



Dolphins, Love and Enchantment: Tracing the Use of Cetacean Products in Brazil

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The human population of the Brazilian Amazon possesses a rich body of beliefs and practices that relate to river dolphins, which are also known as botos (*Inia* and *Sotalia* species). There is a widespread belief in their magical powers in relation to love enchantments. One form that this takes is “dolphin love charms” and these are widely in use in northern Brazil, and also in the largest southern cities. This paper considers the trade of cetacean products in the form of love charms in Brazil. Samples were obtained in the north ($n = 70$), northeast ($n = 3$) and southeast ($n = 59$) regions from 34 shops or municipal markets. A total of 38 of the 131 collected samples were evaluated by complete cytochrome b sequencing, revealing the use of two species: the Guiana dolphin (*Sotalia guianensis*) ($n = 3$) and the domestic pig (*Sus scrofa*) ($n = 10$) and samples containing no animal material ($n = 10$) were also detected. Pigs are used to fake love charm products in Rio de Janeiro. However, whereas in the southeast there is no actual use of dolphin tissues in love charms, there is a widespread use of dolphin tissue in northern Brazil, including, muscle, eyes, penis and vagina. The data confirm a regular trade of dolphin products in large cities in the north and northeast of Brazil and the need for more intense actions from governmental agencies in order to curb this illegal trade.

Keywords: love charms, *Sotalia*, trade, Cytochrome b, phylogeny, Amazon

INTRODUCTION

The human population of the Brazilian Amazon, comprising indigenous, European and African ancestries, possesses a rich body of beliefs and practices that relate to river dolphins or botos (*Inia* and *Sotalia* species). There is a widespread belief in their magical powers in relation to love enchantments. At night, people believe that river dolphins are shape-shifters and can take

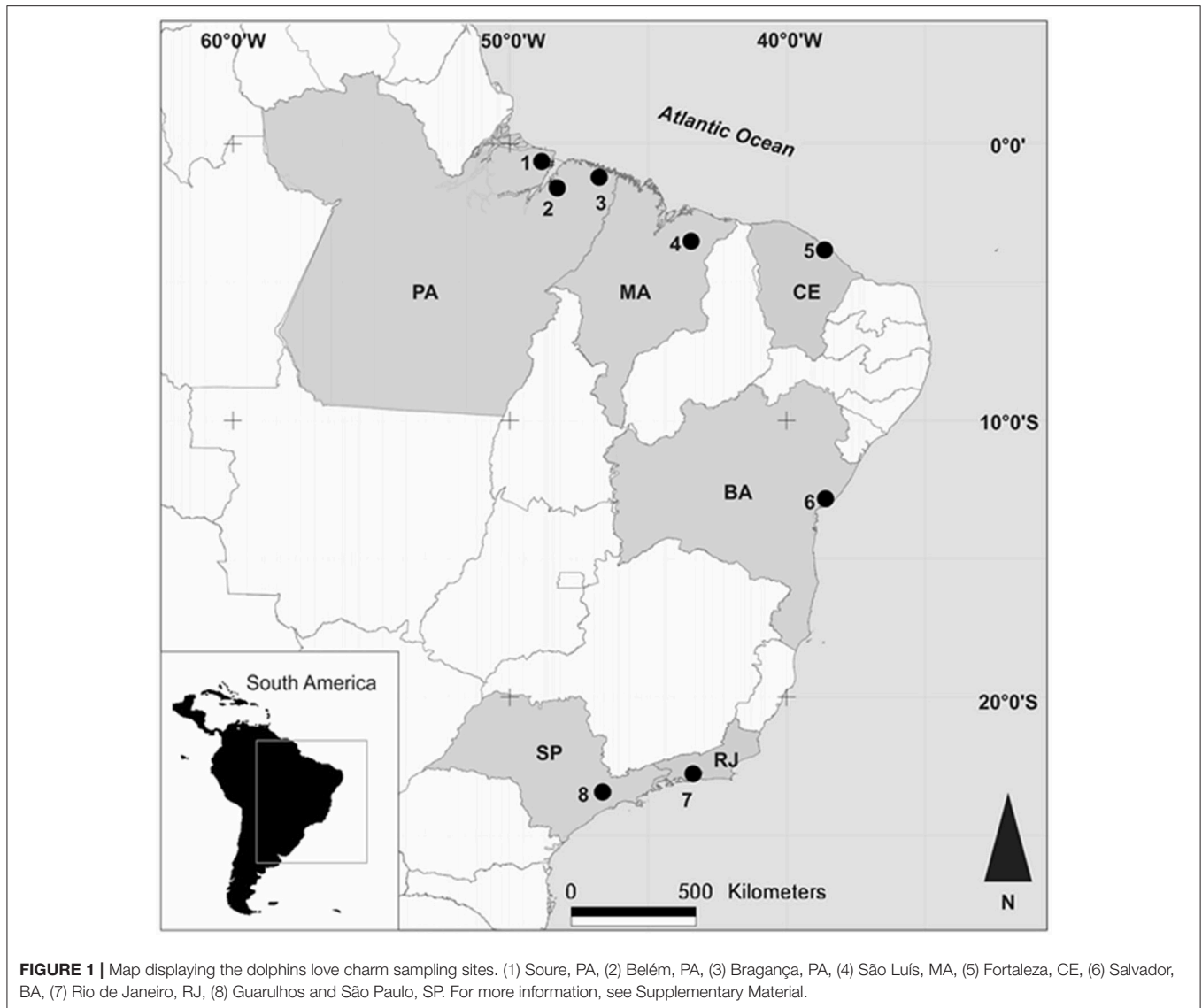
human form, causing harm to humans on land (Cravalho, 1999). In addition, human population along Amazon Basin Rivers believe that young, unengaged, pregnant females blame the botos for their pregnancies. For this reason, botos are considered enchanted creatures (Cravalho, 1999). This remarkable peculiarity related to Amazon dolphins leads to a widespread conviction of their magical powers in relation to love enchantment (Slater, 2001). Not surprisingly, the boto figure appears in the oral tradition of every Amazon basin community, and many of these stories have been compiled by Brazilian

