Tropical Diversity (2019) 1 (1): 12-25.
ISSN: 2596-2388
DOI: 10.5281/zenodo.11099673

RESEARCH ARTICLE

Database of the marine-derived aquatic biota of the Amazon Basin

Banco de dados da biota aquática de origem marinha da Bacia Amazônica

Mauro J. Cavalcanti[1*] https://orcid.org/0000-0003-2389-1902, Edinaldo Nelson dos Santos-Silva[2] https://orcid.org/0000-0002-3340-4541, Luis José de Oliveira Geraldes Primeiro[2] https://orcid.org/0000-0002-3892-8969

[1]Ecoinformatics Studio, Caixa Postal 46521, CEP 20551-940, Rio de Janeiro, RJ.

[2]Laboratório de Plâncton, Coordenação de Biodiversidade, Instituto Nacional de Pesquisas da Amazônia, Av. André Araújo, 2936, CEP 69060-000, Manaus, AM, Brasil.

[*]E-mail: maurobio@gmail.com

Received: December 16, 2018 / Accepted: February 18, 2019 / Published: February 19, 2019

Resumo Um banco de dados integrado, desenvolvido com ferramentas de software livre, é apresentado para catalogar e documentar a diversidade biológica das espécies da biota aquática de origem marinha da Bacia Amazônica, com informações sobre nomenclatura, distribuição geográfica, habitats, situação de conservação, sequências genômicas e bibliografia relevante para 225 espécies válidas de Porifera, Mollusca, Arthropoda e Chordata. O banco de dados completo encontra-se disponível para consulta em http://mar.biotupe.org.

Palavras-Chave: Bacia Amazônica, bancos de dados, informática para biodiversidade.

Abstract An integrated database, developed with free software tools, is presented to catalog and document the biological diversity of the marine-derived species of the aquatic biota of the Amazon Basin, with information on nomenclature, geographic distribution, habitats, conservation status, genomic sequences, and bibliography relevant for 225 valid species of Porifera, Mollusca, Arthropoda e Chordata. The complete database is available for querying at http://mar.biotupe.org.

Keywords: Amazon Basin, databases, biodiversity informatics.

Introduction

The Amazon Basin has the highest known aquatic biodiversity, larger than any other comparable area on Earth (Webb, 1995). The Amazon also presents a larger proportion of marine-derived species, as aquatic mammals, fishes, crustaceans, mollusks, bryozoans, and sponges, than other major tropical river basins (Géry, 1969; Roberts, 1972; Fink & Fink, 1979; Lovejoy, 1997; Lovejoy *et al*., 1998). However, little is yet known about the geographic distribution patterns of those organisms, what creates difficulties for the understanding of the historical events responsible for the huge differentiation observed in this fauna.

The understanding of the history of the Amazon Basin at the end of Tertiary is not yet well known (Sioli, 1964; Hoorn, 1993, 1994; Hoorn *et al.*, 1995, 2010; Räsänen *et al.*, 1997; Monsch, 1998). Many explanations were suggested, for example, for the tidal sediments found in the State of Acre. Some authors (*eg.* Räsänen *et al*., 1995) presented the hypothesis that these deposits would result from an inner (epicontinental) sea in South American, the Amazon Sea. Another hypothesis for the origin of these sediments is that they could represent the deltaic deposition of a great lake, the Amazon Lake (Frailey *et al*. 1988; Marroig & Cerqueira, 1997) from Pleistocene-Holocene age, or the Pebas Lake (Wesselingh, 2006; Wesselingh & Salo, 2006; Wesselingh *et al*. 2002) from Miocene age. The modifications in open environments along the coast of this inner sea or lake would facilitate the migration of aquatic animals, promoting the integration of faunas during the geological history of the South American continent. Brooks *et al*. (1981), Nelson (1984), Lovejoy (1996, 1997), Lovejoy *et al*. (1998, 2006), Lovejoy & Araújo (2000), Lovejoy & Collette (2001), Boeger & Kritsky (2002), Cooke *et* al. (2012), and Bloom & Lovejoy (2017) presented studies on the phylogeny and biogeography of freshwater stingrays (Potamotrygonidae), sardines (Engraulidae), needlefishes (Belonidae), and drums (Sciaenidae) in South America, suggesting that the marine incursions in Amazonia, during the Miocene, were crucial to the evolution ot these groups. With regard to speciation patterns of freshwater fishes, Lowe-McConnell (1969), Lundberg (1998), Lundberg *et al.* (1998), and Hubert & Renno (2006) suggested that large tropical river systems like the Amazon would allow that some species developed geographic isolation in the headwaters of tributaries, postulating that tectonic movements could lead to alterations in the ecological conditions of the rivers (Hoorn *et al*., 1995; Räsänen *et al.*, 1997; Albert *et al*, 2006), which in turn would propitiate the development of physical, chemical, or biotic barriers among the populations and allowing the occurrence of geographic isolation within a hydrographic system. Hamilton *et al*. (2001) and Domning (1982) presented similar inferences in relation to freshwater cetaceans and sirenians, respectively.

