

THE ENVIRONMENTAL CONSEQUENCES  
OF TWO PORTUGUESE COLONIZATION STRATEGIES  
(15<sup>th</sup> AND 16<sup>th</sup> CENTURIES)

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ABSTRACT

This article analyzes two colonization strategies carried out by the Portuguese between the 15<sup>th</sup> and 16<sup>th</sup> centuries, demonstrating how they had opposed consequences on the environment. We propose a new typology of the Portuguese colonies in this period, considering demography, spatial control, and leading economic activities.

The first Portuguese colonization strategy was what we define as colonies of circulation. In this case, occupation of territory was restricted. The Portuguese did not directly control the production of goods they needed; they only controlled their trade. Their domination was done through military occupation and the creation of factories.

The second strategy was what we call colonies of production. Here, the occupation of the territory was extensive the Portuguese directly controlled the production of commodities.

These colonization strategies had distinct environmental consequences. In the first case, the permanent conflicts between the Portuguese and the Maghrebians led to the abandonment of cultivated fields, the reduction of the agricultural frontier, and even the return of wild animals to the outskirts of the cities. Meanwhile, in the Atlantic islands, particularly Madeira, deforestation occurred at unprecedented speeds, exotic species were introduced with severe consequences for the local ecosystem, and rapid soil degradation was promoted.

**Keywords:** Colonies of Circulation, Colonies of Production, Environmental History, Portuguese Colonialism, Early Modern History.

JEL Codes: N4, N5, Q5.

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## INTRODUCTION

This article analyzes the impact of Portuguese colonialism on the environment during the 15<sup>th</sup> and 16<sup>th</sup> centuries. Over the last four decades, historians of various stripes have taken an interest in studying the environmental impacts of colonialism and imperialism. A first generation of researchers, such as Alfred Crosby,<sup>1</sup> William Cronon,<sup>2</sup> and Warren Dean,<sup>3</sup> highlighted how colonial projects were based on transforming the nature of conquered spaces. Proposals such as those of Crosby or Elinor Melville explained the success of colonialism as the result of the alliance between human and non-human colonizers (be they pathogens or alien species).<sup>4</sup>

A new generation of historians writing in the 21<sup>st</sup> century criticizes the radical separation between society and nature present in the first studies of environmental history. Thus, the new approach emphasizes a more complex dialectic, as in Gabriel de Avilez Rocha's study, which reveals how various enslaved people found ways to emancipate themselves through the ecological transformations caused by the introduction of species in the 16<sup>th</sup>-century Caribbean.<sup>5</sup>

In the examination of Portuguese colonialism, scholars within the field of environmental history have traditionally directed their attention toward individual case studies. While this approach holds merit, it inherently restricts the capacity for comprehensive comparison across varying colonization strategies and their resultant environmental impacts. Consequently, we advocate for a classification system within the context of Portuguese colonization, delineating two distinct models or strategies: "colonies of circulation" and "colonies of production". Each of these approaches engendered divergent environmental outcomes.<sup>6</sup>

The first Portuguese colonization strategy was what we define as colonies of circulation. We classify it in this way because the extraction of wealth (produced by non-European labor) by the Portuguese took place through trade and the collection of taxes, i.e., it was exercised in the circulation sphere of the economy. The predominance of circulation is explained by the fact that the Portuguese Crown and its agents had no

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<sup>1</sup> CROSBY 1972; 1986.

<sup>2</sup> CRONON 1983; 1991.

<sup>3</sup> DEAN 1995.

<sup>4</sup> MARQUES and ROCHA 2022: 147-148.

<sup>5</sup> ROCHA 2018.

<sup>6</sup> We developed this typology in our doctoral thesis. Cf. MALECHA TEIXEIRA 2024.

command over producing the goods they were interested in. Limited to the coast and, in many cases, to only part of the towns, the Portuguese had no direct influence on cereal plantations, cattle breeding, cloth production, gold mining, pepper cultivation, or ivory hunting. Limited to the tiny space between the ports and the walls of their fortress and cities, the Portuguese had only to create the conditions to attract the African traders who would bring them these products. Their domination was done through military occupation and the creation of factories (*feitorias*). They only controlled trade, not the production. This model was implemented on the African coast and in the Indian Ocean.

The second strategy corresponds to the colonies of production. This was a model of extensive occupation of the territory, in which the Portuguese directly controlled the production of commodities. This strategy was developed in unpopulated Atlantic archipelagos such as Madeira, Azores, Cape Verde, São Tomé and Príncipe, and later in South America. These colonial areas were built entirely to serve the metropolitan demand for timber, sugar, livestock, cereals, wine, dyes, and more. From the outset, agricultural and livestock activities were geared towards export to meet the demand of European markets. For this production to occur, a significant population transfer was necessary, unlike the colonies of circulation. The settlers were first Europeans (Portuguese, in more substantial numbers, but also Genoese, Venetians, Flemish, and French) and then enslaved Africans from the Canary Islands, the Maghreb, Senegambia, and the Gulf of Guinea (in the case of Brazil, already populated, we must also include the enslavement of indigenous peoples).

These colonization strategies had distinct environmental consequences. Therefore, we have chosen a representative from each colony type to demonstrate these differences. For the colonies of circulation, we took the Maghreb cities occupied by Portugal. For colonies of production, we chose the Madeira archipelago. The choice of these examples is justified by the precocity of the Portuguese presence in both regions; the fact that they are relatively close (the distance between Madeira and the city of Safi, for example, is only 727 kilometers), thus sharing many ecological characteristics; and because they are coetaneous experiences.

