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The first GBIF dataset on the distribution of fish assemblage in inland and transitional waters of Sicily (Central Mediterranean Basin)

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SUMMARY

Mediterranean inland and transitional waters are fragile ecosystems currently facing rapid biodiversity loss due to anthropogenic pressures and climate change. In Sicily, the largest island in the Mediterranean Sea, knowledge of ichthyofaunal assemblages of these ecosystems has remained fragmented, sporadic, and largely confined to "grey" literature for long. The present paper presents a dataset built with the aim to fill this gap. The dataset aggregates 808 occurrence records from 108 water bodies and localities, spanning a 50-year period (1976–2025). Data were recovered from diverse sources, including scientific literature, administrative reports, and conference proceedings, integrated with new unpublished data from recent field monitoring campaigns conducted by ARPA Sicilia following WFD (2000/60/EC) standards. Additionally, other unpublished data from direct information, interviews with local fishermen and acquisition of photographic records directly provided by citizens, were incorporated. The dataset is published on the GBIF platform. It is organized following to the Darwin Core (DwC) standards, in accordance with the FAIR (Findability, Accessibility, Interoperability, and Reusability) Principles. All records were georeferenced using WGS84 coordinates, validated via QGIS, and taxonomically updated according to the World Register of Marine Species (WoRMS) and the Catalogue of Life. The dataset covers 90 species across 26 orders and 41 families, and 68 genera, while the investigated area documents a wide range of habitats, from natural rivers and coastal lagoons to artificial reservoirs and saltworks. The records reveal a research effort geographically asymmetric, with 75% of occurrences concentrated in the eastern portion of the island.

INTRODUCTION

The Global Biodiversity Information Facility (GBIF) is widely recognized the primary international infrastructure for providing open access to biodiversity data (Heberling et al. 2021, Steinke et al. 2025); at present, more than 3.7 billion occurrence records are shared through it (<https://www.gbif.org/>, accessed 27 March 2026). The platform is supported by a global network of participating countries and organizations, and Italy officially joined this global gateway at the end of 2025 (GBIF Italy; <https://www.gbif.org/country/IT/summary>, accessed 27 March 2026). GBIF Italy (Martellos et al. 2026) incorporates 44 publishers (<https://www.gbif.org/country/IT/summary>, accessed 27 March 2026), and it aggregates 7.4 million occurrences published by Italian institutions and a large number of Italian biodiversity data (12.9 million records, 3191 datasets) from international publishers. The University of Palermo recently joined the network as a publisher, and, with the publication of its datasets (Badalucco and Lo Brutto 2026, Badalucco et al. 2026), ensures open access to the present and future biological information, as new science challenges require. As a fundamental part of this process, occurrence datasets integrate information from different sources in a globally standardized matrix (Wieczorek et al. 2012), following the FAIR (Findability, Accessibility, Interoperability, Reusability) Principles (Wilkinson et al. 2016), with an identity and the presence of metadata (Costello and Vanden Berghe 2006).

The dataset presented in this paper focuses on the assessment of inland and transitional water fish biodiversity of Sicily. The dataset collects records from lakes, rivers and transitional waters. Although transitional waters are considered differentiated from strictly inland waters by the Water Framework Directive European Law (WFD, 2000/60/EC), which establishes the ecological standards for water policy in Europe, they represent an ecological continuum of the inland water system. Transitional waters are surface water bodies, partially saline in nature due to their proximity to coastal waters but substantially influenced by freshwater flows (e.g., river mouths) (WFD, art. 2). They are a mosaic of different environments, consisting of water bodies within the coastline (e.g. coastal lakes, saltworks) or its projection (e.g. lagoons, estuaries), dependent on the inland water basin they border. Thus, transitional waters are a bridge between inland and coastal waters, rich in fish

assemblages of marine migrant or brackish fish species, and are ecologically well-identifiable (e.g., Mugilidae zone in rivers) (Zerunian 1982, Pérez-Ruzafa et al. 2011). Due to the long and heterogeneous coast characterized by a high number of rivers, Sicily features an elevated number of transitional waters, including estuary areas, 13 main brackish wetlands (five additional coastal lakes have still to be ecologically characterized), and many other minor wetland systems (Mazzola et al. 2010, Vacante and Aiello 2021, ARPA SICILIA 2023).

General purpose

At the global scale, a significant increase in knowledge on freshwater biodiversity during the 20th century has been observed (Balian et al. 2008), whereas, at a regional scale, scientific contributions remain sporadic and discontinuous in different areas, as observed for the islands of the Mediterranean area (Almaca 1988, Tigano and Ferrito 1996, Changeux 1998, Balian et al. 2008, Regione Autonoma della Sardegna and Università degli Studi di Cagliari 2022a, b).