A huge volume of data is available today in the major biological collections of Amazonia (Magalhães *et al.*, 2001; Magalhães & Bonaldo, 2003) and in large online biodiversity databases (Constable *et al.*, 2010; Edwards *et al.*, 2000; Telenius, 2011). If adequately integrated and analyzed by means of data-mining techniques and statistical methods that make possible to detect patterns and to identify factors and trends, these data can provide valuable subsidies to the conservation and sustainable use of the biological resources represented by this biota. However, a major challenge to achieving this goal is that, though easily acessible from different sources, these data are not available as integrated subsets for specialized target groups as the marine-derived aquatic biota of the Amazon Basin.

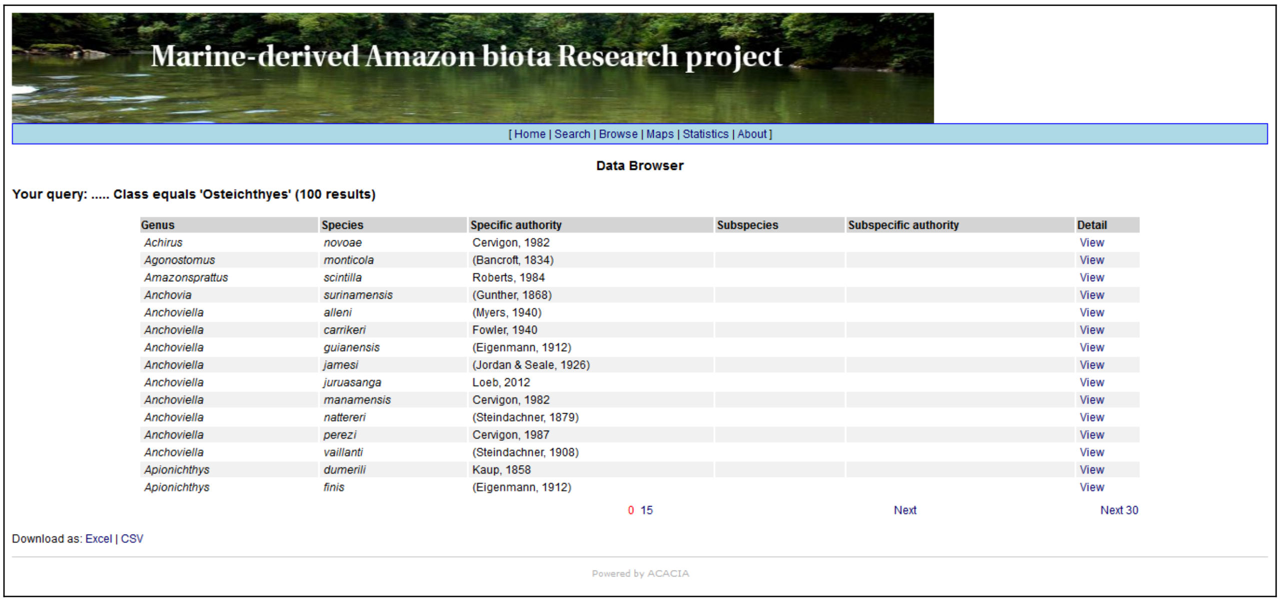
The goal of this study was to implement a tool for cataloging and documenting the biological diversity of the marine-derived species of the aquatic biota of the Amazon Basin which could provide such an integrated database with information on nomenclature, geographic distribution, habitats, conservation status, genomic sequences, and bibliography relevant for each species, compiled from several different sources.

Materials and Methods

For building the database, we used a list of species of selected taxonomic groups (sponges, mollusks, crustaceans, fishes, and aquatic mammals) representative of the marine-derived aquatic biota of the Amazon Basin, compiled from literature data, from the biological collections of the major Amazonian research institutions, and from those available in online databases. This list was previously checked against the Catalogue of Life (www.catalogueoflife.org) taxonomic database to identify and correct possible synonyms and other nomenclatural problems.

The system was entirely based on open source, freely available software tools. The database was implemented using the database management system MySQL (www.mysql.com), on the basis of the generic scheme for biodiversity databases ACACIA (sites.google.com/site/acaciadb). A specialized software tool developed in the Python programming language (www.python.org) was used to populate the database tables from several sources available on the Internet which provide interfaces to application programs, including five data classes: (1) nomenclature and literature data: CoL (www.catalogueoflife.org), FishBase (www.fishbase.org), and WoRMS (www.marinspecies.org); (2) genomic sequence data: Genbank/NCBI (www.ncbi.nlm.nih.gov/genbank); (3) geographic distribution data: Global Biodiversity Information Facility (www.gbif.org), VertNet (www.vertnet.org), and iDigBio (www.idigbio.org); (4) conservation status data: IUCN Red List (www.iucnredlist.org); (5) free text notes: Wikipedia (en.wikipedia.org).

Searches and analyses of these data can be performed by means of a user-friendly Web interface written in the language PHP (www.php.net), with simple menus for browsing and querying the database and generating statistical reports (Fig. 1). Distribution maps are automatically generated by the OpenLayers (www.openlayers.org) integrated tool, on the basis of the georeferenced occurrence records available in the database (Fig. 2). Results of all database queries can be exported to files in Excel, CSV or KML standard formats for use with other software as GIS and statistical packages, for more elaborate display and further analysis.


