



Between the past and the present: following the steps of 19th century naturalists and their contribution to the knowledge of Brazilian ichthyofauna

Entre o passado e o presente: seguindo os passos dos naturalistas do século XIX e sua contribuição para o conhecimento da ictiofauna brasileira

Mariana Bispo de Oliveira^{1*} , Rodrigo Assis de Carvalho²  and

Francisco Leonardo Tejerina-Garro^{1,3,4} 

¹Programa de Pós-graduação em Ecologia e Recursos Naturais, Universidade Federal de São Carlos – UFSCar, Rod. Washington Luiz, s/n, Monjolinho, CEP 13565-905, São Carlos, SP, Brasil

²Departamento de Biologia, Universidade Estadual de Goiás – UEG, Campus Palmeiras de Goiás, Rua S-7, s/n, Bairro Sul, CEP 74190-000, Palmeiras de Goiás, GO, Brasil

³Escola de Ciências Médicas e da Vida, Pontifícia Universidade Católica de Goiás – PUC Goiás, Av. Engler, s/n, CEP 74605-010, Goiânia, GO, Brasil

⁴Programa de Pós-graduação em Sociedade, Tecnologia e Meio Ambiente, Universidade Evangélica de Goiás – UniEVANGÉLICA, Av. Universitária, Km 3,5, Cidade Universitária, CEP 75083-515, Anápolis, GO, Brasil

*e-mail: maribispoliveira16@gmail.com

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Abstract: Aim: To evaluate the contribution of naturalists Francis de Castelnau, Jacob Heckel, Johan Baptist von Spix, Johann Natterer, Louis Agassiz, and Rudolf Kner to the knowledge of taxonomic diversity of freshwater ichthyofauna in Brazil between the years 1829 and 1859. **Methods:** Two data matrices were constructed: one with information on freshwater fish species known in Brazil until 2021 and another based on the list of fish species in South America presented by Castelnau (1855). Both were supplemented with information on taxonomy, geographic distribution, authorship, and geographic distribution. The Taxonomic Diversity Index (Δ) was calculated from the first matrix to assess the contribution of the naturalists and determine the number of species per hydrographic region. The second matrix allowed for a detailed analysis of Francis de Castelnau's contribution. **Results:** Between 1829 and 1859, the five naturalists considered in this study described 171 fish species in Brazil, including several endemic species. Castelnau was the naturalist with the greatest contribution ($\Delta=87.7$), followed by Agassiz (85.5), Spix & Agassiz (85.4), Kner (80.8), and Heckel (48.7). The five naturalists described species from four hydrographic regions: the Amazon (122 species), Paraná (25), Tocantins-Araguaia (18), and São Francisco (13). The 276 fish species cataloged by Francis de Castelnau are mostly from the Neotropical region, including some endemics, originating from watercourses in the southeastern Brazilian region, encompassing species collected for the first time in the watercourses of Central Brazil and some marine species, ranging from small (5 cm) to medium (56.0 cm) in size. **Conclusions:** The five naturalists considered in the study made a significant contribution to the early scientific knowledge (1829-1859) of the Brazilian ichthyofauna, but this contribution varies among the naturalists, with particular emphasis on Castelnau, Agassiz, and Spix & Agassiz, as well as among the hydrographic basins, notably the Amazon.

Keywords: taxonomic diversity index; Francis de Castelnau; Central Brazil; Amazon hydrographic region.



