Long-term monitoring of the fish community in the Minho Estuary (NW Iberian Peninsula)

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Abstract

Background

The paper presents an extensive fish sampling dataset spanning a long-term period (weekly) from 2010 to 2019. The data was collected in Lenta Marina, an upstream area in the Minho Estuary of the NW Iberian Peninsula. To capture fish, fyke nets were utilized as the sampling method. This dataset offers valuable insights into the abundance of each collected taxa, recorded per date.

New information

The dataset reports a comprehensive compilation of fish abundance data, providing a detailed record of how the fish community has changed over time. The dataset clearly shows a trend where the amount of fish from invasive taxa exceeds the count of fish from native taxa.

Keywords

abundance, fish, fyke nets, biodiversity, estuary

Introduction

Estuarine ecosystems play an important role in maintaining fish biodiversity. They are highly biologically productive ecosystems that provide important feeding, spawning, refuge and nursery habitats for various fish species at different stages of development (Cabral et al. 2007, Guerreiro et al. 2021).

Despite their high ecological and socio-economic value, estuaries are currently stressed by a variety of anthropogenic activities, including nutrient over-enrichment (Nixon 2009), habitat loss (Stamp et al. 2022), overexploitation of natural resources (Vasconcelos et al. 2007), the introduction of invasive species (Levin and Crooks 2011), altered freshwater inflows (Palmer et al. 2011), pollution (Gao et al. 2019) and climate change (Ilarri et al. 2022, Souza et al. 2023). It is therefore important to establish long-term monitoring programmes that provide an accurate overview of the state of these ecosystems and how different species populations respond to these different pressures (in terms of abundance and population composition) over the years.

For over a decade, the ichthyofauna within the Minho Estuary, located in the north-western region of the Iberian Peninsula, has been subject to consistent weekly monitoring (Souza et al. 2023). The objective of this study was to document the CPUE (Catch Per Unit Effort) and composition of the fish community inhabiting the Minho Estuary between 2010 and 2019. The primary goal was to record the temporal changes that have occurred within the fish community through time.

Project description

Study area description: The research was carried out in Lenta Marina, a small (660 × 80 m), semi-enclosed bay situated 14.5 km upstream in the Minho estuary (Figs 1, 2). Lenta Marina occupies a location within an estuarine zone characterized by slight salinity fluctuations, with freshwater prevailing in accordance with the patterns of discharge of the river. In summer, Lenta Marina experiences minor saline intrusions, leading to relatively low salinity levels in the area. Specifically, salinity can range from 0 to 2 during late summer and drought conditions (Dias et al. 2016, Dias et al. 2020). The Minho estuary is classified as a mesotidal estuary, characterized by an average depth of 2.6 m and reaching a maximum depth of 26 m (Alves 1996, Antunes et al. 2011).

Sampling methods

Sampling description: Fish samples were collected weekly from January 2010 to November 2019. Fyke nets with a mesh size of 10 mm, a length of 7 m, a mouth diameter of 0.7 m and a central wing of 3.5 m were used to collect the fish (Fig. 3). These nets were consistently set in the morning and left submerged for a few days (*c.a.* 5 days). To ensure even coverage, the fyke nets were always set parallel to the shore and distributed close to the bay mouth (Fig. 1). Although the number of fyke nets used per sampling date varied due to technical issues, up to five fyke nets were employed per sampling date (Fig. 4). After retrieving of the fyke nets, all captured individuals were identified and counted (Fig. 5). During the entire study period, a total of 3,029 samples were collected using the fyke nets.

Permission to collect fish within the study area was obtained in correspondence with the Portuguese Navy.

Geographic coverage

Description: This study was carried out in Lenta Marina in the Minho estuary in the north-west of the Iberian Peninsula.

Coordinates: 41°57'11.2" and 41°57'16.3" Latitude; 8°44'41.6" and 8°44'44.2" Longitude.

