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Let the Elephants Talk—Exploring Ivory, the Ivory Trade, and Exchange in Southeast Africa and the Indian Ocean World in the Early 16th Century

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Abstract: This article explores ivory and ivory trade in early 16th century Southeast Africa, examining them through both historical and environmental lenses. It emphasizes the importance of inter and transdisciplinary research to fully understand the intricacies of the ivory trade, highlighting the need to integrate diverse data sources to understand the sociodynamics of the region and the links between hunted animals, extracted ivory, ivory work and the global networks, and markets in Africa and the Indian Ocean world. In addition, the article also discusses the limitations of the documents used, stressing the complexities of interpreting historical data, the importance of tightly weaving relevant data from other disciplines, and the need for caution when drawing conclusions based on limited evidence. This study contributes to interdisciplinary research on the history of ivory and the ivory trade in Southeast Africa, underscoring the significance of merging historical and environmental perspectives. It encourages future researchers to take a more critical approach and gather more extensive data to gain a deeper understanding of the trade's complexities.

Keywords: African ivories; trading networks; environmental history; sustainability; environmental challenges

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1. Introduction

In the late 15th century, the establishment of a sea route from Europe to India via the Cape of Good Hope represented a pivotal moment in the diffusion of information about previously unfamiliar geographic regions to the Western world. This enabled the acquisition of knowledge about natural resources, particularly those with significant commercial value, such as precious metals and ivory [1] which came to play a crucial role in the emerging global economy. These resources were in great demand in both Western and Eastern markets and were frequently exchanged within the same commercial networks, albeit for different reasons.

Archeological evidence attests to the extensive use of ivory by human populations worldwide, spanning millennia [2,3]. The material's abundance, versatility, and cultural significance, coupled with its ideal properties for carving, resistance to environmental fluctuations, and ease of maintenance [4,5], made ivory a highly coveted resource to produce an array of utilitarian and luxury goods, as well as devotional and artistic objects [3,6–8]. Its ability to resist deterioration and its transportability have contributed to maintaining its economic importance throughout history [9]. As a result, ivory has been in high demand across the globe for both intra-regional and regional consumption and exchange [10]. This demand for ivory led to extensive extractive activities, which had a profound impact on the animal populations producing it (mammoth, elephant, hippopotamus, warthog, walrus, dugong, narwhal, etc.), and on the ecosystems and landscapes, both terrestrial and maritime, in which they reside. The widespread trade of ivory had a significant impact on human ecology [11], as well as on the economic and material culture of nearly all inhabited regions of the world [4].

In the Western world, ivory was a well-known commodity since ancient times. Despite experiencing a period of commercial decline between the 4th and 9th centuries related to the extinction of North African elephant herds and the fall of the Roman Empire [6], ivory trading experienced a boom during the Middle Ages, with Europe being one of the most significant markets. While there is still ongoing debate about the origin of most of the ivory circulating in medieval Europe [5,12,13], ivory sourced from the African savannah elephant (*Loxodonta africana*) of East Africa may have held a prominent position, namely in the Eastern Mediterranean areas [7,14].

In the 10th century, Arab geographers and travelers identified East Africa as the primary source of ivory that reached the Western and Far Eastern markets. According to the accounts of al-Ma'sūdī (c. 893–956), the territory of the Zanj (*Bilad al-Zanj*) ("Bilad al Zanj means Land of the Black. Zanj means black people in Persia. It is mostly used to denominate East Africa", https://sites.google.com/site/historyofeastafrica/istakhri-1. Accessed on 15 November 2022) in East Africa was rich in elephants that were hunted exclusively for their ivory. The trade of ivory tusks from East Africa was instrumental in fostering lucrative commercial ties, linking the African coastal regions with the Red Sea and the Persian Gulf, Oman, India, and China, and reaching Europe via different trade routes. As argued by Chirikure [15], this intercontinental trade network was characterized by internal robustness and cohesion, thus enabling East Africa to exert a considerable degree of agency in determining its interactions with the broader Indian Ocean world (from now on referred to as IOW).

The exact southern boundary of *Bilad al-Zanj* is a subject of debate [16], although it is widely acknowledged that the region ended at Sofala Bay [9,17], an area renowned for its small and safe ports used to export a variety of African commodities, including ivory, as documented by al-Ma'sūdī [18].

Nevertheless, the shipping of ivory from Sofala Bay (Figure 1) does not reveal its origin, as asserted by several scholars in recent research concerning other regions of Southern Africa [2,6]. Additionally, it provides limited knowledge regarding the African elephant populations responsible for supplying ivory for trade, the ecosystems they inhabited and transformed, and the local and regional management strategies used in hunting and trading, as well as the relationship between elephants and human communities. These gaps make it difficult to determine the long-term impacts of these activities on both the Sofala region and its surroundings.

The archeological site of Chibuene in Mozambique (Figure 1), located 5 km south of Vilanculos, presents compelling evidence of the region's involvement in the IOW trade network since the 7th century [19]. In addition, studies conducted in areas such as Botswana, Zimbabwe, and Sashe-Limpopo suggest that elephant ivory would likely have been one of the primary African products used for exchange [5] both regionally and interregional, even before it gained significance in the commercial context of the IOW [10,15]. However, despite this evidence, there is still limited knowledge of the regional multidirectional traffic originating from this network and how far it penetrated the interior of Southern Africa, particularly in relation to areas south of the Limpopo basin, and its integration into the IOW trading networks at the time [15,20].

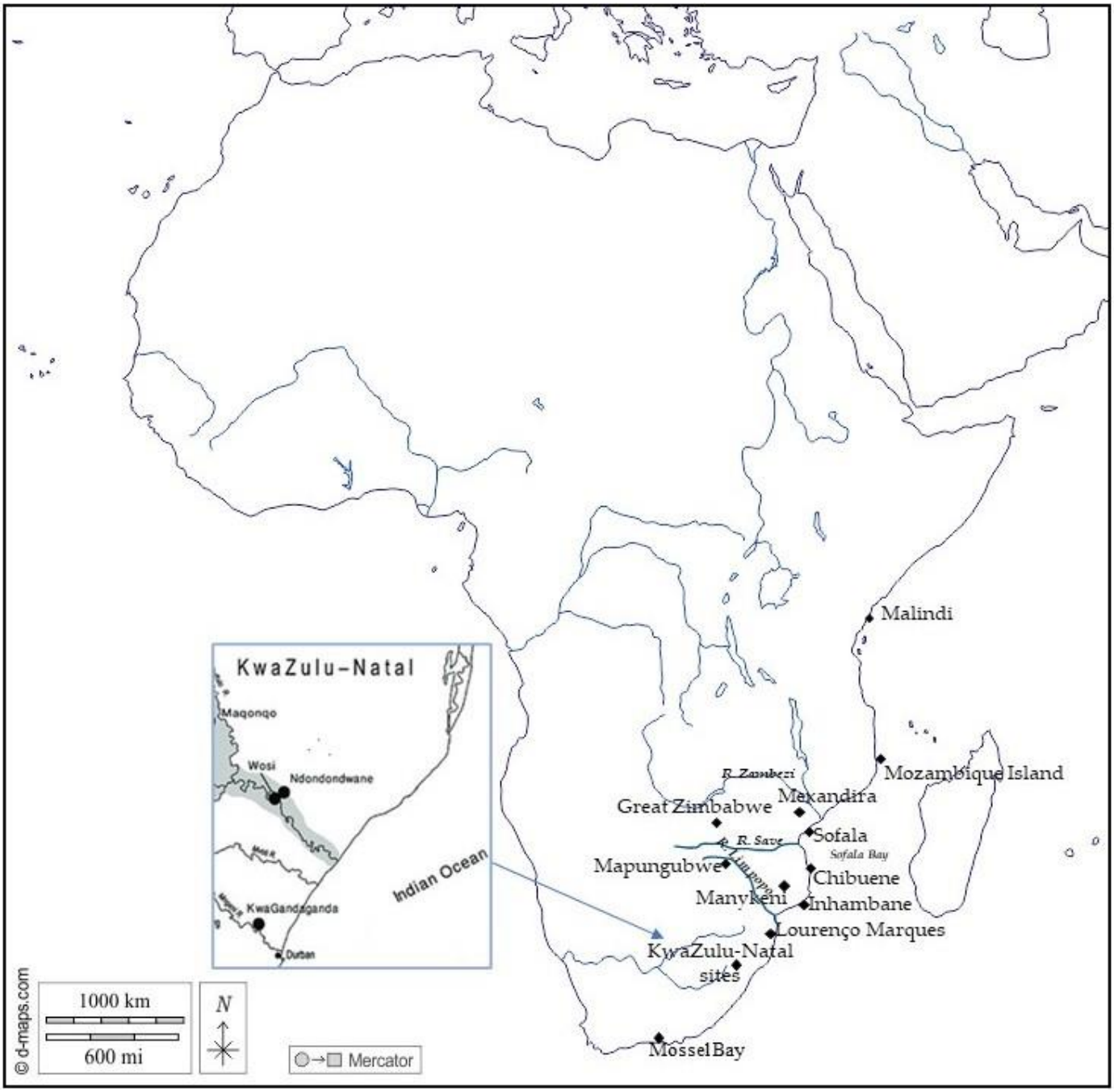

Figure 1. Southeast Africa—relative location of places mentioned in this text. Map created from an image available at https://d-maps.com/pays.php?num_pay=3&lang=en (accessed on 10 May 2013). Detail of the archeological sites of KwaZulu-Natal published by Bradfield [21].