Numerous ichthyological studies and taxonomic revisions have been conducted in Italy, documenting over 60 autochthonous taxa and more than 30 non-indigenous species (NIS) (Gandolfi and Zerunian 1987, Bianco 1995, 2014), but little is known about inland fish species of Sicily (Tigano and Ferrito 1996), the largest Mediterranean island. Few authors have contributed to the study on the Sicilian ichthyofauna since the 19th century, when the first documents described taxa living in the island (Duchi 1988, Zava and Violani 1991, Tigano and Ferrito 1996) enriched by the description of the endemic *Salmo cettii* Rafinesque, 1810 (Rafinesque 1810).

A comprehensive distributional and taxonomic analysis has not been conducted in more than two centuries; the absence of these types of data represent a major gap for Sicily and can negatively influence the management and conservation of these fragile assemblages, globally considered threatened and suffering a biodiversity loss due to rapid changes over the last decades (Dudgeon et al. 2006, Su et al. 2021).

Scientific collections and historical observations, including records several decades old, are increasingly recognized as valuable data sources when integrated with contemporary biological monitoring programs (Telenius 2011). The

development of the present dataset addressed a major challenge of recovering and consolidating fragmented data documenting the recent history of Sicilian aquatic ecosystems.

Thus, the publication of this dataset provides Sicily with its first publicly accessible and standardized set of fish occurrence records covering the past 50 years. This dataset establishes a baseline for future large-scale modelling efforts aimed at understanding long-term biodiversity trends (Telenius 2011). Although this work cannot be considered exhaustive, it represents a valuable starting point for the development of future conservation and management strategies.

Project description

This work was developed within the framework of the National Biodiversity Future Center (NBFC), the first Italian national research centre focused on biodiversity (Cena and Labra 2024). The dataset contributes to one of the NBFC tasks under Spoke 7, i.e. the collection, digitalization and harmonizing of heterogeneous and fragmented biodiversity data to build a comprehensive national knowledge base.

RESULTS

Dataset description

The dataset unifies different sources to provide the first inventory of the fish fauna inhabiting the inland and transitional waters of Sicily. The dataset gathers 808 occurrence records, and it is structured into 36 informative columns (Table 1) following the Darwin Core data schema (Wieczorek et al. 2012), integrating published and unpublished data. Consequently, each row is a set of information related to a single occurrence record, which provides data on the presence in a locality at a certain time of fish fauna.

The published information has been extracted from the scarce scientific literature (49), administrative reports, and grey literature (e.g., conference papers) of the last 50 years. Available Natura 2000 Standard Data Forms (SDF) for Sites of Community Importance (SCIs) and Special Protection Areas (SPAs), the Natura 2000 viewer web site (<https://natura2000.eea.europa.eu/>), and Management Plans of local Nature Reserves have also been consulted. Additional sources were acquired through direct communication by Venera Ferrito (University of Catania).

The unpublished information has been collected through two main methods. First, the integration of new data from two regional monitoring campaigns (spring and autumn) carried out by ARPA – Sicilia (Sicilian Regional Agency for Environmental Protection) in transitional water basins in 2025, aimed at the assessment of the ecological status of waters as required by the Water Framework Directive (WFD; 2000/60/EC). Such field samplings followed the standardized ISPRA protocols (Catalano et al. 2017) in accordance with WFD standards. A 10-meter hand-hauled beach seine with 2-mm mesh size was employed in shallow transitional waters (approx. 0.5-1 m working depth), covering transects of 150 m² per haul. Second, data from direct information, interviews with local fishermen and acquisition of photographic records directly provided by citizens have been integrated into the dataset.

The column *waterBody* indicates the official name of the water body when it was present, and *LocationID* indicates the corresponding Water Information System for Europe (WISE) code (<https://water.europa.eu/>), when available, for unique identification.

Resource link: <https://doi.org/10.15468/jqrkgu>

Dataset name: Ichthyofauna inventory of inland and transitional waters of Sicily (Italy)

Dataset citation: Battiatà M, Badalucco A, Sarà G, Lo Brutto S (2026). Ichthyofauna inventory of inland and transitional waters of Sicily (Italy). University of Palermo. Occurrence dataset <https://doi.org/10.15468/jqrkgu> accessed via GBIF.org on 2026-04-01.