Marine-derived Amazon biota Research project

[Home | Search | Browse | Maps | Statistics | About]

Data Browser

Your query: ..... Class equals 'Osteichthyes' (100 results)

Genus	Species	Specific authority	Subspecies	Subspecific authority	Detail
Achirus	*novoae*	Cervigon, 1982			View
Agonostomus	*monticola*	(Bancroft, 1834)			View
Amazonsprattus	*scintilla*	Roberts, 1984			View
Anchovia	*surinamensis*	(Gunther, 1868)			View
Anchoviella	*alleni*	(Myers, 1940)			View
Anchoviella	*carrikeri*	Fowler, 1940			View
Anchoviella	*guianensis*	(Eigenmann, 1912)			View
Anchoviella	*jamesi*	(Jordan & Seale, 1926)			View
Anchoviella	*juruasanga*	Loeb, 2012			View
Anchoviella	*manamensis*	Cervigon, 1982			View
Anchoviella	*nattereri*	(Steindachner, 1879)			View
Anchoviella	*perezi*	Cervigon, 1987			View
Anchoviella	*vaillanti*	(Steindachner, 1908)			View
Apionichthys	*dumerili*	Kaup, 1858			View
Apionichthys	*finis*	(Eigenmann, 1912)			View

0 15 Next Next 30

Download as: Excel | CSV

Powered by ACACIA

Figure 1 – Database browser, displaying the results of a simple query.

Figure 2 – Distribution map for a selected species.

Results and Discussion

Data were obtained for 225 valid species of marine-derived taxonomic groups, included in

4 phyla, 6 classes, 19 orders, 29 families, and 74 genera (Table 1). These species present 621 names, with 317 synonyms. Chordata (58,7%) is the phylum of the highest species frequency, followed by Arthropoda (22,17%), Porifera (18,7%), and Mollusca (0,43%). The most frequent classes are Osteichthyes (43,48%), Crustacea (22,17%), Demospongiae (18,7%), and Chondrichthyes (12,17%). Decapoda (22,7%), Haplosclerida (18,7%), Perciformes (18,7%), Rajiformes (10,87%), and Clupeiformes (10%) are the orders with the highest species frequency, whereas Trichodactylidae (19,13%), Potamotrygonidae (10,87%), Sciaenidae (8,7%), and Spongillidae (7,39%) are the most frequent families.

Table 1 – Checklist of the marine-derived aquatic biota of the Amazon Basin

PORIFERA
- DEMOSPONGIAE
  - HAPLOSCLERIDA
    - Incertae Sedis
      - *Acanthotylotra alvarengai* Volkmer-Ribeiro et al., 2009
      - *Balliviaspongia wirrmani* Boury-Esnault & Volkmer, 1992
    - Metaniidae
      - *Acalle recurvata* (Bowerbank, 1863)
      - *Drulia batesii* (Bowerbank, 1863)
      - *Drulia brownii* (Bowerbank, 1863)
      - *Drulia conifera* Bonetto & Ezcurra de Drago, 1973
      - *Drulia cristata* (Weltner, 1895)
      - *Drulia ctenosclera* Volkmer & Mothes, 1981
      - *Drulia geayi* (Gravier, 1899)
      - *Drulia uruguayensis* Bonetto & Ezcurra de Drago, 1969
      - *Metania fittkaui* Volkmer-Ribeiro, 1979
      - *Metania kiliani* Volkmer-Ribeiro & Costa, 1992
      - *Metania melloleitaoi* (Machado, 1948)
      - *Metania reticulata* (Bowerbank, 1863)
      - *Metania spinata* (Carter, 1881)
      - *Metania subtilis* Volkmer-Ribeiro, 1979
    - Potamolepidae
      - *Oncosclera atrata* (Bonetto & Ezcurra de Drago, 1970)
      - *Oncosclera intermedia* Bonetto & Ezcurra de Drago, 1973
      - *Oncosclera jewelli* (Volkmer, 1963)
      - *Oncosclera navicella* (Carter, 1881)
      - *Oncosclera petricola* Bonetto & Ezcurra de Drago, 1967
      - *Oncosclera ponsi* (Bonetto & Ezcurra de Drago, 1968)
      - *Oncosclera schubarti* (Bonetto & Ezcurra de Drago, 1967)
      - *Oncosclera spinifera* (Bonetto & Ezcurra de Drago, 1973)
      - *Oncosclera stolonifera* Bonetto & Ezcurra de Drago, 1973
      - *Oncosclera tonollii* (Bonetto & Ezcurra de Drago, 1968)
    - Spongillidae
      - *Corvoheteromeyenia australis* (Bonetto & Ezcurra de Drago, 1966)
      - *Corvoheteromeyenia heterosclera* (Ezcurra de Drago, 1974)
      - *Pottsiela pesae* Volkmer-Ribeiro et al., 2010
      - *Pottsiela spoliata* (Volkmer-Ribeiro & Maciel, 1983)
      - *Saturnospongilla carvalhoi* Vokmer-Ribeiro, 1976
      - *Trochospongilla amazonica* (Weltner, 1895)
      - *Trochospongilla delicata* Bonetto & Ezcurra de Drago, 1967
      - *Trochospongilla gregaria* (Bowerbank, 1863)
      - *Trochospongilla lanzamirandai* Bonetto & Ezcurra de Drago, 1964
      - *Trochospongilla minuta* (Potts, 1887)
      - *Trochospongilla paulula* (Bowerbank, 1863)
      - *Trochospongilla repens* (Hinde, 1888)
      - *Trochospongilla tenuissima* Bonetto & Ezcurra de Drago, 1970
      - *Trochospongilla variabilis* Bonetto & Ezcurra de Drago, 1973
      - *Uruguayella macandrewi* (Hinde, 1888)
      - *Uruguayella pygmaea* (Hinde, 1888)

