



VIRTUAL THREAT: ILLEGAL E-COMMERCE OF SEAHORSES IN BRAZIL UPDATE

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ABSTRACT

Seahorses have been the focus of international trade for many years and wild populations have decreased around the world. The Brazilian government has specific regulation for seahorse protection, however illegal commerce is still a threat. The present study aimed to characterize the profile of seahorse trade in Brazil by analyzing online reports. The research was conducted in February 2025 through internet searches using the Google search engine, as well as social media platforms like Instagram and Facebook. A total of 14 distinct suppliers selling seahorses in Brazil were identified. Most seahorses were intended for the aquarium trade, followed by medicinal, religious, pieces of art, biojewelry and food resources. Seahorse sales were identified across all Brazilian regions. Dried seahorses were the most frequently advertised. *H. reidi* was the most frequently reported, being associated with multiple uses, including aquarium trade, medicinal, and religious purposes. The results showed that, despite existing regulations in the country, the seahorse trade by illegal e-commerce can still be found in Brazil. The two main species are *H. reidi* and *H. patagonicus*. The former are sold live and dried for many purposes, while *H. patagonicus* is mostly sold dried for religious and medicinal uses. Illegal seahorse e-commerce in Brazil threatens three vulnerable species. Existing ordinances lack legislative power, necessitating municipal laws for protection. Strengthened enforcement against illegal trade, long-term population monitoring, and community education are essential. Awareness programs can foster local involvement in conservation, ensuring the survival of seahorses in their natural habitats.

Objective: the present study aimed to characterize the profile of seahorse trade in Brazil by analyzing online reports and social media platforms.

Theoretical Framework: Seahorse populations are declining worldwide due to several human activities, particularly the illegal trade of live and dead animals. E-commerce has become an open market, often with little to no surveillance over transactions. Therefore, it is crucial to understand how seahorses are being illegally traded in Brazilian e-commerce to develop effective strategies for restricting this practice.

Method: The research was conducted through internet searches using the Google search engine. Searches were performed up to the tenth page of Google results, as related pages stopped appearing beyond the fourth page. No restrictions were applied concerning the search period or the sale profile. Searches on Instagram and Facebook were also conducted. Data collection focused on: 1) Type of trade (aquarium, medicinal, religious or other uses); 2) Store location (Brazilian state/other countries); 3) Animal origin (if stated in the advertisement); 4) Seahorse condition (live or dried); 5) Species identification (based on the image provided or the name mentioned in the advertisement); 6) Standardized sale price in US dollars; 7) Language of the advertisement; 8) Shipping options (domestic and/or international); 9) Stock availability.

Results and Discussion: A total of 14 suppliers selling seahorses in Brazil were identified, with sales occurring on Instagram, Facebook, and Google. Ten advertisements remained active, though three reported being out of stock. Most seahorses were sold for aquariums (35%), followed by medicinal and religious uses (22% each). Other purposes included art, bio jewelry, and food. Sales spanned all Brazilian regions, with São Paulo leading. International companies also targeted the Brazilian market. Dried seahorses dominated (65%). Prices varied, ranging from \$3.56 to \$165 USD per specimen. About 71% of advertisements targeted domestic buyers, while others indicated international trade links.

Research Implications: The present research will provide insights into seahorse conservation in Brazil, focusing mainly in public policies and more effective surveillance protocols for the e-commerce.

Originality/Value: This is the first study specifically about seahorse e-commerce in Brazil and the contributions about it will be valuable to develop specific legislation to protect these threatened animals.

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Keywords: Syngnathidae, *Hippocampus*, Trade, South America, Internet.

