

## Distribution of South American manatees, *Trichechus manatus* Linnaeus, 1758 and *T. inunguis* (Natterer, 1883) (Sirenia: Trichechidae)

### Distribuição dos peixes-boi sul-americanos, *Trichechus manatus* Linnaeus, 1758 e *T. inunguis* (Natterer, 1883) (Sirenia: Trichechidae)

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**Abstract:** South America is unique as it is home of two species of manatees: the West Indian manatee, *Trichechus manatus*, and the Amazonian manatee, *T. inunguis*. These species are easily identified by the belly skin coloration, the first is entirely gray whereas *T. inunguis* has a white mark pattern in the belly, and presence of nails in *T. manatus*, absent in *T. inunguis*. The morphology and the range of *Trichechus* species have been clearly established. However, we show that the belly skin coloration and the presence of nails on the pectoral flipper may be polymorphic. These findings prompted us to check all available information about the manatee. In view of lack of accurate data on manatee locations, we produced a gazetteer and a map of *Trichechus* spp. in South America using records obtained by regular monitoring of aquatic mammal strandings conducted by the *Grupo de Estudos de Mamíferos Aquáticos da Amazônia* of the *Museu Paraense Emílio Goeldi*, all available peer-reviewed data, reports, thesis, and newspaper files with photos showing diagnostic characters. These findings showed the need of improving the identification of these species before implementing conservation strategies. Finally, we present a complete report on the extant distribution of these species in South America.

**Keywords:** Amazonas river basin. Amazonian manatee. Aquatic mammals. Atlantic Ocean. Conservation. West Indian manatee.

**Resumo:** A América do Sul é única em registrar duas espécies de peixes-bois: o peixe-boi-marinho, *Trichechus manatus*, e o peixe-boi-da-amazônia, *T. inunguis*. Essas espécies podem ser distinguidas pela coloração ventral; totalmente cinza na primeira, enquanto *T. inunguis* tem um padrão de manchas brancas no ventre, e a presença de unhas nas nadadeiras peitorais, ausentes em *T. inunguis*. A morfologia e a distribuição das espécies de *Trichechus* são claramente estabelecidas. No entanto, mostramos aqui que a mancha do ventre e a presença de unhas na nadadeira peitoral podem ser polimórficas. Esses achados nos instigaram a verificar toda informação disponível a respeito dos registros de peixes-bois. Em vista da falta de dados precisos sobre a localização dos peixes-bois em publicações anteriores, produzimos um gazetteer e um mapa de *Trichechus* spp. na América do Sul, utilizamos registros originais coletados pelo Grupo de Estudos de Mamíferos Aquáticos da Amazônia (GEMAM) do Museu Paraense Emílio Goeldi, todos os dados revisados por pares, incluindo dissertações, teses e arquivos de jornais com fotos evidenciando caracteres diagnósticos. Finalmente, apresentamos um relato completo sobre a distribuição das espécies de peixes-bois na América do Sul e a necessidade de melhorar a identificação dessas espécies, para uma efetiva implementação de estratégias de conservação.

**Palavras-chave:** Bacia do rio Amazonas. Peixe-boi-da-Amazônia. Mamíferos aquáticos. Oceano Atlântico. Conservação. Peixe-boi-marinho.

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## INTRODUCTION

South America is unique in hosting two trichechid species: the West Indian manatee, *Trichechus manatus* Linnaeus, 1758, and the Amazonian manatee, *T. inunguis* (Husar, 1977). These species have been easily identified by their belly coloration, the former being entirely gray and the latter with white pattern. Moreover, *T. manatus* has nails on the pectoral and a diploid number ( $2n$ ) of 48 chromosomes (Gray *et al.*, 2002; Barros *et al.*, 2016), while *T. inunguis* has nailless pectoral and show  $2n = 56$  (Loughman *et al.*, 1970; Assis *et al.*, 1988).

Two subspecies have been proposed to the West Indian manatee: the Florida manatee, *T. m. latirostris* (Harlan, 1824), mostly restricted to the Florida peninsula (United States) and the Antillean manatee (*T. m. manatus*), distributed throughout the Caribbean, Central and South America (Hatt, 1934; Domning & Hayek, 1986; Garcia-Rodriguez *et al.*, 1988; Vianna *et al.*, 2006; Meirelles *et al.*, 2018). The Florida and the Antillean subspecies are remarkably similar in external morphology but can be distinguished by morphometric analysis of cranial characters (Domning & Hayek, 1986). In recent decades, West Indian manatee populations have been affected by habitat degradation (O'Shea & Ackerman, 1995), exceptional cold weather (O'Shea *et al.*, 1985), red tide outbreaks (Buergelt *et al.*, 1984; O'Shea *et al.*, 1991), hunting and incidental catch (Thornback & Jenkins, 1982; Mignucci-Giannoni, 1990; Meirelles, 2008) and collisions with boats (O'Shea *et al.*, 1985). The manatee is a specialized feeder and reduction of seagrass beds due to coastal development poses a serious threat (Best, 1981; Reynolds, 1981).

*Trichechus inunguis* is distributed throughout the major rivers of the Amazon basin, although it is rare in the Tocantins, Xingu and Tapajós rivers in Brazil (Bertram & Bertram, 1973). Information on its distribution in eastern Pará state, including the large Marajó Island, is deficient, imprecise, and limited to a few historical records (e.g., Edwards, 1847; Ferreira, 1903; Domning, 1981). Thousands of manatees have been hunted for centuries in Brazil (Domning, 1982) and, in some regions, they

continue to be hunted at a local scale. Due to their murky water habitat added to the cryptic behavior of the species, accurate population estimates are difficult.

The International Union for Conservation of Nature and Natural Resources (IUCN) presently recognizes *T. manatus* and *T. inunguis* as vulnerable taxa (Marmontel *et al.*, 2016). At present, key accounts of the distribution of the Amazonian manatee fail to provide a clear picture of the precise range of these elusive species (e.g., Husar, 1977; Reeves *et al.*, 1992; Jefferson *et al.*, 1993; Emmons & Feer, 1997).

In this study we present (a) a gazetteer of published and unpublished records of *Trichechus* spp. in South America, including our own unpublished records, these findings prompted us to check all available information about the manatee; (b) a review of former and current records of manatees (*Trichechus* spp.) in South America, mainly along Marajó Island, on the eastern Amazon coast; (c) a discussion on the conservation status of these species on the Eastern Amazon coast.

## MATERIALS AND METHODS

### DATA SURVEY

In view of lack of accurate data on manatee locations in previous published records, we produced a gazetteer of *Trichechus* spp. in South America (Appendix 1, Figure 1). We used all available peer-reviewed data, theses and newspaper files with good photos showing diagnostic characters, for generating a map of manatee distribution in South America.

### SAMPLING COLLECTION

In order to investigate the presence of manatees in rivers in eastern Amazon and the Marajó Bay area, the *Grupo de Estudos de Mamíferos Aquáticos da Amazônia* (GEMAM) of the *Museu Paraense Emílio Goeldi* (MPEG), Belém, Pará state, Brazil, established a collaborative network of investigators and volunteers to search for stranded and live-rescued manatees in November 2005. A toll-free phone number