Uruguayella ringueleti (Bonetto & Ezcurra de Drago, 1962)

MOLLUSCA
BIVALVIA
PHOLADOMYOIDA
Lyonsiidae
Anticorbula fluviatilis (H. Adams, 1860)

ARTHROPODA
CRUSTACEA
DECAPODA
Pseudothelphusidae
Brasiliothelphusa dardanelosensis Magalhaes & Turkay, 2010
Brasiliothelphusa tapajoense Magalhaes & Turkay, 1986
Fredius fittkaui (Bott, 1967)
Kingsleya gustavoi Magalhaes, 2004
Kingsleya junki Magalhaes, 2003
Kingsleya siolii Bott, 1967
Kingsleya ytupora Magalhaes, 1986
Sergestidae
Acetes marinus Omori, 1975
Acetes paraguayensis Hansen, 1919
Trichodactylidae
Bottiella cucutensis (Pretzmann, 1968)
Bottiella medemi (Smalley & Rodriguez, 1972)
Bottiella niceforei (Schmitt & Pretzmann, 1968)
Dilocarcinus pagei Stimpson, 1861
Dilocarcinus septemdentatus (Herbst, 1783)
Dilocarcinus truncatus Rodriguez, 1992
Fosteria venezuelensis (Rathbun, 1905)
Fredilocarcinus apyratii Magalhaes & Turkay, 1996
Fredilocarcinus musmuschiae (Pretzmann & Mayta, 1980)
Fredilocarcinus raddai (Pretzmann, 1979)
Fredius denticulatus (H. Milne-Edwards, 1853)
Fredius reflexifrons (Ortmann, 1897)
Goyazana castelnaui (H. Milne Edwards, 1853)
Moreirocarcinus chacei (Pretzmann, 1968)
Moreirocarcinus emarginatus (H. Milne-Edwards, 1853)
Moreirocarcinus laevifrons (Moreira, 1901)
Poppiana argentiniana (Rathbun, 1905)
Poppiana bulbifer Rodriguez, 1992
Poppiana dentata (Randall, 1840)
Rotundovaldivia latidens (A. Milne-Edwards, 1869)
Sylviocarcinus australis Magalhaes & Turkay, 1996
Sylviocarcinus devillei H. Milne-Edwards, 1853
Sylviocarcinus maldonadoensis (Pretzmann, 1978)
Sylviocarcinus pictus (H. Milne-Edwards, 1853)
Sylviocarcinus piriformis (Pretzmann, 1968)
Trichodactylus borellianus Nobili, 1896
Trichodactylus crassus A. Milne-Edwards, 1869
Trichodactylus dentatus H. Milne Edwards, 1853
Trichodactylus ehrhardti Bott, 1969
Trichodactylus faxoni Rathbun, 1905
Trichodactylus fluviatilis Latreille, 1928
Trichodactylus kensleyi Rodriguez, 1992
Trichodactylus panoplus (von Martens, 1869)
Trichodactylus parvus Moreira, 1912
Trichodactylus petropolitanus (Goldi, 1886)
Trichodactylus quinquedentatus Rathbun, 1893
Valdivia camerani (Nobili, 1896)
Valdivia haraldi Bott, 1969
Valdivia novemdentata (Pretzmann, 1968)
Valdivia serrata harttii (Rathbun, 1905)
Valdivia serrata serrata White, 1847

Zilchiopsis collastinensis (Pretzmann, 1968)
Zilchiopsis cryptodus (Ortmann, 1983)
Zilchiopsis oronensis (Pretzmann, 1968)

