Conference Paper from the X Iberian Symposium on the Hydrographic Minho River Basin
("X Simpósio Ibérico sobre a Bacia Hidrográfica do Rio Minho")

e-ISSN: 2595-5527
10.32435/envsmoke/xibesymp.6
Special Issue, p. 36-43
2021

# THE IMPORTANCE OF TAXONOMY ON BASE SCIENCE: THE CASE STUDY OF THE CRUSTACEAN POPULATIONS OF THE MINHO RIVER ESTUARY (NW IBERIAN PENINSULA)

*Nuno Gomes[1,2]*; Dimítri de Araújo Costa[1,2]; Harold Cantallo[1]; Carlos Antunes[1,2]*

## Abstract

Although species identification is a central component on Biological Sciences, misidentifications are quite common generating error cascade effects on other environmental studies, resulting on erroneous population estimates, status, trends, and distribution data. One of the main causes of these errors occurs when dealing with damaged material, immature specimens, sexual dimorphism, intraspecific variation, and species with poor or outdated descriptions. Furthermore, usually there is no material retained as voucher of the specimens studied in scientific collections, hindering confirmation the identified species, in morphoanatomical and genetic scope. Even with this reliance on species identification taxonomy has been in decline for many years. In this study, we present the case study of the crustaceans identified for the Minho River estuary (NW Iberian Peninsula), using a taxonomic approach comparing these results with the biological surveys obtained through various ecology studies performed for 4 decades. A total of 64 species of crustaceans were identified within this study, in which 44 were new records for the Minho River estuary, compared to the 25 species identified on the biological surveys analyzed. Being one of the first studies of this nature in the Minho River, the main objective will be to provide taxonomic support in future projects in this area, contributing to the knowledge of the fauna of Portugal and the Iberian Peninsula.

**Keywords:** Biological Sciences. Crustacea. Species Identification. Scientific Collections.

[1]Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Terminal de Cruzeiros do Porto de Leixões, Avenida General Norton de Matos, s/n, 4450-208 Matosinhos, Portugal.

[2]Aquamuseu do Rio Minho, Parque do Castelinho, 4920-290 Vila Nova de Cerveira, Portugal.

*Corresponding author: Nuno@ciimar.up.pt

Submitted on: 9 Dec. 2021
Accepted on: 17 Dec. 2021
Published on: 31 Dec. 2021

# 1 Introduction

The starting point of modern taxonomy is attributed to Carl Linnaeus' publications "Species Plantarum" in 1753 (LINNAEUS, 1753) and "Systema Naturae" in 1758 (LINNAEUS, 1758), in which the binomial nomenclature was introduced and subsequentially rules for species descriptions and its terminology were created, laid down the groundwork for the emergence of modern systematics. And although taxonomy is one of the central scientific disciplines for the knowledge of biodiversity and study of environmental sciences, it has been in decline for many years.

Species identification is a central component on the elaboration of species distribution models through population surveys based on presence or absence (COSTA et al., 2015). Nonetheless species misidentifications affect the accuracy of these models (BEERKIRCHER et al., 2009; SHEA et al., 2011), generating error cascade effects on other biological sciences (BORTOLUS, 2008), resulting on erroneous population estimates, status, trends, and distribution data (SHEA et al., 2011). Difficulties on species level identifications are quite common, especially when dealing with damaged material, immature specimens, sexual dimorphism, intraspecific variation, and species with poor or outdated descriptions.

In this study, we present as a case study the crustaceans identified for the Minho River estuary (NW Iberian Peninsula), using a taxonomic approach, and compare those results with the biological surveys obtained through various ecology studies performed during the last 4 decades, in the same study area, with primary or secondary focus based on macroinvertebrate ecology, utilizing the same sampling methodologies. In addition, we emphasize the importance of storing part of the organisms studied in scientific collections, which allows the material to be re-analysed by specialists on further surveys.

# 2 Material and Methods

### Study Area: The Iberian Peninsula and the Minho River

The estuary of the Minho River, located in the Northwest of the Iberian Peninsula has a length of approximately 40 km, with a total area of 23km2 (SOUSA et al., 2008), a maximum width of 2 km, with a medium depth of 4m and a maximum depth of 23m in Vila Nova de Cerveira (ZACARIAS, 2007). With a minimum flow of 60m3/s and a maximum of 2500m3/s (ZACARIAS, 2007), various sedimentary islands and with a mesotidal partially mixed system tending towards a salt wedge estuary during the high floods (SOUSA; GUILHERMINO; ANTUNES, 2005), providing for a variety of habitats such as salt marshes, mudflats, sand flats and freshwater making for a high species diversity.

