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A Comprehensive Occurrence Dataset for European Ostracoda Inhabiting Groundwater and Groundwater-Dependent Ecosystems

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Keywords: alluvial aquifers | conservation | ecotypes | habitat types | hyporheic zone | karst | occurrence data | ostracods | springs

ABSTRACT

Motivation: Groundwater ecosystems sustain a unique and globally important biodiversity but remain understudied due to sampling and exploration challenges, as well as a shortage of taxonomic experts. Groundwater ostracods, like other groundwater taxa, exhibit a high degree of endemism, rarity and subterranean specialisation, positioning them as potentially vulnerable organisms. To better understand biodiversity patterns and the conservation needs of this highly diverse group, we assembled a team of experts to gather the most comprehensive information available about groundwater ostracods in Europe. We present a dataset comprising 2065 occurrence records of 110 species, 11 undescribed species and 5 subspecies of groundwater ostracods. This open dataset may support future research on the distribution, evolutionary pathways and conservation needs of European groundwater ostracods, as well as inspire targeted sampling efforts in regions with currently limited data available.

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Main Types of Variables Contained: Occurrence records of groundwater ostracods, with details about taxonomy, source of records, occurrence locality, habitat type and species dependence on groundwater (obligate [stygobiont] versus facultative groundwater-dwellers [stygophile]).

Spatial Location and Grain: Geographical Europe, spanning 32 countries. Occurrence records were assigned decimal degrees coordinates (EPSG:4326). Most occurrence records are at 100 m resolution.

Time Period: 1915–2024.

Major Taxa and Level of Measurement: Crustacea: Ostracoda. Most records have species or subspecies-level identification, while some are identified to genus or family levels.

Software Format: Comma-separated values file (.csv) and Excel file (.xlsx), with UTF-8 encoding and metadata provided following the Darwin Core standard.

1 | Introduction

The majority of Earth's freshwater is stored beneath the surface (Gleeson et al. 2016) creating unique ecosystems for highly specialised subterranean fauna. Groundwater ecosystems are broadly defined as water-containing subterranean voids occurring in unconsolidated alluvial or colluvial sediments, in pores or fractures of igneous, sedimentary or metamorphic rocks and in saturated soils (e.g., hypotelminorheic habitats, Culver et al. 2006) (Boulton et al. 2023). Since groundwater interacts with multiple biomes, including rivers relying on base flow and terrestrial ecosystems, the concept of groundwater-dependent ecosystems (GDE) was further introduced (Eamus and Froend 2006; Eamus et al. 2016). GDEs are rivers, streams and their floodplains and hyporheic zones, springs and terrestrial ecosystems dependent on the subsurface presence of groundwater. Specific groundwater and groundwater-dependent ecosystems are groundwater-fed wetlands and coastal anchialine cave systems. Due to the vast volume of clean, safe drinking water they contain, groundwater environments are a vital resource in the global water cycle, hosting unique biodiversity and providing essential services to societies (Griebler and Avramov 2015; Koch et al. 2024; Saccò et al. 2024).

Among the array of specialised species that have adapted to permanently inhabit groundwaters, ostracods (Crustacea, Podocopida) stand out as particularly abundant and diverse (Danielopol et al. 1994). Ostracods are one of the oldest crustacean groups, inhabiting marine, freshwater and semi-terrestrial (e.g., mosses) ecosystems, mostly free-living, but also in parasitic/commensal forms (Horne 2003; Karanovic 2012). In Europe, ostracods represent about 7.7% of all groundwater crustacean species (Zagmajster et al. 2014). Moreover, they exhibit a high degree of endemism and rarity, which positions them as potentially highly endangered taxa (Danielopol and Pospisil 2001).

The recent global checklist of the extant non-marine ostracods includes 2420 species in 295 genera, 20 families and four superfamilies (Meisch et al. 2024). Among these, 817 species occur in the Palearctic region. However, the updated global checklist does not indicate which species exclusively inhabit groundwater ecosystems (so-called 'stygobionts' or 'stygobites'), or both surface and subterranean aquatic environments, but not necessarily restricted to either (e.g., 'stygophiles') (Gibert et al. 1994). In *Stygofauna Mundi*, Danielopol and Hartmann (1986) listed 300 stygobiotic ostracod species globally. Later, Malard et al. (2009) presented the results of the PASCALIS project, in which six regions of Europe were intensively sampled across multiple groundwater ecosystems, documenting 48 stygobiotic and stygophilic ostracods, predominantly in the family Candonidae (40 species). During PASCALIS, the Slovenian, northern Italian and Pyrenean regions yielded the highest species richness and rarity scores for groundwater organisms studied across six European countries (Deharveng et al. 2009). Later, Zagmajster et al. (2014) compiled and mapped records of 1570 groundwater crustacean species in Europe, including 114 ostracod species in 20 genera and 7 families, including yet undescribed species.