Archeological findings have provided tangible evidence of the global economic reach of the IOW networks [22–24] but there is still a lack of textual evidence regarding the possible paths that ivory or ivory tusks may have taken within the existing IOW trading networks, as well as on the inland trading circuits. Additionally, information on the multidirectional connections between regional and transregional circuits, as well as on the circulation of goods and commodities from production areas to commercial interfaces, remains elusive. There is a paucity of information on the geographic extent of the territories and the communities engaged in trade activities and on the merchants involved and their strategies to reach the production areas [25], as well as on the types and quantities of ivory

traded. According to Chirikure [15,26], there is limited knowledge regarding the routes and mechanisms through which individuals, commodities, objects, and knowledge moved between inland and the coastal areas in Southern Africa, and Alpers [27] adds that the connections between Southeast Africa and the IOW markets remain poorly understood.

When discussing IOW markets, we are referring to a broad geographical region with flexible boundaries encompassing Indian Ocean Africa (from now on referred to as IOA) where all regions directly or indirectly connected to the IOW networks are included. A wide region where the notion of isolated economic systems is challenging to conceptualize and not consistent with the classical idea of a dichotomy between interior and ocean-based littoral regions since it presupposes the acknowledgment of inescapable connections between them [20]. Therefore, an analysis that concentrates on the concept of historical and/or symbolic spaces and the many patterns of social, economic, and cultural interactions that connect land and sea, and landscapes and seascapes, is more appropriate [28].

Currently, there is no textual evidence on Southeast Africa prior to the early 16th century when the Portuguese began to travel to India by rounding the Cape. Given this limitation, descriptions included in the early Portuguese reports have the potential to offer valuable insight into distinct aspects of local networks. These reports not only offer initial impressions of the region but also provide information on pre-existing conditions prior to Portuguese arrival, which were learned through interactions with local informers. Approaching these documents from this point of view may allow a glimpse into earlier periods, helping to hypothesize the circulation chains of African ivory, both within and beyond the continent, as well as the possible intra-regional connections and forms of exchange related to the locations of trade, as testified by Alcaçova in 1506 [29] and later on by Veloso [30] and Almada [31] in 1516. Similarly, they can also shed light on the involvement of African communities in the dynamics of the IOA and the IOW.

It is acceptable that these documents may contribute to a better understanding of Southeast Africa's integration into the global Afro-Eurasian system suggested by Beaujard [32,33] and supported by Campbell [20,33] within the framework of a global IOW economy. In addition, they may eventually highlight the role of African agency in this intricate system.

The research supporting this paper is driven by these assumptions, as well as the significant knowledge gap surrounding the origins of the ivory traded, the geographic extent of the ivory trading network in Southeast Africa, and its connection to the larger IOW intercontinental circuits. Additionally, this research aims to draw attention to the ambiguity surrounding the nature of ivory itself, as it is still believed to be derived exclusively from elephants, despite evidence suggesting other possible origins [6,12,34].

Moreover, current discussions on the relationship between prestige ivory and symbolic ivory in Africa [35] also reveal limited knowledge of both the use of ivory as a raw material, regardless of whether it is of elephant or non-elephant varieties [12], and the specific role of ivory in pre-16th century African societies, particularly those in Southern Africa [9]. As noted by Alpers [36] and Chaiklin [4], most studies on the ivory trade have tended to concentrate on its significance as a commodity in the IOW area, as opposed to exploring its role at the local level.

In the context of Southeast Africa, the early 16th century Portuguese documents do not make any explicit reference to East African ivory as a commercial commodity of interest to Portugal at the time. However, immediately after Vasco da Gama's first voyage to India (1497–1498), the Portuguese quickly became aware of the significant role that ivory played in the IOW trading circuits [37], and its potential importance as a commodity was soon recognized as equal to or even greater than that of spices. It did not take them long to realize that African ivory would be indispensable for the purchase of beads [38] as well as Indian textiles, which were essential for supplying African and Brazilian markets [4]. As a result, African ivory became far more profitable than the slave trade itself in the 19th century [38].

Objectives and Methodology

Given what has been said, this article aims to explore the subject of ivory and its trade on the Southeast coast of Africa and in the context of the IOW trading networks in the early 16th century, from the dual perspective of history and environmental history. This approach considers the interplay between social and natural systems and the far-reaching implications of their interactions over time. Using a *corpus* of Portuguese documents relating to the first fifteen years of the 16th century, this research emphasizes the importance of analyzing these sources in conjunction with data from other disciplinary areas, namely archeology, environmental history, biology, ecology, chemistry, among others, for a better understanding of the intricacies of the ivory trade in this region and its articulation with the IOW trading networks. Such an approach aims to contribute to a better understanding not only of the sociodynamics of the region, but also the possible links between hunted animals, the extraction of ivory, carving ivory, and global networks and markets in Africa and the IOW.

Additionally, despite our focus on a very short period, we will address the limitations associated with the documents used. This will involve emphasizing the complexities of interpreting historical data and underlining not only the importance of interdisciplinary and transdisciplinary analysis but also the need for caution when formulating conclusions based on limited evidence. This cautionary approach holds particular significance considering that existing research predominantly concentrates on later periods and/or different geographical regions not encompassed by this study. This assertion was supported by an extensive search across internationally recognized databases such as Scopus, Web of Science, the Environmental Historical Bibliography Database, Google Scholar, JSTOR, and Project MUSE, utilizing keywords including "African ivories," "Ivory Trade," "Trading networks," "Southern Africa," "Southern-east Africa," "Indian Ocean," "Archaeology", and "Environmental History" and, therefore, this work also seeks to contribute to filling a gap in these studies. As a result, from a methodological perspective, we propose a thorough examination of the selected documents to extract all data pertaining to the topic under analysis, expecting that this approach will enable the comparison of historical data with data from other fields of study, particularly archeology. Adopting an open and transdisciplinary approach will play a crucial role in establishing a foundational dataset for future research endeavors focusing on this subject within the region.

Lastly, by highlighting the importance of retrieving historical data and incorporating interdisciplinary knowledge to address issues regarding ivory, this study also reflects current concerns about sustainability. On the one hand, historical data offer valuable insights into sustainability, shedding light on past societies' interactions with the environment and their resulting consequences. Consequently, exploring how African communities engage in resource management, embrace technological advances, and adapt to environmental changes, with a specific focus on ivory as a case study, can play a significant role in shaping and developing sustainable practices that impact future interactions between human and elephant communities. On the other hand, historical data provide a conceptual framework for understanding current environmental issues and assist in comprehending their evolution, proving fundamentals to grasping sustainability by enabling the creation of more comprehensive and effective approaches to environmental management. Thus, by recognizing the contribution of historical data to a better understanding of present-day environmental problems, this study is in line with the journal's objectives of addressing the challenges related to sustainable approaches.

2. Ivory: Raw Material or Crafted Objects?

In the context of the IOW trading networks, elephant tusks from East and Southeast Africa are primarily associated with raw ivory, which is highly prized in IOW markets. This is because ivory is considered of exceptional quality and softness compared to the Asian variety, making it the preferred choice of non-African craftsmen [38]. In contrast to West Africa, where the trade in ivory carvings is more frequently referenced than raw

ivory [6,39], scholarly discussions on East and Southeast Africa often overlook locally crafted ivory and ivory objects made by Africans for export or use in the domestic market. Even in northern regions, the Ujiji ivory carvings from the eastern shore of Lake Tanganyika are often considered an exception and, although Swahili oliphants (carved ivory horns) and ivory side-blow trumpets are well-known [40], it has been widely accepted that East Africa lacks a tradition of elaborate ivory carving [38].

However, in recent decades, archeological evidence has emerged that challenges this idea. African workshops were discovered in Southern Africa where ivory was used by local craftsmen in the 7th–10th century [10,24,41], approximately 200 years prior to the date assigned to archeological findings of the Limpopo Valley sites [34]. These findings suggest that both ivory and crafted ivory objects from the southernmost African regions may have been part of both the IOA and IOW trade networks [10,42,43].

In recent archeological excavations carried out at the KwaGandaganda, Ndondondondwane, and Wosi sites (Figure 1) in KwaZulu-Natal, South Africa [24], the amount of waste materials, slivers and offcuts resulting from the carving of objects, is so substantial that it not only raises questions about the number of animals that provided the ivory and the geographical extent of the area where they were hunted but also the structure and organization of these Early Iron Age communities that facilitated the development of such an industry.

The waste materials do not allow an assessment of the number of elephants that may have been killed for their tusks, but the analysis made provided relevant information about their origin. An isotopic analysis of the ivory fragments concluded that the ivory was sourced from different places in Southern Africa, suggesting that elephants would be hunted at various locations and their tusks subsequently transported to these workshops where the ivory objects were produced, which also raises questions regarding the transport conditions and the location and characteristics of the places where the tusks were to be stored before being worked on, as well as the procedures used to ensure their preservation [3]. Consequently, the impact of ivory hunting would have been experienced over a wider area than where the elephants were hunted or where the workshops were located, encompassing a variety of environments, including savannah and wooded/forested habitat habitats [24]. As a result, the wide variety of environments and habitat, which intrinsically influenced the quality of the ivory [38], could potentially guarantee the production of distinct objects based on the quality of the ivory received in the workshops.