### Specimen sampling

Specimens examined were collected during at the International Minho River, on the estuarine zone (Figure 1), with following methods: 1) plankton net with a 200μm mesh, in Caminha, Portugal (41º52'32.40"N / 8º51'30.39"W) on May, 2020; 2) beam trawl in Caminha (41°52'04.8"N / 8°51'18.8"W) on June 2021; 3) by hand on rock in Caminha, Portugal (41º52'00"N / 8º51'15.90"W) on March 2021; 4) glass eel fishing bycatch, in Caminha, Portugal (41º52'59.00"N / 8º50'14.00"W), during a new moon night on flood tides, using stow net (length of float lines 10m, bottom anchored lead line of 15m, height 8m, mesh size 1-2mm, covering an area of 50m2), on April, 2020; 5) glass eel fishing bycatch, in Caminha, Portugal (41º52'44.80"N / 8º50'26.25"W), on March 2021; 6) on sediment sampling on saltmarsh with a Van Veen grab sampler in Caminha, Portugal (41º52'30.42"N / 8º49'52.97"W) on March, 2006; 7) on sediment sampling with a Van Veen grab sampler in Caminha, Portugal (41º53'23.00"N / 8º50'09.92"W), on September, 2020; 8) on sediment in front of Morraceira das Varandas Island (41°52'04.8"N 8°51'18.8"W) on September 2020 with Van Veen grab sampler; 9) in buccal cavity of *Alosa alosa* (Linnaeus, 1758), captured with trammel fishing net in Vila Nova de Cerveira, Portugal (41º55'57.67"N/ 8º45'33.85"W); 10) fyke nets (length 7m, mesh size 10mm, with two funnel shaped openings), in Vila Nova de Cerveira, Portugal (41º57'1.69"N/ 8º44'42.74"W); 11) in gut contents of Alosa sp., captured with seine net in Goián, Spain (41º57'05.11"N / 8º44'53.39"W), on November, 2020.

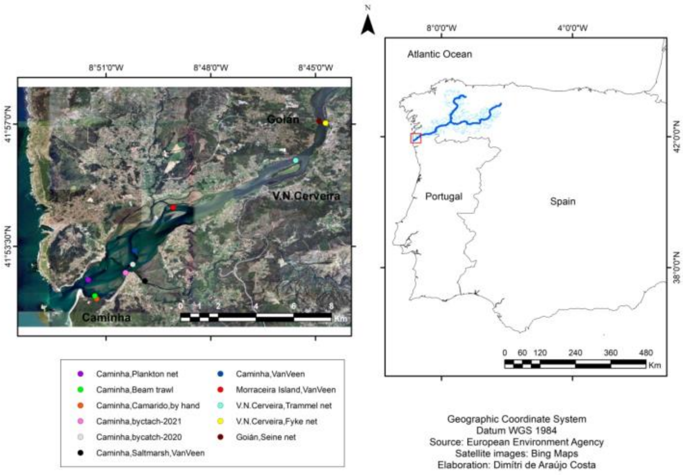


Figure 1- Study area, located at the Minho River estuary (NW Iberian Peninsula), with highlight on the sampling points and methods in the international zone. Satellite images: Bing Maps.

### Crustacean communities' analysis

For the purpose of comparison between quantity of species identified using a taxonomic approach versus the quantity of species identified on studies utilizing ecological approaches, 7 papers were chosen (ANTUNES; WEBER, 1996; COSTA-DIAS et al., 2010; ILARRI et al., 2014; MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; SOUSA et al., 2008; WEBER, 1985) from the same study area, with primary or secondary focus based on macroinvertebrate ecology, utilizing the same sampling methodologies, except for bycatch glass eel sampling, in which was used a stow net with bag.

Species checklist compiled from published literature (including PhD theses) in the Minho River estuary area. Sampling area, depth and sediment description are given whenever available on original publication. The estuary was divided in four different areas: Area 1 (A1): Mouth of the estuary; Area 2 (A2): Transition zone; Area 3 (A3): Salt marsh, Area 4 (A4): Interior zone (Figure 2), in order to accommodate all species according to habitat. The criterion for defining the areas was based on salinity and type of communities present in each area.