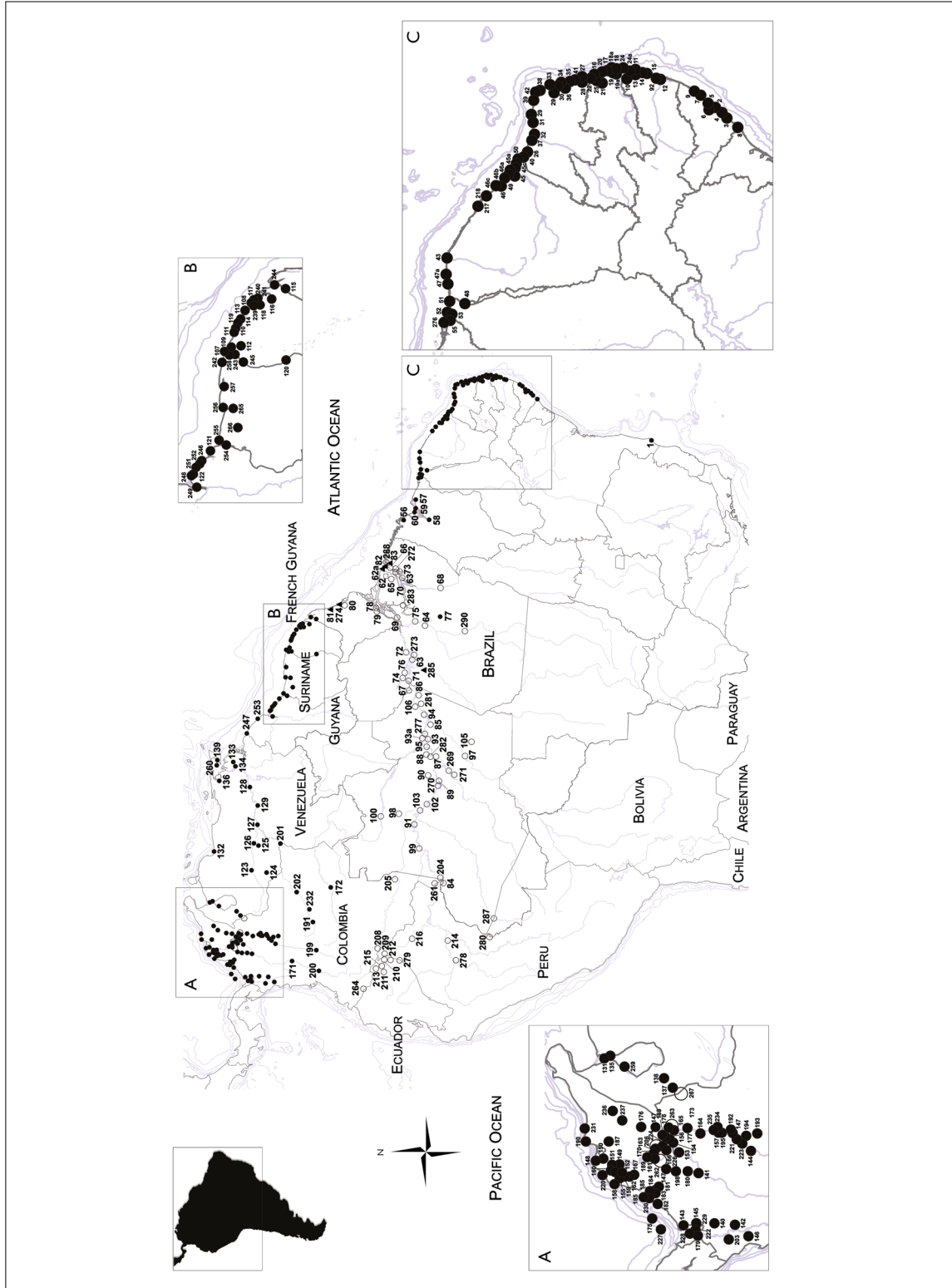


Figure 1. South America map showing all available records of manatees: A) detail of north Colombia and northwestern Venezuela; B) north of Guyana, Suriname, and French Guiana; C) northern Brazil. Black circles indicate *Trichechus manatus* localities, open circles *T. inunguis*, open square sympatry between them, and black triangles *Trichechus* sp. localities. Numbers refer to names of localities listed in Appendix 1.

and additional social media were available for reporting manatee strandings (Bicho D'água, n. d.). These events were regularly monitored between 2005 and 2018. Every two weeks, a coastline stretch of approximately 300 km, including the Marajó Bay area and eastern Pará state coast, were accessed by boat and a four-wheel vehicle or, alternatively, monitored on foot. At least three field assistants took part in surveys. Findings were validated with voucher samples, photographs, and other sources of original information. Field works were conducted under licenses SISBIO/ICMBio to GEMAM, under the numbers 30327-1 and 54305-1. The gazetteer (Appendix 1), with all published records of South American manatees, also includes new records of *Trichechus* vouchers deposited in the mammal collection of the *Museu Paraense Emílio Goeldi* (MPEG).

## MORPHOLOGY

We examined external morphology, including coloration, of *Trichechus* specimens of all available photographs and *in loco* observations during stranding events along eastern Amazon coast. Taxonomic identification was carried out based on external morphological characters as described in Domning & Hayek (1986). Stranded specimens were checked for (a) presence of nails, (b) body coloration (black or grey), (c) skin texture, and (d) presence of white (or pinkish) patch(es) on breast, belly, fluke and/or flippers. We examined all available specimens of *Trichechus* spp. deposited in MPEG (Table 1).

## RESULTS

### GEOGRAPHIC DISTRIBUTION

The most complete map of the geographic distribution of South American manatees (*Trichechus* spp.) is herein presented, including Brazil, French Guiana, Suriname, Guyana, Venezuela, Colombia, Peru, and Ecuador (Figure 1). Appendix 1 shows localities in detail.

In this study, *T. inunguis* has been recorded along the eastern Amazon coast, in the Marajó Bay area,

nearby inlets and channels in sympatry with *T. manatus* in several localities (Table 1). Amazonian manatees have also been reported along the eastern coast of Marajó Island (Table 1, records 21, 22, 24, 32, 39, 40, 41, 42) and adjacent eastern coastline (Table 1, records 26, 35). Presently, 33 specimens of *T. inunguis*, and nine *T. m. manatus* have been deposited in the MPEG (Table 1). In the field work between November 2005 and January 2018 along Eastern Pará, a total of 35 stranded manatees were observed.

## MORPHOLOGY

A total of 15 specimens, stranded, live-captured, or photographed, were examined. Twelve specimens presented typical *T. inunguis* or *T. manatus* morphological attributes (Table 1, Figure 2), including two live specimens with a *T. inunguis* characteristic phenotype (Figures 2A-2C), with whitish/pinkish patches on chest and belly, black body coloration, and nailless flippers. This was the case of MPEG42157 recovered in Colares, Marajó Bay, on 31 July 2012, with a large white patch on the chest and belly and rounded paddle, and Tito (GEMAM748) – a rescued and released orphan, from Furo das Marinhas, Santa Bárbara do Pará, eastern Marajó Bay. Another specimen showed the typical *T. manatus* phenotype, like Udi (MPEG44496) (Figure 2B). However, three other specimens with nails (characteristic of *T. manatus*) showed white belly patches (characteristic of *T. inunguis*). This was the case of one male manatee (Omar, MPEG42229) with the characteristic presence of nails as in *T. manatus*, but with atypical coloration. This calf is held in captivity in Salvaterra, Marajó Island since 20 July 2013. Although it has nails the general appearance resembles a more typical Amazonian phenotype, including a white narrow belly patch and another small one in the caudal fluke. Another specimen, Leleco (MPEG44491), a calf rescued December 13, 2014, in Vila do Pesqueiro, Soure, Marajó Island, also showed an Amazonian phenotype, including a round paddle, large pinkish patch on chest and belly, and pinkish patches on the flippers. A third specimen with nails and an Amazonian phenotype, was stranded alive on Soure, Marajó Island (Figures 2D-2F).

Table 1. Specimens of *Trichechus* deposited in the collection of *Museu Paraense Emílio Goeldi* (MPEG), Belém, Pará state (PA), Brazil, with record number (Rec), species identification, voucher museum number, collecting localities, name of captive animals, sex (S), type of preserved material, and remarks. Legend: F = female, M = male, I = unsexed, GEMAM = *Grupo de Estudos de Mamíferos Aquáticos da Amazônia*, specimen housed at MPEG.

(Continue)

Rec	Species	Voucher	Localities	Coordinates	Name	S	Material	Remarks
1	<i>Trichechus inunguis</i>	MPEG1518	Brazil, Pará, Belém, Icoaraci	-1.2985, -48.4755	-	M	Skeleton	-
2	<i>Trichechus inunguis</i>	MPEG4636	Brazil, Pará, Santarém, Taperinha, rio Ayaya	-2.4865, -54.3127	-	I	Skull, mandible	-
3	<i>Trichechus inunguis</i>	MPEG4637	Brazil, Pará, Santarém, Taperinha	-2.4865, -54.3127	-	F	Skull, mandible	-
4	<i>Trichechus inunguis</i>	MPEG4638	Brazil, Pará, Santarém, Taperinha, rio Ayaya	-2.4865, -54.3127	-	F	Skull, mandible	-
5	<i>Trichechus inunguis</i>	MPEG4639	Brazil, Pará, Santarém, Taperinha, rio Ayaya	-2.4865, -54.3127	-	F	Skull, mandible	-
6	<i>Trichechus inunguis</i>	MPEG4640	Pará, rio Curuá	-6.4056, -54.7287	-	F	Skull, mandible	-
7	<i>Trichechus inunguis</i>	MPEG4641	Brazil, Pará, Monte Alegre, Lago Grande de Maycurú	-	-	I	Skull, mandible	-
8	<i>Trichechus inunguis</i>	MPEG6491	Brazil, captive specimen from Jardim Zoológico de Belém	-	-	F	Skull, mandible	-
9	<i>Trichechus manatus</i>	MPEG6492	Brazil, captive specimen from Jardim Zoológico do MPEG	-	-	F	Skull, mandible	-
10	<i>Trichechus inunguis</i>	MPEG6493	Brazil	-	-	M	Skull, skeleton	-
11	<i>Trichechus inunguis</i>	MPEG6494	Brazil, captive specimen from Jardim Zoológico do MPEG	-	-	M	Skull, skeleton	-
12	<i>Trichechus inunguis</i>	MPEG6495	Brazil	-	-	F	Skull	-
13	<i>Trichechus inunguis</i>	MPEG7959	Brazil, Pará, Oriximiná, rio Trombetas	-	-	F	Skull	-
14	<i>Trichechus inunguis</i>	MPEG8845	Brazil, captive specimen from Jardim Zoológico de Belém	-	-	F	Skull	-
15	<i>Trichechus inunguis</i>	MPEG9138	Brazil, captive specimen from Jardim Zoológico do MPEG	-	-	I	Skeleton	-
16	<i>Trichechus inunguis</i>	MPEG11298	Brazil, Pará, Rio Guamá, mouth of Igarapé Tucunduba	-1.4770, -48.4685	-	F	Skeleton	-
17	<i>Trichechus inunguis</i>	MPEG11838	Brazil, Pará, Cametá, rio Tocantins	-3.3026, -55.3079	-	I	Skin	-
18	<i>Trichechus inunguis</i>	MPEG12755	Brazil, captive specimen from Parque Zoológico do MPEG	-	-	M	Skeleton	-
19	<i>Trichechus inunguis</i>	MPEG22428	Brazil, unknown locality	-	-	M	Skull, mandible	-
20	<i>Trichechus manatus</i>	MPEG37815	Brazil, Pará, Marajó Island, Salvaterra, Porto dos Pescadores	-0.7667, -48.5167	-	I	Skull	-
21	<i>Trichechus inunguis</i>	MPEG44485	Brazil, Pará, Marajó Island, Cachoeira do Arari (GEMAM216)	-1.0167, -48.9667	-	F	Pectoral	Female with fetus



Table 1.