AMEAÇA VIRTUAL: ATUALIZAÇÃO SOBRE O COMÉRCIO ELETRÔNICO ILEGAL DE CAVALOS-MARINHOS NO BRASIL

RESUMO

Os cavalos-marinhos têm sido alvo do comércio internacional há muitos anos, resultando na diminuição das populações selvagens em todo o mundo. O governo brasileiro possui regulamentações específicas para a proteção desses animais, porém o comércio ilegal ainda representa uma ameaça. O presente estudo teve como objetivo caracterizar o perfil do comércio de cavalos-marinhos no Brasil por meio da análise de anúncios online. A pesquisa foi conduzida em fevereiro de 2025 por meio de buscas na internet utilizando o mecanismo de pesquisa Google, além de redes sociais como Instagram e Facebook. Um total de 14 fornecedores distintos que comercializam cavalos-marinhos no Brasil foi identificado. A maioria dos cavalos-marinhos era destinada ao mercado de aquarismo, seguida pelos usos medicinais, religiosos, produção de peças de arte, bijoias e recursos alimentares. A venda desses animais foi registrada em todas as regiões do Brasil, com maior ocorrência no Sudeste, especialmente em São Paulo. Os cavalos-marinhos secos foram os mais anunciados. A espécie *Hippocampus reidi* foi a mais frequentemente relatada, estando associada a múltiplos usos, incluindo aquarismo, medicina e práticas religiosas. Os resultados demonstram que, apesar das regulamentações existentes no país, o comércio ilegal de cavalos-marinhos no e-commerce ainda persiste no Brasil. As duas principais espécies identificadas foram *H. reidi* e *H. patagonicus*. A primeira foi comercializada tanto viva quanto seca para diversos fins, enquanto *H. patagonicus* foi majoritariamente vendida seca para usos religiosos e medicinais. O comércio ilegal de cavalos-marinhos no Brasil ameaça três espécies vulneráveis. Como as portarias existentes não possuem força de lei, há necessidade de criação de leis municipais para garantir a proteção desses animais. O fortalecimento da fiscalização contra o comércio ilegal, o monitoramento de longo prazo das populações e a educação comunitária são fundamentais. Programas de conscientização podem incentivar o envolvimento local na conservação, assegurando a sobrevivência dos cavalos-marinhos em seus habitats naturais.

Objetivo: O presente estudo teve como objetivo caracterizar o perfil do comércio de cavalos-marinhos no Brasil por meio da análise de anúncios online e plataformas de mídia social.

Referencial Teórico: As populações de cavalos-marinhos estão em declínio em todo o mundo devido a diversas atividades humanas, especialmente o comércio ilegal de animais vivos e mortos. O e-commerce tornou-se um mercado aberto, muitas vezes com pouca ou nenhuma fiscalização sobre as transações. Portanto, é essencial compreender como os cavalos-marinhos estão sendo ilegalmente comercializados no e-commerce brasileiro para desenvolver estratégias eficazes de combate a essa prática.

Método: A pesquisa foi realizada por meio de buscas na internet utilizando o mecanismo de pesquisa Google. As buscas foram realizadas até a décima página de resultados, uma vez que páginas relacionadas deixaram de aparecer após a quarta página. Não foram aplicadas restrições quanto ao período de pesquisa ou ao perfil de venda. Também foram realizadas buscas no Instagram e Facebook. A coleta de dados focou nos seguintes aspectos: 1) Tipo de comércio (aquarismo, medicinal, religioso ou outros usos); 2) Localização da loja (estado brasileiro/outros países); 3) Origem do animal (se informada no anúncio); 4) Condição do cavalo-marinho (vivo ou seco); 5) Identificação da espécie (com base na imagem fornecida ou no nome mencionado no anúncio); 6) Preço de venda padronizado em dólares americanos; 7) Idioma do anúncio; 8) Opções de envio (nacional e/ou internacional); 9) Disponibilidade de estoque.

Resultados e Discussão: Foram identificados 14 fornecedores comercializando cavalos-marinhos no Brasil, com vendas ocorrendo no Instagram, Facebook e Google. Dez anúncios permaneceram ativos, embora três informassem estar sem estoque. A maioria dos cavalos-marinhos foi comercializada para aquarismo (35%), seguida pelos usos medicinal e religioso (22% cada). Outros usos incluíram peças de arte, bijoias e recursos alimentares. As vendas ocorreram em todas as regiões do Brasil, com maior incidência no Sudeste, especialmente em São Paulo. Empresas internacionais também direcionaram suas vendas ao mercado brasileiro. Cavalos-marinhos secos foram os mais anunciados (65%). Os preços variaram entre \$3,56 e \$165 USD por espécime. Aproximadamente 71% dos anúncios eram voltados para o mercado interno, enquanto os demais indicavam conexões com o comércio internacional.