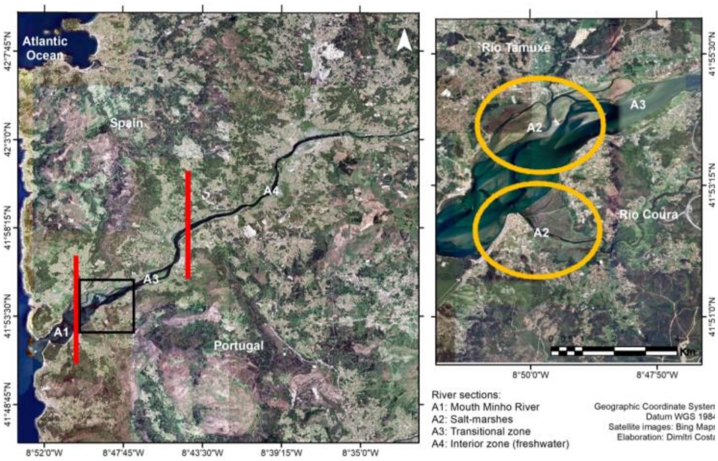


**Figure 2-** Minho River estuary habitat division (A1: Mouth of the river; A2: Salt marshes; A3: Transition zone; A4: Interior zone). Left image: Red lines highlighting section limits; Black square highlighting the area in which the salt marshes are included. Right image: Yellow circles highlighting Rio Coura (Portugal) and Río Tamuxe (Spain) salt marshes.

# 3 Results and Discussion

### Study case on Crustaceans of the Minho River

A total of 64 species of crustaceans were identified within this study in which 49 were new records for the Minho River estuary, compared to the 25 species identified on the 7 papers analysed (Table 1, Table 2, Table 3). As most specimens fail to be screened due to their small sizes and the lack of knowledge on some groups makes them unrecognizable to the "untrained eye" by non-specialists. With 64 species identified, the most diverse group was the Order Amphipoda with 30 species, followed by Isopoda with 18 species, Decapoda with 6, Cumacea with 4, Mysida with 3, Leptostraca with 2, Tanaidacea with 1 and Balanomorpha also with 1 species. Amphipoda was the group which increased its number of species the most with 8 species being identified on the studies analysed versus the 30 species identified in this study (Table 1). Cumacea, Leptostraca and Balanomorpha were recorded on the Minho River for the first time. Also 2 species were recorded for the first time in Portugal *Nebalia strausi* Risso, 1826 and *Parametopa kervillei* Chevreux, 1901, expanding their known distribution range. The exotic species *Austrominius modestus* (Darwin, 1854) was also recorded for the first time on the north region of Portugal.

**Table 1-** Comparison between the number of species recorded in previous studies and the species recorded in this study, by Order.

| Order | Nº of species recorded on previous studies | Nº of species recorded in this study |
|---|---|---|
| Amphipoda | 8 | 29 |
| Balanomorpha | 0 | 1 |
| Cumacea | 0 | 4 |
| Decapoda | 8 | 6 |
| Isopoda | 7 | 18 |
| Leptostraca | 0 | 2 |
| Mysida | 1 | 3 |
| Tanaidacea | 1 | 1 |

**Table 2-** Comparison between the number of species recorded in previous studies and the species recorded in this study, by sampling methodology.

| Sampling methodology | Nº of species recorded on previous studies | New records in this study | Total nº of species recorded |
|---|---|---|---|
| Glass eel fishing bycatch | 4 | 41 | 56 |
| Intertidal | 9 | 2 | 11 |
| Subtidal sediment | 22 | 1 | 24 |
| Fyke nets | 5 | 0 | 5 |
| Beam trawl | 4 | 4 | 8 |

**Table 3-** List of Crustacean species recorded at the Minho River estuary. Area of collection in the Minho River estuary: **A1**- mouth of the river; **A2**- salt marshes; **A3**- transition zone; **A4**- fresh water (reference abbreviation: (WEBER, 1985)-**A**; (ANTUNES; WEBER, 1996)-**B**; (MAZÉ; LASTRA; MORA, 1993)-**C**; (SOUSA et al., 2008)-**D**; (COSTA-DIAS et al., 2010)-**E**; (SOUSA et al., 2013)-**F**; (PICANÇO et al., 2014)-**G**; (ILARRI et al., 2014)-**H**).