(Conclusion)

Rec	Species	Voucher	Localities	Coordinates	Name	S	Material	Remarks
22	<i>Trichechus inunguis</i>	MPEG44486	Brazil, Pará, Marajó Island, Salvaterra, Ponta do Pilão	-	Vitória	F	Tissue	Rehabilitation
23	<i>Trichechus manatus</i>	MPEG42043	Brazil, Pará, Marajó Island, Soure, vila Caju-una	-0.6248, -48.4804	-	F	Skeleton	Stranded dead
24	<i>Trichechus inunguis</i>	MPEG42148	Brazil, Pará, Abaetetuba (GEMAM419)	-1.7247, -48.8813	-	I	Skeleton	Hunted and confiscated
25	<i>Trichechus inunguis</i>	MPEG42156	Brazil, captive specimen from Jardim Zoológico de Belém	-	-	F	Skeleton	-
26	<i>Trichechus inunguis</i>	MPEG42157	Brazil, Pará, Colares, igarapé do Cedro (GEMAM380)	-0.9401, -48.2901	-	F	Tissue	Stranded
27	<i>Trichechus manatus</i>	MPEG42229	Brazil, Pará, Salvaterra, praia do Salazar (GEMAM585)	-0.9232, -48.5304	Omar	M	Tissue	Alive, in rehabilitation
28	<i>Trichechus manatus</i>	MPEG44487	Brazil, Pará, Santo Antônio do Tauá, vila Jutai (GEMAM581)	-1.1516, -48.1329	Jutai	M	Tissue	Died in rehabilitation
29	<i>Trichechus manatus</i>	MPEG44488	Brazil, Pará, Salvaterra, praia do Salazar	-0.9232, -48.5304			Tissue	
30	<i>Trichechus inunguis</i>	MPEG44489	Brazil, Pará, Gurupá (GEMAM586)	-1.3985, -51.6465	Gurupá	M	Tissue	Died in rehabilitation
31	<i>Trichechus manatus</i>	MPEG44478	Brazil, Pará, Salvaterra, praia de Joanes	-0.8796, -48.5063			Tissue	Carcass
32	<i>Trichechus inunguis</i>	MPEG44490	Brazil, Pará, Salvaterra, praia de Joanes (GEMAM617)	-0.8554, -48.5368			Tissue	Carcass
33	<i>Trichechus manatus</i>	MPEG44491	Brazil, Pará, Soure, vila do Pesqueiro (GEMAM645)	-0.6616, -48.4821	Leleco	M	Skeleton	Died in rehabilitation
34	<i>Trichechus inunguis</i>	MPEG44492	Brazil, Pará, Melgaço, Floresta Nacional (FLONA) Caxiuanã, Vila Brabo, Rio Anapú	-			Tissue	
35	<i>Trichechus inunguis</i>	MPEG44493	Brazil, Pará, Vigia (GEMAM671)	-0.7799, -48.1622			Tissue	Stranded dead
36	<i>Trichechus inunguis</i>	MPEG44494	Brazil, Pará, Goianésia do Pará	-3.9653, -48.9008	Vitória	F	Skeleton	
37	<i>Trichechus inunguis</i>	MPEG44495	Brazil, Pará, Melgaço, FLONA Caxiuanã (GEMAM649)	-	Kaluanã	F	Tissue	Alive, in rehabilitation
38	<i>Trichechus manatus</i>	MPEG44496	Brazil, Pará, Salvaterra, vila Água Boa (GEMAM741)	-0.71867, -48.5022	Udi	F	Skeleton	Hydrocephalus
39	<i>Trichechus inunguis</i>	MPEG44497	Brazil, Pará, Salvaterra, praia de Joanes	-0.8796, -48.5063	Joeny	F	Tissue	Alive, in rehabilitation
40	<i>Trichechus inunguis</i>	MPEG44498	Brazil, Pará, Salvaterra, Ponta do Pilão	-0.8832, -48.5144	-		Skeleton	-
41	<i>Trichechus inunguis</i>	MPEG44499	Brazil, Pará, Salvaterra, praia de Joanes (GEMAM746)	-0.8796, -48.5063	-	M	Skeleton	-
42	<i>Trichechus inunguis</i>	GEMAM748	Brazil, Pará, Santa Bárbara do Pará, Furo das Marinhas	-1.1995, -48.3297	Tito	M	Tissue	Rescued and released





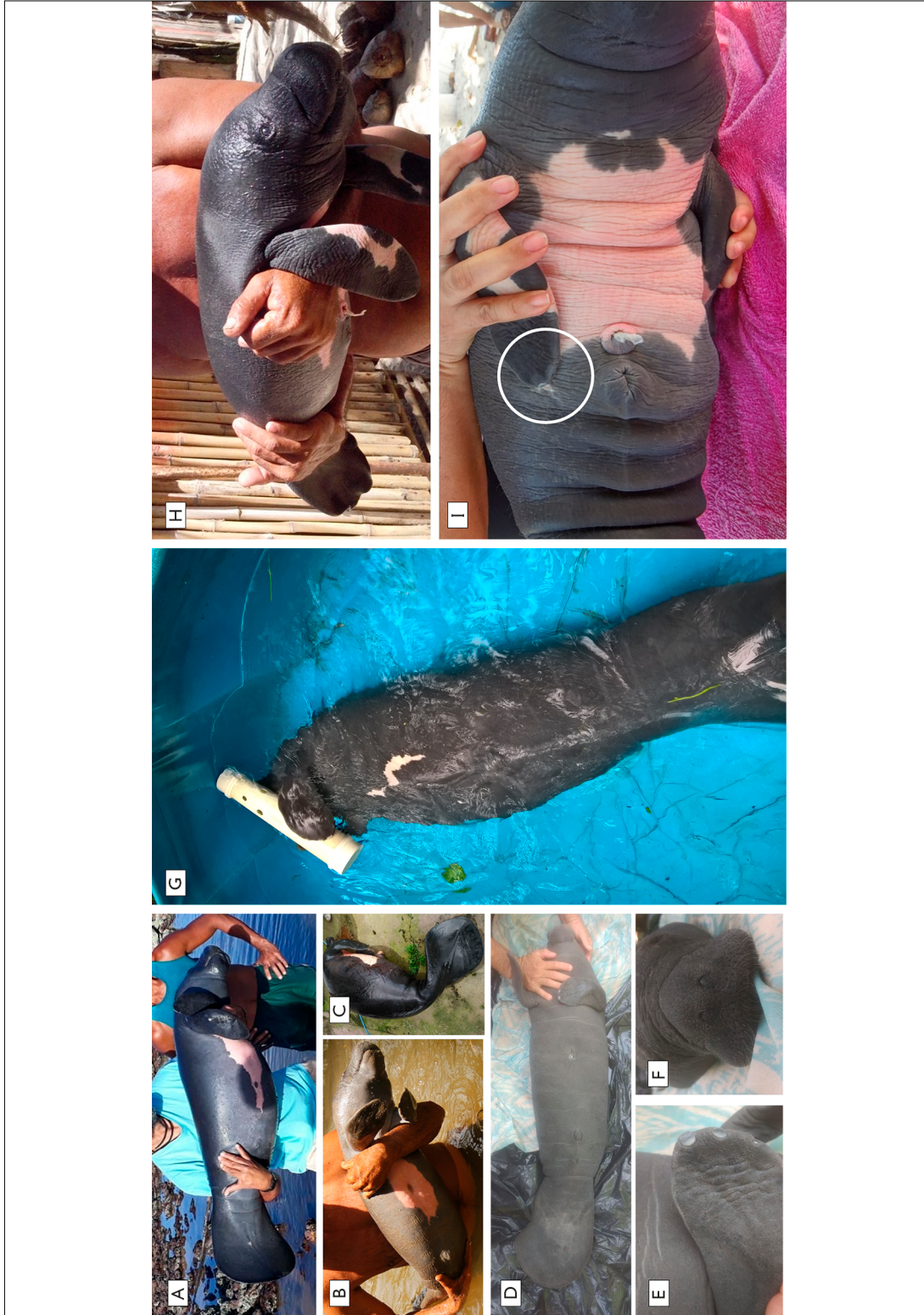


Figure 2. Variation in coloration of *Trichechus* spp. along the eastern coast of Marajó: (A) typical *T. inunguis* live rescued in Joanes, Salvaterra, Marajó Is. (B) in Caxiuanã National Forest in lower Amazon region, and (C) in Soure, Marajó Is., (D-F) typical *T. manatus* rescued in Marajó Is., note the greyish coloration and the presence of nails, (G) Omar (MPEG42229), a live rescued *T. manatus* in rehabilitation in Salvaterra, Marajó Is., note the black coloration, presence of white spots in the belly and tail, round paddle tail, and the presence of nails, (H-I) rescued *T. manatus* in Marajó Is., note the blackish coloration, the presence of white coloration in the belly and flippers and also presence of nails. Photos: (A) Bicho D'água, (B) Janine Valente, (C) Leonardo Silva, (D-F) Renata Emin, (G) Salvatore Siciliano, (H-I) Jacqueline Vieira.

## DISCUSSION

### GEOGRAPHIC DISTRIBUTION

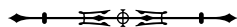
The map and gazetteer provide insights on the distribution of manatees (*Trichechus* spp.) in South America, pointing to Brazil and Colombia as the only two countries with both *T. inunguis* (Amazonian manatees) and *T. m. manatus* (Antillean manatees). The occurrence of two trichechid species within the boundaries of these countries represents a unique situation worldwide and deserves special attention for conservation strategies. According to two reviews (Reeves *et al.*, 1992; Jefferson *et al.*, 1993), Antillean manatees in mainland South America are presently distributed from Alagoas state (10° S), in the Northeast of Brazil, to the Colombian coastline and major inland rivers. Their former southern range in South America having extended further south to the mouth of Rio Doce (19° 37' S), Espírito Santo state, in the southeastern Brazil (Whitehead, 1977). More recently, a manatee rib found amid a pile of weathered bones of humpback whales in Barra de Caravelas (17° 43' S), Bahia state, in September 1990, posed the intriguing possibility that manatees have been recently present at this latitude (Siciliano & Barbosa-Filho, 2016). The Caravelas record has been included in our map and gazetteer, accounting for the likely southern limit of *T. manatus* in South America.