Resumo: Objetivo: Avaliar a contribuição dos naturalistas Francis de Castelnau, Jacob Heckel, Johan Baptist von Spix, Johann Natterer, Louis Agassiz e Rudolf Kner no conhecimento da diversidade taxonômica da ictiofauna de água doce do Brasil entre os anos de 1829 e 1859. **Métodos:** Foram construídas duas matrizes de dados: uma com informações dos peixes de água doce do Brasil conhecidas até 2021 e outra a partir da lista de espécies de peixes da América do Sul apresentada por Castelnau (1855). Ambas foram complementadas com informações sobre taxonomia, distribuição geográfica, autoria e distribuição geográfica. A partir da primeira foi calculado o Índice de diversidade taxonômica (Δ) para avaliação da contribuição dos naturalistas e determinado o número de espécies por região hidrográfica. A segunda permitiu detalhar a contribuição de Francis de Castelnau. **Resultados:** Entre 1829 e 1859 os cinco naturalistas considerados neste estudo descreveram 171 espécies de peixes no Brasil incluindo diversas espécies endêmicas. Castelnau foi o naturalista com maior contribuição ($\Delta=87,7$) seguido de Agassiz (85,5), Spix & Agassiz (85,4), Kner (80,8) e Heckel (48,7). Os cinco naturalistas descreveram espécies de quatro regiões hidrográficas Amazonas (122 espécies), Paraná (25), Tocantins-Araguaia (18) e São Francisco (13). As 276 espécies de peixes catalogadas por Francis de Castelnau são na sua maioria da região Neotropical incluindo algumas endêmicas, provenientes de cursos de água da região sudeste brasileira abrangendo espécies coletadas pela primeira vez nos cursos de água do Brasil Central e algumas marinhas, de pequeno (5 cm) a médio (56.0 cm) porte. **Conclusões:** Os cinco naturalistas considerados no estudo tiveram contribuição expressiva para o conhecimento científico inicial (1829-1859) da ictiofauna brasileira, mas essa contribuição varia por naturalista, com destaque para Castelnau, Agassiz e Spix & Agassiz, e por bacia hidrográfica, notadamente a Amazônica.

Palavras-chave: índice de diversidade taxonômica; Francis de Castelnau; Brasil Central; região hidrográfica amazônica.

1. Introduction

During the 18th century the European scientific community initiated an inventory of the animals, plants, minerals, and fossils of the world; in this way naturalists traveled to different countries to collect samples, including Brazil (Raminelli, 1998). Among the animals, many vertebrates were collected including fish (Vanzolini, 1996). The knowledge of the ichthyofauna in Brazil dates to the great navigations in the 16th century, but significant naturalists' contribution began in 1783 with the Portuguese mission that arrived in Brazil led by Alexandre Rodrigues Ferreira (1756-1815). He was responsible for one of the first descriptions of the Brazilian ichthyofauna, including the species *Arapaima gigas* (Schinz, 1822), known as "the giant of the Amazon" (Göldi, 1985; Vanzolini, 1996).

In mid-1815 the naturalist Johann Natterer (1787-1843) carried out collections of fishes, resulting in a description of a new genus including the species *Lepidosiren paradoxa*, Fitzinger, 1837 (South American lungfish; Natterer, 1839). That fish collection was used by Jacob Heckel (1790-1857) to publish in 1840 a manuscript based on 50 freshwater fish species and posteriorly by the ichthyologist Rudolf Kner (1810-1869). In 1829, the naturalists Johann Baptist von Spix (1781-1826) and Louis Agassiz (1807-1873) described 21 and 54 new species of fish from both marine and freshwater environments, respectively. In the latter environment, 19 species were described by Spix and 20 by Agassiz. The latter

naturalist was responsible for the first contribution to the knowledge of marine ichthyofauna in Brazil with the description of the species *Cathorops spixii* (Agassiz, 1829) (Vanzolini, 1996).

In mid-1843, the French scientific mission arrived in South America (Moraes et al., 2014), headed by the naturalist François-Louis Nompar de Caumont Laporte, comte de Castelnau (1810-1880), to collect several specimens of the South American fauna (Vanzolini, 1996; Rozeaux, 2016). He visited Peru, Paraguay, Bolivia, and Brazil (states of Rio de Janeiro, Minas Gerais, Goiás, Tocantins, and Mato Grosso; Papavero, 1971). While most naturalist focused on the Brazilian coastal region, Castelnau also collected material in the central one, with emphasis on the Araguaia River (Braga, 2018) starting his navigation on the Vermelho River near the Vila Boa city, Goiás (Batista, 2015). The results about the species of fauna collected during the expedition includes 276 fish's species, of which only five do not occur in Brazil; 124 were marine and 20 were new species (Castelnau, 1855). Twenty-nine species were described by Castelnau (1855), of these eight were repeated and 16 were synonyms of species deposited in the Paris Museum (Vanzolini, 1996). A qualitative description of cataloged animal species, including fish, or first described by naturalists who visited Brazil in the 19th century, was carried out by Vanzolini (1996). This author highlights the expressive contribution of the naturalist Francis de Castelnau to the knowledge of the Brazilian

ichthyofauna (276 described species), but it does not allow a direct comparison of the contribution of each naturalist to the knowledge of the Brazilian ichthyofauna diversity, nor does it mention in which watercourses the fishes were collected. Therefore, this study aims to evaluate the contribution of naturalists Francis de Castelnau, Jacob Heckel, Johan Baptist von Spix, Johann Natterer, Louis Agassiz e Rudolf Kner, the former in more detail, to the knowledge of the taxonomic diversity of freshwater ichthyofauna in Brazil between the years 1829 and 1859.

