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ARTICLE

The earliest iconographic record of *Gobioides broussonnetii* La Cepède, 1800 (Gobiiformes: Gobiidae): the species identity of the *"Caramuru"* paintings of Dutch Brazil (1624-1654)

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Abstract. During the Mauritian period of Dutch Brazil (1637-1644), a great deal of information about the biota of northeastern Brazil was obtained, consisting of both written records and paintings. Among them is an eel-like fish, depicted in two paintings labeled *"Caramurû"* and *"Caramuru",* whose taxonomic identity is controversial. One of them, attributed to Albert Eckhout, is part of the *Theatrum Rerum Naturalium Brasiliae* collection, stored at the *Jagiellonian University Library,* in Poland. This painting was possibly a model for the second *"Caramuru",* of unknown authorship, which is deposited at the *Archive of the Russian Academy of Sciences.* These paintings are doubtfully identified as the snake eel *Echiophis intertinctus* (Ophichthidae, Anguilliformes), a proposal likely induced by the vulgar name "caramuru", which is applied to muraenids and ophichthids in Brazil. After careful examination of these two paintings regarding the anatomical details depicted, we concluded that the fish corresponds, with great certainty, to *Gobioides broussonnetii* (Gobiidae, Gobiiformes), popularly known as "aimoré" and "tajasica". Furthermore, we suggest the possibility that the written counterpart of these paintings is the description associated with the woodcut of the fish labeled as *"Tajasica"* in the *Historia Naturalis Brasiliae* (Marggraf *in* de Laet, 1648). The confusion probably stems from mismatches between Georg Marggraf's descriptions and the images of organisms produced at the time, perhaps before the return of Johan Maurits van Nassau-Siegen's entourage to Europe. In an attempt to support our conclusions about the identity of that fish, as well as for historical purposes, we also discuss the vernacular names applied to *G. broussonnetii* and the authorship of the notes made on those paintings.

Keywords. Fish paintings; *Historia Naturalis Brasiliae;* Georg Marggraf; Albert Eckhout; Systematics; Gobiidae.

INTRODUCTION

The Dutch occupation of Brazil in the 17th century by Johan Maurits van Nassau-Siegen and his scientific and artistic entourage

Dutch domination in northeastern Brazil from 1624 to 1654 was a period of great economic, architectural, artistic, and social opulence, which reached its apogee with the coming of Count Johan Maurits van Nassau-Siegen (1604-1679), a statesman and military man, born of the Holy Roman Empire, who was appointed Governor-General of the Dutch possessions in Brazil, known as "Nieuw Holland", in 1636. Johan Maurits arrived in Brazil in early 1637 and lived in the old city of Recife and its surroundings until his return to Europe in 1644 (Ihering, 1914; Albertin, 1986; Françozo, 2010). Maurits, himself a scholar by education, was not only meant to turn the colony into an agricultural and commercial potency, but also to mirror the sophistication of cities in Germany and the Dutch Republic, by hiring intellectuals who came to join his retinue (Brienen, 2010). Some of them devoted themselves particularly to document, both pictorially and descriptively, the fauna and flora of northeastern Brazil (Whitehead, 1976; Boeseman *et al.,* 1990;

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Françozo, 2010). They included the artists Albert van der Eckhout (*ca.* 1607-*ca.* 1666) and Frans Post (1612-1680), the physician and naturalist Willem Pies (1611-1678), better known now as Wilhem Piso, and his assistant Georg Marggraf (1610-*ca.* 1644; for the spelling of his name adopted here, see Material and Methods), a young Saxon naturalist, cartographer, and astronomer, considered a prodigy in academic circles of the time (Gudger, 1912, 1914; Ihering, 1914; Albertin, 1986; Françozo, 2010). The value given to scientific knowledge by Johan Maurits was manifest in his own official residence in Brazil, the Vrijburg Palace, erected on the Island of Antonio Vaz, which contained in its interior and neighborhoods an astronomic observatory (built for Marggraf), a zoo, a botanical garden, tanks to accommodate freshwater and marine fishes, and a main hall decorated by numerous still-life paintings and stuffed animals (Barlaeus, 1647, 1940, 2005; Calado, 1668; Struik, 1985; Teixeira, 2006; Brienen, 2010; Almeida *et al.,* 2011).

Marggraf's competence soon made him the botanist and the zoologist of the Mauritian period, being responsible for numerous observations on plants and animals from northeastern Brazil, as well as for producing technically competent illustrations. He was not lucky enough to witness the publication of his accounts, dying for unknown reasons early at the age of about 33, in Luanda, where he was sent by Maurits to describe and map the region. Likely, prior to his travel to Angola, Marggraf entrusted his notes to Maurits (Gudger, 1912, 1914; Whitehead, 1979a; Françozo, 2010). Marggraf's notes were encrypted, probably because he feared that his zoological and botanical observations, which he had managed to study and collect at great cost, would be compromised, possibly by Piso, with whom he had probably quarreled (see his brother's report in Marggravii, 1685, reproduced by Mangeti, 1731, and translated into English by Whitehead, 1979b; see also Ihering, 1914; Whitehead, 1979b; Brienen, 2001; Françozo, 2010).

Historia Naturalis Brasiliae (1648) – the first compendium on Brazilian biodiversity

Without the participation of both Marggraf (who had died probably in 1644) and Pies, it was Johannes de Laet (1581-1649), director of the West India Company (Ihering, 1914; Albertin, 1986; Françozo, 2010), who took the challenge of decoding the texts of Marggraf (by using a key that was also likely given to Maurits) and associating them with the paintings and drawings that were produced by the artists (including Marggraf himself). A few years later, the efforts of Marggraf and Pies were amalgamated into the magnificent *Historia Naturalis Brasiliae* (henceforth cited as *HNB*), which was edited by de Laet (1648) and printed under the patronage of Johan Maurits. Notes on plants and animals were authored by Marggraf while contributions on medicine and tropical diseases are attributed to Pies (Whitehead & Boeseman, 1989a, b). Perhaps to reduce printing costs, detailed drawings and paintings brought by Nassau have been replaced with poor quality woodcuts in the *HNB.* Pies was dissatisfied with the book *HNB,* which he considered rushed and superficial (Pisonis, 1658). As a consequence, ten years later, he published the book *Gulielmi Pisonis De Indiae Utriusque Re Naturali et Medica Libri Quatuordecim* (Pisonis, 1658) (henceforth referred to as *INML*), where the text was reorganized and biological and ecological data were added (Whitehead & Boeseman, 1989a, b), although this work is repeatedly considered to be a degenerate copy of Marggraf's work (*e.g.,* Marggravii, 1685 *in* Whitehead, 1979b; Linnaeus, 1737; Lichtenstein, 1818, 1822a; Gudger, 1912, 1914; Ihering, 1914).

In the spite of being pre-Linnean and using only vernacular names for species found (thus being nomenclaturally unavailable), the artistic-scientific works carried out throughout the Mauritian period of Dutch Brazil constitute the most complete and reliable testimony for a Brazilian biota close to its original state (*i.e.,* before the massive occupation by western humans), due to its acuity and completeness. The relevance of the work *HNB* was so great that until the end of the eighteenth century, it was the basis of study for anyone interested in the fauna and flora of Brazil (Whitehead & Boeseman, 1989a, b), and subsequent authors gave Latinized binomials for several Marggraf's species (*e.g.,* Linnaeus, 1758, 1766; Bloch, 1787; Bloch & Schneider, 1801; Gmelin, 1789a, b, c; Lichtenstein, 1822a, 1829; Bleeker, 1858). In the 18th and 19th centuries, were published a few somewhat comprehensive articles on the species described by Marggraf and Pies and illustrated in paintings of the Mauritian period (or based on them), which dealt with animals (Schneider, 1786) and plants (Martius, 1853; translated to English by Wallich, 1853a, b, c), while some accounts were devoted to specific groups, such as mammals (Lichtenstein, 1818), birds (Lichtenstein, 1819), amphibians and reptiles (Lichtenstein, 1822b), and fishes (Bloch, 1787; Lichtenstein, 1822a; 1829). More recently, plants (Sampaio, 1942; Moulin *et al.,* 1986; Pickel, 2008; Alcàntara-Rodríguez *et al.,* 2021), arachnids, myriapods, and insects (Lane, 1942), crustaceans (Sawaya, 1942a; Castro, 1962; Holthuis, 1991; Tavares, 1993), fishes (Carvalho & Sawaya, 1942; Paiva & Campos, 1995), amphibians (Sawaya, 1942b), reptiles (Sawaya, 1942b), birds (Hellmayr, 1929; Schneider, 1938; Pinto, 1942; Teixeira, 2000, 2009), and mammals (Sawaya, 1942b; Hershkovitz, 1987) have been reviewed. Most of them, however, deal with de Laet (1648)'s *HNB* and Pisonis (1658)'s *INML* instead of specifically with the paintings that presumably served as the basis for the woodcuts that illustrate those books, much because such paintings were lost or ignored for a long time, coming to light only recently (see below).

The artistic production on the fauna and flora of Dutch Brazil

The artistic production on Brazilian nature brought back to Dutch Republic by Nassau consisted of two folios of watercolors and a vast collection of oil paintings on paper (Ferrão & Soares, 1993; Brienen, 2006, 2010).

Unfortunately, soon after the Nassau's arrival, the iconographic collection on Brazilian Northeastern fauna and flora started to be pulverized (Albertin, 1986). It is known that in 1652, Nassau sold or donated an important part of this collection to his cousin Friedrich Wilhelm I, Elector of Brandenburg and Duke of Prussia (Whitehead, 1979a; Ferrão & Soares, 1993; Whitehead & Boeseman, 1989a, b; Brienen, 2006, 2010). Once the Elector became the owner of those illustrations, he charged the botanist and sinologist, and also his personnel physician, Christian Mentzel, to organize them, which were assembled in three sets: the *Libri Principis* (also called *Handbooks*), which were already bound in two folios; the *Miscellanea Cleyeri,* in a single volume; and the *Theatrum Rerum Naturalium Brasiliae,* arranged in four volumes containing most of oil paintings on paper (Mentzel, 1660-1664) (hereafter abbreviated as *Theatrum*) (Brienen, 2006, 2010). The *Theatrum,* the *Libri Principis,* and the *Miscellanea Cleyeri* were deposited in the Elector's personal library, which became the Königlichen Bibliothek after the accession of Friedrich I in 1668, later being called the Preussische Staatsbibliothek, in Berlin, where they were incorporated in the eighteenth century into the collection called *Libri Picturati,* corresponding to the sections from A-32 to A-35, A-36 and A-37, and A-38, respectively (Wegener, 1938; Whitehead, 1976; Boeseman *et al.,* 1990). The *Libri Picturati* collection remained for almost three centuries in Berlin until World War II, when it was successively transferred elsewhere for safety, until its final destination was lost for three decades, being recovered only in March 1977, at the *Jagiellonian University Library,* Krakow, Poland (Whitehead, 1976; Boeseman *et al.,* 1990). The *Theatrum* appeared as a facsimile edited by Ferrão & Soares (1993) and the three sets on the Dutch Brazil's natural history of the *Libri Picturati* were fully reproduced by Ferrão & Soares (1995).

Likely before these drawings and paintings were given to the Elector of Brandenburg, they served as blueprints for the low-quality woodcuts that illustrated the *HNB* (de Laet, 1648). Whitehead & Boeseman (1989a, b) have suggested that the *HNB*'s woodcuts and these drawings and paintings may have originated from the same preliminary sketches currently lost. However, this is a rather remote possibility, considering that many of these paintings are quite faithful to the original animals and plants, portraying them in their life colors (which were roughly reproduced in the *HNB*'s colorful version). Differences in style, accuracy, and inks utilized in these paintings brought from Dutch Brazil suggest that they are authored by multiple artists. Most of them are in the *Libri Principis* and *Theatrum*. The paintings in the former, attributed by Georg Marggraf (Gudger, 1912, 1914; Scharf, 2019), are scientifically qualified miniature watercolors, depicting specimens arranged in standard positions and often in their natural sizes (despite its small size), revealing relevant anatomical details for each taxonomic group (Phaf-Rheinberger, 2011). Most of paintings in the latter consists of paper oil paintings which are artistically superior to those in the *Libri Principis,* with specimens usually painted in positions where were found (still-life), but sometimes lacking anatomical details (Phaf-Rheinberger, 2011; *pers. obs.*). The authorship of the paintings of the *Theatrum* was the object of ample debate, prevailing the suggestion that would be by Frans Post (*e.g.,* J. Horkel, 1832 *in* Solovyov, 1934a, b; Driesen, 1849; Martius, 1853; Larsen, 1962), while other authors assigned most of them to Albert Eckhout (*e.g.,* Thomsen, 1938; Sousa-Leão, 1945; Schaeffer, 1968a). Schneider (1938) considered part of the works of Zacharias Wagener, whereas those of better quality would be of Frans Post. Most of paintings in the *Theatrum,* consisting of paper oil paintings, are currently recognized as being Albert Eckhout's productions (Albertin, 1986; Brienen, 2006, 2007, 2010).

A collection of watercolors presently based at the St. Petersburg Branch of the Archive of the Russian Academy of Sciences, formerly Leningrad Division of the Archive of the Academy of Sciences of the USSR (Solovyov, 1934a, b; Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990), herein referred to as *St. Petersburg Collection* (formerly called *Lenningrad drawings* by Boeseman *et al.,* 1990), is another valuable source of the naturalistic illustrations from the period of Johan Maurits van Nassau-Siegen in Dutch Brazil. These paintings were first studied in detail by the German physiologist Johann Horkel (1769-1846) (Solovyov, 1934a, b), who compared them to the paintings of the Johan Mauritis' collection that were part of the series *Libri Picturati,* but their results have never been published. The 145-folio collection from St. Petersburg was divided by him into two sets, the Series A, corresponding to the watercolors of the *Libri Principis,* and the Series B, matching the oil paintings of the *Theatrum* (Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990). Although it was speculated that these paintings could be the field-sketches that would have served as the basis for *Theatrum* (Schaeffer, 1968a, 1976), this hypothesis can be totally rejected by the fact that the watermark of one of those paintings allows to date the paper as being of 1650 or later (Albertin, 1986; Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990), therefore older than the paintings of the *Theatrum*. It is most likely that these paintings were made for Johan Maurits as a record shortly before he gave the originals to the Elector of Brandenburg in 1652, as suggested by Horkel (Solovyov, 1934a, b). Horkel, in his notes, suggested that the paintings of the Series B of the *St. Petersburg Collection* are authored by Frans Post, probably assuming he was also the author of *Theatrum*'s paintings (Solovyov, 1934a, b). Boeseman *et al.* (1990) disagreed, suggesting that they would have been painted by Albert Eckhout, for whom most of *Theatrum*'s paintings are currently attributed (Albertin, 1986; Brienen, 2006, 2010). How these paintings reached St. Petersburg is a mystery, but it has been speculated that they may have been acquired by the Czar Peter the Great in the Netherlands in 1717, when he bought the collections of Albertus Seba (1665-1736) and Frederik Ruysch (1638-1731), or would have belonged to the collection of the naturalist Maria Sibylla Merian (1647-1717), whose family moved to that city after her death in the same year (Schaeffer, 1976).

The fishes portrayed during Dutch Brazil and the problem of the identity of *"Caramurus"*

Although the naturalistic images carried out during the Mauritian government in Dutch Brazil have already aroused considerable interest, there are many outstanding issues that require more detailed investigations for both historical and scientific reasons (since several of the specimens portrayed in that epoch are name-bearing types of nominally available species, for instance). It is quite remarkable that the fishes portrayed in those paintings and drawings, which represent a significant portion of the iconographic production of that time, were sparsely studied. The single, somewhat meticulous review of the information about the fishes of the Mauritian period in Brazil was the account of Lichtenstein (1829), who also examined the original paintings of the *Theatrum* and *Libri Principis* [see commentaries made by the ornithologist Olivério Mário de Oliveira Pinto (1896-1981) in the Portuguese translation of the Lichtenstein's articles – Falcão, 1961]. Even in the facsimiles of the *Theatrum* (Ferrão & Soares, 1993, 1995) or in works that reproduced those original paintings (Brienen, 2006, 2010), no updated identification of those fishes was provided.

