PEOPLES, NATURE AND ENVIRONMENTS

Learning to Live Together

Edited by Ana Cristina Roque,
Cristina Brito and Cecilia Veracini

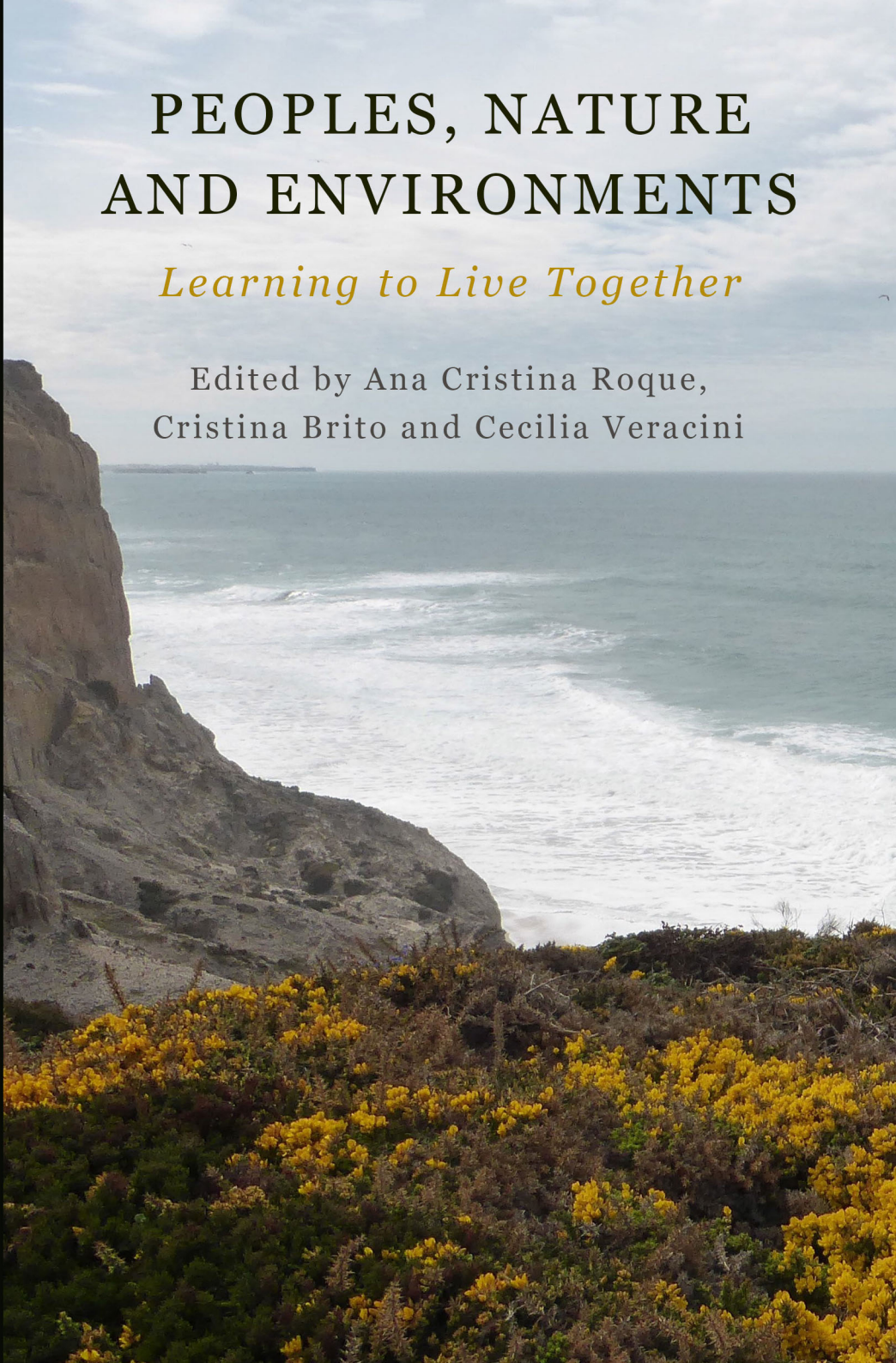

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TABLE OF CONTENTS

Part 3 - Policies, Management and Conservation

Part 4 - Landscape and Heritage

Part 5 - Science and Natural History

Scientific Commission

Amélia Polónia
Carlos Assis
Carlotta Mazzoldi
Cleia Detry
Elena Canadelli
Ermelinda Pataca
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Introduction

Peoples, Nature and Environments

Ana Cristina Roque, Cristina Brito and Cecilia Veracini

The deep and intrinsic interconnection between humans and the natural world is becoming part of the scientific and political agendas, as is the relevant role humankind has – and has had – on the changing of this complex array of equilibriums and relationships.

Since the dawn of humanity, survival has meant dealing with unpredictable natural situations and thus to experience and learn, to know and recognise the potential or diversity of resources that may be used and to adapt and create conditions that allowed such use in a variety of geographic spaces with different characteristics. This process determined specific forms of cultural adaptation to different environments and, consequently, an ensemble of anthropic impacts on natural communities. As a result, the human-nature relationship over time has become a privileged space in which knowledge, technique and science have developed, evincing the primacy of anthropogenic actions on nature.

This idea of nature encompassing an "extraordinary amount of human history" (Williams, 2005, 67) draws attention to the importance of historical and cultural imprints, justifying the emphasis on the dialogue between human, social and natural sciences, and the need for an interdisciplinary cross-cultural approach (e.g. Holm *et al.*, 2013; Kitch, 2017). All these aspects are essential to inform about the role of human beings, in the past and today, or about the role they may play in the future as an integral part of a broader dialogue with the nonhuman world.

The growing interest of the impact of humans on geological, biotic and climatic planetary processes is a sign of an important shift in how humans are coming to understand the relation with the environment. In the last decades, a growing number of scholars from different disciplines began to give great emphasis to the issues of historical interactions, connections and inter-dependency between peoples and the environment (e.g. Hornborg *et*

al., 2007; Hughes, 2001; McNeill & Steward Mauldin, 2015; Mosley, 2010; Nance, 2015, among others). Moreover, recent approaches to human-nonhuman animal interactions strive to re-examine traditional ethical, political and epistemological categories in the context of a renewed attention to and respect for animal life. In anthropology, a concern with new attitudes to understanding cross-species intersections characterises a recent 'multispecies ethnography' (Kirksey & Helmereich, 2010). Similarly, in history and literature, we are witnessing an 'animal turn' (e.g. Alves, 2011; Nance, 2015). As such, a critical reflection on the *status* of our planet, on human subjectivity and actions, and on their inextricable entanglement, is absolutely needed. In other words, we "need to re-frame global environmental change issues fundamentally as social and human challenges, rather than just environmental issues" (Pálsson *et al*., 2011, 5). Another take can be seen in the growing interest in recovering historical information (Roque, 2019) and in the recent animal and ocean turns as well as in the multiple and plural efforts within the environmental humanities (e.g. Haraway, 2008; Van Dooren, 2016; DeLoughrey, 2017; Veracini, 2017; Brito, 2019).

This book – *Peoples, Nature and Environments* – reflects some of these approaches. Bringing together contributors with different scientific backgrounds, perspectives and expertise related to these dynamics and interactions, it aims at exploring their joint potential for an innovative debate on this topic, surpassing the classic human/environment dichotomy and the separation between culture and nature (e.g. Haraway, 2008; Rose *et al.*, 2012; Richter, 2015; Kitch, 2017). The multiple aspects of this complex process of interaction are here addressed in an interdisciplinary and a long-term perspective.

Through multiple contributions informed by humanities, arts, social and natural sciences, the book deals with the way different disciplines approach this relationship. Interdisciplinarity or, as stated by Little (2017, 2), 'inter-humanities' – the interdisciplinarity within the humanities – is an objective of this book. This publication also points out the importance of relating diverse concepts and perspectives to enable a cross-cutting analysis and global perception of the human/nature interface throughout history. Moreover, it addresses the present concerns about our common future, reflecting humans' current commitment in a process of 'relearning' to live with nature.

By combining classic and innovative ways of examining the same theme in a variety of geographic spaces, the book also brings together contributions that merge traditional and scientific knowledge to better understand both the way humans have historically used nature for their

own benefit and the impacts of those same uses. Moreover, it joins authors at different moments of their careers, of different nationalities and genders, thereby broadening perceptions and providing different perspectives of analysis depending on specific cultural backgrounds and social contexts, thus contributing to stimulating a wide and innovative debate in the field of Environmental Humanities (Rose *et al.*, 2012; Little, 2017).

Peoples, Nature and Environments: Learning to live together is organised in five major parts, which mirror its title, and revolves around processes of the interactions of humans with other species; past climate and extreme events; environments, landscapes and human uses and impacts on nature; concepts and policies of management and conservation; and the memory, heritage, culture as well as history of science and natural history. In fact, the different chapters discuss transversally – across methods, subjects, geographies and time scales – how the natural world has been perceived, interpreted and manipulated by people, as well as the consequences of the secular exploitation of the different natural resources and the resulting current imbalances and major threats.

Part 1 – Learning to live together – is a reflection on how we have conceived human-nature relationships and human impacts on the natural world.

Patrícia Vieira brings an innovative approach to the way human beings relate to each other and to nonhumans with a holistic perspective and interspecies dialogue. She discuss theories of cosmopolitanism, embracing all human and nonhuman species, to delineate the notion of interspecies peace as an alternative to the current war of all against all – in a contest for the 'survival of the fittest' both individually and at the level of the species – that characterises most of our relationships with other living beings. This new perspective becomes more pressing when we consider the state of our planet and the effects of the 'war' which *Homo sapiens* is conducting against nature, other animals and himself. Telmo Pievani and Andra Meneganzin outline how the human species has become a dominant evolutionary force. Through a mix of different impacting activities (i.e. fragmentation of habitats, overpopulation, chemical pollution, invasive species, over-exploitation of resources in hunting and fishing), humans have produced the conditions for a serious extinction crisis. Therefore, it depends on us to solve the various problems and not to become the first 'self-endangered species' on Earth.

Part 2 – Climate and Environmental Changes – analyses aspects of this relationship from an historical perspective and from the point of view of

its close relationship with climate and environmental changes. It is unquestionable today that human actions have brought about major changes to the planet with a significant impact on many ecological systems. Yet, no less significant is the present need to be prepared to deal with climatic events with catastrophic consequences, which repeatedly affect a multiplicity of territories considered to be 'at risk'. In recent years we have witnessed a continuum of 'natural' disasters which, all over the world, evidence this need and make it urgent to develop and implement strategies to combat, avoid or minimise them. In this context, reconstructing the trend of climatic and environmental changes over time can be a powerful instrument to understand long term changes and impacts as well as human and nonhuman adaptations.

The contributions of this section bring us case studies from the Iberian Peninsula and Central America during the Little Ice Age (LIA). Cristiana Ferreira and her co-authors show how the climate was directly related to specific human activities in the Iberian Peninsula during the 17th century. Armando Alberola-Romá offers an historical approach to climate disasters in early modern Spain, showing the devastating effects of these extreme events in the past. Then, he and Luis Arrioja-Díaz Viruel, in a comparative study between Spain and the Spanish American colonies in the 18th century, demonstrate the unequivocal relationship between periods of intense rains, floods and earthquakes with production crises, famines, disease and epidemics.

Part 3 – Policies, Management and Conservation – provides an overview of the appropriation and use of different natural resources in different times and geographies, enhancing the importance of historical evidence to better address present-day conservation challenges. It includes chapters dealing with the impact of human activities on aquatic ecosystems during the European expansion, as well as on terrestrial ecosystems, especially in the chapters addressing the perception and conservation of animals and plants.

Ana Catarina Garcia tries to identify what types of occurrences were considered pollution acts and in which terms the idea of 'pollution' was understood through the analysis of two case studies of Portuguese Atlantic insular harbours during the 16th and 17th centuries. Nina Vieira and her colleagues deal with Portuguese expansion during the late 18th century and the perception of aquatic animals – such as whales, manatees and dolphins –, showing how these animals have always been considered valuable and usable resources. The analysis of their exploitation provides information about the overtime variation of their populations and the impacts of human dominance over aquatic ecosystems. Susana Gonçalves Costa and her co-

authors examine the symbolic way humans perceive and organise other animal species. They show that socio-zoologic models categorise species according to their roles in each specific cultural context, with important consequences for endangered species protection. Such a symbolic division between good and bad can influence conservation issues in places where nonhuman primates live. Tânia Minhós and Maria Ferreira da Silva, who worked in the Cantanhez National Park, one of the last pockets of forest in Guinea Bissau, also show the consequences of human impact on nonhuman primates. They studied two primate species who have exhibited changes in their behaviour as a result of the anthropic modification of their habitats. Whereas some species are more plastic and able to change some aspects of their socio-ecology (e.g. diet, dispersal, group size), others fail to adapt to the new environment and suffer from significant population losses or even local extinctions. The anthropic impact on complex ecosystems and the political views associated with these actions are highlighted in the other two chapters. Francisco Bidone attempts to build a coherent relation between economic/developmental thinking and the instruments chosen for policy implementation in the 1960s by the Brazilian government regarding the Amazon forest while explaining the maintenance of an eternal vision of the Amazon as a 'frontier' for economic growth. In turn, Paulo Guimarães, based on recent contributions and on empirical historical research, identifies different types of conflicts resulting from the expansion of extractivism in Portugal since the second half of the 19th century, with special emphasis on the mining industry, agriculture and industrial fishing. He shows how environmental conflicts provide a privileged perspective about competitive visions on the appropriation and use of natural resources and the irreversible processes of the transformation of the environment, while contributing to questioning contemporary representations and nationalist identity constructions of a country.

Part 4 – Landscape and Heritage – points to the relevance of considering and using the operational concepts of 'landscape heritage' and 'cultural landscapes' when analysing past and present situations related to land use practices.

Ana Maria Costa and her colleagues reconstruct the Mesolithic landscape of the Portuguese Sado valley, which was occupied c. 8500-7000 cal BP by Late Mesolithic communities. Their results suggest an extensive brackish environment since at least 8400 cal BP, with an influence of marine water near the area occupied by the Mesolithic groups. The transfer and naturalisation of species is another very important issue

in the comprehension of today's landscape. It deals with contemporary ecological issues, sustainable land use, and political problems as well as with communities' identity. Many of these themes are analysed by Cristina Joanaz de Melo, who examines in particular the case of the *Eucalyptus globulus,* initially imported in Europe as a substitute for quinine and was then, as its use and plantations expanded, considered an undesirable tree in the 20th century. She discusses the process under which the same ecological object suffered a huge change in symbolic value depending on its context, time and space to understand the driving civilisational paradigms. Ana Duarte Rodrigues details the uses of vineyards in the 19th century and the construction of wine landscapes while farmers of the Algarve (south of Portugal) were adapting to their environmental conditions. Christine Rottenbacher's contribution details a public participation process where people experienced repeated contact with 'their' places and discussed cultural landscape values. She presents the results of her experience in landscape planning and contemporary dance performance, developing an assessment method (Moved Planning Process) based on the effects of moving together over sites to negotiate the use and maintenance of the places that build our cultural landscapes.

Part 5 – Science and Natural History – brings together perceptions and experiences related to the progressive 'discovery' of nature and how, over time, they have been scientifically validated, thus promoting successive reconfigurations of knowledge and stimulating epistemic interactions among people of cultures and differentiated technologies. Consequently, this part contributes to a better awareness of the past, present and future role of knowledge as an essential component of a broader dialogue with nature, reinforcing the need for a 'learn to live together' commitment, while, at the same time, drawing attention to the importance of the historical dimension of this process. Hence the chapters of this part follow a chronological order, from the 15th century – the so-called Age of Exploration – to the 20th century. Most of the chapters deal with the circulation of the novelties and their consequences, both in their physical form – *naturalia* – and in the form of ideas, between Europe, Africa and the Americas. Since ancient times, many animals, particularly parrots and primates, have been in great demand as pets, which quickly made them the subjects of highly profitable transnational trade. However, animals were not the only subject of this intercontinental trade. Other transoceanic but 'silent' passengers were living plants, namely seeds, rhizomes, tubers, bulbs and saplings, which were transferred from continent to continent throughout an expanding network of sailing routes during the 16th century.