CHORDATA
CHONDRICHTHYES
CARCHARHINIFORMES
Carcharhinidae
Carcharhinus leucas (Muller & Henle, 1839)
PRISTIFORMES
Pristidae
Pristis pectinata Latham, 1794
Pristis pristis (Linnaeus, 1758)
RAJIFORMES
Potamotrygonidae
Heliotrygon gomesi Carvalho & Lovejoy, 2011
Heliotrygon rosai Carvalho & Lovejoy, 2011
Paratrygon ajereba (Muller & Henle, 1841)
Plesiotrygon iwamae Rosa, Castello & Thorson, 1987
Plesiotrygon nana Carvalho & Ragno, 2011
Potamotrygon boesemani Rosa, Carvalho & Almeida Wanderley, 2008
Potamotrygon brachyura (Gunther, 1880)
Potamotrygon constellata (Vaillant, 1880)
Potamotrygon falkneri Castex & Maciel, 1963
Potamotrygon henlei (Castelnau, 1855)
Potamotrygon humerosa Garman, 1913
Potamotrygon hystrix (Muller & Henle, 1841)
Potamotrygon leopoldi Castex & Castello, 1970
Potamotrygon magdalenae (Dumeril, 1865)
Potamotrygon marinae Deynat, 2006
Potamotrygon motoro (Muller & Henle, 1841)
Potamotrygon ocellata (Engelhardt, 1912)
Potamotrygon orbignyi (Castelnau, 1855)
Potamotrygon schoederi Fernandez-Yepez, 1958
Potamotrygon schuhmacheri Castex, 1964
Potamotrygon scobina Garman, 1913
Potamotrygon signata Garman, 1913
Potamotrygon tatianae Silva & Carvalho, 2011
Potamotrygon tigrina Carvalho, Sabaj Perez & Lovejoy, 2011
Potamotrygon yepezi Castex & Castello, 1970
OSTEICHTHYES
ANGUILIFORMES
Ophichthidae
Stictorhinus potamius Bohlke & McCosker, 1975
ATHERINIFORMES
Belonidae
Belonion apodion Collette, 1966
Belonion dibranchodon Collette, 1966
Potamorrhaphis eigenmanni Miranda Ribeiro, 1915
Potamorrhaphis guianensis (Jardine, 1843)
Potamorrhaphis petersi Collette, 1974
Pseudotylosurus angusticeps (Gunther, 1866)
Pseudotylosurus microps (Gunther, 1866)
BATRACHOIDIFORMES
Batrachoididae
Potamobatrachus trispinosus Collette, 1995
Thalassophryne amazonica Steindachner, 1876
BELONIFORMES
Hemiramphidae
Hyporhamphus brederi (Fernandez-Yepez, 1948)
CLUPEIFORMES
Clupeidae
Rhinosardinia amazonica (Steindachner, 1879)
Rhinosardinia bahiensis (Steindachner, 1879)
Engraulidae
Amazonsprattus scintilla Roberts, 1984

Anchovia surinamensis (Gunther, 1868)
Anchoviella alleni (Myers, 1940)
Anchoviella carrikeri Fowler, 1940
Anchoviella guianensis (Eigenmann, 1912)
Anchoviella jamesi (Jordan & Seale, 1926)
Anchoviella juruasanga Loeb, 2012
Anchoviella manamensis Cervigon, 1982
Anchoviella nattereri (Steindachner, 1879)
Anchoviella perezi Cervigon, 1987
Anchoviella vaillanti (Steindachner, 1908)
Jurengraulis juruensis (Boulenger, 1898)
Lycengraulis batesii (Gunther, 1868)
Lycengraulis limnichthys Schultz, 1949
Pterengraulis atherinoides (Linnaeus, 1766)

Pristigasteridae
Ilisha amazonica (Miranda Ribeiro, 1920)
Pellona altamazonica Cope, 1872
Pellona castelnaeana Valenciennes, 1847
Pellona flavipinnis (Valenciennes, 1837)
Pristigaster cayana Cuvier, 1829
Pristigaster whiteheadi Menezes & de Pinna, 2000

ELOPIFORMES
Megalopidae
Megalops atlanticus Valenciennes, 1847

GOBIESOCIFORMES
Gobiesocidae
Gobiesox juradoensis Fowler, 1944
Gobiesox multitentaculus (Briggs, 1951)
Gobiesox nudus (Linnaeus, 1758)

MUGILIFORMES
Mugilidae
Agonostomus monticola (Bancroft, 1834)
Mugil trichodon Poey, 1875

PERCIFORMES
Eleotridae
Dormitator lophocephalus Hoedeman, 1951
Dormitator maculatus (Bloch, 1792)
Eleotris amblyopsis (Cope, 1871)
Eleotris picta Kner, 1863
Eleotris pisonis (Gmelin, 1789)
Microphilypnus acangaquara Caires & Figueiredo, 2011
Microphilypnus amazonicus Myers, 1927
Microphilypnus macrostoma Myers, 1927
Microphilypnus ternetzi Myers, 1927

Gobiidae
Awaous banana (Valenciennes, 1837)
Awaous flavus (Valenciennes, 1837)
Awaous tajasica (Lichtenstein, 1822)
Gobioides broussonnetii Lacepede, 1800
Gobioides grahamae Palmer & Wheeler, 1955
Gobioides peruanus (Steindachner, 1880)
Sicydium hildebrandi Eigenmann, 1918
Sicydium punctatum Perugia, 1896
Sicydium rosenbergii (Boulenger, 1899)

Percichthyidae
Percichthys chilensis Girard, 1855
Percichthys colhuapiensis MacDonagh, 1955
Percichthys laevis (Jenyns, 1840)
Percichthys melanops Girard, 1855
Percichthys trucha (Valenciennes, 1833)

Sciaenidae
Pachypops fourcroi (Lacepede, 1802)
Pachypops pigmaeus Casatti, 2002
Pachypops trifilis (Muller & Troschel, 1848)
Pachyurus adspersus Steindachner, 1879
Pachyurus bonariensis Steindachner, 1879
Pachyurus calhamazon Casatti, 2001