In the first case, the permanent conflicts between the Portuguese and the Maghreb led to the abandonment of cultivated fields, the reduction of the agricultural frontier, and even the return of wild animals to the outskirts of the cities. Meanwhile, in the Atlantic islands, particularly Madeira, deforestation occurred at unprecedented speeds, exotic species were introduced with severe consequences for the local ecosystem, and rapid soil degradation was promoted.

# 1. ENVIRONMENTAL CONSEQUENCES OF COLONIES OF CIRCULATION: THE CASE OF MAGHREB

Unable to control the fields around the Maghreb towns, the Portuguese used their fortifications as a base for military attacks and raids. For the nobles, organizing small expeditions to plunder Maghrebian peasants and caravaneers was an act of bravery in keeping with the long tradition of the *Reconquista* and the anti-Muslim spirit. In addition, the raid economy ensured the necessary supplies for the towns. In a state of permanent precariousness, the theft of livestock, the pillaging of villages, and the capture and enslavement of peasants and nomads proved indispensable tools for the Portuguese's survival.<sup>7</sup>

This permanent state of war (interrupted here and there by ever-fragile and changing alliances) triggered vast waves of migration. Many inhabitants of the Maghreb coast fled inland to escape the conflict zones. Several documents attest to the underpopulation of the coastal plains. By 1529, Portuguese settlements in the Maghreb were already showing signs of the crisis that led to the abandonment of most towns in the early 1540s. The Duke of Braganza, D. Jaime,<sup>8</sup> wrote a long letter to King D. João III criticizing the planned conquest of the Kingdom of Fez and denouncing the main weaknesses of Lusitanian colonialism in the region. It is an eloquent document that summarizes not only the military difficulties but also the problems of access to natural resources and political control of the territory.

The Duke begins by asserting that “there are not enough captains” to wage war and that, for this reason, it is necessary to review priorities to “increase spending on constructions”.<sup>9</sup> He suggested limiting the defense of towns to infantrymen and avoiding as far as possible chasing Maghrebin knights into the interior, as “this is the thing in which they [the Portuguese] are most in danger [...] and they are only saved miraculously”.<sup>10</sup> The Duke also drew attention to the high price of firewood and coal in the Maghreb, arguing that it was preferable to “bring by sea” from Spain or

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<sup>7</sup> For a history of the Portuguese presence in Morocco, cf. ROSENBERGER 1993; FARINHA 1999; GODINHO 2008.

<sup>8</sup> He was the leader of the troops who conquered Azemmour in 1513, enabling the fortress to be built in the town.

<sup>9</sup> “[...] porque para fazer mais gerra nom a hi tamta abastamça de capitães, [...] e por iso he de ver que nesta mudança nom se ajão de ffazer mais gastos d’obras do que são os das pagas [...]”, CÉNIVAL *et al.* 1934, t. II, Seconde Partie: 446.

<sup>10</sup> “[...] he cousa em que mor periguo se poem, porque cada dia som jugados aos dados, e nom se salvão senão mylagrosamente [...]”, *ibid.*: 446.

the Algarve.<sup>11</sup> At the heart of the Duke of Braganza's criticism was the apparent inability of the Portuguese to conquer the Kingdom of Fez, as they had neither the financial resources nor the number of men needed to populate the country's interior.

And because I have now touched on [the subject of the] conquest, I want to say two words here. They are these: it seems to me that the King of Portugal is not powerful enough to finish the conquest of the Kingdom of Fez, only if he had so much money that he could bring fifty or sixty thousand men from the other cape [that is, from the Iberian Peninsula], with their families moved to settle, and going on winning and building and settling everything together. It is my opinion that it cannot be done any other way because from Fez to the sea, there are thirty leagues unpopulated [...]. It would be necessary, as soon as they began to populate the interior, for there to be so many people in the province that they could resist any siege or gathering of the Moors that might come. As soon as he began to put his hand to it, the conqueror should not abandon it until he had finished and settled and established everything.<sup>12</sup>

In a rare moment of frankness, the Duke of Braganza declared to King João III that this project of conquest and colonization "could be carried out by the King of Castile".<sup>13</sup> The Duke also regretted that the previous monarch, D. Manuel I, had prevented Fernando of Aragon from conquering Tétouan<sup>14</sup> and argued that Ceuta and Alcácer Ceguer should be entrusted to the care of the Grand Master of the Order of the Hospital.<sup>15</sup> "Ceuta and Alcácer, according to the information one has available, produce no other fruit than to receive many attacks and deaths of people and captains, and

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<sup>11</sup> "E pera lenha, de Castela e do Algarve se pode aver, ou carvão, que muytos lugares a hy em Espanha que a tem menos, e a ão mais cara do que lhe custara a eles trazida por mar", *ibid.*: 446.

<sup>12</sup> "E porque agora toquey na conquista, quero dizer aquy duas palavras, e som estas: que me parece que o rrey de Portugal nom he poderoso pera acabar a conquista do rreyno de Feez, senom se tivese tanto dinheiro que pudese trazer d'outro cabo cinquenta ou sesenta mil homens, com suas casas movidas para pavar, e imdo ganhando e edefficando e povoando tudo junto. E de meu conselho se nom pode ffazer d'outra maneyra, porque de Feez ao mar ha trinta legoas de despavoadado [...]; e avia mester, loguo que começassem a povoar no sartão, que ouvesse na provimçia tanta gemte que pudessem rregistir a qualquer cerco ou ajuntamento dos Mouros que viesse; e o conquistador como começasse a por mão nyso, nom na alevamtar ate acabar, e asemtar e fazer chãa de todo", *ibid.*: 449.