Manuel Miranda Fernandes critically reviews some prominent examples of transoceanic plant transfer, highlighting the practical organisation and the trial and error approach required to overcame transportation problems. In contrast, Teresa Nobre de Carvalho discusses the relevance of collecting historical information and the importance of written sources (reports, treatises, letters) for the circulation of knowledge in the Early Modern Period, highlighting both the innovative approach shown in reporting Asian nature and the impact on the structuring of a new botanical knowledge, or on the very construction of a model of dissemination of knowledge that prevailed in the following centuries. As Fabiano Bracht notes, 18th century Portuguese colonial territories can be understood as places of intense and dynamic processes of the construction, extension, and reconfiguration of scientific knowledge. While Bracht focuses on India, Gisele da Conceição addresses similar issues for colonial Brazil. Analysing the panoply of agents and works involved in the processes of the recognition and construction of knowledge about Brazilian nature in this period, she underlines the association between knowledge and science on a transcontinental scale that is clearly global, bringing to the discussion the contribution of the scientific exploration journeys to the construction of a scientific knowledge about nature and, consequently, its integration into the scientific, political and economic context of the time. Wesley Kettle highlights the reports elaborated by scientists, colonial administrators and missionaries on their travels in the Amazon as part of the process of demarcating borders in the second half of the 18th century, and defends the idea of nature as an element capable of generating changes in the process of the Portuguese occupation of the Amazon and consequently modifying the plans of the Crown.

In *Peoples, Nature and Environments: Learning to live together*, all chapters converge on the idea of the long-term human-nature relationship no matter the time, place or context. As humans settled, developed agriculture and urban spaces, colonised islands and shorelines, explored the hinterlands, and interacted with other humans, they impacted and changed the natural world, making out of it a mostly humanised world. And while doing so, they have historically (and culturally) tended to forget their deep connection to animals and plants, to the lands and aquatic spaces they depend on.

We hope, with the present book, to contribute to this new scholarship as well as to the local and global understanding of how humans have related, still relate, and are expected to relate in the future, to non-humans and all parts of our common world.

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PART 1

LEARNING TO LIVE TOGETHER

CHAPTER ONE

INTERSPECIES PEACE: LEARNING TO LIVE TOGETHER

PATRÍCIA VIEIRA

At the dawn of Modernity, Thomas Hobbes (1588-1679) famously wrote that humans lived in a state of nature before they entered the social contract. This "is nothing else but a mere war of all against all," writes Hobbes (1642) in his *De Cive* (*On the Citizen*), only to add later, in *The Leviathan* (Hobbes, 1651), that in the "natural condition of mankind … [t]here is always war of everyone against everyone." Such permanent conflict "consists not in battle only, or the act of fighting," explains Hobbes, "but in a tract of time, wherein the will to contend by battle is sufficiently known," or when there is a "known disposition" to fight (Hobbes, 1651). In other words, the state of nature, grounded upon war, entails a latent condition of hostility that can at any moment turn into open fighting. Hobbes considers this to be a "hateful condition" and believes that all humans "desire […] to be freed from this misery" (Hobbes, 1642). The way out of this predicament is to leave the state of nature and to enter a contract, whereby humanity gives up some of its freedom in exchange for protection from violence. Hobbes calls the state, or *civitas* in Latin, created by the social contract the Leviathan, which he describes as an "artificial animal" and also as an "artificial man; though of greater stature and strength than the natural, for whose protection and defense it was intended […]" (Hobbes, 1651). The Leviathan guarantees its citizens' rights under the rule of law and peace amongst members of a civil society.

Hobbes's thought on the function of the social contract, which I have very briefly sketched above, warrants further scrutiny in light of the topic of this book, especially given its influence on subsequent political philosophy. First, we should pay closer attention to the expression "state of nature" – *status naturae*, in the Latin original from *De Cive* (Hobbes, 1642). Hobbes considers the "state of nature" to be one of permanent war or hostility, which is tantamount to saying that conflict is the normal, default

condition not only of human beings but of all living entities and of the natural world as a whole. War is hereby naturalized as the norm that only humanity can escape from. Even though Hobbes does not mention this explicitly, he assumes that, unlike humans who can create a civil society, non-humans are condemned to forever remain in a warring state of nature. This is how we can understand his famous adaptation of the Latin proverb "*homo homini lupus*" ("man is a wolf to man") in *De Cive* (Hobbes, 1642). To denounce uncivilized human behavior as similar to the conduct of wolves implies that these animals are themselves barbaric and prone to constant fighting. While wolves can do nothing to change their savage nature, Hobbes thinks humans should know better than to give in to their beastly instincts.

A second point we should highlight from Hobbes's thought is the idea that, in the state of nature, the "life of man [is] solitary, poor, nasty, *brutish* and short" (Hobbes, 1651). In the state of nature, humans live like brutes, beasts or animals. In order to become fully human, we need to leave this condition and use our reason to create the Leviathan – an organized state. The departure from the natural state is regarded as an emancipation, an inevitable separation from nature from which humans will never fully recover. This rift between humankind and nature can easily turn into a war against the natural world. In order to end the "war of all [humans] against all [humans]," humanity enters a struggle against nature, perpetually fighting the pull of bestiality that the state of nature represents. By combating nature – animals, plants, and so on, which are the opposite of the artificially engendered Leviathan – humans are battling their inner, brutish instincts, from which they try to distance themselves with the social contract.

It should also be noted that Hobbes chose the name of a monster from the Old Testament, the Leviathan, to describe the civil society created by humans once they abandon the state of nature. The Leviathan is an unnatural beast – it does not exist in the natural world – and is, in this sense, a fitting image for the commonwealth devised by humanity. What is perhaps less congruous with Hobbes's thought is that the Leviathan was used as an image for a demon, or even for Satan, throughout the Middle Ages. Is Hobbes unconsciously hinting at the fact that our leaving the state of nature is something satanical? Is the state (*civitas*, where civilization comes from) more of a demon than a blessing?

A final point to consider in Hobbesian political philosophy is that the Leviathan only guarantees peaceful co-existence within the state. Between different nations – different Leviathans – the state of nature reigns supreme. This is the conundrum that Enlightenment projects for perpetual peace, from

the Abbé de Saint Pierre's proposal for peace in Europe to Immanuel Kant's famous text "Perpetual Peace: A Philosophical Sketch" (1795), tried to solve. So, the creation of the Leviathan means not only a permanent state of war with nature but also with all other Leviathans. Another, pithier definition of the Leviathan could be: "a monster surrounded by war on all sides."

We are clearly still living in the shadow of the Hobbesian paradigm of political philosophy when it comes to our understanding of our relation to the environment. About two hundred years after Hobbes, Darwin saw the connections between different species and even between members of the same species as one of constant struggle. The "survival of the fittest," a phrase coined by Herbert Spencer to describe society in the wake of Darwinian biology, meant that only the victors would live on and those on the losing side would simply wither away. In our post-Darwinian world, the idea that life is a constant state of war of all against all, both at the biological and at the social level, remains. Notions such as "savage capitalism" testify to this translation of the state of nature to all spheres of human endeavor, from politics to economics. According to this view, humanity merely follows a generalized condition of life as a ruthless fight for survival that justifies dominating and exploiting those who might further our goals and slaughtering the ones who stand in the way.

This age-old struggle between humanity and nature is now often tempered by the discourse of conservationism. Still, the protection of the natural world is usually seen in utilitarian terms. Elements of the environment are regarded as "resources" that we need to preserve because their destruction endangers the very conditions for human survival. And the protection of one species or another is even more anthropocentrically driven – think of "save the whales," "save the pandas" and other such campaigns focusing on animals that conform to human standards of magnificence, beauty, and so on. The point is not that these animals do not deserve protection but, rather, that we need to reflect upon why we wish to protect these and not the myriad other species (insects, reptiles) disappearing every year. Is it because they are also mammals, or because they look cute in a picture? I submit that anthropocentrically inspired protectionism is nothing but a variation on the Hobbesian war against nature. We protect our enemies because we have just realized that our lives depend on theirs. In a Hegelian-Marxist framework, this kind of conservationism is reminiscent of the master-slave dialectic. Humans are still the masters, but they have understood that they depend upon their slaves and therefore have decided to protect them.

A much-needed change in our societies' attitudes toward the natural world entails scrutinizing some key concepts of our political and philosophical tradition. Since Hobbes's thought epitomizes many of these notions, I will dwell in some of the blind spots of his political philosophy in my attempt to imagine another kind of relationship with the environment. I will try to uncover alternative traditions of thinking about nature and, following in the footsteps of Kant, put forth a proposal for "Interspecies Perpetual Peace."

I would like to start by delving a bit deeper into the concept of a "state of nature." To do so, we should evoke the root of "status" (as in *status naturae*, translated into English as "state of nature"). Status is a noun related to the Latin verb *sto*, to stand, and *status naturae*, literally the state of nature, thus, means "to be in a natural state, or in a natural condition," "to be in the natural world". The Latin word *status* goes back to the same Proto-Indo-European root as the ancient Greek word *stasis*, which meant both a standstill and dissension or fighting. This etymology is particularly pertinent when we consider the idea of a "state of nature." If we think of *status* in terms of *stasis*, then it can be a situation of permanent hostility but also a condition of stability, in which opposing forces cancel themselves out.

The idea that our status, our very condition as living beings, is predicated on the ambiguity between conflict and stability harks back to pre-Socratic Greek thought. Heraclitus famously wrote that "strife/war [*polemos*, sometimes translated as "strife," other times as "war"] is common" and, in another fragment, that "strife/war is the father of all and king of all" (1948, 28). For Heraclitus, *polemos* refers to the tension inherent in all life, which springs from the clash between opposites. It is an ontological given of existence and, as such, part and parcel of living. The absence of *polemos* would be tantamount to the quiet of the cemetery that Kant mentions as a joke at the beginning of his text on perpetual peace. But while Heraclitus sees friction as the foundation of life, this does not necessarily entail warfare of all against all in the state of nature, as Hobbes imagined. Going back to the link between *status* and *stasis*, the state of nature could signify an ongoing *polemos* that creates a balance or equilibrium between different, opposing forces, a perpetual exchange without definitive victors and vanquished.

Given the pre-Socratic notion of *polemos*, the Hobbesian state of nature appears in a new light. If *polemos* is the ontological condition of humans and non-humans alike, then the stark contrast between the state of nature and culture or civilization, which can only thrive in the Leviathan, comes undone. Animals (or plants, for that matter) are not more brutish, barbaric or savage than humans. They all partake in strife, in *polemos*, a great

equalizer that unites all beings. Such an understanding of humanity undermines the idea that humans are divided between their bodies and their minds, their animal or instinctual and rational or logical selves, a separation that retraces the Cartesian division between *res extensa* and *res cogitans*. This view of humans was what made Hobbes consider that we were at war with our inner, irrational nature and, by extension, with external nature as a whole. The human war against the natural world, part of our desire to abandon the state of nature, is futile in the context of an ontological *polemos* that permeates all life.

The above-mentioned expression from *De Cive* (Hobbes, 1642), "*homo homini lupus*," is nonsensical to the extent that wolves, or any other non-humans, are not intrinsically more polemical than human beings. In fact, humans are the only forms of life capable of cruelty and of willingly inflicting suffering upon others for no other reason than their own amusement. This is Father António Vieira's argument in his "Sermon of Saint Anthony to the Fish" (1654), where he decries humans for behaving worse than animals. While fish only kill and eat each other because they need to nourish themselves, humans do so out of envy and greed and are therefore more deserving of condemnation than animals.

Considering that *polemos* is part of human (and non-human) ontology, it will not disappear with the creation of a civil society. What if, rather than saving us from the war of all against all, the state is itself the cause of permanent hostility, which leads our ontological condition of *polemos* to degenerate into full-fledged wars? As we have already seen, the creation of the state as we know it not only sparked the human war against nature but also the conflict between different nations that engulfs humanity in constant warfare. Perhaps this is the reason why Hobbes named the state Leviathan, a monster or a demon. He was, maybe unwittingly, recognizing the pitfalls of seeing the state as a solution to warfare.

It is pertinent here to turn to another politico-philosophical tradition of conceptualizing the state of nature, not as a war of all against all but, on the contrary, as a peaceful life of plenty in a Golden Age. The myth of a Golden Age of humanity, when we lived in tune with the natural world, was prevalent in ancient Greece and Rome, beginning with Hesiod's description of the past of humankind in *Works and Days*, and continuing with Plato's mention of a Golden Age of Athens in the *Timaeus*, together with Ovid's references to this ideal state in the *Metamorphoses*, as well as with Theocritus's *Idylls* and Virgil's *Eclogues*. This notion is also part of the Judeo-Christian Book of Genesis, which describes the earthly Paradise inhabited by humans before the Fall.

Later political philosophers went back to this idea of a Golden Age to describe human life before the onset of civilization. Rousseau (2002), for instance, wrote in his *Discourse on Inequality* that the "happiest and most durable" stage in human development took place right before the full-fledged development of civil society and, most notably, before the emergence of private property. He believed that humanity was destined to remain at that stage, the "real youth of the world" and that it was some "revolution" or "fatal accident" that removed us from this condition, an accident that "for the common good, should never have happened" (Rousseau, 2002, 119). Rousseau does not address the issue of humankind's relation to the natural world during this privileged time, but we can assume that, akin to animals, human beings lived off the fruit of the land, obviating war both amongst themselves and against the environment, much like what is described in the Book of Genesis. Like Rousseau, Kant also speculates about a state of nature, during which humans lived in "peaceful indolence." However, the German philosopher considers that human life without progress, pleasant as it may be, bears no meaning. Even though development may be painful, humanity needs to follow the dictates of reason and create a civil society.

If our leaving a peaceful existence in tune with nature is considered a fall, can humanity ever return to this state of grace? Can we go back to nature and reverse the current intra- and interspecies war? Will the "wolf [ever] dwell with the lamb / and the leopard […] lie down with the young goat," as the Old Testament (Book of Isaiah) metaphorically put it in its image of a future righteous Earth? Will humans ever live peacefully side by side with non-human beings? While, for Rousseau, the answer would be "no," Kant's approach is more nuanced.

Rousseau does not address our relation to non-humans, but one can surmise from his thought that interspecies war, as much as war amongst humans, derives from the development of civilization. Interspecies peace, then, would entail a return to the past that would approximate the state of nature as much as possible, knowing full well that one would never be able to go back to that perfection.

For Kant, perpetual peace amongst humans arrives at the end of history with cosmopolitanism, which reconstructs the Golden Age of the past through the mediation of human rationality. Interspecies peace would be a matter of extending cosmopolitan rights to non-humans. The foundation of Kantian cosmopolitanism is the "communal possession of the earth's surface" or the "*right to the earth's surface* which the human race shares in common" (Kant, 2008, 106). Interspecies cosmopolitanism, then, would entail recognizing that humans and non-humans have a common possession

of the Earth and a right to occupy it. The world republic (*Weltrepublik*) of cosmopolitanism, which guarantees perpetual peace, would thus need to encompass non-humans; that is to say, it would be an interspecies *res publica* or, rather, a *res-biotica*.

The very notion of the "cosmos" would be at stake under such an interspecies *res-biotica* world – an imperative to discuss the very meaning of the world that Bruno Latour (2004) has already identified. Cosmopolitanism would become "cosmopolitics," in the words of Elisabeth Stengers (2010, 2011), a debate about what the cosmos, or the Earth, really is. The Hobbesian distinction between the state of nature and the Leviathan would turn into ongoing cosmopolitics, a *polemos* within the *res-biotica*. We could conceive of the creation of a world parliament that would include the air, water, earth, energy and all living beings, following in the footsteps of Michel Serres (2009, 40, 51). This cosmo-parliament should avoid the pitfalls of anthropocentrism that tries to impose a human *logos* (speech, reason) upon all other living and non-living entities. It would have to contend with the fact that different beings have different languages and articulate their existence in diverse ways. Interspecies peace would be the outcome of a lively debate amongst the members of this parliament, a debate for which we would still need to create an appropriate language and procedures. Such a cosmopolitical *res-biotica* would be a first step in the long process of learning to live peacefully together with one another and with the non-human beings with whom we share our planet.