Species occurrence data, especially if accompanied by environmental information, are an essential currency in ecological and conservation research, allowing researchers to map biodiversity patterns, assess species extinction risk, identify threatened species or design protected areas (Magurran et al. 2019). Moreover, data on species' distributions are a key ingredient in developing predictive models of biodiversity change when subjected to climate change and other anthropogenic threats (Santini et al. 2021). Such models are being increasingly applied to subterranean species and habitats as well (Mammola and Leroy 2018).

Many databases have been developed to preserve, curate and mobilise aquatic biodiversity data (Smits et al. 2025). Since ostracods live in all aquatic environments and their fossil records span nearly 485 million years, from the Ordovician to the Holocene, they are included in many open accessible biodiversity databases, although none of these is exclusively focused on groundwater environments (Huang et al. 2022). During the ongoing Biodiversa+ project DarCo, an international project focusing on the conservation of subterranean biodiversity in Europe, we are assembling continental-scale data for key subterranean taxa, including Asellidae (Saclier et al. 2024), Copepoda (Cerasoli et al. 2025) and many others in preparation. Against this backdrop, we had the opportunity to work together with groundwater biodiversity experts and stakeholders from different European countries, compiling several datasets that also hold occurrence data for ostracods in groundwaters.

This paper is the outcome of this collective effort, reporting updated and curated information on the occurrence of stygobiotic and stygophilic ostracod species across Europe and across the

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full breadth of groundwater (karstic, fissured and alluvial) and groundwater-dependent ecosystems (primarily springs and hyporheic zones) that are included as an access point to adjacent groundwater ecosystems. The dataset provided herein, named the European Groundwater Ostracoda occurrence Dataset for groundwater and groundwater-dependent ecosystems (EGWOD), enabled an accurate estimation of currently known total ostracod species richness in European groundwaters, as well as the determination of species numbers for each taxonomic rank, from genus to order, along with the number of species in each of the European hydroregions. Furthermore, the compiled dataset enables analyses of species' distribution ranges, revealing species with narrow distributions (including single-site endemics), and the assessment of the extent of ostracod localities that are included within the current network of protected areas within Europe.

2 | Materials and Methods

2.1 | Spatial Validation

We compiled the European Ostracoda occurrence dataset for groundwater and groundwater-dependent ecosystems (EGWOD) from several datasets and databases: the European groundwater crustacean dataset (Zagmajster et al. 2014), the SubBioDB database (Zagmajster et al. 2008, 2012), the Slovenian Ostracoda dataset (Mori and Šalamun 2022) and several datasets obtained from individual researchers in the United Kingdom, Ireland, Croatia, Hungary, Romania, Italy and Austria. Furthermore, we included additional data from 7 publications not yet incorporated within the databases or datasets mentioned above (Klie 1937; Rossetti et al. 2006; Pieri et al. 2015; Mazzini et al. 2017; Pociecha et al. 2021; Knight et al. 2022; Pendino et al. 2024). We sourced these publications from the authors' personal reference libraries and from the Web of Science and Scopus platforms. We georeferenced localities extracted from the literature to the highest practicable resolution using either the spatial coordinates listed in the publication itself, speleological cadasters or other internet sources. All coordinates in our dataset are given in decimal degrees, WGS84 reference system (EPSG:4326). The names of the variables included in the dataset are listed in Table 1.

2.2 | Taxonomic Content, Validation and Species Selection

Taxonomic consistency was checked and followed that of Meisch et al. (2024). In the dataset, we also included undescribed species, recognised as new to science by experts based on morphological and/or molecular identifications. About 9% of the records were at genus or family level. For each species, we defined the ecotype sensu Gibert et al. (1994) (stygobiont: species that accomplish their entire life cycle in groundwater, stygophile: species that can accomplish their entire life cycle either in groundwater or surface water, stygoxene: species that accomplish their life cycle exclusively in surface water but can also occur sporadically in groundwater), using information from Danielopol and Hartmann (1986) and Meisch (2000). From our final dataset, we excluded records of species classified as stygoxenes and all marine species.