Among the fishes that were portrayed during that time, there is one, which appeared in an oil painting in the *Theatrum* under the Tupi name of *"Caramurû"* (Fig. 1), whose Albert Eckhout's authorship has been confirmed (Brienen, 2006, 2010). The painting *"Caramurû"* of the *Theatrum* was presumably copied in a watercolor labeled as *"Caramuru"* currently at the *St. Petersburg Collection* (Fig. 2). In spite of being artistically and technically competent paintings, the fish depicted on them does not appear as a woodcut either in the *HNB* (Marcgravi, 1648) or in the *INML* (Pisonis, 1658). Many works on animals and plants of Brazil employing the descriptions and woodcuts of the *HNB* (de Laet, 1648) and/or *INML* (Pisonis, 1658) were subsequently published in the seventeenth

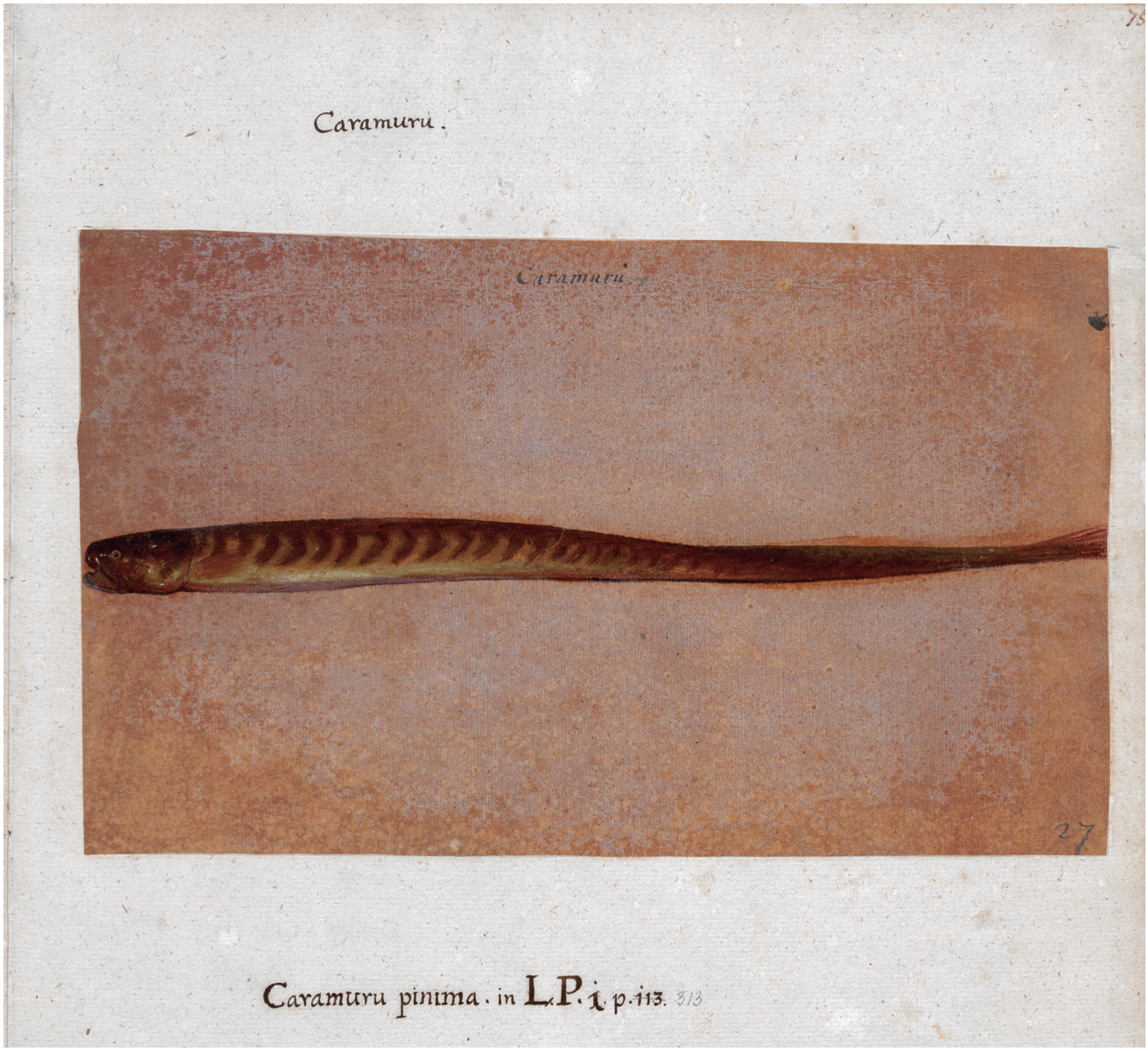


Figure 1. *"Caramurû",* oil painting on paper by Albert Eckhout (1637-1644), folio 75 of the volume 1 *("Icones Aquatilium")* of the *Theatrum Rerum Naturalium Brasiliae* (Mentzel, 1660-1664) (volume A32 of the *Libri Picturati* collection), stored at the *Jagiellonian University Library,* Krakow, Poland.

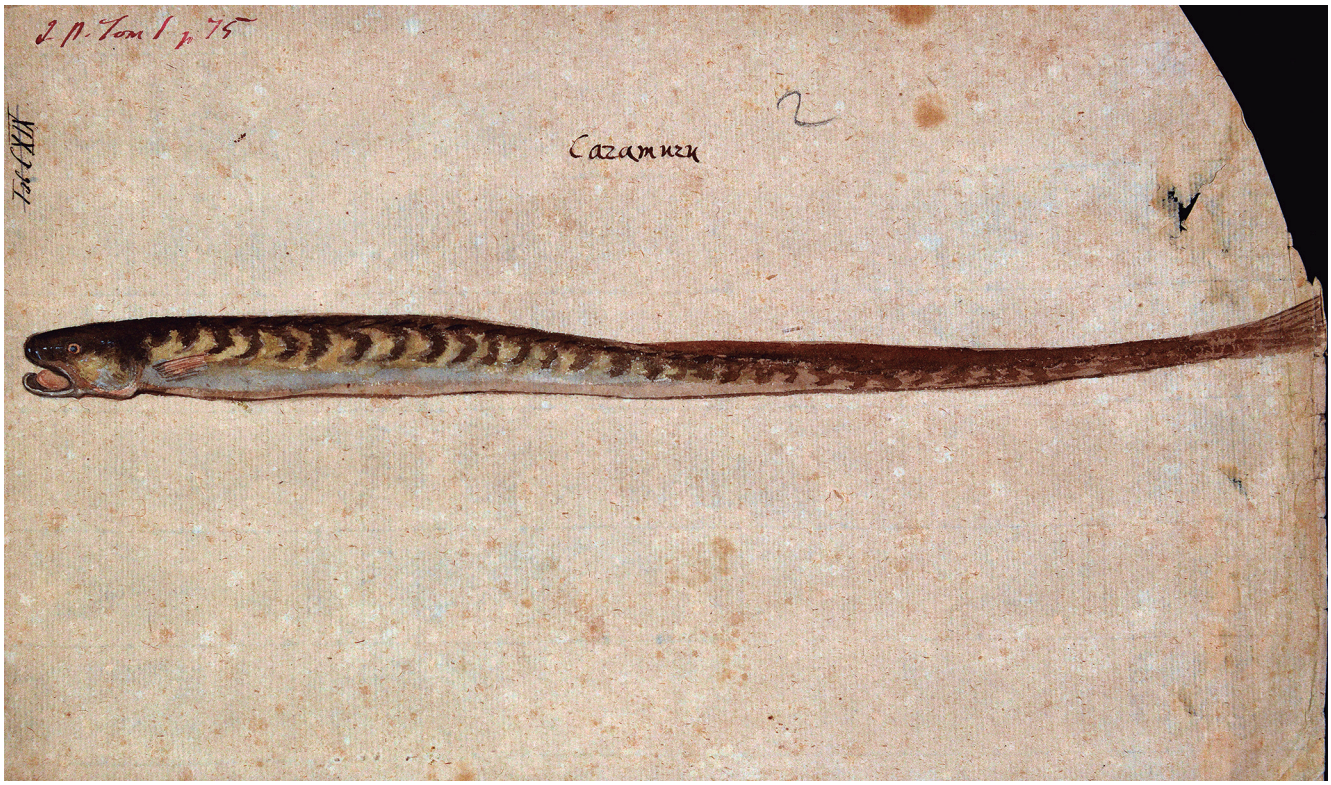


Figure 2. *"Caramuru",* watercolor on paper by anonymous author (*ca.* 1652), folio 60 of the Series B of the *St. Petersburg Collection,* stored at SPbB ARAS *(St. Petersburg Branch of the Archive of the Russian Academy of Sciences),* registered under the archival code Ф.51.Оп.1.Д.122.Л.60 (Fond 55, Inventory 1, Folder 122, Folio 60).

century (*e.g.,* Jonstonus, 1650; Worm, 1655; Willughby, 1686), but none of them made use of the original sources for the images. Most of works concerning the paintings in *Theatrum* (*e.g.,* Erndel, 1716; Anonymous, 1717; Schneider, 1786; Lichtenstein, 1829; Thomsen, 1938; Wegener, 1938; Sousa-Leão, 1945; Schaeffer, 1968a; Wiesinger, 1976; van den Boogaart & Duparc, 1979; Valladares, 1981; Valladares & Mello-Filho, 1989), or more specifically on the fishes contained therein, failed to illustrate or even mention Eckhout's *"Caramurû"* until the 1990s. Although Bloch (1787) and Bloch & Schneider (1801) had contact with the original fish paintings of the Mauritian period of the Dutch Brazil, they apparently only examined the *Libri Principis* (Lichtenstein, 1818; Whitehead & Boeseman, 1989a, b). Eckhout's oil painting of *"Caramurû"* appeared in facsimile reproductions of the *Theatrum* (Ferrão & Soares, 1993: 49; 1995: 49) and in some recent works (Brienen, 2006, 2010), but, as already said, no attempt was made to identify such fish.

No commentary on the *"Caramuru"* watercolor of the *St. Petersburg Collection* was either made in publications about these paintings until the late 1980s (*cf.* Schaeffer, 1968a, b, 1973; Falcão, 1964; van den Boogaart & Duparc, 1979), which appeared only once as a low-quality black and white photograph in Boeseman *et al.* (1990: 166, pl. 25, top left). Boeseman *et al.* (1990) were also the only ones to recently attempt an identification for the *"Caramuru",* based on the watercolor that is part of the *St. Petersburg Collection*. The fish portrayed in that painting was recognized with some doubt as a species of the family Ophichthidae (Boeseman *et al.,* 1990). The authors' discomfort in establishing a firm identification for the *"Caramuru"* is likely due to their assumption that painting would correspond to the Pisonis (1658)'s description of *"Caramurû piníma"* (Boeseman *et al.,* 1990), which is a muraenid indeed (see discussion below). Indeed, such identification as an ophichthid would require accepting that the artist committed a series of inaccuracies, which would be contrast with the expected technique and acuity of its alleged author, Albert Eckhout (Brienen, 2010).

In this account we intend to readdress the identity of the fish labeled as *"Caramuru"* in the paintings produced during the Mauritian period of the Dutch Brazil and discuss the consequences of the new identification herein proposed, such as the existence of a corresponding descriptive text by Marggraf, the identity of the *Theatrum* painting *"T'áyaçica"* (Fig. 3) and the woodcut derived from it (Marcgravi, 1648), the correction of the vernacular name used for that fish, the origin of the portrayed specimen, as well as the authorship of writings in these paintings.

MATERIAL AND METHODS

The name of the Saxon naturalist Georg Marggraf is spelled in different ways in the literature and even in original documents, most often in their Latinized variants, namely: Georg Marcgraf (*e.g.,* Larsen, 1961, 1962; Whitehead, 1979b; Hershkovitz, 1987; Holthuis, 1991; Brienen, 2001, 2006, 2010; Safier, 2014; Scharf, 2019), Georg Marcgrav (*e.g.,* Martius, 1853), Georg Marcgrave (*e.g.,* Lichtenstein, 1818; Darmstaedter, 1928; Hellmayr, 1929; Schneider, 1938; Schaeffer, 1968a; Andrade-Lima

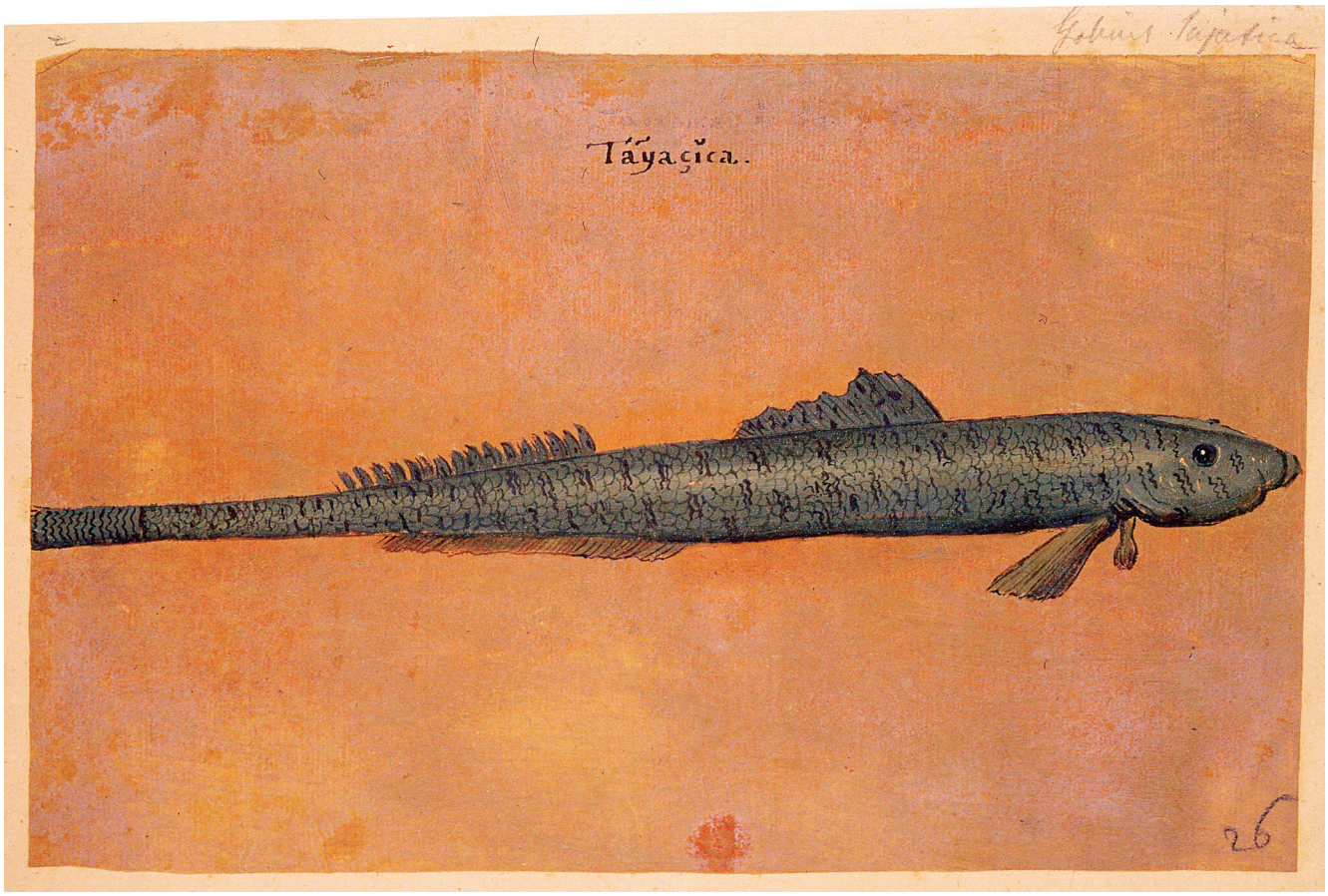


Figure 3. *"T'áyaçica",* oil painting on paper by anonymous author (1637-1644), folio 73 of the volume 1 *("Icones Aquatilium")* of the *Theatrum Rerum Naturalium Brasiliae* (Mentzel, 1660-1664) (volume A32 of the *Libri Picturati* collection), stored at the *Jagiellonian University Library,* Krakow, Poland.

et al., 1977; Albertin, 1986; Boeseman *et al.,* 1990), Georg Marggraf (*e.g.,* Hantzsch, 1896; Moulin, 1979), G. Margrav (*e.g.,* Günther, 1880), Georg Margrave (*e.g.,* Pinto, 1965), Georg Markgraf (*e.g.,* Thomsen, 1938; Wegener, 1938; Pinto, 1965; Schaeffer, 1976; van den Boogaart & Duparc, 1979; Whitehead, 1979a), George Marcgrave (*e.g.,* Gudger, 1912, 1914; Moreira, 1926); Georgi Marcgravi (*e.g.,* de Laet, 1648), Georgii Marggravii (*e.g.,* Marggravii, 1685), Georgio Marckgravio (*e.g.,* Barlaeus, 1647), Georgius Marggravius (*e.g.,* Mangeti, 1731), and Jorge Marcgrave (*e.g.,* Moreira, 1926; Pinto, 1979). Here we will use the name Georg Marggraf, for being employed by himself and for corresponding to the annotation in the record book of baptism of the church of Liebstadt, in the present Germany (Hantzsch, 1896; Meijer, 1972). The same happens to the physician and Dutch naturalist Willem Pies, whose name is usually treated in its Latinized form, Guilhermo Piso (*e.g.,* Pinto, 1979), but also appearing as the following variants: G. Piso (*e.g.,* Pinto, 1965), Guilielmus Piso (*e.g.,* Barlaeus, 1647), Gulielmus Piso (*e.g.,* de Laet, 1648), Guilielmi Pisonis (*e.g.,* de Laet, 1648), Gulielmi Pisonis (*e.g.,* Pisonis, 1658), Vihelm Piso (*e.g.,* Thomsen, 1938); Wilhelm Pies (*e.g.,* Boeseman *et al.,* 1990), Wilhelm Piso (*e.g.,* Lichtenstein, 1818; Martius, 1853; Darmstaedter, 1928; Wegener, 1938), Willem Pies (*e.g.,* Moreira, 1926; Pinto, 1965; Andrade-Lima *et al.,* 1977), Willem Piso (*e.g.,* Larsen, 1962; Schaeffer, 1976; Moulin, 1979; Pinto, 1979; Albertin, 1986; Brienen, 2001, 2006, 2010; Safier, 2014; Scharf, 2019), Willen Piso (*e.g.,* Hershkovitz, 1987), and William Piso (*e.g.,* Hellmayr, 1929). When we refer to people, we use the original presumed names while we refer to their works, we use the spelling as it appears in each of them.