| Order | Species | Reference | Area | Sampling information |
|---|---|---|---|---|
| **Amphipoda** | *Abludomelita gladiosa* (Bate, 1862) | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca aequicornis* Bruzelius, 1858 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca armoricana* Bellan-Santini & Dauvin, 1981 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca lusitanica* Bellan-Santini & Marques, 1986 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca pectenata* Reid, 1951 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca rubella* Costa, 1864 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca serraticaudata* Chevreux, 1888 | This study | A1 | Glass eel fishing bycatch |
| | *Ampelisca spinimana* Chevreux, 1887 | This study | A1 | Glass eel fishing bycatch |
| | *Apherusa jurinei* (Milne-Edwards, 1830) | This study | A1 | Glass eel fishing bycatch |
| | *Aora gracilis* (Bate, 1857) | This study | A1 | Glass eel fishing bycatch |
| | *Bathyporeia pilosa* Lindstrom, 1855 | (MAZÉ; LASTRA; MORA, 1993; SOUSA et al., 2008) | C: A2 and A3; D: Without location | C: dredge on medium and fine sand |
| | *Bathyporeia sarsi* Watkin, 1938 | This study | A1 | Glass eel fishing bycatch |
| | *Caprella danilevskii* Czerniavski, 1868 | This study | A1 | Beam trawl |
| | *Corophium multisetosum* Stock, 1952 | This study; (MAZÉ; LASTRA; MORA, 1993; SOUSA et al., 2008) | This study: A1; C: A4; D: A3 | This study: Glass eel fishing bycatch; C: dredge on gravel and medium sand; D: dredge on gravel, clay, coarse and fine sand |
| | *Corophium volutator* (Pallas, 1766) | (WEBER, 1985) | A: A1, A2 and A3 | A: Intertidal sampling; Possible misidentification |
| | *Dexamine spinosa* (Montagu, 1813) | This study | A1 | Glass eel fishing bycatch |
| | *Echinogammarus marinus* (Leach, 1815) | This study | A1 | On intertidal among *Fucus* spp. |
| | *Echinogammarus stoerensis* (Reid, 1938) | This study | A1 | Beam trawl |
| | *Gammarus chevreuxi* Sexton, 1913 | This study; (MAZÉ; LASTRA; MORA, 1993; SOUSA et al., 2008) | This study: A1; C: A3 and A4; D: A3 | This study: Glass eel fishing bycatch; C: dredge on gravel medium and fine sand; D: dredge on clay, very coarse, medium and fine sand |
| | *Gammarus pulex* (Linnaeus, 1758) | (SOUSA et al., 2008) | A4 | |
| | *Haustorius arenarius* (Slabber, 1769) | This study; (MAZÉ; LASTRA; MORA, 1993; SOUSA et al., 2008) | This study: A1; C: A3; D: A1 | This study: Glass eel fishing bycatch; C: dredge on medium and fine sand; D: dredge on medium sand |
| | *Jassa falcata* (Montagu, 1808) | This study | A1 | Glass eel fishing bycatch |
| | *Lepidepecreum longicorne* (Bate, 1862) | This study | A1 | Glass eel fishing bycatch |
| | *Leptocheirus pilosus* Zaddach, 1844 | This study; (PICANÇO et al., 2014) | This study: A3; G: A2 | This study: Van Veen dredge, on medium sand; G: Van Veen dredge on gravel, coarse and medium sand, at depths ranging between 2 to 3 meters |
| | *Maera grossimana* (Montagu, 1808) | This study | A1 | Glass eel fishing bycatch |
| | *Melita palmata* (Montagu, 1804) | This study; (MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; SOUSA et al., 2008) | This study: A1; C: A2; D: Without location; G: A2 | This study: Glass eel fishing bycatch; C: dredge on medium and fine sand; G: Van Veen dredge at depths ranging from 2 to 3m, on gravel, coarse, medium and fine sand |
| | *Nototropis guttatus* Costa, 1853 | This study | A1 | Glass eel fishing bycatch |
| | *Nototropis vedlomensis* (Bate & Westwood, 1863) | This study | A1 | Glass eel fishing bycatch |
| | *Parajassa pelagica* (Leach, 1814) | This study | A1 | Glass eel fishing bycatch |
| | *Parametopa kervillei* Chevreux, 1901 | This study | A1 | Glass eel fishing bycatch |
| | *Tryphosites longipes* (Bate, 1862) | This study | A1 | Glass eel fishing bycatch |
| | *Urothoe brevicornis* Bate, 1862 | This study | A1 | Glass eel fishing bycatch |
| **Balanomorpha** | *Austrominius modestus* (Darwin, 1854) | This study | A1 | On intertidal rocks, associated with *Fucus* spp. |
| **Cumacea** | *Iphinoe tenella* Sars, 1878 | This study | A1 | Glass eel fishing bycatch |
| | *Iphinoe trispinosa* (Goodsir, 1843) | This study | A1 | Glass eel fishing bycatch |

