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ORIGINAL ARTICLE

The crustacean collection at the National Institute of Mata Atlântica (INMA), former Professor Mello Leitão Biology Museum (MBML)

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ABSTRACT

Zoological collections are fundamental repositories of biodiversity and have an important role in scientific dissemination. The National Institute of Mata Atlântica (INMA, previously called Professor Mello Leitão Biology Museum) founded by Augusto Ruschi is situated in Santa Teresa, Espírito Santo, Brazil, within the Atlantic Forest Biome, being a relevant source for the development of research in this habitat. The aim herein is to inventory the crustacean collection of INMA with a complete list of the species and their habitat. This collection is not yet digitized or available online. The collection totals 52 species in 41 genera, belonging to 26 families and comprises major crustacean groups, with a particular focus on Decapoda. All holdings are from Brazil. It consists of 443 specimens included in 131 records, representing mostly the Espírito Santo carcinofauna. Without online publication of the specimen data, the visibility and use of the collection would likely remain limited. Sourcing specimens through online databases will facilitate the production of guides and taxonomic training, and also more information can be passed on to the community as a whole. Thus, a proposal for future management of the Crustacea collection of INMA is to digitize the data through photos of the specimens and associated labels.

KEYWORDS

Brazil, checklist, Crustacea, Espírito Santo, Zoological collection.

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Introduction

Human activities are causing species extinction at an unprecedented rate (World Conservation Monitoring Centre, 1992) and these extinctions are occurring before even half of the species have been described (Costello *et al.*, 2006). In Brazil, both social and economic developments have been causing ecological damage, and intervention should be urgent as the protection of our biodiversity is fundamental for climate and environmental stability (Marinoni *et al.*, 2005). As biologically rich habitats are destroyed, under pressure from the population growth and economic activities, the extinction rates of plant and animal species are accentuated (Marinoni *et al.*, 2005).

Even though the economy is directly and indirectly dependent on biodiversity (Costello *et al.*, 2006), there is no evidence of increased resources to identify and inventory biodiversity. Actually, the lack of taxonomists and specialists able to identify, describe and classify species is a troubling fact and the progressive decrease in the number of taxonomists for a large number of invertebrate groups is a widespread phenomenon (Giangrande, 2003). Nevertheless, taxonomy at the species level tends to be neglected within ecological works. Reliable taxonomic and systematic data is fundamental for conservation biology and monitoring programmes, which well-maintained biological collections and catalogues are the basis of (Giangrande, 2003; Marinoni *et al.*, 2005). Taxonomic resources include the availability of systematic inventories, the update of species identification guides and the condition of specimens in collections (Costello *et al.*, 2006).

Biological collections are important repositories of biodiversity and fundamental reference systems for the classification of diversity of the natural world, allowing the understanding of speciation, extinction and adaptation processes that produced the current diversity of life. They also provide information for the resolution of issues such as the effects of climate change, the loss of biodiversity or the selection of conservation areas (Alves *et al.*, 2014). Furthermore, they can be used as information sources for various science fields such as evolutionary studies, biogeography, comparative anatomy, conservation and management of natural resources, biotechnology, and molecular genetics, among others (Marinoni *et al.*, 2005; Huxley *et al.*, 2020).

Besides the above reasons, biological collections also have an important role in scientific dissemination (Alves *et al.*, 2014), promoting public display to excite wonderment and educate (Huxley *et al.*, 2020) and encouraging ecotourism by providing elements for exhibitions about the natural history of ecosystems in a region (Marinoni *et al.*, 2005). Thus, zoological collections are the basis for studies of biodiversity as they gather specimens of the fauna, which serve as a valuable resource for future research when well preserved (Shaffer *et al.*, 1998).

