The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera

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Abstract

Background

The use of DNA barcoding allows unprecedented advances in biodiversity assessments and monitoring schemes of freshwater ecosystems; nevertheless, it requires the construction of comprehensive reference collections of DNA sequences that represent the existing biodiversity. Plecoptera are considered particularly good ecological indicators and one of the most endangered groups of insects, but very limited information on their DNA barcodes is available in public databases. Currently, less than 50% of the Iberian species are represented in BOLD.
New information

The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera dataset contains records of 71 specimens of Plecoptera. All specimens have been morphologically identified to species level and belong to 29 species in total. This dataset contributes to the knowledge on the DNA barcodes and distribution of Plecoptera from the Iberian Peninsula and it is one of the IBI database public releases that makes available genetic and distribution data for a series of taxa.

The species represented in this dataset correspond to an addition to public databases of 17 species and 21 BINs. Fifty-eight specimens were collected in Portugal and 18 in Spain during the period of 2004 to 2018. All specimens are deposited in the IBI collection at CIBIO, Research Center in Biodiversity and Genetic Resources and their DNA barcodes are publicly available in the Barcode of Life Data System (BOLD) online database. The distribution dataset can be freely accessed through the Global Biodiversity Information Facility (GBIF).

Keywords

Plecoptera, occurrence records, species distributions, continental Portugal, continental Spain, DNA barcode, COI

Introduction

In freshwater ecosystems, biodiversity assessments and monitoring schemes often require the identification of aquatic insect species (e.g. Pawlowski et al. 2018), an often challenging step, namely when only first instars are available in the sample or when studies are developed in regions poorly known from a faunistic perspective. In such cases, DNA barcoding provides a powerful tool to overcome these challenges by using a fragment of DNA to assign organisms to a species in a rapid and automated way (Hebert et al. 2003). Furthermore, environmental DNA (eDNA) is an emerging tool with great potential in conservation for monitoring past and present biodiversity, both in terrestrial and aquatic ecosystems (Thomsen and Willerslev 2015), especially when DNA barcode reference collections are used to link the obtained sequences to reliably identified organisms. The use of DNA barcoding requires the construction of comprehensive reference collections of DNA sequences that represent the existing biodiversity (Ferreira et al. 2018, Kress et al. 2005, Baird et al. 2011). In Europe, initiatives like the DNA barcoding projects, overseen by the Bavarian State Collection of Zoology in Munich (SNSB-ZSM—www.barcoding. zsm.de) through the “Barcoding Fauna Bavaria project” (BFB—www.faunabavarica.de—Haszprunar, 2009), launched in 2009 and by the “German Barcode of Life project” (GBOL—www.bolgermany.de), launched in 2012 (Geiger et al. 2016), has led to the public release of DNA barcode sequence data of over 300 species of Ephemeroptera, Plecoptera and Trichoptera (Morinierè et al. 2017). As part of the Mediterranean Basin Biodiversity Hotspot, the Iberian Peninsula presents not only high numbers of species, as it also
harbours species with limited distribution range, with many absent in central and northern Europe. The InBIO Barcoding Initiative (IBI) was established to overcome the striking scarcity of genetic data associated with the high biodiversity found in Portugal, focusing mainly on invertebrate taxa. Within the project, a special focus was afforded to aquatic insects, given their role as indicators in biodiversity assessments and monitoring schemes (e.g. Weisser and Siemann 2004, Weigand et al. 2019) and their relevance to food webs and ecosystem functioning. Furthermore, many insect species occurring in the Iberian Peninsula are not represented in public barcode databases (Ferreira et al. 2019, Ferreira et al. 2018, Weigand et al. 2019) and those that exist often show high evolutionary distances to the sequences obtained in this region which may indicate cryptic diversity (Corley et al. 2019b, Corley et al. 2019a, Ferreira et al. 2018). DNA barcoding can therefore be used as a first step in new species discovery and, as such, be used as a tool to help address the taxonomic impediment problem (e.g. Kekkonen and Hebert 2014).