| | | | | |
|---|---|---|---|---|
| | *Diastylis bradyi* Norman, 1879 | This study | A1 | Glass eel fishing bycatch |
| | *Diastylis cornuta* (Boeck, 1864) | This study | A1 | Glass eel fishing bycatch |
| **Decapoda** | *Atyaephyra desmarestii* (Millet, 1831) | This study;(ANTUNES; WEBER, 1996; COSTA-DIAS et al., 2010; ILARRI et al., 2014; WEBER, 1985) | This study: A4; A: Without location; B: A4; E: A2; H: A3 | This study: fyke nets; B: glass eel fishing bycatch; E: beam trawl; H: fyke nets |
| | *Carcinus maenas* (Linnaeus, 1758) | This study; (COSTA-DIAS et al., 2010; ILARRI et al., 2014; MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; WEBER, 1985) | This study: A1; A: Without location; C: Without location; E: A1 andA2; G: A2; H: A3 | This study: glass eel fishing bycatch; E: beam trawl; G: Van Veen dredge at depths ranging from 1,5 to 3 m, in gravel, coarse, medium and fine sand; H: fyke nets |
| | *Crangon crangon* (Linnaeus, 1758) | This study; (ANTUNES; WEBER, 1996; COSTA-DIAS et al., 2010; ILARRI et al., 2014; MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; WEBER, 1985) | This study: A1; A: Without location; B: A4; C: Without location; E: A1, A2 and A3; G; A2; H: A3 | This study: glass eel fishing bycatch; B: glass eel fishing bycatch; E: beam trawl; G: Van Veen dredge at depths ranging from 1.5 to 2m; H: fyke nets; |
| | *Diogenes pugilator* (P. Roux, 1829) | (SOUSA et al., 2008) | D: A1; A2 | D: Van Veen dredge |
| | *Palaemon longirostris* Milne Edwards, 1837 | This study | A1 | Glass eel fishing bycatch |
| | *Palaemon serratus* (Pennant, 1777) | (ANTUNES; WEBER, 1996; ILARRI et al., 2014; WEBER, 1985) | A: Without location; B: A4; H: A4 | A: Intertidal sampling; B: Glass eel fishing bycatch; H: fyke nets |
| | *Procambarus clarkii* (Girard, 1852) | This study; (COSTA-DIAS et al., 2010; SOUSA et al., 2013) | This study: A4; E: A3 and A4; F: A4 | This study: fyke nets; E: beam trawl; F: fyke nets |
| | *Processa modica* Williamson, 1979 | This study | A1 | Glass eel fishing bycatch |
| **Isopoda** | *Ceratothoa* aff. *oestroides* (Risso, 1826) | This study | A3 | Trammel net on Alosa alosa mouth |
| | *Cyathura carinata (Krøyer, 1847)* | This study; (MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; SOUSA et al., 2008; WEBER, 1985) | This study: A1; A: A1 C: Without location; D: A3; G: A2 | This study: Glass eel fishing bycatch; A: Intertidal sampling; C: dredge on medium and fine sand; D: Van Veen dredge in medium and fine sand; G: Van Veen dredge at depths |
| | | | | ranging from 1.5 to 3.5m, on gravel, coarse, medium and fine sand |
| | *Dynamene bidentata* Adams, 1800 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Dynamene magnitorata* Holdich, 1968 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Eurydice affinis* Hansen, 1905 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Eurydice pulchra* Leach, 1815 | (MAZÉ; LASTRA; MORA, 1993; WEBER, 1985) | A: Without location; C: A2 and A3 | A: Intertidal sampling; C: dredge on medium and fine sand |
| | *Gnathia vorax* (Lucas, 1849) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Ischyromene lacazei* Racovitza, 1908 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Idotea balthica* (Pallas, 1772) | (MAZÉ; LASTRA; MORA, 1993) | C: A2 and A3 | C: dredge on medium and fine sand; Possible misidentification |
| | *Idotea chelipes* (Pallas, 1766) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Idotea neglecta* Sars, 1897 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Idotea pelagica* Leach, 1816 | This study | This study: A1 | This study: Beam trawl |
| | *Jaera (Jaera) albifrons* Leach, 1814 | This study | This study: A1 | This study: Beam trawl |
| | *Lekanesphaera hookeri* (Leach, 1814) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Lekanesphaera levii* (Argano & Ponticelli, 1981) | This study; (MAZÉ; LASTRA; MORA, 1993) | This study: A1; C: A2 and A3 | This study: Glass eel fishing bycatch; C: dredge on medium and fine sand (as *Sphaeroma monodi*) |
| | *Lekanesphaera rugicauda* (Leach, 1814) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Paragnathia formica* (Hesse, 1864) | This study ; (PICANÇO et al., 2014) | This study: A1; G: A2 | This study: Glass eel fishing bycatch; G: Van Veen dredge at 3m depth, on gravel and coarse sand |
| | *Sphaeroma serratum* (Fabricius, 1787) | This study; (PICANÇO et al., 2014; WEBER, 1985) | This study: A3; A: Without | This study: Van Veen 4.8m depth, on fine sand; A: Intertidal sampling; G: |