The National Institute of Mata Atlântica (INMA), name changed from the former Professor Mello Leitão Biology Museum (in 2014), was founded in 1949 by naturalist Augusto Ruschi and is located in Santa Teresa, Espírito Santo (ES) - Brazil (Ruschi, 1984). Augusto Ruschi was the director of the Mello Leitão Museum, and was also a professor at the Museu Nacional, Universidade Federal do Rio de Janeiro. The local Museum was created with the aim of supporting scientific-biological research, mainly in the Espírito Santo area (Ruschi, 1984). This institution is located in the Atlantic Forest Biome, being today the main reference on the biodiversity of Espírito Santo and its collections have become a crucial source for the development of research in this biome (Tonini *et al.*, 2018).

The zoological collection was founded by Augusto Ruschi himself and the first deposit of material was a humming bird, *Phaethornis idaliae* (Bourcier and Mulsant, 1856) (Aves, Apodiformes), registered on May 18th, 1940 (Sarmento-Soares and Martins-Pinheiro, 2014). The INMA zoological collection is comprised of seven collections, five of which are vertebrates (with about 41,000 lots and more than 125,000 specimens) and two are of invertebrates: the Crustacea collection and Odonata collection (Hexapoda, Insecta). The Invertebrate collections started in the 21st century and now have about 800 lots and approximately 1,000 specimens (INMA, http://inma.gov.br/instituto/). The major contribution to the Crustacea collection was done by João Luiz Gasparini (UFES) but there is no present curator responsible for it. The vertebrate collections are digitized and

available online, however no data on the invertebrate collection is available for public access.

The INMA publishes, every six months, a scientific magazine "Bulletin of the Professor Mello Leitão Biology Museum". In this bulletin, only three papers referring to crustaceans were found (Teixeira and Sá, 1998; Fernandes *et al.*, 2006; Rodrigues and D'Incao, 2015). Moreover, only Dall'Occo *et al.* (2007) worked with material deposited in the INMA, from Guarapari (ES), indicating the need for further studies in this collection.

The aim of this paper is to provide a detailed inventory of the Crustacea collection of INMA, including a complete list of the specimens and their habitat. Catalogs and inventories allow the tracking of what has already been built and guide the reader in bibliographic research. With wider dissemination, new opportunities for scientific production and the consumption of museum data appear with publicly available inventories and catalogs (Ferreira, 2002).

Material and Methods

The present inventory of the Crustacea collection at INMA was made by checking the hard-copy registers and comparing the data with the associated labels in an effort to complete or correct the available information. Vouchers stored in the Crustacean collection at INMA were analyzed during May and June of 2015 by the senior author. The collection is preserved in 70 % ethanol and stored in glassware (Fig. 1). Relevant literature was consulted to identify the crustaceans at the lowest taxonomic level (Melo, 1996; 1999; 2003), using a stereoscopic microscope. All previously identified species were analyzed by the senior author to confirm their identification.

The following inventory is listed by higher taxonomic levels within Subphylum Crustacea to the species level and the phylogenetic arrangement of families, genera and species are based primarily on De Grave and Fransen (2011) and WoRMS (2020).

Figure 1. The Crustacea collection of INMA. **A**, **B**: View of storage shelves of the collection; **C**: *Calappa sulcata* Rathbun, 1898 (MBML 105); **D**: *Panulirus echinatus* Smith, 1869 (MBML 117). Credits to Miguel A. B. Gonçalves (INMA).

For voucher numbers (MBML) see spreadsheet on Supplementary Material. Registration entries included in the ledger that could not be found in the collection were not cited in the inventory below. Nevertheless, these cases are highlighted in gray in the spreadsheet (see Supplementary Material). The material that was identified and then lost in the flood of 2000 is included herein as it was photographed before being discarded.

The abbreviations used are: AABB – Banco do Brasil Athletic Association (Associação Atlética Banco do Brasil); CR – Critically Endangered; Est. – Estuarine; DD – Data Deficient; Fw. – Freshwater; LC – Least Concern; Mar. – Marine; MBML – Mello Leitão Biology Museum (Museu de Biologia Mello Leitão); NA – Not Applicable; NT – Near Threatened; PEM – Marine State Park (Parque Estadual Marinho); Terr. – Terrestrial; VU – Vulnerable.