As for the structure and organization of the African societies behind this ivory industry, several questions remain unanswered [42,44]. Despite the possibility of thinking about a structure in which hunting for ivory would take place within the framework of well-defined political and territorial units [24], doubts remain regarding both the objectives of this industry and the potential consumers of the ivory objects produced, highlighting the relevance of an investigation that covers both the regional and transregional multidirectional trading circuits in which these objects may have circulated [45], and the impacts of the trade flow on human ecology.

However, it seems indisputable that these archeological finds are, in fact, doubly significant. On the one hand, they challenge previous assumptions regarding the export of ivory objects and raw ivory, the idea that Africans were unable to work with it, and the marginal position of Southern Africa in relation to the broader Afro-Eurasian world system [46] and the IOW transcontinental circuits [27]. On the other hand, they underscore the importance of inter and transdisciplinary research to overcome the limitations of relying on a single source of information for analysis [23], as well as highlight the need to re-evaluate textual evidence, where available, by exploring implicit data to facilitate the re-examination of specific aspects of Southern African history.

Given this new archeological evidence, future analyses of local and regional socioeconomic dynamics must expand to encompass territories beyond Great Zimbabwe, Mapungubwe, and Manikeni (Figure 1), and consider new actors and economic activities within the context of both a transregional and transcontinental history. This analytical per-

spective acknowledges the inherent interdependence among different regions, highlighting the significance of interactions between humans and non-human entities. It underscores the importance of mobility, involving people, animals, and goods, as well as the exchange of knowledge and technologies. Additionally, it recognizes the vital role of African agency in shaping and reshaping commercial networks. By incorporating the active participation and influence of African communities, this perspective aims to redefine discussions on trade and promote a comprehensive understanding of the complex relationships and dynamics involved.

Surprisingly, the possibility of combining archeological and textual evidence highlighted discrepancies in the data. While the archeological findings at KwaZulu-Natal sites reveal remains of elephant and hippopotamus ivory, leading to the assumption that both were in demand in the market, early written documents that mention ivory rarely specify the animal from which it was extracted, and there is no mention of specific markets for each type of ivory. Furthermore, while archeological evidence suggests the existence of African ivory-carving workshops, written documents only refer to raw ivory. The apparent discrepancies in the data underscore the importance of adopting a wider approach encompassing different data sources to gain a more comprehensive understanding of the socio-economic dynamics of the region. As such, a re-evaluation of the animals involved, the types and quantities of ivory, and the geography and diversity of the markets are also warranted.

The inquiry into the relationship between hunted animals, extracted ivory, worked ivory, and markets (export and destination) has informed our re-reading of a collection of Portuguese documents covering the first fifteen years of the 16th century. Through this re-examination, we aim to discern whether these documents can offer insight into the intricate networks of the ivory circulation and trade in Southeast Africa and the IOW, the involvement of African communities in this trade, and the quantities and varieties of ivory supplied to the trading networks.

3. Documents and Data: Problems and Questions

The selection of this *corpus* of documents is based on three assumptions. Firstly, these documents form part of the collection that brings together the Portuguese documents produced in East Africa during the 16th century existing in the various national archives [47], which makes it a very reliable working tool. Secondly, few authors have utilized them to examine the ivory trade in Southeast Africa in the IOW context, as demonstrated by the limited references to them in previous academic works [48]. Thirdly, documents from the early 16th century provide a first impression and assessment of the region and its economic potential. At this incipient stage, the role of ivory from Southeast Africa in the Portuguese imperial agenda of resource appropriation, extraction, and trade in the Indian Ocean was not yet defined [49].

In the early 16th century, upon entering the Indian Ocean, the Portuguese encountered a well-established and thriving trading network [20], primarily dominated by Muslim and Indian merchants [33,50,51]. Over the centuries, the IOW networks had evolved, facilitated by the monsoon system of winds and currents, which connected ports and city-states throughout East Africa, India, the Far East, and most inland African regions [15,19,52,53]. Regional trade routes played a crucial role in connecting internal areas with coastal regions and ports, facilitating the movement of products from the interior and overseas areas, and allowing for the exchange of goods and commodities from all corners of the Indian Ocean with continental regions. This network of regional and intra-regional trade fostered local and regional production and consumption of various commodities and involved a diverse group of producers, consumers, brokers, and markets throughout the IOW. However, as noted by Seshan [25] in her recent study on Gujarat (West Indian coast) and its trading networks in the 16th and 17th centuries, the extent to which regional trade networks operated and can be identified in the history of the IOW remains poorly understood.

In the East African context, trade was mediated by the Swahili along the coast, stretching south to the mouth of the Limpopo River. This was made possible through a network

of small coastal ports, which allowed for the connection between the interior and the ocean-based littoral regions, thereby facilitating the shipment of African goods, such as gold and ivory, either to the Northern Swahili cities, and subsequently to the markets in India and the Far East, or directly to the Indian markets [22]. African commodities were then exchanged for a variety of Indian goods, including textiles, glass beads, and spices [20,22,50,51]. Intra-regional and intercontinental trade via coastal ports has been confirmed by archeological evidence as early as the 7th century [54], indicating the existence and significance of these ports in East and Southeast Africa [19,22,23,55,56], particularly in the area surrounding the Save Delta [54]. This trade was of extreme importance in the region long before the arrival of the Portuguese [57], and ivory was probably one of the main African items circulating within these networks for both internal and external consumption and exchange [5].

Although there is no evidence that East African ivory or the ivory trade were significant interests to the Portuguese during that period, it is worth noting that the earliest Portuguese references to ivory from Southeast Africa do not involve elephant tusks but rather carved ivory objects. The first mentions relate to Aguada de S. Brás (present-day Mossel Bay), where the use of ivory bracelets is recorded; Inhambane, where the use of daggers with ivory sheaths is observed; and Malindi, where particular attention was paid to the "bozinas de marfim", the large, man-sized, elaborately carved elephant tusks used by local musicians during Vasco da Gama's reception by the king [58].

Considering the two distinct types of musical horns existing in East Africa—the Siwa, a large ceremonial horn, and the Mbiu, a small and portable proclamation horn [40]—it is plausible to suggest that the reference to "bozinas de marfim" pertains to the Siwas, the large Swahili trumpets that symbolized political authority and were utilized during official and private ceremonies with public implications [59], including weddings and circumcision ceremonies [40].

These references are significant from a twofold point of view. On the one hand, they provide the first written evidence of worked ivory objects in the early 16th century for regions located further south of the Swahili coastal towns and Sofala Bay; on the other hand, they suggest the existence of the ivory trade circuits closer to the southern areas, which is corroborated by archeological evidence on the trade [19], and existence of local workshops for the manufacturing of ivory bangles and armlets as early as the 7th–10th centuries [60].

Despite the reference to elephant excrements near the water source in Mossel Bay, which confirms the presence of elephants nearby, and the willingness of locals to trade ivory bangles [58], the remaining two references do not provide any information on the source or type of ivory, the craftsmen involved, or the ivory trade in the area. As a result, it is impossible to determine whether the ivory was locally sourced or imported, or whether the ivory objects were crafted locally or obtained through trade. Moreover, the descriptions do not provide any insight into the environmental conditions that might have supported elephant populations in the region.

However, these mentions of ivory provide significant data that not only point to its abundance in the region, which seems to be compatible with Skead's proposed historical distribution of the elephant in the broader Easter Cape [9] but also its current use, trade, and exchange in Southern African societies [5,10]. Consequently, it is not surprising that ivory gradually became a significant item in the Portuguese commercial agenda.

Sporadically mentioned at the beginning of the century, ivory quickly gained a central position among the items traded by the Portuguese factory of Sofala, established in 1505 in Sofala Bay. The fact that local traders and commercial agents came to sell ivory to the factory, and the ease with which the Portuguese began to buy it when traveling inland to buy and sell other goods, must also have contributed to this situation [61].

Throughout the first years of the 16th century, references to ivory become more frequent and provided insight into the potential quantities that may have passed through the Portuguese trading posts of Sofala and Mozambique (from 1507 onwards), prompting questions about the types of ivory and the individuals engaged in its trade. A brief

examination of Table 1 provides evidence of the increasing interest in ivory between 1506 and 1515. In less than a decade, some 28,000.000 kg of ivory plus 52 elephant tusks were shipped through these two factories. The data for 385 tusks mentioned in the letters of Álvaro de Boiro and Cristovão de Faria dated 1514 [62] are not considered here. Although these letters were published in the DPMAC collection, none of them refer to the ivory trade or the East African coast [61].

Table 1. Ivory in Portuguese factories in East Africa (1506–1515). Source: *DPMAC*, vol. I–IV [47].