| | | | | |
|---|---|---|---|---|
| | | | location; G: A2 | Van Veen dredge at 3m depth, on gravel, coarse, medium and fine sand |
| | *Saduriella losadai* Holthuis, 1964 | This study; (ANTUNES; WEBER, 1996; MAZÉ; LASTRA; MORA, 1993; PICANÇO et al., 2014; SOUSA et al., 2008; WEBER, 1985) | This study: A1; A: A3; B: A4; C: A3 and A4; D: A3; G: A2 | This study: Glass eel fishing bycatch; A: Intertidal sampling; B: Glass eel fishing bycatch; C: dredge on gravel, medium and fine sand; D: Van Veen dredge in medium sand; G: Van Veen dredge at depths ranging from 2 to 3.5m, on gravel and coarse sand |
| | *Stenosoma lancifer* (Miers, 1881) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| **Leptostraca** | *Nebalia strausi* Risso, 1826 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Sarsinebalia cristoboi* Moreira, Gestoso & Troncoso, 2003 | This study | This study: A1 | This study: Glass eel fishing bycatch |
| **Mysida** | *Gastrosaccus spinifer* (Goës, 1864) | This study; (MAZÉ; LASTRA; MORA, 1993) | This study: A1; C: A1 | This study: Glass eel fishing bycatch; C: dredge on coarse and medium sand |
| | *Neomysis integer* (Leach, 1814) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| | *Praunus neglectus* (Sars, 1869) | This study | This study: A1 | This study: Glass eel fishing bycatch |
| **Tanaidacea** | *Heterotanais oerstedii* (Krøyer, 1842) | (PICANÇO et al., 2014) | G: A2 | G: Van Veen dredge at depths ranging from 1,5 to 3 meters, in gravel, coarse and medium sand |

A total of 6 species were not identified at species level within this study and 11 on the studies analysed (Table 4), and due to the inexistence of vouchers, re-examination and further identification was not possible, with the identity of these species remaining unresolved. Furthermore, an overlap on the 3 species identified as *Gammarus* sp. (Table 4) (PICANÇO et al., 2014; SOUSA et al., 2008; WEBER, 1985) is also probable although confirmation is not possible.

Regarding possible misidentifications on previous studies, in WEBER, (1985), *Cyathura carinata* (Krøyer, 1847) was misidentified as *Anthura gracilis* (Montagu, 1808) and corrected posteriorly in this same work (handwritten notes performed by the author). While the species identified as *Corophium volutator* (Pallas, 1766) may have been misidentified, as the species *Corophium multisetosum* Stock, 1952 is an abundant and common species on the estuary and *C. volutator* was not recorded before or since this study. In (MAZÉ; LASTRA; MORA, 1993) the species *Idotea balthica* (Pallas, 1772) might also been a misidentification as this species is commonly found in marine environments while this genus is represented in the Minho River estuary by the brackish species *Idotea chelipes* (Pallas, 1766).