storytellers (Santos, 1987, 2004; Simões and Golder, 1995a,b,c; Monteiro, 2002; Val, 2007; Siqueira, 2012; Campos et al., 2013) and novelists (Souza, 1982). Therefore, the magical power and enchantment of this character displays many representations. One of the most emblematic are typically called “love charms”, meaning the use of body parts, mainly genitals, eyes and teeth, of any dolphin, for sexual purposes. Easily detected in many parts of Brazil, far beyond Amazon boundaries, the love charm trade is a common practice, but the extent of this practice and the animal species that are used for this purpose are not clear. A

TABLE 1 | Dolphin love charm samples, with sample number, identification (ID), type of product, tissue, storage, and purchase locality.

Sample number	ID	Product	Tissue	Storage	Purchase locality
CRB3238	U	Perfume	Muscle	Fragrance	PA, Bragança
CRB3239	U	Perfume	Muscle	Water	PA, Bragança
CRB3240	U	Perfume	Muscle	Water	PA, Bragança
CRB3241	U	Perfume	Muscle	Dry	RJ, Rio de Janeiro, Madureira Market
CRB3242	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Madureira Market
CRB3243	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Madureira Market
CRB3244	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Madureira Market
CRB3245	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Madureira Market
CRB3246	U	Perfume	Muscle	Alcohol	BA, Salvador
CRB3247	U	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Tijuca
CRB3248	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Tijuca
CRB3249	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Tijuca
CRB3250	SS	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Tijuca
CRB3251	U	Perfume	Muscle	Fragrance	RJ, Rio de Janeiro, Tijuca
CRB3252	SG	Perfume	Muscle	Fragrance	PA, Belém, Ver-o-Peso Market
CRB3253	SS	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3254	SS	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3255	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3256	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3257	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3302	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3303	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3304	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3305	U	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3306	SS	Perfume	U	Fragrance	RJ, Rio de Janeiro, Andaraí
CRB3307	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3308	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3309	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3310	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3311	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3312	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3313	U	Perfume	Muscle	Fragrance	MA, São Luís
CRB3314	U	Necklace	Eye	Dry	MA, São Luís
CRB3315	U	Necklace	Eye	Dry	MA, São Luís
CRB3316	U	Perfume	Muscle	Fragrance	PA, Soure
CRB3317	U	Necklace	Eye	Dry	PA, Soure
CRB3336	SG	Necklace	Penis	Dry	PA, Soure
CRB3452	SG	Slices	Penis	Dry	RJ, Rio de Janeiro, Centro

U, unknown; SG, *Sotalia guianensis*; SS, *Sus scrofa*. Brazilian states are Pará (PA), Rio de Janeiro (RJ), Bahia (BA) and Maranhão (MA).