2.3 | Data Characterisation

2.3.1 | Geographic Distribution

Species' occurrence by distribution ranges and ostracod family distributions were mapped in QGIS (QGIS.org 2024), using the Natural Earth Countries (www.naturalearthdata.com) as a base layer. For the species'occurrence by distribution, we grouped data according to the number of localities where a species was recorded. Prior to the analyses and for the published dataset, we removed duplicate records using the package 'dplyr' version 1.1.4 (Wickham et al. 2023) in R. For mapping the number of species records, we clustered records occurring within 400 km × 400 km square windows. We assessed the completeness of sampling with species accumulation curves using localities (latitude and longitude coordinates) as sampling units. For hydroregions, we used the HydroBASINS Level 3 shapefile as a base layer (Lehner and Grill 2013). HydroBASINS Level 3 was chosen because it represents large river basins that broadly correspond to major hydrogeological units. Ideally, such analysis would be conducted using stygoregions (Hahn 2009), which would better represent groundwater units than surface-based hydroregions. However, to our knowledge, no recent study attempted to delineate the stygoregions at the European level, preventing the optimal analytic framework. Data was grouped according to the number of hydroregions in which a species occurred. In QGIS, we performed spatial intersections based on the locations of our records to assign hydroregions and aggregate data for further processing.

To assess the relation of the Last Glacial Maximum (LGM) extent to occurrences of ostracod species, we used a Quaternary glaciations shapefile (Ehlers et al. 2011) and mapped occurrence records on it. Ostracod occurrence records were categorised according to their ecological type (stygobiont or stygophile), and the position according to LGM was discussed.

We compared occurrence data in EGWOD with those of the Global Biodiversity Information Facility (GBIF) (GBIF.org 2025; https://doi.org/10.15468/dl.pgjxyr, https://doi.org/10.15468/dl.v6vspc, https://doi.org/10.15468/dl.c4yykf, https://doi.org/10.15468/dl.c6z5md, https://doi.org/10.15468/dl.nkc9ub, https://doi.org/10.15468/dl.by2ghg, https://doi.org/10.15468/dl.cscckx). From GBIF, we downloaded occurrence data by family. In the case of the family Cyclocyprididae, which is not fully recognised by GBIF yet, we extracted data based on genus. We compared GBIF and EGWOD, focusing on the number of species and occurrences.

2.3.2 | Sampling Site Characterisation

Based on the information from the source databases/datasets we distinguished among four types of sampling sites: caves, springs (mostly karstic aquifers, but also fissured or alluvial aquifers), interstitial (alluvial aquifers), wells (mostly alluvial aquifers,

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TABLE 1 | Description of the data fields in the European Groundwater Ostracoda occurrence Dataset for groundwater and groundwater-dependent ecosystems (EGWOD).

Column name	Description
ID	Occurrence record ID
datasetName	Official name of the source, if any, or unofficial name of the source
informationWithheld	Name of the provider of the dataset
taxonID	Taxon ID as set in the source dataset
class	Class following nomenclature by Meisch et al. (2024)
order	Order following nomenclature by Meisch et al. (2024)
family	Family following nomenclature by Meisch et al. (2024)
genus	Genus following nomenclature by Meisch et al. (2024)
species	Species following nomenclature by Meisch et al. (2024)
scientificNameAuthorship	Author and year following nomenclature by Meisch et al. (2024)
verbatimIdentification	Taxon species full name as provided in the source
scientificName	Valid taxon species full name following nomenclature by Meisch et al. (2024)
taxonRank	Taxon rank to which the sample was determined (Family, Genus, Species, Subspecies)
lineage	In a case of several lineages—specification of lineages
dateIdentified	Date of sampling if available
identifiedBy	Surveyors if available
decimalLatitude	N—measured in degrees (WGS 84, EPSG: 4326)
decimalLongitude	E—measured in degrees (WGS 84, EPSG: 4326)
geodeticDatum	The coordinate system/georeference protocol
elevationInMeters	Altitude provided in meters if available
verticalDatum	Predefined or calculated (def/cal)
locationID	Locality ID if set in source dataset
locality	Descriptive name of the exact locality
municipality	Name of the municipality or nearby larger settlement
stateProvince	Province if available
region	Region if available
country	Country in which the sample was collected in
locationRemarks	As defined in source database
habitat	Sampling site type classified and synchronised to the same terminology (Interstitial—Hyporheic zone; Interstitial—Phreatic Zone; Cave; Spring; Well; NA)
MeasurementOrFact	Stygobiont—exclusively from GW, Stygophile—predominantly occurring in GW
references	Name of the source (literature, project, database)
basisOfRecord	Literature/dataset/observation
rightsHolder	Rights of the data
Input.into.DB—name	The name of the person that input data into DB

