Data Descriptor: Iberian fish records in the vertebrate collection of the Museum of Zoology of the University of Navarra

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The study of freshwater fish species biodiversity and community composition is essential for understanding river systems, the effects of human activities on rivers, and the changes these animals face. Conducting this type of research requires quantitative information on fish abundance, ideally with long-term series and fish body measurements. This Data Descriptor presents a collection of 12 datasets containing a total of 146,342 occurrence records of 41 freshwater fish species sampled in 233 localities of various Iberian river basins. The datasets also contain 148,749 measurement records (length and weight) for these fish. Data were collected in different sampling campaigns (from 1992 to 2015). Eleven datasets represent large projects conducted over several years, and another combines small sampling campaigns. The Iberian Peninsula contains high fish biodiversity, with numerous endemic species threatened by various menaces, such as water extraction and invasive species. These data may support the development of large biodiversity conservation studies.

| Design Type               | observation design ● species comparison design ● time series design |
|---------------------------|---------------------------------------------------------------------|
| Measurement Type(s)       | specimens collected in one encounter                                |
| Technology Type(s)        | observational method                                                 |
| Factor Type(s)            |                                                                     |
| Sample Characteristic(s)  | Teleostei ● Iberian Peninsula                                         |

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Background & Summary

The Iberian Peninsula is considered one of the most biodiverse European regions and a fish biodiversity hotspot. The Iberian freshwater fish fauna has the greatest European percentage of endemism (73% of the species) because of its long-term geographical isolation, which occurred during the last glaciation, the Mediterranean climate and the high number of different river basins. This biodiversity is high at the species level but low at the family level, as most of the species belong to the family Cyprinidae. Further, although local alpha diversity is low compared to that of tropical rivers, beta diversity, endemic species and threats make the Iberian rivers relevant ecosystems from the perspective of conservation.

Iberian freshwater fish biodiversity is highly threatened: populations of 52% of the native species are under some degree of threat according to the International Union for the Conservation of Nature (IUCN). The main threat to Iberian freshwater fish is water extraction, which affects 60% of the native species, followed by introduced species (42% of the total Iberian freshwater fish richness), which affects 50% of the native species. Other important threats include climate change and pollution.

The unique physical and biological characteristics and the long history of human activities make the Iberian Peninsula a very interesting place for the study of threats and conservation of freshwater fishes. However, Iberian freshwater fish species have received little attention.

Gathering primary biodiversity data is necessary to improve our knowledge of the ecology, impacts and conservation status of freshwater fishes. Occurrence data are very useful for determining the distribution of species. However, distribution ranges are changing due to the diverse impacts caused by human activities. Accurately predicting the effects of human threats on communities and species requires more data. Time series of abundance data have proven essential for predicting population trends and assessing the risk of extinction of species. If such data are accompanied by biological data, such as length and weight of individuals within a population, studies could be performed to analyse changes in population structure and dynamics caused by human impacts. Models performed using these different data may prove more reliable for assessing human impacts and population trends, which would lead to better conservation and management plans for numerous species.

This Data Descriptor presents 12 different datasets of freshwater fish samplings in diverse locations of Spain performed by the Department of Environmental Biology of the University of Navarra in various rivers in Spain since 1992. Some of the studies have been completed, while others are open to further sampling campaigns in future years. In total, 146,342 occurrence records have been published to date, making this ichthyological collection one of the most important in Spain, with the aim of offering the most complete information, both occurrence and measurement data, regarding the collected freshwater fish specimens.

Methods

Study area

Spain is the largest country of the Iberian Peninsula, located in southwestern Europe, delimited to the north by the Pyrenees and to the south by the Strait of Gibraltar. It is surrounded by the Mediterranean Sea to the East, the Cantabrian Sea to the north and the Atlantic Ocean to the West. The prevailing climate is Mediterranean, with hot, dry summers, rainy springs and autumns, and mild winters. Vegetation series in this climate are dominated by evergreen forests of holm oak (Quercus ilex L.) and shrubs (Quercus cocifera L., Thymus vulgaris L., Rosmarinus officinalis L. and others). In northern Spain, near the coast, the Oceanic climate predominates, with rain evenly distributed through the year, humid summers and mild winters. The vegetation there is dominated by deciduous forests of oak (Quercus robur L.) and beech (Fagus sylvatica L.). In the inland regions, these climates have continental and mountainous influences that create more extreme temperature variations.

