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Araneae.it 2.0: the new updated version of the digital catalog of the Italian Spiders and other Arachnids (Arachnida: Araneae, Opiliones, Scorpiones, Pseudoscorpiones, Palpigradi, Solifugae)

Marco ISAIA[1,*], Marco TOLVE[1], Paolo PANTINI[2]

[1]*Department of Life Sciences and System Biology, University of Turin* – marco.isaia@unito.it; ORCID: https://orcid.org/0000-0001-5434-2127 (MI); https://orcid.org/0000-0002-3013-7337 (MT)
[2]*Museo Civico di Scienze Naturali "E. Caffi", Piazza Cittadella 10, I-24129 Bergamo, Italy* – paolo.pantini@comune.bergamo.it; ORCID: https://orcid.org/0000-0001-8332-1915
*Corresponding author

Abstract
We present ***Araneae.it 2.0***, the updated and expanded digital platform for documenting the Italian spider fauna. The catalog currently includes 1,735 species, with taxonomic data aligned with the World Spider Catalog (Version 26). Distribution maps are now available at regional and provincial levels for all species, and at point-based resolution for endemics, aliens and other relevant species with an indication of the coordinate precision. Although georeferencing is still in progress, at the time of publication, major improvements in spatial resolution are given for 219 species—comprising 154 endemics/sub-endemics, 22 alien, and 43 species of conservation concern, of medical interest or of limited occurrence. This online resource provides a solid foundation for future assessments of extinction risk, as well as for evaluating biodiversity and knowledge levels of spiders—and to a lesser extent, other arachnids—in Italy, with particular emphasis on Italian endemic spider species. Moreover, it supports the ongoing development of a comprehensive trait database, which will enable ecological and conservation-focused studies on Italian arachnids. These efforts will enhance our capacity to assess species vulnerability, analyze functional diversity, and guide evidence-based conservation strategies for the Italian arachnid fauna.

Key words: biodiversity informatics, species distribution, Italian spiders, endemism, conservation planning.

Introduction

Spiders (Araneae) are among the most diverse and ecologically significant arthropod groups in terrestrial ecosystems. Despite their high biodiversity and functional relevance, comprehensive and accessible data on their distribution and ecology remain limited in many parts of Europe. In Italy—a country characterized by complex topography, biogeographic heterogeneity, and a remarkable number of endemic species—faunistic knowledge has historically been scattered across taxonomic papers, regional checklists, and museum collections.

To consolidate this dispersed information, the platform ***Araneae.it*** was launched in 2019 as the first freely accessible, species-level catalog of Italian spiders (Pantini & Isaia 2019). All taxa are continuously reviewed and updated in accordance with the World Spider Catalog, while unverified records are either removed or explicitly annotated. Since its creation, the scope of the platform has expanded to include other arachnid orders—Opiliones, Scorpiones, Pseudoscorpiones, Palpigradi, and Solifugae—each curated and regularly updated in collaboration with taxonomic specialists. In this way, ***Araneae.it*** serves not only as a taxonomic and faunistic reference, but also as a tool to promote arachnological research and facilitate biodiversity assessments in Italy.

With the release of version 2.0, ***Araneae.it*** has evolved into a more comprehensive and interactive resource. The new version introduces major enhancements in geographic resolution and visual content, including national, regional, and provincial distribution maps, occurrence records, bibliographic references, and photographic documentation. This paper presents the main features of ***Araneae.it 2.0***, provides updated faunistic data for the Italian arachnid fauna, and discusses the platform's role in biodiversity monitoring, ecological research, and conservation planning.