Version: 1.2

Download *URL:*
https://www.gbif.org/occurrence/download?dataset_key=59af8c53-b22b-40d1-8db5-9e7421d3936c

Licence: CC BY 4.0

Data curation

Taxonomic nomenclature of published records was updated according to the World Register of Marine Species (WoRMS Editorial Board 2026) and Catalogue of Life (Banki et al. 2026). Unpublished records were identified with taxonomic keys from ISPRA guidelines (Catalano et al. 2017) and Zerunian's manual (Zerunian 2004).

Table 1. Description of the dataset attributes. For each field, the Darwin Core term and a brief definition are provided.

Field	Definition
occurrence ID	Unique persistent identifier for each specific occurrence record.
basisOfRecord	The nature of the record.
institutionCode	Acronym of the organization managing the data.
higherGeography	Broadest geographic names associated with the location.
country	Full name of the country where the event occurred.
stateProvince	Name of the administrative region.
locationID	WISE (https://water.europa.eu/) identifier for the specific water body.
locationRemarks	Additional notes describing the specific site characteristics.
waterBody	Name of the aquatic environment.
eventDate	The date the sampling event was recorded.
eventRemarks	Notes about the specific sampling event or conditions.
decimalLatitude	Geographic latitude in decimal degrees.
decimalLongitude	Geographic longitude in decimal degrees.
georeferenceProtocol	Description of the method used to determine coordinates.
geodeticDatum	The spatial reference system.
kingdom	Full scientific name of the kingdom.
phylum	Full scientific name of the phylum.
class	Full scientific name of the class.
order	Full scientific name of the taxonomic order.
family	Full scientific name of the taxonomic family.
genus	Full scientific name of the taxonomic genus.
scientificName	Full original name.
acceptedNameUsage	The currently accepted scientific name for the taxon.
acceptedNameUsageID	Unique identifier for the accepted name.
scientificNameAuthorship	Authorship information for the scientific name.
taxonRank	Taxonomic rank of the most specific name in the dwc:acceptedNameUsage
taxonRemarks	Additional notes regarding the taxonomic identification or status.
recordedBy	List of names of people who collected the data.
identifiedBy	List of names of experts who identified the taxon.
occurrenceRemarks	Notes about the specific individual or occurrence event.
projectTitle	The name of the data project.
associatedReferences	List of publications or reports linked to the record.

Coordinates of published records have been extracted from sources; when they were not explicit, they have been deducted based on the description of the site. Temporal information has been extrapolated from literature; cells are empty when the information was not explicit. Coordinates and date of unpublished data have been reported. All coordinates have been handled in QGIS environment (QGIS Development Team, QGIS 3.34.11. [Software].

Version 3.34.11, 2025), and georeferenced by WGS84 (World Geodetic System 1984) datum.

The dataset was created and handled in Microsoft® Excel® per Microsoft 365 MSO (Version 64-bit 2510 Build 16.0.19328.20244); final data curation was handled in OpenRefine version 3.10.0 for Windows.

Taxonomic coverage

The dataset contains 808 teleostean records, representing 90 species which belong to 26 orders, 41 families and 68 genera.

Taxonomic upgrades regarded *Microlipophrys adriaticus* (Steindachner & Kolombatovic, 1883) (syn. *Lipophrys adriaticus* (Steindachner & Kolombatovic, 1883)), *Microlipophrys dalmatinus* (Steindachner & Kolombatovic, 1883) (syn. *Lipophrys dalmatinus* (Steindachner & Kolombatovic, 1883)), *Salaria basilisca* (Valenciennes, 1836) (syn. *Lipophrys basiliscus* (Valenciennes, 1836)), *Salaria pavo* (Risso, 1810) (syn. *Lipophrys pavo* (Risso, 1810)), *Symphodus cinereus* (Bonnaterre, 1788) (syn. *Crenilabrus cinereus* (Bonnaterre, 1788)), *Chelon auratus* (Risso, 1810) (syn. *Liza aurata* (Risso, 1810)), *Chelon ramada* (Risso, 1827) (syn. *Liza ramada* (Risso, 1827)), *Chelon saliens* (Risso, 1810) (syn. *Liza saliens* (Risso, 1810)), *Chelidonichthys lucerna* (Linnaeus, 1758) (syn. *Trigla lucerna* Linnaeus, 1758), *Buglossidium luteum* (Risso, 1810) (syn. *Solea lutea* (Risso, 1810)), *Solea solea* (Linnaeus, 1758) (syn. *Solea vulgaris* Quensel, 1806), *Synapturichthys kleinii* (Risso, 1827) (syn. *Solea kleini* (Risso, 1827)).