previous study (Best and da Silva, 1989) identified the Amazon river dolphin (*Inia geoffrensis*) as the most frequently traded species in two public markets, “Ver-o-Peso” in Belém, located in the state of Pará, and the Municipal Market of Manaus, in the state of Amazonas, both in northern Brazil. In this context, Siciliano (1994) raised concern over the trade of dolphin’s eyes and genitals, attributed to Guiana dolphins (*Sotalia guianensis*), in the fishing town of Vigia, located on the eastern Pará coast. In fact, recent studies have proven either the marine origin of these dolphin samples or the fact that they are simply fake (Sholl et al., 2008). Scholl et al. indicated that, from the total of 21 love charm samples obtained in Belém, all were from *S. guianensis*, a salt water dwelling species. In contrast to botos, that inhabit continental waters, Guiana dolphins are found in shallow coastal waters, usually associated with mangroves and estuaries, where they feed on the most abundant schooling fish in the area (Lopes et al., 2012). Botos, on the other hand, are usually found in large

river systems, where they feed on large fish (Best and da Silva, 1989). *Inia geoffrensis* and *Sotalia guianensis* are both listed as Data Deficient by the IUCN. Love charms obtained in Manaus (Amazonas) and Porto Velho (Rondônia) markets have also been found to be derived from the Guiana dolphin (Gravena et al., 2008). Moreover, Gravena et al. assigned the presence of pig and sheep to several samples, especially as eye charms. In general, information on the love charm trade in Brazil is quite limited, restricted to only a few studies carried out in northern Brazil. Wildlife DNA forensic testing to gain knowledge on the geographic origin and species identification of illegal samples associated with wildlife or derived products is one the most efficient tools for detecting illegal trades. In addition to incidental dolphin captures by fisheries, this love charm trade seems to stimulate dolphin capture. In Brazil, dolphin species belonging to two genera, *Inia* and *Sotalia*, are involved in the illegal wildlife trade: the Amazon river dolphin *Inia geoffrensis* and the Guiana



FIGURE 2 | Love charm samples. **(A)** “Dolphin perfume charm” from São Luís, Maranhão state, **(B)** “Dolphin sex attractive” from Bragança, Pará state, **(C)** Eye dolphin from Bragança, Pará state; **(D)** “Dolphin perfume charm” from Tijuca, Rio de Janeiro, Rio de Janeiro state, **(E)** Dried penis from Mercado de Madureira, Rio de Janeiro, Rio de Janeiro state, **(F)** “Dolphin sex attractive” from Ver-o-Peso Market, Belém, Pará state.

dolphin *Sotalia guianensis*. Both are considered endangered by the Brazilian red list of threatened fauna since 2008 (Chiarello et al., 2008).

This work aims to: (1) trace the origin of love charms traded in Brazil; (2) verify the types of love charms in current use in the Brazilian North, Northeastern and Southeastern regions, including the megalopolises of São Paulo and Rio de Janeiro; (3) test their authenticity as “true” dolphin products; and (4) provide the first broad coverage of the love charm trade in Brazil.

MATERIALS AND METHODS

“Love charm” samples were purchased at 34 municipal markets or religious-article stores in North ($n = 70$, Pará and Maranhão), Northeastern ($n = 3$, Ceará and Bahia), and Southeastern ($n = 59$, Rio de Janeiro and São Paulo, **Table 1**, **Figure 1**) regions of Brazil. Field research was conducted from September 2011 to January 2016. From a total of 131 samples, 15 were teeth ($n = 7$), bones ($n = 1$), and oil ($n = 7$) and were, thus, not investigated.

A list of shops visited by city, their addresses and the articles purchased, along with their value in Brazilian currency, are provided in Supplementary Material 1. A total of 38 love charm samples were selected for species identification. Among perfumes, defined as fragrances with a piece of “dolphin” tissue inside the vial, the most common items were dehydrated eyes, penis (or dried penis portions) and vaginas (**Table 1**). Dehydrated

penises are usually sold as a single piece, although one shop in Rio de Janeiro offered them in thin slices. Less common items found in Pará, Bahia and Rio de Janeiro included vials containing “dolphin” and “whale” oils and small, sun-dried, pieces of blubber and muscle labeled as “botos” (**Figure 2**). A very uncommon item was a newborn Guiana dolphin (*S. guianensis*) skull from the Ver-o-Peso market in Belém, Pará. Sequences of the mitochondrial gene Cytochrome *b*, referred to as *MT-CYB*, following HGNC rules (Eyre et al., 2006; HGNC, 2009) were analyzed for species identification.

Thirty-eight DNA samples were isolated through the phenol-chloroform protocol (Sambrook et al., 1989). The complete *MT-CYB* (ca. 1,140 bp) was PCR-amplified with CB-out 1 and CB-out 2 primers [19], by a pre-denaturation step at 94°C for 2 min; 35 denaturation cycles at 94°C for 30 s, annealing at 54°C for 30 s, an extension step at 72°C for 90 s, and a final extension step at 72°C for 5 min. Amplicons were purified using the GFX PCR DNA and Gel Band Purification kits (GE Healthcare, Brazil). Sequencing reactions were performed with CB-out 1, CB-out 2, CB-in 1 and CB-in 2 (Cassens et al., 2000). Amplicons were labeled with the XL and BigDye® Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems) and loaded on an ABI Prism™ 3130 platform.