The primary iconographic and bibliographic sources herein studied are as follows:

1) *Theatrum Rerum Naturalium Brasiliae,* Vol. I-IV, Berlin, edited by Christian Mentzel (1660-1664). The four volumes currently make part of the *Libri Picturati* collection, which is housed at the Jagiellonian University Library in Krakow, Poland, assigned to the sections A-32, A-33, A-34, and A-35, respectively. The *"Caramurû"* is the folio 75 (Fig. 1) of the Volume I of the *Theatrum ("Icones Aquatilium"),* corresponding to the section A-32 of the *Libri Picturati.* It is an oil painting on paper, 19 cm high and 31.3 cm wide (Brienen, 2006, 2010). The authorship of this painting is confidently attributed to Albert Eckhout (Albertin, 1986; Brienen, 2006, 2010). This painting has been reproduced as photographs in Ferrão & Soares (1993, 1995) and Brienen (2006, 2010). Eckhout's *"Caramurû"* was copied as a watercolor by an unknown author, captioned *"Caramuru",* currently corresponding to the folio 60 of the *St. Petersburg Collection* (Fig. 2) (Boeseman *et al.,* 1990: pl. 25, top left; see below). The second picture herein utilized is that one labelled *"T'áyaçica".* It is an oil painting on paper, 19 cm high and 31.3 cm wide (Brienen, 2006, 2010). The authority

of this painting is unknow. The *"T'áyaçica"* is the folio 73 (Fig. 3) of the Volume I of the *Theatrum ("Icones Aquatilium"),* also making part of the section A-32 of the *Libri Picturati*. This painting has been reproduced as photographs in Ferrão & Soares (1993, 1995) and Brienen (2006, 2010). This oil painting was copied as a watercolor by an unknown author, captioned *"Tajasicá",* currently corresponding to the folio 59 of the *St. Petersburg Collection* (Boeseman *et al.,* 1990: pl. 24, bottom right).

2) *St. Petersburg Collection*. Series A and B, produced anonymously around the year 1652. The 145-folio sheets of the so-called *St. Petersburg Collection* are divided into two sets, the Series A and B, corresponding to copies of the miniature watercolors of the *Libri Principis* (also called *Handbooks*) and the oil paintings of the *Theatrum,* respectively (Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990). The *"Caramuru"* is the folio 60 (Fig. 2) of the Series B of the *St. Petersburg Collection* [stored at SPbB ARAS *(St. Petersburg Branch of the Archive of the Russian Academy of Sciences),* registered under the archival code Ф.51.Оп.1.Д.122.Л.60 (Fond 55, Inventory 1, Folder 122, Folio 60)]. It has been speculated that Eckhout would have made these copies himself to keep track of his work, especially in the circumstance that they would be delivered to the Elector of Brandenburg (Boeseman *et al.,* 1990), but this is quite unlikely considering the differences in style, technique, and accuracy. Considering the moderate quality of the paintings and lack of detail in some of them, some being simple drafts, it has been speculated that these drawings were quick copies made for personal use only (Boeseman *et al.,* 1990). Examination of the watermarks on the papers on which the paintings of the *St. Petersburg Collection* were made indicate that these documents date from 1650 or later (Albertin, 1986; Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990). Therefore, the date of 1652 established by Horkel (Boeseman *et al.,* 1990) for this collection is a reasonable guess. The authorship of this painting, as well as of all set, is unknown. The *"Caramuru"* painting has 19.4 cm high by 32 cm wide (Boeseman *et al.,* 1990). The paper lacks a watermark which, according to Boeseman *et al.* (1990), suggests that this painting was done in its lower half. A low quality, black and white photographic reproduction appeared in Boeseman *et al.* (1990: 169, pl. 25, top left).

3) *Libri Principis*. Vol. I-II, authored by Georg Marggraf (1638-1644). These two volumes also integrate the *Libri Picturati* collection, as sections A-36 (https://jbc.bj.uj.edu.pl/dlibra/publication/193891/edition/192080) and A-37 (https://jbc.bj.uj.edu.pl/dlibra/publication/193892/edition/183824), respectively, which are housed at the Jagiellonian University Library in Krakow, Poland. The authorship of the *Libri Principis,* also called *Handbooks,* has been primarily attributed to Johan Maurits (*e.g.,* Bloch, 1787), Frans Post (*e.g.,* Schneider, 1938 – in part), Zacharias Wagener (*e.g.,* Schneider, 1938 – in part; Thomsen, 1938; Wegener, 1938) and Marggraf himself (*e.g.,* Lichtenstein, 1818, Gudger, 1912, 1914; Honour, 1975; Brienen, 2007). However, evidence favors the late author for the most images: 1) Marggraf was known to be a technically trained illustrator; 2) in de Laet (1648)'s forewords to *HNB,* it is mentioned that Marggraf made the images from living models; 3) the watercolors of animals and plants contained in the *Handbooks* combine with the Marggraf's descriptive texts (reason why more than half was used to compose the *HNB*'s woodcuts); 4) the handwriting of the Brazilian vernacular names written above most of the animals and plants in the *Libri Principis* is very similar to that preserved in the Marggraf's astronomical notes deposited in the Gemeente Archief, Leiden; and 5) Marggraf's exhaustive work as an illustrator is revealed by himself in a letter addressed to de Laet (de Laet, 1648; Marggravii, 1685; Lichtenstein, 1818; Whitehead, 1979b; Brienen, 2001). It seems that the first volume is authored by Marggraf while second volume may have been painted by five artists, including Marggraf (Brienen, 2001). The picture of *"Caramurû piníma",* also herein studied, is found in the page 313 (Fig. 4) of the second volume of the *Libri Principis,* which corresponds to the section A-37 of the *Libri Picturati*. This painting has been reproduced as a photograph in Ferrão & Soares (1995, vol. 3: 55). The style of this painting and the handwriting of *"Caramurû piníma"* are the same of most of the images of the first volume, which are attributed to Marggraf. Therefore, this watercolor is also assigned to Marggraf. It is estimated that the *Libri Principis* were prepared from March or April 1638, when Marggraf arrived in Brazil, until 1644, when he probably died in Luanda and Johan Maurits van Nassau-Siegen returned to Europe (*cf.* Brienen, 2001).

4) *Historia Naturalis Brasiliae, auspicio et beneficio Illustriss. I. Mauritti Com. Nassau illius provinciae et maris summi praefecti adornata. In qua non tantum plantae et animalia, sed et indigenarum morbi, ingenia et mores describuntur et iconibus supra quingentas illustrantur.* L. Elzevirium, Amsterdam, i-viii, 1-122, [1-2], i-iii, 1-292, [1-2] p. This volume has been edited by de Johannes de Laet (1648). The authorship of the *HNB* is usually attributed in the literature to both naturalists Pies and Marggraf, in this order (*e.g.,* Thomsen, 1938; Andrade-Lima *et al.,* 1977; Whitehead, 1979a; Whitehead & Boeseman, 1989a, b; Brienen, 2001; Absolon *et al.,* 2018), sometimes cited in the opposite order (*e.g.,* Albertin, 1986; Safier, 2014; Scharf, 2019), or to Pies alone (*e.g.,* Hershkovitz, 1987), regardless of who was responsible for writing each part. Few authors explicitly assigned the parts of the *HNB* separately to each (*e.g.,* Gudger, 1912, 1914; Holthuis, 1991). However, the work is divided into two main parts which are explicitly attributed to each of those authors (*cf.* de Laet, 1648). The first part, authored by Pies, is a medical treatise addressed to

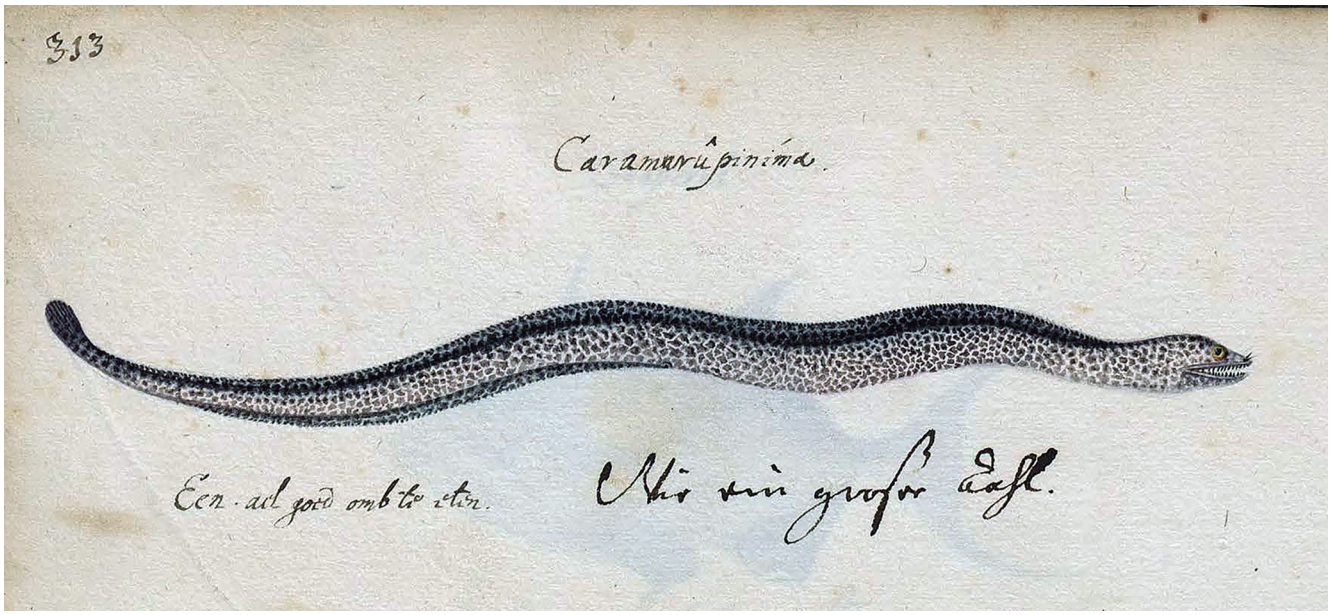


Figure 4. *"Caramurû piníma"* (= *Gymnothorax moringa*), watercolor likely authored by Georg Marggraf (*ca.* 1638-1644), page 313 of the second volume of the *Libri Principis* (section A-37 of the *Libri Picturati* collection), stored at the *Jagiellonian University Library,* Krakow, Poland.

Brazil, consisting of four chapters ("books") describing environments, diseases, poisons (and antidotes), and medicinal plants (Pisonis, 1648), while the part related to the descriptions of the plants and animals, with naturalistic remarks, formed by eight chapters ("books") (Marcgravi, 1648), which make up the bulk of the work, was in charge of Marggraf (*cf.* de Laet, 1648). Although attributed to Marggraf, the eighth book, devoted to the geography and the inhabitants of Brazil and Chile, is predominantly authored by de Laet, with minor contributions from the first author (*cf.* Whitehead, 1979a; Françozo, 2009). As evidenced by the present study, it is absolutely necessary to discriminate who was the author of each part, since, as will be seen, the lack of communication between Marggraf and Pies caused some of the confusions related to the identity of the paintings in question. In addition, it is well known that the person who organized the contributions of each author was Johannes de Laet, who did not count with collaboration neither Marggraf, nor Pies. For these reasons, when the reference is made on its totality, the work *HNB* will be referred to as that of de Laet (1648), its editor. When appropriate, each part will be assigned to its specific author. The rare colored edition examined for this study is part of the collection of the Peter H. Raven Library, Missouri Botanical Garden (https://doi.org/10.5962/bhl.title.565), being available online at the Biodiversity Heritage Library (https://www.biodiversitylibrary.org).

5) *Gulielmi Pisonis De Indiae Utriusque Re Naturali et Medica Libri Quatuordecim, Quorum Contenta Pagina Sequens Exhibet.* Ludovic & Dainel Elzevier, Amsterdam, 327 p. As already mentioned, this book is authored by Willem Pies (Pisonis, 1658), having been printed in 1658. The copy used in this study belongs to the Peter H. Raven Library, Missouri Botanical Garden (https://doi.org/10.5962/bhl.title.9669), being available online at the Biodiversity Heritage Library (https://www.biodiversitylibrary.org).

In order to elucidate the taxonomic identity of the fish depicted in the aforementioned paintings, drawings and woodcuts, the following fish specimens, housed in ichthyological collections, were examined:

Awaous tajasica (Lichtenstein, 1822a) (Gobiidae, Gobiiformes): LIRP 1022, 1 ex. (67.1 mm SL), Brazil, São Paulo State, Ubatuba, unnamed stream affluent of Rio Picinguaba, at Parque Estadual da Serra do Mar – Núcleo Picinguaba (44°50′50″W, 23°21′36″S), coll. H.F. Santos and Dardis, G.Z.P., iv.1998; LIRP 1030, 1 ex. (57.5 mm SL), Brazil, São Paulo State, Ubatuba, Rio Picinguaba (44°48′56″W, 23°21′13″S), coll. K.F. Arantes, viii.2000; LIRP 1045, 4 ex. (37.4-63.5 mm SL), Brazil, São Paulo State, Ubatuba, Rio Picinguaba, at Parque Estadual da Serra do Mar – Núcleo Picinguaba (44°50′17″W, 23°20′29″S), coll. H.F. Santos, vi.1997; UNT 9259, 3 ex. (91.2-134.5 mm SL), Brazil, State of Bahia, Ilhéus, Rio Almada, at Castelo Novo (39°11′17″W, 14°39′25″S), coll. A. Akama and A.B. Soares, 21.i.2009.

Gobioides broussonnetii La Cepède, 1800 (Gobiidae, Gobiiformes): LIRP 14232, 2 ex. (186.3-204.3 mm SL), aquarium material; MCP 8229, 1 ex. (264.6 mm SL), Brazil, Rio Grande do Sul State, Tramandaí, Lagoa de Tramandaí (50°07′W, 29°58′S), coll. C.A.S. Lucena, S. D'Incao, and J. Renato, 01.i.1979; MCP 8230, 1 ex. (212.5 mm SL), same data as MCP 8229; MCP 8231, 1 ex. (277.6 mm SL), same data as MCP 8229; MNHN-IC-0000-4209, 1 ex. (226.1 mm SL), holotype of *Gobioïdes Broussonnetii* and possible holotype of *Gobius brasiliensis* Bloch & Schneider, 1801, Surinam (?), unknown coll. and date; MZUSP 81124, 2 ex. (191.2-225.9 mm SL), Brazil, São Paulo State, Iguape, in mangrove near Icapara (47°27′31″W, 24°40′45″S), coll. J.C. Nolasco and E. Baena, 02.iv.2003.

Echiophis intertinctus (Richardson, 1844) (Ophichthidae, Anguilliformes): USNM 274249, 1 ex. (562.0 mm SL), United States of America, Florida State, Sarasota, "Red Tide" Kill 100 yds South of Cape Haze Marine Laboratory, Gulf of Mexico, Atlantic Ocean, coll. R.F. Cressey, 23.viii.1966.

Gymnothorax moringa (Cuvier, 1829) (Muraenidae, Anguilliformes): LIRP 853, 1 ex. (424.8 mm SL), Brazil, Bahia State, Cumuruxatiba, tidal pool on reef at Coroa Vermelha beach (39°00′26″W, 16°20′16″S), 0.5 m deep, coll. R.M.C. Castro, 21.iii.1985.