Implicações da Pesquisa: A presente pesquisa fornecerá informações valiosas para a conservação dos cavalos-marinhos no Brasil, com ênfase na formulação de políticas públicas e no aprimoramento de protocolos de fiscalização do comércio na internet.

Originalidade/Valor: Este é o primeiro estudo voltado especificamente para o comércio na internet de cavalos-marinhos no Brasil. Suas contribuições serão essenciais para o desenvolvimento de legislações específicas visando à proteção desses animais ameaçados.

Palavras-chave: Syngnathidae, *Hippocampus*, Comércio, América do Sul, Internet.

AMENAZA VIRTUAL: ACTUALIZACIÓN SOBRE EL COMERCIO ELETRÓNICO ILEGAL DE CABALLITOS DE MAR EN BRASIL

RESUMEN

Los caballitos de mar han sido objeto de comercio internacional durante muchos años, lo que ha provocado la disminución de sus poblaciones silvestres en todo el mundo. El gobierno brasileño cuenta con regulaciones específicas para la protección de estos animales; sin embargo, el comercio ilegal sigue representando una amenaza. El presente estudio tuvo como objetivo caracterizar el perfil del comercio de caballitos de mar en Brasil mediante el análisis de anuncios en línea. La investigación se llevó a cabo en febrero de 2025 a través de búsquedas en Internet utilizando el motor de búsqueda Google, así como en plataformas de redes sociales como Instagram y Facebook. Se identificaron un total de 14 proveedores distintos que comercializaban caballitos de mar en Brasil. La mayoría de los ejemplares estaban destinados al comercio de acuarios, seguido de usos medicinales, religiosos, producción de piezas de arte, biojoyería y recursos alimentarios. Se registraron ventas de caballitos de mar en todas las regiones de Brasil, con mayor incidencia en la región sureste, especialmente en São Paulo. Los caballitos de mar secos fueron los más anunciados. La especie *Hippocampus reidi* fue la más reportada, asociándose con múltiples usos, incluyendo acuarios, medicina y prácticas religiosas. Los resultados muestran que, a pesar de las regulaciones existentes en el país, el comercio ilegal de caballitos de mar en el comercio electrónico sigue presente en Brasil. Las dos principales especies identificadas fueron *H. reidi* y *H. patagonicus*. La primera se comercializa tanto viva como seca para diversos fines, mientras que *H. patagonicus* se vende principalmente seca para usos religiosos y medicinales. El comercio ilegal de caballitos de mar en Brasil amenaza a tres especies vulnerables. Las ordenanzas existentes carecen de poder legislativo, por lo que es necesario implementar leyes municipales para su protección. Es fundamental fortalecer la fiscalización contra el comercio ilegal, realizar un monitoreo a largo plazo de las poblaciones y fomentar la educación comunitaria. Los programas de concienciación pueden promover la participación local en la conservación, garantizando la supervivencia de los caballitos de mar en sus hábitats naturales.

Objetivo: El presente estudio tuvo como objetivo caracterizar el perfil del comercio de caballitos de mar en Brasil mediante el análisis de anuncios en línea y plataformas de redes sociales.

Marco Teórico: Las poblaciones de caballitos de mar están en declive en todo el mundo debido a diversas actividades humanas, en particular el comercio ilegal de animales vivos y muertos. El comercio electrónico se ha convertido en un mercado abierto, a menudo con poca o ninguna vigilancia sobre las transacciones. Por lo tanto, es crucial comprender cómo se están comercializando ilegalmente los caballitos de mar en el comercio electrónico brasileño para desarrollar estrategias efectivas que restrinjan esta práctica.

Método: La investigación se llevó a cabo mediante búsquedas en Internet utilizando el motor de búsqueda Google. Las búsquedas se realizaron hasta la décima página de resultados, ya que después de la cuarta página dejaron de aparecer páginas relacionadas. No se aplicaron restricciones en cuanto al período de búsqueda ni al perfil de venta. También se realizaron búsquedas en Instagram y Facebook. La recolección de datos se centró en los siguientes aspectos: 1) Tipo de comercio (acuarios, medicinal, religioso u otros usos); 2) Ubicación de la tienda (estado brasileño/otros países); 3) Origen del animal (si se indicaba en el anuncio); 4) Condición del caballito de mar (vivo o seco); 5) Identificación de la especie (según la imagen proporcionada o el nombre mencionado en el anuncio); 6) Precio de venta estandarizado en dólares estadounidenses; 7) Idioma del anuncio; 8) Opciones de envío (nacional y/o internacional); 9) Disponibilidad de stock.