but in some cases also karstic or fissured aquifers). If further information was available, we also defined the following categories based on PASCALIS protocols (Dole-Olivier et al. 2009): cave–karstic saturated zone; cave–karstic unsaturated zone; spring–karstic saturated zone; spring–karstic unsaturated zone; interstitial–hyporheic zone; interstitial–phreatic zone. We visualised the results in R, using 'ggplot2' package, version 3.5.1 (Wickham et al. 2024).

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2.3.3 | Estimating Coverage of Ostracod Localities by Protected Areas

We estimated the percentage of records within Protected Areas (Natura 2000, Emerald and WDPA) by overlapping the shapefile with occurrence records of ostracods using intersection tools in QGIS. Natura 2000 is a network of protected areas in the European Union aimed at conserving natural habitats and species under the Birds and Habitats Directives (Council Directive 2009/147/EC, Council Directive 92/43/EEC). The Emerald Network, modelled after Natura 2000, extends similar conservation objectives to non-EU countries under the Bern Convention (CETS 104). The WDPA (World Database on Protected Areas) is a global database of currently designated terrestrial and marine protected areas (UNEP-WCMC and IUCN 2024). For Natura 2000 (temporal coverage from 2022) and the Emerald Network (temporal coverage from 2023), we used layers from the European Environment Agency's data hub (EEA, https://www.eea.europa.eu/en/analysis). Layers for WDPA were extracted from the World Database on Protected Areas (UNEP-WCMC and IUCN 2024) in December 2024. However, this analysis is related only to the 2-dimensional aspects of nature protection, since the map-based databases (Natura 2000, Emerald and WDPA) used in this analysis are working on surface coverage and thus might not include individual caves, which are in many countries ex lege protected (e.g., Slovenia, Hungary). Thus, there is a small risk that some protected caves are not located beneath the protection areas used in this analysis.

3 | Results

3.1 | Species Richness and Distribution of Species

The final dataset contains a total of 2065 records across 32 countries, although most records are concentrated in a few countries (e.g., France, Slovenia, Austria; Figure 1). Forty-two records were identified only to family and 132 to genus level, respectively. A total of 2022 records (98.00%) included precise spatial coordinates (spatial precision < 100 m), and 1902 records (92.11%) contained information on sampling site type.

Some of the data (996 records) did not include information on the year of collection. The oldest record dates to 1915, and the most recent ones are from 2024. Annual ostracod records before the year 2000 are few and mostly do not reach more than 10 records per year. Since then, the number of published records has been steadily increasing, generally exceeding 10 records