<sup>13</sup> "o pode ffazer o rey de Castela", *ibid.*: 449.

<sup>14</sup> "[...] por iso me pesou muito de voso pay [D. Manuel] nom dar licenã para se tomar Totuão a el Rey voso avoo [D. Fernando d'Aragon]", *ibid.*: 448.

<sup>15</sup> "Camto a se dar ao Mestre [from the Order of the Hospital], nom tenho eu duvida senom quere-lo ele tomar [...] Eu de boa vontade lhe darya Çeita e Alcacer [...]", *ibid.*: 449.

the lands of the hinterland, which surround them, are all mountainous and of little use".<sup>16</sup>

D. Jaime's critique focuses on the fundamental contradiction of the colonies of circulation. The few Portuguese troops did not directly control production and were constantly weakened. In the long term, one-off military victories were no longer enough or were largely Pyrrhic victories. The fields around towns affected by war and raids became a no-man's-land. Without the security to continue their crops, farmers abandoned the land, allowing wild animals to return.

Moroccan historian Ahmed Bouchareb was one of the first to link the presence of wild animals, particularly lions, and the demographic crisis caused by war, emigration, and epidemic famine.<sup>17</sup> However, he does not see that the wars and raids were closely linked to the colonization strategy implemented in Maghreb. Let's look at a few examples.

In 1519, the bishop of Safi, D. João Subtil, organized a hunting expedition near Azemmour for his amusement. The result of this expedition was as follows: "Eighty pigs were killed, as well as huge wild bulls, gazelles, and partridges [...], and on another day, near the river, more than a hundred pigs died [...]"<sup>18</sup>

In 1527, the nobleman Antonio Leyte wrestled a lioness on the outskirts of Mazagan.<sup>19</sup> He used this story to prove to the King his courage and value. These hunts and battles with wild beasts fuelled the cavalry spirit of Portuguese nobles. The beasts served to amuse the aristocrats, and tales of their pursuits served as proof of their worth as brave warriors.

Because it seems to me that Your Highness would like to know about heroics and bravery and the people who do them, I want to tell you about what I saw a man in my company do to a lioness. I heard that a big lioness was walking nearby, and she had two giant cubs with her; one day, they ate a bunch of cats, and my men came to tell me, so I searched for the lioness. And I found them in a large bush, and there were nine men on horseback with me, and we surrounded her. The great lioness rose with great ferocity and with great roars, and a man called Antoneo Rodriguez was carrying a crossbow and shot at her. The lioness went after him, caught up with him, and took him by the horse's hips with her front

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<sup>16</sup> "Çeita e Alçaçer nom fazem outro fruyto, segundo a enfformação que homem tem, senom rreçeber muytas afrontas e mortes de gentes e de capitães; e a terra do sertão, que confyna com eles, he tudo serra e de pouquo proveito", *ibid.*: 450.

<sup>17</sup> BOUCHAREB 1988: 501.

<sup>18</sup> "[...] oyenta porcos se mataram e touro brabo muito grande e gazelas e perquispes [...] e outro dia pello rryo morreram mais de cem porcos [...]", CÉNIVAL *et al.* 1934, t. II, Seconde Partie: 253.

<sup>19</sup> *Ibid.*: 389-390.

paws and mouth, and the man gave her a cut with the sword in one paw from atop the horse. But she didn't go limp, and the lioness knocked him off his horse with the strength of her arms, and the man fell. From the fall, he hit his head on a rock, immediately got up with his sword, and went towards the lioness. The lioness, although brave, feared him and turned around howling. The man stood up with his sword in his hand, which was the best thing, in my opinion, that a man could do [...] It was the bravest beast I'd seen here, and yet it died; and of the many, I've killed here, I've never seen another so courageous, nor so big and fast.<sup>20</sup>

Other authors from the late 15<sup>th</sup> and 16<sup>th</sup> centuries considered the presence of lions to be either a cause or a consequence of population reduction. According to the German printer, known in Portugal as Valentim Fernandes, Portuguese attacks on the Maghreb coast in the first decade of the 16<sup>th</sup> century led the inhabitants of Anfa to abandon the town. Although beautiful and endowed with rich buildings, this once mighty city, he writes, is now "inhabited by beasts and lions".<sup>21</sup> The cosmographer and marine expert Duarte Pacheco Pereira refers to a village in the valley of the Salé River called al-Mansur (*villa dalmancora*), located seven leagues from the coast. According to the author, "it is said that the lions depopulated and destroyed it because they ate so many of its inhabitants that the few who remained fled and went to live elsewhere".<sup>22</sup> In the forest near Mahmora (Ma'mūra), according to the Pope's geographer Leo Africanus, "the danger from lions is great. These animals most often devour animals