The acronyms for the fish collections cited here have the following meanings: **LIRP,** Laboratório de Ictiologia de Ribeirão Preto, Department of Biology, Faculdade de Filosofia, Letras e Ciências Humanas, Universidade de São Paulo, Ribeirão Preto, Brazil; **MCP,** Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; **MZUSP,** Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; **UNT,** Laboratório de Ictiologia Sistemática, Universidade Federal do Tocantins, Tocantins, Brazil; **MNHN,** Muséum national d'Histoire naturelle, Paris, France; and **USNM,** National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. "SL" is an abbreviation for standard length, which is the measurement taken from the anterior end of the specimen's snout to the posterior limit of its trunk, at the base of the caudal fin.

RESULTS AND DISCUSSION

The species identity of *"Caramuru"* paintings of the *Theatrum* and *St. Petersburg Collection*

The *"Caramuru"* portrayed in the folio 75 (Fig. 1) of the Volume I of the *Theatrum "Icones Aquatilium"* and in the folio 60 (Fig. 2) of the Series B of the *St. Petersburg Collection,* is here, for the first time, identified as *Gobioides broussonnetii* (Gobiiformes: Gobiidae) (Figs. 5-6), originally described by La Cepède (1800) as *"Gobioïdes Broussonnetii".*

Despite the striking stylistic and technical differences between these two paintings, both were obviously made from the same fish model, considering the coincidence of perspective and the details depicted. The oil painting of *"Caramuru"* of the *Theatrum* (Fig. 1) is of excellent artistic quality while the watercolor of the *St. Petersburg Collection* is of moderate standard (Fig. 2), although bearing more vivid colors than the former. The canvas of the Eckhout's *"Caramurû"* painting, as a whole, is darkened, with an orange hue, bearing visible dark spots on its periphery (Fig. 1). The painting of the *St. Petersburg Collection* is slightly more imprecise as a portrait of *G. broussonnetii.* The paper on which the *"Caramuru"* of the *St. Petersburg Collection* is painted is much lighter and speckled with stains (Fig. 2). The darker yellow and misty hue of the illustrations of the *Theatrum* must have been caused by the protective natural varnish possibly applied after Lichtenstein's study which substantiated his series of articles on the subject (Lichtenstein, 1818, 1819, 1822a, b, 1829), since that author mentioned that when he examined these paintings, they presented bright and saturated tones, a description more compatible with paintings devoid of varnish (Scharf, 2019).

Both paintings depict an elongated, cylindrical fish, which occupies the entire canvas length, from the snout tip to the caudal fin, although the terminus of this fin has been cropped (Figs. 1-2). The fish in both paintings is slightly rolled to left at its anterior half so that its back is more visible in this region. The fish in both paintings has a rounded head (Figs. 1-2). In the *St. Petersburg Collection,* the fish's snout is slightly pointed and more elongated (Fig. 2) while in the Eckhout's *"Caramurû"* the snout is shorter and has a smoother profile (Fig. 1), which matches better to *G. broussonnetii* (Figs. 5-6). The mouth is broad and obliquely oriented (Figs. 1-2). The corner of gape extends approximately to an imaginary vertical line through the middle of the eye, with posterior edge of maxilla on the imaginary vertical line through the posterior border of eye or slightly behind (Figs. 1-2). The anterior tip of lower jaw is ventral to an imaginary horizontal line through the ventral margin of eye (Figs. 1-2). The eye is small, well-defined and rounded, dorsally situated (Figs. 1-2). The eyeball is dark in both paintings, surrounded by a narrow ring, orange in the *Theatrum*'s *"Caramurû"* (Fig. 1) and yellowed in the *"Caramuru"* of the *St. Petersburg Collection* (Fig. 2). All these features of the snout, eye, and mouth fit perfectly to those of *G. broussonnetii* (*cf.* Menezes & Figueiredo, 1985: fig. 79; Cervigón, 1994: fig. 91; Murdy, 1998: figs. 10-11; Caires & Costa, 2018: 395, unnumb. fig.; Figs. 5-6).

Both paintings show a fish with the dorsal half of the trunk well demarked by warmer colors, orange in the *Theatrum* painting (Fig. 1) and yellow in the *St. Petersburg Collection* painting (Fig. 2), while the ventral half of the trunk is distinctly lighter, white (Figs. 1-2). The fish in both paintings shows conspicuous, anteriorly directed chevron-like brown to black markings on dorsal half of the trunk (Figs. 1-2). The chevron-like markings of the *"Caramuru"* painting of the *St. Petersburg Collection* are more noticeable, exhibiting about 30 (Fig. 2), while these markings in the Eckhout's *"Caramurû"* are less conspicuous, being possible to count 25 (Fig. 1). Such a color pattern corresponds exactly to that exhibited by individuals of *G. broussonnetii* (*cf.* Dawson, 1969; Cervigón, 1994; Murdy, 1998) (Fig. 5), especially when alive, whose dorsal part of the trunk is golden while the ventral part is white (Fig. 6).

In both paintings, rays of a long dorsal-fin base are notably illustrated as regularly spaced, dark, and thin strokes, which originate approximately just posterior to the imaginary vertical line that passes through the external border of the pectoral fin, withvestige of a (spinous?) ray visible from the region above the fourth and fifth chevron-like marking in the *Theatrum* painting (Fig. 1) and above the fourth chevron-like marking in the painting of the *St. Petersburg Collection* (Figs. 2, 7A). The dorsal fin extends posteriorly to cover the procurrent rays of the caudal fin (Figs. 1-2), being especially seen in the painting of the *St. Petersburg Collection* (Fig. 7B). It is not

Figure 5. *Gobioides broussonnetii,* MZUSP 81124, 225.9 mm SL, Brazil, State of São Paulo, Iguape.

Figure 6. *Gobioides broussonnetii,* live specimen in aquarium (not preserved): (A) body; (B) detail of head. Courtesy of Benjamin Lee (https://www.amiidae.com).

possible to determine the number of rays of the dorsal fin of the fish of the *St. Petersburg* painting because they are not clearly visible in the last fifth of the fish's trunk, although they are clearly represented in the terminal portion of its trunk (Fig. 7).

The pectoral fin is evident and broad, laterally located, with strokes that indicate its rayed pattern, but it is not possible to specify how many rays. The fin is evenly colored, being orange in the *Theatrum* painting (Fig. 1) and yellow in the *St. Petersburg Collection* painting (Fig. 2). The fish in both paintings does not show either a pelvic or an anal fin (Figs. 1-2). As mentioned, the mid-ventral portion of the anterior half of the fish is rolled, which may explain the fact that the pelvic and anal fins are not visible from that view.

The first attempts to identify the gobiid portrayed in the paintings that are part of the *Theatrum* and the *St. Petersburg Collection* are the names that appear in these, *"Caramurû"* (Fig. 1) and *"Caramuru"* (Fig. 2), respectively. Interestingly, the Tupi name "karamuru" or "caramuru" traditionally applies to moray eels of the family Muraenidae, especially those belonging to the genus *Gymnothorax* Bloch, 1795 (*cf.* Ihering, 1968; Clauzet *et al.,* 2007; Navarro, 2013), as well as to snake eels of the family Ophichthidae. Besides the name *"Caramuru",* Mentzel (1660-1664) added the entry *"Caramuru-pinima"* in the index of common names of Brazilian fishes and crustaceans *("Index Piscium & Cancroru in hoc Tomo Primo contentorum secundum Appellationes Brasiliensium")* of the *Theatrum* (Fig. 8) for Eckhout's painting in the folio 75. The name

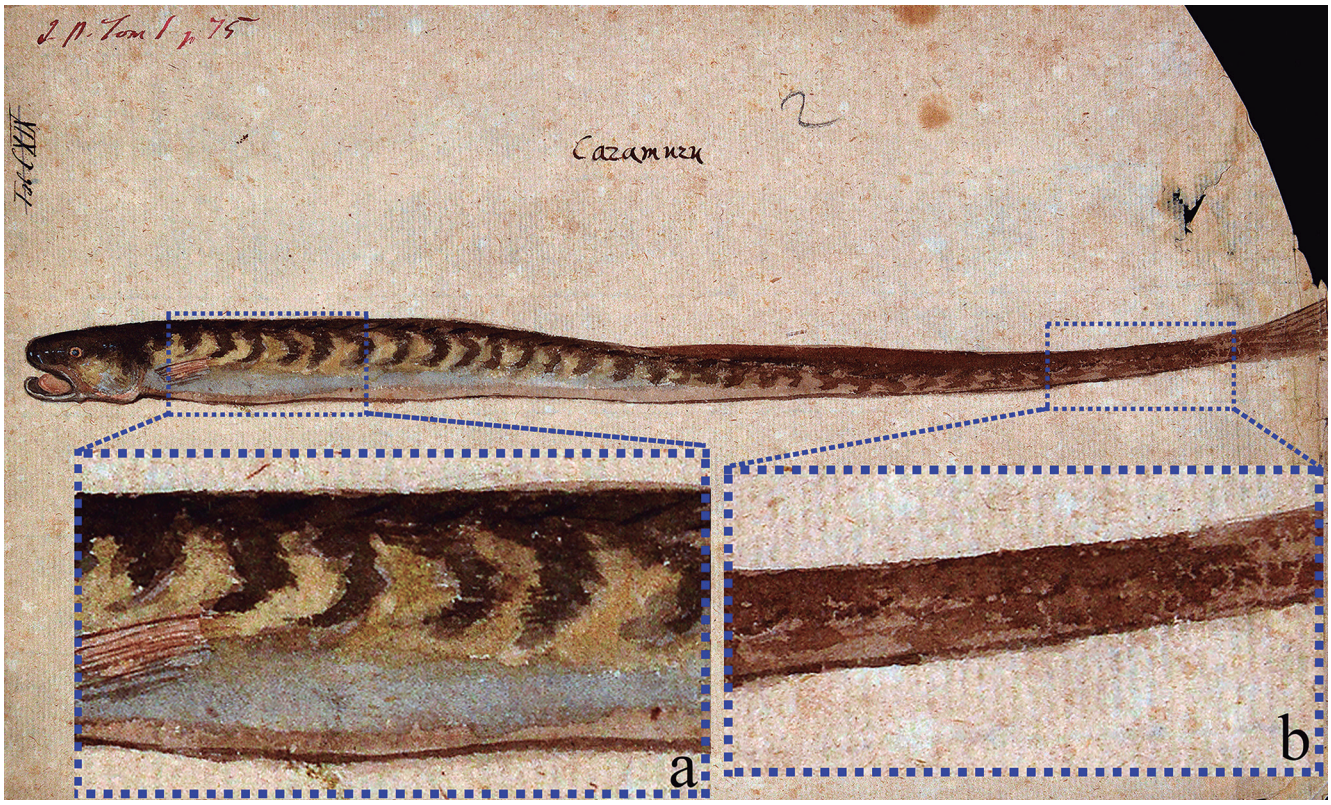
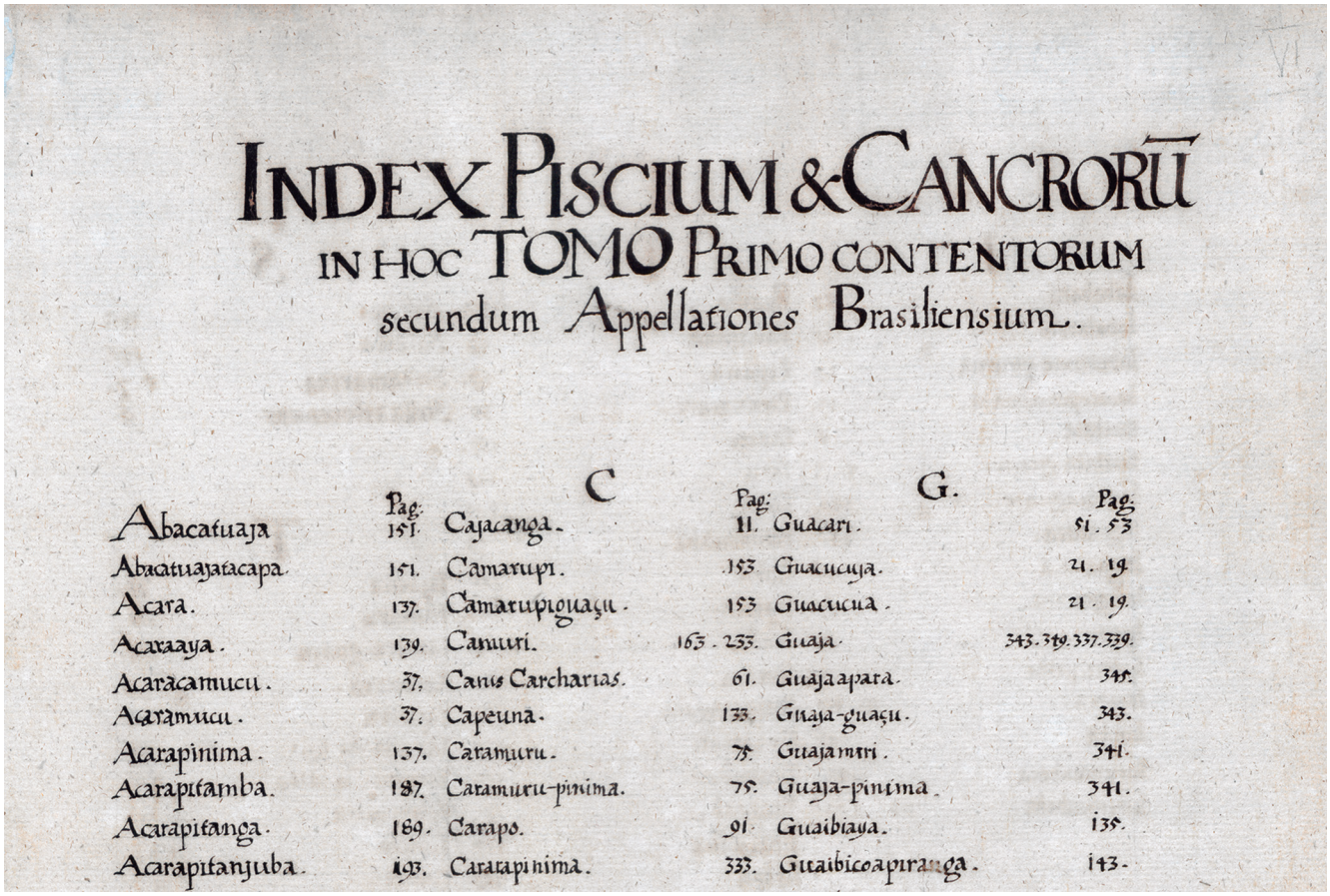


Figure 7. Details of dorsal fin of *"Caramuru"*, by anonymous author (*ca.* 1652), folio 60 of the Series B of the *St. Petersburg Collection*, stored at SPbB ARAS *(St. Petersburg Branch of the Archive of the Russian Academy of Sciences)*, registered under the archival code Ф.51.Оп.1.Д.122.Л.60 (Fond 155, Inventory 1, Folder 122, Folio 60): (A) anterior region; (B) posterior region.


INDEX PISCIUM & CANCRORŪ
IN HOC TOMO PRIMO CONTENTORUM
secundum Appellationes Brasiliensium.

C

	Pag:		
Abacatuaja	151.	Cajacanga.	
Abacatuajaracapa.	151.	Camarupi.	
Acara.	137.	Camarupiguaçu.	
Acaraaya.	139.	Camuri.	
Acaracamucu.	37.	Canis Carcharias.	
Acaramucu.	37.	Capeuna.	
Acarapinima.	137.	Caramuru.	
Acarapitamba.	187.	Caramuru-pinima.	
Acarapitanga.	189.	Carapo.	
Acarapitanjuba.	193.	Cararapinima.	

G.

	Pag:		
	11.	Guacari.	51. 53
	153.	Guacucuja.	21. 19
	153.	Guacucua.	21. 19
163.	233.	Guaja.	343. 349. 337. 339.
	61.	Guajaapara.	345.
	133.	Guaja-guaçu.	343.
	75.	Guajamiri.	341.
	75.	Guaja-pinima.	341.
	91.	Guaibiaya.	135.
	333.	Guaibicoapiranga.	143.

Figure 8. Excerpt of the *"Index Piscium & Cancroru in hoc Tomo Primo contentorum secundum Appellationes Brasiliensium"* of the volume 1 *("Icones Aquatilium")* of the *Theatrum Rerum Naturalium Brasiliae* (Mentzel, 1660-1664) (section A32 of the *Libri Picturati* collection), stored at the *Jagiellonian University Library,* Krakow, Poland.