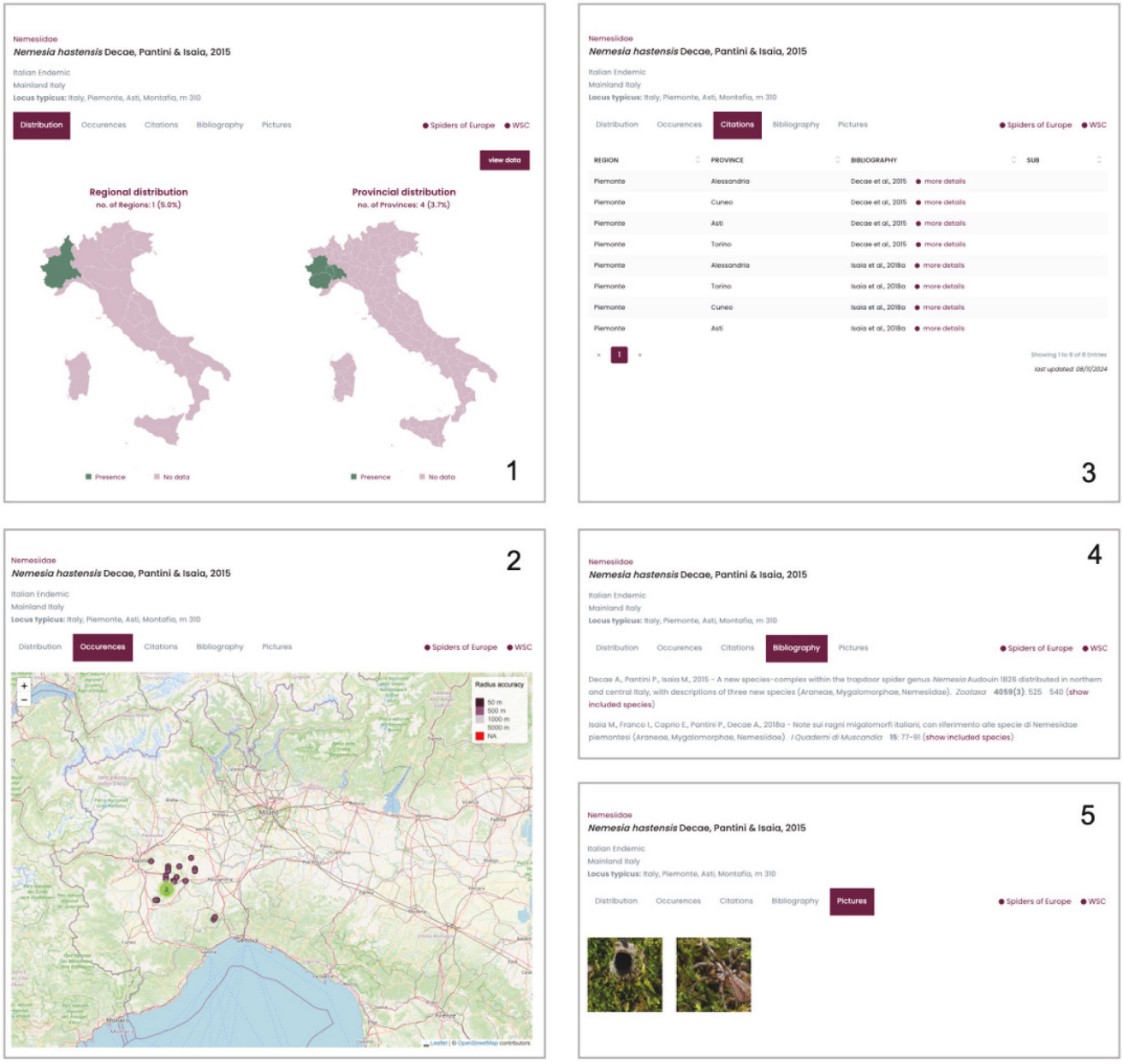

Fig. 1 - Example of a species page on Araneae.it version 2.0 for the Italian endemic *Nemesia hastensis* Decae, Pantini & Isaia 2015. The species' profile on Araneae.it version 2.0 now includes interactive maps detailing its distribution and summarizing its rarity across Italian regions and provinces (**1**) and occurrence records with an indication of coordinate precision (**2**), alongside citations (**3**), bibliography (**4**), and photographs (**5**). Green dots with the internal number in (2) indicate localities cited by more than one source.

Materials and methods

All data presented in ***Araneae.it*** are exclusively derived from published sources. In addition to works explicitly focused on the Italian fauna, the dataset also incorporates studies in which authors examined material originating from Italy. Unpublished sources such as dissertations, posters, technical reports, social media, websites, and online forums are deliberately excluded to ensure consistency, traceability, and scientific reliability of the information.

The revision of ***Araneae.it*** was conducted through a standardized yet flexible process designed to enhance both taxonomic accuracy and geographic resolution. Distribution data, compiled from the literature at regional and provincial levels and already systematically incorporated in the previous version, are now visually represented through interactive maps.