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<sup>20</sup> "Porque me parece que V. A. levava gosto de saber de ombridades e valentias e pessoas que has fazem, lhe quero dar conta de hũa que ora aqui vy fazer a hum homem em minha companhia com hũa lioa. Eu soube que hũa grande lioa andava perto d'aqui e trazia consigo dous filhos ja grandes, e hum dia cevaram-se em hum fato de gato e vyerão-m'o dizer, e eu fui em busca d'ella. E acheio-os em hum grande mato, e erão comigo nove de cavalo, e rrodeamola, e a lioa grande ergueo-se com grande ferocidade e com grandes urros, e hum homem que ha nome Antoneo Rodriguez trazia hũa besta e tirou-lhe, e ha lioa saio apos elle e alcançouho, e tomou-o pollas ancas do cavalo com as mãos e com ha boqua, e ho homem lhe deu de cima do cavalo hũa cutelada com ha espada per hũa paa de que não ficou manqua, e a lioa derribou-lhe o cavalo com ho pesso dos braços, e o homem caio, e da queda deu ainda com ha cabeça em hũa pedra, e alevantou-se prestes em pee com a espada na mão e deu ao andar pera a lioa, e há lioa com quanto brava estava ho rreceu, e se virou urrando, e ho homem ficou em pee com a espada na mão, que foi a milhor sorte, a meu ver, que homem podia fazer, [...] Foi a mais braba alymaria que eu aqui vy, e comtudo morreo; e de muytos que aqui ja matey não vy outro tal de braba, nem tamanha e ligeira", *ibid.*: 389-390.

<sup>21</sup> "Anaffe cidade despouorada de fremosos edificios e muy fremosa e de boom parecer E foy em outro tempo muy poderosa e agora he fecta habitaçam de bestas feras e lyões [...]", FERNANDES 1997 [1507]: 7.

<sup>22</sup> "Item; Jaz o Rio de Calle & a Villa dalmancora nornordest & susuduest & tem sete leguas na Rota & este castello dalmancora dizem que os Lioões ho despouoaram & destroirom por que comerom tanta gente delle que alguma pouca que ficou fugio & foy uiuer em outras partes", PEREIRA 1892 [1506]: 27.

and people who are not used to them because the lions of this forest are the most ferocious there are in the whole of Africa".<sup>23</sup> Further on, the author corrects himself: it's in Teflefelt,<sup>24</sup> a small town fifteen miles east of Mahmora, where we find "extremely ferocious lions, even worse than those I mentioned above".<sup>25</sup> On the other hand, the lions of Agla were known to be "so cowardly by nature that even children frighten them by screaming and put them to flight".<sup>26</sup> In the streets of Fez, a saying could be heard: "You're as brave as the lions of Agla, whose tails the calves eat".<sup>27</sup>

Lions play an important role in Morocco's history. As early as Roman times, they were exported to entertain the empire's citizens in circuses and coliseums. Centuries later, especially from the 17<sup>th</sup> century onwards, the lion became a symbol of strength and authority for Maghrebian sultans. But before that, the lion appeared linked to the miraculous powers of saints and pious men in popular veneration. The Berber hermit Abū 'Izza is said to have taken a lion by the ear, showing the people of Fez that there was nothing to fear. Similarly, the great sūfī Abū Madiān is said to have domesticated a lion.<sup>28</sup> Leo Africanus, speaking about the city of Thagia (Berber name for Mūlāy Būa'za) in the Atlas Mountains, says that "[a]round the city, admirable forests are the lair of furious lions".<sup>29</sup> A local saint was renowned for "numerous miracles against the lions".<sup>30</sup> Leo Africanus himself claims to have been "endangered by lions" in the same region.<sup>31</sup>

Throughout the 16<sup>th</sup> century, wars and famine crises led to a sharp drop in the Maghreb population, increasing the presence of wild animals near human settlements. We raise this subject to support the hypothesis that the colonization of circulation developed in the Maghreb has favored (although

<sup>23</sup> "[...] le danger des lions est grand. Ces animaux dévorent le plus souvent bêtes et gens qui ne sont pas habitués à eux parce que les lions de cette forêt sont les plus féroces qu'il y ait dans toute l'Afrique", LÉON L'AFRICAIN 1980 [1550]: 172.

<sup>24</sup> The location of this village is inaccurate. It indeed doesn't correspond to Tiflet, whose creation is more recent. Cf. note 82, *ibid.*: 175.

<sup>25</sup> "[...] des lions extrêmement féroces, pires encore que ceux dont j'ai parlé ci-dessus", *ibid.*: 175.

<sup>26</sup> "[...] tellement couards par nature que même les enfants leur font peur en criant et les mettent en fuite", *ibid.*: 257.

<sup>27</sup> "Tu es courageux comme les lions d'Agla auxquels les veaux mangent la queue", *ibid.*: 257.

<sup>28</sup> ROSENBERGER 1997.

<sup>29</sup> "[a]utour de la ville, d'admirables forêts sont le repaire de lions furieux", LÉON L'AFRICAIN 1980 [1550]: 168.

<sup>30</sup> "[...] de nombreux miracles contre les lions", *ibid.*: 168.

<sup>31</sup> "en péril à cause des lions", *ibid.*: 168.

it cannot be considered the only factor) the recrudescence of wildlife to the detriment of areas cultivated by man.

The presence of these wild beasts resulted from a form of colonization in which land occupation was restricted because the Portuguese failed to control agricultural production, as they did not directly subdue the local populations. When alliances with the Portuguese no longer met the demands of the Maghrebian rulers, entire villages were easily displaced, and fields were abandoned.<sup>32</sup> The Portuguese launched attacks and raids to re-impose their authority, creating a permanent climate of war that agricultural activity could not withstand. This dynamic is characteristic of colonies of circulation. This is why the environmental consequence of this colonization strategy was, to a large extent, the reduction in arable land and the return of large wild mammals, such as wild boar, deer, and especially lions.