2. Material and Methods

2.1. Study area

Brazil is the fifth largest country in the world and it has the highest availability of freshwater globally, concentrating about 12% of the total volume (Lima, 2001) distributed in 12 hydrographic regions (Amazon, Tocantins-Araguaia, West Northeast Atlantic, Parnaíba, East Northeast Atlantic, São Francisco, East Atlantic, Southeast Atlantic, South Atlantic, Uruguay, Paraná and Paraguay; ANA, 2015), with different vegetation covers (Coutinho, 2016; Figure 1). The aquatic organisms present in these basins, such as fish, belong to the Neotropical region, characterized by a high species richness, including several endemic ones (Narváez-Gómez et al., 2018).

2.2. Data collection

Data were organized into two matrices: the first formed by freshwater fish species whose geographic distribution comprises Brazil compiled from the FishBase database (Froese & Pauly, 2023); the second with information extracted from Castelnau (1855).

In the first matrix and for each species, the following information was collected: i) taxonomic classification (order, family, and species), ii) name of the naturalist describing the species between 1829 and 1859 (in this case, Johann Baptist von Spix, Louis Agassiz, Rudolf Kner, Jacob Heckel and Francis-Louis de la Porte, Comte de Castelnau), iii) place of occurrence (marine or freshwater), iv) type of occurrence: native, i.e., one that occurs within its native range (IUCN, 2023); endemic, when the species are unique to a certain water body, place or region (Martens & Segers, 2009), in this case, the watershed; non-native, when the species occurs outside their native range (Pereyra, 2020), but is mentioned as present in a Brazilian hydrographic basin, v) maximum size, that is,

length (cm) between the tip of the snout and the tip of the caudal fin, vi) common name and vii) geographic distribution expressed by the Brazilian hydrographic region.

In the second matrix, the information extracted from Castelnau (1855) was the same mentioned for the first matrix with some modifications. The categories of the place of occurrence were modified (Southern, Central, Western and Eastern Atlantic Ocean, Southwest and Western Atlantic, Northwest Atlantic, Indus and Eastern Pacific Ocean, and South and Central America) and added the 11 collection sites of the species, that is, the place or places (names of Brazilian states or rivers) that Castelnau (1855) indicated for the species listed by him (states: Pará, Amazonas, Rio de Janeiro, Bahia, Minas Gerais, and Goiás; rivers: Plata, Vermelho, Ucayali, Crixás, Tocantins, and Araguaia).

The species in the first data matrix were organized by descriptor naturalist and by hydrographic region for subsequent analyses. In the second matrix, information was added regarding the revision made by the authors of the taxonomic identification of the species (order, family, genus and species) mentioned by Castelnau (1855) based on the digital platforms FishBase (Froese & Pauly, 2023), Eschmeyer's Catalog of Fishes: Genera, Species, References (Fricke et al., 2022), GBif (2022) and Checklist of the Freshwater Fishes of South and Central America (Reis, 2003).

2.3. Data analysis

It was quantified the contribution of the naturalists to the taxonomic identification of ichthyofauna's diversity by hydrographic region.