Resultados y Discusión: Se identificaron un total de 14 proveedores que vendían caballitos de mar en Brasil, con ventas a través de Instagram, Facebook y Google. Diez anuncios permanecieron activos, aunque tres informaron estar sin stock. La mayoría de los caballitos de mar se vendieron para acuarios (35%), seguidos por usos



medicinales y religiosos (22% cada uno). Otros usos incluyeron piezas de arte, biojoyería y recursos alimentarios. Las ventas se registraron en todas las regiones de Brasil, con mayor incidencia en São Paulo. Empresas internacionales también dirigieron su comercio al mercado brasileño. Los caballitos de mar secos fueron los más anunciados (65%). Los precios variaron entre \$3.56 y \$165 USD por ejemplar. Aproximadamente el 71% de los anuncios estaban dirigidos al mercado interno, mientras que el resto indicaba conexiones con el comercio internacional.

Implicaciones de la investigación: La presente investigación proporcionará información valiosa sobre la conservación de los caballitos de mar en Brasil, centrándose principalmente en políticas públicas y protocolos de vigilancia más efectivos para el comercio electrónico.

Originalidad/Valor: Este es el primer estudio específicamente sobre el comercio electrónico de caballitos de mar en Brasil, y sus contribuciones serán valiosas para el desarrollo de una legislación específica que proteja a estos animales amenazados.

Palabras clave: Syngnathidae, *Hippocampus*, Comercio, América del Sur, Internet.

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1 INTRODUCTION

Seahorses are distributed across tropical and temperate regions worldwide, inhabiting several ecosystems such as seagrass beds, rocky shores, coral reefs, and mangroves (Lourie *et al.*, 1999). These animals have been on the planet for around 20 million years, having their origin in the Thetys Ocean and subsequently expanding their distribution throughout the years to other oceans (Casey *et al.*, 2004). The Atlantic Ocean species are more recent, and currently, around 12 seahorse species are recorded in this region (Foster & Vincent, 2004). Despite their slower mobility compared to other fish, recent studies have shown their ability to migrate and undertake large-scale movements (Boehm *et al.*, 2015; Qin *et al.*, 2022), which explains their widespread global distribution. However, seahorse populations have been facing severe anthropogenic pressure, presenting small size populations around the world (Foster & Vincent, 2004).

Among the many anthropogenic threats, key factors include unregulated coastal occupation, leading to habitat destruction (Harasti, 2016), the lack of coastal and marine use plan, and bycatch, particularly from industrial fishing (Lawson, 2017). Additionally, the trade of dried seahorses for medicinal and religious purposes, as well as the live animal market for the aquarium trade, further contributes to their population decline (Foster *et al.*, 2019; König & Hoeksema, 2021). These activities impact all 46 seahorse species (*Hippocampus* spp.) globally.



Despite these pressures, several international and national agreements and measures have been implemented to reduce the trade of both live and dried seahorses.

One of the key measures was the inclusion of the *Hippocampus* genus in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2002, marking a significant step toward reducing the pressure of live animal trade on wild populations. As a major outcome of these efforts, in 2021, the first quantitative analysis of live seahorse trade was published, revealing that most seahorses currently in trade came from captivity rather than being harvested from the wild (Foster *et al.*, 2021). Brazil was an active exporter of seahorses for many years and in 2002 signed the CITES convention.

In addition to signing the CITES agreement, Brazil also included the three seahorse species found along its coast in the Ordinance 445/14 (MMA, 2014), further reinforced by Ordinance 148/22 (MMA, 2022), which prohibits the capture, captivity, handling, and domestic trade of these animals. However, reports documented by the Brazilian seahorse conservation initiative Projeto Cavalos-Marinheiros indicate that illegal trade remains an ongoing issue. Based on this context, the present study aimed to characterize the profile of seahorse trade in Brazil by analyzing online reports and social media platforms.