This is a very different environmental consequence from that observed in colonies of production, where the ecological impact of colonization has been much more severe, this time to the detriment of nature.

## 2. ENVIRONMENTAL CONSEQUENCES OF COLONIES OF PRODUCTION: THE CASE OF MADEIRA

The extensive occupation and agro-export economy that defined the colonies of production generated diametrically different environmental consequences to those created by the colonies of circulation. Whereas the Maghreb under Portuguese occupation saw the decline of cultivable areas and the advance of wild animals, the islands of Macaronesia witnessed the rapid advance of the agricultural frontier, leading to the destruction of the original fauna, the consumption of the forest and the degradation of the soil.

Of all these archipelagos, Madeira is the most significant for the period under study.<sup>33</sup> The toponymy sums it up poetically: in Portuguese, *Madeira* means wood, revealing the importance of this commodity in the early years of colonization. It was the first group of islands to be discovered and occupied and the world's leading sugar producer and exporter between 1480 and 1522. We will therefore focus our analysis on Madeira while drawing attention to the fact that the ecological crisis of this ecosystem in

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<sup>32</sup> On the delicate diplomacy between Portuguese colonial agents and local Maghreb powers, cf. MALECHA TEIXEIRA 2023.

<sup>33</sup> For a history of Portuguese colonization of Madeira, cf. MOORE 2009; RILEY 1998; VIEIRA 1990; VERLINDEN 1960.

the 1520s (caused by the planting of sugar cane) was reproduced identically in São Tomé in the 1570s and Pernambuco, Brazil, in 1640.<sup>34</sup>

The Venetian traveler Ca' da Mosto, writing in the 1450s, tells us that when the island of Madeira was conquered in 1420, "there was not an inch of land that was not covered with immense trees".<sup>35</sup> A century later, the situation was completely reversed. In the 1570s, the great poet Camões claimed that the forests that gave Madeira its name no longer existed:

We passed the great Island of Madeira,  
Called such for its many stats of trees,  
The first of the islands we populated,  
More famous for its name than for its glory [...] <sup>36</sup>

The entire ecosystem has been altered and compromised in less than two centuries. The production of colonial space was at the expense of nature. Chroniclers and travelers have preserved a sort of "origin myth" of Madeira: the first settlers set fire to the forest, making way for agriculture. Ca' da Mosto describes this episode as follows:

The island of Madeira, or Isle of the Woods, takes its name from the fact that when the lord's sailors discovered it, no inch of land was uncovered with immense trees, so much so that the first inhabitants had to set fire to it. The fire burned so long and with such force that Governor João Gonçalves Zarco, his wife and children, and all those on the island had to escape the fury of the flames and certain death by taking refuge in the sea for two days and two nights, without eating or drinking, and up to their necks in water. They had to cut down many of these trees to be able to plow the land.<sup>37</sup>

Writing nearly fifty years later, Diogo Gomes exaggerates the episode. While Ca' da Mosto claims that the fire lasted two days and two nights, Gomes asserts that it lasted nine years.

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<sup>34</sup> MOORE 2009: 353.

<sup>35</sup> "[...] il n'y avait pas un pouce de terre qui ne fût couvert d'arbres immenses", CA' DA MOSTO 1994 [1455-1456]: 31.

<sup>36</sup> "Passamos a grande Ilha da madeira, / Que do muito aruoredo assi se chama, / Das que nos pouoamos, a primeira, / Mais celebre por nome que por fama: [...]", CAMÕES 1916 [1576]: 270.

<sup>37</sup> "L'île de Madère ou île des Bois tire son nom de ce que, quand elle fut découverte par les marins du seigneur, il n'y avait pas un pouce de terre qui ne fût couvert d'arbres immenses, au point que les premiers habitants durent y mettre le feu. Ce feu brûla si longtemps et avec une telle force que le gouverneur João Gonçalves Zarco, sa femme, ses enfants et tous ceux qui étaient sur l'île, durent pour échapper à la fureur des flammes et à une mort certaine, se réfugier en mer pendant deux jours et deux nuits, sans boire ni manger, avec l'eau jusqu'au cou. Ils doivent abattre une grande partie de ces arbres pour pouvoir labourer la terre", CA' DA MOSTO 1994 [1455-1456]: 31-32.

[...] But when the knights wanted to know the soil quality under the hay and leaves, whether fertile or barren, they set fire to the hay and leaves on the ground.

The fire grew so great that the houses and everything burned down. Men and women had no other remedy than to get up to their necks in water, and even then, they thought they would burn to death. [...] And they say that the island burned constantly for nine years because the fire was impossible to put out due to the large mass of leaves that had accumulated for so long.<sup>38</sup>

Despite the differences between the accounts, the authors converge on a narrative of the origin of Madeira's occupation by a "baptismal fire"<sup>39</sup> Whether the first fire lasted two days or nine years, the fact is that fire was the form by which the archipelago's forests were systematically destroyed to make way for agriculture. "Madeira's deforestation was, in other words, registered not only in the physical landscape; it was also inscribed in the collective memory of how this landscape was formed"<sup>40</sup> This myth of origin, therefore, converges to explain the rapid and unprecedented deforestation.