Detailed examination of the map indicates two gaps in the distribution of *T. m. manatus* in South America, one along the Venezuelan coastline, in accordance with Lefebvre *et al.* (1989) and Luna (2013) who proposed that this major discontinuity was likely due to unsuitable habitats. One gap, herein reported, was found along vast stretches of the northern coast of Brazil, known as '*Reentrâncias Maranhenses*', or simply '*Lençóis Maranhenses*', established as a National Park in 1981. The *Lençóis Maranhenses* represents an open sandy dune environment spread over 75 km of coastline very unsuitable as a habitat for manatees, located in the coast, near and south São Luis do Maranhão, between -2.35693, -43.27116 and -2.56476, -42.7880.

Our findings also provided compelling evidence of recent recolonization around Marajó Island, in agreement with a previous report on the mouths of the Amazon and the vicinity of Belém where *T. inunguis* and *T. manatus* had apparently been heavily hunted to the verge of extinction (Domning, 1981).

Our review indicated that *Trichechus inunguis* is widely distributed in the Amazon basin, following the main course of the Amazon River and its major tributaries to Colombia, Peru, and Ecuador. Records of *T. inunguis* in French Guiana, Suriname, Guyana, and Venezuela are presently unavailable, although Amazonian manatees have been found to occasionally penetrate southern Guyana close to the boundary with Brazil (Bertram & Bertram, 1973; Lima, C. *et al.*, 2019). This finding has been confirmed by a recent manatee rescue in the Takutu river (= Tacutu), on the border of Brazil and Guyana (Marmontel *et al.*, 2016).

As above stated, previous reports on the potential distribution of Amazonian manatees in eastern Pará state have been incomplete because several authors restricted their potential occurrence in eastern Amazonia to a vast geographic area frequently referred as 'Marajó Island', failing to define the actual range of these elusive species. Along the eastern Amazon coast, *T. inunguis* has been herein confirmed in the Marajó Bay area and nearby inlets and channels (Table 1). The influx of abundant freshwater during the rainy season (December-June) may favor the spreading of Amazonian manatees throughout this vast territory, when the mixed waters in Marajó Bay undergo reduced salinity as attested by recent regular records in Furo das Marinhas (1° 21' 4" S, 47° 34' 20" W), Mosqueiro (1° 9' 49" S, 48° 28' 15" W), and Ourém (1° 33' 0" S, 47° 6' 0" W) localities (Rosário & Santos, 2014; Prestes *et al.*, 2020). These findings are in accordance with previous work that reported the presence of *T. inunguis* in the coast of French Guiana (Vilaça & Santos, 2019), with strong influence of fresh water, and then with low salinity. The records herein presented revise the distribution map of Amazonian manatees in Brazil (Figure 1).





Eastwards Pará state coastline there is a vast coastline with numerous large bays bordered by mangrove ecosystem, referred as the 'Salgado Paraense', offer a potentially suitable habitat to Antillean manatees although it has remained poorly surveyed for decades.

We found *Trichechus inunguis* throughout the lower Amazon and its tributaries, including Marajó Island and its Atlantic coast and coastal islands, and from the northern (Amapá state, Brazil) to the southern shore of the Amazon estuaries (Pará state, Brazil). These findings contradicted Domning's (1981) assertion that *Trichechus inunguis* would not inhabit regions with a high inflow of saltwater. Domning (1981) stated that *Trichechus manatus* apparently was 'exterminated from the Atlantic coast of Pará', assuming that this species, and not *T. inunguis*, formerly occurred in this region. This author concluded that any zone of sympatry between *T. manatus* and *T. inunguis* was highly restricted, if ever present, and that these species had mutually exclusive distributions (*i.e.*, parapatric). However, both manatee species are presently common and have been recorded by us in a wide area of sympatry on the eastern coast of Marajó Island, providing the first evidence that *T. inunguis* and *T. manatus* were syntopic. Although some populations have been reduced with respect to historical levels (Lefebvre *et al.*, 1989), these findings suggest that manatee populations are recovering, as was the case of other marine species like the humpback whale and the northern elephant seal (Stewart *et al.*, 1994; Thomas *et al.*, 2016; Zerbini *et al.*, 2019). Similar findings were also reported for *T. inunguis* (Cantanhede *et al.*, 2005) in disagreement with a previous postulation that a low reproductive rate imposed a limit to the ability of manatees to recover from population reduction (Thornback & Jenkins, 1982; Marmontel, 1995).

## MORPHOLOGY

In this study, external morphology, and coloration in live *Trichechus* specimens examined in the field and the Salvaterra (Marajó Isl.) rehabilitation center revealed that these traits were variable. Domning & Hayek (1986) stated

that nails represented primitive mammalian traits, and that their loss in *T. inunguis* was a derived trait, in accordance with findings of vestigial nails in *T. inunguis* newborns which were subsequently absent in adults (Luna, 2013). Noteworthy, Domning & Hayek (1986) described an atypical ventral coloration in a female manatee from Rio Arari, Marajó Island, together with a detailed and comparative description of *Trichechus* spp. coloration, "*T. senegalensis* Link, 1795 and *T. manatus* normally are uniformly dark in color without distinct markings [...] *T. inunguis*, in contrast to the other species, is said to be constantly characterized by [...] a white breast patch" (Domning & Hayek, 1986, p. 91). This description, however, was only valid for the majority of individuals rather than for all; in fact, unmarked specimens had been reported by Stannius (1845, p. 2), Edwards (1847, p. 149) and Pereira (1944, p. 39), as well as two of the three specimens in Natterer's original type-series (von Pelzeln, 1883, p. 91-92). Domning & Hayek (1986) further stated that

Of 23 individuals examined by one of us (DPD), three were completely unmarked, three had only a tiny and inconspicuous belly patch, ten had a single, "normal" patch or a pair of patches confined to the chest and/or abdomen, and seven had multiple ventral patches extending onto the throat and/or tail. In one of the later, the patches consisted of white mottling on broad areas of the belly and tail, and in one of the second category there was also some gray speckling on the belly and indistinct pinkish areas on the throat and chest (figure 1 in Domning & Hayek, 1986). The belly patches may be either white or bright pink, possibly depending on the visibility of vascularized layers through the skin. When referring to nails, these authors mentioned: "Small nails on the lateral surfaces of the tips of one or more digits normally characterize *T. manatus* and *T. senegalensis* Link, 1795; their absence gave Behavior patterns in the west Indian manatee, with emphasis on feeding and diving its name. However, Stannius (1845, p. 2) found a single nail on each flipper in a young Amazonian manatee from Para [sic Pará]".

Generally, conventional descriptions of *Trichechus* spp. coloration are vague, stating that Amazonian manatees were grey to black, while most of them showed white or

pink belly and chest patches (Jefferson *et al.*, 1993, 2008). In West Indian manatees “the colour of the skin is generally grey to brown, sometimes with a green, red, white, or black tinge caused by algal and/or barnacle growth. The short hairs are colourless. Calves appear to be a darker shade of grey, almost black” (Jefferson *et al.*, 1993, p. 524). According to Emmons & Feer (1997), *T. manatus* was “similar to Amazonian manatee except larger; flippers with large, flat nails on their tips; underparts gray or with pink blotches, without white patches”.

Our data on the coloration and external morphology of recovered *T. manatus* along the eastern coast of Pará contradicted these previous reports and provided strong evidence of color polymorphism. We noted that some *T. manatus* specimens had nails but also whitish or pinkish patches on the chest and/or belly, including flippers, with typical coloration of *T. inunguis*. It has been postulated that colored body patches in mammals might be useful for intraspecific signaling (Caro, 2005) in mate selection, which can lead to reproductive isolation, even in sympatry (White & Kemp, 2016). It is notable that *T. inunguis* also showed an apparent polymorphism with respect to nails, which were detected in at least two specimens (Luna, 2013; Domning & Hayek, 1986).

## THREATS TO MANATEES ON EASTERN AMAZON COAST

Throughout our field studies along the Amazon coastline we identified several threats to manatees since 2005, as the 35 stranded manatees between November 2005 and January 2018 along eastern Pará. Other threats included incidental catches in gillnets and fixed trap nets as well as illegal hunting, mainly of calves, and water contamination (GEMAM, unpublished data). The use of fishing corrals built in submerged aquatic vegetation beds in Pará accounted for serious threats to manatees. Recently, in the spring of 2018, an intentional killing of a stranded manatee was reported in Joanes, Marajó Island. Necropsy and histopathologic findings in a newborn *T. inunguis* from Goianésia do Pará, Pará state

confirmed chronic systemic bacterial infection caused by *Salmonella enterica* subsp. *enterica* (Correa Neto, 2017).

Moreover, one large Amazonian manatee incidentally caught in gillnets in Rio Arari, Cachoeira do Arari, Marajó Island on 16 July 2007 was killed for food consumption and later recovered for genetic analysis (MPEG44485, Table 1). A young male *T. inunguis* named Tito (GEMAM748) was caught by a small gillnet set off Furo das Marinhas, in Santa Bárbara do Pará, on 23 June 2017. It was disentangled alive and rescued by our team and forwarded to the MPEG rehabilitation center in Belém. Being in good health, it was released at the same spot a week later.