"caramuru-pinima" usually applies to moray eels of the genus *Gymnothorax* with a mottled color pattern, usually formed by small rounded and oval spots. The Tupi substantive "pinima" means small freckles (Navarro, 2013). This is probably a reference to the Marggraf's oil painting entitled *"Caramurû piníma",* which is part of the second volume of the *Libri Principis* (Fig. 4). This Marggraf's painting unquestionably shows a specimen of the spotted moray *Gymnothorax moringa,* which is widespread in the Western Atlantic, from South Carolina and Bermuda to southeastern Brazil, and is also reported in the islands of Ascension and St. Helena (Menezes, 2003a; Smith, 2012). As will be discussed in greater detail below, Horkel made a note, in red ink, on the *"Caramuru"* of the *St. Petersburg Collection* (Fig. 2) to indicate its correspondence with the Eckhout's *"Caramurû"* of the *Theatrum* (Fig. 1).

Although no *"Caramuru"* is mentioned in the *HNB* (de Laet, 1648), Pies cited a *"Caramurú"* in the *INML* (Pisonis, 1658). Despite the description of the *"Caramurú"* by Pies (Pisonis, 1658) is very abbreviated and lacks illustrations, it provides sufficient information to affirm that it refers to a muraenid of the genus *Gymnothorax* Bloch, 1795 (and not to *Gobioides broussonnetii* or *Echiophis intertinctus*). Pies mentioned that individuals of *"Caramurú"* measure from 10 to 12 palms *("decem aut duodecim palmos longis")* (Pisonis, 1658: 296), *i.e., ca.* 100-120 cm (1 ancient palm = 9.6 cm), a range considerably larger than the maximum size of *G. broussonnetii,* which is known to reach up to about 50 cm SL (*cf.* Cervigón, 1994; Murdy, 1998). More importantly, Pies reported that those fishes are poisonous *("quia morsus illorum quoque sunt admodum venenati")* (Pisonis, 1658: 296), a remarkable biological characteristic which is not known to be present neither in *G. broussonnetii* nor in *E. intertinctus.* Instead, such toxic properties are found in moray eels of the genus *Gymnothorax* (*e.g.,* Randall, 1958; Scheuer *et al.,* 1967; Vernoux *et al.,* 1985a, b; Murata *et al.,* 1990; Böhlke & Randall, 2000; Jiang *et al.,* 2012; Chan, 2017). Accordingly, the presence of toxins has been also detected in *Gymnothorax moringa,* as well as many cases of poisoning by this species have been reported (*cf.* Vernoux *et al.,* 1985a, b; Bourdeau & Bagnis, 1989; Bourdeau, 1992; Gaitán Espitia, 2007; Borbón Ramos, 2015). It is not surprising that *"Caramurú"* was treated by Pies, considering he was especially concerned in describing venomous animals of medical interest (Pisonis, 1658). Furthermore, it is likely that Pisonis's (1658) *"Caramurú"* corresponds to the Georg Marggraf's oil painting on the page 313 of the second volume of the *Libri Principis* (volume A37 of the *Libri Picturati* collection) (Fig. 4), correctly captioned as *"Caramurû piníma".*

The single modern attempt to identify the *"Caramuru"* paintings of the Dutch Brazil was made by Boeseman *et al.* (1990), based on the watercolor of the folio 60 of the Series B of the *St. Petersburg Collection* (Fig. 2). The authors tentatively identified that fish as an individual of the spotted spoon-nose eel *Echiophis intertinctus* (Ophichthidae) (Fig. 9), known to occur in the Western Atlantic, from North Carolina to southeastern Brazil (Menezes, 2003b). Boeseman *et al.* (1990)'s conclusion was probably influenced by the Tupi inscription *"Caramuru"* and by the annotation *"I. P. Tom 1 p. 75",* likely made by Horkel (Fig. 2), to indicate its correspondence with the oil painting *"Caramurû"* of the folio 75 of the volume 1 *(Index Piscium?), Icones Aquatilium,* of the *Theatrum* (Fig. 1), which was also assigned to *"Caramuru-pinima"* by Mentzel (1660-1664) (see above). Furthermore, Boeseman *et al.* (1990) mistakenly recognized the *"Caramuru"* of the *St. Petersburg Collection* as the *"Caramurú"* described by Pies (Pisonis, 1658), which is, as above mentioned, a specie of moray eel of the genus *Gymnothorax,* likely *G. moringa.*

It is relevant to note that the Boeseman *et al.* (1990)'s identification was made with some suspicion by themselves who stated that such proposal should be accepted "taking considerable artistic licence in fin shapes and markings for granted" (Boeseman *et al.,* 1990: 91). It is unclear what those authors meant to say about the fin shapes since they could barely identify the dorsal fin in that painting and the pectoral fin pictured is not much different from that of *E. intertinctus* (Fig. 9); remaining fins were not identified in the *"Caramuru"* of the *St. Petersburg Collection* (Boeseman *et al.,* 1990). The color pattern of the fish depicted in the watercolor of the *St. Petersburg Collection* (Figs. 2, 7) is, in fact, very different from that exhibited by *E. intertinctus,* which is constituted by roughly elliptical blotches of variable size (Figueiredo & Menezes, 1978; Cervigón, 1991; Fig. 9A). In fact, the *"Caramuru"* shows about 30 anteriorly directed dark chevron-like markings on trunk, which are distinctly more conspicuous on its dorsal half (Figs. 2, 7), a color pattern that is, on the other hand, fully compatible with that of *G. broussonnetii* (Figs. 5, 6A). The chevron-like markings along the trunk of Eckhout's *"Caramurû"* are also perfectly represented (Fig. 1), though somewhat less obvious than those of the watercolor of the *St. Petersburg Collection* (Figs. 2, 7).

Boeseman *et al.* (1990)'s identification of the *"Caramuru"* of the *St. Petersburg Collection* as *Echiophis Intertinctus,* from a morphological perspective, was probably based on the elongate body, the presence of the pectoral fin, and the presumed absence of the pelvic fins (Figs. 2, 7). Although the serpentine aspect of ophichthids and muraenids is particularly striking, this condition is also shared by *Gobioides broussonnetii* (Figs. 5, 6A). As mentioned, the absence of the pelvic fin in the paintings of *"Caramuru"* can be explained by the position in which the fish was portrayed, causing the fin to be hidden under the body (Figs. 1-2, 7).

In addition to those incongruencies, several features that are blatantly depicted in the paintings of *"Caramuru"* are missing in *Echiophis intertinctus* whereas they are distinctly exhibited by *Gobioides broussonnetii.* The gill opening of eel morays, including *Gymnothorax,* and *E. intertinctus,* is a small lateroventral slit, extending from the level of the dorsalmost limit of the base of the pectoral fin to just below the level of the mouth cleft (Figueiredo & Menezes, 1978; Cervigón, 1991; Smith, 2012; Fig. 9B), while in *G. broussonnetii* is broad, extending dorsally up above the horizontal line crossing the eye (Figs. 5-6)

as it is evident in the painting of the *St. Petersburg Collection* (Fig. 2), and even more conspicuously in the *Theatrum* painting (Fig. 1). In addition, in *E. intertinctus* the posterior extremity of the mouth extends posteriorly far beyond the vertical through the eye (Figueiredo & Menezes, 1978; Cervigón, 1991; Smith, 2012; Fig. 9B), as is commonly seen in ophichthids and muraenids, whereas in *G. broussonnetii* the corner of the mouth extends posteriorly just to the vertical through the eye (Figs. 5-7), a condition accurately portrayed both in the oil painting of the *Theatrum* (Fig. 1) and in the watercolor of the *St. Petersburg Collection* (Fig. 2).

Figure 9. *Echiophis intertinctus,* USNM 274249, 562.0 mm SL, United States of America, Florida State, Sarasota, "Red Tide" Kill 100 yds South of Cape Haze Marine Laboratory, Gulf of Mexico, Atlantic Ocean: (A) body, right side; (B) detail of head, left side. Photographs of Sandra Raredon.

Boeseman *et al.* (1990) mentioned that the *"Caramuru"* of the *St. Petersburg Collection* had a "vague dorsal fin originates at about half body length (below the middle of the vernacular name)". However, as above mentioned, the dorsal fin is well illustrated in the *"Caramuru"* of the *St. Petersburg Collection,* with its origin far ahead of what was reported by those authors, appearing at least above the third mark of the trunk (Figs. 2, 7), and a little behind in the *"Caramurû"* of the *Theatrum* (Fig. 1), approximately as would be expected in a specimen of *Gobioides broussonnetii* (Figs. 5-6). On the other hand, the dorsal fin of *Gymnothorax* species and *Echiophis intertinctus,* as well as in other ophichthids and muraenids, is unique, low (so that its origin is barely discernible externally), continuously attached to the caudal fin posteriorly (*cf.* Figueiredo & Menezes, 1978; Cervigón, 1991; Smith, 2012; Ray *et al.,* 2015; Fig. 9A). In *G. broussonnetii* there are two dorsal fins connected by a membrane, although the anterior one is distinguishable from the posterior one by its five spinous rays that are inserted closer to each other than the soft rays of posterior dorsal fin, with 18 elements (Murdy, 1998; confirmed in seven specimens, *pers. obs.;* Figs. 5, 6A). The outer border of the pectoral fin of *E. intertinctus* is conspicuously dark (Cervigón, 1991; Fig. 9B) while in *G. broussonnetii* the external border of the fin is yellow, like the other regions of the fin, or is slightly hyaline (Figs. 5-6), as depicted both in the *Theatrum* painting (Fig. 1) and in the painting of the *St. Petersburg Collection* (Fig. 2). All morays lack pectoral fins after metamorphosis (Smith, 2012). Boeseman *et al.* (1990) were uncertain about whether a caudal fin was represented in the painting or not. Although the terminus of the caudal fin has been cropped (Fig. 2), in the same way as in the original *"Caramurû"* of the *Theatrum* (Fig. 1), a detailed examination of the painting shows that the bases of the caudal rays are undoubtedly documented, represented by long brown scratches (Figs. 2, 7A-B). The same condition, though somewhat less conspicuous, is observable in the painting of the *"Caramurû"* of the *Theatrum* (Fig. 1). These observations indicate that the specimen reproduced in both paintings probably had a long caudal fin, which is perfectly compatible with *G. broussonnetii* (Figs. 5, 6A), but not with *E. intertinctus,* which has an inconspicuous caudal fin (Figueiredo & Menezes, 1978; Cervigón, 1991; Fig. 9A).

Therefore, the artist's inaccuracy to paint the *"Caramuru"* of the *St. Petersburg Collection* and, by extension, of Albert Eckhout who authored the *Theatrum*'s *"Caramurû"* and from which the former was probably copied, as implied by Boeseman *et al.* (1990), is largely unfounded because they are both fairly faithful reproductions of an individual of *Gobioides broussonnetii*.

A putative correct identification of the Eckhout's *"Caramurû"* of the *Theatrum* as *Gobioides broussonnetii* could be attributed to Bloch & Schneider (1801), according to information contained in the description of *Gobius brasiliensis,* currently considered a synonym of the former species (Jordan & Evermann, 1898; Murdy, 1988). Although very abbreviated, Bloch & Schneider's (1801: 69) description presented some features that can be recognized in *G. broussonnetii,* namely: body slender *("corpore terete"),* caudal fin elongated and narrow *("cauda elongata, constricta"),* and caudal fin oblong, lanceolate *("pinna caudali oblonga, lanceolate").* Despite that some meristic features mentioned in the description of *G. brasiliensis* do not match *G. broussonnetii* (12 pectoral-fin rays *vs.* 17-20 in *G. broussonnetii;* Murdy, 1998), two of them, although also discrepant, are congruent with long unpaired fins, which are distinctive characteristics of *G. broussonnetii* [18-21 dorsal-fin rays *vs.* 23 (5 + 18) in *G. broussonnetii,* and 19 anal-fin rays *vs.* 17 in *G. broussonnetii*].

Bloch & Schneider (1801: 69) stated that they relied their description of *Gobius brasiliensis* upon information taken from the *Libri Principis* (or *Handbooks*), referred to as *"Pr. Mauritii MS".* Furthermore, the absence of an asterisk preceding the nomen *G. brasiliensis,* used by Bloch & Schneider (1801: xviii) to indicate when specimens from Bloch's collection had been used, seems to reinforce the hypothesis that this species was exclusively described on the basis of a secondary source. However, there is evidence that contradicts or, at least, casts strong doubts on this hypothesis.

First, a complete survey of the *Libri Principis* did not reveal any description or illustration assignable to *Gobioides broussonnetii.* Alternatively, one might think that the source for the description would be *Theatrum*'s *"Caramurû"* (Fig. 1). Nonetheless, it appears that Bloch & Schneider (1801) only examined the *Libri Principis,* never having glimpsed the *Theatrum* (Lichtenstein, 1818; Whitehead & Boeseman, 1989a, b), despite these volumes being available at the same library. More importantly, for the description of *Gobius brasiliensis,* Bloch & Schneider (1801: 69) used many characters that are actually present in *G. broussonnettii,* but that cannot be observed in the *"Caramurû"* painting, such as the shape and size of caudal fin, and the number of the dorsal-, pectoral-, pelvic-, anal-, and caudal-fin rays (Fig. 1). Even more extraordinary is that Bloch & Schneider (1801: 69) mentioned that *G. brasiliensis* had a blue *("coelureo")* body, a characteristic only observable in living specimens of *G. broussonnetii,* which makes this species to be commonly known as "violet goby" in English (Jordan & Evermann, 1898; Dawson, 1969; Pezold, 2015). This information leads us to believe that Bloch & Schneider (1801) used another pictorial source or, more likely, at least one specimen, which would contradict the indication that no fish from the collection was used. Such incongruence is not surprising at all since Schneider *in* Bloch & Schneider (1801) warned that, in many cases, asterisks were either omitted by the printer or originally forgotten. As far as we know, there are no type specimens of *G. brasiliensis* at the Museum für Naturkunde der Humboldt Universität zu Berlin (*cf.* Kullander, 2003), where the fishes of the Bloch collection were transferred at the end of the 19th century (Paepke, 1999). It is possible that Bloch studied other specimens of *G. brasiliensis* (= *G. broussonnetii*) deposited at the Muséum national d'Histoire naturelle, in Paris, where he was in 1797 meeting La Cepède (*cf.* Coquebert, 1800; La Cepède, 1802; Karrer *et al.,* 1994). Curiously, Schneider

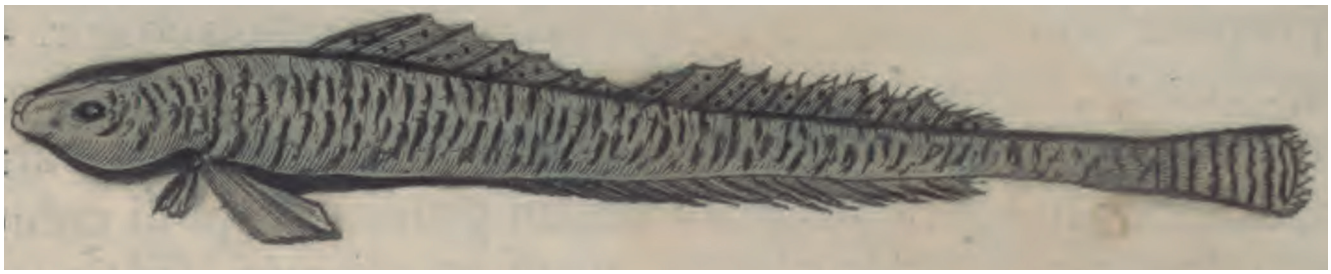


Figure 10. *"Tajasica",* woodcut of *Historia Naturalis Brasiliae* (Marcgravi *in* de Laet, 1648: 144).

in the addendum of Bloch & Schneider (1801: 548) described *Gobius Oblongus* Schneider (1801), supposedly as a replacement name for *G. broussonnetii,* whose holotype is supposedly deposited at the Muséum national d'Histoire naturelle (MNHN-IC-0000-4209; the same holotype for *Gobioides Broussonnetii*). It is possible, therefore, that type specimens of *G. brasiliensis* can be found at this same collection. As a consequence, the suggestion that Bloch & Schneider (1801) identified the *Theatrum "Caramurû"* painting as *G. brasiliensis* and, therefore, as *G. broussonnetii,* remains in the speculative field, demanding more data.