	Quiloa *		**Sofala**		**Mozambique**		
	Tusks	**Undifferentiated**	**Tusks**	**Undifferentiated**	**Tusks**	**Undifferentiated**	**Objects**
1506	699		2 [a] 48 [b]	558,000 kg			
1507	264	2 pieces					
1509				5,581,440 kg			
1512				3,084,480 kg			
1513				2,350,080 kg	2	5,280,380 kg	6 Bozinas
1514				4,789,206 kg		4,700,160 kg	
1515				1,556,918 kg			
	963 tusks	2 pieces	50 tusks	17,920,124 kg	2 tusks	9,980,540 kg	6 *Bozinas*
A total of 1015 elephant tusks, of which 963 were confiscated. Two pieces of undifferentiated ivory. 6 bozinas (Siwas) 27,900,664 kg							

* Ivory confiscated in vessel seizure actions without registering in the books of the trading posts. [a] small tusks; [b] mixed: large and small tusks.

While the official figures in Table 1 (see below) may seem impressive and easily suggest that as many as 1,000 elephants could have been killed for their tusks, we must recognize that any attempt to establish a direct correlation between these figures and the actual number of elephants killed will always be speculative. Even considering that, as argued by Forssman et al. [34], a male elephant tusk can weigh an average of 60 kg, and a female elephant tusk 10 kg, mean values can vary significantly, with tusks of adult males ranging from 50 to 79 kg, and tusks of adult females between the 18 to 20 kg (e.g., https://seaworld.org/animals/all-about/elephants/characteristics/#:~:text=Each%20adult%20male%20tusk%20weighs,kg%20(220%20lb. Accessed on 14 April 2023). Furthermore, Table 1 only pertains to the recorded volume of trade in the books of the trading post, on behalf of the King of Portugal, during the examined period. It does not account for the existence of parallel private trade, smuggling, or even the misreporting of ivory as a different commodity. Consequently, the actual numbers related to the volume of ivory traded would undoubtedly be higher than the recorded values.

In addition, the weight system used during the 16th century in the IOW presents a further challenge to the calculation of ivory exports, namely regarding the use of the bahar. Despite its widespread use as a measure of weight for various goods, its value was not standardized and varied between different locations [60]. Therefore, not only was it challenging to accurately document the volume of traded commodities, especially when there is no mention of which bahar was used, but there was also a high probability of underestimating or overestimating the volume of traded goods.

Even within the Portuguese trading posts in East Africa, notable disparities were evident, with 10 bahars of ivory weighing either 2937.6 kg (Bahar of Sofala) or 2478.6 kg (Bahar of Mozambique). This divergence of 0.459 kg in weight for the same quantity of ivory across different trading posts added further complexity to accurately ascertaining ivory exports. The variability of the bahar, combined with the absence of unofficial

commercial records, not only posed a substantial challenge for determining the volume of exported ivory, influencing corresponding price estimations, but also underscores the necessity of accounting for variations in measurement systems when analysing historical commercial data.

On the other hand, the difficulty of the Portuguese in controlling the Indian Ocean trade in this period is undeniable. Documents from 1506 [63,64] attest to the Portuguese strategy of seizing vessels belonging to Muslims and Indian traders to restrict trade [49,65,66], namely on ivory. However, despite these efforts, trade continued to thrive, indicating its resilience and importance in the economy of the IOW.

Therefore, given the limitations of the available sources, it is crucial to exercise caution in interpreting the numbers and recognize the narrow scope of our understanding of ivory and its trade in the IOW during this period.

4. Exchange and Trade: Ivory Trading Circuits and Networks

According to the textual evidence supporting Table 1, the growing involvement of the Portuguese in the ivory trade appears to be evident from 1506 onwards. The fact the Portuguese acted against Muslim and Indian merchants may support this progressive interest [49,66]. However, for this period, it is not easy to identify what may have been specific ivory-related procedures, as well as the main actors involved in the ivory trade.

Still, the actions against Muslim and Indian traders are indicative of the persistence and importance of trading activities involving Southeast Africa and the IOW networks. These networks depended heavily on interpersonal relationships and family kinship networks [11,49,66] and relied on brokers and commercial agents who ensured direct relationships with, and between, African chiefs. Due to these factors, old networks persisted in using the same channels and procedures, providing the same goods and merchandise, and reinventing trade routes, markets, and alternative ports [67], thus demonstrating the vitality and agency of African networks in their interactions with the IOW. As a result, although the Portuguese exerted pressure on the resources traditionally traded in the IOW, it is unlikely that they immediately achieved commercial dominance or replaced existing network leaders. Instead, this pressure likely increased the demand for these resources, with the Sofala coast remaining a significant source of ivory flowing from the interior [68].

Nowadays, the word "ivory" is commonly associated with elephant tusks, evoking images of poaching and the slaughter of entire herds for their valuable tusks. However, it is important to consider whether it is accurate to equate the terms "ivory" and "elephant tusks" as interchangeable concepts.

The absence of specific information regarding the animal sources of ivory in most of the Portuguese records analyzed underscores the possibility that the Portuguese may have traded not just elephant ivory. The terms "ivory," "elephant tusks," and "ivory trade" were used interchangeably. This suggests that, in addition to elephant ivory, other unidentified animal species, such as hippopotamus (*Hippopotamus amphibius*), warthog (*Phacochoerus africanus*), or even marine mammals, could also have been a source of ivory, as we know was the case for later periods [5,37,69,70]. Consequently, when analyzing the records on large quantities of ivory traded in the early 16th century, it is plausible to question whether a significant part of the ivory did not originate from other animals than elephants [49].

This point, having not been studied and controversial, requires textual evidence, which is currently unavailable for this period. However, it cannot be overlooked, as it poses the hypothesis that multiple animal species may have been used to extract ivory for trading purposes. Consequently, the differentiation between ivory and tusks is not devoid of ambiguity.

Tusks and pieces of ivory are explicitly distinguished in the documents reporting the ivory confiscated in 1506 and 1507 [64,70]. A few years later, other documents provide a precise indication of the number of tusks, their weight, and value [62], and subsequently, in the 18th century, we find different categories, such as large, medium, small, and ceira tusks. Portuguese documents from the 18th century inform that, at the time, other than

considering "pieces of ivory" and "assorted ivory", ivory was classified into four categories according to its weight: thick ivory (Marfim grosso), teeth that weighed more than 18 *Arrateis* (about 9 kg); medium ivory (Marfim meão), teeth from 13.5 to 18 *Arrateis* (from 6.5 to 9 kg); small ivory (Marfim pequeno), three *Arrateis* teeth and three-quarters to 13.4 *Arrateis* (from 1.8 to 6.5 kg); ivory ceira (Marfim ceira or seira), teeth with less than 3 *Arrateis* and three-quarters (less than 1.8 kg) [71]. It is possible these differences correspond to a commercial reorganization in response to the growing demand in the 18th and 19th centuries, given the different uses of ivory [38] and the diversification of markets [72]. However adequate textual and/or material evidence is needed to interpret these historical classifications, as weight-based classifications of ivory may not necessarily capture the full range of variations in quality, the relationship between quality, type, and intended object, or even the specific needs of different markets [36,38] in earlier periods.

In contrast, it appears that in later periods, such ambiguity regarding the type of ivory was less prevalent. Between 1861 and 1862, for instance, the Mozambique customs books documented exports of "assorted ivory" and "assorted hippopotamus" [73], which leaves no doubt that ivory and elephants were considered synonymous at this time. However, even with this clarification, questions remain regarding whether previous centuries' references to "pieces of ivory" or "assorted ivory" always referred to elephant ivory.

Similarly, it is difficult to conclusively determine that a region referred to as "ivory-rich" is necessarily a region with the presence and/or hunting of elephants, hippos, or any other animal that might be a source of ivory. The earliest extensive accounts of the hinterland of Sofala associate ivory with regions located west and north of the Portuguese factory, in the Zambezi basin likely near the Pungué and the Buzi Rivers. Subsequent documents attest to the abundance of elephants and hippos in these areas [74,75], as well as the practice of hunting them. In fact, according to Maugham, at the beginning of the 20th century, elephants in Zambezia were far from being considered an endangered species. Despite experiencing a significant population decline because of intensive hunting in the 19th century, elephants remained relatively abundant in the Zambezi basin, extending northwards to the Mozambique district and eastwards to Quelimane. Nonetheless, the early 16th century documents only refer to these regions as "ivory-rich areas," providing no specific information regarding the presence or hunting of elephants and hippos, or the ivory trade.

Under these circumstances, is it reasonable to assume that we are referring to the same geographical area? If so, the regions rich in ivory in the early 16th century align with the areas where elephants and hippos continue to thrive and be hunted three centuries later. This direct correlation highlights two fundamental factors in the ongoing discourse on the decline of African elephant populations during the last two centuries: the diminishing ability of African ecosystems to sustain elephant populations due to habitat modifications and the extensive hunting of elephants for ivory [76]. At the same time, it reinforces the argument about the relationship between the decline of elephant populations and extensive hunting for commercial purposes in the 19th century [76,77]. Additionally, this correlation prompts a broader examination of sustainability-related concerns.

Regional and intra-regional trade of ivory is well-documented in areas located north of the Zambezi basin [36,38,78], and although it is hard to conclude the different types of ivory traded, it is well-established that ivory held significant importance as a medium of exchange in Africa [11] as well as in certain Indian markets [72]. Ivory was one of the several "currencies with value" used in Southeast Africa [15,79] and, in the Portuguese case, was even used to pay wages [80]. The origin of the practice of remunerating in ivory remains unclear. However, given the utilization of ivory as currency, the mention of its use for paying salaries and services in the Portuguese East African trading posts highlights the crucial role played by the internal and external circulation of ivory within the OIA and IOW networks, and underscores the difficulties involved in regulating and controlling its trade.