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CHAPTER TWO

HOMO SAPIENS: THE FIRST SELF-ENDANGERED SPECIES

TELMO PIEVANI AND ANDRA MENEGANZIN

ANTHROPOCENE DEFAUNATION: A VERY RISKY TRANSITION

Edward O. Wilson, Niles Eldredge, Peter Ward and Norman Myers, all distinguished evolutionists and biodiversity experts, claimed twenty years ago that, in light of the dramatic rate of extinction of species induced by human activities in recent centuries, the biosphere is going through a 'mass extinction', that is, a rapid loss of biodiversity on a global scale (Eldredge, 1995, 1998; Myers & Knoll, 2001; Ward, 1994, 2000; Wilson, 2003). More precisely, they argued, we are confronting the Sixth Mass Extinction, that is, nothing less than the last five catastrophes caused by volcanic eruptions, ocean acidification, climatic fluctuations, changes in the atmosphere's composition, impacts of asteroids on Earth, or a combination of these factors. The last of these was the best-known massive event that 66-65 million years ago wiped out most of the dinosaurs (except a small branching group that evolved into birds) and almost two-thirds of all other organisms, and is known as the Cretaceous-Tertiary extinction (K-T). As regards the speed of impact and the mortality rate, Wilson and his colleagues argued (Eldredge, 1995, 1998; Ward 1994, 2000; Myers & Knoll, 2001; Wilson, 2003), the ongoing extinctions caused by *Homo sapiens* today can be fairly comparable with the previous five.

The official label "Sixth Mass Extinction" was first introduced by the paleoanthropologist Richard Leakey and science writer Roger Lewin to indicate the anthropic sequel of the Big Five in 1992, denouncing the destruction of biodiversity (mainly large mammals) in Africa (Leakey & Lewin, 1992). Two pioneering studies, separately proposed in 1995 by Robert May and Stuart Pimm's authoritative teams (Lawton & May, 1995;

Pimm *et al*., 1995), gave the first confirmations. If we compare the rates and amounts of extinction during the recorded mass extinctions with the range of species losses over the past few centuries, we see very similar trends. But what kind of evidence do we have that humans are now allowing or even causing a new mass extinction?

At that time, the thesis was based on inevitably inaccurate statistics, and described with the language of militant ecologist movements rather than empirical science. Many received it as an exaggeration, a yielding to 'catastrophism'. After all, it was estimated that the Earth could still be inhabited by at least five million animal species. Several studies, however, began to use the label "Sixth Mass Extinction". In 2010, Hoffmann *et al.* reported alarming percentages of extinction in amphibians, corals, freshwater molluscs and sharks, in addition to mammals, reptiles and birds.

In March 2011, an international team from Berkeley led by the palaeontologist Anthony D. Barnosky verified the measures of "recent" extinctions over the last few millennia by integrating palaeontological data and current accounts in order to provide all the necessary statistical precautions. They came to a rather worrying conclusion, which was published in *Nature* (cf. Barnosky *et al.*, 2011): the Sixth Mass Extinction is not yet underway, but we are close, and doing nothing to stop it. The title of *Nature*'s article was: "Has the Earth's sixth mass extinction already arrived?" The extinction rates of the past 500 years (22% in mammals, 47-56% in gastropods and bivalves) far exceed those recorded in the fossil record for the five major extinctions of the past 540 million years. Thus we are on a mass extinction trajectory, with accelerating rates: "Our results confirm that current extinction rates are higher than would be expected from the fossil record. (…) The Earth could reach the extreme rates of the Big Five mass extinctions within just a few centuries if current threats to many species are not alleviated" (Barnosky *et al.*, 2011, 51). Humans may be more effective exterminators than asteroids and volcanic eruptions.

In July 2014, further confirmation was published in *Science*, and now the statistics are becoming increasingly realistic. According to the refined calculations produced by the ecologist Rodolfo Dirzo's team at the Department of Biology at Stanford, human impacts on animal biodiversity are bringing about global environmental changes that are going to show increasing effects on ecosystems' functioning and on the health of our own species (Keesing *et al.*, 2010; Civitello *et al.*, 2015; Ostfeld, 2017). Our planet is no longer the same. The current analysis is not just based on indirect extrapolations and calculations of the disappearances of whole species, but also on the demographic and biogeographic trends of local

populations in recent decades. The population level is crucial: for genetic reasons, the size of a biological population is inversely related to the vulnerability to extinction.

Every year we are losing a total amount of 11,000 to 58,000 species, concentrated mainly in tropical regions (the level proposed by Edward O. Wilson in 2003 was 30,000 species a year, perfectly in the midst of this range). One species is being lost every twenty minutes. We are extinguishing species that we have not yet even had time to describe. The frightening technical term coined for this phenomenon by Rodolfo Dirzo in *Science* is "Anthropocene defaunation" (Dirzo *et al.,* 2014). Note that the hitherto informal term "Anthropocene", proposed by Paul Crutzen in 2002 in *Nature*, is unofficially entering the scientific jargon (although there is no consensus about its real utility and its starting point inside the Holocene) (Lewis & Maslin, 2015; Monastersky, 2015). The current human impacts are sufficiently large to be recorded in geological records. This represents a singular evolutionary transition because, for the first time in the Earth's history, a single species, *Homo sapiens*, has become a major geological force. Within a few centuries, our species has been successful in altering the composition of the atmosphere and transforming the surface of the planet at a level visible in the stratigraphic record (Crutzen, 2002). Hence the justification for the name 'Anthropocene' for the new geological epoch.

We do not pay money for ecosystem services, and therefore we are often unaware of the true cost of maintaining them. But with the disappearance of thousands of species every year, ecosystems are becoming progressively less efficient in ensuring their services, such as water purification, nutrient cycling and soil maintenance. The genetic variability of populations and species is the fuel of evolution, free insurance against adversities and attacks from pathogens. In the Anthropocene, we are losing that vital genetic diversity (Novacek, 2001) and late interventions will be much more expensive. As an example, 75% of food crops in the world depend on pollinators. All of the above concerns the effects of extinction, but what about the causes?[1]

THE FORTHCOMING MASS EXTINCTION

According to recent data, the Sixth Mass Extinction and the previous Big Five share the same proximate geophysical causes for the loss of

[1] For an extended discussion of this issue, see Pievani (2015).

biodiversity, making the comparison among them not a matter of suggestive metaphors, but a valuable insight with regard to understanding current environmental crises. Gerta Keller, Professor of Palaeontology and Geology at Princeton University, proposed, along with her team (Keller, 2008), a model for the multiple convergent factors that caused the extinction at the end of the Cretaceous. Keller argues that a theory for mass extinctions cannot point at a single catastrophic cause to explain macro-evolutionary patterns, since these result from a mix of different and simultaneous conditions. For example, there is general agreement in recognising that a single asteroid could not have been the only cause of the mass extinction at the end of the Cretaceous, but rather a major contributing factor. This means that the extinction's magnitude would have been lower in the absence of other stressors that had already triggered the pump of extinction. This also applies for the past mass extinctions, and may perhaps hold in the near future too.

According to such models (Arens & West, 2008; Brook *et al.,* 2008), a mass extinction will only occur when a synergy between unusual events arises, like in a "perfect storm" when different critical parameters converge. Namely, the three major processes, and the consequences of their interactions, are as follows:

1 – accelerated climate change;
2 – alterations of atmospheric composition;
3 – ecological stresses with abnormal intensity.
4 – Along with positive feedback among the three.

The convergence of these processes has resulted in mass extinctions in the past: "the loss of more than three-quarters of species in a geologically short interval" (Barnosky *et al.*, 2011, 51-52). The pump of extinction starts its pruning with the branches of many different phylogenetic lines, eventually reaching a peak, a culminating event like a collision or multiple volcanic eruptions, that unleashes the final wave of global crisis (some mass extinctions are composed of several waves of extinction). The question now is if it is possible to apply the "Perfect Storm Model" to the impact of human activities on biodiversity. According to Barnosky and his colleagues (Barnosky *et al.*, 2011), the current situation fits the description, as follows:

1 – accelerated climate change? YES, in progress.
2 – alterations of atmospheric composition? YES, in progress.

3 – ecological stresses with abnormal intensity? YES, due to human activities, since a long time ago.
4 – Positive feedback among the three? YES, in the early phase of this.

All the key conditions are met. In such a perfectly created storm, not even catastrophic events like a large asteroid impact or a devastating volcanic eruption are required to strike a fatal blow. According to Pereira *et al.* (2010), in the absence of better and more efficient policies aimed at mitigating the damage, global biodiversity will maintain its downward trend over the 21st century

As can be seen, the key parameters of the 'perfect storm' are proximate geophysical causes of mass extinctions, analysed from a paleontological perspective. But what about the remote causes that placed *Homo sapiens* in the condition of detonating a global geological and environmental crisis of such proportions? It is an old story indeed. The last branch of genus *Homo* flourished by out-competing at least three other human species. It is well established that when Palaeolithic hunters colonised the Americas, Australia, and Pacific Islands – even if some doubts remain about the role played by concomitant climate oscillations – dozens of large mammals and flightless birds who lived there died off within a few millennia of their arrival. The archaeological record – today based on comprehensive country-level data on the distribution of these large-bodied animals – shows a series of regional mass extinctions of megafauna, as the animals of these regions were unused to human contact and predation and had low reproductive rates, making them particularly vulnerable. Thus the destructive environmental impact of our species began in earnest towards the end of the Pleistocene (Cavalli-Sforza & Pievani, 2012).

There is, however, an ongoing debate within the geologist community on the problem of assessing the anthropogenic signatures in the geological record and on the criteria that should be followed to formally mark the beginning of a whole new geological epoch, the Anthropocene. The impact of human activity should define a unique stratigraphic unit, observable in geological and stratigraphic material (rocks, glacial ice, marine sediments) for millions of years in the future (Lewis & Maslin, 2015).

Today, no formal agreement has yet been reached on where to set the starting date of such a new geological epoch. Scholars are divided among different options, based on the event or process they find most eligible to mark the beginning of the Anthropocene. For example, the already mentioned megafauna extinction between 50,000 and 100,000 years ago that wiped out about half of the large-bodied animals around the world

was among the first proposed candidates. It is debated whether the uneven losses across continents (18% in Africa, 36% in Eurasia) and the different timings make the extinction lack the required precision for an Anthropocene marker.

Another candidate is the origin of agriculture that first occurred around 11,000 years ago in South America, Southwest Asia and China, but that still lacks global synchrony. More recently, the arrival of Europeans in the Caribbean (1492), which has always been considered a major event in world history, has been proposed as an Anthropocene marker too, due to the rise of global trade and therefore the globalisation of human foodstuffs and domesticated species, with well-preserved deposits of pollen marking a stratigraphic change. Other options are the Industrial Revolution, due to the accelerated fossil fuel use and societal changes at a global scale, and 1964, when the Great Acceleration reached a peak in anthropogenic impact with the nuclear explosions.

It is important to note that setting an earlier date for the beginning of Anthropocene should not mean 'normalising' the anthropogenically-induced environmental change. Long-term processes must not be politicised in terms of inevitable outcomes, thus lowering the sense of responsibility of contemporary *Homo sapiens* and discouraging environmental policies. From an evolutionary perspective, our interpretation places the premise for today's ecological dominance of our species in the deep time of human history, at the end of the Pleistocene.

WE KNOW THE CAUSES

This story, therefore, does not present a single anthropic activity that is causing the bad fate of biodiversity today. It has deep roots in human history. Through a mix of different behaviours with variable impacts, we have produced the conditions for a global and rapid extinction crisis. In other words, the Anthropocene signals the fact that *Homo sapiens* has become a dominant evolutionary force (Pievani, 2013). According to the "HIPPO" causal model proposed by Edward O. Wilson (2010), updated and revisited here (HIPPOC), the human impact on biodiversity is due to a convergence of different and interacting factors:

H – Habitat fragmentation and alteration of species-areas relationships (i.e. forest clearance, conversion into pasture, and intensive cultivations, mining and quarrying activities);
I – Invasive species and diffusion of new pathogens (the inter-continental remixing of alien species due to travel and commerce

has been able to cause mass extinctions on scales from local to entire regions, as well as on islands and archipelagos);

P – Population growth and urban macro-agglomerates (producing barriers and limitations to the dispersal of animals and plants);

P – Pollution (agricultural, industrial and chemical pollution of air, water and soils);

O – Overexploitation of biological resources by overfishing and overhunting;

C – Climate change: initially characterised only in crude estimates, current models include climatic warming and growing evidence for ecological mismatches in the seasonal cycles of species (mostly in long-distance migratory birds), polar species becoming endangered, the restructuring of ecological communities in tropical forests, and alarming global effects triggered by ocean acidification (mostly in coral reefs) (Pievani, 2015).

In addition, we should consider the non-linear interactions between the six forces (for example, the fragmentation of territory and global warming in tropical forests; devastating synergic effects of pollution, overexploitation and climate change on coral reefs). This unprecedented relationship between a globally invasive species and the biosphere generates an *evolutionary gap*: the rates of biological evolution (i.e. biogeographical displacements, adaptations to different temperatures, etc.) are on average ten times slower than the rates of human-caused changes, so the usual processes of ecological recovery after disturbance are being overridden.

A distinction, however, needs to be drawn between two extinction processes in biohistory. The *background extinctions* of species are normal, steady (and necessary) processes in the economy of nature that occur at relatively low rates and which result from the ongoing evolutionary processes in environments characterised by high competition and limited resources. In contrast to this, the major turnover-pulses of evolution had far more dramatic rates and consequences. Those *mass extinctions* were global catastrophes under which entire classes of terrestrial and sea biodiversity collapsed (Bambach, 2006), like at the end of the Ordovician (445 million years ago, related to a glaciation event); at the end of the Devonian (360 million years ago); and at the end of the Triassic (200 million years ago, the mass extinction that paved the way for the dinosaurs). It is interesting to note that the victims of one mass extinction may well have been the lucky survivors of a previous one.

The pattern of this periodic pruning of the tree of life is distinct from background extinctions (which have an average rate of 2-4 taxonomic families disappearing every million years), as if the 'business as usual' of evolution were not simply accelerated but temporarily overwhelmed. Mass extinctions unleash a disruptive power in a relatively short time on a geological scale, and they strike across all classes and orders with low selectivity.

THREATENING THE SURVIVAL OF OUR OWN CIVILISATION

The human-induced extinction wave we are witnessing today is likely to bring self-harming consequences for our own species, since the ongoing decimation of life-forms is also affecting the life-support conditions and the ecosystem services on which our civilisation depends (Daily & Matson, 2008; Cardinale *et al*., 2012; Ceballos *et al.*, 2015). Humans' dependence and impact on biodiversity have mostly been studied as separate phenomena, but today's urgency of rethinking the policies of conservation demand an integrated perspective that must not be confined to merely ethical and emotional appeals.

Plants, nonhuman animals and microbes define the ecological niche we live in – a delicate equilibrium of interdependent relationships, in which we do not only represent the major active modifiers of the environmental states and the selective pressures at work, but in which we are also modified by the ecological and evolutionary feedback that the niche returns to its constructors. "Niche Construction Theory" (NCT) (Odling-Smee *et al*., 2003) provides a useful theoretical framework to appreciate the current unsustainability of the human niche and the self-endangering feedback at stake, providing an integrative scenario in which *Homo sapiens* can no longer be treated as a mere exogenous phenomenon (Albuquerque *et al.*, 2014).

Unlike many other species that alter the environment through their metabolic, physiological and behavioural activities, the major alterations we impose are driven by our socially transmitted information and culture (Laland & O'Brien, 2012). As we have seen, the major evolutionary event that triggered a cascade of effects in the selective pressures was the introduction of agriculture and the domestication of species. By the time *Homo sapiens* reached the capacity for ecosystem engineering, the biosphere had undergone dramatic changes, with the reshaping of global species' distribution and the introduction of new ones. These resulted from intensive and complex niche construction activities that responded to the

needs of industrial economies, of an expanding population and of the reinforcement of the transport network (Boivin *et al*., 2016).

The legacies of change in both biota and abiota, usually referred to as "ecological inheritance" (Odling-Smee, 1988), do not require the existence of environmental replicators but of the intergenerational persistence of the causes of change (mainly through repeated acts of construction) (Laland & O'Brien, 2012). This identifies a different form of inheritance than the inheritance of genes: the transmission includes material resources that are passed down to later generations without reproduction, but through an external environment. Multiple organisms (not only genetic relatives) are involved in a constant transmission process (i.e. not confined to single reproductive events) to many other organisms throughout their whole lifetime, within and between generations. When it comes to *Homo sapiens*, as seen in previous paragraphs, the predominance of the human niche over the biosphere has become increasingly alarming.