These essential differences between climates shape and determine river ecosystems and species, creating four different freshwater ecoregions within the Iberian Peninsula: the first includes the Cantabric Coast, with Oceanic climate. In this ecoregion, rivers are shorter and fast flowing through large mountains, with water all year. The second ecoregion is Eastern Iberia, which includes rivers that flow into the Mediterranean Sea (the Ebro, Ter and Júcar are the most important river basins). In this ecoregion, Mediterranean is the predominant climate, with continental characteristics in some areas. The third ecoregion is Western Iberia, which includes the Tagus and Duero river basins. These rivers flow to the Atlantic Sea through lands dominated by the Mediterranean climate. The last ecoregion is Southern Iberian; its most important basins are the Guadiana, Guadalquivir and Segura river basins. This ecoregion is dominated by the Mediterranean climate and includes the driest areas of the Iberian Peninsula. In the last three ecoregions, dominated by Mediterranean climate, rivers present high flow variability between seasons, with seasonal floods and droughts.

There are five main rivers in the Iberian Peninsula, the Ebro, Duero, Taio, Guadiana and Guadalquivir, as well as numerous smaller basins. Due to this variability of climates, basins and habitats, the Iberian Peninsula has a high degree of freshwater fish biodiversity and endemism.

For this work, 233 localities of the Ebro, Duero, Tagus, Guadiana, Guadalquivir, Bidasoa, Ter, Muga and Turia river basins were sampled. They belong to eight Autonomous Communities and 15 provinces: Navarra, La Rioja, Catalonia (Lleida and Gerona), Aragon (Huesca, Zaragoza and Teruel), Castilla y León (Zamora, Burgos and Salamanca), Valencian Community (Valencia), Extremadura (Caceres and Badajoz) and Andalusia (Huelva and Córdoba). Most of the sampling locations (69%) and specimens (87%) were...
collected in Navarra, followed by Aragon, with 16% of the locations and 9% of the individuals. Eastern Iberia was the most sampled ecoregion, and the Ebro (Navarra, Aragon and La Rioja) was the most sampled river basin based on locations and specimens collected (Figure 1).

Samplings were conducted on dates during all seasons of the periods 1992–1998 and 2001-2015.

Field sampling
In total, 148,812 specimens were collected by electrofishing, using an external generator (Honda EC3600) connected to an electrofishing control box and backpack electrofishing units (300–600 V, 0.2–2A). Two electrofishing methods were used, varying among projects: three-run depletion between two stop-nets; and semi-quantitative surveys, giving fish densities by catch per unit of effort (CPUE, number of specimens captured per hour)\(^{10}\). The sampling time of the semi-quantitative samplings varied between 15 min and 2 h, with 30 min being the most common sampling duration. The captured individuals were anaesthetized with tricaine methanesulphonate (MS-222; Sigma Chemical Co., St. Louis, MO) or 2-phenoxyethanol, identified, counted and measured (total length in millimetres, and, in some cases, weight in grams). Species recording and identification were performed by R. Miranda, J. Oscoz, P.M. Leunda, I. Vedia, I. Tobes, C. García-Fresca and A. Vilches using suitable literature\(^{11,12}\).

Preservation
Once surveys were complete, fishes were returned to the river. For later studies, some captured specimens were euthanized with an overdose of anaesthesia, either preserved in jars with 70% ethyl alcohol or dried, and deposited in the Museum of Zoology of the University of Navarra. Each specimen was labelled with a unique collection number and introduced into the Museum database (Zootron v4.5 (ref. 13). In total, 2497 specimens from different datasets were preserved in jars or dried in the Museum (Table 1). Then, datasets were exported to DarwinCore v1.4 format, revised, and corrected if necessary. Finally, Integrated Publishing Toolkit (IPT) resources for each dataset were created, metadata were added, and the Darwin Core Archives were uploaded. The resources were published in the Spanish Global Biodiversity Information Facility (GBIF) IPT node (http://www.gbif.es/ipt).

Figure 1. Map of Spain with the locations of all the sampling sites (black dots), the rivers (grey lines) and the river basins (black lines).
The Museum of Zoology of the University of Navarra (MZNA, Pamplona, Spain) has curated the scientific research materials of the Department of Environmental Biology since 1980. The Museum has provided data for the GBIF\textsuperscript{14}.

### Data Records

Datasets include occurrence records and measurements (total length and weight) of captured fish. There are 146,342 occurrence records, representing 148,812 fish specimens. The collection comprises 13 families and 40 species of fishes (and one hybrid), belonging to the orders Anguilliformes, Cypriniformes, Siluriformes, Esociformes, Salmoniformes, Cyprinodontiformes, Scorpaeniformes and Perciformes. Cyprinidae is the most abundant family, with 25 species and 81% of the specimens. The other most abundant families are Salmonidae and Nemacheilidae, with 11 and 7% of the total specimens, respectively. Of the 40 species recorded, 20 are endemic to Spain, and 14 are invasive. Moreover, 12 species are under some degree of threat according to the International Union for Conservation of Nature (IUCN)\textsuperscript{15}: one is Critically Endangered, one Endangered, nine Vulnerable and one Near Threatened. Two species are not evaluated by the IUCN (Table 2).