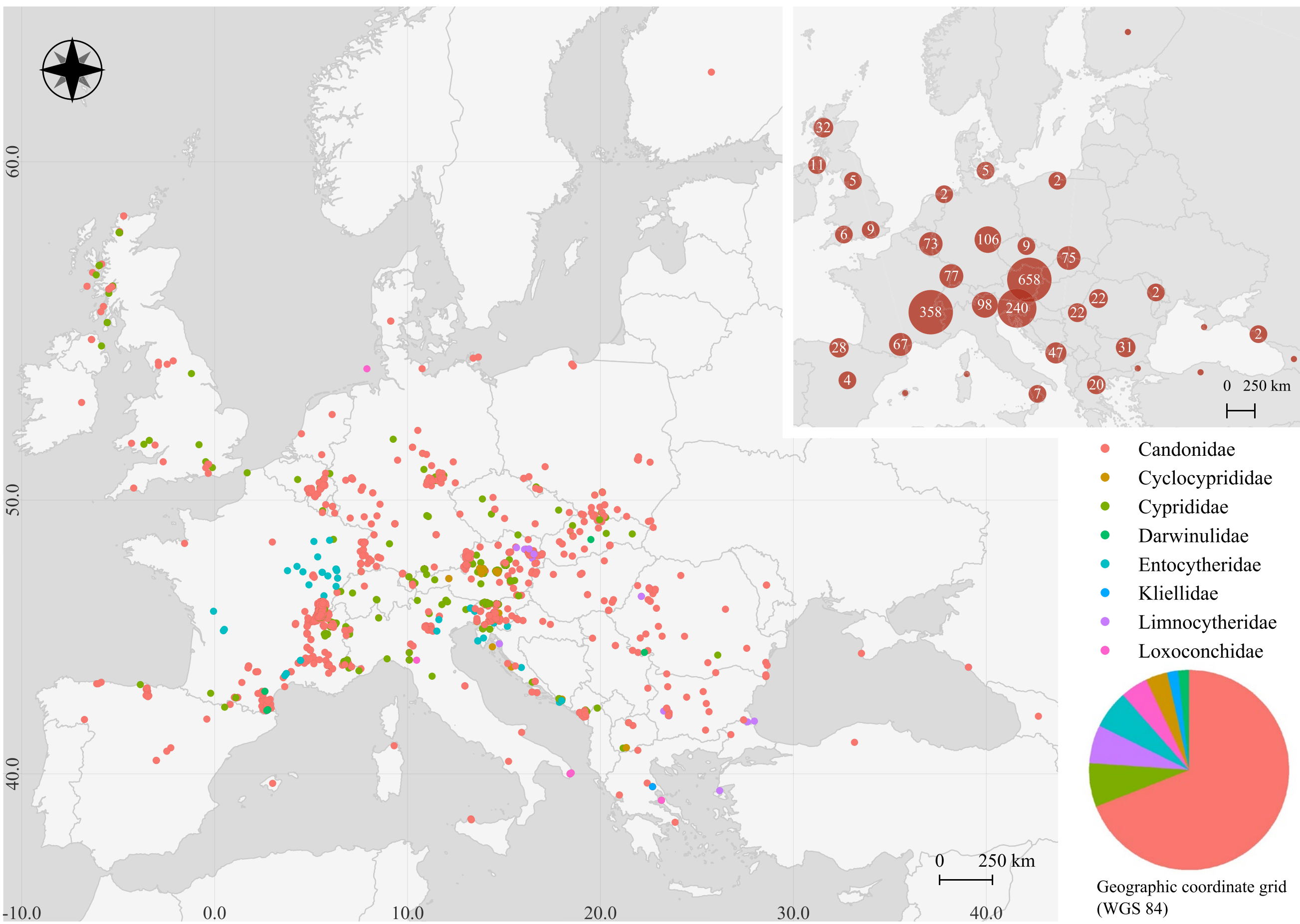

FIGURE 1 | Occurrence of stygobitic and stygophilic ostracods in Europe. Data are grouped by families. In the top-right corner, a grouping of data is presented to show the number of records in a certain area: The dots are clustered based on 400 km × 400 km square windows, not based on a fixed grid. In the bottom-right corner is a pie chart showing the percentage of species per family. For the base layer, a Natural earth image was used in the WGS 84/Pseudo-Mercator CRS (EPSG:3857).

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per year (Figure S1) and peaking in the years 2004, 2002 and 2012 with 234, 217,188 records per year, respectively. EGWOD contains 110 valid species and 5 subspecies (according to Meisch et al. 2024) from 29 genera and 8 families of Ostracoda (Crustacea, Podocopida). We included also 11 species new to science that are formally not described yet. The most species-rich family is Candonidae with 74 species and 3 subspecies, followed by Cyprididae, Limnocytheridae and Entocytheridae (Figure 1, Table S1).

A total of 33 species occur at a single locality (Figure S2, Table S2), and 43 species are known from five or fewer localities. Additionally, 82 species are found in only one hydroregion, with the highest number of species (27) in region 5 (region code 2030008490; Dniester-Lower Danube), followed by region 6 (region code 2030009230; Thrace) with 21 species (Figure S3, Table S3).

The species accumulation curve based on unique coordinates shows a logarithmic increase in species richness with increasing sampling effort (Figure 2). Although the curve gradually approaches an asymptote, it has not yet reached it, indicating that further sampling is required to comprehensively assess subterranean ostracod biodiversity in Europe.

3.2 | Occurrences of Species in Different Sampling Site Types

The highest number of records was from springs, followed by interstitial, while records from caves and wells were much lower (Table 2). Records from wells could incorporate alluvial, karstic, or fissured aquifers. About 160 records lacked information about the sampling site type.