Exploring the dynamics of ivory as a medium of exchange at the regional level can present an opportunity to uncover significant clues about the nature of the commodities

procured through the ivory trade as part of an economic system that relied on the exchange of goods for other commodities, as argued by [15]. Such an approach can also help in identifying local and regional trading networks involving different products and actors (suppliers, commercial agents, brokers, final consumers, etc.). Furthermore, by establishing connections between these "ivory payments" and the broader ivory trade in the IOW, a comprehensive understanding of the international networks and their participants can be achieved, encompassing both maritime and terrestrial connections. This comprehensive perspective contributes to a more nuanced understanding of the economic and social dynamics of the ivory trade, shedding light on the cultural and political factors that may have influenced its growth and persistence over time. Ultimately, it can provide insight into ivory supply and demand patterns and the integration of regional networks into broader global trading systems.

During the early 16th century, Portuguese participation in the ivory trade in the Indian Ocean became increasingly prominent and persisted throughout the following centuries. Despite Portugal's attempts to regulate all trade in the Indian Ocean during this period [49,65,66], it ultimately adopted the existing IOW trading pattern of exchanging ivory for non-African goods, namely Indian textiles, and glass beads. This trend confirmed that African ivory remained in high demand in India and was sold there at profitable rates, as reported by Albuquerque in 1514 [80].

The transport of ivory shipments from Sofala, bound for Goa, on the west coast of India, via Mozambique, was redirected to Surat, located on the banks of the Tapti River in Southern Gujarat. Within the trading hub of Surat, ivory was used to acquire indigo, bloodstones, and textiles, which were later destined for shipment to Sofala and Malacca [80]. This intricate commercial network facilitated the circulation of goods and fostered economic relations between the regions involved. While evidence supports the use of ivory as currency in India during the 18th century [72], it remains uncertain whether this practice was prevalent in earlier centuries. Nevertheless, it is evident that the profits generated from the ivory trade were primarily allocated to the procurement of diverse textiles intended for shipment to the Portuguese factories in Eastern Africa and Malacca [80]. The choice of Surat as a trading partner was most likely a deliberate strategic decision, given its location at the intersection of the IOW trading networks and those of the Mughal Empire, providing access to Central Asian and European markets [25]. Additionally, as Machado asserts, Surat in the 16th century already held a privileged position among the ivory markets, with connections to the Western and Northern Indian marketplaces, as well as a prestigious ivory carving industry that primarily relied on African ivory as its main source [72].

In the case of the textiles sent to Africa, the Portuguese used them for purchasing almost everything, including ivory, which, in turn, would be sent to India to buy Indian products, namely textiles [80]. This ivory–textile relationship persisted throughout the following centuries, reinforcing the idea of the connection and interdependence of these products [37,72]. In line with Machado's study on Indian Ocean trade in the 18th and 19th centuries [72], a thorough analysis of the ivory–textile relationship during the early 16th century holds the potential to yield valuable insights into the production and marketing channels of these two commodities. An inquiry of this nature can reveal valuable insights into pricing strategies and the factors that have influenced price disparities among different regions [81,82] while contributing to a more comprehensive understanding of the social, cultural, and economic contexts in which these items were produced, marketed, and consumed. This, in turn, highlights the interconnectedness of different regions within the broader IOW network.

Additionally, this inquiry has the potential to reveal the degree of African involvement and agency in these transactions. While studying Indian textile manufacturing for the East African market during the 18th century, scholars such as Machado [83] have already provided evidence of the involvement of African communities in dictating production patterns to align with their preferences as end consumers. Recent research further substantiates

this idea, emphasizing the significant role of African selectiveness and decision-making in determining the products obtained through the IOW trade system [53]. Consequently, a deeper exploration of this interaction has the potential to shed light on its historical origins and the extent of African agency within this relationship.

In the early 16th century, historical evidence [61] indicates that Indian textiles served as the primary currency for trading ivory at the Portuguese factory of Sofala (Table 2). This trend persisted in subsequent years, as confirmed by sources such as Silveira [84] and Mocquet [85]. Therefore, parallels can be drawn between this scenario and the 18th century, particularly regarding the role of textiles and the direct involvement of African communities as end consumers in selecting the types and patterns of fabrics to be exchanged for their goods, including ivory.

Table 2. Ivory sold by local traders at the Sofala trading post (1515). Source: Lopes [61].

Trader	Ivory			Period of Year	Currency of Exchange	
	Origin	Quantity	Equivalence		Textiles	Other
Caciz	No mention	2.5 *arrobas*	36,720 kg	February	5 *vespiças * simples*	
		2 *arrobas*	29,376 kg	July	2 *vespiças * dobradas*	
Caxena	No mention	6 *arrobas*	88,128 kg	January	32 varas 1/4 de *Bretanha branca*	
Cafres	Mexandira	1 *quintal*	58,752 kg	March	2 *vespiças** 1 *tafecira** 1 *bertangil**	
Cafres	Muconde's chieftaincy	1.5 *arroba*	22,032 kg	March	-	Arm bracelets
Cafres	Querengue	1.5 *arrobas*	22,032 kg	March	2 *reras**	
		2 *quintais*	117,504 kg	May	1 *bertangil** 1 *fanbule * pequeno* 1 *vespiça * dobrada* 1 *zandim** 1 *tafecira** 1 vara de *Bretanha* 3 varas de *pano da terra estreito* 2 varas de *dote*	
Jumar	No mention	1 *arroba*	14,688 kg	September	1 *vespiça * dobrada*	
Macameu Pando	No mention	7.5 *arrobas*	110,160kg	February	6 *bertangis**	
Mombaquere (on behalf of the king of Sofala)	Sofala Kingdom	3.5 *arrobas*	51,408 kg	April	1 *vespiça * simples* 11 varas de *Bretanha* e *Naval*	
		1 *arroba*	14,688 kg	May	5,5 varas de *dote*	
		6.5 *arrobas*	95,472 kg	May	6 *vespiças * dobradas*	Pepper (2 *arráteis*)
		6 *quintais* et 1 *arroba*	367,200 kg	July	20 *vespiças * dobradas* 10 *sabones**	
		7 *arrobas*	102,816 kg	July	1 *tafecira** 1 *zandim** 2 *vespiças * dobradas* 1 *macacere** 4 *sabones**	

Table 2. *Cont.*

Trader	Ivory			Period of Year	Currency of Exchange	
	Origin	Quantity	Equivalence		Textiles	Other
Mostafa	No mention	1.5 *arrobas*	22,032 kg	April	4 varas de *Naval* 1 *vespiça* * *simples*	
		3 *arrobas*	44,100 kg	April	3 *vespiças* * *dobradas*	
		1 *arroba*	14,688 kg	June	4 varas de *Bretanha branca*	
Tibo	No mention	2 *arrobas*	29,376 kg	March	2 *vespiças* * dobradas	
		2.5 *arrobas*	36.720 kg	May	5 *vespiças* * *simples*	
		2.5 *arrobas*	36,720 kg	May	9 varas e 1/4 *Bretanha branca*	
		1.5 *quintais*	88,128 kg	June	4 *macaceres* * 3 *vespiças* * *dobradas*	
			1,527,542 kg			

Arroba: 14,688 kg; Arrátel: 0,459 kg [71]. Quintal: 58,752 kg [86] * Indian fabrics.

However, it is worth noting that in the southernmost areas, such as Lourenço Marques (Maputo) Bay and its surroundings, historical documents from the second half of the 16th century related to shipwrecks reveal that the primary commodity used for exchange was not textiles, but rather glass beads. This finding was consistent with the archeological evidence, which has shown that glass beads were likely one of the most sought-after trade items in Southern Africa, and they may have even arrived in the region through trade circuits that were independent of those supplying Central East Africa and the Northern Swahili cities [22,87–89].

According to the historical accounts provided by Portuguese shipwreck survivors, glass beads from Cambay (Western India, in the Gulf of Cambay) were the only currency accepted for the purchase of ivory in the Lourenço Marques Bay (Maputo) region. The use of these beads by local inhabitants was regarded as an indication of their involvement in the ivory trade. To gain access to the ivory trade, the Portuguese were compelled to obtain these beads in Cambay, as they were deemed the only acceptable currency for exchange [90]. This observation provides evidence of the substantial impact that consumer preferences and choices had on the products being traded and their perceived value. Consequently, it is justifiable to assert that factors such as cultural and social practices, fashion trends, and consumer preferences can exert a considerable influence on the dynamics of both the ivory trade and exchange practices.

On the other hand, the fact that glass beads are so highly valued in this region highlights the importance of understanding the connections between international networks and the regional Southeast African trade circuits, as well as the significance and impact of local preferences in these exchanges. Given this context, is it reasonable to question the specific relationships with Surat and Cambay in the early 1600s. The documents analyzed suggest that, while Surat would have played a crucial role in the textile trade, trade with Cambay might have been mainly associated with glass beads, which were vital for the ivory trade in southern regions, despite the widespread circulation of the well-known Cambay fabrics in the Indian Ocean via Gujarati merchants. This situation may have persisted until the 16th century when the ports of Diu and Surat gained prominence due to the silting up of Cambay's port [27]. Further research into this topic may provide insight into the complexities of these relationships and their impact on trade and exchange during the period in question. However, regardless of the outcome of this research, it is important to acknowledge that African agency was of substantial importance in both cases.