Fish sampling data are split into 12 datasets with internal cohesion (Data Citations 1–12): six are part of PhD theses (Data Citations 1–6); five are multi-year funded projects (Data Citations 7–11) and another one (Data Citation 12) gathers several smaller samplings (Table 1). Datasets are accessible at the GBIF.

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| Dataset name                                                                 | Field method     | Occurrence records | Measurement records (length) | Measurement records (weight) | Preserved records | Updates                      | Repository                                      | Data link                                           |
|-------------------------------------------------------------------------------|------------------|--------------------|-----------------------------|----------------------------|------------------|------------------------------|-------------------------------------------------|---------------------------------------------------|
| Fishes in MZNA-Vert: Freshwater communities in the Larraun river (Spain). PhD project, Javier Oscoz & Master project, A. Cos | Electrofishing   | 15,912             | 13,912                      | —                          | —                | Closed dataset               | GBIF                                            | http://doi.org/10.15470/8sqajx                   |
| Fishes in MZNA-Vert: anatomy of cyprinids of Spain. PhD project, Rafael Miranda | Electrofishing   | 1249               | 1113                        | 1112                       | 1249             | Closed dataset               | GBIF                                            | http://doi.org/10.15470/9nnmvw                   |
| Fishes in MZNA-Vert: Foraging ecology of the kingfisher. PhD project, Antonio Vilches | Electrofishing   | 21,868             | 21,864                      | —                          | 10                | Closed dataset               | GBIF                                            | http://doi.org/10.15470/wf9dpv                   |
| Fishes in MZNA-Vert: cyanipid and salmonid communities in the rivers Erro and Urederra (Spain). PhD project, Cristina García-Fresca | Electrofishing   | 27,033             | 27,008                      | —                          | 338               | Closed dataset               | GBIF                                            | http://doi.org/10.15470/9hoh5u                   |
| Fishes in MZNA-Vert: interactions between signal crayfish and fish communities. PhD project, Iván Vedia | Electrofishing   | 3012               | 3012                        | —                          | —                | Closed dataset               | GBIF                                            | http://doi.org/10.15470/9nqev7                   |
| Fishes in MZNA-Vert: freshwater populations in the Eroz river (Spain). PhD Project, Pedro Leunda | Electrofishing   | 41,232             | 41,129                      | —                          | 614               | Closed dataset               | GBIF                                            | http://doi.org/10.15470/yvffl1                   |
| Fishes in MZNA-Vert: populations affected by the Itoiz dam in the Iraz river (Spain) | Electrofishing   | 8567               | 8567                        | —                          | 2                 | Closed dataset               | GBIF                                            | http://doi.org/10.15470/c6f2m                   |
| Fishes in MZNA-Vert: ecological assessment of the Aragon river in Sangüesa (Spain) | Electrofishing   | 3450               | 3450                        | —                          | —                | Open dataset, updates when necessary | GBIF                                            | http://doi.org/10.15470/msoj1m                   |
| Fishes in MZNA-Vert: distribution of freshwater blenny in the Segre and Susia rivers (Spain) | Electrofishing   | 3018               | 3014                        | 142                        | 6                 | Closed dataset               | GBIF                                            | http://doi.org/10.15470/2ldy9                   |
| Fishes in MZNA-Vert: ecological assessment of the Guadalop river in Aliaga (Spain) | Electrofishing   | 432                | 432                         | —                          | —                | Closed dataset               | GBIF                                            | http://doi.org/10.15470/sa3a33                   |
| Fishes in MZNA-Vert: monitoring program in the Suspiro stream (Spain) | Electrofishing   | 518                | 518                         | 338                        | —                | Open dataset, updates when necessary | GBIF                                            | http://doi.org/10.15470/1mnlp                   |
| Fishes in MZNA-Vert: baseline freshwater sampling campaigns | Electrofishing   | 22,031             | 21,969                      | 1149                        | 278               | Open dataset, updates when necessary | GBIF                                            | http://doi.org/10.15470/czweds                   |

Table 1. Summary of the main characteristics of the datasets.
river, studied species, etc. Three of the resources are ongoing projects and will be updated when necessary, whereas the other nine are finished projects (Table 1).