Interactive maps are embedded directly into species pages, allowing users to explore multi-scale distribution patterns. Each species profile follows a structured and

user-friendly layout, providing comprehensive taxonomic and distributional information (Fig. 1).

At the top of each page, the species name is displayed along with the taxonomic authority and year of description. Below this, visual tools illustrate the species' distribution across different administrative units, such as Italian provinces and regions, offering a precise view of known occurrences. An index of rarity, representing the percentage of Italian regions or provinces where the species occurs, is also provided. For endemic, alien, and other notable species, detailed occurrence maps and estimates of coordinate precision are included. A concise summary of overall distribution—often referencing biogeographic areas or well-known regions (e.g., "Western Alps")—complements the maps.

Each page also includes direct links to two major online spider resources, Spiders of Europe (Nentwig et al. 2025) and the World Spider Catalog (WSC 2025), facilitating access to broader taxonomic and bibliographic information. High-quality photographs, provided by a network of researchers and citizen scientists and verified for taxonomic accuracy, further enhance the platform's visual component.

To contextualize our work and assess its completeness, the data in this version were compared with the Global Biodiversity Information Facility (GBIF) to identify missing taxa and discrepancies, ensuring consistency and highlighting areas where ***Araneae.it*** provides unique or more accurate data. Overall, each species page combines taxonomic precision with accessibility, making the platform a valuable tool for researchers and conservationists working on Italian spider fauna.

Results

As of September 2025, ***Araneae.it*** 2.0 documents a total of 1,735 valid spider taxa, representing the most up-to-date taxonomic framework for the Italian spider fauna at national, regional, and provincial levels (Fig. 2). In addition,