## CONCLUSIONS

In conclusion, the Amazonian manatee is widely distributed in the Amazon River basin and all major tributaries, limited only by rapids. It is also found in the mouth of the Amazon River as far as the influence of the plume, reaching the French Guiana. In Marajó Bay, the Amazonian manatee is sympatric with the Antillean manatee. The current distribution of the Antillean manatee comprises the Sergipe state, in Northeastern Brazil and up north along the South American coastline. Two gaps in the distribution were detected: one along the Lençóis Maranhenses, in Maranhão, Brazil and another along the coast of Venezuela.

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Appendix 1. List of localities of *Trichechus* specimens in South America. Number before localities refers to Figure 1. Acronyms: AMNH = American Museum of Natural History, New York, NY, USA; Aquasis = Associação de Pesquisa e Preservação de Ecossistemas Aquáticos, Caucaia, Ceará state, Brazil; IDSM = Instituto de Desenvolvimento Sustentável Mamirauá, Tefé, Amazonas state, Brazil; CMA = Centro Mamíferos Aquáticos do ICMBio, Itamaracá, Pernambuco state, Brazil; MN = Museu Nacional, UFRJ, Rio de Janeiro, Brazil; MPEG = Museu Paraense Emílio Goeldi, Belém, Pará state, Brazil.

*Trichechus* sp.

## **BRAZIL**

### **Amapá state**

(274): RIO AMAPÁ GRANDE: Domning (1981),

(81) CALÇOENE: Cunaní - incidental capture in Domning (1981),

(80) MARACÁ: Ilha de Maracá - incidental capture in Domning (1981),

**Pará state** (82) SOURE: Ilha de Marajó, Vila do Pesqueiro – this study,

(62a) SALVATERRA: Ilha de Marajó, Vila de Monsarás – this study.

*Trichechus manatus manatus* Linnaeus, 1758

## **BRAZIL**

### **Alagoas state**

(NOT LOCATED): Pescana and Tabuia - interview in Lima, R. (1997),

(2) BARRA DE SÃO MIGUEL: interview in Lima, R. (1997),

(3) CORURIBE: Praia da Lagoa do Pau, Praia de Miaí, and Distrito de Poxim - interview in Lima, R. (1997),

(4) JEQUIÁ DA PRAIA: Praia Barra de Jequiá and Praia de Lagoa Azeda - interview in Lima, R. (1997),

(5) MACEIÓ: Praia de Cruz das Almas - incidental capture in nets in Borobia & Lodi (1992), Praia da Garça Torta, Praia de Guaxuma, Praia de Ipióca, Praia de Jacarecica, Praia de Jatiúca, Praia de Riacho Doce, and Praia de Sahuauí - interview in Lima, R. (1997),

(6) MARECHAL DEODORO: Praia do Francês and Prainha de Barra Nova - interview in Lima, R. (1997),

(7) PARIPUEIRA: interview in Lima, R. (1997),

(8) PIAÇABUÇU: Praia do Peba - interview in Lima, R. (1997),

(9) PASSO DE CAMARAGIBE: Barra de Camaragibe and Praia dos Morros - interview in Lima, R. (1997),

### **Amapá state**

(275) MOUTH OF RIO UAÇÁ: incidental capture in Silva *et al.* (2013),

(77) OIAPOQUE: Taperebá, Rio Oiapoque - Domning (1981),

### **Bahia state**

(1) CARAVELAS: MN 30493 - Siciliano & Barbosa-Filho (2016),

### **Ceará state**

(217): CASCAVEL: Praia de Balbino - incidental capture in Meirelles (2008),

(218) CAUCAIA: Praia de Icaraí - incidental capture in Meirelles (2008),

(43) ACARAÚ: Praia da Volta do Rio - incidental capture in Meirelles (2008),

(44) AQUIRAZ: Praia do Barro Preto and Praia de Porto das Dunas - incidental captures in Meirelles (2008),



Appendix 1.

(Continue)

(45) ARACATI: incidental capture in Meirelles (2008), (45a) Praia de Quixaba - Aquasis 10 in Meirelles (2008), (45b) Praia de Canoa Quebrada, S0112/114 in Meirelles (2008), (45c) Praia Fontainha - interview in Lima, R. (1997), Praia de Majorlândia, Retirinhos, and Praia Quitérias - interview in Lima, R. (1997), Praia do Retiro Grande - incidental capture in Meirelles (2008),

(46) BEBERIBE: Barra de Sucatinga and district Parajuru - incidental capture in Meirelles (2008) and interview in Lima, R. (1997), Lagoa de Dentro - incidental capture in Meirelles (2008), Praia Cabo Verde - interview in Lima, R. (1997), reserva extrativista Prainha do Canto Verde and Praia do Diogo - incidental captures in Meirelles (2008), Praia de Parajuru - Aquasis 2 in Meirelles (2008), Praia Uruaú - interview in Lima, R. (1997), (46a) Praia de Morro Branco - interview in Lima, R. (1997),

(47) CAMOCIM: Praia de Bitupitá - interview in Lima, R. (1997), (47a) district Guriú - interview in Lima, R. (1997),

(48) FORTALEZA: incidental captured in Borobia & Lodi (1992),

(49) FORTIN: Praia de Pontal do Maceió - interview in Lima, R. (1997),

(50) ICAPUÍ: Aquasis 36 in Alves *et al.* (2013), Praia de Ponta Grossa and Praia de Tremembé - interview in Lima, R. (1997), Praia da Redonda - incidental capture in Meirelles (2008),

#### **Maranhão state**

(58) RIO MEARIM - incidental capture in Domning (1981),

(54) ALCÂNTARA: Ponta das Pedras – hunted, Siciliano (1991), Rio Pericumã - stranded in present study,

(55) ARAIOSES: Barra das Canárias - sighting in present study,

(56) CURURUPU: sightings in present study,

(57) HUMBERTO DE CAMPOS: Baía de Tubarão - found dead in present study, Rio Mapará - sightings in present study,

(59) SÃO JOSÉ DE RIBAMAR: Praia de Guarapiranga, - sightings in present study, rescued in Parente *et al.* (2004), Praia de Panaquatira - Conceição *et al.* (2020),

(60) SÃO LUÍS: sighting in Domning (1981),

(61) VILLAGE OF COIMARA = Boqueirão: incidental capture in Domning (1981),

#### **Pará state**

(62) SALVATERRA: Ilha de Marajó, Porto dos Pescadores,

(83) SANTO ANTÔNIO DO TAUÁ: present study,

#### **Paraíba state**

(16) BAÍA DA TRAIÇÃO: Praia Tramataia - interview in Lima, R. (1997),

(17) CABEDELÓ: UFPB550,

(18) CONDE: Barra do Abiaí - incidental capture in Borobia & Lodi (1992),

(18a) PRAIA DE COQUEIRINHO - CMA 0150111/13 - sighting in Borobia & Lodi (1992) and interview in Lima, R. (1997), Praia de Jacumã - interview in Lima, R. (1997),

(19) JOÃO PESSOA: Barra de Gramame and Praia do Poço - interview in Lima, R. (1997), Praia de Tambaú - UFPB545, Praia do Bessa - UFPB546,

(19a) Praia da Penha - interview in Lima, R. (1997),

(20) LUCENA: Barra do Rio Miriri - interview in Lima, R. (1997),



Appendix 1.

(Continue)

- (21) MAMANGUAPE: interview in Lima, R. (1997),
- (22) MATARACA: Barra de Camaratuba - interview in Lima, R. (1997),
- (23) PARNAMIRIM: mouth of Rio Pitimbú - sighting in Borobia & Lodi (1992),
- (24) PITIMBÚ: Rio Abiaí - live capture in Borobia & Lodi (1992), Praia de Acaú - interview in Lima, R. (1997) and incidental capture in nets in Borobia & Lodi (1992), Ponta dos Coqueiros, INPA150, INPA151,
- (24a) Praia de Pontinha - interview in Lima, R. (1997),
- (25) RIO TINTO: mouth of Rio Mamanguape - sighting in Borobia & Lodi (1992),

#### **Pernambuco state**

- (92) CABO DE SANTO AGOSTINHO: Praia de Gaibu - interview in Lima, R. (1997),
- (10) GOIANA: Banks da Rocha (1971), Rio Goiana - incidental capture in Borobia & Lodi (1992), Praia de Atapuz, Praia Carne de Vaca, and district of Ponta de Pedras - interview in Lima, R. (1997),
- (11) ILHA DE ITAMARACÁ: Canal de Santa Cruz estuary – sightings in Borobia & Lodi (1992),
- (12) IPOJUCA: Praia de Nossa Senhora do Ó - live capture in Borobia & Lodi (1992),
- (13) ITAPISSUMA: interview in Lima, R. (1997),
- (14) PAULISTA: Praia de Pau Amarelo - interview in Lima, R. (1997),
- (15) RECIFE: Maria Farinha - interview in Lima, R. (1997),

#### **Piauí state**

- (276) PORTO DOS TATUS: Ilha Grande - interview in Lima, R. (1997),
- (51) CAJUEIRO DA PRAIA: Praia de Barra Grande - interview in Lima, R. (1997),
- (52) LUÍS CORREIA: Praia do Coqueiro - interview in Lima, R. (1997),
- (53) PARNAÍBA: Praia da Pedra do Sal - interview in Lima, R. (1997),

#### **Rio Grande do Norte state**

- (219) CAIÇARAS: Rio Fundo, and São José do Gostoso - interview in Lima, R. (1997),
- (26) AREIA BRANCA: Praia de Caraúbas, Praia Upanema, and Praia da Ponta do Mel - interview in Lima, R. (1997),
- (27) BAIA FORMOSA: Praia de Sagi, CMA 0150111/14,
- (28) CANGUARETAMA: Barra do Cunhaú and Sibaúma - interview in Lima, R. (1997),
- (29) CEARÁ-MIRIM: Praia de Muriú - interview in Lima, R. (1997),
- (30) EXTREMOZ: Barra do Rio, Graçandu, and Genipabu - interview in Lima, R. (1997),
- (31) GALINHOS: interview in Lima, R. (1997),
- (32) MACAU: interview in Lima, R. (1997),
- (33) MAXARANGUAPE: Barra de Maxaranguape and Praia de Maracajaú - interview in Lima, R. (1997), (34) NATAL: Praia de Areia Preta, stranded in Borobia & Lodi (1992), Praia de Pitanguí, Praia de Ponta Negra, Redinha, and Praia do Rosado - interview in Lima, R. (1997),
- (35) NÍSIA FLORESTA: Praia de Barreta, Praia da Barra de Tabatinga, Praia de Búzios, Praia de Pirangi do Norte, and Praia de Pirangi do Sul - interview in Lima, R. (1997),
- (36) PARNAMIRIM: Cotovelo and Praia de Cotovelo - interview in Lima, R. (1997),
- (37) PORTO DO MANGUE: interview in Lima, R. (1997),



Appendix 1.