The highest number of species occurred in wells and caves, then in the undefined sampling site category, springs, and the hyporheic zone. The most common species in caves was *Fabaeformiscandona breuili*, in wells and the hyporheic zone *Marmocandona zschokkei*, in springs *Cavernocypris subterranea* and in the phreatic zone *Cryptocandona kieferi danubialis* (Table 2).

The most common ostracod family in our dataset, Candonidae, was present in all sampling site types, but was most abundant in wells. The only other family found across all sampling site types was Cyclocyprididae, which occurred most abundantly in springs. The greatest family diversity was observed in caves and wells, where seven out of eight families were present in both sampling site types (except for Klieidae in caves and Darwinulidae in wells). The lowest family diversity was observed in the phreatic

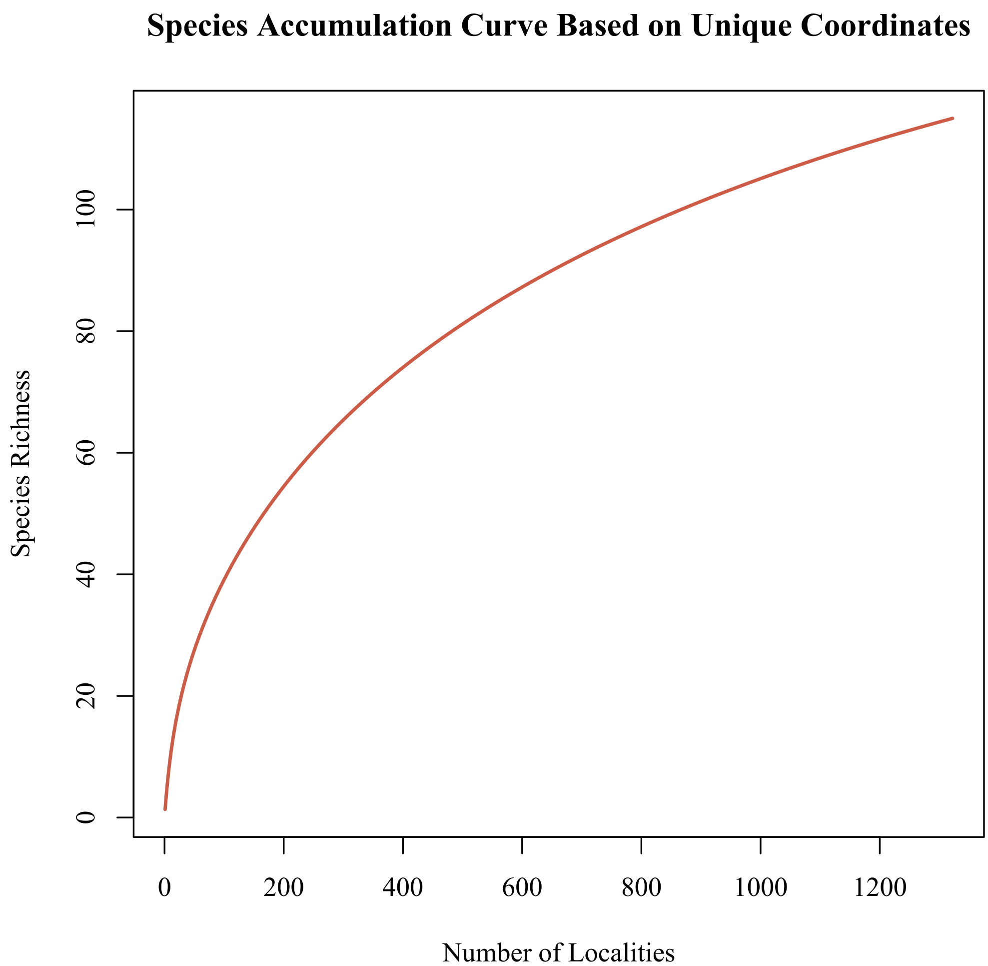

FIGURE 2 | Species accumulation curve illustrating the relationship between sampling effort, determined by the number of localities and species richness. The accumulation curve is based on geographic localities, determined by latitude and longitude coordinates.

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zone, where only Candonidae, Cyclocyprididae, Cyprididae, and Entocytheridae were present. Klieidae were only recorded in wells, 80% of Entocytheridae specimens occurred in caves and roughly 70% of Cyprididae species were recorded in springs (Figure S4).