Still, once trade circuits are defined, it is important to ascertain the currency used and the paths behind these transactions. While textiles and glass beads mostly originated in

India, the producers and trade channels were not necessarily the same. Therefore, tracing the trading circuits and commercial connections between different producers, traders, and consumers is crucial to understanding the dynamics of the IOW trading network and its interactions with African societies and markets over time. The sourcing of the raw materials, the production of the finished goods, and the distribution of those goods along multidirectional trade routes are all important factors to consider when trying to understand the economic dynamics of these networks and their connections.

The archeological evidence of the 10th to 13th century glass bead trade between Southern Africa and India highlights the existence of possible independent trade routes linking the two regions [22]. However, the absence of textual evidence thus far presents a challenge in evaluating potential regional shifts, particularly regarding whether the arrival of the Portuguese in the 16th century and the growing demand for ivory led to alterations in established trade routes or changes in ivory procurement methods.

Based on the records pertaining to the transport of ivory from Sofala until 1515, it is estimated that around 18 tons of ivory were traded at the Portuguese factory. However, if we also considered the ivory sent from the Mozambique factory to India in the same period, which was likely also sourced from Sofala, the total number increases to roughly 28 tons of ivory purchased and shipped officially by the two Portuguese factories (Table 1). Additionally, fifty-two tusks and six Siwas must be included. In the case of the 52 tusks, it is difficult to estimate their weight due to variation in the weight of tusks from different genders and sizes. According to Forssman et al. [34], the average weight of a tusk can range from 60 kg for adult males to 10 kg for females, which allows us to think that the approximate total weight of the 52 tusks could vary between 3120 kg and 520 kg of ivory depending on whether we assume that these are male or female tusks. However, the absence of data on the tusk's size introduces an element of speculation to any estimation made. As argued by Romanis [48], determining the average weight of each tusk traded poses a challenge, and reliable estimates cannot be made.

Based on the data available for the initial fifteen years of the 16th century, it can be deduced that the documented information spans only a period of seven years, between 1506 and 1515. During this period, approximately 28 tons of ivory (not specified as elephant ivory) plus 52 tusks were traded. These figures allow us to estimate that a total of 28,400 to 31,000 tons of ivory could have been exchanged in the Portuguese trading posts of Sofala and Mozambique during that time. This corresponds to an average annual trade of less than 4,5 tons of ivory. Hence, despite the absence of comprehensive and continuous records regarding the ivory trade during the initial 15 years of the century, the figures ascertained do not line up with Beachey's [38] estimate of an average of 15 tons (GBP 30 000) per year exported from Sofala in the 16th century, or with Spinage's [91] estimate of 69 tons of ivory exported from Beira between 1512 and 1515. This is a very relevant and sensitive question since none of the authors provide documentary evidence supporting these values, and references to Beira cannot even be considered. Beira (village, city, port...) did not exist in the 16th century. Still, it seems plausible that the actual amount of ivory exported exceeded Thomaz's [86] calculation of 2.701 kg for the years 1508–1509.

The presence of 52 tusks indicates a minimum of 26 dead elephants. However, this calculation, although plausible, is also speculative. It does not consider variables such as the fact that not all elephants have two tusks [92,93] and that there are distinctions in weight and growth between male and female tusks. In addition, we have no way to determine the ratio of male to female elephants in 16th century herds, and as previously mentioned, it is possible that ivory from other animals may have been included in the count. It is, therefore, difficult to determine the exact number of elephants that were targeted exclusively for their tusks for commercial gain or whether part of this ivory came from animals that died from natural causes. The above observations apply equally to the 699 tusks that were seized in 1506, as the exact number of dead animals that correlate with the given number of tusks remains ambiguous.

Nevertheless, up to this point, current findings seem to align with the conclusions of the initial studies conducted in the 1980s regarding the correlation between elephant hunting, the African ivory trade, and the need for caution and careful analysis when it comes to this subject [94].

5. Animals and Geographies, Quality, and Trade: Looking for Answers

Relying on the early 16th century Portuguese documents underlines the difficulty of consensus on the meaning of the word "ivory" at the time. In most cases, we have no way of knowing whether this term refers only to elephant tusks.

As previously mentioned, the term "ivory" may not refer exclusively to elephant ivory, and categorizations such as "assorted ivory" may be subject to multiple interpretations. In either case, these terms may cover elephant tusks of different sizes or ivory of various qualities, including poor-quality ivory that is cracked or dried out, which would be packaged and sold separately regardless of weight, as described by Sir Robert Cowan in the mid-18th century [78]. Furthermore, these designations can be extended to include ivory obtained from dead elephants, which is less suitable for carving due to the weathering out of the tusk's natural oils, and even ivory sourced from other animal species such as hippos, warthogs, or even whales.

In turn, to assess or predict the impact of the ivory trade on elephant populations, it is important to determine the number of elephants killed for their tusks, and that is not possible to discover. As previously discussed, it is crucial to recognize that estimating factors such as elephant herd size, gender distribution, or the relationship between tusks and gender in the early 16th century is hampered by limited data availability. Scholars have noted that our understanding of elephant distribution and population dynamics in East Africa prior to the 16th century is largely based on speculative deduction [77] drawn from knowledge derived primarily from the last two to three centuries. The development of models for analyzing these issues clearly reflects these constraints [24,34,60,76,77]. Consequently, establishing a direct correlation between the amount of traded ivory and the number of elephants (male and female) killed for their tusks in the 16th century becomes a complex task, with significant implications for our understanding of the potential impact of ivory extraction and trade on elephant populations. Additionally, although some studies [2] have identified natural accumulations of elephant carcasses from which tusks may have been extracted for trading purposes, their numerical significance remains limited, making it difficult to accurately estimate the amount of ivory from dead animals that potentially may have entered commercial circuits. According to Parker and Martin [94], in recent centuries, ivory obtained from dead animals may have outnumbered ivory resulting from specific hunting for commercial purposes. Consequently, it is essential to underscore the significance of this factor in the examination of preceding eras, despite any limitations in its measurability, to avoid disregarding its potential impact on the overall analysis.

On the other hand, it is important to consider whether the origins of elephant ivory can be unequivocally identified. As asserted by Parker [95], traders in the 1970s claimed to be able to identify the areas of origin of elephant ivory based on observable traits, such as the color and texture of the traded tusks. Contemporary advances in analytical methodologies, as demonstrated by studies examining tusks [96,97], archeological ivory [24,60], and museum specimens, have enabled scientifically rigorous determinations regarding such identification [2,3]. However, determining the origins of traded ivory remains a challenging task given the lack of precise textual evidence and the non-existence of objects, or the impossibility of accessing them. References are typically imprecise and, most often, relate to the place of purchase and/or port of shipping of the ivory (e.g., "Sofala ivory" or "Ivoy from Sofala"). They provide no evidence to support the assertion that the elephants from which the ivory was extracted lived or were hunted in that specific region [2].

It is equally difficult and inappropriate to apply the concept of borders to the various kingdoms mentioned since their extent and limits were largely unknown. Moreover, even the term kingdom may not be entirely appropriate since it reflects a Western perspective.

Therefore, applying the concept of borders to determine the geographic location of elephant herds and their relation to the ivory trade would be a difficult task. The kingdom of Mexandira, for instance, located immediately west of the territory of the Portuguese settlement of Sofala, was said to possess ivory [30], and merchants from there were known to come and sell it at the factory of Sofala. However, in the absence of direct evidence, it is difficult to determine whether the kingdom of Mexandira had elephants in its territories and whether commercial hunting was practiced there.

The simple fact that ivory was sold by merchants from Mexandira at the trading post of Sofala (Table 2) does not necessarily imply that the ivory was sourced from elephants living or hunted within the territory under the rule of the King of Mexandira. Additionally, questions arise regarding the specific ecological conditions of the area when considering the ivory trade. Was this kingdom home to large herds of elephants, or did it primarily function as an intermediary in the trade between the interior plateau and the coastal ports? While Mexandira is, for this period, the only mentioned kingdom located south of the Buzi River, thus occupying a potentially less humid territory, the lack of information about its precise location makes it difficult to draw conclusions [17,49,77]. Moreover, what information do we have about the quality of this ivory and the connections between its origin, quality, and market value? According to Thorbahn [78], tusk coloration may be influenced by the elephant's diet, which in turn depends on its habitat. This idea had already been suggested by Beachey in 1967 [38], who argued that variations in ivory quality between savanna and forest elephants were related to their places of origin. In East Africa, elephant ivory was mostly extracted from savanna elephants (*Loxodonta africana*), but its quality varied according to the wetter or drier areas they inhabited, with ivory from the latter being the softest and most suitable for carving. This characteristic made it highly desirable in India, where it was the only type of ivory suitable for making bracelets worn by both Hindu and Muslim women in wedding ceremonies [36,72].

Thus, the quality of ivory is a crucial factor affecting its demand and value in different markets. However, in the case of the ivory from Mexandira, the absence of data on its quality makes it difficult to draw conclusive statements about its destination market. The analysis of the ivory trade requires considering the impact of ivory's origin, weight, texture, condition, size, and shape on its quality [78], as this affects its potential uses and desirability in different regions.