Callionymus pusillus Delaroche, 1809 now includes *Callionymus festivus* Pallas, 1814 which is not anymore a valid name.

Recent molecular evidence has also reassigned a new genus to two freshwater taxa. The Appenine roach, previously known as *Rutilus rubilio* (Bonaparte, 1837), is now referred to as *Sarmarutilus rubilio* (Bonaparte, 1837) (Bianco and Ketmaier 2014). Similarly, the freshwater blenny, historically recorded under various names, *Blennius fluviatilis* Asso y del Rio, 1801, *Lipophrys fluviatilis* (Asso y del Rio, 1801), or *Salaria fluviatilis* (Asso y del Rio, 1801), has been updated to *Salariopsis fluviatilis* (Asso y del Rio, 1801) according to Vecchioni et al. (2022).

Recent studies have confirmed that *Gambusia holbrooki* Girard, 1859 is the only species translocated to Europe (Vidal et al. 2010, Sanz et al. 2013); consequently, all records originally reported in literature as *Gambusia affinis* (Baird & Girard, 1853) or *G. affinis holbrooki* (Girard, 1859) were updated to *G. holbrooki* in our dataset, reflecting current taxonomic knowledge.

Regarding species belonging to the Mugilidae family and the *Carassius* genus, identification to species level may be challenging without taxonomical keys; as a result, they were often reported with the Italian or English common names in the original sources. Consequently, their identification in the dataset is reported at a higher taxonomical level (family or genus) when the species name was not specified.

Pike records are listed as *Esox lucius* Linnaeus, 1758 in literature; however, these identifications are antecedent the description of the Southern Pike, *Esox cisalpinus* Bianco & Delmastro, 2011, and they have never been reviewed. Since the origin of the Sicilian population is unknown, its taxonomic species identification remains uncertain (Marrone and Naselli-Flores 2015, IUCN 2023) and the taxon has been included at genus level in the dataset.

Finally, nine of 13 occurrences belonging to the Ictaluridae family and one occurrence of Salmonidae family were not identified at the species level.

Geographic and temporal coverage

The study area corresponds to the island of Sicily, whose extreme boundary coordinates are the following: northernmost latitude WGS84: 38.26860 N, southernmost latitude 36.68435 N, westernmost longitude 12.46436 E, and easternmost longitude 15.63692 E, defining the maximum geographical extent of the dataset.

The dataset comprises 108 waterbodies and localities, corresponding to 291 geographic coordinates, shown in Fig. 1. Approximately 75% of the records fall into the southeastern part of Sicily, showing a significant discrepancy in the distribution of records.

Data derive from natural waters as lakes and rivers for inland waters, and lagoons, mires, ponds, coastal lakes and estuaries for transitional waters; semi-natural or natural-like waters (i.e. man-made structures with natural-like ecological features) as reservoir and saltworks; finally, few occurrences were also reported from strictly artificial environments, as urban underground flows and cattle troughs.

Data ranges from 1976 to 2025. The column *eventRemarks* contains additional information when available (i.e. season).