Plecoptera is a neopteran exopterygote insect order characterised by a combination of mainly primitive characters, whose phylogenetic relationships with other insect orders are not completely resolved (Zwick 2000). Except in a few cases, they are amphibiotic animals, with eggs and nymphs occurring in freshwaters and adults inhabiting the terrestrial environment. The commonly called stoneflies are worldwide distributed, except in Antarctica and many islands and are usually associated with unpolluted and well-preserved waters, mainly rivers and streams, where they play important roles as part of their biota (Fochetti and Tierno de Figueroa 2008, Stewart 2009) contributing to important ecosystem services (DeWalt and Ower 2019). Their high vulnerability to environmental changes have driven stoneflies to be one of the most endangered groups of insects (Fochetti and Tierno de Figueroa 2008, Tierno de Figueroa et al. 2010).

A total of 3718 Plecoptera species have been described all over the world and 489 of them have been reported in Europe (DeWalt and Ower 2019). The European stonefly fauna, included in seven of the 16 existing families, is one of the best studied worldwide, but the degree of knowledge differs between countries. Of the Western European countries, Portugal is one of the less studied from a taxonomic and faunistic point of view. Furthermore, less than 50% of the Iberian Plecoptera have their DNA barcode sequenced. Although the first reports of stonefly species in Portugal date from the mid-XIXth century (Pictet 1841), only a few new records were added for this country during the following hundred years by authors such as Pictet A.E., Albarda, Kempny or Navás (in: Sánchez-Ortega et al. 2002). It was not until 1963 when the first exhaustive work on faunistic and chorology of stoneflies from Portugal, particularly for those of Serra da Estrela, was published as part of a wider study on the Iberian Peninsula (Aubert 1963). Afterwards, the main contributions to the knowledge of the taxonomy and/or faunistics of Plecoptera from Portugal were those of Zwick (1972), Whytton da Terra (1979), Berthélémy and Whytton da Terra (1980), Tierno de Figueroa et al. (1998), increasing the number of recorded species in the country from 25 to 53. More recently, the Portuguese fauna have been also studied in general publications for the Iberian Peninsula, such as those by Sánchez-Ortega et al. (2002) and Tierno de Figueroa et al. (2003), Tierno de Figueroa et al. (2015). According to Tierno de Figueroa et al. (2018), a total of 56 species were recorded in continental
Portugal, without considering Isoperla luzoni Tierno de Figueroa & Vinçon, 2005, whose presence should be confirmed. No Plecoptera species has ever been collected in the Portuguese archipelagoes of Madeira and the Azores. Other areas from the Iberian Peninsula have been better studied regarding their Plecoptera fauna. Currently, 148 species of Plecoptera have been reported in the Iberian Peninsula and Balearic Islands (two of them endemic from the Balearic Islands), 144 species in Spain and 43 in Andorra (Tierno de Figueroa et al. 2018).

The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera dataset contains records of 71 specimens of Plecoptera collected in the Iberian Peninsula, all of which were morphologically identified to species level, for a total of 29 species. This is the first IBI dataset on freshwater insects available in the Global Biodiversity Information Facility (GBIF). All specimens have their DNA barcodes made publicly available in the Barcode of Life Data System (BOLD). Overall, this paper increases the available information on Iberian freshwater insects by sharing and publicly disseminating the distribution records and DNA barcodes of specimens from our reference collection.

**General description**

**Purpose:** This dataset aims to provide a first contribution to an authoritative DNA barcode sequences library for Iberian Plecoptera. Such a library should facilitate DNA-based identification of species for both traditional molecular studies and DNA-metabarcoding studies, as well as freshwater biomonitoring programmes and constitute a valuable resource for taxonomic research on Iberian Plecoptera and its distribution.