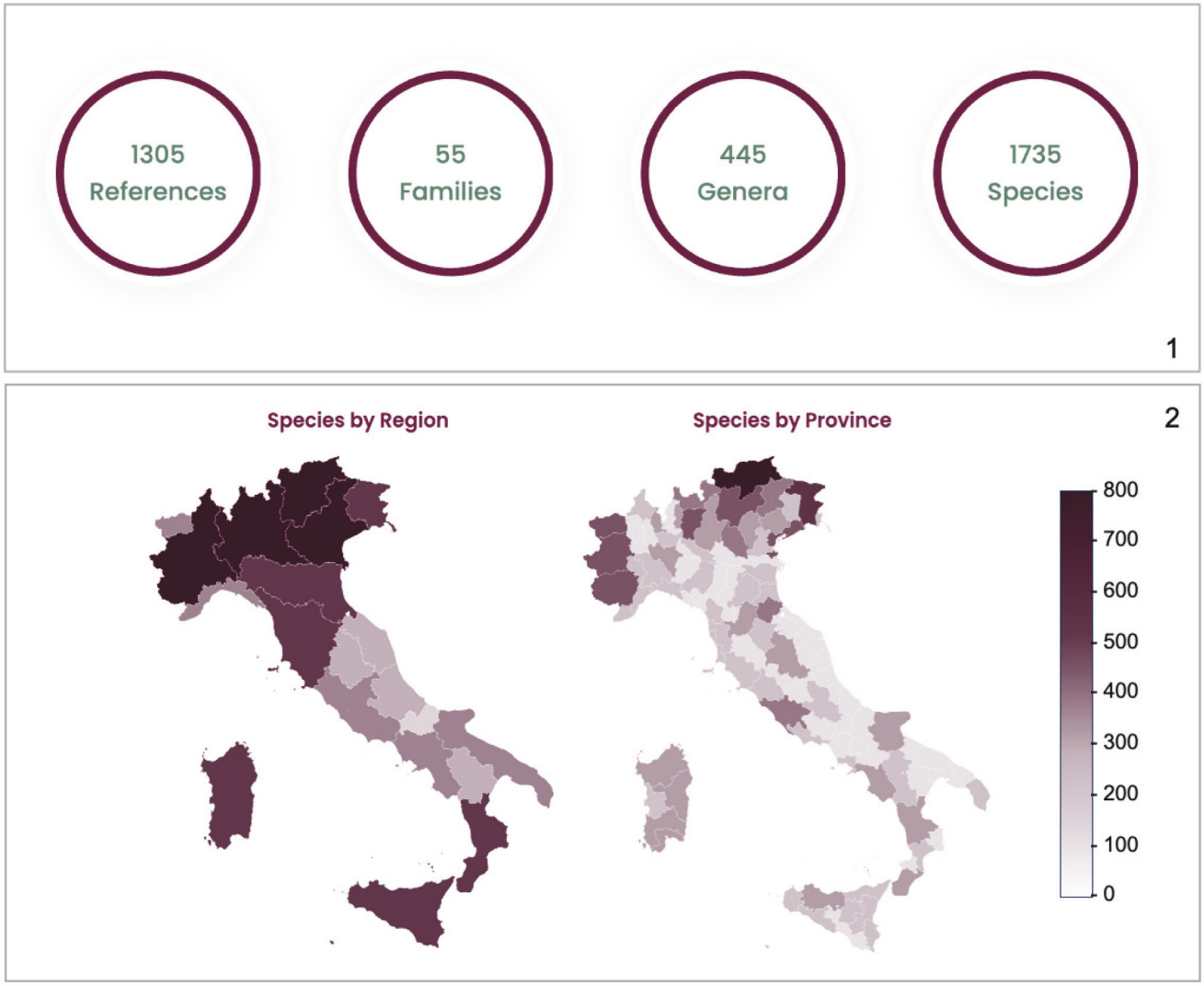

Fig. 2 - Data from Araneae.it version 2.0 at the time of publication: data at the national level (**1**), and species richness by region and by province in Italy (**2**).

128 taxa are listed in the "Omitted Taxa" section, which includes names excluded from the main list due to issues such as doubtful identification, misidentification, or implausible occurrence in Italy. Since its launch in 2019, the platform has added 11,481 new records, increasing the database from 50,043 to 61,884 entries as of September 2025. Moreover, 41 species described as new to science between 2019 and 2025 are now included in the Italian fauna. This continuous revision ensures alignment with the latest scientific standards and provides a reliable foundation for biodiversity research.

Overall, in the last ten years, the documented Italian spider fauna shows a clear increase in taxonomic knowledge (Fig. 3). The number of families remained relatively stable (54 to 53), while the number of genera increased from 422 to 444. Similarly, the total number of species and subspecies rose from 1,603 to 1,735, reflecting ongoing taxonomic work, discoveries, and updated records over the ten-year period.

Among the recorded fauna, 216 taxa are endemic to Italy, accounting for approximately 13.3% of the total spider fauna. An additional 128 taxa occur in Italy and one or more neighboring countries. Combined, these 357 species—representing 20.5% of the Italian spider fauna—include highly localized taxa often restricted to islands, alpine habitats, or caves, making them particularly important for conservation assessments.

The geographical distribution analysis indicates that only 10 species are recorded across all twenty Italian regions, whereas 352 species are reported from at least ten regions. At the provincial scale, there are no species occurring in all provinces, and only 28 species are recorded in at least half of them. Strong regional differences are evident in the number of species reported (Table 1, Fig. 2): Trentino-Alto Adige hosts the highest number of species (841), while Molise has the lowest (100). At the provincial level, Bolzano stands out with 784 species, whereas Chieti (9),