Results

A total of 443 specimens from 110 lots were examined in the Crustacea collection of INMA. Several lots were subsequently divided resulting in a total of 135 lots.

Subphylum Crustacea Brünnich, 1772

Class Malacostraca Latreille, 1802

Subclass Eumalacostraca Grobben, 1892

Superorder Eucarida Calman, 1904

Order Decapoda Latreille, 1802

Suborder Dendrobranchiata Spence Bate, 1888

Superfamily Penaeoidae Rafinesque, 1815

Family Penaeidae Rafinesque, 1815
(1 lot, 2 specimens unidentified) – Mar.

Suborder Pleocyemata Burkenroad, 1963

Infraorder Achelata Scholtz & Richter, 1995

Family Palinuridae Latreille, 1802

Justitia longimanus (H. Milne Edwards, 1837) (1 lot, 1 specimen) – Mar.; LC

Palinurellus gundlachi von Martens, 1878 (1 lot, 1 specimen) – Mar.; LC

Panulirus argus (Latreille, 1804) (1 lot, 1 specimen) – Mar.; NT

Panulirus echinatus Smith, 1869 (1 lot, 1 specimen) – Mar.; DD

Panulirus laevicauda (Latreille, 1817) (3 lots, 5 specimens) – Mar.; NT

Infraorder Anomura Macleay, 1838

Superfamily Paguroidea Latreille, 1802
(1 lot, 11 specimens unidentified) – Mar.

Family Diogenidae Ortmann, 1892

Calcinus tibicen (Herbst, 1791) (2 lots, 2 specimens) – Mar.

Clibanarius vittatus (Bosc, 1802) (1 lot, 1 specimen) – Mar.; Est.

Clibanarius cf. *vittatus* (Bosc, 1802) (1 lot, 1 specimen) – Mar.; Est.

Petrochirus diogenes (Linnaeus, 1758) (2 lots, 2 specimens) – Mar.

Infraorder Astacidea Latreille, 1802

Family Enoplometopidae Saint Laurent, 1988

Enoplometopus antillensis Lütken, 1865 (1 lot, 1 specimen) – Mar.; DD

Infraorder Brachyura Latreille, 1802

Family Aethridae Dana, 1851

Hepatus pudibundus (Herbst, 1785) (4 lots, 24 specimens; 1 specimen transferred to didactic material collection) – Mar.

Family Calappidae De Haan, 1833

Calappa sulcata Rathbun, 1898 (1 lot, 1 specimen) – Mar.

Calappa gallus (Herbst, 1803) (3 lots, 4 specimens) – Mar.

Family Dromiidae De Haan, 1833

Dromia erythropus (Edwards in Catesby, 1771) (1 lot, 2 specimens) – Mar.

Family Epialtidae MacLeay, 1838

Macrocoeloma subparallelum (Stimpson, 1860) (1 lot, 1 specimen) – Mar.
Nibilia antilocapra (Stimpson, 1871) (1 lot, 1 specimen) – Mar.
Stenocionops spinosissimus (Saussure, 1857) (1 lot, 1 specimen) – Mar.
Stratiolibinia bellicosa (De Oliveira, 1944) (2 lots, 3 specimens) – Mar.

Family Eriphiidae MacLeay, 1838

Eriphia gonagra (Fabricius, 1781) (2 lots, 7 specimens) – Mar.

Family Gecarcinidae MacLeay, 1838

Cardisoma guanhumi Latreille, 1828 (1 lot, 1 specimen) – Mar.; Est.; Terr.; CR
Johngarthia lagostoma (H. Milne Edwards, 1837) (2 lots, 2 specimens) – Mar.; Terr.; CR

Family Grapsidae MacLeay, 1838

Goniopsis cruentata (Latreille, 1803) (5 lots, 6 specimens) – Mar.; Est.; LC

Family Leucosiidae Samouelle, 1819

Persephona lichtensteinii Leach, 1817 (1 lot, 3 specimens) – Mar.
Persephona mediterranea (Herbst, 1794) (2 lots, 5 specimens) – Mar.