**Additional information:** A total of 71 specimens of Plecoptera were collected and DNA barcoded (Suppl. materials 1, 2, 3). Sequences of cytochrome c oxidase I (COI) DNA barcodes are 658 bp long (Folmer region) with the exception of *Leuctra cazorlana*, from which a fragment of 325 bp was obtained. From the 29 species barcoded, 18 (62%) from seven families are new to the DNA barcode database BOLD at the moment of the release (marked with quotation mark (”) in the Species field of Table 1). Six additional BINs from these datasets are new to BOLD (marked with asterisk symbol (∗) in BOLD BIN field of Table 1). Therefore, this dataset represents a significant contribution to enhance the species and genetic diversity of Iberian Plecoptera fauna represented in public libraries.

| Family       | Species            | IBI code | BOLD code | BOLD BIN   | GenBank   | BOLD BIN |
|--------------|--------------------|----------|-----------|------------|-----------|----------|
| Capniidae    | Capnioneura libera*| INV00770 | IBIPP042-20 | AEC8556 | MT407216 | AEC8556   |
|              | Capnioneura mitis* | INV02034 | IBIPP045-20 | AEC7867 | MT407200 | AEC7867   |

Table 1. List of species that were collected and DNA barcoded within this project. " Indicate species new to BOLD database and " new BINs in BOLD database.
| Family          | Species                     | IBI code  | BOLD code | BOLD BIN | GenBank  | BOLD BIN |
|-----------------|-----------------------------|-----------|-----------|----------|----------|----------|
|                 |                             | INV02035  | BOLD046-20| MT407211 | AEC7867  |
|                 |                             | INV02036  | BOLD047-20| MT407226 | AEC7867  |
|                 | Capnioneura petitpierre*a   | INV03768  | BOLD079-20| MT407228 | AEC8557  |
|                 | Capnopsis schilleri         | INV03770  | BOLD009-19| MT407199 | ADV3255  |
| Chloroperlidae  | Chloroperla acuta*          | INV06355  | BOLD099-20| MT407268 | AEC9580  |
|                 | Siphonoperla torrentium     | INV00467  | BOLD002-19| MT407262 | ADT9540  |
|                 |                             | INV03933  | BOLD011-19| MT407247 | ADT9540  |
|                 |                             | INV03934  | BOLD012-19| MT407207 | ADT9540  |
|                 |                             | INV06330  | BOLD095-20| MT407206 | ADT9540  |
|                 |                             | INV06354  | BOLD098-20| MT407244 | ADT9540  |
|                 |                             | INV06359  | BOLD100-20| MT407208 | ADT9540  |
|                 |                             | INV06360  | BOLD101-20| MT407265 | ADT9540  |
| Leuctridae      | Leuctra andalusia*a         | INV03771  | BOLD010-19| MT407238 | ACX4018  |
|                 | Leuctra cazorlana*a         | INV03775  | BOLD082-20| MT407235 |
|                 | Leuctra franzi*             | INV03718  | BOLD076-20| MT407220 | AEC8030  |
|                 | Leuctra geniculata          | INV02033  | BOLD007-19| MT407255 | AAM4209  |
|                 |                             | INV03720  | BOLD008-19| MT407267 | AAM4209  |
|                 | Leuctra iliberis*           | INV02025  | BOLD052-20| MT407209 | AEC6493  |
|                 |                             | INV02026  | BOLD044-20| MT407261 | AEC6493  |
|                 | Leuctra major               | INV03719  | BOLD077-20| MT407242 | ACB2856  |
|                 | Tyrrenoleuctra lusohispanica*| INV00350  | BOLD017-19| MT407256 | ACD6989  |
|                 |                             | INV00405  | BOLD023-19| MT407263 | ACD6989  |
|                 |                             | INV002875 | BOLD048-20| MT407257 | ACD6989  |
|                 |                             | INV002926 | BOLD074-20| MT407222 | ACD6989  |
| Nemouridae      | Amphinemura guadarramensis* | INV06379  | BOLD102-20| MT407223 | AEC7918  |
|                 | Amphinemura sulcicollis     | INV00773  | BOLD004-19| MT407202 | AAM5074  |
|                 | Nemoura cinerea             | INV00367  | BOLD033-20| MT407251 | ADS8217  |
|                 |                             | INV00368  | BOLD001-19| MT407266 | ADS8217  |