Taxonomic coverage

Description: The dataset comprised the records of 70,857 individuals belonging to 20 species, 1 genus sp. and 2 subspecies taxa of fish from 12 families. The taxon identification numbers (acceptedNameUsageID) were based on GBIF Backbone Taxonomy (GBIF Secretariat 2022), whereas the common name of the species (vernacularName) were based on FishBase (Froese and Pauly 2023).

Taxa included:

Rank	Scientific Name	Common Name
species	*Petromyzon marinus* Linnaeus, 1758	Sea lamprey
species	*Anguilla anguilla* (Linnaeus, 1758)	European eel
genus	*Alosa* Linck, 1790	Allis and twaite shads
species	*Cobitis paludica* (de Buen, 1930)	Iberian loach
species	*Achondrostoma arcasii* (Steindachner, 1866)	Panjorca

species	*Pseudochondrostoma duriense* (Coelho, 1985)	Douro nase
species	*Squalius carolitertii* (Doadrio, 1988)	Iberian chub
subspecies	*Salmo trutta* subsp. *fario* Linnaeus, 1758	Brown trout
subspecies	*Salmo trutta* subsp. *trutta* Linnaeus, 1758	Sea trout
species	*Atherina boyeri* Risso, 1810	Sand smelt
species	*Chelon auratus* (Risso, 1810)	Golden grey mullet
species	*Chelon labrosus* (Risso, 1827)	Thicklip grey mullet
species	*Chelon ramada* (Risso, 1827)	Thinlip grey mullet
species	*Mugil cephalus* Linnaeus, 1758	Flathead grey mullet
species	*Gasterosteus aculeatus* Linnaeus, 1758	Three-spined stickleback
species	*Dicentrarchus labrax* (Linnaeus, 1758)	European seabass
species	*Platichthys flesus* (Linnaeus, 1758)	European flounder
species	*Lepomis gibbosus* (Linnaeus, 1758)	Pumpkinseed
species	*Micropterus salmoides* (Lacepède, 1802)	Largemouth bass
species	*Tinca tinca* (Linnaeus, 1758)	Tench
species	*Gobio lozanoi* Doadrio & Madeira, 2004	Iberian gudgeon
species	*Carassius auratus* (Linnaeus, 1758)	Goldfish
species	*Cyprinus carpio* Linnaeus, 1758	Common carp

Temporal coverage

Data range: 2010-1-05 - 2019-11-12.

Notes: Sampling was continuous with a few days in each month from January 2010 to November 2019.

Usage licence

Usage licence: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: Long-term monitoring of the fish community in the Minho Estuary (NW Iberian Peninsula)

Resource link: https://doi.org/10.5281/zenodo.8279744

Number of data sets: 1

Data set name: DATA_estuarine_fish_V03.tsv

Download URL: https://zenodo.org/record/8279744/files/DATA_estuarine_fish_V03.tsv

Data format: TSV

Description: The dataset contains data from fyke nets deployed in the Minho Estuary (Portugal) from 2010 to 2019. The sampling frequency varied but, on average, data was collected weekly using up to five different fyke nets. However, due to technical issues, the sampling pattern is not constant, with some fyke nets staying underwater for shorter or longer periods, and occasionally having a variable number of fyke nets per event. The dataset includes 33 variables that follow Darwin Core standard (Darwin Core Maintenance Group 2021) whenever possible. These variables provide detailed information about the sampled organisms and their taxonomic classification. The dataset offers valuable insights into the biodiversity dynamics of the Minho Estuary ecosystem during the specific time period.