Family Menippidae Ortmann, 1893

Menippe nodifrons Stimpson, 1859 (3 lots, 7 specimens) – Mar.

Family Mithracidae MacLeay, 1838

Mithrax hispidus (Herbst, 1790) (4 lots, 6 specimens) – Mar.

Family Ocypodidae Rafinesque, 1815

Minuca mordax (Smith, 1870) (2 lots, 3 specimens) – Est.
Ocypode quadrata (Fabricius, 1787) (4 lots, 5 specimens) – Mar.
Uca maracoani (Latreille, 1802) (3 lots, 7 specimens) – Mar.; Est.; LC
Ucides cordatus (Linnaeus, 1763) (2 lots, 2 specimens) – Mar.; Est.; NT

Family Percnidae Števčić, 2005

Percnon gibbesi (H. Milne Edwards, 1853) (1 lot, 1 specimen) – Mar.; NA

Family Plagusiidae Dana, 1851

Plagusia depressa (Fabricius, 1775) (1 lot, 2 specimens) – Mar.

Family Portunidae Rafinesque, 1815

Achelous spinimanus (Latreille, 1819) (1 lot, 2 specimens) – Mar.; LC
Arenaeus cribrarius (Lamarck, 1818) (2 lots, 5 specimens) – Mar.; LC
Callinectes bocourti A. Milne-Edwards, 1879 (3 lots, 6 specimens) – Est.; LC
Callinectes danae Smith, 1869 (2 lots, 6 specimens) – Mar.; Est.; LC
Callinectes larvatus Ordway, 1863 (1 lot, 2 specimens) – Mar.; Est.
Callinectes ornatus Ordway, 1863 (2 lots, 2 specimens) – Mar.; Est.; LC
Callinectes sapidus Rathbun, 1896 (5 lots, 14 specimens) – Est.; DD
Cronius ruber (Lamarck, 1818) (3 lots, 5 specimens) – Mar.; LC

Family Sesarmidae Dana, 1851

Aratus pisonii (H. Milne Edwards, 1837) (1 lot, 1 specimen; photographed; lost during flood) – Est.
Armases angustipes (Dana, 1852) (1 lot, 2 specimens) – Mar.; Est.; LC

Sesarma rectum Randall, 1840 (1 lot, 1 specimen) – Est.; LC

Family Trichodactylidae H. Milne Edwards, 1853

Trichodactylus fluviatilis Latreille, 1828 (12 lots, 31 specimens) – Fw.; LC
Trichodactylus cf. *fluviatilis* Latreille, 1828 (1 lot, 1 specimen) – Fw., LC
Trichodactylus sp. (1 lot, 3 specimens) – Fw.

Infraorder Caridea Dana, 1852 (1 lot, 1 specimen unidentified) – Mar.; Est.; Fw.

Family Atyidae De Haan, 1849

Atya scabra (Leach, 1816) (1 lot, 2 specimens) – Fw.; NT
Atya sp. (3 lots, 33 specimens) – Fw.

Family Palaemonidae Rafinesque, 1815
(1 lot, 1 specimen unidentified) – Mar.; Est.; Fw.

Macrobrachium carcinus (Linnaeus, 1758) (1 lot, 1 specimen) – Est.; Fw.; VU
Macrobrachium iheringi (Ortmann, 1897) (1 lot, 10 specimens) – Fw.; LC
Macrobrachium olferesii (Wiegmann, 1836) (1 lot, 4 specimens) – Fw.; LC
Macrobrachium sp. (15 lots, 177 specimens) – Mar.; Est.; Fw.

Family Rhynchocinetidae Ortmann, 1890

Cinetorhynchus rigens (Gordon, 1936) (2 lots, 3 specimens) – Mar.