|                 | Nemoura lacustris           | INV00389  | BOLD020-19| MT407258 | AEB8934  |
|                 |                             | INV00392  | BOLD021-19| MT407215 | AEB8934  |
| Family       | Species                        | IBI code     | BOLD code  | BOLD BIN | GenBank    | BOLD BIN |
|-------------|--------------------------------|--------------|------------|----------|------------|----------|
|             | Protonemura alcazaba           | INV00345     | IBIPP016-19| AEB9369* | MT407225   | AEB9369  |
|             |                                | INV00382     | IBIPP018-19|          | MT407224   | AEB9369  |
|             |                                | INV00385     | IBIPP019-19|          | MT407214   | AEB9369  |
|             |                                | INV00454     | IBIPP024-19|          | MT407212   | AEB9369  |
|             |                                | INV04847     | IBIPP037-20|          | MT407250   | AEB9369  |
|             |                                | INV06416     | IBIPP103-20|          | MT407264   | AEB9369  |
|             |                                | INV00404     | IBIPP022-19| AEC1305* | MT407237   | AEC1305  |
|             | Protonemura meyeri             | INV02028     | IBIPP067-20| AEC7157* | MT407227   | AEC7157  |
|             |                                | INV02031     | IBIPP005-19| ADS3277  | MT407253   | ADS3277  |
|             |                                | INV02032     | IBIPP006-19|          | MT407252   | ADS3277  |
| Perlidae    | Eoperla ochracea*              | INV02021     | IBIPP043-20| AEC9593  | MT407249   | AEC9593  |
|             | Perla madritensis*             | INV00640     | IBIPP026-19| AEB9929  | MT407260   | AEB9929  |
|             |                                | INV00677     | IBIPP027-19|          | MT407245   | AEB9929  |
|             |                                | INV00688     | IBIPP028-19|          | MT407205   | AEB9929  |
|             |                                | INV00764     | IBIPP039-20|          | MT407233   | AEB9929  |
|             |                                | INV05226     | IBIPP038-20|          | MT407232   | AEB9929  |
|             | Perla marginata                | INV04280     | IBIPP013-19| AAL2357  | MT407210   | AAL2357  |
|             |                                | INV04281     | IBIPP014-19|          | MT407221   | AAL2357  |
| Perlodidae  | Guadalgenus franzi*            | INV00344     | IBIPP015-19| AEB8450  | MT407248   | AEB8450  |
|             |                                | INV00355     | IBIPP055-20|          | MT407230   | AEB8450  |
|             |                                | INV00358     | IBIPP032-20|          | MT407269   | AEB8450  |
|             | Hemimelaena flaviventris*      | INV00507     | IBIPP025-19| AEC1314  | MT407236   | AEC1314  |
|             |                                | INV00766     | IBIPP040-20|          | MT407243   | AEC1314  |
|             |                                | INV02925     | IBIPP031-19|          | MT407218   | AEC1314  |
|             | Isoperla bipartita*            | INV00828     | IBIPP029-19| AEC0487  | MT407203   | AEC0487  |
|             |                                | INV00850     | IBIPP030-19|          | MT407231   | AEC0487  |
|             | Isoperla grammatica            | INV00183     | IBIPP053-20| AEC9627  | MT407254   | AEC9627  |
|             |                                | INV00479     | IBIPP034-20|          | MT407240   | AEC9627  |
|             |                                | INV00500     | IBIPP003-19|          | MT407213   | AEC9627  |
|             |                                | INV00548     | IBIPP035-20|          | MT407234   | AEC9627  |
| Family       | Species                  | IBI code | BOLD code  | BOLD BIN  | GenBank  | BOLD BIN  |
|--------------|--------------------------|----------|------------|-----------|----------|-----------|
|              | *Isoperla pallida*      | INV03772 | IBIPP050-20 | MT407259  | AED0411  | MT407259  |
|              | *Brachyptera auberti*   | INV04837 | IBIPP092-20 | MT407241  | AEC8527  | MT407241  |
|              | *Rhabdiopteryx thienemanni* | INV03773 | IBIPP051-20 | MT407239  | AEC7722  | MT407239  |