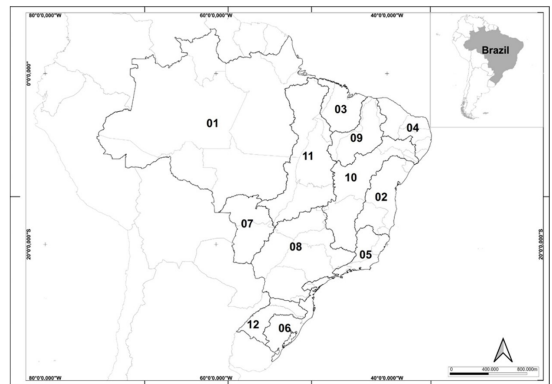


Figure 1. Brazilian hydrographic regions. 1 = Amazon; 2 = East Atlantic; 3 = West Northeast Atlantic; 4 = East Northeast Atlantic; 5 = Southeast Atlantic; 6 = South Atlantic; 7 = Paraguay; 8 = Paraná; 9 = Parnaíba; 10 = São Francisco; 11 = Tocantins-Araguaia; 12 = Uruguay.

For that, the data from the first matrix were used to calculate richness, which is the total number of species (Cianciaruso et al., 2009). Afterwards, the phylogenetic diversity was estimated, that is the measure of diversity within a community (in this case, fish species) incorporating the phylogenetic relationships of the described species (Magurran, 2013) using the Clarke and Warwick Index (Clarke & Warwick, 1999). This index describes the average taxonomic distance, i.e., the average length of the path among all species presents in a community expressed by the Taxonomic Diversity Index (Δ), which estimates the number of nodes between any two individuals in a community (Clarke & Warwick, 1998). This calculation considers the presence/absence of elements in the data matrix. Thus, the contribution of each naturalist is related to the phylogenetic diversity of the species he described. The greater the phylogenetic distance between species, the greater the contribution to the studied diversity. Since the value of taxonomic diversity depends on the pool of species, the pool of species used to calculate it was the same for all five naturalists and it was formed by all species described by them.

The data from the second matrix were used to evaluate the contribution of Castelnau (1855), that is the fish species' taxonomic data mentioned in his book were quantified by taxon and compared with the taxonomic revision made by the authors as described above.

To evaluate the species' geographical distribution, two variables were considered: i) place of occurrence (marine or freshwater) and ii) type of occurrence (native, endemic, or non-native). In addition, the maximum size available for each species was used for the biological variable, and eight class intervals ranging

from 5.0 to 464.0 cm were elaborated. All statistical analyses were performed using R software, *vegan* package, *taxondive* function (R Core Team, 2023).

3. Results

3.1. Contribution of naturalists

Results indicated that species richness and taxonomic diversity were not directly proportional, that is, an increase in species richness was not necessarily followed by an increase of taxonomic diversity (Figure 2). For example, the naturalist Castelnau displays a low richness ($S=29$ species) and the highest taxonomic diversity ($\Delta=87.7$) when compared to Kner ($S=73$; $\Delta=80.8$; Figure 2). The naturalist Heckel presents the last position ($S=38$ species; $\Delta=43.7$).

Among the naturalists considered, Kner made the greatest contribution in terms of species description (88 species in 11 out of 12 hydrographic regions), followed by Heckel (46 in six regions), Spix & Agassiz (33 in nine regions), and Castelnau (31 in seven regions). Agassiz had the lowest number of species described (11 in four regions; Table 1).

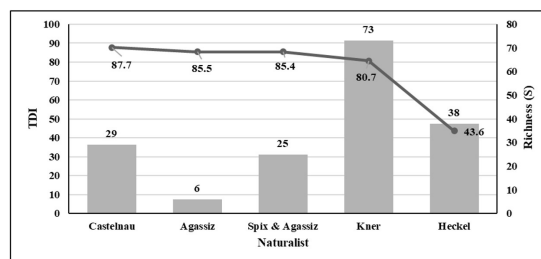


Figure 2. Richness (S ; bars) and Taxonomic Diversity Index - TDI (Δ ; line) of the Brazilian ichthyofauna described by the naturalists considered in this study between 1829 and 1859.

Table 1. Fish's richness described by each naturalist and Brazilian hydrographic region between 1829 and 1859.