Column label	Column description
parentEventID	An identifier for the broader dwc:Event that groups this and potentially other dwc:Events.
eventID	An identifier for the set of information associated with an Event (something that occurs at a place and time). May be a global unique identifier or an identifier specific to the data set.
eventDate	The date-time or interval during which an Event occurred. For occurrences, this is the date-time when the event was recorded. Not suitable for a time in a geological context.
year	The four-digit year in which the dwc:Event occurred, according to the Common Era Calendar.
startDayOfYear	The earliest integer day of the year on which the dwc:Event occurred (1 for January 1, 365 for December 31, except in a leap year, in which case it is 366).
endDayOfYear	The latest integer day of the year on which the dwc:Event occurred (1 for January 1, 365 for December 31, except in a leap year, in which case it is 366).
country	The name of the country or major administrative unit in which the dcterms:Location occurs.
countryCode	The standard code for the country in which the dcterms:Location occurs.
geodeticDatum	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in dwc:decimalLatitude and dwc:decimalLongitude are based.
decimalLatitude	The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are north of the Equator, negative values are south of it. Legal values lie between -90 and 90, inclusive.

decimalLongitude	The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are east of the Greenwich Meridian, negative values are west of it. Legal values lie between -180 and 180, inclusive.
DEIMS.iD	Unique alpha-numeric identifier of the site. The DEIMS-ID is automatically generated by DEIMS-SDR and adds the deims.org url as a prefix.
habitat	A category or description of the habitat in which the Event occurred.
basisOfRecord	The specific nature of the data record.
samplingProtocol	The names of, references to, or descriptions of the methods or protocols used during an Event.
sampleSizeValue	A numeric value for a measurement of the size (time duration, length, area, or volume) of a sample in a sampling event.
sampleSizeUnit	The unit of measurement of the size (time duration, length, area, or volume) of a sample in a sampling event.
samplingEffort	The amount of effort expended during a dwc:Event.
occurrenceStatus	A statement about the presence or absence of a dwc:Taxon at a dcterms:Location.
occurrenceID	An identifier for the dwc:Occurrence (as opposed to a particular digital record of the dwc:Occurrence). In the absence of a persistent global unique identifier, construct one from a combination of identifiers in the record that will most closely make the dwc:occurrenceID globally unique.
organismQuantity	A number or enumeration value for the quantity of organisms.
organismQuantityType	The type of quantification system used for the quantity of organisms.
degreeOfEstablishment	The degree to which an Organism survives, reproduces, and expands its range at the given place and time.
vernacularName	A common or vernacular name.
scientificName	The full scientific name, with authorship and date information if known. When forming part of an Identification, this should be the name in lowest level taxonomic rank that can be determined. This term should not contain identification qualifications, which should instead be supplied in the IdentificationQualifier term.
acceptedNameUsageID	An identifier for the name usage (documented meaning of the name according to a source) of the currently valid (zoological) or accepted (botanical) taxon.
taxonRank	The taxonomic rank of the most specific name in the scientificName.
kingdom	The full scientific name of the kingdom in which the taxon is classified.
phylum	The full scientific name of the phylum or division in which the taxon is classified.
order	The full scientific name of the order in which the taxon is classified.
family	The full scientific name of the family in which the taxon is classified.

genus	The full scientific name of the genus in which the taxon is classified.
scientificNameAuthorship	The authorship information for the scientificName formatted according to the conventions of the applicable nomenclaturalCode.

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Author contributions

The authors have contributed to this data paper according to the following CRediT statements.

Conceptualization: CA

Data curation: ATS, MII

Formal analysis: ATS, MII

Funding acquisition: CA

Investigation: ACB, AL, AM, AR, ARC, CA, MJA, MHC, MM

Methodology: CA

Project administration: CA

Resources: CA

Software: ATS, MII

Supervision: CA

Validation: ATS, MII

Visualization: ATS, MII

Writing - original draft: ATS, MII

Writing - review & editing: ATS, CA, ED, MII

References

- Alves A (1996) Causas e Processos da Dinâmica Sedimentar na Evolução Actual do Litoral do Alto Minho. http://repositorium.sdum.uminho.pt/ (February 27, 2023)