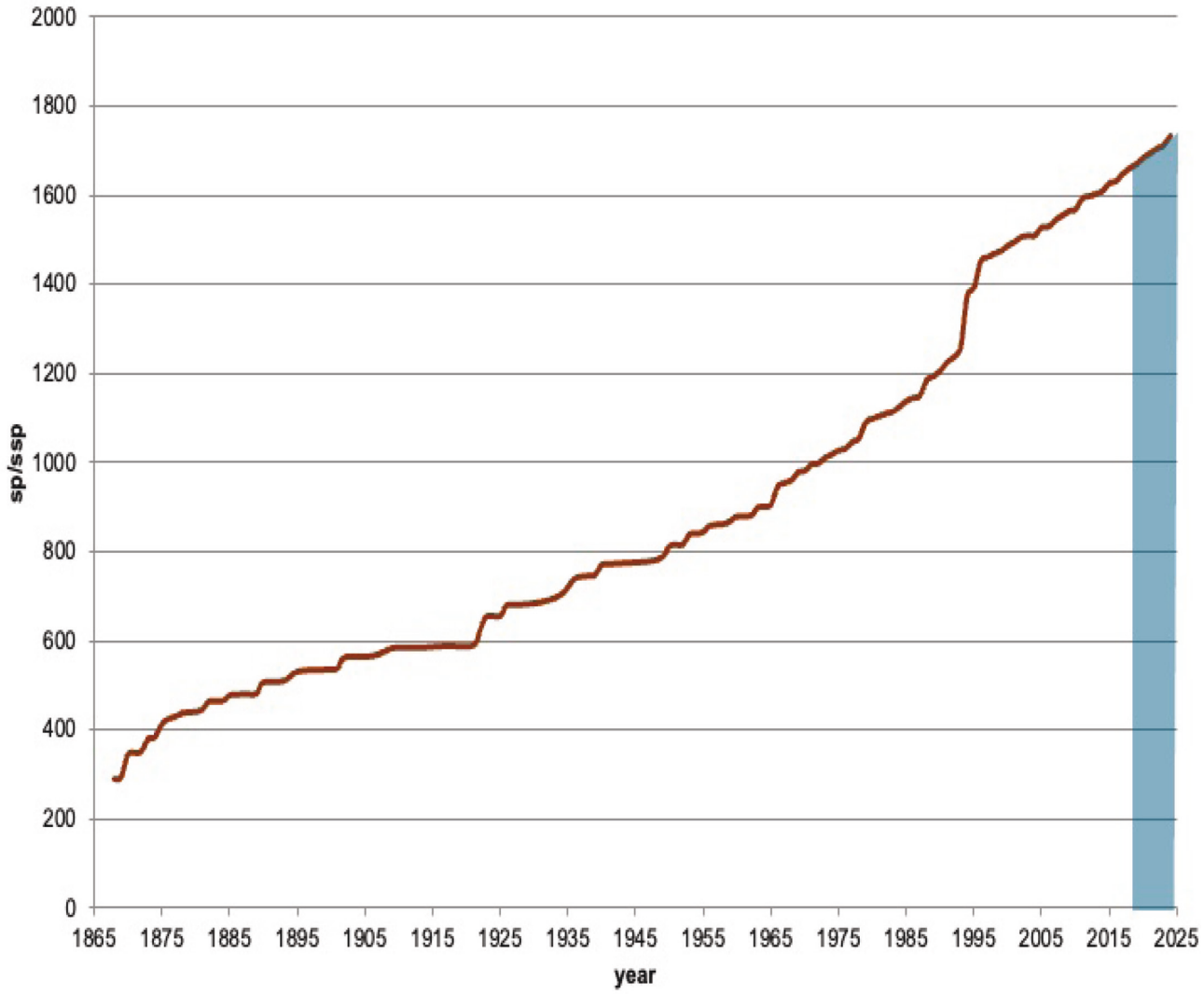

Fig. 3 - Cumulative line chart representing the increase of knowledge in Italian spiders, summed over time from 1868 to present (September 2025). The shaded blue area represents the increase in taxa since the launch of the platform.

Rimini (8), Benevento (8), and Crotone (4) remain particularly poorly studied.

Analysis of distributional patterns highlights the remarkable contribution of endemic taxa to the Italian spider fauna. The breakdown by families (Table 2) shows a highly uneven distribution, showing that Italian endemism is concentrated in a limited number of families, particularly those occurring in insular, alpine, or subterranean environments, underscoring their biogeographic and conservation importance. Dysderidae exhibit the highest proportion of endemics, with 73 out of 85 species (86%), followed by Leptonetidae (75%), Nesticidae (67%), and Cybaeidae (64%), all groups mostly associated with subterranean or other restricted habitats. Nemesiidae (54%) and Agelenidae (57%) also contribute significantly. In absolute numbers, however, Linyphiidae account for the largest share, with 128 endemic taxa (26%), reflecting both their high species richness and the presence of narrowly distributed lineages. By contrast, large families such as Salticidae (4%), Lycosidae (6%), and Theridiidae (3%) include only a small proportion of endemic taxa. Finally, some small families (e.g., Pimoidae and Ctenizidae) show 100% endemism, although this is based on only two or three species.

The georeferencing process for endemics, alien species, and other species of interest is ongoing. To date, 219 species of spiders have been georeferenced, comprising 154 endemics/sub-endemics, 22 alien species, and 43 species of conservation or medical relevance or of limited occurrence.