Sequences were edited and assembled with ChromasPro (McCarthy, 1988) and Bioedit (Hall, 1999). Assembled sequences were compared to data from the Basic Local Alignment Search Tool (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>) confirm

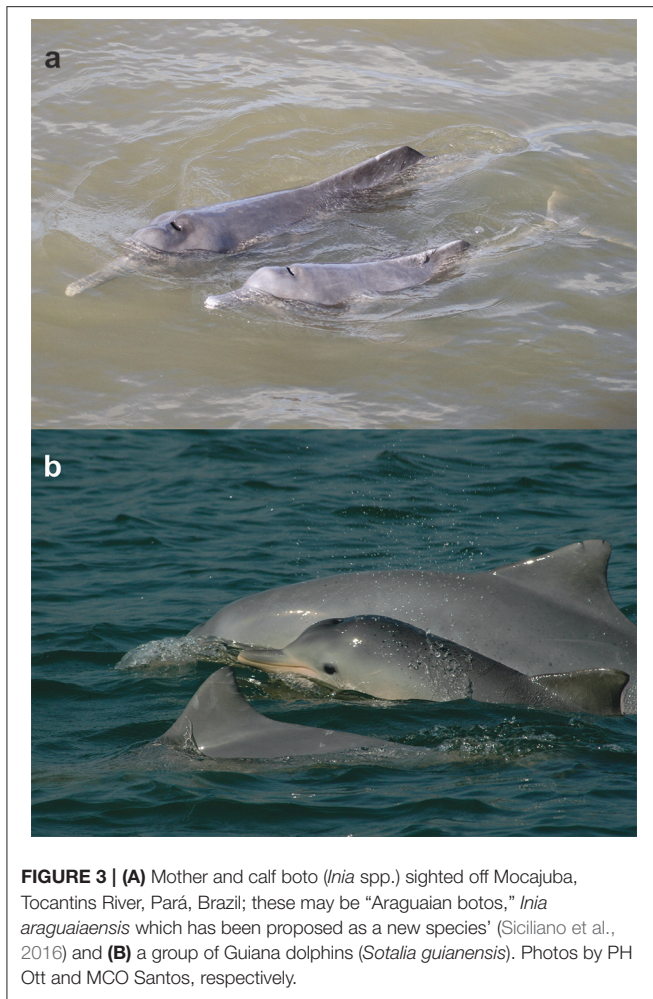


FIGURE 3 | (A) Mother and calf boto (*Inia* spp.) sighted off Mocajuba, Tocantins River, Pará, Brazil; these may be “Araguaian botos,” *Inia araguaiaensis* which has been proposed as a new species’ (Siciliano et al., 2016) and **(B)** a group of Guiana dolphins (*Sotalia guianensis*). Photos by PH Ott and MCO Santos, respectively.

identification. Subsequently, pre-identification related sequences from GenBank (<https://www.ncbi.nlm.nih.gov/genbank/>) were used for comparisons. Sequences were aligned using MEGA v.6 (Tamura et al., 2011) and the phylogenetic *MT-CYB* analyzes included the sequences herein obtained (GenBank accession numbers KY236017-KY236029) plus *Sotalia guianensis* (EF488216 to EF488223, EF457552), *Sotalia fluviatilis* (EF457551), *Inia geoffrensis* (EU554562), *Tursiops truncatus* (AF084095), and *Sus scrofa* (AB015065, AM492546, AM492548, AM492551, AM492569, AM492595, AM492597, AM92621, AM492653, KJ476220, KJ476229) sequences.

Genetic distance estimates were carried out with complete deletion using Kimura’s two parameters with MEGA v.6. To infer phylogenetic relationships, the best evolution model was chosen using the ModelGenerator v. 0.85 (Keane et al., 2006). According to the Bayesian information criterion (BIC) and Akaike information criterion 2 (AIC2), the Tamura-Nei model with estimation of the proportion of invariable sites (TrN+I) was used. Phylogenetic reconstructions of the *Sotalia guianensis* *MT-CYB* sequences were performed using PHYML 3.0 (Guindon et al., 2010) for maximum likelihood (ML) with a bootstrap analysis based on 1,000 replicates. Branch support was calculated

using the approximate likelihood ratio test (aLRT) with a SH-like interpretation. Bayesian analyzes (BA) were carried out using MrBayes 3.2.1 (Ronquist and Huelsenbeck, 2003) sampling every 100th generation until 10,000 trees were obtained (with a burn-in of 1,000). Effective sample size (ESS) and convergence diagnostic values were considered when above 100 and 1, respectively. Topologies were generated and edited with FigTree v1.4.0 (Rambaut, 2012). DNAsp 5 was used for haplotype estimates and nucleotide diversity (Librado and Rozas, 2009). NETWORK (Bandelt et al., 1999) was used for reconstructing a median-joining (MJ) network to evaluate sub-population structures and geographic distribution patterns. MJ was calculated using variable sites only.