The fires not only caused the disappearance of the forest but also transformed Madeira into a timber importer. Valentim Fernandes expresses his awareness of the relationship between sugar cultivation and the lack of wood on the island in the 1500s.

This island was entire of giant trees, thick and so tall that they reached the sky / And all the wood they cut down no longer grows / And so if this sugar trade is lost, it will be because of the firewood that, after the one born here is finished, they will have to bring in from outside, which will be done at high cost and expense, etc. // <sup>41</sup>

The forests were not simply burned down. Wood was a vital export product for construction, furniture production, barrels, and ships. In this

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<sup>38</sup> "[...] Porém desejando o cavaleiro saber a qualidade da terra que estava sob o feno e as folhas de arvore, se era fértil ou estéril, incendiaram feno e folhas que estavam pelo chão. / Cresceu o fogo, e de tal sorte se fez grande, que as casas com tudo o tinham arderam. Homens e mulheres não tinham outro remédio senão meter-se em água até o pescoço, e ainda assim julgavam morrer queimadas. [...] E dizem que durante nove anos a ilha ardeu sempre, porque o fogo era impossível de apagar por causa da grande massa de folhas, que por tanto tempo se tinha acumulado", GOMES 1889 [1507]: 27.

<sup>39</sup> MOORE 2009: 351.

<sup>40</sup> *Ibid.*: 351.

<sup>41</sup> "Esta ilha era chea de grandíssimo arvoredado grosso e basto e tam altos que sayam aos çeos / E quanta madeyra cortam nom naçe mais / E por yssso se este tracto de açúcar se ha de perder ha de ser pella lenha que despois de acabada esta que aqui nação lha ham de trazer de fora pello qual se fara com grande custa e despesa etc. // ", FERNANDES 1997 [1507]: 141.

sense, between 1420 and 1450, Madeira's economy was entirely oriented towards exporting timber and cultivating cereals in the areas opened up by deforestation. This allowed the first settlers to profit from the timber trade, while agricultural production was not lucrative. This strategy was later reproduced in São Tomé and Brazil.<sup>42</sup>

The significant export of wood from the islands compensated for the chronic shortage of this product in the Kingdom (the result of centuries of intense deforestation). Throughout the 15<sup>th</sup> century, while much forest was still available in Madeira, wood was sold at low prices in Portugal, thus cheapening the costs of civil and naval construction. These lower costs made Madeira sugar even more competitive on the world market.<sup>43</sup>

Ca' da Mosto describes the production of furniture on the island as early as the 1450s:

Along these waterways, there are sawmills where woodwork and all kinds of planks found in Portugal and elsewhere are permanently manufactured.

Among these woods, there are two that are particularly prized: the first is cedar wood, highly fragrant and similar to cypress, which is used to make beautiful long, wide planks, crates, and other structures; the second is yew wood, which is also used to create beautiful pieces of reddish color.<sup>44</sup>

Gaspar Frutuoso, in his chronicle on the islands, evokes the importance of Madeira's forests for developing the Kingdom's naval industry. He establishes a direct relationship between the development of a greater variety of vessels and the wood extracted from the islands.

And on the island, there was such a quantity of wood, so beautiful and hard, that they took copies of boards, beams, and masts to many parts, all of which was sawn with mills or water saws, of which there are still many today in the northern part of the same island: and at this time, because of the tremendous amount of wood that they took from there to the Kingdom, they began to make ships with crow's nest and forecastles out of it, because before there were none in the Kingdom, nor did they have anywhere to sail to, nor were there any ships other than caravels from the Algarve, and balingers in Lisbon and Oporto.<sup>45</sup>

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<sup>42</sup> MOORE 2009: 354-355.

<sup>43</sup> *Ibid.*: 355.

<sup>44</sup> "Le long de ces cours d'eau, on trouve des moulins à scier où l'on fabrique en permanence des ouvrages de bois et toutes sortes de planches qu'on trouve au Portugal et ailleurs. / Parmi ces bois, il en est deux qui sont particulièrement prisés: le premier est le bois de cèdre, fort odorant et semblable au cyprès, dont on fait de très belles planches longues et larges, des caisses et d'autres ouvrages; le second est le bois d'if, avec lequel on fabrique également de très belles pièces, d'une couleur que tire sur le rouge", CA' DA MOSTO 1994 [1455-1456]: 32.

<sup>45</sup> "E na ilha havia tanta quantidade de madeira tão fermosa e rija, que levavam para

The deforestation of Madeira to grow sugar cane marks an essential break in the relationship between humans and the forest. Medieval Mediterranean sugar production also involved deforestation. However, the speed of this process could be measured in centuries, whereas in Madeira, it was a matter of decades. In 1452, the island exported relatively little sugar. By 1490, it was already Europe's leading producer, overtaking Sicily and Cyprus. Fueled by investments from Genoese and Flemish merchants and cultivated by enslaved Canarian and later African labor, sugar production grew *pari passu* with deforestation. By 1510, 160 km<sup>2</sup> of forest had already been cut down, equivalent to almost a quarter of the island and half of the accessible forest. Only twenty years after the beginning of the sugar crop, in 1472, Madeira was already exporting 280 tons, rising to an impressive 2500 tons in 1506. The crisis was as dizzying as the rise: by 1530, exports had fallen to the levels of 1472.<sup>46</sup> How can we explain this rapid cycle of rising and falling production?