In environmental conservation and ecology, the impact of human action has traditionally been investigated in two forms: *acute* disturbances (drastic environmental changes) and *chronic* anthropogenic disturbances (CAD; Singh, 1998). In the case of tropical forests, where the impact of CAD is studied most, clear-cutting, logging, anthropogenic fires fall within the first definition, whereas the chronic form is characterised by more subtle activities that remove only a small fraction of biomass at a time, but at a constant rate and for the long term. Such activities are, to use the same example, the collection of firewood, fodder and secondary forest products (seeds, leaves, tree oils, etc.). The main problem with chronic activities is the fact that their persistence does not allow enough time for the ecosystems to recover adequately, making CAD one of the most widespread sources of habitat degradation in developing countries (Singh, 1998) and a cause of the decrease in taxonomic and phylogenetic diversities (Ribeiro *et al.,* 2015; Ribeiro *et al*., 2016). Human-driven ecological disturbances, along with better-known drivers of biodiversity loss like habitat fragmentation and defaunation, provide important examples of human niche construction, whose effects persist for longer than the lifetime of the constructors themselves and are passed on to the following generations (ecological inheritance).

In NCT, organisms, including *Homo sapiens*, and environments are engaged in reciprocally caused relationships that are at play both on the ontogenetic and on the phylogenetic timescales. We have already explored one form of this relationship in the previous sections by analysing the history and magnitude of human impact on global biodiversity; it is crucial now to explore the second form by focusing on the impact of biodiversity

loss on human activities and health. There is a vast array of phenomena that can be fruitfully analysed from a niche construction perspective, ranging from the ecological and economic impact of pollinator declines to the global consequences of overfishing and ocean acidification. Here we will go through a couple of examples related to our health and the ecology of infectious diseases.

There is a burgeoning body of literature that is beginning to show that reduced biodiversity affects the transmission of pathogens to human beings, livestock, wildlife and plants (Keesing *et al.*, 2010; Civitello *et al.,* 2015; Ostfeld, 2017). The reasons behind the inhibitory effect on pathogens displayed by environments with high biodiversity are linked to biotic homogenisation and the so-called 'dilution effect', which arises from the following observations. The majority of infectious human diseases have a zoonotic origin, with pathogens that are for the most part host generalist, meaning that they are capable of infecting multiple species of the host (that vary in their susceptibility to infection). The reservoir-hosts – the species that are more likely to acquire and transmit diseases – are those that are the most widespread, overrepresented and resilient to the perturbations induced by humans. Consequently, higher interspecific diversity (that includes species sensitive to anthropogenic perturbations) can 'dilute' the effect of the reservoir species and the general risk of infection.

A study conducted by researchers at the University of São Paulo, Brazil, found that, in tropical forests, biodiversity can play a role in preventing malaria outbreaks due to two different mechanisms: the dilution effect provided by warm-blooded mammals acting as a biological 'shield' for human people and the competition between vector and non-vector mosquito species for blood feeding (Laporta *et al*., 2013). Malaria is reported to have caused 429,000 deaths and 212 million new cases in 2015 (World Malaria Report, 2016), making it a concrete threat to nearly half of the world's population – Sub-Saharan Africa still carries the greatest portion of the global burden.

Another important case which is worth mentioning here is the Ebola outbreak in West Africa, which is hypothesised to have been the result of a combination of policy-driven changes in Guinea and Liberia, brought about by neoliberal development (Wallace *et al.*, 2014). According to such hypotheses, the increase in oil palm plantations (*Elaeis guineensis*) in Guinea's forested regions seems to have strongly impacted the forest epizoology. The first case of Ebola in West Africa was documented in the Guéckédou area, with a landscape characterised by a mosaic of villages enclosed by dense vegetation, with crop fields of oil palm that provide an

ideal man-bat interface. Frugivore bats (Chiroptera, *Pteropodidae*) are a key Ebola reservoir (healthy carriers), and they are attracted to oil palm trees, where they migrate in search of food and shelter, thus shifting their foraging behaviour as the forest gradually disappears. The lethal virus can be transmitted through direct contact with the infected animal via contaminated body fluids.

A more recent study (Olivero *et al*., 2017) got to the bottom of the coupling between the loss of closed forests and the Ebola virus disease outbreaks by confirming an increased probability of an Ebola outbreak in sites that suffered recent deforestation events. A possible explanation is that deforestation is likely to push infected wild animals into areas inhabited by humans, increasing the probability of contact between them, by disrupting animal movements and population densities. This provides a straightforward case of undesired feedback induced by politically- and economically-driven niche activities that impact the population distribution of the endemic fauna and the ecosystem ecology in general, reminding the representatives of *Homo sapiens* of their role and weight in the interconnected nature of an ecosystem. As we know, pathogens are among the strongest selective forces that have acted on human populations throughout our entire evolutionary track. Since pathogens diminish the host's reproductive potential, due to poor health or death, selection is therefore driven on the genetic variants that affect resistance, increasing the frequency of favoured alleles, and decreasing that of detrimental ones (Karlsson *et al.*, 2014). This means that through changes in biodiversity (and therefore in our niche), we are not only affecting the evolutionary trajectories of other species (Palumbi, 2001), but also our own evolution, posing new challenges that can reshape, in the long-term, the distribution of human populations on the planet.

THE COST OF HUMAN NICHE CONSTRUCTION

The fact that one species interferes with the ecological equilibria and the evolutionary trajectories of other species by altering the pace of evolutionary change, modifying the population distribution or altering the ideal environmental conditions for them to prosper is still part of natural history. As regards extinction, about 99.9% of species that ever existed are extinct. What is unprecedented today is the role of one species in triggering a global mass extinction event, the fastest of all time, which clearly presents harmful recoil effects for the dominant species itself. *Homo sapiens* is actively altering the conditions that ensure its own stay on the planet. To put it differently, the Anthropocene extinction is a threat

not for biodiversity itself, but for the ecological conditions that currently allow human survival. In a human niche construction perspective, the beginning of Anthropocene should be established at the time when anthropogenic-transformative niche activities became dominant over the biosphere.

Even if the Sixth Mass Extinction cannot be considered a done deal, the sad irony of the story is that our efforts to slow or stop the Sixth Mass Extinction may not be enough. According to Butchart *et al.* (2010), one of the outcomes of the United Nations Convention on Biological Diversity – local conservation initiatives – are multiplying and having success. It may not be enough to reverse the general trends of habitat destruction, but averting the dizzying decay of biodiversity loss and the ecosystem services' degradation is still possible, although the window for making concrete changes is rapidly closing. This is the grand challenge for society and researchers that must be solved within the next few decades. The deadline can no longer be postponed. Pollution, long-lasting consequences of climate change, disease outbreaks (as analysed in the previous section), overpopulation and the overconsumption of resources must become a priority in the global policy agenda.

In order to reach effective and rapid results, particular attention should be paid to the economic impact of biodiversity loss and the risks for global health – i.e. the eco-evolutionary feedbacks that are already impacting *Homo sapiens*. In the worst-case scenario, however, even if we are so myopic as to endanger the conditions of our survival, scientific models tell us that life will carry on anyway in other forms (Weisman, 2008), probably to the advantage of the most opportunistic species, such as rats (Zalasiewicz, 2008). Indeed, just after our departure, a cornucopia of new experiments of life, like after every previous mass extinction, would plausibly blossom on Earth. The end of our species would only represent another new beginning. From a philosophical point of view, the Sixth Mass Extinction can provide an anthropological warning about the contingency of life and the fragility of our story as hominins.

Author contribution statements

Telmo Pievani contributed to this paper with sections 1, 2 and 3.
Andra Meneganzin contributed with sections 4 and 5.

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PART 2

CLIMATE AND ENVIRONMENTAL CHANGES

CHAPTER THREE

THE IMPACT OF THE LITTLE ICE AGE IN CENTRAL PORTUGAL

CRISTIANA FERREIRA, PIERLUIGI ROSINA, FRANCESC BURJACHS AND LUIZ OOSTERBEEK

INTRODUCTION

The Little Ice Age (LIA) triggered environmental changes and important socio-economic transformations, due to its effects on agriculture (e.g. Pfister & Brazdil, 2006). Climate change has important edaphological consequences which impact on agricultural land use. Changes in agricultural possibilities and practices had a remarkable socio-economic impact on Europe and Asia (e.g. the end of the human colonization of Greenland).

For the Iberian Peninsula, the LIA climate has been reconstructed with multiproxy analysis by different authors (González-Trueba *et al*., 2008; Araújo, 2008; Morellón *et al*., 2011; Martins *et al*., 2012; García-Ruiz *et al*., 2014) and climatic oscillations are quite well known. This cold period determined the development and growth of glaciers (González-Trueba *et al.,* 2008; García-Ruiz *et al.*, 2014), and relevant modifications in the coastline of Portugal, namely the increase of dune areas (Araújo, 2008). During the LIA, there was an increase in flooding intensity and in the sedimentation along the valleys of rivers, as was referred to by Benito *et al*. (2003, 2008). This phenomenon was also recognized in the Lower Tagus Valley by Vis *et al*. (2010) and Gomes *et al.* (2012).

The aim of this paper is to approach the environmental changes, the variations in agricultural activities and other anthropic impacts on the landscape of the Lower Tagus Valley during the LIA through pollen analysis. For this purpose, a sedimentary core was collected at Paúl do Boquilobo, a swamp area in alluvial soils surrounded by agricultural fields. A sediment core was studied, constituted by sand sediment at the bottom and silt-peat on the top, suggesting that stabilization of the swamp

in this core location was relatively recent. This observation was confirmed during the Non-Pollen-Palynomorphs (NPP) analysis by the presence of stagnant water algae. The upper part of this core corresponds almost entirely to the LIA, taking into account the absolute dating in the bulk of the sediment (AMS radiocarbon, Beta 278335: 430 ± 40 BP – 540-440 cal BP – 1420-1500 cal AD, INTCAL .04).

The Paúl do Boquilobo farm belonged to the Knights Templar Order in the Late Middle Ages, and was later transferred to the Order of Christ (when this order inherited the rights of the former), which became a key player in the Portuguese discoveries. In 1432, i.e. at the dawn of the LIA, it was given to Henry the Navigator in "*sesmaria*", i.e. autonomy for agricultural food production expansion and global land management.

As discussed below, the palynological analysis does not allow us to consider that the variation in economic activities was only due to climate change, since it may also be attributed to changes in state policies, these two dimensions being interlinked. The "*sesmarias*" law was promulgated in Portugal in 1375 to improve the agricultural production of the young state in a context of population growth and food shortage (perhaps already resulting from progressively colder environmental conditions). Other important historical marks that influenced agricultural policies were the Iberian Union in 1580, the Restoration of Independence in 1640, and the agrarian reforms during the Pombaline-enlightenment period (1752-1777).

Considering both historical and geographical studies in Portugal and in the region (e.g. Brito, 1994; Conde, 1996; Oosterbeek, 2013), the period that runs from the 15th to the 19th century can be divided into four main stages. In the first one, after major popular and bourgeois rebellions in the late 14th century, a relevant debate was conducted on how to cope with the recurrent food deficit of the country, in which it was discussed which strategy to choose: an intensification of agricultural production combined with moderate terrestrial expansion into Northern Africa (the "*sesmarias*" policy announced such a strategy, which was also at the basis of the conquest of Ceuta in 1415); or the option of developing long-distance exchanges based on commercial priority (this was already present in the Ceuta expansion, but would become dominant only after 1430 with the African Atlantic trading posts and, later, trade-based colonies). The exodus from the higher plateaux with lower agricultural productivity, combined with a contemporary coastal population growth, became a relevant demographic support for the maritime expansion of the Portuguese.

Trade would become the major economic basis of the Portuguese expansion, reaching a climax by 1500, when they reached Brazil (having

completed the maritime route to India two years before), thus dominating both the Atlantic and Indian oceans. Yet, the shortage of basic food supplies remained a reality, and the expansion itself generated cash flow difficulties by the mid-15th century, and again after 1530 (Costa *et al.*, 2011).

In stage three, the quality of the soils, the low demographic density, the emigration of a large part of the population (up to 10% according to some authors, e.g. Arroteia, 1985) and the possibility of accessing food supplies from the neighbouring country explain why the dynastic crisis of the late 16th century (leading to the union with Spain under a Spanish king) did not generate a massive rejection of the merge (as had happened 200 years before).

The final stage started with the recovery of independence in 1640, which inaugurated a process of continuous economic decay, with brief moments of improvement (namely the enlightened 18th-century leadership of the Marquês de Pombal). But, on the whole, Portugal was losing its strategic relevance in the context of an emerging capitalist global system (Hobsbawn, 1988). Hereinafter, trade would become the key component of the economy.

To what extent the food production shortage (a problem that is recurrent in Portugal even today) was a result of environmental and climatic constraints or of socio-political options (including a very early process of coastal demographic concentration) remains to be assessed. In our study, we intend to assess this process through an analysis of pollen and NPP collected in a sedimentary core from this most important humid area of central Portugal.

REGIONAL SETTING

The Paúl do Boquilobo is located in Central Portugal, in the lower Tagus Basin (Portuguese Middle Tagus region) (Figure 1), where its tributary, the Almonda River, flows into it. In this region, the Tagus River valley is bordered to the north and west by a limestone massif and to the east by an ancient metamorphic massif, the south being the sedimentary drainage basin of the Tagus. This has been infilled since the Miocene, while in the Quaternary a basin inversion caused the formation of a fluvial staircase (Rosina *et al*., 2014). The area of Paúl do Boquilobo is characterized by alluvial and fluvial deposits, its altitude varying between 12 m and 24 m. While in the limestone area the maximum elevation reaches 600 m, on the left bank of the Tagus River, to the south, the maximum elevation is close to 200 m.

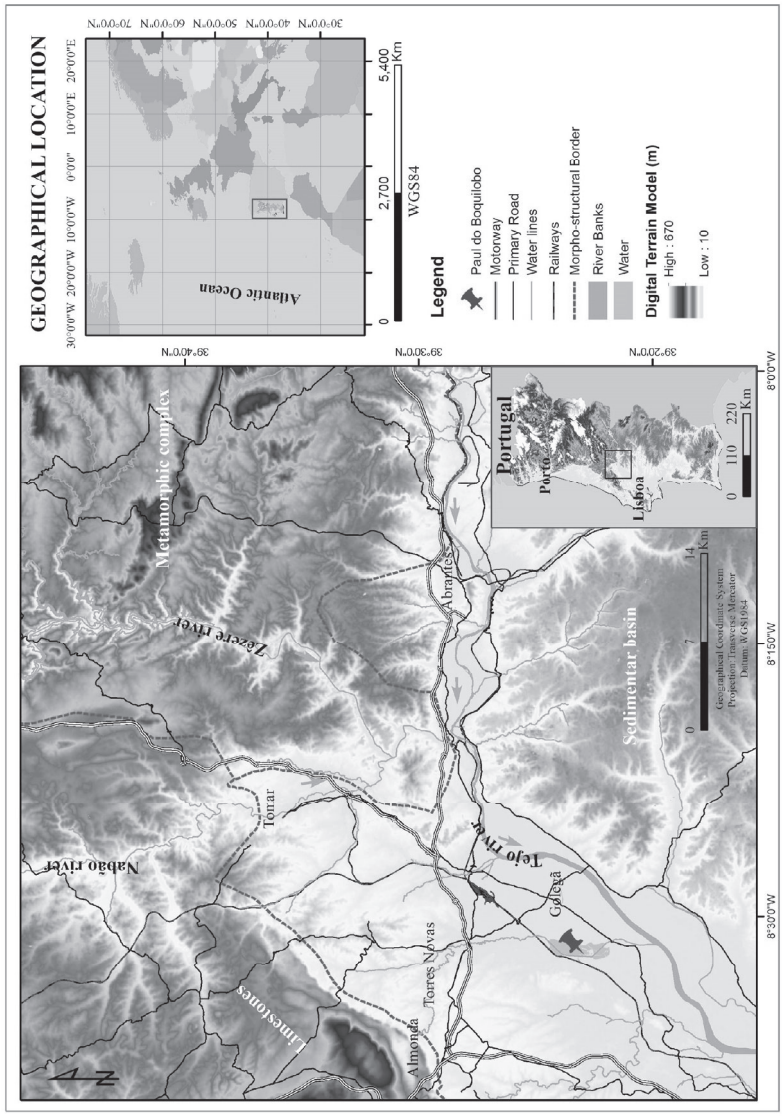

Figure 1. Geographical location of Paúl do Boquilobo.

Paúl do Boquilobo is an important humid area of this region, being seasonally flooded during the overflow of the Almonda and Tagus rivers, while the lower areas may remain flooded all the year round.