**Table 4-** List of specimens without species level identification. Area of collection in the Minho River estuary: **A1**- mouth of the river; **A2**- salt marshes; **A3**- transition zone; **A4**- fresh water (reference abbreviation: (WEBER, 1985)-**A**; (ANTUNES; WEBER, 1996)-**B**; (MAZÉ; LASTRA; MORA, 1993)-**C**; (SOUSA et al., 2008)-**D**; (COSTA-DIAS et al., 2010)-**E**; (SOUSA et al., 2013)-**F**; (PICANÇO et al., 2014)-**G**; (ILARRI et al., 2014)-**H**).

| Order | Species | Reference | Area | Sampling information |
|---|---|---|---|---|
| **Amphipoda** | Calliopiidae sp. | This study | A1 | Glass eel fishing bycatch |
| | Calliopiidae sp.1 | (MAZÉ; LASTRA; MORA, 1993) | Without location | |
| | Calliopiidae sp.2 | (MAZÉ; LASTRA; MORA, 1993) | Without location | |
| | *Caprella* sp. | This study | A1 | Beam trawl |
| | *Centromedon* sp. | This study | A1 | Glass eel fishing bycatch |
| | *Corophium* sp. | (PICANÇO et al., 2014) | A3 | Van Veen dredge |
| | *Gammarus* sp. | (WEBER, 1985) | Without location | Intertidal sampling |
| | *Gammarus* sp. | (SOUSA et al., 2008) | Without location | Van Veen dredge |
| | *Gammarus* sp. | (PICANÇO et al., 2014) | A2 | Van Veen dredge |
| | *Leptocheirus* sp. | This study | A1 | Glass eel fishing bycatch |
| | *Leptocheirus* sp. | (MAZÉ; LASTRA; MORA, 1993) | Without location | |
| | *Protohyale (Protohyale)* sp. | This study | A1 | Glass eel fishing bycatch |
| **Decapoda** | *Liocarcinus* sp. | (MAZÉ; LASTRA; MORA, 1993) | Without location | |
| | *Palaemon* sp. | (COSTA-DIAS et al., 2010) | A2 | Beam trawl |
| **Isopoda** | *Cymodoce sp.* | This study | A1 | Glass eel fishing bycatch |
| **Mysida** | *Mysis* sp. | (WEBER, 1985) | Without location | Intertidal sampling |
| | *Praunus* sp. | (SOUSA et al., 2008) | Without location | Van Veen dredge |

Species diversity is higher on the river mouth with a total of 60 species found, with 47 of them being exclusively sampled in this area (Table 5). The salt marshes and the transitional zone had 16 and 17 species sampled respectively, with one of them being only sampled on the Coura River salt marsh (Table 3, Table 5). The area with least diversity was the interior zone (mainly freshwater, up to 0.07 PSU salinity during the summer months) with 6 species, one of them only sampled in this area (Table 3, Table 5) Although the species *Ceratothoa* aff. *oestroides* was only collected at the transitional zone, the fact that this species has a parasitic behaviour, links its distribution to the host fish distribution (Allis shad: *Alosa alosa* Linnaeus, 1758). Nevertheless, this raises the interesting question on how this isopod species handles the sudden shifts on salinity while migrating upstream with its host, in this case Allis shad. Apart from some brackish water species resident in the river estuary, most of the species examined were adventitious marine fauna transported upstream through the dynamics of rising tides (Table 2), making this ecological compartment the least known for this section of the Minho River estuary. Resident brackish water species were found on the mouth river, salt marshes and transitional areas, while species commonly found on freshwater had their distribution mostly restricted to the interior and transitional zones. The species sampled across the entirety of the study area include *Saduriella losadai* Holthuis, 1964, *Gammarus chevreuxi* Sexton, 1913 and *C. multisetosum* (Table 3).

**Table 5-** Number of species per area.

| Area | Nº of species sampled | Nº of species sampled exclusively on the respective area |
|---|---|---|
| River mouth (**A1**) | 60 | 47 |
| Salt marshes (**A2**) | 16 | 1 |
| Transitional zone (**A3**) | 17 | 1 |
| Interior zone (**A4**) | 6 | 1 |

Since most works on ecology do not require species level identification, a large fraction of the local macroinvertebrate fauna will remain invisible, resulting on large biodiversity underestimations. Furthermore, the lack of knowledge on some micro-habitats may reveal more hidden biodiversity. This problematic raises a few interesting questions, such as how to approximate ecological surveys to taxonomic rigorous identifications and how these two sciences can improve each other with sampling and identification methodologies that can satisfy both approaches to fauna surveys.