RESULTS

A wide variety of love charms, sold in vials containing perfumes or fragrances were found in all markets and shops visited in the cities of Belém, Soure and Bragança in Pará, São Luís in Maranhão, Salvador, in Bahia; Rio de Janeiro, in Rio de Janeiro, and São Paulo and Guarulhos, in São Paulo (Supplementary Material 1, **Figure 1**). Data indicated a wide spectrum of vials and product textures and demonstrated that the commerce of cetacean products is more common in the North and Southeastern regions compared to the Northeast (Supplementary Material 1). Every religious shop visited in Rio de Janeiro and Belém displayed love charms available for purchase. Dried dolphin eyes, penis and vagina were only found in Belém, Soure and São Luís, in Maranhão, but also at the Mercado de Madureira, in Rio de Janeiro (**Figures 1, 2**). Thirteen samples were identified by molecular phylogeny (**Table 1**), while other samples containing only liquid contents, liquid and plant material or very degraded animal contents, could not be amplified. The ML and BA analyzes clearly indicated that the samples belonged to two species: Guiana dolphins (*Sotalia guianensis*) (**Figure 4**) and *Sus scrofa* (**Figure 5**).

Successfully sequenced samples were compared to data from the online database. Three samples were identified as *Sotalia guianensis* (**Figure 3**). Genetic distances varied from 0.001 to 0.008 among *S. guianensis* specimens (**Table 2**). The DNAsp analysis indicated a diversity of 0.8897 and eight haplotypes, three exclusive and five shared by four or two individuals. The median joining network indicated a star-like topology, with the central haplotype shared by four samples, including three GenBank sequences, and one sample sequenced herein, with all other haplotypes, except H8, directly connected to the central haplotype (**Figure 4A**). The phylogenetic reconstruction of the *Sotalia MT-CYB* sequences demonstrated the monophyly of the genus (90 bootstrap, 0.97 pp), divided into the *S. fluviatilis* lineage and the clade comprising *S. guianensis* samples (**Figure 4B**).

Surprisingly, ten samples were identified as originating from pigs’ (*Sus scrofa*), with 100 and 95% cover and identity, respectively, identified through a BLAST search carried out at the NCBI database (**Table 3**). The genetic distance among *Sus scrofa* samples ranged from 0.001 to 0.016 (**Table 3**). The DNAsp analysis indicated a diversity of 0.8238 and 12 haplotypes, with

TABLE 2 | Kimura 2 parameter genetic distance estimates for *Sotalia guianensis*.

	HAP	Register/GB	Locality	1	2	3	4	5	6	7
<i>Sotalia guianensis</i>	H 01	CRB3252	BRA, PA, Belém, Ver-o-Peso Market							
	H 02	CRB3336	BRA, PA, Soure	0.004						
		EF488217	BRA, PA, Belém, Ver-o-Peso Market							
		EF488218	BRA, PA, Belém, Ver-o-Peso Market							
		EU022545	Unknown							
	H 03	CRB3452	BRA, RJ, Rio de Janeiro	0.005	0.001					
		EU022547	Unknown							
	H 04	EF488219	BRA, PA, Belém, Ver-o-Peso Market	0.005	0.001	0.003				
	H 05	EF488220	BRA, PA, Belém, Ver-o-Peso Market	0.005	0.001	0.003	0.003			
		EF488221	BRA, PA, Belém, Ver-o-Peso Market							
		EF488222	BRA, PA, Belém, Ver-o-Peso Market							
		EU022546	Unknown							
	H 06	EF457552	BRA, AP	0.005	0.001	0.003	0.003	0.003		
	H 07	EF488216	BRA, PA, Belém, Ver-o-Peso Market	0.007	0.003	0.004	0.004	0.004	0.004	
		EU022548	Unknown							
	H 08	EF488223	BRA, PA, Belém, Ver-o-Peso Market	0.008	0.004	0.005	0.005	0.005	0.005	0.005
	EU022549	Unknown								

HAP, Haplotype; GB, GenBank accession number. Brazilian (BRA) states are Pará (PA), Rio de Janeiro (RJ), Amapá (AP), and Amazonas (AM).

only H1 and H9 being shared (**Figure 5**). H9 is shared by one sample evaluated in this study from Andaraí, Rio de Janeiro (**Table 3**) and one sample from Sri Lanka.