The insufficient historical data on these issues highlights the significant gaps in our knowledge of Southern African elephant distribution, their ecology, and the environments in which they lived. Additionally, they bring to light uncertainties regarding the impact of these environmental factors on ivory quality, as well as the diverse and multifaceted societal meanings and implications ascribed to ivory within various African societies. Overall, these knowledge gaps and constraints underscore the importance of re-evaluating the use of written records and exploring alternative sources, including archeological and environmental evidence, to increase our understanding of the historical dynamics between elephant populations and human societies. This includes investigating the reciprocal impacts between elephants and human ecology, shedding light on the intricate relationships and influences they have exerted on one another. By employing a multidisciplinary approach and integrating diverse data sources, we can gain a more comprehensive and nuanced understanding of the history of elephant populations and their interactions with human societies.

6. Disputing Agency: The Ivory Challenge

The work by Forsmann, Page, and Selier [34] on the importance of elephants in the development of African societies and the emergence of the state provides valuable insights for considering these questions. By analyzing archeological data, geo-climatic features, and estimating elephant populations, the authors suggest that the abundance of elephants in the Greater Mapungubwe Landscape in the 10th century contributed to the establishment of farming communities and the sustainable development of other economic activities, in addition to the ivory trade. Their conclusions challenged the previous assumption that the

ivory trade was the primary driver of the development of the Mapungubwe complex [9]. Instead, they underline the importance of animal agency, arguing that the presence of elephants acted as a stimulus for the formation of settlements and the establishment of farming communities, contributing to a more diversified and sustainable economy. Their study highlights the value of interdisciplinary methodologies that integrate archeological, environmental, and historical data to provide novel perspectives on the interplay between human and non-human communities and the environment. In addition, it underlines the importance of moving beyond textual sources and embracing a variety of data sources to gain fresh insights into the history of human interactions with the natural world.

As noted earlier, archeological discoveries in KwaZulu-Natal have also challenged previous assumptions about ivory and ivory trading by demonstrating that this trade involved sourcing ivory not only locally but also from distant regions, with the intention of regional and transoceanic trade. This suggests a higher level of organization than previously thought [24], and it is in line with the increasing evidence of commercial activity during the first millennium AD, including imports of glass beads and other goods. However, while sites such as KwaGandaganda, Wosi, and Ndondondwane preserve some of the earliest indications of large-scale ivory processing in Southern Africa (7th–10th centuries) and may have served as precursors to a broader regional trading network in the following centuries, we still lack sufficient data to delineate trade routes and determine the geographic extent of the regional trading circuits, as well as who participated in them and how.

The origin of ivory arriving at the Portuguese factory of Sofala in 1515 is largely uncertain. References suggest vague locations between the Pungé and Buzi Rivers or simply mention its transportation by agents of the King of Sofala, providing us only with a general understanding of the Zambezi basin as the contextual framework [17,49]. It is thus reasonable to assume that most of the ivory traded through this regional network originated from the southern areas of the Zambezi basin and that the ivory reached Sofala via pre-established trade routes, which had been established for the exchange of various commodities, such as gold and slaves, long before the 16th century [98–100]. Hence, the arrival of the Portuguese did not have an immediate impact on the trading practices in the region. The continuity of trade and exchange activities suggests a consistent pattern of linking communities, resources, and market demand. This enduring framework facilitated the movement of goods and services, fostering economic interactions and sustaining socio-cultural connections over time.

Unfortunately, the limited availability of academic investigations, such as those conducted by Alpers [36], Reid [10], or Coutu [60], with a focus on the southern regions, represents a significant hindrance to the identification and possible mapping of potential trade routes and networks associated with ivory trade in earlier historical periods. Moreover, although it seems logical that a multidirectional exchange occurred between various regions of Southern Africa and the IOW [15], uncertainty persists regarding potential links between trade routes in the Zambezi basin and the Limpopo and Maputo basins. Historical records do not indicate whether these routes were interconnected or separate.

Wood's research on the circulation of glass beads brings attention to the possible existence of IOW trade routes that did not intersect and were geared toward distinct products, markets, and consumers. This argument lends support to the notion that glass beads may have served as currency for the ivory trade in Southern Africa long before the 16th century [22,101]. As previously mentioned, this idea is reinforced by Portuguese documents from the second half of the 16th century [90] and underlines the importance of examining the relationship between these links and environmental changes, such as the siltation of Cambay's port [27] and its subsequent impact on both IOW trading networks and the African societies.

We know the African interior plateau states experienced significant changes during the 15th century [102], which may have been related to climate change [103]. The Little Ice Age (LIA), a period characterized by a substantial cooling trend, exerted influence on the interplay between human societies and the natural environment [104,105] and

brought about significant changes to both the natural environment and human societies. In Southeast Africa, Pikirayi [103] argues that these changes prompted a reorganization of the trade routes connecting inland states to coastal ports, as well as the possible displacement of animal populations, such as elephant herds, to areas distant from the coast and their traditional hunting grounds. As such, these changes have had far-reaching implications, not only on the environment but also on the reconfiguring of ancient ivory trading routes and landscapes and the very relationship between human and animal communities. However, so far, the existing data do not provide sufficient information to determine which routes emerged from this reorganization and whether they were connected to the presence of Europeans. On the other hand, as there are also no biographical studies on ivory artifacts from Southeast Africa prior to the 16th century, it becomes more difficult to unravel the geographic distribution and migration patterns of elephant herds during this period [24]. This dearth of research also makes it difficult to fully understand the cultural and economic significance of ivory in African societies that engage in its trade, as well as societies that serve as intermediaries or final consumers of this commodity.

Additionally, several unanswered questions persist regarding the value of ivory, whether derived from elephants or other animals, including assessment criteria such as weight, size, quality, or its value as a means of exchange.

The examination of the Portuguese records of 1515 can give an idea of the goods used as currency to acquire ivory, with textiles being the primary commodity [49,66]. Nonetheless, to grasp the market value of the transactions, a further inquiry is required to clarify the importance of the different exchanges, which mostly involved a specific Indian cotton fabric, known as vespiça. Vespiça was an Indian coarse cotton cloth that the Portuguese bought in Cambay to sell in East Africa. It could be simple or folded, its price varied between 2 and 2.5 meticais and, at least in 1515, it seems to have been the main currency of exchange for ivory at the Sofala trading post [49]. At the time, although all commodities were priced in relation to the gold metical, their market prices varied due to several factors such as supply and demand, quality, and even political and diplomatic situations that determined occasional allies and enemies. These factors also impacted the purchase price and value of ivory, making it difficult to understand, for instance, the meaning of exchanging "two arrobas of ivory for two vespiças duplas" [61].

On the other hand, during these 15 years, a diverse range of fabrics and other goods were used as currency for trading ivory. Ivory was bartered for Indian fabrics, European fabrics, and a blend of Indian and European textiles, in addition to pepper and large arm bangles (Table 2). However, it remains unclear whether these variations in trade were influenced by the quality of the ivory, the identity of the seller or his representative, the quantity of ivory available in the market, or the stock of textiles at the factory. Consequently, as the specific value attributed to each textile employed as a medium of exchange remains unknown, accurately establishing the exact value of the ivory presents a significant challenge.

In 1515, the transport of ivory to Sofala followed the rhythm of the seasonal monsoons (Table 3). Traders took advantage of the window of time between the end of the rainy season and the beginning of the dry season to transport different commodities from the interior to sell them at the coastal ports. As Table 3 shows, ivory was often the only commodity, which may raise the question of the existence of traders specializing in the ivory trade and, consequently, the pertinence of a deeper investigation into this possibility. However, it is important to keep in mind that the available dataset covers a limited period of only 15 years, which calls for caution when drawing speculative conclusions on these matters.

In July 1515, although the exact amount of ivory at the factory is uncertain, it is estimated that it took about 12 h to transport the existing stock from the factory's warehouses to a caravel bound for Mozambique [61], and it is very likely that the same caravel was loaded with 470.016 kilos or more of ivory, which the representative of the *king* of Sofala brought to sell to the factory at the end of that month. Considering this information, it is

reasonable to deduce that the caravel departing from Sofala for Mozambique during the July monsoon season carried over 1.5 tons of ivory [49].

With more systematic data on the frequency of local traders visiting the coastal trading post and the loading times of ships departing from Sofala to Mozambique, we would have a clearer understanding of this scenario. Supplementary data about the origin and quality of the ivory procured by the king of Sofala's representative, as well as the existence of commercial hunting practices in the Kingdom of Sofala, would certainly deepen our knowledge. Yet, given the circumstances, the substantial amount of ivory sold to the trading post in July 1515 by the representative of the king of Sofala should be considered with caution, especially since it has no parallel, at least until the mid-16th century. The exceptional nature of this event raises skepticism regarding its origin solely from commercial elephant hunting. Instead, it could be an isolated incident like those observed later, in the 18th century, which were ascribed to the mortality of many animals due to unknown epidemics [71]. Nevertheless, regardless of occasional fluctuations in ivory shipments, it is important to note that information derived from Portuguese sources indicates a remarkable upward trajectory in the ivory trade starting from the 16th century. This growth is accompanied by an increase and diversification of the agents and markets involved in this trade, resulting in greater pressure on elephant populations and the extraction of tusks for commercial purposes, consequently impacting human ecology, as well as the landscape and overall environment.