- Antunes C, Araújo MJ, Braga C, Roleira A, Carvalho R, Mota M (2011) Valorização dos recursos naturais da bacia hidrográfica do rio minho [Final report of the project natura Miño-Minho].
- Cabral H, Vasconcelos R, Vinagre C, França S, Fonseca V, Maia A, Reis-Santos P, Lopes M, Ruano M, Campos J, Freitas V, Santos P, Costa MJ (2007) Relative importance of estuarine flatfish nurseries along the Portuguese coast. Journal of Sea Research 57: 209-217. https://doi.org/10.1016/j.seares.2006.08.007
- Darwin Core Maintenance Group (2021) List of Darwin Core terms. Biodiversity Information Standards (TDWG). URL: https://dwc.tdwg.org/list/
- Dias E, Morais P, Cotter A, Antunes C, Hoffman J (2016) Estuarine consumers utilize marine, estuarine and terrestrial organic matter and provide connectivity among these food webs. Marine Ecology Progress Series 554: 21-34. https://doi.org/10.3354/meps11794
- Dias E, Barros AG, Hoffman J, Antunes C, Morais P (2020) Habitat use and food sources of European flounder larvae (Platichthys flesus, L. 1758) across the Minho River estuary salinity gradient (NW Iberian Peninsula). Regional Studies in Marine Science 34 https://doi.org/10.1016/j.rsma.2020.101196
- Froese R, Pauly D (Eds) (2023) FishBase. www.fishbase.org. Accessed on: 2023-8-08.
- Gao Y, Yang Q, Li H, Wang X, Zhan A (2019) Anthropogenic pollutant-driven geographical distribution of mesozooplankton communities in estuarine areas of the Bohai Sea, China. Scientific Reports 9 (1). https://doi.org/10.1038/s41598-019-46047-5
- GBIF Secretariat (2022) GBIF Backbone Taxonomy. Checklist dataset. https://doi.org/10.15468/39omei. Accessed on: 2023-8-08.
- Guerreiro MA, Martinho F, Baptista J, Costa F, Pardal MÂ, Primo AL (2021) Function of estuaries and coastal areas as nursery grounds for marine fish early life stages. Marine Environmental Research 170 https://doi.org/10.1016/j.marenvres.2021.105408
- Ilarri M, Souza A, Dias E, Antunes C (2022) Influence of climate change and extreme weather events on an estuarine fish community. Science of The Total Environment 827 https://doi.org/10.1016/j.scitotenv.2022.154190
- Levin LA, Crooks JA (2011) Functional consequences of invasive species in coastal and estuarine systems. Treatise on Estuarine and Coastal Science17-51. https://doi.org/10.1016/b978-0-12-374711-2.00704-x
- Nixon S (2009) Eutrophication and the macroscope. Hydrobiologia 629 (1): 5-19. https://doi.org/10.1007/s10750-009-9759-z
- Palmer T, Montagna P, Pollack JB, Kalke R, DeYoe H (2011) The role of freshwater inflow in lagoons, rivers, and bays. Hydrobiologia 667 (1): 49-67. https://doi.org/10.1007/s10750-011-0637-0
- Souza A, Dias E, Antunes C, Ilarri M (2023) Disruptions caused by invasive species and climate change on the functional diversity of a fish community. ARPHA Preprints e108383 https://doi.org/10.3897/arphapreprints.e108383
- Souza AT, Ilarri MI, Dias E, Araújo MJ, Roleira A, Braga AC, Carvalho AR, Mota M, Correia MH, Lages A, Moura A, Antunes C (2023) Long-term monitoring of the fish community in the Minho Estuary (NW Iberian Peninsula). URL: https://zenodo.org/record/8046541
- Stamp T, West E, Robbins T, Plenty S, Sheehan E (2022) Large-scale historic habitat loss in estuaries and its implications for commercial and recreational fin fisheries. ICES Journal of Marine Science 79 (7): 1981-1991. https://doi.org/10.1093/icesjms/fsac141