Family Thoridae Kingsley, 1879

Thor amboinensis (de Man, 1888) (1 lot, 1 specimen) – Mar.

Infraorder Stenopodidea Spence Bate, 1888

Family Stenopodidae Claus, 1872

Stenopus hispidus (Olivier, 1811) (2 lots, 3 specimens) – Mar.

Superorder Peracarida Calman, 1904

Order Isopoda Latreille, 1817

Suborder Cymothoida Wägele, 1989

Superfamily Cymothoidea Leach, 1814

Family Cirolanidae Dana, 1852
(2 lots, 2 specimens unidentified) – Mar.

Subclass Hoplocarida Latreille, 1802

Order Stomatopoda Latreille, 1817

Suborder Unipeltata Latreille, 1825

Superfamily Lysiosquilloidea Giesbrecht, 1910

Family Lysiosquillidae Giesbrecht, 1910

Lysiosquilla scabricauda (Lamarck, 1818) (1 lot, 1 specimen) – Mar.

All holdings in the Crustacea collection of INMA are from Brazil (see Supplementary Material) and comprise major crustaceans groups, with a particular focus on Decapoda (98.5 %). Currently, the collection has a total of 52 species, 41 genera belonging to 26 families, consisting mainly of large taxa (> 2 cm). A total of 443 specimens were located, included in 131 lots, representing mostly the Espírito Santo carcinofauna, with a concentration around Aracruz city, including the area of Santa Cruz Marine Biology Station. Besides this, a few lots were collected in other states: four lots (eight specimens) were collected from Bahia; four lots (four specimens) from Maranhão; and three lots (three specimens) from Rio de Janeiro (Supplementary Material).

The oldest specimen in the Crustacea collection is *M. carcinus* collected in August 1961 by Belmiro Perini (MBML 107) and the latest species was *C. danae* collected by Mikael Mansur Martinelli in January 2015 (MBML 127), at the present analysis (Supplementary Material).

Holdings were within class Malacostraca and, except for *L. scabricauda* (order Stomatopoda), all specimens were from subclass Eumalacostraca.

Within superorder Peracarida, only the order Isopoda (family Cirolanidae) was represented. Within the order Decapoda, there were only two specimens of suborder Dendrobranchiata (family Penaeidae; Fig. 2).

Six of the nine existing infraorders within the suborder Pleocyemata were found in the collection: Achelata, Anomura, Astacidea, Brachyura, Caridea and Stenopodidea. Among these taxa, Brachyura was the most diverse represented by 15 families (34 species; Fig. 3) in the collection; second was Caridea with four families (six species).

The family Portunidae showed the highest richness of species including eight species (42 specimens), followed by Palinuridae with five species (nine specimens). Epialtidae and Ocypodidae presented four species each (six specimens and 17 specimens, respectively). Despite being the most abundant family with 192 specimens, the Palaemonidae comprised only three species, followed by Trichodactylidae and Atyidae, which totalled 35 specimens each.

Mostly the collection consists of marine species, which were collected mainly from littoral or continental shelf localities. About 5.8 % of the species inventoried herein occur in freshwater environments, including families exclusively of this habitat such as Atyidae and Trichodactylidae. A single terrestrial brachyuran crab species (*C. guanhumi*) is stored in the collection.

Only one specimen (MBML 11, *P. gundlachi*) of the total of 443 deposited in the collection (0.2 %) is currently cataloged in a published paper and none are presently databased.

Aratus pisonis (MBML 22, Mucuri River, Bahia) was discarded after the flood that affected all zoological collections of INMA in 2000. However, as it was photographed before the disaster, it was mantained in the collections list.

Hepatus pudibundus (MBML 56) was without any information on locality thus was transferred to a didactic collection at INMA, mantaining its lot number for reference.

Four lots were listed in the hard-copy registers (MBML 42; 57; 70; 72) but were not found in the collection nor identified previously, therefore they were not included in this inventory (yet they are shown at the end of the spreadsheet highlighted in gray; see Supplementary Material).