The rich volcanic soil of the island of Madeira guaranteed the fertility of the land. Ca' da Mosto affirms that "its lands [are] rich and fertile; although it is as mountainous as Sicily, it does not fail to be fertile and produces 30,000 *staio*<sup>47</sup> of Venetian wheat every year, sometimes more, sometimes less".<sup>48</sup> However, the Venetian traveler observed the soil's rapid exhaustion even then: "Its land used to yield 60 to 70 *staio* per field, but now it only yields 30 to 40 *staio* because the land is running out every day".<sup>49</sup> The ash from burning forests was used to renew soil fertility, but its effect was short-lived. Once the nutrients were fully absorbed, new inflows of ash fertilizer were needed, increasing the demand for more forest burning.<sup>50</sup>

Madeira is not located in the tropical zone. So, unlike São Tomé and Brazil, which had a hot and humid climate suitable for growing sugar, it was necessary to redirect water from the rivers to sustain its plantations. The

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muitas partes copia de taboas, traves, mastros, que tudo se serrava com engenhos ou *serras d'agoa*, dos quaes ainda hoje ha muitos da banda do Norte da mesma ilha: e neste tempo, pela muita madeira que dahi levavam para o Reyno, se começara com ella a fazer navios de gávea e castello d'avante, porque dantes não os havia no Reyno, nem tinham para onde navegar, nem havia mais navios que caravellas do Algarve, e barineis em Lisboa e no Porto", FRUCTUOSO 1873 [1590]: 65.

<sup>46</sup> MOORE 2009: 351-352.

<sup>47</sup> An old measure of grain capacity, ranging from about 150 to 300 liters.

<sup>48</sup> "[...] ses terres [sont] riches et fertiles; bien qu'elle soit aussi montagnaise que la Sicile, elle ne laisse pas d'être féconde et produit chaque année 30.000 setiers de froment vénitien, parfois plus, parfois moins", CA' DA MOSTO 1994 [1455-1456]: 32.

<sup>49</sup> "Son terroir rendait jadis 60 à 70 setiers par terrain, mais il n'en rend plus que 30 à 40 parce que les terres s'épuisent de jour en jour", *ibid.*: 32.

<sup>50</sup> MOORE 2009: 356.

mountainous topography favored developing an irrigation system through canals, still known today as *levadas*. Their construction dates back to the 1430s and 1440s. Taking advantage of the fluctuating altitudes, especially in the southern part of the island, a gigantic system of canals was created that is unparalleled worldwide. Today, the remaining *levadas* stretch for 2100 kilometers, which is particularly surprising on an island where the distance between the easternmost and westernmost points is only 50 kilometers.<sup>51</sup>

Gaspar Frutuoso attributes the construction of the first *levada* in the town of Santa Cruz, in the captaincy of Machico, to a certain Raphael Catanho, a Genoese, at an uncertain date. The canal was between 4.5 and 5 leagues long and cost more than 100,000 *cruzados* because it crossed mountains and depressions.

To irrigate the sugar cane plantation in this town [...], a *levada* of water was built so far away that from the place where it rises to the town, it measures four and a half leagues or close to five, on which more than a hundred thousand *cruzados* were spent, because it traverses great mountains and depressions [...]. Raphael Catanho, a Genoese [...], was the first to begin to draw this water, and then the King ordered it to be carried out: and, because of its high cost, it is no longer used.<sup>52</sup>

It can be seen, therefore, that the canals also ran out and soon dried up. The cultivation of sugar cane was devastating, consuming the forest, the rivers, the soil, and the enslaved workforce. The chronology of this crisis is still a matter of debate. We can retain the decades between 1516 and 1537 as the period of rapid decline. However, as we have seen with the quotes from Valentim Fernandes, signs of the exhaustion of the soil and the rarity of available wood could already be seen in 1507. By the 1530s, sugar production had fallen to the same levels as in the 1470s. The rapid decline in sugar production in Madeira was not the result, as some authors have claimed since the 19<sup>th</sup> century, of competition with São Tomé or the Canaries. In 1529, São Tomé produced no more than 80 tons of sugar. It was primarily an agroecological problem, combined with climate change on the island (caused by deforestation), a labor shortage, and, to a lesser extent, competition from other production centers.<sup>53</sup>

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<sup>51</sup> *Ibid.*: 356; VIEIRA 1994: 51.

<sup>52</sup> “Para se regarem canas de assucar nesta villa [...], se tirou huma levada d’agoa de tão longe, que do logar onde nace até a villa serão quatro legoas e meya ou perto de cinco, na qual se gastaram mais do cem mil cruzados, por vir de grandes serras e funduras; [...]. *Raphael Catanho*, genoes, [...], foi o primeiro que começou a tirar esta agoa, e depois El-Rey a mandou levar ao cabo: e, pelo muito custo que fazia, já se não usa”, FRUTUOSO G. 1873 [1590]: 78.

<sup>53</sup> MOORE 2009: 359-360.

As well as deforestation, depletion of the soil, and alteration of Madeira's hydrology, Europeans were also responsible for introducing alien species to the archipelago, causing a severe imbalance in the local biota. Over the decades, the settlers brought cattle, pigs, and sheep to Madeira, Deserta, and Porto Santo (all part of the same archipelago). About Madeira, Ca' da Mosto says it was "abundant in meats"<sup>54</sup> and about the island of Porto Santo, he states that "it abounds in cattle and wild boars and is teeming with rabbits".<sup>55</sup>

The case of the Porto Santo's rabbits is paradigmatic for analyzing the impact of colonies of production on the environment. According to the chronicler Gomes Eanes de Zurara and Valentim Fernandes, in 1420, Prince Henry the Navigator granted permission for Bartolomeu Perestrelo – an Italian navigator from Piacenza and father-in-law of Christophe Colomb – to start breeding rabbits.