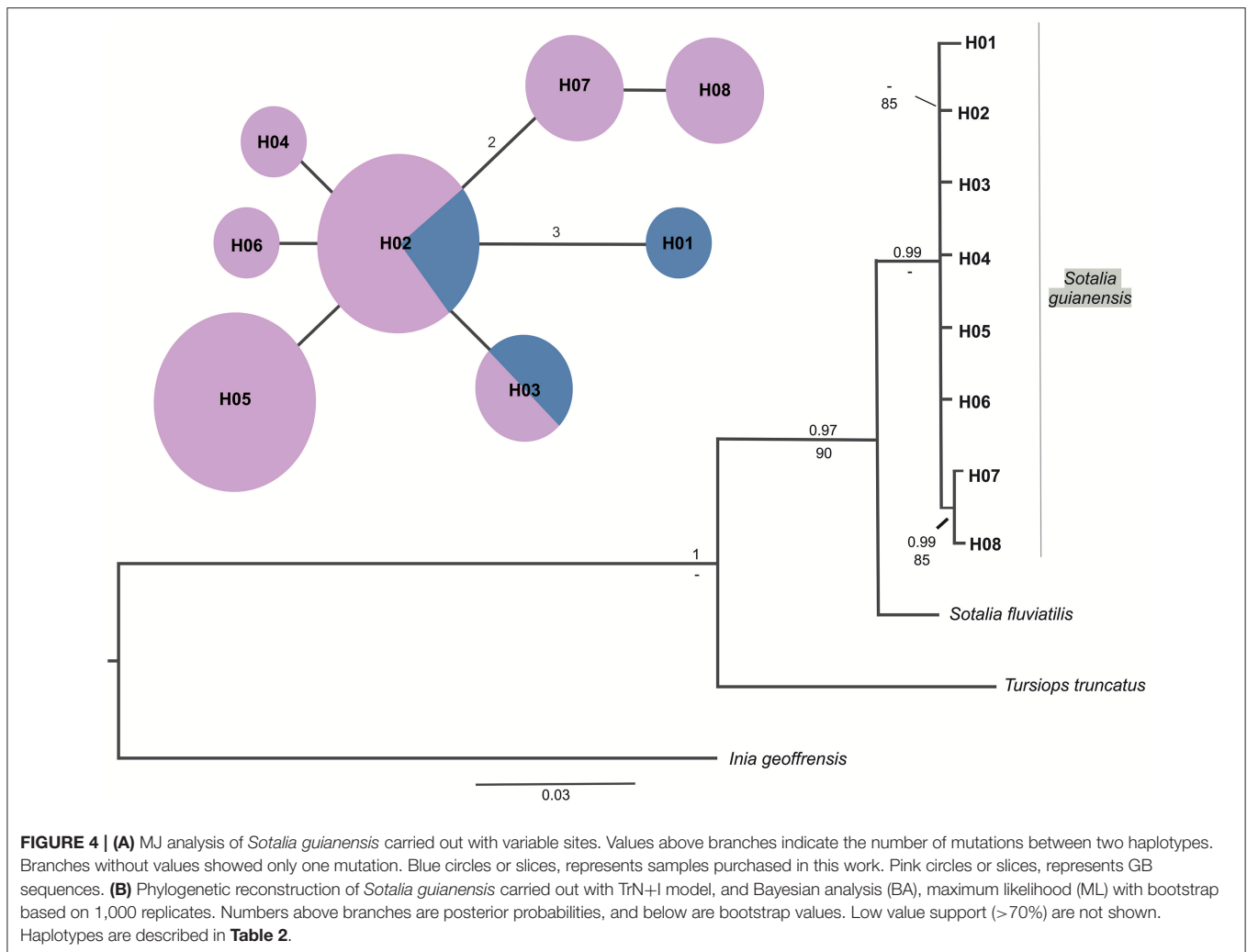
DISCUSSION

Previous studies in Brazil have documented the use of *Sotalia* dolphin fat for therapeutic purposes in Northeastern Brazil, in the states of Piauí, Paraíba, and Maranhão, and suggested a geographic continuum in the use of cetaceans as medicine in fishing communities located on the northeastern coast (Alves and Rosa, 2006, 2007). Additional information has been provided on the use of *Sotalia* dolphins for medicinal and magic/religious purposes in Northern Brazil based on short surveys conducted at Belém and Soure in 2005 (Alves and Rosa, 2008). Alves and Rosa refer to the specimens as tucuxi dolphins (*Sotalia fluviatilis*), without any molecular analysis being conducted. However, subsequent studies based on Cytochrome b sequences, also conducted on samples from the Ver-o-Peso Market in Belém, proved that the love charms were Guiana dolphins (*Sotalia guianensis*) (Sholl et al., 2008). Sholl et al. postulated that *S. guianensis* specimens incidentally captured in gill nets off the Pará and Amapá coasts were the main source of the products found in regional markets. The present study confirms the current sale of cetacean products available in Belém and Soure as being Guiana dolphins, and adds Bragança to the list of cities where dolphin love charms are widely sold in the state of Pará (**Figure 4, Table 2**). The ML and BA analyzes were not well-resolved enough to define the geographic origin of the samples, since specimens from Rio de Janeiro and Pará can share the same haplotype (Sholl, 2010).