3.3 | Protected Area Coverage

A total of 1027 ostracod records occur within the World Database on Protected Areas (WDPA), representing 51% of the records (Table 3 and Figure S5). Of these records, 766 fall within the Natura 2000 network of protected areas (38%), 33 (< 2%) fall within Emerald protected areas and the remaining are covered by national protection schemes.

3.4 | Comparison With Existing Datasets

When comparing the EGWOD dataset to the GBIF dataset (Table S4), we observed a large mismatch in available information. Multiple species and genera were missing from the GBIF occurrence records. The genera *Cyclocypris* and *Cypria*—classified under the family Cyclocyprididae by Meisch et al. (2024)—are listed under different families in GBIF: *Cyclocypris* under Candonidae and *Cypria* under Cyprididae. In total, EGWOD includes 1891 species occurrence records, while GBIF contains 881 occurrence records corresponding to species listed in EGWOD. Some genera—specifically *Cryptocandona*, *Pseudocandona*, *Cyclocypris*, *Herpetocypris* and *Vestalenula*—have more occurrence records in the GBIF dataset; however, the majority of these records lack precise coordinate information.

4 | Discussion

The most recent checklist for the Palearctic region comprises 817 non-marine ostracod species (Meisch et al. 2024). Given that our dataset included 110 species and 5 subspecies, we can infer that approximately 10%–20% of all ostracods in the Palearctic region are restricted to or tightly affiliated with groundwater ecosystems. This is not surprising since groundwater is globally the largest freshwater biome (Griebler et al. 2014), hosting over 10,000 species from different animal groups (Martinez et al. 2018). Arguably, however, groundwater ostracods are still under-sampled and understudied compared to surface species, owing to the logistical challenges of sampling and exploring subterranean environments (Zagmajster et al. 2010; Ficetola et al. 2019; Mammola et al. 2021), as well as their challenging taxonomy, shortage of taxonomists, and lack of molecular studies (Karanovic et al. 2020).

About 65% of species in the dataset belong to the family Candonidae, clearly positioning this family as the most successful in colonising groundwater ecosystems in Europe. Similarly, extensive subterranean candonid radiations have been reported from North and Central America (Külköylüoğlu et al. 2023), West Africa (Hotèkpo et al. 2024) and Northwest Australia (Pilbara) (Karanovic 2007). Most likely, the success of Candonidae in groundwater colonisation is due to the fact that most species in this family are crawlers, preadapted to movement in sand and gravel substrates (Danielopol 1978, 1980). Globally, the highest species richness of non-marine ostracods, including both surface and groundwater species, is found in the family Cyprididae (43% of species), while only 21.5% of species belong to the Candonidae (Meisch et al. 2024). However,

TABLE 2 | Summary of sampling site types: number of records and species, and most common taxa.

Sampling site type	Number of occurrences	Number of species	Most common species	Most common genus
Cave	225	52	*Fabaeformiscandona breuili*	*Sphaeromicola*
Interstitial—hyporheic zone	401	40	*Marmocandona zschokkei*	*Fabaeformiscandona*
Interstitial—phreatic zone	441	29	*Cryptocandona kieferi danubialis*	*Cryptocandona*
Spring	613	44	*Cavernocypris subterranea*	*Cavernocypris*
Well	222	52	*Marmocandona zschokkei*	*Marmocandona*
Unknown	163	45	*Typhlocypris eremita*	*Fabaeformiscandona*

TABLE 3 | Current inclusion of groundwater ostracod localities in the set of protected areas in Europe.

Protected area (PA)	Number of occurrences within the PA	Number of occurrences outside the PA	Percentage of occurrences within the PA
Natura 2000	766	1256	37.9
Emerald	33	1989	1.6
WDPA	1027	995	50.8

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in the Palearctic region the proportion of candonid species is higher than cyprids, although still not reaching half of all species. According to Meisch et al. (2024), almost all of the species included in EGWOD are exclusively found in the Palearctic region, with the exception of five species. *Vestalenula boteai* and *Herpetocypris reptans* also occur in the Oriental region, with *H. reptans* additionally found in the Neotropical and Nearctic regions. *Cavernocypris subterranea* and *Fabaeformiscandona wegelini* are also present in the Nearctic region.