The Paúl is situated in the Mediterranean phytogeographic region (Rivas-Martínez, 1987), its environment consisting of a wetland with characteristic marshes. On the river banks, and on the edges of seasonally flooded zones, the vegetation communities are composed of riparian species like *Alnus glutinosa*, *Fraxinus excelsior, Fraxinus angustifolia*, *Salix atrocinerea*, *Salix alba*, *Populus nigra*, and *Crataegus monogyna*. In the permanently flooded area, the most abundant species are hygro-hydrophyte communities like *Nymphaea alba*, *Sparganium erectum*, *Phragmites australis* and *Scirpus lacustris.*

In the surrounding area, the fertile alluvial soils support intensive agricultural exploitation, mainly based on corn production. The outer flooded areas are nowadays the target for intensive production of *Olea europaea*, while the higher hills are mainly dominated by forestry activities (mainly *Eucalyptus globulus* and *Pinus pinaster*).

MATERIALS AND METHODS

Fieldwork sampling was carried out with a geotechnical drilling machine and the core was collected in PVC tubes. The drilling reached a maximum depth of 9.70 m. At 8.70 m a layer of clay material was reached, attributed to the Miocene.

In the laboratory, the core was divided into two sections: one for further sedimentological studies, and the other for palynological studies. A systematic sampling following a sequence of 5 cm was made, consisting of a total of 37 samples, although only 24 samples (corresponding to 2 m depth) are presented in the diagrams (Figure 4), because the remaining samples did not contain a minimum of 100 pollen and NPP.

The sediment samples from the core of the Natural Reserve of Paúl do Boquilobo were subjected to a physical-chemical treatment to isolate the pollen residue. The sedimentary samples of the core were treated by isolating the pollen residue as established by Burjachs *et al*. (2003), following Goeury and Beaulieu (1979), with modifications after Girard and Renault-Miskovsky (1969). The elimination of carbonates was achieved with the addition of hydrochloric acid (HCl) and the elimination of humic acid and clay with sodium hydroxide (NaOH). The next phase involved the concentration and flotation in dense liquor (Thoulet Liquor) and the destruction of the fibreglass filter and silicates with the addition of hydrofluoric acid (HF). The pollen residue was placed in glass slides to

allow for pollen identification and counting. The statistical study for the creation of the pollen diagrams was achieved by calculating the absolute and relative frequencies of the identified palynomorphs with *Tilia* software (Grimm, 1991-2015). The measurement of the pollen concentration followed Loublier (1978). The pollen residue was embedded in glycerine and sealed with *histolaque* to make it possible to move the sample for a more complete observation of the pollen's and NPP's morphological features, and slides were counted using an optical microscope (Olympus CX41 transmitted-light microscope).

Pollen identification was made based on Moore *et al.* (1991) and Reille (1995, 1998, 1999) and the pollen reference collection of the Archaeobotany Laboratory of IPHES (Institut Català de Paleoecologia Humana y Evolució Social, Tarragona, Spain). For NPP identification and interpretation, we followed the palaeoecological literature (e.g. van Geel, 1978, van Geel *et al*., 1981; van Hoeve & Hendrikse 1998; Carrión & van Geel, 1999).

RESULTS AND INTERPRETATION

The two diagrams of Paúl do Boquilobo presented in Figure 2 and Figure 3, including pollen and NPP dynamics, demonstrate environmental changes within a local and regional overview.

In the pollen diagram, the sequence was divided into two principal Pollen Zones (PZones A and B), numbered from bottom to top, based on the CONISS analysis (Grimm, 1987) of the pollen assemblage. The first phase should precede the Little Ice Age, even if it is without absolute dating, with a different lithology and very low pollen concentration. The same situation happens in the NPP diagram, the first phase presenting less variability than the second.

1. Pollen

The first zone (before the LIA, including the subzones A1a, A1b, A2a and A2b; Figure 2) precedes the Little Ice Age. It generally presents a low representation of trees and aquatic species and, as we can see in the diagram, a high herbaceous representation. However, this group presents very low variability.

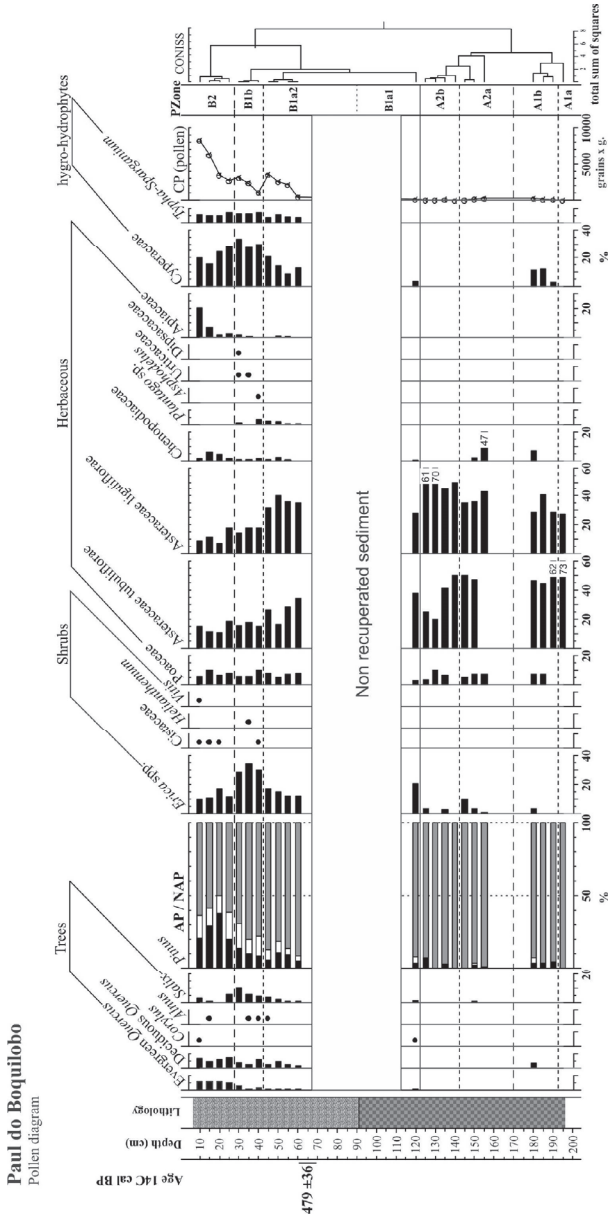

Figure 2. Pollen diagram from Paúl do Boquilobo.

The second zone was divided into four subzones (Figure 2), which include the evolution of vegetation during the LIA, taking into account the absolute dating. The subzone B1a2 presents a growing pollen concentration and it is characterized by the increase in the percentage of AP (Arboreal Pollen) as well as in taxonomic variability. We can see the increase of *Pinus* spp. such as evergreen *Quercus*, deciduous *Quercus* and some riparian species like *Salix* and *Alnus*. The NAP (Non-Arboreal Pollen) are more representative in this phase, with an important presence of *Erica* spp, but also because the herbaceous species (Asteraceae tubuliflorae type and Asteraceae liguliflorae type), as well as the hygro-hydrophytes Cyperaceae, occur in high percentages.

In subzone B1b, there occurs a small increase of riparian species (*Salix* and *Alnus*), *Pinus* spp., and *Quercus.* However, it is possible to observe that *Erica* spp. presents its highest percentage in the whole sequence, while other shrubs (Cistaceae and *Helianthemum* type) were also identified. This subzone also presents a greater variability of herbaceous species such as *Asphodelus*, Urticaceae and Dipsacaceae, but with a decrease in the representation. The hygro-hydrophytes Cyperaceae and *Typha-Sparganium* increase their representation in this phase.

In subzone B2, there occurs an increase of AP (with the highest percentage of *Pinus* spp.) and of evergreen *Quercus* and deciduous *Quercus,* and the presence of *Corylus* and *Alnus.* In comparison with the former subzone, the shrubs and herbaceous species present a decreasing tendency, with the exception of Apiaceae and Chenopodiaceae that evidence a larger representativeness. This phase also presents the highest pollen concentration.

In global terms, this second phase presents an increasing occurrence of *Pinus* spp., consistent with anthropic activities, but it also may be an indicator of a recovery of woodland communities throughout the LIA, since other arboreal taxa, such as deciduous *Quercus* and *Salix* sp., also increase their representativeness. This phase also presents a greater variability of trees species. In the areas furthest from the flood zone, with good insulation and less moist soils, a xeric forest of evergreen *Quercus*, Ericaceae and Cistaceae developed. The thermophilous taxa of deciduous *Quercus* and *Corylus* composed the forest transition. In the areas closer to the flood zones, riparian communities of *Alnus* and *Salix* developed. In this phase, there still occurs a significant representation of taxa related to an aquatic or humid environment, suggesting a phase of greater moisture. This whole set of taxa, as well as its representation throughout this phase, is indicative of the development of a more humid and temperate climate, with likely growing water levels, favouring the development of riparian

communities as well as of aquatic species. This phase also shows a greater variability of herbaceous species, which will have growing frequencies along the LIA. The identified genera and families include many species related to human activities such as agriculture, grazing, or the conditioning of spaces or paths (for example, *Plantago* spp., Chenopodiaceae, Urticaceae, Poaceae).

2. Non-pollen Palynomorphs (NPP)

The next diagram (Figure 3) shows the NPP dynamics. In the first phase (including subzones A1a, A1b, A2a and A2b), there is lower taxonomical variability when compared to the rest of the sequence. An increase of Pseudoschizaea is evident. These palynomorphs are associated with moments of erosion or the fast deposition of sediment (Scott, 1992; Pantaleón-Cano *et al*., 1996). In this case, such an increase could be related to a moment of erosion, when the flooding level went down and left the soil exposed to erosion processes, eventually accelerated by land-use intensification practices, as referred to by some authors (e.g. López-Sáez & López-García, 2003).

In the second phase, the NPP emphasizes its wetter nature, which is consistent with what was previously observed with the pollen data. The phase was divided into three subzones through cluster analyses. Subzone B1 is characterized by the presence of Pteridophytes, like *Isoetes*, which increase their representation, triletes spores and *Selaginella,* as well as some microalgae, but with low variability and representativeness; it was also possible to identify *Gloeotrichia*, *Zygnema* and *Spirogyra,* algae typical of stagnant waters. The fungi and zoo-remains were the most representative groups, influenced principally by the fungi *Glomus* spp. and the zoo-remain Type 52.

Subzone B2a, from a general point of view, presents greater taxonomic variability. However, the algae group is characterized by low values and two new taxa, *Botryococcus* and *Rivularia*, which are indicators of open waters and mesotrophic conditions (van Geel *et al*., 1989). The fungi increase their representation (Polyporisporites, Dicellaesporites, Exesisporites) and we recognized the presence of *Puccinia* and *Alternaria*-type. The zoo-remains maintained the same evolution. In the undefined group, the Pseudoschizaea present a little increase. The monolete spore *Isoetes* maintained the same values until the top of this phase, when it starts decreasing.

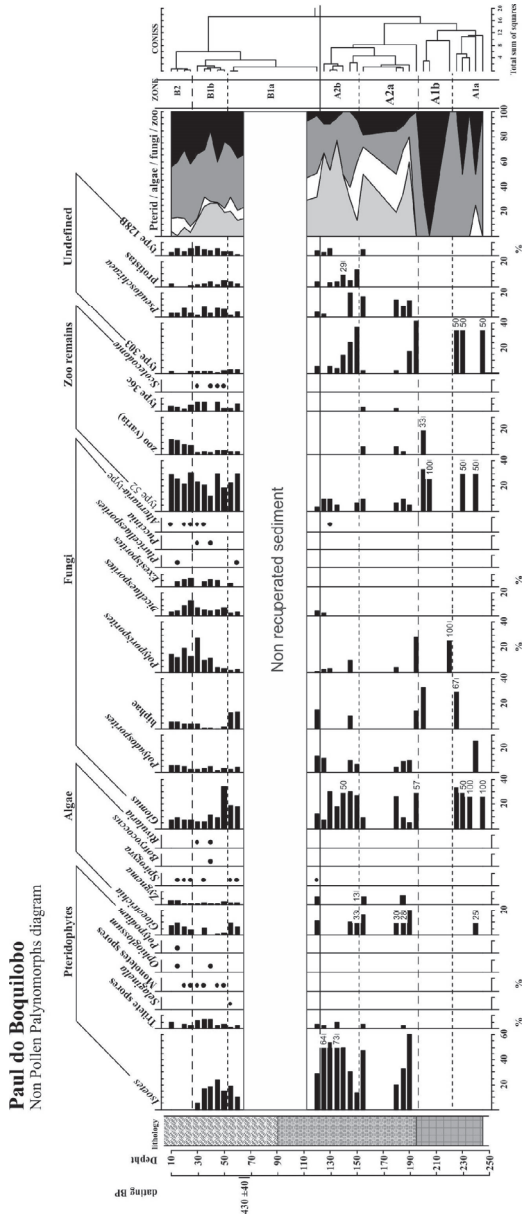

Figure. 3. Non-pollen Palynomorphs diagram from Paúl do Boquilobo.

Subzone B2b presents less variability than subzone B2a, but also presents the highest concentration of NPP. In the algae group, despite the absence of *Botryococcus* and *Rivularia,* an increase of *Gloeotrichia* and *Zygnema* may be seen. Some fungi decrease their representation, like Dicellaesporites and Exesisporites, but Polyporisporites and *Glomus* sp. show the same values. In this phase, one can also see the absence of *Isoetes* and a decrease of all pteridophytes.

Generally, in the second phase, we can observe higher variability in the group of algae, which proliferate in moist conditions, such as *Botryococcus* and *Spirogyra*, characteristic of stagnant waters in a permanent or periodical regime; *Zygnema*, characteristic of eutrophic environments, with slow watercourses; and finally *Gloeotrichia*, characteristic of areas with abundant aquatic vegetation. The higher variability of pteridophytes also suggests greater water availability and humidity.

All these palynomorphs appear following a time when riparian and aquatic species have their highest peaks. In the fungi, it was possible to identify *Puccinia* for the first time. This fungus parasitizes angiosperm leaves (van Geel *et al*., 1981). *Alternaria* was also identified; this parasitizes leaves in organic substrates and is related to wet environments (Jarzen & Elsik, 1986).

FINAL REMARKS

The Paúl do Boquilobo palynological analyses revealed that the area was influenced by climatic changes during the LIA, reflected in the variation of available water resources and related to anthropic behavioural strategies. The swamp stabilization in the site where the core was collected happened only along the last subzone (B2a and B2b, Figure 3), which was particularly evidenced by the presence of algae. Apparently, swamp location could be related not only to climate changes, but also to changes in fluvial dynamics.

In addition to climatic and environmental changes produced by the LIA, historical events, such as the new impetus for an agricultural economy, have also influenced the landscape (Figure 4). The effect of this economy option resulted in increased erosion in the period subsequent to the Middle Ages (Vis *et al*., 2010). Anthropic influence was recognized by agricultural indicators and forestry activities in the palynological record (e.g. van der Knaap & van Leeuwen, 1995; Muñoz-Sobrino *et al*., 2005; Danielsen, 2008; Morales-Molino *et al*., 2011; Danielsen *et al*. 2012).

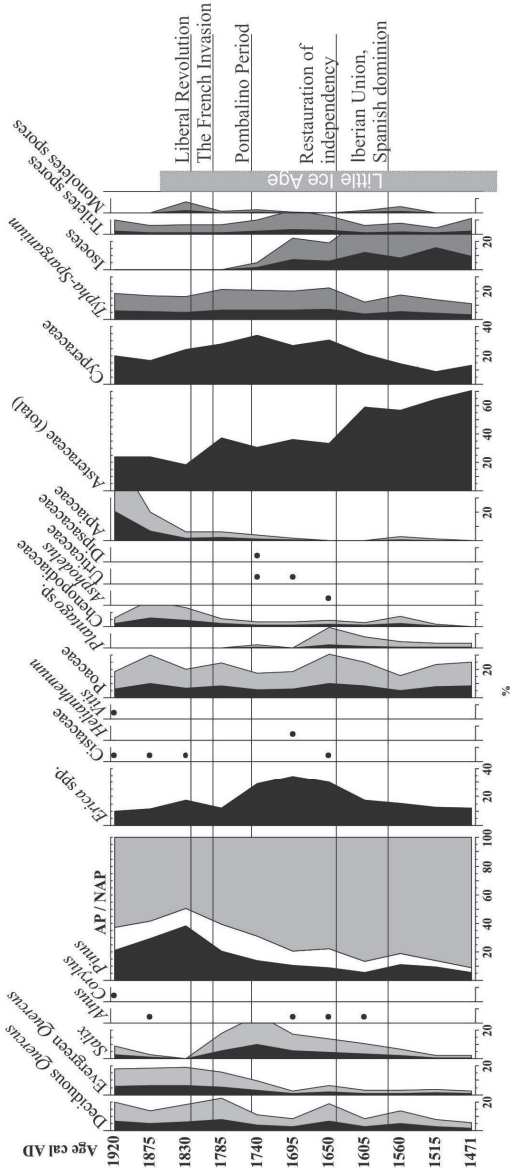

Figure 4. Synthetic pollen diagram (with estimated chronology), its relation with historical events and the Little Ice Age climatic event, based on Fagan (2000) and Le Roy Ladurie (2004-9).