The sale of dolphin love charms was also confirmed in all other visited cities in the states of Maranhão (São Luís), Ceará

(Fortaleza), Bahia (Salvador), Rio de Janeiro (Rio de Janeiro), and São Paulo (São Paulo and Guarulhos), indicating the widespread use of these products in Brazil. The love charms were much alike in all locations, presented as small vials containing perfumes or fragrances. In fact, these vials are very similar in appearance, which could represent specific dealers or similar sources. On the other hand, in Fortaleza, Ceará, necklaces and bracelets adorned with *S. guianensis* teeth were the only love charm product found in a public market. Adornments using Guiana dolphin teeth were also found at the traditional open-air market at Praça da República, in Belém. Because of this, handicraftsmen were sought out by the authors (SS and REL) and were found to be in possession of a large amount of *Sotalia* teeth on the ferryboat that cruises from Camará to Belém, Pará. The handicraftsmen reported they had purchased the teeth from various fishing villages during their trip to the Amazon. Additionally, some Guiana dolphin dried penis samples analyzed herein were purchased at the Mercado de Madureira in Rio de Janeiro, but the retailer stated that this material came from Northern Brazil.

A remarkable aspect of the present study is the confirmation of the widespread use of dolphin love charms in the city of Rio de Janeiro, where every visited religious shop had samples available for sale. In fact, a popular newspaper in Rio de Janeiro has published on this issue, connecting increased love charm sales, especially from “dolphins,” to Valentine’s Day in Brazil (June 12th) (Extra, 2013). Even more surprisingly was the fact that the products from Rio de Janeiro were fake and were identified as originating from pigs’ (*Sus scrofa*) (**Figure 5, Table 3**). It is worth mentioning that *Sus* samples, like the dolphin love charms, are from different breeds, suggesting different origins of the alleged fake pieces inserted in the vials, as indicated in **Figure 5**. This can be explained by the fact that several *Sus* raised in Brazil



belong to different breeds and origins, including Asian (Meishan, Jiaxing and Jinhua), Portuguese (Alentejana and Bísara), Spanish (Galega and Perijordina), and Italian (Napolitana) breeds, among others (Castro et al., 2002). This suggests that the trade of fake love charms is widespread in Rio de Janeiro, with more than one source of pig samples.

This scenario poses a clear contrast between products sold in northern Brazil, especially in Pará, and those from Rio de Janeiro. It seems that dolphin products in northern Brazil are still being used on a regular basis, with Guiana dolphin specimens incidentally captured in gill nets serving as the source for this market. As commonly observed along the beaches of northern Brazil, dolphin carcasses (*Inia* and *Sotalia*) can be found with their teeth, eyes or other parts removed. In order to evaluate the accidental capture of dolphins, 190 interviews were conducted with artisanal fishermen on the northeastern coast of Pará, and at Marajó island, highlighting the use of eyes and genitals for creating love charms (Martins, 2015). Dolphin and whale captures in Brazil are illegal. In contrast, dolphin love charms sold in the state of São Paulo did not include dolphin tissues, and all

vendors informed that law enforcement has been applied and that this was a prohibited practice.

Even though the dolphin love charm trade in São Paulo is limited to fragrances, with no pieces of dolphins or other products added, in Rio de Janeiro the items were false, produced by adding pig tissues, to increase sales and profit. Nevertheless, it seems clear that the dolphin eye, penis and vagina trade is still present, mainly in Northern Brazil. The data presented herein confirms the regular trade of dolphin products, representing an active market in large North and Northeastern cities. Although it is clear that the majority of dolphin samples came from incidentally caught specimens, it is important to note that a small fraction could be represented by botos, not covered in our samples. In addition, Guiana dolphins caught in gill nets represent almost 90% of the 700 specimens deposited at the marine mammal collection at the Emílio Goeldi Paraense Museum, while botos represent less than 3%. This could be due to the fact that Guiana dolphins are widely distributed, and probably more abundant, than botos. As a common source of love charms, the apparent high levels of incidental Guiana dolphin captures

TABLE 3 | Kimura 2 parameter genetic distance estimates for *Sus*.