(Continue)

- (38) RIO DO FOGO: Praia de Pititinga, and Praia de Zumbi - interview in Lima, R. (1997),  
(39) SÃO MIGUEL DO GOSTOSO: Tourinhos Praia dos Morros - interview in Lima, R. (1997),  
(40) TIBAU: interview in Lima, R. (1997),  
(41) TIBAU DO SUL: Praia da Pipa - interview in Lima, R. (1997),  
(42) TOUROS: Praia de Perobas, Praia do Cajueiro, and Lagoa do Sal - interview in Lima, R. (1997).

## COLOMBIA

(NOT LOCATED) Atrato river, Ciénaga La Grande - sightings in Caicedo-Herrera *et al.* (2004),

### Santander and Cesar departments

(NOT LOCATED) Río Lebrija - sightings in Caicedo-Herrera *et al.* (2004),

### Atlantico and Bolivar departments

(NOT LOCATED) Tapacomocho in Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),

(220) CIÉNAGA DEL TOTUMO: Río Magdalena - sightings in Caicedo-Herrera *et al.* (2004),

### Antioquia department

(NOT LOCATED) EL RETIRO - sightings in Caicedo-Herrera *et al.* (2004),

(221) CIÉNAGA SARDINATA: Río Magdalena - sightings in Caicedo-Herrera *et al.* (2004),

(222) BAHÍA CANDELARIA: Río Atrato and Río Cauca - incidental captures in Montoya-Ospina *et al.* (2001),

(223) CIÉNAGA DE BARBACOAS: Río Magdalena - sightings in Caicedo-Herrera *et al.* (2004),

(140) BARRANQUILLA: Río Magdalena, Bocas de Ceniza - incidental capture in Montoya-Ospina *et al.* (2001),

(141) CAUCASIA: sightings in Caicedo-Herrera *et al.* (2004),

(142) MURINDÓ: sightings in Caicedo-Herrera *et al.* (2004),

(143) NECOCLÍ: sightings in Caicedo-Herrera *et al.* (2004), Río Atrato - incidental capture in Montoya-Ospina *et al.* (2001),

(144) PUERTO BERRÍO: sightings in Caicedo-Herrera *et al.* (2004),

(145) TURBO: sightings in Caicedo-Herrera *et al.* (2004),

(146) VIGÍA DEL FUERTE: sightings in Caicedo-Herrera *et al.* (2004),

(147) YONDÓ: sightings in Caicedo-Herrera *et al.* (2004),

**Armenia department** sightings in Caicedo-Herrera *et al.* (2004),

### Atlántico department

(NOT LOCATED) DEL BANCO - sightings in Caicedo-Herrera *et al.* (2004),

(148) BARRANQUILLA: sightings in Caicedo-Herrera *et al.* (2004),

(149) MANATÍ: sightings in Caicedo-Herrera *et al.* (2004),

(151) REPELÓN: sightings in Caicedo-Herrera *et al.* (2004),

(152) SANTA LUCIA: sightings in Caicedo-Herrera *et al.* (2004),

(150) PALMAR DE VARELA: sightings in Caicedo-Herrera *et al.* (2004),

### Bolivar department

(NOT LOCATED) Canal del Dique - incidental captures in Montoya-Ospina *et al.* (2001),

BAHIA BARBACOAS: Río Magdalena - incidental captures in Montoya-Ospina *et al.* (2001),





Appendix 1.

(Continue)

- (224) ISLA DE MOMPÓS: Río Magdalena - incidental captures in Montoya-Ospina *et al.* (2001),  
(225) CORREGIMIENTO DE SAN ANTONIO – sightings in Caicedo-Herrera *et al.* (2004),  
(226) ALTILLO DE LOBA - sightings in Caicedo-Herrera *et al.* (2004),  
(154) ALTOS DEL ROSARIO: Sightings in Caicedo-Herrera *et al.* (2004),  
(153) ACHÍ: Corregimiento de Achí, sightings in Caicedo-Herrera *et al.* (2004), Río Cauca - incidental capture in Montoya-Ospina *et al.* (2001),  
(155) ARJONA: sightings in Caicedo-Herrera *et al.* (2004),  
(156) CALAMAR: sightings in Caicedo-Herrera *et al.* (2004), Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),  
(157) CANTAGALLO: sightings in Caicedo-Herrera *et al.* (2004),  
(158) CARTAGENA: corregimiento Pasacaballos - sightings in Caicedo-Herrera *et al.* (2004), Córdoba, Corregimientos de Tacamocho - sightings in Caicedo-Herrera *et al.* (2004),  
(159) GAMBOTE: sightings in Caicedo-Herrera *et al.* (2004),  
(161) MAGANGUÉ: Coyongal – sightings in Caicedo-Herrera *et al.* (2004), corregimiento in Tacaloa Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001), Tacasaluma – sightings in Caicedo-Herrera *et al.* (2004),  
(160) MAHATES: sightings in Caicedo-Herrera *et al.* (2004),  
(163) MOMPOS: La Peña, sightings in Caicedo-Herrera *et al.* (2004),  
(162) MARIA LA BAJA: sightings in Caicedo-Herrera *et al.* (2004),  
(165) REGIDOR: sightings in Caicedo-Herrera *et al.* (2004),  
(164) MORALES: sightings in Caicedo-Herrera *et al.* (2004), Río Magdalena, El Dique - incidental capture in Montoya-Ospina *et al.* (2001),  
(166) PINILLOS: sightings in Caicedo-Herrera *et al.* (2004), Río Cauca - incidental capture in Montoya-Ospina *et al.* (2001),  
(167) SAN CRISTÓBAL: sightings in Caicedo-Herrera *et al.* (2004),  
(168) SAN ESTANISLAO: sightings in Caicedo-Herrera *et al.* (2004), SAN PABLO - sightings in Caicedo-Herrera *et al.* (2004),  
(169) SIMITÍ: sightings in Caicedo-Herrera *et al.* (2004),  
(170) TALAIGUA NUEVO: Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),

#### **Caldas department**

- (171) RIOSUCIO: sightings in Caicedo-Herrera *et al.* (2004),

#### **Casanare department**

- (172) LA POYATA: Río Meta - incidental capture in Montoya-Ospina *et al.* (2001),

#### **Cesar department**

- (NOT LOCATED) Río Cesar, Arroyo El Delirio - incidental capture in Montoya-Ospina *et al.* (2001),

- (173) AGUACHICA: sightings in Caicedo-Herrera *et al.* (2004),

- (174) CHIMICHAGUA: sightings in Caicedo-Herrera *et al.* (2004),

- (175) CHIRIGUANA: sightings in Caicedo-Herrera *et al.* (2004),

- (176) EL PASO: sightings in Caicedo-Herrera *et al.* (2004),

- (177) GAMARRA: sightings in Caicedo-Herrera *et al.* (2004), LA GLORIA, Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),



Appendix 1.

(Continue)

(178) TAMALAMEQUE: sightings in Caicedo-Herrera *et al.* (2004),

#### **Chocó department**

(NOT LOCATED) Momil - sightings, Caicedo-Herrera *et al.* (2004),

(227) BRAZO LEON: Río Atrato - incidental captures in Montoya-Ospina *et al.* (2001),

(228) GOLFO DE URABÁ: Río Atrato - incidental captures in Montoya-Ospina *et al.* (2001),

(229) CIÉNAGA MARRIAGA: Río Atrato - incidental captures in Montoya-Ospina *et al.* (2001), (203) RÍO TRUANDÓ: incidental capture in Montoya-Ospina *et al.* (2001),

(179) UNGÍA: sightings in Caicedo-Herrera *et al.* (2004),

#### **Córdoba department**

(NOT LOCATED) sightings in Caicedo-Herrera *et al.* (2004), mouth of Río Sinu, Playa del Viento in Río Sinú, Tierralta in Río Sinú, and Cienca Grade de Lorica in Río Sinú - incidental captures in Montoya-Ospina *et al.* (2001),

(230) BOCA DE TINAJONES: Río Sinú - incidental captures in Montoya-Ospina *et al.* (2001),

(180) AYAPEL: sightings in Caicedo-Herrera *et al.* (2004), Río San Jorge, Ciénaga de Ayapel - incidental capture in Montoya-Ospina *et al.* (2001),