Pachyurus francisci (Cuvier, 1830)
Pachyurus gabrielensis Casatti, 2001
Pachyurus junki Soares & Casatti, 2000
Pachyurus paucirastrus Aguilera, 1983
Pachyurus schomburgkii Gunther, 1860
Pachyurus squamipennis Agassiz, 1831
Pachyurus stewarti Casatti & Chao, 2002
Petilipinnis grunniens (Schomburgk, 1843)
Plagioscion auratus (Castelnau, 1855)
Plagioscion casattii Aguilera & Rodrigues de Aguilera, 2001
Plagioscion montei Soares & Casatti, 2000
Plagioscion squamosissimus (Heckel, 1840)
Plagioscion surinamensis (Bleeker, 1873)
Plagioscion ternetzi Boulenger, 1895
PLEURONECTIFORMES
Achiridae
Achirus novoae Cervigon, 1982
Apionichthys dumerili Kaup, 1858
Apionichthys finis (Eigenmann, 1912)
Apionichthys menezesi Ramos, 2003
Apionichthys nattereri (Steindachner, 1876)
Apionichthys rosai Ramos, 2003
Apionichthys sauli Ramos, 2003
Apionichthys seripierriae Ramos, 2003
Catathyridium garmani (Jordan, 1889)
Catathyridium grandirivi (Chabanaud, 1928)
Catathyridium jenynsii (Gunther, 1862)
Catathyridium lorentzii (Weyenbergh, 1877)
Hypoclinemus mentalis (Gunther, 1862)
Pnictes asphyxiatus (Jordan, 1889)
TETRAODONTIFORMES
Tetraodontidae
Colomesus asellus (Muller & Troschel, 1849)
Colomesus psittacus (Bloch & Schneider, 1801)
Colomesus tocantinensis Amaral et. al, 2013
MAMMALIA
CETACEA
Delphinidae
Sotalia fluviatilis (Gervais & Deville,1853)
Sotalia guianensis (P.-J. van Beneden, 1864)
Iniidae
Inia araguaiensis Hrbek et al., 2014
Inia geoffrensis boliviensis d'Orbigny, 1834
Inia geoffrensis geoffrensis de Blainville,1817
Inia geoffrensis humboldtiana Pilleri and Gihr, 1978
SIRENIA
Trichechidae
Trichechus inunguis Natterer, 1883

As of the geographic distribution of the species in the Amazon Basin, there are 5,689 occurrence records from 2,570 localities. *Potamorrhaphis guianensis* with 411 records (7,22%), *Percichthys trucha* with 351 records (6,17%), *Plagioscion squamosissimus* with 347 records (6,1%), *Colomesus asellus* with 241 records (4,24%), and *Amazonsprattus scintilla* with 203 records (3,57%) are the species with the highest number of records.

There are 2,502 nucleotide sequences and 1,507 protein sequences for 69 species (30% of the total) in the database, of which 18 species present more then 40 sequences and the remaining present from 2 to 36 sequences.

With relation to conservation status, following the criteria of IUCN, 3 species

(*Bottiella cucutensis*, *Bottiella medemi,* and *Trichechus inunguis*) are included in category Vulnerable (VU), 2 (*Pristis pectinata* and *Pristis pristis*) in category Critically endangered (CR), 2 (*Carcharhinus leucas* and *Potamotrygon magdalenae*) in category Near threatened (NT) and 1 (*Trichodactylus crassus*) in category Endangered (EN), with 42 species included in category Least concern (LC), 29 in category Deficient data (DD) and 151 in category Not evaluated (NE). No species is included in the categories Extinct in the wild (EW) or Extinct (EX).

Caution is required in interpreting these figures on the conservation status of marine-derived species from the Amazon Basin, as there are no global estimates in the literature on how much of this biota is still unknown and not properly documented. Thus, the two species of *Pristis* listed as "Critically endangered" are not endemic of the Amazon Basin and, in fact, are not obligate freshwater species, despite their ability to live in freshwater habitats (Thorson, 1974); the same applies to *Carcharhinus leucas*, one of the species listed as "Near threatened" (Thorson, 1972). In both cases, the conservation status applies to these species as a whole and does not imply that they are endangered or threatened in the Amazon Basin: in this regard, Fernandez-Carvalho *et al.* (2014) found that the Amazon estuary harbors the largest remaining population of *P. pristis* in the Atlantic. On the other hand, *Trichodactylus crassus*, the only species listed as "Endangered", comprises a sixth of the freshwater crabs of the world facing a high risk of extinction (Cumberlidge *et al.,* 2009), but its geographic distribution is restricted to localities of the Atlantic Forest and Caatinga (Almeida *et al.,* 2008; Souza-Carvalho, 2013), therefore outside the Amazon Basin. What should really be emphasized is the very large number of species (151 out of 225 species in the database, or 67% of the total) that have not even had their conservation status evaluated.

The complete database of the marine-derived aquatic biota of the Amazon Basin is available for querying at http://mar.biotupe.org.

Conclusions

A major result of this study was the development and public availability of a comprehensive database on the marine-derived aquatic biota of the Amazon Basin. Currently, this database is the only such initiative even implemented in the world, consolidating the available data on this biota all over its geographic range from many distributed sources. Besides, the free, generic, and flexible information technology developed for implementing the database (the ACACIA scheme for taxonomic databases and associated software) can be used for the development of such integrated biodiversity databases targeting other biotas and taxonomic groups of interest, as for example, the marine-derived aquatic biotas of the Congo/Zambezi and Ganges/Mekong/Yangtze river basins.

Acknowledgements

We thank Debora Drucker, Paulo Roberto Duarte Lopes, and Paulo Gorgosinho for reviewing the original manuscript and providing constructive criticisms and valuable suggestions. The authors remain responsible for any errors and omissions.