Beyond spiders, ***Araneae.it 2.0*** continues to cover all other arachnid orders present in Italy. A comparison with the 2019 dataset shows a general increase in recorded diversity. Opiliones rose from 134 to 136 species, and Scorpiones show a remarkable increase from 20 to 29 species, reflecting improved knowledge and new records. Palpigradi slightly increased from 14 to 15 species, while Solifugae remain represented by a single species. The list of pseudoscorpions, following a thorough revision by Giulio Gardini (personal communication 2022), increased from 227 taxa to 248 taxa. These changes highlight the dynamic nature of arachnid taxonomy in Italy and the importance of continuous data updates.

For these non-spider arachnids, the platform currently provides taxonomic checklists and general distributional information across mainland Italy, Sardinia, and Sicily, including notes on endemic species. The checklists are continuously curated and updated in close collaboration with taxonomic experts, ensuring that ***Araneae.it 2.0*** remains a reliable and current reference for the Italian arachnofauna.

Table 1 - Number of spider species recorded in each Italian region (updated September 2025).

Region	Taxa
Trentino-Alto Adige/ Südtirol	841
Lombardia	812
Veneto	792
Piemonte	734
Friuli Venezia Giulia	662
Emilia-Romagna	589
Toscana	582
Sardegna	551
Calabria	539
Sicilia	522
Valle d'Aosta	465
Lazio	444
Liguria	430
Puglia	390
Campania	343
Umbria	291
Basilicata	228
Abruzzo	180
Marche	178
Molise	100

Discussion

Araneae.it 2.0 addresses longstanding limitations in the documentation of the Italian spider fauna. The platform provides not only a consolidated taxonomic reference, but also multi-scale geographic data essential for understanding distribution patterns, detecting sampling gaps, and informing conservation strategies.

Distribution patterns reflect both an uneven sampling effort—highlighted by regions and provinces with very few records, as discussed above—and the high environmental heterogeneity of Italy, which encompasses markedly different habitats from north to south. Overall, northern regions are considerably better studied than southern ones, pointing to a geographical bias in knowledge of spider diversity. Furthermore, many species with broad ecological tolerance and strong dispersal capacity are likely underestimated and may have wider distributions than currently recorded. Conversely, the high number of endemic and rare species suggests that many are restricted to localized areas or specific habitats absent elsewhere in the peninsula, reflecting a complex biogeographical history.

The availability of high-resolution maps, especially for endemic taxa, is one of the platform's most valuable features. For these species, point-level data with explicit

Table 2 – Species richness, number of endemics, Italian endemics and endemism rate per spider family currently documented in *Araneae.it* version *2.0* (September 2025).

Family	Number of sp/ssp	Endemics	Italian endemics	Rate of endemism
Linyphiidae	502	128	75	25%
Dysderidae	85	73	54	86%
Agelenidae	65	37	18	57%
Gnaphosidae	177	22	13	12%
Nemesiidae	26	14	13	54%
Zodariidae	26	12	8	46%
Nesticidae	12	8	5	67%
Cybaeidae	11	7	1	64%
Liocranidae	24	7	7	29%
Amaurobiidae	14	6	4	43%
Leptonetidae	8	6	6	75%
Lycosidae	105	6	1	6%
Salticidae	144	6	4	4%
Thomisidae	80	6	4	8%
Theridiidae	117	4	4	3%
Pimoidae	3	3	1	100%
Ctenizidae	2	2	-	100%
Oonopidae	10	2	-	20%
Philodromidae	41	2	-	5%
Clubionidae	30	1	1	3%
Hahniidae	12	1	1	8%
Miturgidae	9	1	-	11%
Pholcidae	7	1	1	14%
Phrurolithidae	6	1	1	17%
Segestriidae	6	1	1	17%

Table 3 - Comparison of data between Araneae.it and GBIF. The table shows the number of records, families, species/subspecies (sp/ssp), and taxa uniquely reported by *Araneae.it* or GBIF. * indicates the number of direct observations in iNaturalist, ** indicates taxa exclusively reported by each database.

	Araneae.it	GBIF
Records	61,884	48,273 (38,831*)
Families	56	50
Taxa (sp/ssp)	1,735	1,096
Exclusively reported therein	707	69 (21**)

precision indicators allow for refined analyses of range size, fragmentation, and population isolation—key variables in assessing extinction risk under IUCN Red List criteria. This makes ***Araneae.it 2.0*** a vital tool for future conservation assessments of Italian spiders.