Discussion

According to De Grave and Fransen (2011), the order Decapoda currently includes approximately 18,000 species of different forms such as: shrimps, lobsters, crabs, swimming crabs and hermit crabs. They are cosmopolitan and found in marine, estuarine, freshwater and terrestrial environments. In the oceans, they are distributed in all depths, from the supralitoral to the deep sea.

In Brazil, there are about 1,000 species of Decapoda based on a recent update of the Brazilian Fauna Taxonomic Catalog (http://fauna.jbrj.gov.br/fauna/listaBrasil/PrincipalUC/PrincipalUC.do?lingua=pt): 407 species of Brachyura (crabs and swimming crabs), 241 species of Caridea (shrimps), 181 species of Anomura (crabs and hermit crabs), 51 species of Dendrobranchiata (shrimps), 36 species of Axiidea (mud shrimps), 14 species of Achelata (lobsters), 13 species of Astacidea (lobsters), 11 species of Gebiidea

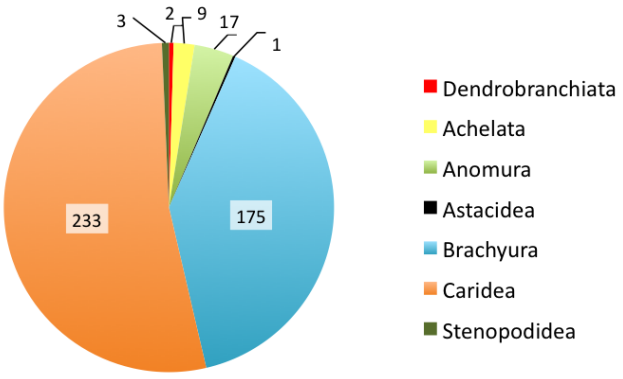

Figure 2. Relative abundance of infraorders of Decapoda registered in the Crustacea collection of INMA.

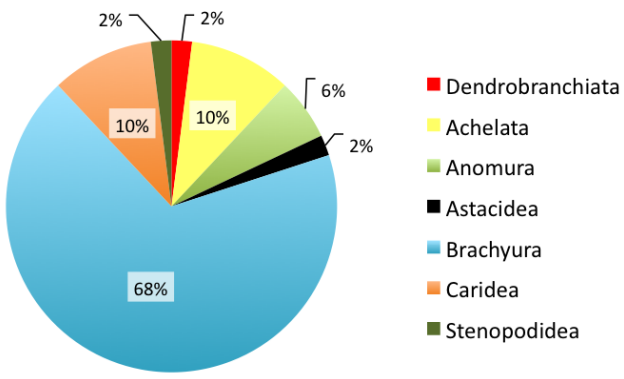

Figure 3. Richness of infraorders of Decapoda registered in the Crustacea collection of INMA.

(mud shrimps), three species of Stenopodidea (shrimps) and one species of Polychelida (lobster) (Cardoso, 2020).

In the Crustacea collection at INMA, Brachyura is also the most representative group followed by Caridea. However, Achelata showed the same number of species as Caridea. Anomura and Dendrobranchiata have low representation and Axiidea and Polychelida are not represented. Despite the small number of specimens (and consequently species) in the INMA collection, it holds the main representatives of Brazilian Decapoda.

The collection includes quite important crustaceans as species endemic to Brazil, species at some level of risk of extinction and species of economic relevance. Some of these cases will be discussed below.

According to the ICMBio/MMA (2018a), the list of Overexploited or Threatened species (annex II of Normative Instruction (https://www.icmbio.gov.br/portal/images/stories/IN%2005%20-%20peixes%20e%20invertebrados.pdf) nº 05/04) includes crustaceans such as: the mangrove crabs *C. guanhumi* and *U. cordatus*, the lobsters *P. argus* and *P. laevicauda* and the swimming crab *C. sapidus*.