Valenciennes *in* Cuvier & Valenciennes (1837) suggested that Bloch & Schneider (1801) based their description of *Gobius brasiliensis* on the oil painting *"T'áyaçica"* of the *Theatrum* (Fig. 3) while Günther (1861) proposed that the description of that species was inspired in the woodcut of *"Taiasica"* of the *HNB* (Marcgravi, 1648) (Fig. 10). Boeseman *et al.* (1990) agreed with these authors, identifying the painting of the *"Tajasicá"* (Folio 59) of the *St. Petersburg Collection,* possibly a quick copy of the *Theatrum* painting (Fig. 3), as a specimen of *Gobioides broussonnetii* (the senior synonym of *G. brasiliensis* – Murdy, 1998). These conclusions, however, are unfounded since *G. brasiliensis,* even with all the incongruities pointed out, is a junior synonym of *G. broussonnetii* whereas the paintings of *"T'áyaçica"* of the *Theatrum* (Fig. 3) (and its woodcut in the *HNB;* Fig. 10) and *"Tajasicá"* of the *St. Petersburg Collection* (folio 59 of the *St. Petersburg Collection* – Boeseman *et al.,* 1990: pl. 24, bottom right) are based on a specimen of *Awaous tajasica,* as below detailed.

The descriptive text for *"Caramurû"* in the *Historia Naturalis Brasiliae* (1648)

It is intriguing to say the least that Marggraf would have left Albert Eckhout's beautiful image of *"Caramurû" (i.e., Goibioides broussonnetii)* without description. For this reason, we suppose that there could be a descriptive text made by Marggraf for the *"Caramurû"* in the *HNB,* which was wrongly associated with a woodcut. To test this hypothesis, we reviewed all descriptions and illustrations of elongated fishes in the *HNB,* especially those belonging to the order Gobiiformes, hoping to reveal some description or images that could match to Eckhout's *"Caramurû".* In the course of this action, we have found that the description of *"Tajasica"* may be a very good candidate (Marcgravi, 1648: 144), for the reasons detailed below. The woodcut of the *HNB* (Fig. 10) that was associated by de Laet with the description of *"Tajasica"* was based on the oil painting on paper by unknown author (Brienen, 2006, 2010), which currently corresponds to folio 73 of the *Theatrum* (Fig. 3), or both were made from the same, currently lost, original sketch. Pies (Pisonis, 1658: 68-69) also provided a description for a *"Taiasicá",* as well as reproduced its *HNB*'s woodcut, but this is shorter and in no way adds to the Marggraf's (Marcgravi, 1648) much more complete and accurate account (*cf.* Valenciennes *in* Cuvier & Valenciennes, 1837).

To support our hypothesis, we reproduced below every sentence of the Marggraf's decription assigned to *"Tajasica"* (Marcgravi, 1648: 144), originally written in Latin, with our English translation in brackets, followed by comments:

1) *"Piscis octo aut novem digitos longus, corpore obterete & pyramidali, extenuatur enim versus caudam".* [= An eight or nine inches fish, with body depressed and pyramidal, tapering towards the caudal fin.]. The size assigned to *"Tajasica"* by Marggraf, from 8 to 9 inches (Marcgravi, 1648), *i.e.,* 20-22.5 cm, seems to be a rather large for a *Awaous tajasica* specimen. In the two revisions of *A. tajasica* the largest reported specimens did not exceed 17 cm [a 162.9 mm SL male in Watson (1996) and a 168.8 mm SL male specimen in Trevisan (2016)]. On the other hand, *Gobioides broussonnetii* is significantly longer, usually reaching 25 cm SL, but not infrequently exceeding 50 cm SL (*cf.* Cervigón, 1994; Murdy, 1998; Caires & Costa, 2018).

2) *"Caput est illi grossiusculum & compressum: oculi eminentes & nigri, circello áureo: os edentulum".* [= Head is a little thick and depressed: eyes protruding and black, with small golden circle: toothless mouth.]. This portion of the description, while somewhat generic, also seems to apply better to *Gobioides broussonnetii* than to *Awaous tajasica,* as the head of the former is noticeably depressed (Fig. 6) while the head in the latter, on the contrary, is noticeably deep (Figs. 11-12), and the eyes have a conspicuous yellow circle (Fig. 6B), a feature not so evident in *A. tajasica* (Fig. 12A-B). Both species have a single-teeth row on premaxilla, although in *A. tajasica* the teeth are conical, much larger and more robust than in *G. broussonnetii,* whose premaxillary teeth are pointed, much smaller and slender. Thus, it would be easier to confuse an

Figure 11. *Awaous tajasica,* UNT 9259, 134.5 mm SL, Brazil, State of Bahia, Ilhéus, Rio Almada, at Castelo Novo.

edentulous condition in the jaws of *G. broussonnetii* than in *A. tajasica*.

3) *"Sex habet pinnas; nimirum sub qualibet branchia unam oblongam, sub his in medio inferius unam breviorem: unam in medio dorso aliam longiorem versus postremam dorsi partem, & è regione hujus unam in infimo corpore: septima est cauda, oblonga & in exitu rotundata".* [= It has six fins, namely; one elongate under each gill [opening], under these, one short, midventral fin; the longest fin on middorsal [region], towards posterior dorsal part of trunk; and an opposite one, on the ventral region of the body: the seventh is the caudal, elongate and rounded at extremity.]. There is a striking inconsistency in the morphology of the dorsal fin when comparing the description of *"Tajasica"* in the *HNB* (Marcgravi, 1648: 144) and its respective woodcut (Fig. 10) with the fish commonly identified as *Awaous tajasica* (Figs. 11-12) and the original watercolor (Fig. 3) that probably served as a model for that woodcut (Fig. 10). In the description in the *HNB* a single dorsal fin is mentioned for *"Tajasica",* which would be the longest fin, reaching the posterior part of the trunk (Marcgravi, 1648). Accordingly, the woodcut that accompanies the description of *"Tajasica"* shows the first and second dorsal fins noticeably fused together, although there is a concavity apparently marking their limits (Fig. 10). It is noteworthy that the original watercolor of *"Tajasica"* that probably served as the basis for the woodcut used in the *HNB,* as well as the folio 59 of the *St. Petersburg Collection,* its likely copy (Boeseman *et al.,* 1990: pl. 168, bottom right), show a fish in which the first and second dorsal fins are markedly separated from each other (Fig. 3), as already pointed out by Lichtenstein (1822a) and Boeseman *et al.* (1990). Such a condition of the two distanced dorsal fins is precisely that one exhibited by specimens of *A. tajasica* (Figs. 11-12), a feature that Marggraf, a keen naturalist, could hardly have missed it. Interestingly, adults of *Gobioides broussonnetii* (Figs. 5-6) have the first and second dorsal fins distinctively fused to each other (a condition present even in 15.0 mm SL larva – Ruple, 1984: 585, fig. 311), as mentioned in the *"Tajasica"* description in the *HNB* (Marcgravi, 1648). A reasonable conclusion is that de Laet, in his work of editing *HNB,* altered the original representation in the woodcut to make it more compatible with Marggraf's description that he presumed to belong to this species.

4) *"Tegitur squamulis parvis, coloris hyalini pallidi, maculis variis fuscis vermiculatis variegatus per totum, exceptis pinnis postbranchialibus & infimo ventre, quae ex pallido subflavescunt. Cauda est undata fusco".* [= Body is covered with small scales, pale hyaline, with numerous brown vermiculations on the whole body, excepting the postbranchial [pectoral] fins and ventralmost part of the belly, which are pale yellow. Caudal fin is dark.]. The numerous brown vermiculations on the body mentioned in the Marggraf's description assigned to *"Tajasica"* (Marcgravi, 1648) may be either the irregular bars in the oil painting of the *Theatrum*'s *"T'áyaçica"* (Fig. 3), also represented in the woodcut of the *HNB* (Fig. 10) or the chevron-like markings of the Eckhout's *"Caramurû"* (Fig. 1). In the Marggraf's description assigned to *"Tajasica",* the caudal fin is said to be dark (Marcgravi, 1648), which does not match either the oil painting on paper of the Folio 73 of the *Theatrum* (Fig. 3), nor the woodcut of the *HNB* (Fig. 10), nor specimens of *Awaous tajasica,* whose caudal fin is hyaline with irregular dark bands (Figs. 11-12). On the other hand, the caudal fin of *Gobioides broussonnetii* is markedly dark (Figs. 5, 6A), as in this description.

5) *"Latet in arena absconditus, ideoque capitur pedibus, eos ponendo super arenam ubi latet".* [= This fish lies hidden in the sand, and therefore it can be caught when one put the feet on the sand where it lies.]. Such brief characterization of fish behavior and habitat applies to both *Awaous tajasica* and *Gobioides broussonnetii,* although the former is most commonly encountered in gravel bottoms (*pers. obs.*). Interestingly, dragging feet through mud in shallow waters to dislodge individuals from their burrows is a fundamental step in artisanal fishing for *G. broussonnetii* in Vigia, at the mouth of the Amazon River, in Pará state, Brazil (Bragança, 2005).

6) *"Coctus atque assus bene sapit & convenit cum Hollandorum Post est enim carne albissima & friabili".* [= Baked or roasted has good flavor and resembles the Dutch "Post", with white and friable flesh.].

Figure 12. *Awaous tajasica:* (A) approximately 30.0 mm SL, juvenile, live specimen in aquarium (not preserved), Brazil, São Paulo State, Ubatuba, Rio Puruba, under the bridge on road BR-101, about 1.5 km from its mouth in Atlantic Ocean (23°20′58″S, 44°56′41″W); (B) approximately 40.0 mm SL, juvenile, live specimen in aquarium (not preserved), the same specimen in "a", photograph of Pedro P. Rizatto; (C) approximately 12 cm TL, adult, live specimen in natural habitat (not preserved), Brazil, São Paulo State, Itanhaem, unnamed stream affluent of Rio Branco (Rio Itanhaem basin) (24°01′36.2″S, 46°42′19.6″W), photograph of Ricardo M.C. Castro, taken on December 18, 2017.

Although we cannot say anything about its gastronomic characterization, it is more likely that a larger fish, such as *Gobioides broussonnetii,* would be more commonly used in food.

Therefore, several characters in Marggraf's description of *"Tajasica",* related to morphology of the head and dorsal and caudal fins, coloration, and even ecological and behavioral attributes, form a compelling body of evidence that its correspondence with the *HNB* woodcut is incorrect. As we concluded, this is most likely the description that would apply to Albert Eckhout's *"Caramurû",* herein identified as *Gobioides broussonnetii*.

The question of the identity of the illustrations of *"Tajasica"* and their correspondence with *Awaous tajasica*

In view of the finding that Marggraf's description of *"Tajasica"* in the *HNB* (Marcgravi, 1648) actually corresponds to Eckhout's *"Caramurû"* (Fig. 1) and, consequently, to *Gobioides broussonnetii,* it remains to be seen whether the woodcut with which the *HNB* description was associated (Fig. 10), and its original *Theatrum* painting (Fig. 3), may on fact be assigned to *Awaous tajasica* or another fish species.

Since the formal description as *Gobius Tajasica* (= *Awaous tajasica*) by Lichtenstein (1822a), there have been doubts about the identity of this species and its correspondence with Marggraf's *"Tajasica"* in the *HNB* (Marcgravi, 1648). Valenciennes *in* Cuvier & Valenciennes (1837) questioned the matching between Marggraf's *"Tajasica"* (Marcgravi, 1648) and *Gobius Tajasica* (= *Awaous tajasica*), by arguing that the specimens studied by Lichtenstein (1822a) to describe that species have a much larger head than that depicted in the *Theatrum*'s *"T'áyaçica"* (Fig. 3), and they are smaller, concluding that the fish portrayed in that painting would be *Gobius brasiliensis* (therefore, *Gobioides broussonnetii,* its senior synonym – Murdy, 1988). Jordan & Evermann (1898) agreed with Valenciennes *in* Cuvier & Valenciennes (1837), but they did not add any information on this issue. Boeseman *et al.* (1990) also misidentified the *"Tajasicá"* of the folio 59 of the *St. Petersburg Collection* and, by extension, the *"T'áyaçica"* of folio 73 of volume I of the *Theatrum* (Fig. 3) and its corresponding woodcut in the *HNB* (Fig. 10), as *G. broussonnetii.* Such suggestions are based, in our opinion, on the misrepresented, excessively elongated *A. tajasica* in the *Theatrum* oil painting (Fig. 3) and in woodcut of the *HNB* (Marcgravi, 1648) (Fig. 10), an imperfect condition also reproduced in the *"Tajasicá"* of the folio 59 of the *St. Petersburg Collection* (Boeseman *et al.,* 1990: pl. 24, bottom right). We also assume that none of these authors carefully read the descriptive part of the *"Tajasica"* (Marcgravi, 1648), which would lead them to perceive the incongruity of the description with the engraving that accompanies it (Fig. 10).

Boeseman *et al.* (1990) further added that the Lichtenstein (1822a) specimens would presumably be identical to Marggraf's *"Amore Guacu"* (Marcgravi, 1648: 166). Despite some compatible generic characters, the description of *"Amore Guacu"* (Marcgravi, 1648) presents several features inconsistent with those of *Awaous tajasica,* namely: small eyes *("Oculli illi parvi…"),* general rusty coloration, but a little white in the belly *("Piscis in totum ferrei coloris, in ventre tamen paululum è ferreo albicat".),* and is said to be edible *("Est edulis".).* Indeed, the woodcut of *"Amore Guacu"* in the *HNB* (Marcgravi, 1648) very vaguely resembles a specimen of *A. tajasica,* bearing a totally different color pattern. On the other hand, it closely resembles *Eleotris pisonis* (Gmelin, 1789) (Eleotridae), as previously suggested by Valenciennes *in* Cuvier & Valenciennes (1837) [as its junior synonym *Eleotris gyrinus* Valenciennes *in* Cuvier & Valenciennes, 1837 (*cf.* Castro-Aguirre *et al.,* 1999)]. Watson (1996: 13) stated that Lichtenstein (1822a: 273) based the original description of *Gobius Tajasica* on a woodcut, presumably the one associated with Marggraf's description of *"Tajasica"* (Fig. 10) (Marcgravi, 1648). However, this does not seem to be the case since the author, in his description of *Gobius Tajasica,* only mentioned that the individuals he received from Brazil (which are the type specimens) agreed with Marggraf's description of *"Tajasica"* (Marcgravi, 1648). Indeed, despite Lichtenstein (1822a)'s mere mention that the description of *Gobius Tajasica* agreed with that of *"Tajasica"* (Marcgravi, 1648), there is no objective evidence that the author based his description, even part of it, on the Marggraf's *"Tajasica"* in the *HNB* (Marcgravi, 1648), such that the fish on which Marggraf's description was based does not become one of the types of *G. Tajasica.* Unfortunately, Lichtenstein (1822a) gave the specific epithet of *"Tajasica"* to his new species, greatly contributing to the confusion. It is likely, therefore, that Lichtenstein (1822a) only referred to the woodcut that accompanies the description (Fig. 10), this one actually belonging to *Awaous tajasica,* as we will argue below.

From our perspective, the morphological characterization of *Gobius tajasica* (= *Awaous tajasica*) provided by Lichtenstein's (1822a) is fully compatible with the fish being currently identified as *Awaous tajasica:* the total length of 15.0-17.5 cm (6-7 inches); transverse markings along the entire body; head contained 5 times in body length; 6 rays in the first dorsal-fin; 12 rays in the second dorsal-fin; 16 rays in the pectoral fin, 5 rays in the pelvic fin; 12 rays in the anal fin; rounded caudal fin; jaws with sharp teeth; and soft, thick, prominent lips (*cf.* Watson, 1996; Trevisan, 2016; Figs. 11-12). Although there may be some doubts about specific details of the Lichtenstein's (1822a) description which cannot be resolved because the type specimens are currently lost (Kullander, 2003; Peter Bartsch, *pers. comm.*), we are quite confident that description can be attributed to the species currently recognized as such (Figs. 11-12). In addition, several characters illustrated in the oil painting of *"T'áyaçica"* of the *Theatrum* (Fig. 3) and its respective woodcut in the *HNB* (Marcgravi, 1648; Fig. 10) indicate that those illustrations actually correspond to a specimen of *A. tajasica.* Despite of its poor quality, the oil painting of *Theatrum* (Fig. 3) is

technically and artistically much better than the woodcut (Fig. 10), showing details that are typical of *A. tajasica* (but not of *Gobioides broussonnetii*), namely: lateral profile of the snout forming a broad curve down; prominent cheek, produced by hypertrophied jaw musculature; medium sized eye; small, subterminal mouth, with gape extending posteriorly on vertical well anterior the orbital edge; and irregular, narrow bars on the head, trunk, and dorsal and caudal fins (Figs. 11-12). Although the watercolor of the folio 59 of the *St. Petersburg Collection* is probably a poorer copy of the *Theatrum*'s *"T'áyaçica"* (Fig. 3), the same distinctive characteristics of *A. tajasica* can also be found there (Boeseman *et al.,* 1990: 24, bottom right).