Drawing on Alpers' theories [36], Beaujard [33] proposes that the expansion of the ivory trade, much like the slave trade, is explained by the necessity of meeting the global demand for products that allow African elites to uphold their social standing by accessing goods deemed essential to maintain their status. Additionally, Lane [2] and Campbell [106] have emphasized the significance of increasing global economic pressure, mainly through the IOW trading systems and networks since the middle of the first millennium, while Chirikure [15] advocates for a reassessment of the role of African agency in comprehending the shifts in trade and exchange patterns over the longue durée.

However, it is also important to recognize the cultural and ecological significance of elephants for the different African societies, which should never be neglected or underestimated under any circumstances. The development of agricultural or/and cattle-keeping practices can be related to the presence or absence of elephants [11] and, in extreme situations, the survival of human communities can even depend on the presence of elephants as a source of food [90]. Historical accounts from the early 17th century suggest that elephants were killed primarily for meat, with ivory being a by-product that was used for trade [107]. This highlights the need to understand and explore the complex relationship between elephants and human communities in Africa before considering their involvement in the ivory trade, as well as the role of the animal agency in this relationship. Therefore, such an examination should not only focus on the interaction between human societies and elephants but also the broader relationship between societies and nature.

These questions underscore the imperative for inter and transdisciplinary collaboration to progressively gather knowledge that can address the dearth of data concerning Southern Africa ivory, the dynamics between human and animal communities, and the overall interactions of these communities with the environment.

Table 3. Commodities sold by local traders to the Sofala trading post (1515) [61].

Trader	Origin	Year	January	February	March	April	May	June	July	August	September	October	November	December
Caciz	No mention	1515		Ivory				Pottery Ivory Cereals	Pottery Ivory Cereals	Pottery Ivory Cereals	Pottery Ivory Cereals			
Cafres	Inharumba	1515								Cereals				
Cafres	Mexandira	1515			Ivory	Rice								
Cafres	Muconde's chieftancy	1515				Ivory								
Cafres	Querengue	1515			Ivory									
Caxena	No mention	1515	Ivory								Cereals			
Faque Baquar	No mention	1515									Cereals			
Faque Girote	No mention	1515									Cereals			
Inhemogen	No mention	1515					Salt							
Jumar	No mention	1515									Ivory Cereals			
Mafomede Acem	Sofala Kingdom	1515		Honey		Honey			Mel		Cereals			
Maquameu Pando	Non identified	1515		Ivory				Cereals						
Mombaquere	Sofala Kingdom	1515	Honey			Ivory	Ivory Wood		Ivory Wax					
Mostafa	No mention	1515				Ivory		Ivory						
Mouro	Sofala region	1515					Resin							
Merchant	No mention	1515					Herbal medicines	Meat						
Merchants	No mention	1515				Meat		Meat		Meat Salt Chickens				
Tibo	No mention	1515			Ivory		Ivory Cereals	Ivory Cereals	Ivory Cereals	Ivory Cereals	Ivory Cereals			

7. Conclusions Foreseeing Future Research

Historical records and archeological evidence confirm the presence of elephant herds in Southeast Africa in the 16th century, with elephants playing a crucial role in the region's economy and ecological dynamics. However, despite the region having a long ivory-related history well before the period analyzed in this study, several crucial questions remain unanswered about the intricate details of the trade in the early 16th century. These questions encompass ambiguities about the types and quantities of the ivory traded, the organization of local and internal trade networks, the potential inclusion of non-elephant sources of ivory, and the geographical origins of the ivory traded. Adding to these uncertainties are the challenges of assessing elephant distribution, understanding their population dynamics, and the role that ivory hunting may have played in this context during that time.

These assertions result from an investigation based on meticulous scrutiny of the existing written documentation pertaining to the precise geographic region and time period under examination. In doing so, due recognition was given to existing gaps in knowledge, thus underscoring the imperative for additional research efforts aimed at effectively addressing these unresolved issues. Consequently, in the analysis of the historical evidence presented here, the importance of carefully examining the documentation is underlined, while cautioning against the temptation to extrapolate interpretations of recent data into the past. The emphasis on records from this period underlines the need to be cautious when estimating the extent and impact of ivory trafficking, avoiding generalizations that may not precisely depict the situation during that period. Conducting a rigorous examination of the existing and accessible data for each specific historical period is essential to derive reliable conclusions, regardless of the significance of comparative analysis. Such a methodology, emphasizing the importance of a comprehensive examination, should be employed not only in studies focusing on short-term periods, such as the present one, but also investigations spanning longer timeframes.

Further examination of the documents also revealed difficulties in identifying distinct types of ivory, determining the species of hunted animals, and identifying precise connections and trade routes between the different markets. These difficulties arise due to the absence or poor quality of records, as well as the complexities of the trade process. Additionally, this research has emphasized the importance of looking at the trade relationships between the IOA and the IOW and how commodities such as ivory, textiles, and beads played a crucial role in shaping these relationships, highlighting Africa's active role and agency in shaping these interconnected systems.

On the other hand, the evidence presented in the examined documents suggests that the fact that elephants were in large numbers, and ivory was used as a medium of exchange, contributed to making these animals prime hunting targets for ivory extraction, fueling an ivory trade that, over the centuries, has resulted in significant environmental impacts on elephant populations and their habitat. Therefore, we cannot fail to think about the impact of elephants on their ecological niche. Elephants help in seed dispersal, creating paths, and identifying and forming water sources, as well as regulating plant communities [108] and changing the landscape [109]. Despite competing with human communities for the most desirable resource areas, their disappearance can lead to significant environmental consequences, such as changes in vegetation and biodiversity decline [110].

Throughout the centuries, the demand for ivory led to increasing hunting and widespread poaching, causing a decline in elephant numbers, and stressing ecological imbalances [111]. Hence the importance of studying ivory and the ivory trade in Southern Africa in the long term, both from a historical and environmental point of view.

Problematizing these issues underlines the urgent need for an interdisciplinary and transdisciplinary approach to a broader understanding of the historical context of the region in direct relation to the history of ivory and the ivory trade, as well as the intricate dynamics inherent in the relationships between human and animal communities and their interaction with the environment. Consequently, the study of Southeast African ivory and the ivory

trade, when approached from a historical and environmental perspective, assumes great importance for understanding the economic, social, and ecological significance of African elephants, as well as the ecological interdependence between elephants, wild animals, and ecosystems. The development of the present research study has, therefore, highlighted the necessity for additional investigations to delve into the long-term effects of the ivory trade on elephant populations and ecosystems in this region.

Building upon existing knowledge about the significance of elephants and the ivory trade in the region during the 16th century, future research should focus on the importance of addressing the above-mentioned unanswered questions. To achieve this objective, it is recommended to carry out a comprehensive analysis of the documentary evidence, carefully evaluating the available data. However, due to the constraints imposed by the existing registries and the intricate nature of commercial ivory hunting, it is imperative to engage in interdisciplinary and transdisciplinary collaborations. These collaborative efforts are crucial to successfully identifying distinct types of ivory and determining the species of animals hunted, as well as understanding the impact of the ivory trade on both elephants and human ecology, and the ecosystems affected by the eventual displacement or disappearance of elephant herds.

Therefore, future research should deepen the investigation into the long-term environmental impacts of extensive elephant hunting for ivory extraction, focusing on the role of elephants, as well as the relationship between elephant and human communities. By examining the consequences of elephant population decline on vegetation and biodiversity over a long time period, such research will contribute to a better understanding of the ecological interdependencies between elephants and their habitat. This historical framework will address present concerns regarding the protection of vulnerable species, regulation of trade, and broader implications for wildlife and ecosystems.

Additionally, the economic, social, and ecological significance of African elephants in the context of the ivory trade should be explored. Investigating the role of ivory within the IOA and IOW context will provide valuable insights into the historical dynamics of both African and Indian ocean trading networks. This approach will highlight the need to understand the connections between human societies, the natural environment, and cultural practices when studying the ivory trade. By taking a holistic standpoint encompassing both historical and environmental dimensions, the research outcomes will contribute to ongoing discussions on sustainability and sustainable practices.

Given current concerns about environmental issues, the conservation of endangered species, and the imperative of sustainable practices, the present study makes a compelling case for revisiting the past and adopting methodological approaches that acknowledge the interconnection between human societies and the environment. By doing so, the study encourages us to learn from historical insights and use them to shape a sustainable future.

Environmental history, through its examination of the intricate interactions between societies and the natural world, highlights the significance of employing inter and transdisciplinary methodologies to tackle global environmental challenges, including the loss of biodiversity. Concurrently, comprehending the interdependency between human societies and the natural world is paramount for devising sustainable solutions, and environmental history serves as a platform to delve into the historical underpinnings of these challenges while fostering the development of multifaceted approaches. Consequently, beyond its valuable contribution to ongoing scholarly discourse on environmental issues and challenges, conducting a comprehensive analysis of historical evidence can uncover substantial and noteworthy insights into the operational mechanisms of commercial networks within the IOW system. Such an investigation, by presenting unpublished data, prompts a reassessment of the dynamics within these circuits, positioning Southern Africa at the epicenter of this system and emphasizing the role of African agency within it.

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