References

Albert, J. S., Lovejoy, N. R. & Crampton, W. G. R. 2006. Miocene tectonism and the separation of cis- and trans-Andean river basins: evidence from Neotropical fishes. Journal of South American Earth Sciences 21: 14-27.

Bloom, D. D. & Lovejoy, N. R. 2017. On the origins of marine-derived freshwater fishes in South America. Journal of Biogeography 44: 1927-1938.

Boeger, W. A. & Kritsky, D. C. 2002. Parasites, fossils and geologic history: historical biogeography of the South American freshwater croakers, *Plagioscion* spp. (Teleostei, Sciaenidae). Zoologica Scripta 32: 3-11.

Brooks, D. R., Thorson, T. B. & Mayes, M. A. 1981. Freshwater stingrays (Potamotrygonidae) and their helminth parasites: testing hypotheses of evolution and coevolution. In: Advances in Cladistics. Proceedings of the First Meeting of the Willi Henning Society. Funk, V. A. & Brooks, D. R. (eds). New York Botanical Garden, New York, pp. 147-175.

Brooks, D. R. 1995. Neotropical freshwater stingrays and their parasites: a tale of an ocean and a river long ago. Journal of Aquariculture and Aquatic Sciences 7: 52-61.

Constable, H., Guralnick, R., Wieczorek, J., Spencer, C., Peterson, A.T. 2010. VertNet: a new model for biodiversity data sharing. PloS Biology 8: e1000309.

Cooke, G.; Chao, N. & Beheregaray, L. 2012. Marine incursions, cryptic species and ecological diversification in Amazonia: the biogeographic history of the croaker genus *Plagioscion* (Sciaenidae). Journal of Biogeography 39: 724-738.

Costa, J.B.S.; Bemerguy, R.L.; Hasui, Y.; Borges, M.S.; Ferreira Júnior, C.R.P.; Bezerra, P.E.L.; Costa, M.L. & Fernandes, J.M.G. 1996. Neotectônica da região amazônica: aspectos tectônicos, geomorfológicos e deposicionais. Geonomos 4: 23-44.

Domning, D.P 1982. Evolution of manatees: a speculative history. Journal of Paleontology 56: 599-619.

Edwards, J. L., Lane, M. A. & Nielsen, E. S. 2000. Interoperability of biodiversity databases: Biodiversity information on every desktop. Science 289: 2312-2314.

Fernandez-Carvalho, J., Imhoff, J.L., Faria, V.V., Carlson, J.K. & Burgess, G.H. 2014. Status and the potential for extinction of the largetooth sawfish *Pristis pristis* in the Atlantic Ocean. Aquatic Conservation: Marine and Freshwater Ecosystems 24: 478-497.

Fink, W. L. & Fink, S. V. 1979. Central Amazonia and its fishes. Comparative Biochemistry and Physiology 62A: 13-29.

Frailey, C. D., Lavina, E. L., Rancy, A. & Souza Filho, J. P. 1988. A proposed Pleistocene/Holocene lake in the Amazon basin and its significance to Amazonian geology and biogeography. Acta Amazonica 18: 119-143.

Géry, J. 1969. The freshwater fishes of South America. In: Biogeography and Ecology in South America, Vol.2. Fittkau, E. J. *et al.* (eds.). W. Junk, The Hague, pp. 828-848.

Hamilton, H., Caballero, S., Collins, A. G. & Brownell, Jr., R. L. 2001. Evolution of river dolphins. Proceedings of the Royal Society London, Biological Sciences 268: 549-556.

Hoorn, C. 1993. Marine incursions and the influence of Andean tectonics on the Miocene depositional history of northwestern Amazonia: results of a palynostratigraphic study. Paleogeography, Paleoclimatology, Paleoecology 105: 267-309.

Hoorn, C. 1994. An environmental reconstruction of the paleo-Amazon River system (Middle-Late Miocene, NW Amazonia). Paleogeography, Paleoclimatology, Paleoecology 112: 187-238.

Hoorn, C. 2006. Mangrove forests and marine incursions in Neogene Amazonia (Lower Apaporis River, Colombia). Palaios 21: 197-209

Hoorn, C., Guerrero, J., Sarmiento, G. & Lorente, M. 1995. Andean tectonics as a cause for changing drainage patterns in Miocene northern South America. Geology 23: 237-240.

Hoorn, C.; Wesselingh, F.; ter Steege, H.; Bermudez, M.; Mora, A.; Sevink, J.; Sanmartín, I.; Sanchez-Meseguer, A.; Anderson, C.; Figueiredo, J.; Jaramillo, C.; Riff, D.; Negri, F. R.; Hooghiemstra, H.; Lundberg, J.; Stadler, T.; Sarkinen, T. & Antonelli, A. 2010. Amazonia through time: Andean uplift, climate change, landscape evolution, and biodiversity. Science 330: 927-931.

Hubert, N. & Renno, J.-F. 2006. Historical biogeography of South American freshwater fishes. Journal of Biogeography 33: 1414-1436.

Latrubesse, E. M., Silva, S. A. F., Cozzuol, M. & Absy, M. L. 2007. Late Miocene continental sedimentation in southwestern Amazonia and its regional significance: biotic and geological evidence. Journal of South American Earth Sciences 23: 61-80.