2 THEORETICAL FRAMEWORK

2.1 THE INTERNET AS A VECTOR OF CHANGE IN COMMERCIAL RELATIONS

In recent decades, the internet has established itself as one of the most significant transformative forces in global commercial relations. From the emergence of early e-commerce systems to the rise of highly sophisticated digital platforms, the World Wide Web has reconfigured buying and selling practices, consumption patterns, interactions between businesses and consumers, and organizational structures (Reis *et al.*, 2018).

The impact of the internet on commerce can be understood from several dimensions. First, it has profoundly changed the dynamics of access to information. Previously, consumers depended on traditional channels—such as sales representatives, printed catalogs, or in-person visits—to learn about products and services. With the internet, this informational asymmetry has been significantly reduced. Today, consumers can compare prices, check user reviews, access technical specifications, and even negotiate directly with suppliers, often without intermediaries. Therefore, The interaction between companies and customers has been transformed by digital marketing turning the process into a personalized and data-driven



process (Kotler and Keller, 2012).

Another structural shift was the emergence of electronic commerce (e-commerce), which decentralized points of sale. With several platforms, small businesses began to compete on equal footing with large retailers, eliminating geographic barriers and reducing operational costs. E-commerce brought new market opportunities and also changed the usual supply chains, reshaping business model (Turban *et al.*, 2018). This digitalization not only diversified commercialization channels but also enabled the rise of platform-based business models, such as delivery apps, streaming services, and online marketplaces.

Additionally, the internet has redefined the role of the consumer as an active agent in commercial relations. Today, the customer not only consumes but also produces content (such as reviews, unboxing videos, tutorials) and directly influences the reputation of brands and products, creating the “network society”, in which digital information flows shape culture, politics, and the economy in an interdependent manner.

In summary, the internet has not only altered the means by which commercial relations occur but has also redefined their foundations. It has transformed consumers, businesses, products, markets, and even business models. Organizations that understand these changes and invest in innovation, digital governance, and customer relationships tend to position themselves more competitively in an increasingly digitized, dynamic, and data-driven environment.

2.2 ORNAMENTAL FISH E-COMMERCE

The ornamental fish industry represents one of the fastest-growing sectors in the global pet trade, valued at billions of dollars annually. In recent years, the rise of e-commerce has profoundly reshaped the way ornamental fish are marketed, sold, and distributed. The transition from traditional brick-and-mortar pet stores to online platforms has enabled greater access for consumers, diversified supply chains, and expanded international trade in ornamental species (Peh, J. H., & Azra, 2025).

E-commerce in the ornamental fish trade offers a range of benefits and facilities to customers, providing detailed product descriptions, high-resolution images, and even videos of live specimens, enhancing consumer trust and satisfaction. Additionally, sellers can reach a global market, bypassing geographical constraints. According to Livengood and Chapman (2009), the ornamental fish industry is characterized by high species diversity and a fragmented market structure, which benefits from the increased connectivity and scalability that digital commerce platforms offer.



Despite its advantages, the online sale of live ornamental fish introduces significant logistical and ethical challenges. The transportation of live animals requires strict adherence to animal welfare standards and efficient handling to minimize stress and mortality. Inadequate packaging, temperature fluctuations, and delays in shipping can negatively impact fish health. Mortality during transport is a persistent concern in the ornamental aquatics trade, especially when animals are shipped internationally (Tlustý *et al.*, 2013). The implementation of best practices in shipping and handling protocols is thus critical for the long-term sustainability of the industry.

Another key concern in ornamental fish e-commerce is the biosecurity risk associated with the movement of live animals across borders (Chan *et al.*, 2019). Ornamental fish are potential vectors for invasive species and aquatic pathogens, which can pose a serious threat to native biodiversity and aquaculture systems. Several viral and parasitic infections have been linked to the global trade of ornamental fish, emphasizing the need for rigorous health screening and quarantine procedures in both exporting and importing countries (Whittington & Chong, 2007).

Furthermore, e-commerce platforms can unintentionally contribute to illegal or unregulated trade. Some species sold online may be listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), and their trade requires specific permits. However, the online nature of the transaction can obscure regulatory oversight. For instance, Murray and Watson (2014) warned that online aquarium trade could be a pathway for illegal wildlife trafficking, especially when sellers operate across jurisdictions without proper monitoring.