HAP	Register/GB number	Locality	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Sus scrofa</i>	CRB3242 - 45	BRA, RJ, Madureira Market													
	CRB3248 - 49	BRA, RJ, Tijuca													
	CRB3253 - 54	BRA, RJ, Andaraí													
H101	KJ476229	BRA, RJ, Guapimirim													
	AM492653	POR	0.001												
	KJ476220	BRA, MS, Aquidauana	0.001	0.002											
	AM492546	IND, Asmat Territories	0.012	0.012	0.012										
	AM492621	ITA	0.012	0.012	0.012	0.011									
	AM492548	IND, Asmat Territories	0.012	0.013	0.013	0.012	0.001								
	AM492551	IND, Asmat Territories	0.012	0.013	0.013	0.012	0.001	0.002							
	AB015065	JAP	0.012	0.013	0.013	0.013	0.008	0.009	0.009						
	AM492595	SRL	0.013	0.014	0.014	0.014	0.009	0.010	0.010	0.010	0.001				
	CRB3306	BRA, RJ, Andaraí													
H110	AM492569	IND, Bali	0.014	0.015	0.015	0.015	0.010	0.011	0.011	0.002	0.001				
	AM492597	CHI, Zichong	0.014	0.015	0.015	0.015	0.010	0.011	0.011	0.002	0.003	0.004			
H112	CRB3250	BRA, RJ, Tijuca	0.015	0.016	0.016	0.016	0.011	0.012	0.012	0.003	0.004	0.004	0.001		
	<i>Sus barbatus</i> (AM492662)	Malayan Peninsula	0.037	0.038	0.038	0.038	0.036	0.037	0.037	0.037	0.038	0.039	0.039	0.040	
<i>Sus celebensis</i> (AM492663)		IND, Sulawesi	0.042	0.043	0.041	0.039	0.035	0.036	0.036	0.036	0.037	0.038	0.038	0.039	0.039

Portugal (POR), Indonesia (IND), Italy (ITA), Japan (JAP), Sri Lanka (SRL), China (CHI), Brazilian (BRA) states are Rio de Janeiro (RJ) and Mato Grosso do Sul (MS).

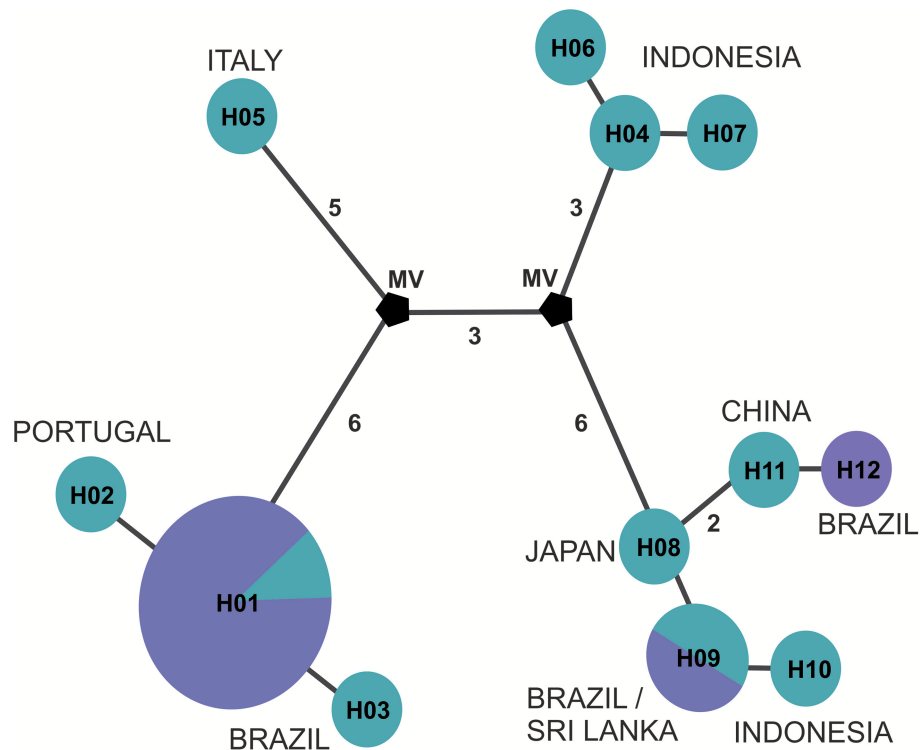


FIGURE 5 | MJ analysis of *Sus scrofa* carried out with variable sites. Values next to branches indicate the number of mutations between two haplotypes. Branches without values, showed only one mutation. Purple circles or slices, represents samples purchased in this work. Green circles or slices, represents GB sequences. Haplotypes are described in **Table 3**.

clearly stimulates the love charm trade, and, thus, requires urgent action from environmental agencies.

AUTHOR CONTRIBUTIONS

Conceived and designed the experiments: SS, RE-L, MV, CB. Performed the experiments: MV, CB. Analyzed the data: SS, MV, CB. Contributed reagents, materials, analysis tools: SS, RE-L, MV, CB. Wrote the paper: SS, RE-L, MV, CB. Performed the molecular identification of the dolphins: SS, MV, CB. Provided data and comprehensive interpretation of the results: SS, RE-L, MV, CB.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2018.00107/full#supplementary-material>

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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