The law of "*sesmarias*" was created to face the agricultural deficit, rural exodus and overlaying economic crisis, which occurred in Europe in the 14th century, and which was intended to force landowners to produce, to force descendants from farmers to remain in the same activity instead of moving into trade or related activities, and to regulate prices in order to increase food production and prevent depopulation.

Although the "*sesmarias*" law is prior to the period under study in this paper, its effects were evidenced in the appearance of species related to anthropogenic activities, such as *Plantago*, which is related to grazing activity.

With the Iberian Union (1580-1640), there was a little decrease of *Pinus* and deciduous *Quercus*, which is probably related to climatic conditions, but also to intentional deforestation to make room for agro-pastoral activities.

After the restoration of the country's independence, the beginning of the recovery of woodlands and humidity indicators can be observed, which could be associated with climatic reasons. The samples also evidenced the intensification of anthropogenic activity that extends to the Pombal Enlightenment period and its agrarian reforms.

A later increase of the woodlands could be related to climatic improvement towards the end of the LIA, but also to the countryside exodus and related agricultural decay as a result of the Napoleonic invasion (1808). It was also by the end of the LIA that major agriculture reforms were set under a liberal regime (1830), following a severe civil war that, once again, contributed to major food supply difficulties.

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CHAPTER FOUR

CLIMATE, NATURAL THREATS AND DISASTERS IN 18TH CENTURY SPAIN: NOTES FOR A HISTORICAL STUDY*

ARMANDO ALBEROLA ROMÁ

INTRODUCTION

The atmosphere and nature generate extreme hydrometeorological and geological phenomena with devastating effects. Extreme events such as persistent droughts interrupted by exceptional rainfall and big floods, heat waves followed by cold waves, earthquakes and tsunamis, volcanic eruptions or hurricanes immediately make the headlines, whether on TV or in printed and digital news. None of this is new, except for the speed at which reports reach us and the quality of the information.

We know these events are not new because, using documentary sources of high qualitative value, historical analysis allows us to establish a detailed inventory of extreme geological, atmospheric or biological events that happened centuries ago, together with the consequences and human suffering they generated. Similarly, historical analysis demonstrates that these calamities have persisted over the centuries in specific geographical areas at precise moments in time and under given circumstances. Accounts of political-administrative disaster management, economic and human damage evaluations and technical projects tested to prevent and avert problems can also be found, not forgetting references to popular religious remedies proper to modern centuries that are surprisingly

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persistent today[1].

In this study we review the extreme events that took place in 18th-century Spain and the devastation they inflicted. We highlight their reiterations in specific areas over long periods, emphasising the importance of historical analysis to understand many events that continue today. These extraordinary events are perfectly represented in "historical memory" because of the traces they left: the "ordinary" does not usually make the news. A long-term analysis allows a true catalogue of disasters to be drawn up and thus identify their frequency and respective political responses.

CLIMATIC OSCILLATIONS IN THE IBERIAN PENINSULA

Climate oscillations have had powerful impacts on agricultural yields at any time. Peasants and societies have generally always been unsettled by hydrometeorological anomalies. Similar concerns continue today, though we have the means to moderate negative effects. Global warming is highly alarming, inescapable, and its end consequences almost entirely unknown (Quereda et al., 2001; Uriarte, 2003; Martín-Vide, 2008; Toharía, 2013). But Nature's behaviour and the progressive deterioration of the environment, subject to very different threats over the centuries, are also worrying. Hence the importance of historians and their contributions as scholars of history and of the climatic and environmental past.

Preindustrial societies – dependent as they were on agriculture for their survival and progress – lacked instruments to protect them from the calamities engendered by climatic oscillations. Nor did they dispose of – at least until the Enlightenment – essential scientific-technical tools to develop precise observations, for example, of temperature, rainfall, cloudiness or winds that led to an understanding of climatic variability. This information was crucial in the sixteenth to 18th centuries because a mini glaciation called the Little Ice Age (LIA) took place during this period (Grove, 1988; Lamb, 1972; Alberola-Romá, 2014).

This climatic pulsation occurred after the *Medieval Climate Optimum* and lasted from the beginning of the fifteenth century until the mid-19th

[1] There are many sources that provide information, among them: civil and religious public documentation (municipal, notarial, ecclesiastical councils, resolutions of Monarchy Councils, expert reports, etc.), private documentation (correspondence, diaries, records of trips, notebooks of farmers, etc), dates of harvests of wine or salt, consumption of firewood and coal, rogations, etc. See all this in Alberola-Romá & Mas-Galvañ, 2016; Alberola-Romá, 2016; Martín-Vide & Barriendos, 1995.

century. It had a global reach and was characterised by the progressive cooling of the terrestrial climate. The LIA coincided, in its most acute phase, with the Modern Age, and its essential features consisted of great variability, irregularity and meteorological extremism, causing the relative worsening of environmental conditions, a drop in average Earth temperatures of around 1ºC-2ºC, greater frequency of winter cold in central and northern Europe and a substantial increase in rainfall. Abundant information from official and private sources (see Alberola-Romá & Mas-Galvañ, 2016 for a compilation of these sources) offers a detailed description of people's sufferings as a result of poor harvests, the escalation of grain prices and the appearance of famines, epidemics, social unrest and riots. In sum, beyond the climate, the crisis was demographic, economic and social.

COLD AND HEAT

The Iberian Peninsula suffered the consequences of two oscillations or 'anomalies' at the beginning and the end of the 18th century. The first phase was the final phase of the Maunder minimum (1645-1715); the second was the 'Maldá Oscillation' that prevailed over the century's last four decades (Barriendos & Llasat, 2003). Despite a moderation in temperatures, 'climate disorder' reigned in the middle of both phases. There were continued contrasts and variations. Very cold periods alternated with extreme heat, while simultaneous extreme hydrometeorological events were ever more frequent.

At the beginning of the 18th century, the cold and instability that had prevailed since 1645 coincided with the cruel years of the War of Succession and the severe winters of 1708-1709 and 1716 (Kamen, 1974; Le Roy Ladurie, 1991, 2004; Font, 1988, 71-94; Alberola-Romá, 2014). Official documentation, accounts by chroniclers, *dietaristas* and the correspondence of some enlightened individuals bear witness to all of this; moreover, 1717 and 1718 had very hot and dry summers that lasted into the twenties, coinciding with harsh local droughts and very poor harvests (Alberola-Romá, 2009a, 2014). Cold winters took place in the years 1726 (especially in the Mediterranean basin), 1728-1729, 1738-1739, 1739-40 (the 'great winter' that affected the whole Peninsula), 1744-1745, 1747, 1748 ("*that were cruel and extremely icy")*, 1754-1755 and 1758 during which, according to Martínez Pingarrón, the royal librarian, *"the whole of Madrid turned into a block of ice"* and the *"cruel"* cold caused several deaths (see Alberola-Romá, 2009a). The following summer was terrible, with intense drought, extraordinary heat and abundant diseases. The winter

of 1750 turned out to be humid and very chilly in the Cantabrian Mountains and the northwest of the peninsula. The correspondence of different enlightened individuals reveals ample news and references to the harsh summers of the forties and fifties. Records can be found of the atmospheric instability under which Carlos III arrived in Madrid in early December 1759.

During the second half of the 18th century, winters were cold and humid while summers were of intense heat; nevertheless, the feeling of atmospheric disorder was accentuated by repeated and extreme opposite episodes, as is widely recounted in official and private documentation and in instrumental observations by institutions and individuals that I had the opportunity to study in detail (see Alberola-Romá, 2009a, 2015). With the 'Maldá Oscillation' (Barriendos & Llasat, 2003), the sixties inaugurated a new cold phase marked by big freezes in December 1763 in the interior, the terrible winter of 1765-1766 in which the Ebro river froze as it passed through Tortosa, the cold summer of 1766 throughout the north of the peninsula, frequent heavy snowfalls – in 1766, 1774 and 1779 –, perilous summer storms and hailstorms, and the great wind and rain storms, such as those that shook the Spanish Levante at the start of October 1779. These climatic disorders became increasingly frequent in the eighties. A thermal recovery took place in 1790 lasting until the end of the third decade of the 19th century, although there was a cold wave in January 1797 in the northeast of the peninsula during which the Llobregat River froze. The succession of mild winters and hot summers normalised and there is no evidence of great cold or exceptional frosts, except in January 1806, especially in Castilla and even in the Mediterranean (Alberola-Romá, 2014).

DROUGHT AND FLOODING

Drought is inherent to a large part of the Iberian Peninsula because of its geographical position in the Mediterranean basin. During the 18th century, local and short cycle droughts prevailed, though generalised and long droughts took place in 1749 and 1753. *Pro pluvia* rogations, penitential processions, sermons and other religious ceremonies provide excellent evidence and allow an inventory of the most destructive droughts in Hispanic lands to be established (Martín & Barriendos, 1995; Alberola-Romá et al., 2016). Based on the correspondence of a variety of enlightened individuals, heat and drought dominated the mid-century, and the situation worsened after the loss of a number of crops (Alberola-Romá, 2009a). There was hunger and social unrest. Subsistence riots took place,

such as those that would bring down the Finance Minister, the Marquis de Esquilache, in 1766, at court.

The drought severely affected the Levante and the Balearic Islands in the years 1772-1774, 1779 and 1792. A terrible drought struck the Aragon region of the Monegros between 1779 and 1784 as well as the northern plateau between 1779 and 1796. Documentary sources describe an "extreme and detrimental" drought in 1792 that affected Valencian and Murcian lands. A 1799 drought over the whole of the southeast is described as "*tremenda"* (devastating). The sources also emphasise the 1801 drought that battered these same lands and Andalusia: it lasted until 1803, ended the harvests, and caused food shortages, and the year 1803 was subsequently remembered as the "year of hunger" (Alberola-Romá, 2009b).

In stark contrast, intense rainfall also dealt a blow. Rivers overflowed, fields and towns were inundated, but this did not solve the problems of the droughts. Abundant official reports were sent to the Council of Castile. They demonstrate the immediate mobilisation of political leaders in the affected areas and the use of all available means of disaster relief. Chroniclers, popular literature and the press also addressed these events from different informative, scientific and religious perspectives (see Alberola-Romá, 2015 for a compilation and analysis of sources on the topic).

In the first half of the 18th century, Catalan rivers regularly overflowed every four years in the autumn. They caused disasters in the Ampurdán, the Maresme and the Tarragona regions, particularly in the case of the river Ter – 1716, 1726, 1732 and 1737 – and the Llobregat – 1726, 1734 and 1749. Valencian rivers behaved in an identical way, especially the Júcar, which flooded in 1709, 1714 and 1716. The Segura river flooded more than twenty-six times. In the thirties, heavy rains caused big floods in the northern plateau, Andalusia and the Levante. Also worthy of note are the floods of the Turia river in Valencia in September 1731 and in the spring of 1736, and the floods that affected Orihuela in June and September 1731 and 1733, April 1736, October 1739 and November 1745 (Alberola-Romá, 2010, 96-115). Following the 1743 floods, the Ebro river floods also caused significant damage to riverside towns, especially Zaragoza and Tortosa.

During the last third of the 18th century, severe climatic anomalies abounded. Worthy of note is the simultaneous nature with which exceptional and extreme hydrometeorological episodes occurred in the Mediterranean area with devastating consequences. Humid summers and autumns combined with early and extreme winters followed by cold and

snowy springs were lethal for agriculture. Contemporary commentators clearly perceived the situation[2]. They gave accounts in their own diaries or epistolary correspondence, making records of what they believed was a climate mutation that was altering the normal functioning of the seasons[3].

The seventies were relatively dry during the first half of the decade and quite rainy in the second half. Worthy of note are the generalised precipitations on the Atlantic front during the 1777-1778 biennium. There was significant stormy activity in the Mediterranean basin during 1778 and 1779: the Turia flooded Valencia in the autumns of 1770 and 1776, and the Segura flooded Orihuela in 1773 and 1776. Salamanca and Girona were submerged in January and December 1777 (Alberola-Romá, 2014, 200-208).

Rainfall and climate disorder increased in the eighties, undoubtedly affected by the volcanic eruptions of Laki (in Iceland in 1783), Asama (in Japan in 1783) and Vesuvius (in Italy in 1787) (Alberola-Romá, 2012a). Catalonia sustained big floods (in Mataró, August 1783) as did the Valencian region (in Cullera, Sueca and Orihuela in 1783 and 1784) and the town of Valencia (1784). At the end of 1783, Seville was devastated by a great flood of the Guadalquivir. Precipitations were very heavy in the first months of 1786 in Andalusia, Galicia and the Cantabrian cornice and, the following year, violent storms and torrential rains lashed the Mediterranean coast in January and in the autumn, producing floods in Catalonia and resulting in fatalities and great destruction. At the end of September, the Aragón River flooded Sangüesa, and at the beginning of October the Ebro flooded Tortosa (Alberola-Romá, 2014, 217-218). The year 1788 was very rainy and unstable: in February, Zamora, Salamanca and Valladolid were flooded and, at the end of summer, an imposing storm swept north-east, causing the Ebro and Segura to overflow once again.

In the latter part of the century, high-intensity spring rainfall on the northern plateau proliferated, as evidenced by numerous rounds of *pro serenitate* (1793 and 1799). In autumn, torrential rains caused numerous Catalan rivers to overflow, flooding Girona (1790), Montblanc and Tarragona (1792), Badalona (1795) and the Llobregat delta (1793, 1794, 1797, 1799). A major storm hit the whole Valencian region in September 1793 causing fatalities and substantial damage to roads and hydraulic infrastructure in Castellón de la Plana, Alcoy, Valencia and the south of Alicante (Alberola-Romá, 2014, 228-230). Before this, the Júcar had

[2] For example, the 'baron' of Maldá (Barriendos & Llasat, 2003), Father Teixidor or Fray José Rocafort (Alberola-Romá, 2014, 2010).

[3] For a more detailed analysis of these events, see the study by Alberola-Romá and Arrioja in this volume.

flooded Alzira and Algemesí in September 1791 while the Turia had flooded Teruel in July. At the end of the century, a new "tragic and disastrous" Segura flood submerged Orihuela in October 1797. The drought, however, struck these lands again in 1800 and continued until 1807, according to the countless *pro pluvia* rogations held (Zamora, 2002).

OTHER THREATS AND DISASTERS: DISEASES AND PLAGUES

Climate oscillations in former times constitute one variable among others – both endogenous and exogenous – that have conditioned the development of societies. Other catastrophic manifestations of Nature, such as earthquakes or volcanic eruptions, environmental conditioning factors, calamities due to diseases or the effects of pests on agriculture have had huge impacts at all times. For reasons of space, we will leave earthquakes aside and focus on threats of biological origin, which are closely linked to existing environmental conditions.

Tertian fevers, or malaria, took over from the much-feared plague in the 18th century. Considered in the Mediterranean as '*la enfermedad del medio*', i.e. a disease linked to the environment, it appeared as soon as summer heats fell on depressed and flooded areas as well as rice fields (Braudel, 1976). Although mortality rates were not worrisome, its high morbidity and invalidating effects meant the disease had notable economic impacts since it affected peasants during the harvests, a key moment in the agrarian cycle (Peset, 1972; Mateu, 1987; Alberola-Romá & Bernabé, 1998-1999). The combat against tertian diseases consisted of both therapeutic measures and legal provisions to limit the expansion of rice cultivation and foster the drying of coastal lagoons, interior lagoons, and marshlands.