Six species of Palinuridae are found in Brazil (Holthuis, 1991; Tavares, 2003) and five of these were found in the collection: *J. longimanus*, *P. gundlachi*, *P. argus*, *P. echinatus*, and *P. laevicauda*. These species have high economic importance, nevertheless *P. argus* and P. *laevicauda* are classified as "Near Threatened" (NT) (Santana *et al.*, 2016). *Panulirus echinatus* was categorized as "Data Deficient" (DD), although it can be considered overexploited in some locations (Santana *et al.*, 2016).

The species *E. antillensis* is another lobster categorized as "Data Deficient" (DD), despite this species being intensely captured for the aquarium trade, reaching high value on the international market (Bezerra *et al.*, 2016).

The family Gecarcinidae consists of terrestrial crabs (Melo, 1996), with two species occurring in Brazil: the yellow crab *J. lagostoma* and the blue crab *C. guanhumi* (guaiamú, goiamú or guaiamun), with outstanding commercial interest (Pinheiro *et al.*, 2016a). *Johngarthia lagostoma* is endemic to oceanic islands (Fausto-Filho, 1974; Manning and Chace, 1990; Hartnoll *et al.*, 2006), occuring on all Brazilian oceanic islands (ICMBio/MMA, 2018a,b). These two species have been affected by different anthropogenic pressures, mainly in relation to the degradation and fragmentation of their habitats, putting their conservation in risk (Pinheiro *et al.*, 2016a), hence they are categorized as "Critically Endangered" (CR) (ICMBio/MMA, 2018a,b).

The mangrove ecosystem houses crustacean species such as *G. cruentata* and *U. cordatus* (uçá or swamp ghost crab), the latest being considered one of the most important species of mangrove fauna (Melo, 1996). Both species suffer threats related to the vulnerable condition of mangroves, which have been suppressed by human activities, although there are no signs of population reduction in *G. cruentata*, which is categorized as "'Least Concern" (LC) (Pinheiro *et al.*, 2016d). Nevertheless, *U. cordatus* is categorized as "Near Threatened" (NT) (Pinheiro *et al.*, 2016b).

The Portunidae family includes swimming crabs, and in Brazil it is represented by 21 species, 19 of which are native (Melo, 1996). The INMA collection comprises eight Portunidae species, of which *C. sapidus* is categorized as "Data Deficient" (DD) (Pinheiro *et al.*, 2016c).

Trichodactylidae is composed of freshwater crabs (Melo, 2003) represented by 30 species in Brazil (Magalhães, 2003). *Trichodactylus fluviatilis* is also an endemic species, being registered in the northeast, southeast and south of Brazil (Magalhães, 2003), coinciding with the former extension of the Atlantic Forest (Melo, 2003) and reaching up to 500 m in altitude (Rocha and Bueno, 2004). Despite its wide area of distribution, this species was categorized as "Least Concern" (LC) (Magalhães, 2016).

Atyidae is a family of freshwater prawns and is quite diverse worldwide, however in Brazil only four species are reported, including *A. scabra* (see De Grave and Fransen, 2011). This species was categorized as "Near Threatened" (NT) due to anthropogenic activities, pollution, environmental degradation and deforestation (ICMBio/MMA, 2018a).

The family Palaemonidae has a wide geographical distribution and includes species with great economic interest (Ramos-Porto and Coelho, 1998; Melo, 2003). *Macrobrachium carcinus* is a freshwater prawn that is categorized as "Vulnerable" (VU) (ICMBio/MMA, 2018a) and *M. iheringi* is a native freshwater species

distributed in the southeast and central west of Brazil (Melo, 2003; Mantelatto et *al*., 2016), categorized as "'Least Concern" (LC) (ICMBio/MMA, 2018a).

The caridean family Rhynchocinetidae is composed of a single genus, *Cinetorhynchus* Holthuis, 1995 and is represented in the collection by *C. rigens*, which usually occurs in shallow waters from temperate to tropical regions (Okuno, 1997) and is widely distributed in the Atlantic Ocean (Melo, 2007). It inhabits deep crevices and submarine caves of coral and rocky reefs, hiding during daytime and emerging at night to actively move and feed on the surfaces (Okuno, 1993; 1994).

