be extended to the whole checklist of the Italian fauna to improve the accessibility and reusability of the dataset. It would also be possible to extend this website to include marine species with minor changes, by integrating in the map the GeoJSON shapes of marine areas.

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SUPPLEMENTARY MATERIAL

The description of the dataset, as well as the bibliographic sources used for compiling the checklist can be found in the Supplementary Materials.

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