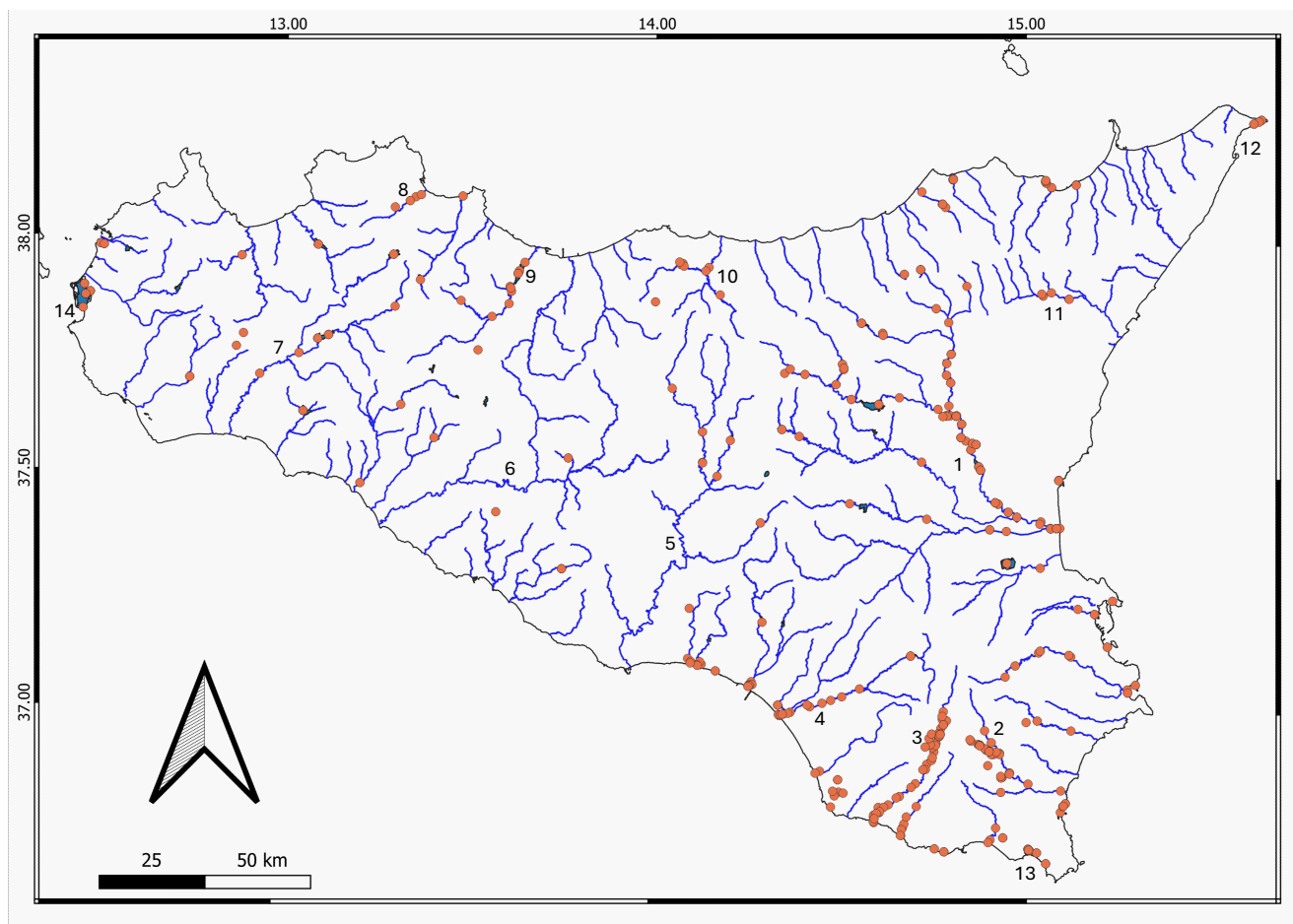


Figure 1. Spatial distribution of the fish fauna occurrence records in Sicily. The map shows the density of the 808 occurrences (red dots) and their distribution across the hydrographic system and transitional waters. Main rivers (1-11) and transitional waters (12-14) are numbered as follows: (1) Simeto River, (2) Tellaro River, (3) Irminio River, (4) Acate-Dirillo River, (5) Salso-Imera Meridionale River, (6) Platani River, (7) Belice River, (8) Oreto River, (9) San Leonardo River, (10) Pollina River, (11) Alcantara River, (12) Lakes of Capo Peloro, (13) Pantano Longarini Wetland System, (14) Stagnone di Marsala. River network layer source: ARPA – Sicilia.

CONCLUSIONS

The dataset presented in this study constitutes the first effort to integrate and harmonize knowledge regarding ichthyofauna in the inland waters of Sicily, including the transitional environments. Thus, this scientific product can be considered a first result of a collaborative effort between academic researchers, regional agencies, and local stakeholders who are involved in the conservation of Mediterranean aquatic ecosystems. The digitization of published scientific data, integrated with new unpublished data in an open, standardized format, represents a step forward in this field of research for the Mediterranean area.

The collection of 808 records across 108 water bodies and localities provides a first

distributional and taxonomic picture of the fish assemblages, retracing the recent history of the largest island of the Mediterranean Sea. The differences in record density between the eastern and western sides are evidence of asymmetric research effort over decades.

In the modern era, much like the role historically played by physical collections and museum specimens, the digitization and standardization of this type of biodiversity data constitute a new reference for large-scale studies. Following this metaphor, datasets published in public open-access repositories such as GBIF can be continuously updated and new data can be added, linking the historical and the new data of this study to future field surveys. Thus, the dataset bridges the

gap between historical and modern information systems; it ensures transparency and reproducibility, providing clear guidance for future studies. It can be considered an ongoing initiative making the beginning of a monitoring continuum, linking the past, the present and the future for a better understanding of the fish biodiversity across the island.

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