Since comprehensive studies based on local fauna are still far from being completed, especially regarding the knowledge on Portuguese and the Iberian crustacean fauna, a great effort is still needed to meet the taxonomical requirements in modern biological sciences.

# 4 Conclusions

Taxonomy, applied through specialists in the groups studied, is essential for the reasonable development and support of studies in environmental sciences. Works involving ecology, for example, should integrate taxonomists in their analyses and allow the storage of part of the studied material in scientific collections, obeying the good scientific conduct of re-analysis of the studied biological material. The taxonomic study of crustaceans from International Minho River served as an example in this work to highlight the importance of good identification, allowing the verification of new occurrences for the studied area, as well as the establishment of exotic species. Other areas of environmental sciences should therefore follow this conduct, thus valuing the laborious and dedicated work of taxonomists in each group under study.

# REFERENCES

ANTUNES, C.; WEBER, M. The glass eel fishery and the by-catch in the Rio Minho after one decade (1981-1982 and 1991-1992). **Archives of Polish Fisheries**, v. 4, p. 131–139, 1996.

BEERKIRCHER, L. et al. Effects of species misidentification on population assessment of overfished white marlin *Tetrapturus albidus* and roundscale spearfish *T. georgii*. **Endangered Species Research**, v. 9, p. 81–89, 10 dez. 2009.

BORTOLUS, A. Error cascades in the Biological Sciences: the unwanted consequences of using bad taxonomy in ecology. **AMBIO: A Journal of the Human Environment**, v. 37, n. 2, p. 114–118, 2008.

COSTA-DIAS, S. et al. Factors influencing epibenthic assemblages in the Minho Estuary (NW Iberian Peninsula). **Marine Pollution Bulletin**, v. 61, n. 4–6, p. 240–246, 2010.

COSTA, H. et al. Impacts of Species Misidentification on Species Distribution Modelling with Presence-Only Data. **ISPRS International Journal of Geo-Information**, v. 4, n. 4, p. 2496–2518, 16 nov. 2015.

ILARRI, M. I. et al. Influence of the invasive Asian clam *Corbicula fluminea* (Bivalvia: Corbiculidae) on estuarine epibenthic assemblages. **Estuarine, Coastal and Shelf Science**, v. 143, n. March, p. 12–19, 2014.

LINNAEUS, C. **Species plantarum exhibentes plantas rite cognitas ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas**. Holmiæ [Stockholm]: Impensis Laurentii Salvii, 1753.

LINNAEUS, C. **Systema naturae per regna tria naturae :secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis**. Editio dec ed. Holmiæ [Stockholm]: Impensis Direct. Laurentii Salvii, 1758.

MAZÉ, R. A.; LASTRA, M.; MORA, J. Macrozoobentos del estuario del Mino (NO de Espana). **Publicaciones Espec. Inst. Español Oceanogr.**, v. 11, p. 283-290, 1993.

PICANÇO, T. C. et al. Influence of the abiotic characteristics of sediments on the macrobenthic community structure of the Minho estuary saltmarsh (Portugal). **Limnetica**, v. 33, n. 1, p. 73-88, 2014.

SHEA, C. P. et al. Misidentification of freshwater mussel species (Bivalvia:Unionidae): contributing factors, management implications, and potential solutions. **Journal of the North American Benthological Society**, v. 30, n. 2, p. 446-458, jun. 2011.

SOUSA, R. et al. Subtidal macrozoobenthic assemblages along the River Minho estuarine gradient (north-west Iberian Peninsula). **Aquatic Conservation: Marine and Freshwater Ecosystems**, v. 18, p. 1063-1077, nov. 2008.

SOUSA, R.; GUILHERMINO, L.; ANTUNES, C. Molluscan fauna in the freshwater tidal area of the River Minho estuary, NW of Iberian Peninsula. **Annales de Limnologie**, v. 41, n. 2, p. 141-147, 2005.

WEBER, M. **Zur Ökosystemstruktur des Minhoästuars, Iberische Westküste**. PhD thesis. University of Kiel, 1985.

ZACARIAS, N. G. **Influência da batimetria e do caudal fluvial na propagação da maré no estuário do Rio Minho**. Bachelor's Thesis, Universidade de Évora, Évora, Portugal, 2007.