- Vasconcelos RP, Reis-Santos P, Fonseca V, Maia A, Ruano M, França S, Vinagre C, Costa MJ, Cabral H (2007) Assessing anthropogenic pressures on estuarine fish nurseries along the Portuguese coast: A multi-metric index and conceptual approach. Science of The Total Environment 374: 199-215. https://doi.org/10.1016/j.scitotenv.2006.12.048
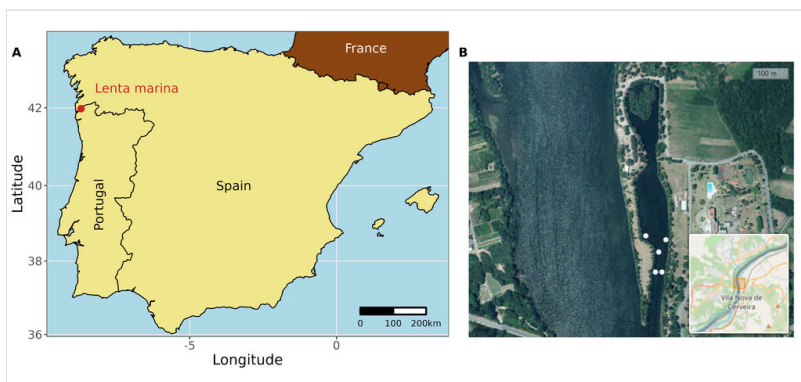
Figure 1.

Spatial representation of the study area and sampling locations in the Minho Estuary. A) A map of the Iberian Peninsula, with an indication of the sampling location within the Minho Estuary. B) A zoomed-in view of the study area, highlighting the precise deployment locations of the fyke nets (white circles) inside the Lenta Marina.

Figure 2.

A photograph showing the view of the study area (Lenta Marina) in Minho Estuary. The image shows the semi-enclosed bay, characterized by the presence of near-shore vegetation and the calm water surface where the fish samplings took place (Photo by Ronaldo Sousa).

Figure 3.

A photograph showing the removal of a fyke net from the water in Minho Estuary (Photo by Carlos Antunes).
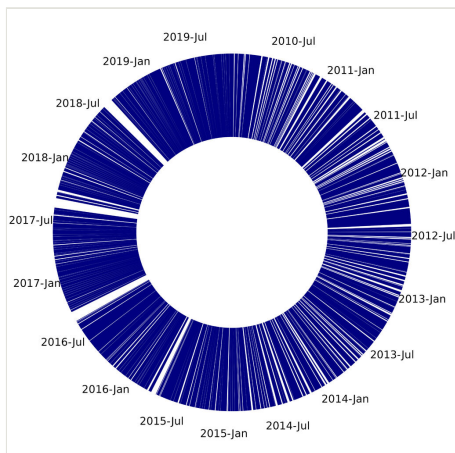
Figure 4.

Days when samples were collected in the study area (Lenta Marina) in the Minho Estuary (i.e. days when fyke net(s) were underwater). Blue = fyke net(s) deployed; white = no fyke net deployed.

Figure 5.

Treemap showing the total abundance of the most representative species during the long-term monitoring. The area of each rectangle is proportional to the total abundance of the species in all samples collected, and the yellow numbers in the bottom right corner indicate the total abundance per species. Red background color refers to the invasive species, with the category others corresponding to the least abundant species in the group, in this case representative of two species: *Gobio lozanoi* (n = 255) and *Carassius auratus* (n = 20). Blue background color refers to the native species, with the category others corresponding to the least abundant species in the group, in this case it is representative of eight species: *Mugil cephalus* (n = 167), *Salmo trutta fario* (n = 162), *Dicentrarchus labrax* (n = 100), *Chelon auratus* (n = 51), *Chelon labrosus* (n=28), *Squalius carolitertii* (n = 20), *Petromyzon marinus* (n = 12), *Alosa* (n = 1).