Hydrographic region	Naturalist					Total
	Castelnau	Agassiz	Spix & Agassiz	Kner	Heckel	
Amazon	13	7	16	54	32	122
East Atlantic	1	-	1	2	-	4
East Northeast Atlantic	-	-	1	1	-	2
Paraguay	2	-	-	8	1	11
Paraná	1	1	4	11	8	25
Parnaíba	-	-	1	1	-	2
São Francisco	2	2	5	3	1	13
South Atlantic	-	-	1	-	-	1
Southeast Atlantic	2	-	-	1	-	3
Tocantins-Araguaia	10	1	3	1	3	18
Uruguay	-	-	-	5	1	6
West Northeast Atlantic	-	-	1	1	-	2
Total	31	11	33	88	46	209

The Amazon region had the highest number of species described (122), followed by the Paraná region (25), Tocantins-Araguaia (18), and São Francisco (13); in all cases with contributions from the five considered naturalists (Table 1). The South Atlantic region had the lowest species richness described (1; *Lycengraulis grossidens* Spix & Agassiz, 1829) by the naturalist Spix & Agassiz (Table 1). Twenty-nine species described by naturalists are present in two (e.g., *Prochilodus nigricans* Spix & Agassiz, 1829 in the Amazon and Tocantins-Araguaia regions), three (e.g., *Cichla monoculus* Agassiz, 1831 in the Amazon, Paraná, and Tocantins-Araguaia), or four (e.g., *Xiphophorus hellerii* Heckel, 1848 in the Amazon, Paraná, São Francisco, and Tocantins-Araguaia) hydrographic regions, reflecting the difference in the richness mentioned in Table 1 and Figure 2.

3.2. Information extracted from Castelnau (1855)

This naturalist contributed with the record of 276 fish species distributed in 46 orders, 96 families and 131 genera. He described 31 fish species belonging to seven of the 12 Brazilian hydrographic regions: Amazon (13 species), Tocantins-Araguaia (10), Southeast Atlantic, São Francisco and Paraguay (2 for each region), East Atlantic and Paraná (1 for each region). Two described species *Caranx guarapucu* (Castelnau, 1855) and *Caranx bonito* (Castelnau, 1855) do not have their place of occurrence informed. Four species (*Ageneiosus ucayalensis* Castelnau, 1855, *Retroculus lapidifer* (Castelnau, 1855), *Baryancistrus niveatus* (Castelnau, 1855), and *Rhamphichthys marmoratus* (Castelnau, 1855) has confirmed occurrence for two hydrographic regions.

A comparison of the taxonomic status of the species mentioned by Castelnau (1855) to that resulting of the revision performed in this study shows differences, except for the genus taxon (Figure 3).

Regarding the geographic distribution of the species collected by Castelnau (1855), it is observed that 39% (130 species) are present in South and Central America, 46% (150) correspond to other locations, and 15% (50) did not have available localization. Some species were described by Castelnau (1855) in more than one region. In the case of Brazil, the fish species collected by Castelnau (1855) were concentrated in the Southeast region (67%), that is in Bahia (35%; 60 species) and Rio de Janeiro (32%; 55)

with several species registered in both locations, Amazon (14%; 25) and Goiás (13%; 22) and other regions (6%) completing the list.

Regarding the types of occurrences, Castelnau (1855) mentions 136 native species from the Neotropical region, which in this work are classified as endemic (45 species), non-natives (44) and with no available information (51). Native species are divided between freshwater (69) and marine (68) species. Of the endemic species, 41 are freshwater, and four are marines. Considering the places of occurrence, it is observed a greatest richness among freshwater species (131 species), followed by the marine ones (116) and those that do not have the place of occurrence available (29).

The body size of described species ranged from 6.1 to 464.0 cm (Figure 4), the smallest species being *Corydoras splendens* (Castelnau, 1855) and the largest *Arapaima gigas* (identified by Castelnau as *Vastres gigas*). Most species (157) are small and medium-sized, falling into the first size class, which ranges from 5.0 to 56.0 cm; the remaining 71 species are large, ranging from 56.0 to 464.0 cm (Figure 4). Forty-six species do not have their maximum size available.

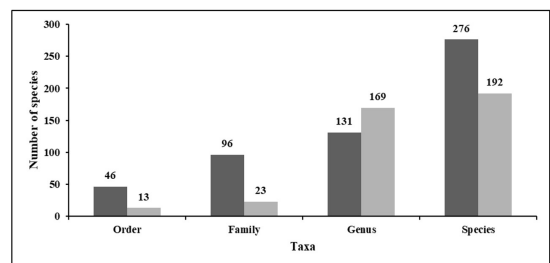


Figure 3. Taxonomic status of species catalogued by Castelnau (1855) (dark bars) and that resulting of the revision performed in this work (grey bars).