To mitigate these risks, stakeholders in the ornamental fish trade must invest in regulatory compliance, transparency, and education. Government agencies, non-governmental organizations, and online marketplaces should collaborate to implement verification systems, certification labels, and educational content that inform both sellers and buyers about ethical sourcing and proper care. Additionally, research into supply chain optimization, fish welfare during transport, and the use of technology for health monitoring is crucial for enhancing sustainability.

2.3 THE GLOBAL E-COMMERCE SEAHORSES' TRADE

The global trade of seahorses has undergone significant transformation with the advent of e-commerce platforms. Traditionally harvested for traditional medicine, curiosities, and the



aquarium trade, seahorses are now increasingly traded online, raising concerns about sustainability, regulation, and conservation.

E-commerce has facilitated the expansion of the seahorse trade by providing a platform for sellers and buyers to transact across borders with relative anonymity. This digital marketplace has made it easier to circumvent traditional regulatory frameworks, leading to increased instances of illegal trade. Many seahorses sold online originate from countries with export bans, indicating a substantial portion of the e-commerce trade operates outside legal parameters (Hicks, 2023).

In response to declining seahorse populations, all *Hippocampus* species were listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2002, with implementation beginning in 2004. This listing requires that international trade be conducted sustainably and legally. However, enforcement has been inconsistent

3 METHODOLOGY

The research was conducted in February 2025 through internet searches using the Google search engine. The following Portuguese keywords were used: *venda cavalo-marinho* (seahorse sale), *venda cavalo marinho* (sea horse sale), *compra cavalo-marinho* (seahorse purchase), *compra cavalo marinho* (sea horse purchase), with additional searches including the term *seco* (dried) at the end of each phrase. Searches were performed up to the tenth page of Google results, as related pages stopped appearing beyond the fourth page. No restrictions were applied concerning the search period or the sale profile.

Searches on Instagram and Facebook were conducted using the same Portuguese keywords. On all platforms, as well as: *loja cavalo marinho* (sea horse stores). Data collection focused on: 1) Type of trade (aquarium, medicinal, religious or other uses); 2) Store location (Brazilian state/other countries); 3) Animal origin (if stated in the advertisement); 4) Seahorse condition (live or dried); 5) Species identification (based on the image provided or the name mentioned in the advertisement); 6) Standardized sale price in US dollars; 7) Language of the advertisement; 8) Shipping options (domestic and/or international); 9) Stock availability.

All collected data were compiled and analyzed using descriptive statistics to provide an overview of e-commerce. No further investigation of closed social media groups was conducted.