**Project description**

**Title:** The name “The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera” refers to the first data release of DNA barcodes and distribution data of stoneflies within the InBIO Barcoding Initiative.

**Personnel:** Pedro Beja (project coordinator), Nuno Fonseca (project chair), Sónia Ferreira (taxonomist and IBI manager), Joana Paupério (IBI manager), Pedro Sousa (project technician), Filipa MS Martins (PhD student), Joana Veríssimo (PhD student), all affiliated to CIBIO-InBIO and Jose Manuel Tierno de Figueroa (taxonomist), Department of Zoology, University of Granada.

**Study area description:** Iberian Peninsula (Fig. 1)

![Map of the localities where Plecoptera samples were collected in the Iberian Peninsula.](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAIgAAADgCAIAAABX...)

Figure 1. Map of the localities where Plecoptera samples were collected in the Iberian Peninsula.
**Design description:** Plecoptera specimens were collected in the field, morphologically identified and DNA barcoded.

**Sampling methods**

**Study extent:** Iberian Peninsula.

**Sampling description:** The studied material was collected in 40 different localities from the Iberian Peninsula (Suppl. materials 1, 2). Sampling was conducted between 2004 and 2018 on a wide range of habitats, using mainly hand-held sweep-nets or direct search for specimens. Collected specimens were examined in ethanol using a binocular stereoscopic microscope and they were stored in 96% ethanol for downstream molecular analysis. Morphological identification was performed using keys and descriptions from literature (mainly Tierno de Figueroa et al. 2003 and Tierno de Figueroa et al. 2015).

DNA extraction and sequencing followed the general pipeline used in the InBIO Barcoding Initiative (Ferreira et al. 2018). Briefly, genomic DNA was extracted from leg tissue using EasySpin Genomic DNA Tissue Kit (Citomed) following the manufacturer’s protocol. The cytochrome c oxidase I (COI) barcoding fragment (Folmer region) was amplified as two overlapping fragments (LC and BH), using two sets of primers: LCO1490 (Folmer et al. 1994) + Ill_C_R (Shokralla et al. 2015) and Ill_B_F (Shokralla et al. 2015) + HCO2198 (Folmer et al. 1994), respectively. The partial COI mitochondrial gene (Folmer region) was then sequenced in a MiSeq benchtop system. OBITools ([https://git.metabarcoding.org/obitools/obitools](https://git.metabarcoding.org/obitools/obitools)) was used to process the initial sequences which were then assembled into a single 658 bp fragment using Geneious 9.1.8. ([https://www.geneious.com](https://www.geneious.com)).

**Quality control:** All DNA barcodes sequences were compared against the BOLD database and the 99 top hits were inspected in order to detect possible issues due to contamination or misidentifications. Prior submission to GBIF, data were checked for errors and inconsistencies with OpenRefine 3.2 ([http://openrefine.org](http://openrefine.org)).

**Step description:** Specimens were collected in 40 different localities of the Iberian Peninsula. Sampling was conducted from 2004 to 2018 and consisted of direct search of specimens on rocks and vegetation of streams and river margins and in the use of entomological nets to intercept specimens in flight. Specimens collected were stored in 96% ethanol. A tissue sample (leg) was removed, from which DNA was extracted and the COI DNA barcode fragment was sequenced. Data generated were submitted to BOLD, GenBank and GBIF.