Most single-site records in the dataset occur in Southern France and on the Italian and Balkan peninsulas. However, this pattern may be partly artifactual due to higher sampling effort in France, Austria and Slovenia. This may lead to misleading interpretations of subsequent data and suggests the need for additional sampling in western France, most of the Pyrenees and parts of the Italian and Balkan peninsulas, which are well-known hotspots of endemism for other aquatic (Deharveng et al. 2009) and terrestrial subterranean taxa (e.g., spiders; Mammola et al. 2018). Noteworthy, most of the species observed within the LGM (Last Glacial Maximum) boundaries are stygophilic, suggesting that they most likely recolonised the deglaciated lands after the ice retreated (Figure S6). This confirms that long-term climatic changes were a driving force for an extinction and general absence of subterranean species within the LGM boundaries (Culver and Pipan 2010; Zagmajster et al. 2014; Mammola et al. 2019).

The species accumulation curves reveal a logarithmic increase in species richness with increasing sampling effort, as measured with the number of localities (Figure 2). As the curve has not yet reached the asymptote, the current sampling effort remains insufficient to capture Europe's groundwater ostracod diversity. Additional sampling, particularly in the undersampled areas, would likely reveal further species, as many groundwater species appear to have narrow distributions. Whether this reflects true endemism or simply limited sampling remains to be investigated.

Most records came from springs and alluvial groundwater, which is to be expected since the former sampling site is easily accessible, while the latter is widespread across Europe and the focus of several European research groups. However, research on groundwater fauna has primarily been conducted in caves rather than alluvial groundwater, suggesting that ostracods are not typical cave/karst inhabitants, also due to their close association with sediments, into which most species tend to burrow for shelter. Nevertheless, it could be that ostracods are typically more abundant in 'ecotones', that is, ecosystems, such as springs and hyporheic zones, rather than caves and deep alluvial aquifers. Ecotones generally tend to have higher species richness than adjacent ecosystems due to the cross-over and mixing of species from different ecosystems across the ecotone (Mori 2015). Accessibility of sampling sites is, besides the lack of taxonomic expertise, one of the main obstacles in groundwater research (Zagmajster et al. 2010; Ficetola et al. 2019; Mammola et al. 2021). There is also the possibility that during cave surveys, these tiny organisms are neglected when focusing on 'macro' invertebrates, such as amphipods and isopods. The number of species occurring in different types of sampling sites within the dataset can be correlated with the fact that more easily accessed sampling sites are more intensively sampled. However, due to their limited connectivity, the fauna of karstic aquifers can often display a high degree of endemism, representing biodiversity hotspots (Siegel et al. 2023). In contrast, alluvial aquifers are generally better connected and have thus been regarded as an *interstitial highway*, a long-term dispersal route for all meiobenthic organisms, hosting more species with larger ranges (Ward and Palmer 1994).

About half of the ostracod records in our database occur within some type of protected area. From a 'glass-half-full' perspective, this is cause for optimism, as this percentage is higher than both the global (Sánchez-Fernández et al. 2021) and European (Mammola et al. 2024) averages for protection of subterranean ecosystems. However, from a 'glass-half-empty' perspective, it highlights that half of the groundwater ostracod diversity remains without formal protection. Thus, it would be important to evaluate if current protected areas are covering the most rare and endemic ostracods, or primarily common, widespread species (e.g., Premate et al. 2024). Furthermore, conservation measures adopted within surface-designated protected areas usually neglect the three-dimensional nature of subterranean ecosystems, thus are not necessarily effective in evenly preserving subterranean species along their vertical dimension (Mammola et al. 2024).

We believe that the curated dataset, despite bias towards certain regions, will facilitate a better understanding of the evolutionary pathways of different ostracod lineages, their distributional patterns, and ecological preferences. The dataset is a great asset to support further research and conservation efforts into this overlooked and often neglected fauna. The possibilities to use the dataset include, for example, the development of predictive models on different scenarios of carbon emissions to anticipate potential range changes under climate change, or to explain the current distributional ranges by exploring local abiotic variables, available through global GIS-supported systems (e.g., climatic and hydrogeological data). With these and many other potential questions in mind, we envision this dataset as a crucial resource for advancing our understanding of subterranean ecosystems and their often-overlooked biodiversity, ultimately contributing to more effective conservation efforts.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The dataset and the related metadata is available from the DRYAD repository under https://doi.org/10.5061/dryad.1g1jwsv7c.

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