Extraordinary rainfall took place throughout the century, mainly in the Levante region, but increased during the last quarter of the century, causing a proliferation of flooded areas. Thus, when the great 1783 epidemic begun in Lérida, tertian fevers spread beyond their usual territories and reached Catalonia, Aragon, La Mancha, Castilla la Nueva, Andalusia and Extremadura, transforming an endemic disease into an epidemic (Alberola-Romá, 1985; Alberola-Romá & Bernabé, 1998-1999). The impact was devastating: in 1786, almost one million people were affected, and over 100,000 died (Pérez-Moreda, 1980, 342). Doctors in La Alcarria, Almagro, Ciudad Real or Puertollano describe how malaria settled in 1784 and did not retreat until the beginning of the nineties. Other physicians, such as Manuel Troncoso or Antonio Ased Latorre, published booklets in which they linked the outbreak of tertian fevers in Córdoba

and Aragón to intense rainfall (Alberola-Romá, 2015, 11-14). The Royal Medical-practice Academy of Barcelona (*Real Academia Médico-práctica de Barcelona*) also kept numerous reports in its archives (*Memorias)* on the epidemics suffered by several Catalan cities at the end of the century (Alberola-Romá, 2015).

Variations in environmental conditions were also linked to the formation of locust pests. The locust of the *Thunberg Dociostarus maroccanus* genus, as well as the *Calliptamus italicus*, was endemic in the Iberian Peninsula in past centuries. Its reserve areas or herd foci were in the pastures of Extremadura, Andalusia and La Mancha and the Aragon region of Monegros. Whenever environmental and climatic conditions in these enclaves were appropriate, this naturally solitary orthoptera turned into a social animal and formed dreaded plagues that were instantly associated with divine punishment for committed sins. For that reason, technical-legal measures set up by authorities coexisted with spiritual remedies encouraged by the Church (Alberola-Romá, 2005; 2012b, 21-50). The former consisted of organising groups of volunteers armed with whips or large butterfly nets to capture as many specimens as possible and to bury them or set them on fire. Other measures included: the ploughing of empty land to avoid hatching, releasing pig herds to devour the so-called "*canutos*" and thereby prevent them from reproducing the following spring, the constant monitoring of fields and meadows, etc. Despite their limitations, poor effectiveness and high cost, these measures were legally grounded in 1755 with the 'Instruction' (*Instrucción*) promulgated by the Council of Castile[4].

In the first half of the 18th century, locust attacks occurred in 1708-1709, 1721, 1723 and 1727 (López & Aponte, 1993, Alberola-Romá, 2012b). However, the greatest plague began in the summer of 1754 in Extremadura, spreading to Portugal, La Mancha, Andalusia, Albacete, Murcia and Valencia. It lasted until 1758 and had a huge impact because of the large territory involved. Its lethal effects on agricultural production put an end to three harvests. During its course, the 1755 *Instrucción* mentioned above was approved, establishing the rules to follow in the case of locust plagues. William Bowles, an Irish naturalist at the service of the Spanish Crown, described the effects of this plague in his *Introduction to Natural History* (1775), characterising the morphology and customs of the orthoptera in its different states and recommending certain actions to combat it effectively (Alberola-Romá, 2005, 2012b). On 14 October 1756,

[4] *Novísima Recopilación de las leyes de España mandada formar por el señor don Carlos IV*, Libro VII, Título XXXI, ley VII, pp. 651-659.

the impact of the plague led Fernando VI to ordain the San Gregorio Ostiense relics to be removed from their Navarra sanctuary and be brought across a large area of the Spanish peninsula. The truth is, despite being considered the most powerful anti-locust talisman, the saint's remains ultimately bore little effect: the plague extinguished itself when appropriate conditions appeared (Alberola-Romá, 2012b, 41-45).

There were plague alerts almost every year between 1770 and 1800, and some of them were unfounded. In the seventies of the 18th century, infestations affected Toledo, Talavera de la Reina, Toro, the Alcudia Valley, the Campo de Montiel, the La Mancha areas of Alcaraz and Almagro, the Extremadura towns of Castuera and La Serena, some Sevillian counties and the Aragonese Monegros (Gascón, 1994; Vázquez & Santiago, 1993; Alberola-Romá, 2012b; Alberola-Romá & Pradells, 2012). In the last two decades of the 18th century, persistent drought coexisted with substantial increases in exceptional rainfall with disastrous effects and great thermal alterations. Thus, hydrometeorological disasters and tertian fever epidemics were accompanied by new locust attacks at the usual locations in the years 1780-1783, 1786-1790, 1791-1791, 1795-1796 and 1798. At the end of the century, extreme weather conditions contributed to the disappearance of plagues, although they would also cause a succession of bad harvests, an increase in the price of grain, hunger, crisis and social unrest, a prelude to the difficult years of the War of Independence.

FINAL REFLECTIONS

During the 18th century, a range of exceptional hydro-meteorological and biological episodes lashed the Iberian peninsula with devastating consequences, leading to significant material and human disasters and economic and demographic crises. The events gave rise to abundant handwritten and printed information, which has allowed me to create a detailed picture of how and when the episodes took place, the extent to which people, goods and infrastructures were affected as well as the before and after of economic and social realities in the affected territories. Adopting a historical perspective when studying these events allows us to identify the systematic recurrence, if not the survival, of phenomena – especially hydrometeorological events – that continue to occur at certain times of the year and cause considerable destruction and alterations in the territory, as well as economic losses, thousands of victims and, sadly, a large number of deaths.

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CHAPTER FIVE

CLIMATIC EXTREMISM AND CRISIS ON THE IBERIAN PENINSULA AND NEW SPAIN (1770-1800): NOTES FOR A COMPARATIVE STUDY*

ARMANDO ALBEROLA ROMÁ
AND LUIS A. ARRIOJA DÍAZ-VIRUEL

INTRODUCTION

From 1450 to 1880, Europe and North America were dominated by a climatic pulsation known as the Little Ice Age (LIA), which caused marked variability in temperatures and atmospheric conditions. This was not a case of homogeneous climate change but, rather, of the continuous presence of natural anomalies (Lamb, 1972; Grove, 1988; Bradley & Jones, 1992). One singular phase of those anomalies occurred near the end of the 18th century along the Mediterranean fringe of the Iberian Peninsula, leaving people of that time with the sensation that they were experiencing previously unknown climatic behaviors. Spanish historiography has called this pulsation the *Oscilación Maldà* (Maldà Oscillation), for it was distinguished by numerous extreme hydrometeors and failed harvests (Barriendos & Llasat, 2009; Alberola-Romá, 2008, 2010, 2012).

But those anomalies also manifested themselves on the other side of the Atlantic, in the Vice-Royalty of New Spain, where periods of extreme drought and heavy rains were a constant in the 1770-1800 period, devastating fields and triggering severe agricultural crises. As in the Mediterranean, those events were documented and gave rise to reflections on the evolution of the climate and nature (Florescano, 1969; Florescano

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& Swan, 1995; Garza, 2014). The coincidence of these alterations on both sides of the Atlantic was no accident, because the root cause was found in the pulsations of the LIA. This chapter analyzes the correlations among, and the scope of, those climatic alterations on the Iberian Peninsula and New Spain between 1770 and 1800.

"CLIMATIC DISORDER" AND ITS CONSEQUENCES (1770-1779)

By the end of the Maünder Minimum cycle in the 18th century, Europe and America were moving towards a warmer phase. Spain experienced the thermal variations and extreme episodes of the so-called *Maldá Oscillation* (Alberola-Romá, 2014; Barriendos & Llasat, 2009; Alberola-Romá, 2014, 116-130, 199-248; Alberola-Romá, 2010, 168-219). It is well-known that this *Oscillation* affected atmospheric circulation and caused long, harsh winters, short, cool springs, and very hot summers. Torrential rains and floods also formed part of these changes, while droughts occurred as a colophon that impacted all of Spain. This is confirmed by contemporary documental and periodical sources, such as the *Memorial Literario*, whose pages included "meteorological diaries" and news on catastrophic hydrometeorological events (Alberola-Romá, 2015; Alberola-Romá & Mas, 2016; Mas, 2017). Other observations were made using scientific instruments that confirmed those climatic oscillations (Alberola-Romá, 2008). We also know, for example, that drought was a widespread phenomenon between 1770 and 1779 (Alberola-Romá, 2014) that depleted harvests and caused disease and social unrest (Alberola-Romá & Pradells, 2012). As if this did not suffice, between 1776 and 1783 Spanish agriculture also suffered from the occurrence of plagues, epizootics and floods (Alberola & Arrioja-Díaz, 2019).

On the other side of the Atlantic, experiences in New Spain revealed that droughts were recurrent and intense, as from 1770 to 1809 no fewer than 11 episodes were recorded (Florescano & Swan, 1995; García-Acosta *et al*., 2003). The drought of 1770-1772 deserves special attention because it was accompanied by circumstances that increased its intensity and generated multiple problems. That phenomenon affected the provinces of México, Puebla, Oaxaca, Veracruz, Tabasco and Yucatán, bringing freezing winters, intense summer heat, and plagues of locusts. Documents from the time registered the hardships that arose[1]: famine, disease, death,

[1] Archivo General de la Nación, México (AGNM), *Alcaldes mayores*, vol. 1, exps. 118-122; AGNM, Tributos, vol. 52, exp. 1.

shortages of all kinds and scarcity of food (Arrioja-Díaz, 2016; Peniche, 2009; Quezada, 1995).

Although the climatic alterations of the period played a determinant role in the appearance of droughts and plagues, it is also true that the presence of other phenomena contributed to their formation. Here, we refer to five volcanic eruptions that occurred in the Kingdom of Guatemala: Momotombo (1764), Pacaya (1765), Cerro Quemado (1765), Izalco (1770) and Masaya (1772). As is well-known, eruptions were always a key element in the climatic variations of the LIA; indeed, a quick look at the annals of history suffices to appreciate how those events played havoc with temperatures, solar luminosity, trophic chains, and the life of many animals (Arrioja-Díaz, 2016).

While we have already mentioned that drought was a threat on the Iberian Peninsula, it was not alone, but accompanied by flooding, swollen currents and rivers that overflowed their banks. This was a constant, for example, for the Ebro, Duero, Guadalquivir, Llobregat, Ter, Francolí, Segre, Besós, Júcar and Turia Rivers. We cannot forget smaller Mediterranean streams that, though usually dry, could be transformed into perilous torrents when intense rains occurred. These precipitations of high intensity, so characteristic of the Spanish Levant, abounded in 1775-1780, causing numerous problems, as towns were flooded, fields washed away, infrastructure damaged, and communications cut. Clear evidence of these contrasts were the supplications to relieve these phenomena – both *pro pluvia* and *pro serenitate* – that were raised to the Heavens on similar dates and in places not widely separated.

Between 1770 and 1819, Rafael Amat y de Cortada, *barón* de Maldá, noted in his diaries innumerable news bulletins on the climate that referred to Catalonia[2], while the Augustinian José de Rocafort and the Dominican José Teixidor did likewise for Castellón and Valencia, and other local chroniclers and scholars recorded events that occurred throughout Spain (Alberola-Romá, 2010, 2014). Meanwhile, ledgers and other public documents provide evidence of floods and deluges that they described as "extraordinary", or "terrifying avenues". In 1776, the Turia River destroyed the Mar Bridge and caused flooding in Valencia. Around the same time, the Segura River inundated the city of Orihuela on three occasions (Alberola-Romá, 2005, 2010, 125-163). In Catalonia, overflows of the Besós and Llobregat Rivers provoked similar disasters, and, barely a year later, Girona was submerged by the waters of the Ter, Onyar, Galligants and Güell Rivers. In 1779, the Francolí River overran its banks

[2] Known as the *Calaix de sastre*, it fills 52 volumes written between 1769-1819.

and ravaged bridges in Valls, while the Júcar, Serpis, Montesa, Albaida and Sellent Rivers all swelled to such a degree that they caused extensive damage in Xàtiva, Alzira and Gandía (Alberola-Romá, 2010). In stark contrast, that decade ended with droughts in the Levant and frequent torrential rains in the province of Valencia.

For New Spain, we do not have abundant studies on floods and deluges in the 18th century, but recent work by Adrián García-Torres and Mario Cuéllar allows us to at least approach this reality (García-Torres, 2018; Cuéllar, 2017). Thus, we can suggest that between 1770 and 1779 there was a concordance between the extreme phenomena that precipitated over the Iberian Peninsula and New Spain – a concordance that acquires nuances as a function of the physical particularities of each territory, the predominant atmospheric conditions on both sides of the Atlantic and, above all, the actions that human groups performed – or failed to perform – to contain those climatic pulsations.

THE COMPLEX DECADE OF THE EIGHTIES

The recurrent presence of climatic anomalies in 18th century Spain was one expression of atmospheric disorder on a global scale that brought on numerous, and no less exceptional, events of an exogenous character, including the eruption of the Laki volcano in 1783 that set off an environmental and human catastrophe in Iceland, altered the atmosphere of both Europe and North America, and perturbed temperatures and agricultural yields worldwide (Alberola-Romá, 2012; Barriendos & Gómez, 1997). Indeed, we know that this eruption aggravated climatic conditions in Spain, as shown by the deluges that occurred in Aragón, Catalonia and Valencia between 1783 and 1784[3] (Alberola-Romá, 2010, 2012, 2014). Special mention must be made of the 1783 season, which impacted regions throughout Valencia, damaging fields and destroying communications with Catalonia. This was another period that witnessed the emission of abundant implorations *pro serenitate* in many places in Catalonia. In Andalusia, meanwhile, the Guadalquivir River overflowed its banks in December 1783, causing enormous problems in Seville, as Cándido María Trigueros described in his epic poem, *La Riada*.

These hydrometeorological excesses did not go unnoticed by contemporaries. Around 1785, the atmospheric variations became so disconcerting that some men, like Maldá, penned in their diaries that the

[3] There are abundant reports of significant cases where rivers swelled or overran their banks, including the Gállego, Cinca, Llobregat, Besós, Francolí, Montlleó, Millars, Palancia, Júcar, Turia and Segura (Alberola-Romá, 2010).

situation was "extraordinary" and that the climate was changing. Reports on affected populations mention alterations in temperature, humidity and agricultural cycles, while some physicians commented on the effects that these "excessively humid" seasons were having on human health. Between 1785 and 1789, excessive rains fell constantly. In 1785, the Júcar River flooded the city of Alzira, and between 1786 and 1787, rain dominated life in Andalucía, Galicia and Cantabria. In those years, as well, spring storms caused flooding in Catalonia, overflowed the Ebro River, wreaked destruction in Tortosa, and triggered severe problems in the Ebro delta.

The year 1788 was especially cold and wet, with widespread flooding in Castile and Navarra. In September of that year, an atmospheric perturbation swept across Tarragona to the frontier with France, causing the Ebro River to once again fill the streets of Tortosa with water, while the cities of Barbastro and Fraga succumbed to the enraged currents of the Vero and Cinca Rivers. Barcelona and its surrounding area remained under water for several weeks, and the city of Orihuela was flooded by currents from the Segura River. At the end of that year, temperatures descended to the point that the Ebro River was frozen for two weeks. The consequence of these events included severe affectations of agricultural activities and shortages of seed and bread that triggered crises, starvation and popular unrest[4].

By 1789, shortages of all kinds coupled with price increases set off riots in Barcelona and other localities in Catalonia. Of course, it was in July of that year that the French Revolution broke out, preceded by intense cold in January and February, late snowfalls in March, and droughts that once again threatened agricultural production. That decade turned out to be a dreadful one for the Spanish Mediterranean, because the agricultural crisis was worsened by outbreaks of malaria caused by the excessive humidity. Little by little, this disease advanced into the peninsula until it reached epidemic proportions.