**Geographic coverage**

**Description:** Iberian Peninsula

**Coordinates:** 35.97 and 43.99 Latitude; 9.55 and 3.34 Longitude.
Taxonomic coverage

Description: This dataset is composed of data relating to 71 Plecoptera specimens. All specimens were determined to species level. Overall, 29 species are represented in the dataset. These species belong to 16 genera and seven families.

Taxa included:

| Rank   | Scientific Name | Common Name |
|--------|-----------------|-------------|
| kingdom| Animalia        | Animals     |
| phylum | Arthropoda      | Arthropods  |
| class  | Insecta         | Insects     |
| order  | Plecoptera      | Stoneflies  |
| family | Capniidae       |             |
| family | Chloroperlidae  |             |
| family | Leuctridae      |             |
| family | Nemouridae      |             |
| family | Perlidae        |             |
| family | Perlodidae      |             |
| family | Taeniopterygida |             |

Temporal coverage

Data range: 2004-6-22 - 2018-5-19.

Notes: The sampled material was collected in the period from 22 June 2004 to 19 May 2018

Collection data

Collection name: InBIO Barcoding Initiative

Collection identifier: 4ec2b246-f5fa-4b90-9a8d-ddafc2a3f970

Specimen preservation method: “Alcohol”

Curatorial unit: Voucher tube - 1 to 71, DNA extractions - 1 to 71
Usage rights

Use license: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera

Resource link: dx.doi.org/10.5883/DS-IBIPP01

Number of data sets: 1

Data set name: DS-IBIPP01 IBI-Plecoptera 01

Download URL: http://www.boldsystems.org/index.php/Public_SearchTerms?query=DS-IBIPP01

Data format: dwc, xml, tsv, fasta

Description: The InBIO Barcoding Initiative Database: contribution to the knowledge on DNA barcodes of Iberian Plecoptera dataset can be downloaded from the Public Data Portal of BOLD (http://www.boldsystems.org/index.php/Public_SearchTerms?query=DS-IBIPP01) in different formats (data as dwc, xml or tsv and sequences as fasta files). Alternatively, BOLD users can log-in and access the dataset via the Workbench platform of BOLD. All records are also searchable within BOLD, using the search function of the database.

The InBIO Barcoding Initiative will continue sequencing Iberian Plecoptera for the BOLD database, with the ultimate goal of comprehensive coverage. The version of the dataset, at the time of writing the manuscript, is included as Suppl. materials 1, 2, 3 in the form of one text file for record information as downloaded from BOLD, one text file with the collection and identification data in Darwin Core Standard format (downloaded from GBIF, Ferreira et al. 2020) and of a fasta file containing all sequences as downloaded from BOLD.

It should be noted that, as the BOLD database is not compliant with the Darwin Core Standard format, the Darwin Core formatted file (dwc) that can be downloaded from BOLD is not strictly Darwin Core formatted. For a proper Darwin Core formatted file, see http://ipt.gbif.pt/ipt/resource?r=plecoptera_01&v=1.2 (Suppl. material 2).

All data are available in the BioStudies database (http://www.ebi.ac.uk/biostudies) under accession number S-BSST402.