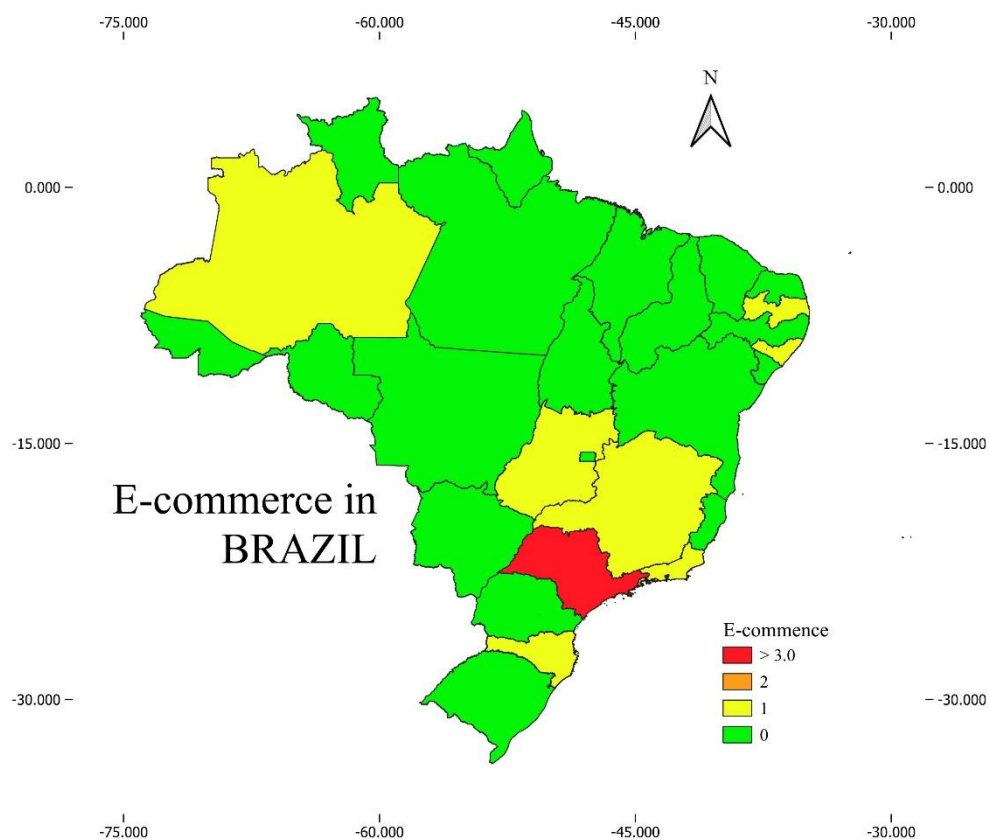
4 RESULTS AND DISCUSSION

A total of 14 distinct suppliers selling seahorses in Brazil were identified. Among them, two were selling in Instagram, one in Facebook, and the remaining were found in Google searches. Of the 14 advertisements, 10 were still active, although three reported being out of stock at the time of analysis. Most seahorses were intended for the aquarium trade (35%, $n = 5$), while medicinal and religious uses accounted for 22% ($n = 3$) each. Other uses included pieces of art (7%, $n = 1$), bio jewelry (7%, $n = 1$), and food resources (7%, $n = 1$).

Seahorse sales were identified across all Brazilian regions (Figure 1), with the southeastern region, particularly São Paulo, having the highest occurrence, encompassing multiple uses (aquarium trade, religious use, and bio jewelry). Additionally, international companies from the United Kingdom, Ukraine, Turkey, and Colombia also advertised in Portuguese, targeting both live ($n = 1$) and dried ($n = 3$) seahorse markets.

Figure 1

Domestic e-commerce report in the Brazilian states.





Dried seahorses were the most frequently advertised, comprising 9 (65%) of the 14 listed, while the remaining 5 (35%) involved live specimens. The seahorse species identified in the advertisements were *Hippocampus reidi* (46%, $n = 6$), *Hippocampus patagonicus* (23%, $n = 3$), and *Hippocampus zosterae* (8%, $n = 1$). Three international companies offered several dried seahorse species without specifying the exact taxa (23%). Regarding species-specific trade, *H. reidi* was the most frequently reported, being associated with multiple uses, including aquarium trade, medicinal, and religious purposes (Table 1).

The sale prices of seahorses varied considerably. For the aquarium trade, individual specimens were priced between \$29.88 and \$165.00 USD. For medicinal purposes, seahorses were sold for \$120 USD each, whereas those sold for food purposes were priced at \$100 USD per ton. The religious market prices ranged from \$3.56 to \$9.90 USD per specimen. Approximately 71% ($n = 10$) of the advertisements targeted the domestic Brazilian market, while the remaining listings indicated international trade connections.

Table 1

Matrix of the multiple uses of the seahorses reported in the Brazilian e-commerce according to the seahorse species.

	COMMERCIAL USES				
	Aquarium trade	Religious use	Medicinal	Piece of art	Food resource
<i>H. reidi</i>	X	X	X		
<i>H. patagonicus</i>		X		X	X
<i>H. zosterae</i>	X				
Several species			X		X

The results showed that, despite existing regulations in the country, the domestic seahorse trade can still be found in Brazil. Part of this trade had already been reported in a broader global study on seahorse e-commerce, which identified some international export companies selling dried specimens to Brazilian market (Hicks, 2023), including B2Brazil, which was also reported in the present study. Other companies selling seahorses in Brazil previously reported by Hicks (2023) were prosecuted and did not appear in our search. Besides those companies, the present study also detected others, possibly due to the kind of search conducted using the Portuguese language to expand the ability to identify local suppliers, encompassing a wide range of commercial niches, including both live and dried seahorses for several purposes.