In short, even knowing that the recognition of the identity of *Awaous tajasica* would greatly benefit from the examination of its type specimens, which currently could not be found (Kullander, 2003; Peter Bartsch, *pers. comm.*), the description offered by Lichtenstein (1822a) is enough to characterize the species. In addition, the woodcut associated with the descriptive part of the *"Tajasica"* (Marcgravi, 1648) (Fig. 10), but especially the oil painting of the *Theatrum* that served as its basis (Fig. 3), despite the imperfections, also allow us to identify *A. tajasica*.

The vernacular names historically applied to *Gobioides broussonnetii*

It is relevant to mention that the vernacular name *"Tajasica",* and other variants (*e.g.,* "tajacica", "taissica-pintada"), are applied locally to *Gobioides broussonnetii* (Garcia, 1915; Rosa, 1980; Costa, 1937, 1976), but not to *Awaous tajasica*. Garcia (1915), in his lexicon about words used in the State of Pernambuco, Brazil, mentioned that the local name for *"Gobios* [sic] *brasiliensis",* a junior synonym of *G. broussonnetii* (Murdy, 1998), is "tajacica", which has been repeated in more current regional dictionaries (Costa, 1937, 1976). Rosa (1980) cited the popular name "taissica-pintada" for *G. broussonnetii* in the Paraíba State, northeastern Brazil. The mistaken use of the Tupi name "tajacica", and its variables, to *Awaous tajasica* (*e.g.,* Ihering, 1940, 1968) was likely perpetuated by the mismatch between the Marggraf's description of *"Tajasica"* (Marcgravi, 1648: 144), which corresponds to *G. broussonnetii* and the woodcut (Fig. 10) and its respective watercolor of the *Theatrum* (Fig. 3), which, in fact, are representations of *A. tajasica,* as we also concluded.

Other vernacular names used for *Gobioides broussonnetii* in northeastern Brazil are "aimoré", "amborê", and variants (*e.g.,* Soares-de-Sousa, 1587; Araújo *et al.,* 2004). In northern Brazil, it is known as "amuré" (Bragança, 2005). While dealing with the benthic fishes that inhabit the mud bottoms in Bahia, northeastern Brazil, Soares-de-Sousa (1587) recognized two morphological types of gobiids inhabiting the estuaries of rivers. One of them was called "aimoré", said bearing the appearance and color of "enxarrocos" (fishes of the family Cottidae, Scorpaeniformes). Among the species of gobiids that occur in estuarine environments in northeastern Brazil (Araújo *et al.,* 2004), the most plausible to be the Soares-de-Sousa (1587)'s *"aimoré"* is *Bathygobius soporator* (Valenciennes, 1837), due to the general aspects of head and trunk, shape and arrangement of the fins, including a wide pectoral fin, and the mottled color pattern (*cf.* Figueiredo & Menezes, 1978; Cervigón, 1994). Papavero & Teixeira (2014) identified the Soares-de-Sousa (1587)'s *"aimoré"* as *G. broussonnetii* but provided no justification for such a decision. The second gobiid quoted by Soares-de-Sousa (1587) was the *"aimoréoçú"* (= "amoregûasu" according to Navarro, 2013), which would, according to him, resemble the "eirós" from Lisbon, which are eels *Anguilla anguilla* (Linnaeus, 1758) (Anguiliidae, Anguiliformes). Such a comparison made by Soares-de-Sousa (1587) was probably induced by these fishes share an elongate body aspect, a feature also consistent with *G. broussonnetii,* which we believe is its best identification. Furthermore, the Tupi suffix "-gûasu" (or "-üasu") of the name *"amoregûasu"* means large (Navarro, 2013), a qualifier more suitable for *G. broussonnetii* that is the largest gobiid from northeastern Brazil (*cf.* Araújo *et al.,* 2004), with adults commonly measuring 25 cm SL, but nor rarely reaching up to 50 cm SL or more (*cf.* Cervigón, 1994; Murdy, 1998; Caires & Costa, 2018). Papavero & Teixeira (2014) recognized Soares-de-Sousa's (1587) *"aimoréoçú"* as *Awaous tajasica,* perhaps based on Ihering (1940, 1968)'s "emboré-guaçu" that was identified as *Chonophorus tajacica,* which is, instead, a short-bodied and much smaller gobiid, reaching the maximum length of 16.9 mm SL (Trevisan, 2016) (Figs. 11-12). In addition, although *A. tajasica* can be found in brackish waters, the primary occurrence of adults is in freshwaters, in sand or rocky habitats of the lower reaches of rivers where salinity is zero (Sabino & Castro, 1990), while a muddy environment at the mouth of rivers, as reported by Soares-de-Sousa (1587), is much more typical of *G. broussonnetii* (Cervigón, 1994; Smith, 1997; Barletta-Bergan *et al.,* 2002; Bragança, 2005; Rodríguez & Villamizar, 2006). Soares-de-Sousa (1587), therefore, provides the first putative record of *G. broussonnetii* in the literature, then named *"aimoréoçú".*

The vernacular names "amoreia" or "amoré" are sometimes used to denominate anguilliforms in Brazil, being probably corruptions of the Portuguese terms "amorea" or "moreia", of Greco-Roman origin, that are applied to these fishes in Portugal (*cf.* Valle, 1585 *in* Ayrosa, 1938; Soares-de-Sousa, 1587 *in* Varnhagen, 1879). These European vulgar names were appropriated by the Brazilian language probably in the seventeenth century causing considerable confusion because of the phonetic similarity with the Tupi name "aimoré", which applies originally to gobiids (*cf.* Papavero & Teixeira, 2014).

The authorship of the writings on the paintings of the *"Caramuru"*

As already known, the paintings of the *"Caramuru"* of the *Theatrum* and *St. Petersburg Collection* display numerous writings that represent different historical layers.

Accurately determining the authors of these annotations, or at least excluding some hypotheses of authorship, beyond the historical value *per se,* is critical to building an understanding of what led to their tortuous taxonomic paths.

It is highly tempting to attribute that mistake of identifying the goby *Gobioides broussonnetii* as a *"Caramuru"* to Johannes de Laet because he was the first reviewer of the Marggraf's work, having assumed the difficult task of matching the naturalist's texts with the paintings produced during the Mauritian period in Dutch Brazil (Ihering, 1914; Albertin, 1986; Françozo, 2010). De Laet's well-known errors in associating text with paintings (which probably served as the basis for the *HNB* woodcuts) are by no means surprising, considering that Marggraf's texts are often summary, the reference works on the Brazilian fauna and flora were very limited at that time, and such a work was conducted without any assistance from Marggraf (already deceased at time) and Pies. In one of the most egregious cases, de Laet (1648) listed among the reptiles an individual of the fish *Myrichthys ocellatus* (Lesueur, 1825) (Ophichthidae), treated as *"Amore pinima"* (Lichtenstein, 1822b; Martius, 1863, Boeseman *et al.,* 1990). To support his taxonomic decision, de Laet (1648) added a snake tongue to the woodcut in the *HNB,* which is absent in the corresponding oil painting on paper of the *Theatrum* (*cf.* Mentzel, 1660-1664; Ferrão & Soares, 1993, 1995). De Laet (1648) also failed to find the illustration of the "mucu" among the paintings, whose description clearly refers to "mussum" *Synbranchus* sp. (Synbranchidae, Synbranchiformes), which is actually on page 383 of the second volume of the *Libri Principis* (*Libri Picturati,* Vol. A37). Therefore, it would seem quite reasonable to place this new error of matching the descriptive part and the illustration (woodcut) of *"Tajasica"* in the *HNB* in de Laet's account. However, it is noteworthy that none of the Tupi names that appear in the *HNB* (de Laet, 1648) were written with graphic accents, diacritical marks, and letter c-cedilla, which contrasts with the flagrant zeal for these linguistic details in the nomenclature applied to the naturalistic paintings of the Dutch Brazil. This finding may suggest that at least some mistaken names in the *HNB* may have already been written on the paintings and drawings when they were still in Dutch Brazil, having been these names only uncritically repeated by de Laet.

It has been suggested that some inscriptions of the popular names in the *Theatrum*'s paintings were either by Christian Mentzel, when written in small block letters, in black ink, or by the painter, when in gray calligraphy (Schneider, 1938; Albertin, 1986). As is well known, Mentzel assigned the popular names to organisms illustrated in the paintings during his work of organizing them for the *Theatrum, Libri Principis,* and *Miscellanea Cleyeri* sets (Albertin, 1986). Such associative work was based on the descriptions and woodcuts appearing in the *HNB* and *INML* (de Laet, 1648; Pisonis, 1658). By mistakenly assuming that the *"Caramurû"* of the *Theatrum* and the *"Caramurû piníma"* of the second volume of the *Libri Principis* (Marggraf, *ca.* 1638-1644) were the same fish, Mentzel placed two entries of names in the index for the former painting (Fig. 8). However, we do not believe this inscription on canvas of the *"Caramurû"* is either authored by Mentzel, for the following reasons. Firstly, the letters of this inscription (Figs. 1, 13A) are quite distinct from those surely belonging to him, as, for instance, those annotations made on the cardboard that frames the paintings, in the present case, one above the painting (Figs. 1, 13B), which reproduces the name of the painting, and another below of the same (Figs. 1, 13C), which makes reference to the *Libri Principis.* Indeed, the letters of the name *"Caramurû"* of the *Theatrum* are tilted to the right, besides that author used a graphical accent in the attempt to register the most faithful native pronunciation (Figs. 1, 13A) while the Mentzel's letters are vertical and this author never used graphical signs (Figs. 1, 13B-C). At last, it is noticeable that the identifications with vernacular names are made directly on the canvases. It is well known that the Elector of Brandenburg, owner of the paintings, was very careful with his collection, as expressed by Mentzel himself (1660-1664). In line with this assumption, Mentzel added a cardboard frame to each painting to protect them and to have a surface for himself to make notes. Therefore, it is quite possible that if Mentzel intervened directly in the originals, such as adding inscriptions to them, he would cause an unwanted dissatisfaction to his master.

It is quite remarkable that all paintings of fishes and crustaceans of the *Theatrum* attributed to Albert Eckhout have their presumed corresponding Tupi names recorded in the same handwriting as the *"Caramurû"* (*e.g.,* Figs. 1, 13A), unlike what happens with *Theatrum* paintings assigned to other artists (*e.g.,* Fig. 3). The *"Caramurû"* painting is one of the 20 illustrations of the 69 that make up the volume *"Icones Aquatilium"* of the *"Theatrum"* that was safely attributed to Albert Eckhout, based on stylistic comparisons (Brienen, 2006, 2010). At first sight, this might suggest that it is Eckhout's own handwriting. However, there is evidence, commented below, that leads us to formulate an alternative hypothesis.

The vernacular name *"Caramurû"* of the *Theatrum* (Mentzel, 1660-1664) is handwritten, in italicized, black, tilted to the right letter, placed at the top of the canvas, above the fish illustration (Figs. 1, 13A). First of all, that writing style is quite distinct from that of Eckhout (*cf.* Egmond & Mason, 2004). On the other hand, that morphology of the handwritten letters (Fig. 13A) bears strong resemblance to the Georg Marggraf's handwriting, which is well characterized in the Tupi names that he wrote in each of the numerous paintings of the *Libri Principis* (Fig. 13F), most of his own making (*cf.* Ferrão & Soares, 1995).

The last letter "u" of the word *"Caramurû"* in the *Theatrum* has a circumflex accent, probably intended to indicate the stressed syllable of the word. Several of the Tupi names that appear in *Theatrum* and *Libri Principis* were written using graphic accents to indicate stressed syllables, sound elision, and letter suppression, likely in attempt to register the most faithfully the native pronunciation. These language resources were probably used by

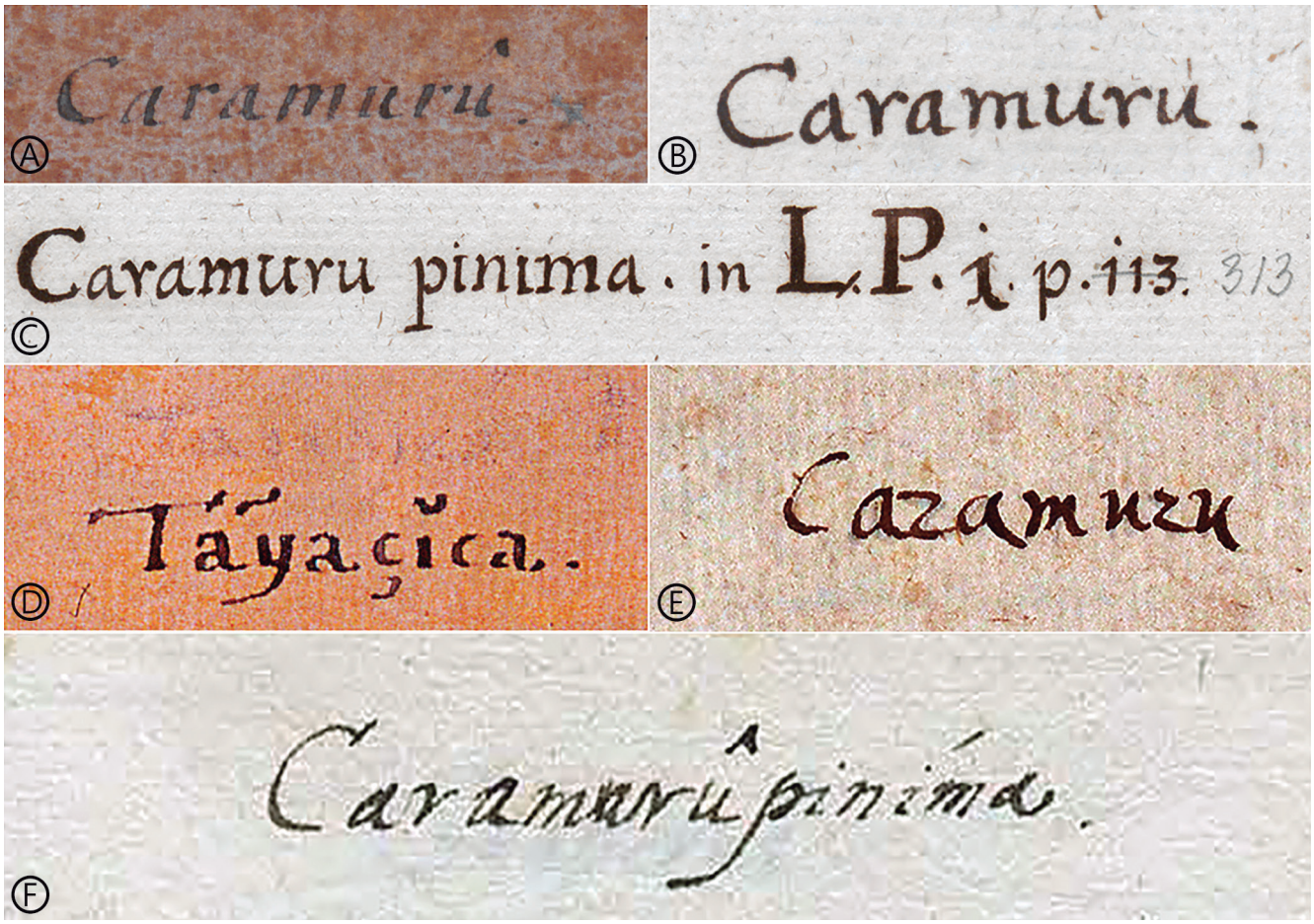


Figure 13. Details of the annotations of Tupi names captioned on paintings of the Mauritian period of the Dutch Brazil (1637-1644): (A) *"Caramurû",* on oil painting on paper by Albert Eckhout (1637-1644), folio 75 of the volume 1 *("Icones Aquatilium")* of the *Theatrum Rerum Naturalium Brasiliae* (Mentzel, 1660-1664), probably written by Georg Marggraf; (B) *"Caramuru",* on background cardboard of the Eckhout's *"Caramurû",* written by Christian Mentzel; (C) *"Caramurû piníma"* (= *Gymnothorax moringa*), on background cardboard of the Eckhout's *"Caramurû",* written by Christian Mentzel; (D) *"T'áyaçica",* on oil painting on paper by anonymous author (1637-1644), folio 73 of the volume 1 *("Icones Aquatilium")* of the *Theatrum Rerum Naturalium Brasiliae* (Mentzel, 1660-1664), written by unknown author; (E) *"Caramuru",* on watercolor (*ca.* 1652), folio 60 of the Series B of the *St. Petersburg Collection,* written by unknown author; (F) *"Caramurû piníma"* (= *Gymnothorax moringa*), on watercolor likely authored by Georg Marggraf (*ca.* 1638-1644), page 313 of the second volume of the *Libri Principis,* written by Georg Marggraf.

those who were close to the sound source and who had a good command of the local language; such graphic accents were mostly suppressed in subsequent versions, such as *HNB* (de Laet, 1648) and *INML* (Pisonis, 1658).