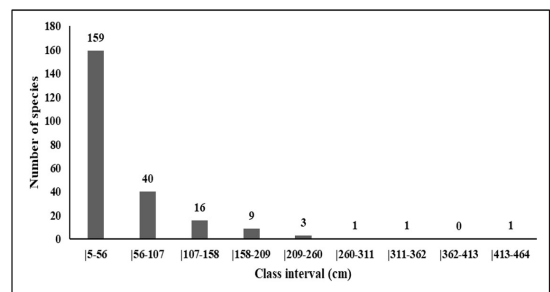


Figure 4. Maximum size (cm) of the species catalogued by Castelnau (1855).

4. Discussion

Naturalist of the 18th and 19th century had a great importance to start the description of the fish fauna in Brazil, and it is important to know how these naturalists contributed individually to this knowledge. In terms of taxonomic/phylogenetic diversity, the results indicate that Heckel has the lowest contribution to the description of Brazilian freshwater fish species. This naturalist worked on the description of species collected by Natterer, who dedicated six years to the collection of fish, mainly in the watercourses of the Southeast Atlantic, Paraná, São Francisco, and Amazon hydrographic regions, and encompassing the states of Rio de Janeiro, São Paulo, Minas Gerais, Mato Grosso, and the Amazon (von Ihering, 1902). Heckel mainly described species from the Amazon and Paraná regions (Vanzolini, 1996). Therefore, Heckel described fish species from the same families (Sciaenidae, Cichlidae, and Poeciliidae), which implies a greater phylogenetic similarity among them since they all belong to the Perciformes order. A similar situation may explain the results obtained for Kner ($\Delta=80.8$). This naturalist also worked with part of the specimens collected by Natterer (Vanzolini, 1996) belonging to two orders (Characiformes and Siluriformes), mainly from the Amazon, Paraná, Uruguay, and Paraguay regions.

In turn, the naturalist Castelnau, despite describing a smaller number of species (29), covered five orders (Characiformes, Gymnotiformes, Myliobatiformes, Perciformes, and Siluriformes), mainly from the Amazonian and Tocantins-Araguaia hydrographic region, the latter located partially in Central Brazil (Papavero, 1971; Vanzolini, 1996), where fish populations were sampled for the first time by Castelnau, all this explains why he made the greatest contribution to taxonomic diversity description ($\Delta=87.7$).

The naturalist Louis Agassiz described six species and 29 species in co-authorship with Spix, all based on the collections made by Spix and Martius in Brazil between 1817 and 1820. They traveled through various Brazilian states, with a particular focus on the northern region (Amazonian and Tocantins-Araguaia hydrographic region) and the southeastern region (Paraná and São Francisco; von Spix, 1940). The described species belong to four orders (Characiformes, Clupeiformes, Perciformes, and Siluriformes). This explains Agassiz's second high contribution to the taxonomic diversity index ($\Delta=85.5$) among the naturalists considered during the period from 1829 to 1859.

This, the contribution of each naturalist seems related to the number of taxonomic groups, orders for example, collected.

The analysis of the taxonomic classification of fish species cataloged by Castelnau (1855) compared to the current classification performed in this study shows a higher number of species, except for the genus taxon. This result seems related to the methods used to describe the species. During the period considered in this study (1829 to 1859), the method used to describe the species primarily relied on visible morphological characteristics as proposed by Carl Linnaeus. This method contrasts with the modern ones, which incorporate various molecular techniques in addition to morphological features (Pavan & Monteiro, 2014). This situation allows for a better taxonomic classification of fish species and explains the difference between Castelnau's (1855) taxonomic classification of fish and the revised one performed in this study.

Regarding the geographical distribution of the species cataloged by Castelnau (1855), it is observed that 39% (130 species) are in South and Central America. This result does not reflect his journey through these continents but rather the data after the update, that is, some species mentioned by Castelnau (1855) as geographically distributed in Brazilian watercourses have distribution in other regions. This is the case of the species *Synodontis clarias* (Linnaeus, 1758), misidentified by Castelnau (1855) and reported to be present in the Crixás River, Tocantins-Araguaia basin, but which is a species found in watercourses of the Senegal (Froese & Pauly, 2023).