Some of the uses identified in this study have been commonly reported for seahorses, such as the aquarium trade (Baum & Vincent, 2005; Perry *et al.*, 2010; Rosa *et al.*, 2011; König



& Hoeksema, 2021), in which Brazil was once the fifth largest globally exporter of wildlife seahorses (Konig & Hoeksema, 2021). Another use reported was for religious purposes, particularly for the African-origin religions rituals, such as *Candomblé*. In this tradition, the seahorse is the sacred symbol of Logun-Edé, a religious entity. The animal represents the ambiguous nature of the entity, as it is neither a horse nor a fish (Léo-Neto & Alves, 2010). Therefore, several Afro-descendant religious rituals in Brazil use dried seahorses, sustaining a specific trade, as presented by our data (21%).

Medicinal use was also widely reported and appears to be a common practice in Brazil (Alves *et al.*, 2010), particularly among coastal communities. Seahorses are used in several treatments ranging from asthma (Silva *et al.*, 2004; Alves *et al.*, 2010) to more severe conditions such as epilepsy (Alves *et al.*, 2009). Less common uses were also identified, such as in bio jewelry (e.g., necklaces) and even as home decorations. Zooartisanry is not an uncommon practice in Brazil, especially in the northeastern region. However, mollusks and echinoderms are the most frequently reported materials in this craft, with seashells and starfish being the most commonly used (Alves *et al.*, 2010).

The widespread trade across multiple Brazilian states, including inland states with no direct coastal connection must be highlighted, as it suggests a dispersal of selling spots throughout the country. Additionally, the international market perceives Brazil as a potential buyer of both live and dried seahorses.

The two most frequently recorded species along the Brazilian coast, *Hippocampus reidi* and *Hippocampus patagonicus* (Rosa *et al.*, 2007), were also the most commonly observed in domestic e-commerce. However, *H. patagonicus* was exclusively traded as a dried specimen, whereas *H. reidi* was sold both live and dried. Live records of *H. patagonicus* on the Brazilian coast are rare, as when this species reaches the shore, it remains at depths of up to 30 meters. They are usually seen when they are incidentally caught in trawl nets and generally do not survive onboard fishing vessels (Silveira *et al.*, 2020; Freret-Meurer *et al.*, 2022). Therefore, it is possible that the Patagonian seahorses were obtained as bycatch and then traded for many purposes. On the other hand, *H. reidi* is more common in shallow waters along the Brazilian coast (Freret-Meurer & Andreato, 2008; Freret-Meurer *et al.*, 2018) and is easily captured by collectors specifically targeting the seahorse trade.

The price of seahorses varies significantly depending on the purpose. Live specimens for aquariums and those sold in bulk for medicinal purposes tend to have higher prices. In contrast, seahorses used for religious purposes are less expensive, potentially reflecting the economic power of the primary consumers of this resource. Considering the data presented in



this brief study on the illegal e-commerce of seahorses in Brazil, several considerations must be highlighted for the conservation of these animals. Three seahorse species can be found along the Brazilian coast with populations classified as vulnerable; therefore, the establishment of relevant legislation to protect these animals is of utmost importance. Although two ordinances provide a certain level of protection for them, an ordinance is not a legislative tool and can be revoked at any time without the force of law. Therefore, it is crucial to implement municipal laws according to the local realities of seahorse populations to ensure their protection at a regional level.

In addition to legal measures, it is recommended to increase the enforcement of regulations across several levels of seahorse trade, ensuring that institutions involved in illegal commerce are classified under environmental crimes and subject to appropriate legal penalties. Furthermore, long-term monitoring of wild seahorse populations is essential to assess whether their numbers continue to decline or show signs of recovery. Educational initiatives, such as training courses and environmental awareness programs for coastal communities, should also be promoted to enhance understanding of the threats facing these species. This approach would encourage local communities to contribute to conservation efforts through monitoring and support for the protection of seahorses in their natural habitats.

5 CONCLUSION

Considering the data presented in this brief study on the illegal e-commerce of seahorses in Brazil, several considerations must be highlighted for the conservation of these animals. Three seahorse species can be found along the Brazilian coast with populations classified as vulnerable; therefore, the establishment of relevant legislation to protect these animals is of utmost importance. Although two ordinances provide a certain level of protection for them, an ordinance is not a legislative tool and can be revoked at any time without the force of law. Therefore, it is crucial to implement municipal laws according to the local realities of seahorse populations to ensure their protection at a regional level.

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ACKNOWLEDGMENTS

This research was supported by Projeto Cavalos-Marinheiros, Universidade Santa Úrsula and Petrobras by the Petrobras Social and Environmental Program.

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