(181) CHIMÁ: sightings in Caicedo-Herrera *et al.* (2004),

(182) CULEBRA: Río Meta - incidental capture in Montoya-Ospina *et al.* (2001),

(183) LORICA: sightings in Caicedo-Herrera *et al.* (2004),

(184) PURÍSIMA: sightings in Caicedo-Herrera *et al.* (2004),

(185) SAN ANTERO: Río Sinú - incidental capture in Montoya-Ospina *et al.* (2001),

(186) SAN BERNARDO DEL VIENTO: sightings in Caicedo-Herrera *et al.* (2004),

#### **Magdalena department**

(NOT LOCATED) San Sebastian in Río Magdalena, Don Diego River, Río Sevilla, Fundación River, Río Frió - incidental captures in Montoya-Ospina *et al.* (2001),

(231) BURITACA RIVER: incidental captures in Montoya-Ospina *et al.* (2001),

(187) ARACATACA: Ciénega Grande de Santa Marta: incidental capture in Montoya-Ospina *et al.* (2001),

(188) EL BANCO: Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),

(189) PINTO: Río Magdalena - incidental capture in Montoya-Ospina *et al.* (2001),

(190) SANTA MARTA: Ciénega Grande de Santa Marta, Tagangaba - incidental capture in Montoya-Ospina *et al.* (2001),

#### **Meta department**

(NOT LOCATED) Corregimiento Caño Chicagua, Curumaní el Banco, – sightings in Caicedo-Herrera *et al.* (2004), La Hermosa in Río Meta, Piñalitos in Río San Jorge, Aguas Pietras in Río Sinú, Bugre in Río Sinú - incidental captures in Montoya-Ospina *et al.* (2001),

(232) PUERTO GAITAN: Río Meta - incidental captures in Montoya-Ospina *et al.* (2001),

(233) PUERTO KENNEDY: sightings in Caicedo-Herrera *et al.* (2004),

(191) PUERTO LÓPEZ: Río Meta - incidental capture in Montoya-Ospina *et al.* (2001),

#### **Sucre department**

(NOT LOCATED) Corregimiento Ciénaga de Santiago Apóstol, and Santa Cruz y Tolú - sightings in Caicedo-Herrera *et al.* (2004),



Appendix 1.

(Continue)

(197) SAN BENITO ABAD: sightings in Caicedo-Herrera *et al.* (2004),

(198) SAN MARCOS: Río San Jorge - incidental capture in Montoya-Ospina *et al.* (2001),

#### **Santander department**

(NOT LOCATED) Sabana de Torres - sightings in Caicedo-Herrera *et al.* (2004),

(234) CIÉNAGA DE PAREDES: Río Magdalena - incidental captures in Montoya-Ospina *et al.* (2001),

(235) CIÉNAGA DE COLORADO: Río Magdalena - incidental captures in Montoya-Ospina *et al.* (2001),

(236) VALLEDUPAR: sightings in Caicedo-Herrera *et al.* (2004),

(237) VILLA ROSA: sightings in Caicedo-Herrera *et al.* (2004),

(192) BARRANCABERMEJA: sightings in Caicedo-Herrera *et al.* (2004),

(193) CIMITARRA: sightings in Caicedo-Herrera *et al.* (2004),

(194) PUERTO PARRA: sightings in Caicedo-Herrera *et al.* (2004),

(195) PUERTO WILCHES: sightings in Caicedo-Herrera *et al.* (2004),

#### **Tolima department**

(199) PURIFICACIÓN: sightings in Caicedo-Herrera *et al.* (2004),

#### **Valle del Cauca department**

(200) EL CERRITO: Corregimiento El Cerrito, sightings in Caicedo-Herrera *et al.* (2004),

#### **Vichada department**

(NOT LOCATED) Isla el Pañuelo in Río Meta - incidental capture in Montoya-Ospina *et al.* (2001),

(201) PUERO CARREÑO: Río Meta - incidental capture in Montoya-Ospina *et al.* (2001),

(202) SANTA ROSALÍA: Río Meta, El Bordereño - incidental capture in Montoya-Ospina *et al.* (2001).

#### **FRENCH GUIANA**

(NOT LOCATED) Approuagé river and Mana River- interview in Thoisy *et al.* (2003), Mahury river, Cayenne - Castelblanco-Martínez (2015),

(238) AWALA-YALIMAPO: sighting in Thoisy *et al.* (2003),

(108) BOURDA: sighting in Thoisy *et al.* (2003),

(239) CAYENNE RIVER: interview in Thoisy *et al.* (2003),

(109) COSWINE: sighting in Thoisy *et al.* (2003),

(110) COUNAMAMA: interview in Thoisy *et al.* (2003),

(240) ÎLET LA MÈRE: interview in Thoisy *et al.* (2003),

(111) IRACOUBO: interview in Thoisy *et al.* (2003),

(112) Javouhey: sighting in Thoisy *et al.* (2003),

(241) KAW RIVER: sighting in Thoisy *et al.* (2003),

(113) KOUROU: sighting in Thoisy *et al.* (2003),

(242) LES HATTES: interview in Thoisy *et al.* (2003),

(114) MALMAMOURY: sighting in Thoisy *et al.* (2003),

(243) MARONI RIVER: interview in Thoisy *et al.* (2003),



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- (244) OUANARY RIVER - interview in Thoisy *et al.* (2003),
- (115) OYAPOCK: sighting in Thoisy *et al.* (2003),
- (116) RÉGINA: sighting in Thoisy *et al.* (2003),
- (117) RÉMIRE-MONTJOLY: sighting in Thoisy *et al.* (2003),
- (118) ROURA: sighting in Thoisy *et al.* (2003),
- (119) SINNAMARY: interview in Thoisy *et al.* (2003),
- (245) ST LAURENT: interview in Thoisy *et al.* (2003).

### **GUYANA**

- (NOT LOCATED) Akawini river, Arapiaco river, Berbice river, Canje river - Bertram & Bertram (1973), Nanniekrek, Sebai river, and Wuini river - Bertram & Bertram (1973),
- (246) ABARY RIVER: Bertram & Bertram (1973),
- (246) BARIMA RIVER: Bertram & Bertram (1973),
- (121) COURANTYNE: Bertram & Bertram (1973),
- (248) DEMERARA RIVER: Bertram & Bertram (1973),
- (249) ESSEQUIBO RIVER: Bertram & Bertram (1973),
- (122) GEORGETOWN: UNEP (1995),
- (250) KIATUNA RIVER: Bertram & Bertram (1973),
- (251) MAHAICA RIVER: Bertram & Bertram (1973),
- (252) MAHAICONY RIVER: Bertram & Bertram (1973),
- (253) POMERROM RIVER: Bertram & Bertram (1973).

### **SURINAME**

- (NOT LOCATED) Nanni Crrek - Duplaix & Reichard (1978), Cottica river and its tributaries Perica river and the small stream Koopmans and Barbakoeba - Duplaix & Reichard (1978), Coesewijne river, tributary of Coppename river - Duplaix & Reichard (1978), Wayombo river, tributary of Coppename river - Duplaix & Reichard (1978),
- (254) COURANTYNE RIVER: Bertram & Bertram (1973),
- (256) SARAMACCA RIVER: Duplaix & Reichard (1978),
- (257) SURINAME RIVER: Duplaix & Reichard (1978),

#### **Marowijne district**

- (258) WANE KREEK - UNEP (1995),

#### **Nickerie district**

- (255) NICKERIE RIVER: and its tributaries Maratakka and Paraíso rivers - Duplaix & Reichard (1978),

#### **Saramacca district**

- (265) TABITI RIVER: tributary of Coppename river - Duplaix & Reichard (1978),
- (266) TAPOERIPA KREEK: UNEP (1995),

#### **Sipaliwini district**



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(Continue)

(120) COTTICA RIVER: Dekker (1974).

### TRINIDAD and TOBAGO

(139) Gran Laguna, Oropouche Norte, Charamel and Otoire rivers - UNEP (1995), Pantano de Nariva and Río Oropouche Norte - UNEP (1995), Río L'Embranche, Manzanilla Norte - sighting in UNEP (1995).

### VENEZUELA

(260) GOLFO DE PÁRIA: in Sucre and Monagas - Boede *et al.* (2013),

(259) NORTHEASTERN LAGO MARACAIBO – Montiel-Villalobos & Barrios-Garrido (2005),

#### Anzoátegui state

(NOT LOCATED) mouth of Neveri river - UNEP (1995),

#### Apure state

(123) BRUSUAL: interview in O'Shea *et al.* (1988),

(125) EL SAMAN: interview in O'Shea *et al.* (1988),

(124) ELORZA: interview in O'Shea *et al.* (1988),

(126) SAN FERNANDO DE APURE: interview in O'Shea *et al.* (1988),

#### Bolívar state

(NOT LOCATED) Maripa - interview in O'Shea *et al.* (1988),

(127) CAICARA: interview in O'Shea *et al.* (1988),

(128) CIUDAD BOLÍVAR: interview in O'Shea *et al.* (1988),

(129) LAS MAJADAS: interview in O'Shea *et al.* (1988),

#### Carabobo state

(132) PUERTO CABELLO: sighting, UNEP (1995), Costa Barlovento - Boede *et al.* (2013),

#### Delta Amacuro state

(133) PUEBLO PALO BLANCO: interview in O'Shea *et al.* (1988),

(134) TUCUPITA: interview in O'Shea *et al.* (1988), Caño Manamo,

#### Monagas state

(NOT LOCATED) El Silencio - interview in O'Shea *et al.* (1988),

(135) BARRANCAS: interview in O'Shea *et al.* (1988),

(136) CARIPITO: interview in O'Shea *et al.* (1988),

#### Sucre state

(NOT LOCATED) Caño La Brea - UNEP (1995), Turuépano - Boede *et al.* (2013),

#### Zulia state

(137) CASIGUA: interview in O'Shea *et al.* (1988),

(131) CAPITÁN CHICO, Maracaibo: Santa Rosa de Agua Parque Ecoturístico "Tierra de Sueños" - Fundación Azul Ambientalistas, 2014, Lago de Maracaibo - interview in O'Shea *et al.* (1988),

(138) ENCONTRADOS: interview in O'Shea *et al.* (1988).