### Technical Validation

The two electrofishing techniques used are standardised and have been validated. Species identification was performed using suitable literature, and scientific names were validated using W. N. Eschmeyer’s Catalog of Fishes. Before publication in GBIF, DARWIN_TEST application

| Family        | Species                                                   | n   | IUCN category                  | Origin  |
|---------------|-----------------------------------------------------------|-----|--------------------------------|---------|
| Anguillidae   | Anguilla anguilla                                         | 35  | Critically endangered A2bd+4bd | Native  |
| Blennidae     | Salarias fluviatilis                                     | 1808| Least concern                  | Native  |
| Centrarchidae | Lepomis gibbosus                                         | 25  | Least concern                  | Introduced |
| Micropterus   | microtus salmoids                                        | 42  | Least concern                  | Introduced |
| Cobitidae     | Cobitis calderoni                                        | 216 | Endangered A2ce+3ce            | Endemic |
| Cobitis       | paludica                                                 | 4   | Vulnerable A2ce+3ce            | Endemic |
| Cottidae      | Cottus aterus                                             | 137 | Least concern                  | Native  |
| Cyprinidae    | Aschrodontosoma arcuta                                    | 1981| Vulnerable A1ce                | Endemic |
|                | Alburnus alburnus                                        | 2617| Least concern                  | Introduced |
|                | Barba x comizo x Lucioobarbus microcephalus              | 3   | Endemic                        |         |
|                | Barba haasi                                               | 763 | Vulnerable A2ce+3ce            | Endemic |
|                | Barba meridionalis                                       | 53  | Near threatened                | Native  |
|                | Carassius auratus                                        | 85  | Least concern                  | Introduced |
|                | Cyprinus carpio                                           | 190 | Least concern                  | Introduced |
|                | Gobius kiosani                                            | 8813| Least concern                  | Endemic |
|                | Beeshondontosoma lomensis                                | 31  | Vulnerable A2ce+3ce            | Endemic |
|                | Lucioobarbus bocagei                                      | 171 | Least concern                  | Endemic |
|                | Lucioobarbus comizo                                      | 31  | Vulnerable A2ce                | Endemic |
|                | Lucioobarbus grallii                                     | 15,401| Least concern                | Endemic |
|                | Lucioobarbus guaraoni                                     | 37  | Vulnerable A1ce                | Endemic |
|                | Lucioobarbus microcephalus                                | 42  | Vulnerable A2ce+3ce            | Endemic |
|                | Lucioobarbus sclareri                                    | 85  | Least concern                  | Endemic |
|                | Parachondrostoma maggi                                    | 28,861| Least concern                | Endemic |
|                | Phoxinus bigeri                                            | 59,191| Least concern               | Native  |
|                | Pseudachondrostoma polylepis                              | 213 | Least concern                  | Endemic |
|                | Rutilus rutilus                                           | 172 | Least concern                  | Introduced |
|                | Scardius erythrospilthalmus                               | 51  | Least concern                  | Introduced |
|                | Squallion albumoides                                      | 249 | Vulnerable A1ce                | Endemic |
|                | Squallion caroleteri                                      | 34  | Least concern                  | Endemic |
|                | Squallion laetianus                                       | 216 | Least concern                  | Endemic |
|                | Squallion pyreanicus                                      | 92  | Not evaluated                  | Endemic |
|                | Squallion valentiniu                                      | 3   | Vulnerable B1ab               | Endemic |
|                | Tinca tinca                                               | 66  | Least concern                  | Introduced |
| Esocidae       | Esoc lucius                                               | 5   | Least concern                  | Introduced |
| Ictaluridae    | Ameiurus melas                                            | 207 | Least concern                  | Introduced |
| Nemacheilidae  | Barbatula quignaudi                                      | 10,780| Least concern              | Endemic |
| Percidae       | Sander lucioperca                                         | 33  | Least concern                  | Introduced |
| Pocilidae      | Gambusia holbrooki                                        | 6   | Least concern                  | Introduced |
| Salmonidae     | Oncorhyncus mykiss                                       | 130 | Not evaluated                  | Introduced |
|                | Salmo trutta                                              | 15,924| Least concern              | Native  |
| Siluridae      | Silurus glanis                                            | 7   | Least concern                  | Introduced |

Table 2. Species and specimens in the 12 datasets, along with family, IUCN category and zoogeographic origin data.
(v3.3 (ref. 18)) was used to eliminate possible mistakes in the coordinates, characters, taxonomy and the date format.

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U. Otxotorena, O. Palacios, M. Pascal, O. Paz, J. Piedrafita, G. Redondo, M. Rodriguez, L. Romeo, J.A. Salinas, I. Salvo, M. Serrano, G. Telletxea, I. Tobes, D. Usán, I. Vedia, P. Verdonckt, M. Vilches, J.M. Vilches, K. Westfall D and A. Zapata collaborated during the field surveys.

**Author Contributions**

A.A.R. prepared and transformed fish sampling data to GBIF standards and created dataset metadata. She also wrote the Data Descriptor. D.G. supervised data management and publication as well as metadata and Data Descriptor writing. R.M. was the principal investigator of the published fish samplings and supervised and revised the GBIF datasets and the Data Descriptor.

**Additional Information**

**Competing financial interests:** The authors declare no competing financial interests.

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