Furthermore, the inclusion of other arachnid orders ensures a broader taxonomic scope, enabling holistic biodiversity studies that go beyond spiders alone. Since 2019, these sections have been updated through collaboration with experts, ensuring their scientific accuracy and alignment with current taxonomy. In the future, similar efforts to those already established for spiders will be extended to the other groups of Arachnids occurring in Italy, for which this work has already begun.

Photographic coverage continues to grow, enriching species pages and contributing to public engagement, educational outreach, and citizen science. These images, alongside interactive tools that allow filtering by taxonomy, geographic region, and endemism, make the platform both scientifically robust and accessible to a broader audience.

The comparison between ***Araneae.it 2.0*** and the Global Biodiversity Information Facility (GBIF) (data downloaded on 09/01/2025) underscores the fundamental role of curated national platforms in biodiversity research (Tab. 3). While GBIF provides a powerful framework for aggregating vast amounts of biodiversity data, its reliance on heterogeneous sources inevitably leads to the inclusion of misidentifications, unresolved synonymies, and geographically implausible records. In contrast, ***Araneae.it***, with its 1,735 validated taxa (as of time of publication), offers a taxonomically consistent and geographically precise catalog of the Italian spider fauna. Entire families absent from GBIF, such as Mysmenidae, Prodidomidae and Synaphridae, are covered in ***Araneae.it***, and doubtful records are systematically filtered out. A notable example is *Pimoa breuili* (Fage, 1931), a species endemic to the Cantabrian Mountains in northern Spain, which appears in GBIF as occurring in Italy based on a single male specimen conserved in Stuttgart. Although molecular analyses seem to confirm the identity of this specimen, its occurrence in central Italy is biogeographically implausible and has never been corroborated by further records, strongly suggesting a labeling or provenance error. Similar issues affect other species: *Parastalita stygia* (Joseph, 1882) a cave-dwelling endemic of Slovenia, Croatia, and Bosnia and Herzegovina, is attributed to Italy based on immature specimens from "Reggio Aspromonte"; *Berlandina cinerea* (Menge, 1872), a species with a Siberian–European distribution, is reported from Sicily, although subsequent records from the same locality confirm instead the presence of *B. plumalis* (O.Pickard-Cambridge, 1872); and *Latrodectus mactans* (Fabricius, 1775), the notorious North-American black widow, is erroneously listed for Sardinia due to misidentified museum material dating back to 1958.

These discrepancies highlight a broader point: global databases and national checklists should be regarded as complementary rather than competing resources. Global platforms excel at providing scale and interoperability, whereas national initiatives, curated by domain experts, ensure taxonomic accuracy, geographic resolution, and contextual interpretation of records. In the case of Italian spiders, ***Araneae.it 2.0*** provides a level of precision unattainable by automated aggregators, making it indispensable for conservation planning, ecological analyses, and biogeographic studies. As such, ***Araneae.it 2.0*** serves not only as the authoritative reference for Italian arachnology, but also as a model for how national platforms can effectively complement global biodiversity infrastructures.

Conclusions and perspectives

Araneae.it 2.0 is an authoritative resource on Italian arachnids, combining updated taxonomy, detailed distributional data. Its integration of interactive maps, point-based localities for relevant species establishes it as a model for regional biodiversity platforms. Detailed distributional data at the provincial and regional level and at high resolution for other arachnids than spiders are currently being processed and will be presented in the near future.

Looking ahead, one of the primary objectives is to use the platform's spatial data to evaluate the extinction risk of Italian endemic species of Arachnids, many of which are restricted to small, vulnerable habitats. The distribution maps—complete with coordinate precision—are essential for calculating area of occupancy (AOO) and extent of occurrence (EOO), key metrics for conservation assessments. Furthermore, a further perspective is to make curated data downloadable by users, further enhancing transparency, reusability, and integration into other biodiversity research and conservation efforts.

In parallel, on a longer term, we are developing a species-level trait database for all Italian spider taxa that will be made available in the platform. This dataset will include ecological, behavioral, and morphological traits and will support macroecological studies, vulnerability assessments, and functional biodiversity research. Together with the existing spatial and taxonomic data, it will greatly enhance the platform's potential for ecological modeling and conservation planning.

By ensuring regular expert updates, ***Araneae.it 2.0*** stands as a long-term, evolving infrastructure for Italian arachnology and biodiversity science.

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