| Column label | Column description |
|--------------|--------------------|
| processid    | Unique identifier for the sample |
| Field               | Description                                                                                                                                 |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| sampleid            | Identifier for the sample being sequenced, i.e. IBI catalogue number at Cibio-InBIO, Porto University. Often identical to the "Field ID" or "Museum ID" |
| recordID            | Identifier for specimen assigned in the field                                                                                                                                                  |
| catalognum          | Catalogue number                                                                                                                                                                               |
| fieldnum            | Field number                                                                                                                                                                                     |
| institution_storing | The full name of the institution that has physical possession of the voucher specimen                                                                                                           |
| bin_uri             | Barcode Index Number system identifier                                                                                                                                                           |
| phylum_taxID        | Phylum taxonomic numeric code                                                                                                                                                                    |
| phylum_name         | Phylum name                                                                                                                                                                                      |
| class_taxID         | Class taxonomic numeric code                                                                                                                                                                     |
| class_name          | Class name                                                                                                                                                                                       |
| order_taxID         | Order taxonomic numeric code                                                                                                                                                                    |
| order_name          | Order name                                                                                                                                                                                       |
| family_taxID        | Family taxonomic numeric code                                                                                                                                                                   |
| family_name         | Family name                                                                                                                                                                                      |
| subfamily_taxID     | Subfamily taxonomic numeric code                                                                                                                                                                |
| subfamily_name      | Subfamily name                                                                                                                                                                                   |
| genus_taxID         | Genus taxonomic numeric code                                                                                                                                                                     |
| genus_name          | Genus name                                                                                                                                                                                       |
| species_taxID       | Species taxonomic numeric code                                                                                                                                                                  |
| species_name        | Species name                                                                                                                                                                                      |
| identification_provided_by | Full name of primary individual who assigned the specimen to a taxonomic group                                                                                                           |
| identification_method | The method used to identify the specimen                                                                                                                                                    |
| voucher_status      | Status of the specimen in an accessioning process (BOLD controlled vocabulary)                                                                                                          |
| tissue_type         | A brief description of the type of tissue or material analysed                                                                                                                                   |
| collectors          | The full or abbreviated names of the individuals or team responsible for collecting the sample in the field                                                                                        |
| lifestage           | The age class or life stage of the specimen at the time of sampling                                                                                                                               |
| sex                 | The sex of the specimen                                                                                                                                                                          |
| lat                 | The geographical latitude (in decimal degrees) of the geographic centre of a location                                                                                                            |
| lon                 | The geographical longitude (in decimal degrees) of the geographic centre of a location                                                                                                          |
| elev                | Elevation of sampling site (in metres above sea level)                                                                                                                                            |
| country | The full, unabbreviated name of the country where the organism was collected |
|---------|--------------------------------------------------------------------------|
| province_state | The full, unabbreviated name of the province ("Distrito" in Portugal) where the organism was collected |
| region | The full, unabbreviated name of the municipality ("Concelho" in Portugal) where the organism was collected |
| exactsite | Additional name/text description regarding the exact location of the collection site relative to a geographic relevant landmark |

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Supplementary materials

Suppl. material 1: IBI-Plecoptera 01 library - Specimen details doi

Authors: Sonia Ferreira, Jose Manuel Tierno de Figueroa, Lorenzo Quaglietta, José Manuel Grosso-Silva, Pedro B Lopes, Pedro Sousa, Pedro Beja
Data type: Record information - specimen data
Brief description: The file includes information about all records in BOLD for the IBI-Plecoptera 01 library. It contains collection and identification data. The data are as downloaded from BOLD, without further processing.
Download file (27.85 kb)

Suppl. material 2: IBI-Plecoptera 01 library - Specimen details - Darwin Core Standard doi

Authors: Sonia Ferreira, Jose Manuel Tierno de Figueroa, Filipa Martins, Joana Veríssimo, Pedro Sousa, Pedro Beja
Data type: Record information - specimen data in Darwin Core Standard format
Brief description: The file includes information about all records in BOLD for the IBI-Plecoptera 01 library. It contains collection and identification data. The data are downloaded from GBIF, without further processing.
Download file (72.12 kb)

Suppl. material 3: IBI-Plecoptera 01 library - DNA sequences doi

Authors: Sonia Ferreira, Jose Manuel Tierno de Figueroa, Filipa Martins, Joana Veríssimo, Joana Paupério, Pedro Sousa, Pedro Beja
Data type: Genomic data, DNA sequences
Brief description: COI sequences in fasta format. Each sequence is identified by the BOLD ProcessID, species name, marker and GenBank accession number, separated by pipe. The data are as downloaded from BOLD.
Download file (48.79 kb)