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*Trichechus inunguis* (Natterer, 1883)

## **BRAZIL**

### **Amazonas state**

(NOT LOCATED) RDS Piagaçu-Purus - sighting in Best (1983), Lago Aranucú - IDSM00/01, Lago Anuã - interview in Franzini *et al.* (2013), Paranã do Castanho - IDSM97/07, Rio Japurá - IDSM98/02L, *Reserva de Desenvolvimento Sustentável Piagaçu-Purus* (Caua-Cuiuanã - sighting in Souza (2015), Itapuru - interview in Best (1983), sightings in present study, incidental capture in Best (1983), Poço do Varela (Beabá) – recorded in Rosas *et al.* (2003), Jaruá, comunidade Arapari in IDSM93/01,

(282) ANAMÃ: rescued in present study,

(84) ATALAIA DO NORTE: rescued, Mundo Animal,

(85) AUTAZES: rescue in present study,

(90) BADAJÓS: Codajás municipality – hunted, present study,

(86) BARREIRINHA: sightings, present study,

(87) BERURI: rescued in present study,

(88) CAAPIRANGA: rescued in present study,

(89) COARI: rescued in present study, Coari Grande - interview in Franzini *et al.* (2013),

(91) FONTE BOA: Rio Panauã, Lago Guedes - IDSM01/47,

(281) GUAJARÁ: Marmotel (2019),

(104) ILHA DOS MACHADO: IDSM00/04 in Barros *et al.* (2016),

(93) IRANDUBA: lago do Baixio in Ilha do Baixio – rescued in present study,

(93a) CACAU-PIRÊRA DISTRICT: Porto das Balsas - rescued in present study,

(94) ITACOATIARA: hunted, present study,

(268) LAGO AIAPUA: sighting in Best (1983),

(269) LAGO ARAPARI: recorded in Rosas *et al.* (2003),

(270) LAGO COARI: interview in Franzini *et al.* (2013),

(271) LAGO JARI: recorded in Rosas *et al.* (2003),

(273) LAGO DO PIORINI: Codajás municipality – hunted, present study,

(96) LAGO MAMORI: rescued in present study,

(277) CAREIRO DA VÁRZEA: rescued in present study,

(95) MANACAPURU: rescued in present study, Balneário do Miriti, km 75 on the road to Manuel Urbano - rescued in present study, Comunidade Betel and Comunidade São Sebastião - rescued in present study, Costa do Botija, Comunidade Jesus de Nazaré - incidental capture in nets in present study,

(97) MANICORÉ: rescued in present study,

(98) MARAÃ: Panauã, upstream mouth of Lago do Guedes - IDSM01/01, São Francisco do Boia, Rio Aranapú, mouth of Lago Gigante - IDSM00/09,

(99) PARINTINS: Villa Bella Imperatriz, Santa Clara, Rio Amazonas - AMNH93124,

(105) RIO ARAUAZINHO: tributary of Rio Aripuanã – INPA\_CCM81,



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- (287) RIO URUCU: Coari municipality - interview in Franzini *et al.* (2013),  
(100) SANTA ISABEL DO RIO NEGRO: Rio Negro - rescued in present study,  
(101) SILVES: Comunidades Jacu, Taperebatuba e Igarapé-Açu – hunted, present study,  
(102) TEFÉ: mouth of Lago Tefé - AMNH76813,  
(103) UARINI: Lago do Cipó - IDSM01/13, São Raimundo do Jarauá, comunidade Jarauá: IDSM00/06,  
(106) UATUMÁ: hunted, present study,

### **Amapá state**

- (NOT LOCATED) Ilha do Juruá, South of Cabo Norte - incidental capture in Domning (1981),  
(78) MACAPÁ: incidental capture in Domning (1981),  
(80) MARACÁ: Ilha de Maracá, Jipioca Ecological Station - Marmontel *et al.* (2016),  
(79) SANTANA: Rio Pirativa – rescued in present study,

### **Pará state**

- (NOT LOCATED) Rio Paru - INPA29, Ilha de Marajó, Canal Perigoso - INPA178-180,  
(63) ABAETETUBA: MPEG42148,  
(64) ALTAMIRA: Rio Curuá,  
(73) BELÉM DO PARÁ: mouth of Igarapé Tucunduba, Rio Guamá - MPEG11298,  
(65) CACHOEIRA DO ARARI: Rio Arari – MPEG 44485, Ilha de Marajó - INPA182,  
(286) CAMETÁ: Rio Tocantins: this study,  
(66) COLARES: Igarapé do Cedro - MPEG42157,  
(284) COMUNIDADE PIXUNA DO TAPARÁ: Santarém municipality - rescued in present study,  
(67) FARO: Rio Amazonas, Rio Inhamundá - AMNH96167,  
(68) GOIANÉSIA DO PARÁ: Rio Capim - MPEG44494,  
(69) GURUPÁ: MPEG44489,  
(70) ICOARACI: Ilha do Arapiranga - MPEG1518,  
(71) JURUTI: hunted, present study,  
(72) MONTE ALEGRE: Rio Mayairú, Lago Grande - MPEG04641,  
(76) ÓBIDOS: Lago Pauxis - rescued in present study,  
(74) ORIXIMINÁ: Rio Trombetas - MPEG07959,  
(283) PORTEL: Ilha de Marajó, Rio Acuti-Pereira,  
(62) SALVATERRA: Ilha de Marajó, Joanes - GEMAM 604 in Sousa (2011),  
(272) SANTA BÁRBARA: rescued in present study,  
(75) SENADOR JOSÉ PORFÍRIO: Tabuleiro do Embaubau - Paschoalini *et al.* (2016),  
(285) TAPERINHA: MPEG4635, MPEG4637, Taperinha in Rio Ayaya - MPEG4636, MPEG4638-4639.

### **COLOMBIA**

- (NOT LOCATED) Isla Charal, Isla Chimborazo, Isla El Indio, Isla Playa Caimanes, and La Angela – Castelblanco-Martínez *et al.* (2009),



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**Amazonas department**

(NOT LOCATED) Río Cotuhé – sightings in Caicedo-Herrera *et al.* (2004),  
(261) LORETO MOCAGUA: sightings in Caicedo-Herrera *et al.* (2004),  
(204) LETICIA: Evans & Herald (1970),  
(205) MIRITÍ-PARANÁ: sightings in Caicedo-Herrera *et al.* (2004),

**Bolívar department**

(262) MAGANGUÉ, Puerto Nariño – sightings in Caicedo-Herrera *et al.* (2004),

**Caqueta department**

(NOT LOCATED) Husar (1977), Boca Meta - Castelblanco-Martínez *et al.* (2009),

**Caldas department**

(NOT LOCATED) San Jose - Castelblanco-Martínez *et al.* (2009),

**Cesar department**

(263) EL BURRO: Castelblanco-Martínez *et al.* (2009),

**Guainía department**

(NOT LOCATED) Isla Santa Helena - Castelblanco-Martínez *et al.* (2009),

**Magdalena department**

(206) TRONCONAL: Castelblanco-Martínez *et al.* (2009),

**Nariño department**

(264) PUNTA LAJAS: Castelblanco-Martínez *et al.* (2009),

**Norte de Santander department**

(207) TRES BOCAS: Castelblanco-Martínez *et al.* (2009),

**Putumayo department**

(NOT LOCATED) Río Igará-Paraná, affluent of Río Putumayo - sightings in Caicedo-Herrera *et al.* (2004),  
(208) PUERTO LEGUÍZAMO: sightings in Caicedo-Herrera *et al.* (2004),

**Sucre department**

(NOT LOCATED) Puerto Sucre – Castelblanco-Martínez *et al.* (2009),

**Vaupés department**

(NOT LOCATED) Apoporis - Husar (1977),

**Vichada department**

(NOT LOCATED) Raudal Bachaco – Castelblanco-Martínez *et al.* (2009).

**ECUADOR**

(NOT LOCATED) Río Anangu, tributary of Río Napo, and Río Lagarto Cocha, tributary of Río Aguarico - sightings in Timm *et al.* (1986),  
(209) LAGUNA COCHA: near the mouth of Río Aguarico - sighting Timm *et al.* (1986),  
(213) LAGUNA GRANDE: upper Río Cuyabeno - sighting in Timm *et al.* (1986),  
(210) LAGUNA ZANCUDO COCH: Río Aguarico - sighting in Timm *et al.* (1986),



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(211) RÍO NAPO: near San Francisco - sighting in Timm *et al.* (1986),

(212) RÍO YASUNÍ: near confluence with Río Napo - sighting in Timm *et al.* (1986).

**PERU, Amazonas region**

(NOT LOCATED) Lagoa El Dorado - interview in Landeo-Yauri *et al.* (2013),

**Ucayali region**

(280) TAPICHE RIVER: AMNH8691,

**Loreto region**

(215) NAPO: Río Napo, near San Roque - sighting in Timm *et al.* (1986),

(278) PACAYA SAMIRIA NATIONAL RESERVE: interview in Landeo-Yauri *et al.* (2013),

(214) RÍO SAMIRIA: sighting in Timm *et al.* (1986),

(216) RÍO CURARAY: AMNH73594,

(279) RÍO CURARAY MOUTH: Maynas province - AMNH 73594.