[...] When they had all their things ready, they set off for the said island [Porto Santo]. And it was agreed that among the things they would take with them to launch on the said island would be a rabbit, which had been given to Bartolomeo Perestrelo by a friend, the rabbit being pregnant in a cage. She gave birth in the sea, so they all arrived at the island. And while they were lodged in their huts organizing their homes, they let the rabbit loose with her young to breed, who very soon multiplied so much that they overcrowded the land so that they couldn't sow anything that the rabbits wouldn't spoil [...] for which reason the men left that island, and went on to the other of Madeira [...].<sup>56</sup>

What could have been the start of profitable production turned into an ecological hecatomb. The rabbits reproduced rapidly and got out of control, consuming all the island's plants and making the land uncultivable. Both Zurara and Fernandes agree that this was why the Portuguese favored colonizing the island of Madeira (and started growing sugar there) over Porto Santo.

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<sup>54</sup> "[...] abonde en viandes [...]", CA' DA MOSTO 1994 [1455-1456]: 34.

<sup>55</sup> "[...] abonde en bœufs et sangliers et pullule de lapins", *ibid.*: 30.

<sup>56</sup> "[...] os quaaes tendo todas suas cousas prestes, partiram vyagem da dicta ilha [Porto Santo] E acertousse que antre as cousas que levavam consigo pera lançarem na dicta ilha, assy era hũa coelha, aqual fora dada ao Bertollameu Perestrelo per huũ seu amigo, indo a coelha prenhe em hũa gayolla; e acertousse de paryr no mar, e assy levarom todo aa ilha. E sendo elles alojados em suas cabanas pera ordenarem suas casas, soltarom aquella coelha com seus filhos pera fazer criaçom, os quaaes em muy breve tempo multiplicarom tanto, que lhe empacharom a terra, de guisa que nom podyam semear nhũa cousa que elles nom stragassem [...] por cuja rezom leixarom aquella ilha, e passaramse aa outra da Madeira [...]", AZURARA 1841 [1456]: 386-387.

In 1420, Prince D. Henrique ordered Bartolomeu Perestrello to return to the island of Porto Santo to populate it / with many rabbits. Because of this, it was no longer possible to plow the land / And so, because there was no water and the land itself was barren, they didn't work it as much as on the island of Madeira, but they raised many cattle and collected a lot of dragon's blood<sup>57</sup> // .<sup>58</sup>

The examples mentioned here for the island of Madeira can also be seen in the other colonies of production. The ecological crisis directly results from the commodification of nature and the organization of large-scale production for export. The speed with which sugar plantations destroyed Madeira's ecosystem contrasts with the slower exhaustion of Cyprus or Sicily. In Madeira, exhaustion resulted from decades of cultivation, while it took centuries in the Mediterranean.

## CONCLUSION

Environmental history, as it has been studied over the past four decades, firmly establishes a clear correlation between colonialism and alterations in the management of natural resources. Scholars have examined specific instances to illustrate this correlation and have subsequently extrapolated generalizations to delineate the environmental history of colonial endeavors. In our article, we have chosen a comparative approach, elucidating how different contemporary colonization strategies yield disparate environmental outcomes. We have devised a framework for categorizing these strategies, placing a significant emphasis on the organizational dynamics of economy and spatial management.

The production of goods determined how colonial space was produced. As trade was the main economic activity in the Maghreb and the other African trading posts, the interventions in space involved building structures to protect the circulation of commodities. Wars and raids to enforce political domination and the Portuguese commercial monopoly in these regions led to a reduction in cultivated areas, allowing wild animals to return to the vicinity of the cities. On the islands of Macaronesia, on the other hand, where Portuguese colonization was interested not only in

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<sup>57</sup> It is a bright red resin which is obtained from different species of several plants *Calamus* genus.

<sup>58</sup> "Anno de 1420 mandou ho Jffante dom Anrrique tornar aa ylha do Porto Sancto a Bertolomeo Perestrello pello pouorar a dita ilha / pero com a multidão dos coelhos e por cuja causa se nom pode nella fazer laura / E assi pera (sic) nom auer agoas e terra em sy ser steril nom se fez tanta obra nella como em a ylha de Madeyra porem criam se nella muytos gaados e apanham nella muyto sangue de dragam //", FERNANDES 1997: 145.

trade but also in the production of goods, the ecological impact was the opposite. Nature was the object of conquest, commodified, and consumed to exhaustion through production.

In the Madeira archipelago, the successful implementation of a colony of production led to the destruction of its ecosystem. It was the success of the commercialization of timber, the cultivation of sugar, and the introduction of non-native species contributed to the depletion of soil fertility, water resources, and extensive deforestation. Conversely, in the Maghreb region, as elucidated through the testimony of the Duke of Braganza, the technical impracticability of outright conquest of the entire Kingdom of Fez (in other words, turning the region into a production colony) necessitated the adoption of a colonization strategy circumscribed within the domain of circulation. In order to render this strategy feasible, it became imperative to quell resistance from the Maghreb populace and, concurrently, capitalize on trade and opportunistic raids. The abandonment of arable fields and the return of wild animals was therefore a result of the difficulties of colonizing the region.

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