Thus, the presence of the above taxa in the Crustacea collection of INMA reinforces the importance of this collection, because it also contributes to historical knowledge about taxa with an endangered, or at least some concern, status. Voucher specimens, especially in the case of invertebrates, are very important for red listing since it enables comparison of taxonomic identifications and the analysis of historical change in the distribution of species through time (Salvador and Cunha, 2020).

Regarding the systematic breadth of this collection, it follows the general pattern of Crustacea diversity in Brazil and is represented mostly by the order Decapoda. Besides the order Decapoda, only two other groups were found in the collection: order Stomatopoda (subclass Hoplocarida) and order Isopoda (superorder Peracarida). The order Isopoda included the family Cirolanidae is represented by only two specimens.

Within the order Stomatopoda, the shallow water species *L. scabricauda* was identified, which is widely distributed along the Western Atlantic Ocean (Schram, 2010; Lucatelli *et al*., 2012).

The Crustacea collection of INMA is also important for its regional representation, holding diverse material of the Espírito Santo carcinofauna mainly of marine and freshwater habitats. Nevertheless, the collection has remained underutilized by scientific and professional communities during most of its history as just one species (*P. gundlachi*) was treated in a scientific paper (Dall'Occo *et al*., 2007).

Without online publication of the specimen data, the visibility and use of the collection through data queries and loans for research would likely remain limited. The existing data will be enhanced by future research projects, each study adding value to, and validating the importance of this collection (Alves *et al*., 2014).

The value of natural history collections depends on the information that is associated with the specimens and a specimen will only hold scientific value if it has minimal information associated with its place and also date of collection (Alves *et al*., 2014). That being said, the correct management of this data and its accessibility are essential for a collection to be a scientific tool and stimulus for more investigations.

The process of data digitization should be an important step in a properly curated collection, to guarantee its integration with data from other institutions. Moreover, the sharing of collections through the digitization of specimens and associated labels, in addition to facilitating collaboration among the scientific community, will result in a more rapid response with less financial cost than would loaning of material in traditional ways (Marinoni *et al*., 2005). Furthermore, sourcing specimens through online databases will facilitate the production of guides and taxonomic training (Costello *et al*., 2006) and enable access to information on systematics and related disciplines.

The aim of a biology museum is to facilitate free access to basic biodiversity data and as biodiversity informatics can increase the visibility and availability of taxonomic knowledge and its associated data, thus its dissemination should be planned even for a small sized collection such as the Crustacea collection of INMA.

Along with making the collection data available via the Internet, more general information can be passed on to the community as a whole. Educating the public that historical collections remain dynamic with the potential of generating new knowledge will assist in changing the current mindset, mainly in Brazil, that museums are institutions intended only for deposit of old material without any practical use (Marinoni *et al*., 2005).

Collection managers should include electronic databases as part of their collections organization. Therefore, the proposed first step in the management of the Crustacea collection of INMA is to digitize the data through photos of the specimens and associated

labels. After that, creating a database, following the Darwin Core data model (http://rs.tdwg.org/dwc) is critical, and including this material in a digital platform such as GBIF - Global Facility Information System (http://www.gbif.org), which aims to facilitate free access to basic biodiversity data. Practices and reccommendations for the digitization of natural history collections are well known, but all these tasks need financial investment from authorities. The survey of Vollmar *et al*. (2010) pointed out that the main impediments to the digitization of collections, in order of relevance, are: funding, time, staff, lack of institutional support, infrastructure/technology, and curation practices.

The collaboration between museums and the scientific community, with a view to accessibility of specimens and associated information, will make it possible to reinforce the role of zoological collections as scientific infrastructures of reference at the national and even international level.

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Supplementary Material

Registration entries for voucher material deposited in the crustacean collection of the Instituto Nacional da Mata Atlântica (MBML).

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