Lovejoy, N. R. 1996. Systematics of myliobatoid elasmobranchs: with emphasis on the phylogeny and historical biogeography of neotropical freshwater stingrays (Potamotrygonidae: Rajiformes). Zoological Journal of the Linnean Society 117: 207-257.

Lovejoy, N. R. 1997. Stingrays, parasites, and neotropical biogeography: a closer look at Brooks et al.'s hypotheses concerning the origins of neotropical freshwater rays (Potamotrygonidae). Systematic Biology 46: 218-230.

Lovejoy, N. R., Bermingham, E. & Martin, A. P. 1998. Marine incursion into South America. Nature 396: 421-422.

Lovejoy, N. R. & Araújo, M. L. G. 2000. Molecular systematics, biogeography and population structure of Neotropical freshwater needlefishes of the genus *Potamorrhaphis*. Molecular Ecology 9: 259-268.

Lovejoy, N. R. & Collette, B. B. 2001. Phylogenetic relationships of New World needlefishes (Teleostei: Belonidae) and the biogeography of transitions between marine and freshwater habitats. Copeia 2001: 324-338.

Lovejoy, N. R., Albert, J. S. & Crampton, W. G. R. 2006. Miocene marine incursions and marine/freshwater transitions: evidence from Neotropical fishes. Journal of South American Earth Sciences 21: 5-13.

Lowe-McConnell, R. H. 1969. Speciation in tropical freshwater fishes. Biological Journal of the Linnean Society 1: 51-75.

Lundberg, J. G. 1998. The temporal context for the diversification of neotropical fishes. In: Phylogeny and Classification of Neotropical Fishes. Malabarba, L. R., Reis, R. E., Vari, R. P., Lucena, Z. M. S. & Lucena, C. A. S. (eds). EDIPUCRS, Porto Alegre, pp. 48-68.

Lundberg, J. G., Marshall, L. G., Guerrero, J., Horton, B., Malabarba, M. C. S. L. & Wesselingh, F. 1998. The stage for neotropical fish diversification: a history of tropical South American rivers. In: Phylogeny and Classification of Neotropical Fishes. Malabarba, L. R., Reis, R. E., Vari, R. P., Lucena, Z. M. S. & Lucena, C. A. S. (eds). EDIPUCRS, Porto Alegre, pp. 13-48.

Magalhães, C., Campos dos Santos, J. L. & Salem, J. I. 2001. Automação de coleções biológicas e informações sobre a biodiversidade da Amazônia. Parcerias Estratégicas 12: 294-312.

Magalhães, C. & Bonaldo, A. B. 2003. Coleções biológicas da Amazônia: estratégias sugeridas para o desenvolvimento e plena realização das suas potencialidades. In: Coleções Biológicas de Apoio ao Inventário, Uso Sustentável e Conservação da Biodiversidade. Peixoto, A. L. (ed.). Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rio de Janeiro, pp. 149-167.

Marroig, G. & Cerqueira, R. 1997. Plio-Pleistocene South American history and the Amazon lagoon hypothesis: a piece in the puzzle of Amazonian diversification. Journal of Comparative Biology 2: 103-119.

Monsch, K. A. 1998. Miocene fish faunas from the northwestern Amazonia basin (Colombia, Peru, Brazil) with evidence of marine incursions. Paleogeography, Paleoclimatology, Paleoecology 143: 31-50.

Nelson, G.J. 1984. Identity of the anchovy *Hildebrandichthys setiger* with notes on relationships and biogeography of the genera *Engraulis* and *Cetengraulis.* Copeia 1984: 422-427.

Räsänen, M. E., Linna, A. M., Santos, J. C. R. & Negri, F. R. 1995. Late Miocene tidal deposits in the Amazonian foreland basin. Science 269: 386-389.

Roberts, T. R. 1972. Ecology of fishes in the Amazon and Congo basins. *B*ulletin of the Museum of Comparative Zoology, Harvard 143: 117-147.

Sioli, H. 1964. General features of the limnology of Amazonia. Verhandlungen der internationalen Vereinigung für theoretische und angewandte Limnologie 15: 1053-1058.

Telenius, A. 2011. Biodiversity information goes public: GBIF at your service. Nordic Journal of Botany 29: 378-381.

Thorson, T.B. 1972. The status of the bull shark, *Carcharhinus leucas*, in the Amazon River. Copeia 1972: 601-605.

Thorson, T.B. 1974. Occurrence of the sawfish, *Pristis perotteti*, in the Amazon river, with notes on *P. pectinatus.* Copeia 1974: 560-564.

Webb, S. D. 1995. Biological implications of the middle Miocene Amazon seaway. Science 269: 361-362.

Wesselingh, F.P. 2006. Miocene long-lived lake Pebas as a stage of mollusc radiations, with implications for landscape evolution in western Amazonia. Scripta Geologica 133: 1-17.

Wesselingh, F.P.; Räsänen, M.E.; Irion, G.; Vonhof, H.B.; Kaandorp, R.; Renema, W.; Romero Pittman, L. & Gingras, M. 2002. Lake Pebas: a palaeoecological reconstruction of a Miocene, long-lived lake complex in western Amazonia. Cainozoic Research 1: 1-2.

Wesselingh, F. & Salo, J.A. 2006. Miocene perspective on the evolution of the Amazonian biota. Scripta Geologica 133: 439-458.