In this regard, Marggraf is an excellent candidate because he was known to be talented with multiple languages, including Latin and Portuguese, as witnessed by one of his surviving letters addressed to de Laet (*cf.* Whitehead, 1979a). Furthermore, just like the word *"Caramurû",* all Tupi names in the *Libri Principis,* mostly handwritten by Marggraf, also bear graphic accents. For these reasons, we believe who wrote the name *"Caramurû"* on the *Gobioides broussonnetii*'s painting by Eckhout, which is presently part of the *Theatrum,* was Georg Marggraf himself.

It is not surprising that Marggraf's handwriting appears in Eckhout's paintings. Albert Eckhout was by far the most skilled artist of naturalistic objects at Johan Maurits van Nassau-Siegen's disposal. Therefore, it was to be expected that Eckhout's work was closely supervised by Georg Marggraf, who probably identified the organisms in the paintings by adding their regional names.

It was not possible to recognize the authorship of the handwriting in the *"T'áyaçica"* painting of the *Theatrum* (Fig. 3), though it is quite different from that attributed to Marggraf (compare Figs. 13D and 13F). The same rationale used to consider the Tupi name *"Caramurû"* in the Eckhout's painting as an inscription that preceded the return of Dutch Brazil paintings to Europe may be applied to *"T'áyaçica",* since this word was spelled with graphic accent and diacritical marks (Figs. 3, 13D). In any case, the erroneous association between the text of the *"Tajasica"* of the *HNB* (which corresponds to *Gobioides broussonnetii*) and the *"T'áyaçica"* painting of the *Theatrum* (which, in fact, corresponds to a specimen of *Awaous tajasica*), caused that the Eckhout's *"Caramurû"* (a specimen of *G. broussonnetii*) was left without its corresponding description.

We conclude that all those writings were made in Brazil, therefore before reaching de Laet's hands (and obviously Mentzel's as well), as the inscriptions have many graphic accents (Figs. 1, 3, 13A, 13D, and 13F), something that only someone familiar with the Portuguese could do. However, a technical comparison of the name

"Caramurû" written in the Eckhout's oil painting with de Laet's handwriting is still pending to definitively exclude the possibility of his authorship of this inscription in that painting. Actually, an in-depth investigation of the annotations made on the paintings of the Dutch Brazil during the Mauritian period, aiming at identifying their authorships and dating, still needs to be undertaken. The findings will certainly illuminate solutions to taxonomic puzzles such as those discussed here.

For composing the *Theatrum,* each canvas was mounted on a lighter cardboard paper. On the cardboard framing the *Theatrum*'s *"Caramurû"* there are two inscriptions in black ink, both with the same handwriting (Fig. 1), attributed to Christian Mentzel (Schneider, 1938; Albertin, 1986): the smaller, located above the painting, is a copy of the vernacular name that appears on the painting without graphical accent, and the larger, where it reads *"Caramuru pinima, in L.P.i, p. 113"* ("*p. 113*" is crossed out and corrected in pencil to "*p. 313*") (Fig. 1). This latter is likely a Mentzel (1660-1664)'s attempt to associate it to the Georg Marggraf's oil painting on the page 313 of the second volume of the *Libri Principis* (volume A37 of the *Libri Picturati* collection) (Fig. 4), which is doubtless a specimen of *Gymnothorax moringa*.

As expected, there is no collation of the Eckhoult's *"Caramurû"* painting with the *HNB* or *INML,* as Mentzel did for many other *Theatrum* paintings, when noting in the header of the frame. Indeed, Mentzel, in the *Theatrum*'s preface, clarified that illustrations and descriptions were not perfectly attached and some descriptions were not associated to any of the drawings. It is supposed that Mentzel made no association with these works, although Pies mentioned in his *INML* a writing text for a *"Caramurú"* (Pisonis, 1658: 296). This Pies *"Caramurú"* was the Marggraf's *"Caramurú Piníma"* of the *Libri Principis.* Curiously, in the index of common names of Brazilian fishes and crustaceans *("Index Piscium & Cancroru in hoc Tomo Primo contentorum secundum Appellationes Brasiliensium")* of the *Theatrum,* Mentzel (1660-1664) provided two entries to the folio 75, which corresponds to the Eckhout's *"Caramurû": "Caramuru"* and *"Caramuru pinima"* (Fig. 4).

The number "27" in Arabic numerals, written in pencil in the lower right corner of the paper, corresponds to the sequenced numbering of the paintings that make up the volume 1 *("Icones Aquatilium")* of the *Theatrum.* Albertin (1986) attributed this inscription to Horkel, when in 1832 he made a comparative study between the drawings of the *Theatrum* and those of the *St. Petersburg Collection,* which seems to be a plausible guess.

The author of the *"Caramuru"* of the *St. Petersburg Collection* (Fig. 2), as well as all other paintings and drawings contained in this collection, cannot be determined. This painting is captioned by the Brazilian vernacular name *"Caramuru",* lacking any graphic accent, positioned above the fish, written in Nankin ink, bearing the same position, font size and writing style (Figs. 2, 13B) (though clearly different) as the inscription on Eckhout's painting in the *Theatrum* (Figs. 1, 13A), identified herein as belonging to Marggraf. This appears to be the generalized layout of the *St. Petersburg Collection,* as it can be appreciated from a cursory analysis of the other folios of the Series B (*cf.* Boeseman *et al.,* 1990). There is a top-left inscription in red ink *("I. P. Tom 1 p. 75")* (Fig. 2), presumably made by Horkel (Whitehead & Boeseman, 1989a, b; Boeseman *et al.,* 1990), to indicate its correspondence with plate 75 of Volume 1 *(Index Piscium?), Icones Volatilium,* of the *Theatrum.* In the upper part of the left border (Fig. 2), there is a black ink inscription of Roman numerals *("Taf CXIX"),* which seemingly refers to "fishes and aquatic crustaceans" (Boeseman *et al.,* 1990); this inscription is crossed out by a pencil scratch. Unlike other folios of the Series B, in the painting of *"Caramuru"* there is no indication of the corresponding pages in the *HNB* and/or *INML,* suggesting that the person who took the notes did not recognize that fish in these works, either in woodcuts or in texts.

The use of Tupi name "caramuru" and its variants

The application of the Tupi name "caramuru" to *Gobioides broussonnetii* is remarkable because there is no other record of its usage for this species or its synonyms. In Atlantic waters, the Tupi name "caramuru" and its variants, such as "caramurú", "caramurù", "caramaru", "curumara", and "karamuru", are consistently applied to moray eels belonging to the families Muraenidae and Ophichthidae, from at least the sixteenth century to the present day, including to those whose representants are found in the northeastern Brazil [*e.g.,* Cardim, 1583 *apud* Papavero & Teixeira, 2014; Valle, 1585 *in* Ayrosa, 1938 (cited as Anonymous, 1622 by Ayrosa, 1938, but authorship recognized as belonging to Father Leonardo do Valle by Papavero & Teixeira, 1999); Soares-de-Sousa, 1587 *in* Varnhagen, 1879; d'Abbeville, 1614; Cardim, undated (before 1625); Pisonis, 1658; Father Anselm Eckart, undated, and two anonymous manuscripts, one from 1756 and one undated, all from the 18th century *apud* Papavero, 2015; Martius, 1863; Castelnau, 1855; Tastevin, 1922; Ihering, 1940, 1968; Figueiredo & Menezes, 1978]. Castelnau (1855) even utilized this Tupi name to compose the specific epithet for a moray eel he recognized as new, then being baptized as *Murenophis caramuru* Castelnau, 1855 [currently a junior synonym of the spotted moray *Gymnothorax moringa* – Smith, 2012], in reference to its common name given in Bahia, northeastern Brazil. As mentioned above, Georg Marggraf himself, on *p. 313* of the second volume of the *Libri Principis* (section A-37 of the *Libri Picturati*), correctly used the popular name "caramuru" for a muraenid species (Fig. 4).

These findings make us believe that the name of *"Caramurû"* written in the oil painting of the *Theatrum* was a mistake. Indeed, there are a few reports in the literature of the usage of the name "caramuru" for fishes other than moray eels. There is a single reference to the use of the name *"Carámurú"* for the South American lungfish *Lepidosiren paradoxa* Fitzinger, 1837 (Lepidosirenidae) in the Rio Madeira, in the locality of "Borba" (Natterer, 1839). All further applications of the name "caramuru" for

L. paradoxa in the literature are secondary sources, actually based on Natterer (1839) (*e.g.,* Hogg, 1841; Duméril *et al.,* 1854; Günther, 1880; Miranda-Ribeiro, 1909; Magalhães, 1931). Castelnau (1855) mistakenly suggested that such a name (which was wrongly spelled by him as *"Caraucuru"*), could be a corruption of "caramuru". The misleading idea that the term "caramuru" would also be used interchangeably with the Tupi term "pirapucu" (actually the characin *Boulengerella* Eigenmann, 1903) (*e.g.,* Magalhães, 1931) probably originates in the glossary of Brazilian indigenous languages by Martius (1863), where it is mentioned that these words would have the same meaning (*i.e.,* elongated fish), but not that they could be interchangeably applied for the same fish species. Apparently, from the 18th century (see Jesuit manuscripts in Papavero, 2015) the Tupi name "caramuru" was also employed to designate lampreys (*e.g.,* Varnhagen, 1879; Navarro, 2013), due to mistaken assumption by European travelers that they were the same or closely related fishes.

Although elongated, the general appearance of *Gobioides broussonnetii* differs markedly from that of a moray eel, so it is highly unlikely that it received such a name at the time. Therefore, our hypothesis is that the name "caramuru", which appears associated with the paintings of *G. broussonnetii* in both *Theatrum* (Fig. 1) and the *St. Petersburg Collection* (Fig. 2), was due to a misidentification, according to the reasons detailed above.

About the origin of the fish used as a model for the *Theatrum*'s *"Caramurû"* and the destination of the material studied by Marggraf in Dutch Brazil

The question of the identity of the species illustrated by Albert Eckhout, in the present work identified as *Gobioides broussonnetii,* could be ultimately clarified by examining the specimen that he used as a model. Recognizing the specimens used by Marggraf or Pies would be of paramount importance because several post-Linnean taxonomic descriptions were presumably based on the Marggraf's descriptions of the *HNB,* in such a way that these specimens used in illustrations became types. Although it is known that many animals were collected for the study of Marggraf and Pies, as Marggraf himself reveals in a letter addressed to de Laet (*cf.* Whitehead, 1979a), it is not known whether the specimen of *G. broussonnetii* painted by Eckhout was preserved or not. It is known that as soon as the specimens collected during the Nassau Government of the Dutch Brazil arrived back in Holland, they dispersed rapidly, being donated, exchanged, sold, and auctioned, then going to the University of Leiden, Theatrum Anatomicum of Leiden, Mauritshuis (now the Mauritshuis Museum), Ambulacrum Horti Medici, and part resting in the hands of naturalistic collectors such as Albertus Seba, Ole Willumsen Worm (1588-1654), Willum Olsen Worm (1633-1704), and Frederik Ruysch (Martius, 1853; Andrade-Lima *et al.,* 1977; Moulin, 1979; Whitehead, 1979a; Albertin, 1986; Teixeira, 2006; Françozo, 2010). The only surviving specimens known to date are some plants, which are currently kept in herbarium at the Botanical Museum of the University of Copenhagen and Vahl's herbarium, both in Copenhagen, and in the Sherard's herbarium in Oxford (Andrade-Lima *et al.,* 1977; Whitehead, 1979a; Moulin *et al.,* 1986; Souza, 2006). Boeseman (1970) traced the convoluted paths covered by the specimens belonging to the curiosity cabinet of Albertus Seba, one of the possible receptors of the Marggraf and Pies specimens. The whereabouts of the biological specimens collected in Brazil during the Mauritian period is a subject that undoubtedly merits a proper investigation.

The exact origin of the specimen used by Eckhout to illustrate his *"Caramurû"* is unknown. A possible source for trying to determine the provenance of the animals collected would be to know the itineraries of the collecting trips. The three known expeditions carried out by Marggraf were made in the interior of the northeastern Brazil, in Paraíba, Pernambuco, and Rio Grande do Norte (Gudger, 1912, 1914; Whitehead, 1979a; Brienen, 2001). In the seventeenth century, fishes were not usually fixed and preserved in a liquid solution, such as formaldehyde and ethyl alcohol, but stuffed, which caused deformation and loss of the life coloration. Fishes decay rapidly, losing colors, especially the brighter ones derived from guanine crystals, within a few hours. It is quite remarkable, however, that Marggraf's watercolors in the *Libri Principis,* as well as Eckhout's oil paintings of the *Theatrum,* show fishes in natural shape, portrayed with the correct colors in life (or immediately after death), which indicates that these illustrations were made shortly after the collection of their model specimens. Brienen (2010) assumed that those portrayed fishes had recently been fished in the lakes of the gardens of the Friborg Castle, the main residence of the Count of Nassau, while the marine specimens were brought by fishermen. Therefore, these artists either accompanied the field expeditions or these specimens were collected locally and quickly brought into their hands.

Gobioides broussonnetii is an amphidromous species, occurring in shallow waters of the Western Atlantic, from South Carolina to southern Brazil, in the State of Rio Grande do Sul (Murdy, 1998). Adults of *G. broussonnetii* are known to preferentially inhabit the muddy bottom of bays, estuaries, and mouths of large rivers, being also found in mangroves (Cervigón, 1994; Smith, 1997; Barletta-Bergan *et al.,* 2002; Bragança, 2005; Rodríguez & Villamizar, 2006). *Gobioides broussonnetii* is classified as a detritivore, feeding on small-sized organic matter, which includes detritus, diatom and filamentous algae, microcrustaceans, bivalves, gastropods, and foraminiferans (*cf.* Mata-Cortés *et al.,* 2004; Bragança, 2005; Rodríguez & Villamizar, 2006). The species is still found in these environments in Northeastern Brazil (*e.g.,* Oliveira, 1972; Rosa, 1980; Barletta-Bergan *et al.,* 2002; Reis-Filho & Oliveira, 2014), including in the lower Rio Capibaribe, in spite of strong pollution of its waters and the anthropic occupation of the region (Lins *et al.,* 2007). Thus, it is quite probable that at least some fishes portrayed during the Mauritian period of Dutch Brazil (1624-1654),

including that individual of *G. broussonnetii* used as a model for Albert Eckhout's *"Caramurû"* painting that is now part of *Theatrum* (Fig. 1), came from Mauristaad and Recife, and their neighborhoods, in the estuary of the Rio Capibaribe.

Final remarks – Commentaries about the paintings of the *St. Petersburg Collection*

Boeseman *et al.* (1990) concluded that the watercolors of the *St. Petersburg Collection* were copies made from the oil paintings that now make up the *Theatrum,* and not the other way around, based on the finding that the watermarks on the first set are from the year 1650 or later, therefore of more recente dates than those of Eckhout's oil paintings. The finding that the *"Caramuru"* watercolor of the *St. Petersburg Collection* (Fig. 2) is a slightly more imperfect version compared to the oil painting of the *Theatrum* (Fig. 1), seems to support this hypothesis. Boeseman *et al.* (1990) suggested that the author of most of the paintings in the *St. Petersburg Collection* would be Albert Eckhout himself, perhaps to keep the record of his own work (maybe for Johan Maurits van Nassau-Siegen – see Solovyov, 1934a, b), especially in the circumstance that these would be donated to the Elector of Brandenburg (Whitehead, 1979a; Ferrão & Soares, 1993; Whitehead & Boeseman, 1989a, b; Brienen, 2006, 2010). This possibility is plausible considering that the reproduction of the *"Caramurû"* in the *St. Petersburg Collection* is considerable accurate, replicating details such as the color pattern, the dorsal-fin rays, which would be expected from the author himself or from someone doing a copy under the author's supervision. However, due to remarkable differences in style, technique, and accuracy, it is likely that the artist who copied the *Theatrum* painting was probably not Albert Eckhout. In addition, since the *"Caramuru"* of the *St. Petersburg Collection* (Fig. 2) is a copy of the *Theatrum*'s oil painting (Fig. 1), it is likely that its identification was made by the artist himself. In this case, a comparison between the handwritings in the paintings of the *Theatrum* (here attributed to Marggraf) (Figs. 1, 13A) and the *St. Petersburg Collection* (Figs. 2, 13E) show striking differences, especially in the use of graphic accent. It is unlikely that Albert Eckhout would have copied his original paintings without properly reproducing their names, even though, in the case of the *"Caramurû",* that name had been likely written by Georg Marggraf.

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