In Brazil, Castelnau (1855) collected more species in the southeastern region, in the states of Rio de Janeiro (55 species) and Bahia (60), places where he resided for a longer time as the French consul (Vanzolini, 1996). However, he was the first naturalist to collect fish in the watercourses of Central Brazil (Castelnau, 1850), where he described 26 species (considering Goiás and Minas Gerais), eight of which were authored by him. Castelnau (1848) indicates that the knowledge of the flora and fauna of this region was limited due to the lack of any means of communication.

Out of the 276 species cataloged by Castelnau (1855), 136 are native to the Neotropical region, which extends from central Mexico to southern Brazil, including Central America, the Caribbean, and South America (Murphy & Lugo, 1986; Antonelli & Sanmartín, 2011), where 35 biodiversity hotspots are located (Tundisi & Matsumura-Tundisi, 2008). Forty-five species are endemic to the Neotropical region, of which 11 were identified by Castelnau (1855).

Forty-four species are non-native, as their current location does not coincide with the Neotropical region. An example of this situation is the species *Xyrichthys splendens* Castelnau, 1855, which is mentioned by Castelnau (1855) as occurring/collected in the state of Bahia but is currently located in the United States of America.

Among the species described by Castelnau (1855), notable ones include *Baryancistrus niveatus* (Castelnau, 1855), *Loricariichthys castaneus* (Castelnau, 1855), *Parancistrus aurantiacus* (Castelnau, 1855), *Pseudacanthicus spinosus* (Castelnau, 1855), *Pterygoplichthys pardalis* (Castelnau, 1855), *Hypostomus alatus* Castelnau, 1855, *Hypostomus asperatus* Castelnau, 1855, and *Hypostomus subcarinatus* Castelnau, 1855) from the Loricariidae family, of which two are endemic (*B. niveatus* and *P. spinosus*). Fish of this family are known as armored catfish or acaris, typically exhibiting benthic habits and having their bodies covered in bony plates (Santos et al., 1984; Britski et al., 1999; Graça, 2004) and comprise the sixth-largest family in the world (Nelson, 1984). They occur in various environments but prefer lotic habitats (Britski et al., 1999). They are well-known species, although many still have undefined statuses due to significant intra-specific variation (Weber, 2003). Castelnau (1855) also described the species *Potamotrygon henlei* (Castelnau, 1855) from the Potamotrygonidae family, known as the fire stingray, endemic to the Tocantins-Araguaia basin (Froese & Pauly, 2023), as well as the species *Serrasalmus gibbus* Castelnau, 1855 from the Serrasalminidae family.

Castelnau (1855) collected both freshwater and marine fish species. Freshwater species represent 47%, marine species represent 42%, and the remaining 11% correspond to species for which the occurrence location is not specified. Out of the 247 species with reported occurrence locations, there are amphidromous species, which means they reproduce in freshwater, develop in the sea, and return to freshwater as juveniles for feeding, growth, and reproduction (McDowall, 2007). This is the case for the species *Achirus achirus* Linnaeus, 1758. Among the cataloged species, there are some mentioned as belonging to freshwater environments, but upon verification, they are marine species. However, it is difficult to determine precisely because Castelnau (1855) often only mentioned the state and not the specific location (e.g., river or basin). Most of the species (157) cataloged by Castelnau (1855) are small and medium-sized, contradicting the idea presented by Böhlke et al. (1978) that between the 17th century and 1866, large-sized species of greater commercial interest were described.

5. Conclusion

The naturalists considered in this study contributed, between the years 1829 and 1859, to the description of 171 species of Neotropical ichthyofauna found in Brazil, including several endemic species. Four hydrographic regions had species descriptions by all the naturalists considered in the study, with the Amazon region having the highest number of species. The naturalist Francis de Castelnau made the greatest contribution, while naturalist Jacob Heckel made the smallest contribution to the description of the taxonomic diversity of Brazilian ichthyofauna. The 276 fish species cataloged by Francis de Castelnau are mostly from the Neotropical region, including some endemic species, originating from watercourses in the southeastern region of Brazil, comprising species collected for the first time in the watercourses of Central Brazil, as well as some marine species ranging from small (5.0 cm) to medium-sized (56.0 cm).

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