In New Spain, climatic conditions during the 1780-1789 period were also marked by sudden changes. It is clear that the cycles of precipitation from 1780-1784 were considered "beneficial", but this was not the case for the two-year period 1785-1786, which was called the "biennium of hunger". In fact, some authors consider this the period that experienced the most severe climatic and agricultural crises reported for New Spain (Florescano, 1969; Pastor, 1980). Those two years witnessed the convergence of a whole series of natural threats that collapsed agricultural production. Droughts were a decisive phenomenon in that crisis, for they

[4] Archivo Histórico Nacional (AHN), *Consejos*, legs. 37168, 37185 and 37195.

struck precisely the zones where corn production predominated, known as "Mexico's breadbasket"; that is, the central region, the so-called *Bajío* and the western provinces. It is likely that the only areas that did not suffer those ravages were the south and southwest, but as the drought conditions in the center of the Vice-Royalty intensified, all outlying areas were forced to transport their seeds to the affected zones. The situation became so complex that many towns in Oaxaca, Puebla and Veracruz were deprived of food. (Pastor, 1980, 30-31; Arrioja-Díaz, 2011, 95-100)

Drought also interfered with trophic chains, allowing the proliferation of predatory animals and, as a result, the deaths of species that acted as barriers to biological threats. In addition, many crops were invaded by plagues of fungus (*chahuistle*), weevils, locusts, worms and rodents. The water level in some aquifers fell and some fish species experienced severe reductions. Something similar occurred with flocks of small livestock, as they were attacked by ticks (*Riphicephalus microplus*) and contagions of *babesiosis* (also a form of tick infection). The absence of rain also reduced the multiplication of plants, roots and tubers that complemented human diets. The problems generated by those events were manifested in multiple ways: starvation, scarcity, shortages, privations, implorations *pro pluvia*, and outbreaks of unrest (Florescano, 1969, 149; Pastor, 1980, 35-36).

Drought was followed by frosts and, with them, disease. These climatic alterations were instrumental in allowing a series of microorganisms to proliferate in spaces where they never existed in olden times. These disorders were followed by outbreaks of disease that ravaged the poorly-nourished populations (Behringer, 2010, 96-97). The consequence of all this was that approximately 500,000 people died throughout the Vice-Royalty. While mortality rates certainly provide stark evidence of climatic and agricultural crises, they are not the only signs, for we know that the after-effects of these climatic pulsations caused many marriages to be postponed, lowered birth rates, carried away many mothers and fathers, and erased thousands of children from the nation's population pyramids (Robinson, 2005). Indeed, some historians have suggested that the climatic pulsations of the 18th century should be understood as a key factor that triggered emancipation movements in New Spain (Florescano, 1969, 22-30; Davies, 1972, 481-524), movements that, we should note, proceeded under torrential rains, atypical hailstorms, suffocating summers, and monumental floods.

THE FINAL DECADE: ATMOSPHERIC CONTRASTS, DESTRUCTION AND CRISIS

Beginning in 1790, Spain experienced a thermal recovery that extended until 1840, but the period was still marked by persistent harsh winters, short wet springs, and hot summers. In Mediterranean lands, the co-occurrence of drought with sudden copious rainstorms continued to predominate. Once again, evidence for the seriousness of these climatic alterations comes from the abundant prayer meetings *pro serenitate* and *pro pluvia* that took place.

This is not the place to catalogue the many ravages wreaked by the floods of 1790-1800; rather we will simply note that these phenomena occurred throughout the Peninsula: Ter and Onyar (1790), Llobregat (1792), Francolí and Besós (1792, 1795), Ebro (1793, 1794, 1797, 1799), Júcar (1791, 1794, 1795), Serpis, Montnegre and Vinalopó (1793) and Segura (1796, 1797) (Llasat *et* al., 1999; Alberola-Romá, 2010). However, it is important to emphasize, specifically, the atmospheric perturbation that occurred in Valencia in 1793. Documents indicate that those seasons discharged copious amounts of water that, literally, formed avenues which destroyed mills, roads, harvests and towns from Castellón to Murcia. In subsequent years, summer storms and hail abounded in the provinces of the interior, especially in 1793, 1794, 1795, 1796 and 1799 (Alberola-Romá, 2005, 2010). In the year 1794 alone, almost 400 households in Burgos lost their harvests after a severe September hailstorm. Just two years later, hailstorms in June once again devastated the province of Burgos (Sanz, 2013, 117-140).

While the 1796 drought in the Levant was dreadful, Aragón and Seville suffered "terrible inundations", while the city of Orihuela was deluged by the "tragic flood" of San Nicasio in 1797. In the ensuing years, atmospheric instability worsened and water scarcity continued into the early 19th century with, obviously, prejudicial effects on agricultural production and cattle-raising (Anes, 1970, 147-154).

The re-incidence of these extreme expressions of nature concerned the government to the extent that the Count of Floridablanca dictated – between 1777 and 1792 – providences to the councilors of Castile and provincial *intendentes* to help them confront these disasters. The complaints and memorials of the time offer lamentable and conflicting images of the lived reality, as in the case of the orders that Floridablanca sent to the Count of Campomanes to quickly attend to the needs of the towns devastated by floods, frosts, droughts or plagues.

In contrast to those wet conditions, scarce precipitation was a recurring condition in the Indian territories. For New Spain, we know that drought occurred in 1796-1797, causing the widespread destruction of crops. Then, in 1809-1810, this phenomenon returned with similar intensity, generating a widespread agricultural crisis (Florescano, 1969, 146; Florescano & San Vicente, 1985). The 1796-1797 drought primarily affected the provinces of Oaxaca, Veracruz, Tabasco and Yucatán, which were predominantly populated by Indigenous peoples who practiced subsistence agriculture. In addition to its ravages on agriculture, this drought served as a prelude to the activation of the endocrine systems of millions of insects that soon came to form a particularly damaging plague. Thus, the chain of droughts, locust plagues and climatic disorders together created a situation so adverse that in some towns those events transcended in time and were expressed in the local memory in writings that speak of fear and desolation (Arrioja-Díaz, 2012).

Many of these alterations had direct repercussions for the geography of New Spain. In some places, people simply ceased to plant seeds, some fruit crops were extinguished, and never-before-seen plagues destroyed plants and animals. In others, new species were introduced due to the migrations of certain animals and vegetable species seeking to adapt to the new environmental conditions.

CONCLUSIONS

Any approach to the history of climate in the Iberian Peninsula and Mexico during the 1770-1800 period necessarily entails examining the terminal phase of the so-called Little Ice Age (LIA) and – above all – linking this to a series of extreme natural phenomena that profoundly impacted those territories. Without doubt, this was a time in which conditions both atmospheric and natural experienced alterations, contrasts and threats. Centering scholarly attention on these events further entails reflecting on the scope of extreme climate conditions in the agrarian world; a world that, as is well-known, housed the vast majority of the people of Spain and Mexico. Hence, it is not strange to learn that the inhabitants of the countryside viewed the climate as a crucial element of their reality. “Normal” climatic conditions meant access to harvests and food at low prices and the availability of resources. However, when those conditions underwent changes, the reality of rural areas became plagued with problems. In Emmanuel Le Roy Ladurie’s view, the extreme climate that prevailed in Europe and North America through the second half of the 18th century brought with it adverse storms and biological threats, the

proliferation of failed harvests accompanied by high prices, the propagation of epidemics and cycles of high mortality, while also triggering migrations and social unrest (Le Roy Ladurie, 2017, 36-37).

In effect, the history of the Iberian Peninsula and New Spain between 1770 and 1800 was linked to climatic anomalies and extreme nature. The constant presence of natural phenomena manifested the atmospheric changes that were occurring worldwide and configured a whole array of agricultural, economic and social problems. During those years, the extreme climate showed itself in varied ways, including droughts, floods and tempests; worse yet, it propitiated the formation of biological plagues, and epidemic and epizootic outbreaks. The degree of vulnerability reached its peak when the effects of volcanic activity combined with thermal variability in the oceans. But the question is: what factors allowed these anomalies to precipitate simultaneously on two continents, and affect their environmental conditions so violently? One of the most convincing arguments attributes this to volcanic activity, the accumulation of particles in all levels of the atmosphere, and the dynamism of sunspots. It is certainly no coincidence that the 18th century witnessed an intense cycle of volcanic eruptions on three continents: America, Asia and Europe; a cycle that not only reduced solar luminosity, but also contaminated agricultural fields, extinguished plant and animal species, and induced the concentration of warm air in certain territories. Taken together, these conditions generated a new atmospheric configuration on the planet. As we suggest in this chapter, these oscillations must be analyzed in light of the environmental and physical specificities of each space, and understood by one of the premises of the LIA – namely, the sudden change in temperatures.

Given the foregoing, the history of Spain and New Spain during the 1770-1800 period reveals that there was no decade in which agriculture and society did not suffer the ravages of the climate, especially the presence of three phenomena: droughts, intense rains and plagues of insects. Indeed, the recurrence of these phenomena was so evident that it was recorded in numerous news reports, letters, dispositions, implorations and processions issued or organized by civil and religious authorities. This recurrence can serve us well as we seek to document one of the most extreme pulsations of the LIA on two continents.

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PART 3

POLICIES, MANAGEMENT AND CONSERVATION

Chapter Six

Aquatic animals, now and then: Appropriation of nature in Portuguese America and early notions of overexploitation and human impacts

Nina Vieira, Cristina Brito and Ana Cristina Roque

INTRODUCTION

Aquatic animals have always been an inseparable part of human history. Inhabitants of the ocean and freshwater systems, they were considered major resources, supporting human subsistence and trading activities. They played a key role in the building of societies, as well as in the structuring of great empires. Aquatic beings have always been key triggers of new geographic discoveries and peoples' displacements across territories, and the sea was a driving force in the search for creative solutions (Zuppa, 2001, 65). Historical sources have provided valuable insights into the multiple strategies adopted by different animal species to adapt to changes in their natural habitats, with specific references to freshwater and marine animals in a wide variety of contexts. This enables us to rewrite the histories of coastal and oceanic spaces in which people are inevitably also involved (Bolster, 2006). Oysters, shells, pearls (e.g. Warsh, 2018), small, large and flying fish, sharks, turtles, manatees, whales, seals and hippos, as well as the use or consumption of their by-products – such as meat, skin, teeth, fur, oil and ambergris (e.g. Brito *et al*., 2015) – are a consistent presence in the history of the intercultural relations of the modern Atlantic world.

Whales inhabit all oceans. By the end of the Middle Ages, many Europeans living by the sea would probably have been familiar with them.

Together with some types of fishing, whaling was the most extensive form of exploitation of a living resource (Reeves & Smith, 2003) and it was probably the main biomass removal from the ocean at that time, as far as marine mammals are concerned.

Whale exploitation started with the first human settlements in coastal areas, as early as pre-historical times, across different regions and ecosystems of the globe (Reeves & Smith, 2006, 82), and its economic significance in history is well documented, mainly the American whaling type.

Throughout history, whaling practices have been represented in several writing, visual and artistic formats (Brito, 2016). In the Northeast Atlantic, most coastal species were gathered and/or hunted off the Iberian coast since at least the 11th century, as testified by both written sources and archaeological remains along the Portuguese coast. This is evidenced by the use of whales' bones, meat and blubber during the period of the Islamic occupation of the Iberian territory (Pereira, 2015, 1106) and the medieval and early modern ages (Brito, 2011; Teixeira *et al*., 2014).

The whale, a 'royal fish' in medieval Europe, was, in fact, an important source of protein and oil for lighting (Szabo, 2008). In the context of the Portuguese overseas expansion, whales escorted the sea fleets; maritime travel reports described them mostly as monsters and symbols of bad omens at sea. However, on land, regardless of the territory, the Portuguese considered whales a very useful resource (Brito *et al*., 2016).

From 1614 to 1801, whaling became a monopoly of the crown, giving high profits to the Portuguese Crown and its entrepreneurs, in good hunting years. And, in Brazil, this was an important activity, which significantly contributed to the settlement of the Portuguese in South America (Ellis, 1969; Vieira, 2018).

Unlike whales, manatees do not inhabit European waters. The three different species found on the coasts of West Africa and Central and South America were unknown to the Portuguese and Spanish travellers and explorers until the early modern period. Thus, they easily became part of a group of tropical creatures which populated the European imaginary about a New World and an all-new set of fauna possibilities (Brito, 2016).

Pre-Columbian indigenous communities across the Americas used manatees for food and the production of everyday objects and war artefacts (e.g. O'Donnell, 1981) and manatee meat was offered by locals to Europeans upon their first contacts. Foreigners appropriated this local novelty – and its multiple uses – as a result of the observation of local practices and assessment of indigenous knowledge, following a progressive epistemic interaction with the indigenous communities. It soon became clear to Europeans that this large, herbivorous and slow-moving

aquatic mammal was easy to capture and a potentially interesting commercial resource. Even though their exploitation was dependent on local expertise, manatees quickly turned into a common and valuable food and trading item, exploited by seamen and explorers (Vieira & Brito, 2017), pirates and settlers (e.g. Little, 2007, 132-133; Wheat, 2016, 201).

Whales and manatees became one of the main subjects of management issues, which started emerging at the end of the 18th century. This followed two centuries of continuous exploration, where indigenous experience, combined with imperial authority and technical capacity for the extraction of living resources, led to the extirpation of some populations. The appropriation of these animals as exploitable resources was a common business. Yet, on the advent of their disappearance, concerns eventually rose.

In this chapter we aim to address the relationships between humans and non-humans, tracing a history of the appropriation, use and commercialisation of whales (Order Cetacea) and manatees (Order Sirenia) in Portuguese America in the late 18th century. The stories about these particular aquatic animals are not often included in historiography, and this environmental history perspective may contribute to the reconstruction of a new historicity of the ocean. For this purpose, we will use some of the documents included in *Memorias Economicas,* a 5-volume collection of essays published in the 18th century by the Royal Academy of Sciences of Lisbon, as well as some of the Portuguese works resulting from the *Viagem Filosofica* to Brazil in 1783-1792. In this way, we intend both to identify the connection between the process of the overexploitation of nature and Portuguese political and economic strategies, and to disclose historical information on the impacts of human activities and dominance over non-human animal populations and ecosystems.

DOMINGOS VANDELLI AND THE ECONOMIC EXPLOITATION OF AMERICAN AQUATIC ANIMALS

Consistent with the 18th century European Enlightenment movement, the creation of the Academy of Sciences (later the Royal Academy of Sciences) in Lisbon in 1779 contributed to the development of a scholarly and scientific elite in Portugal. The Academy proposed an intellectual movement for the promotion of the State and its economy, which, in addition to educating the people, would allow Portugal to put an end to a long philosophical, pedagogical and scientific isolation from Europe (Munteal Filho, 1993, in Marques, 2005). Alongside the reform of the University of Coimbra, the foundation of the Academy aimed at demonstrating the will

and commitment of Portuguese rulers to adopt and invest in new policies in the European framework.

This was the context at the time Domenico Vandelli arrived in Portugal in 1764. Vandelli was a prominent figure in the field of scientific and educational reforms (Vaz, 2002). He had been invited by the Portuguese King, in 1768, to plan and develop the Royal Botanical Garden of Ajuda, in Lisbon, of which he became director in 1791 after being a professor at the University of Coimbra between 1772 and 1791 (Cabral, 2018, 5).

In his works on natural history, he drew attention to the importance of natural products and the benefits of their economic exploitation. In this context, he referred specifically to the under-exploitation of aquatic animals in the Portuguese territories of Africa and South America. According to him, at a time when other nations benefited from the abundance of whales in the South Atlantic, Portugal needed to invest in new factories to ensure the exploitation of this natural resource for its own benefit (Vandelli, 1798a, 191).

Given the decrease of the North Atlantic whales' populations, the inhabitants of New England had begun to explore whaling on the coast of Africa and West Atlantic Islands since the early 1760s. By replacing oar-propelled whaleboats with ocean-going sloops and small brigs, they were able to process whale oil on board, producing an oil with better quality than the whale fat stored in barrels (Alden, 1964). Therefore, knowing about sperm whales' (*Physeter macrocephalus*) occurrence off the coast of Brazil in 1773 (Alden, 1964; Hart & Edmundson, 2017), the number of foreign vessels increased considerably on that coast, most probably constituting one of the main reasons for both the ruin of whaling in Brazil and the reduction of local populations of whales (Correa, 1820, in Araujo, 1822, 295).

Considering this situation as well as the wide range of aquatic animals with potential economic benefits (whales, manatees, turtles and even hippopotamuses), Vandelli defended the position that Portugal needed to invest in the modernisation of existing factories and in the construction of new ones to guarantee the exploitation and commercialisation of these resources, which should be used as profitable assets (Vandelli, 1789b, 235-236).

WHALING PRACTICES IN THE *MEMORIAS ECONOMICAS*

In line with Vandelli's proposals, Manoel Ferreira da Camara, a Brazilian engineer and politician, wrote the first "*Ensaio de Descripção Fizica, e Economica da Comarca dos Ilheos na America"* in 1789 (Camara, 1789),

later included in the *Memorias Economicas*, in which he defended the urgency of investing not only in agricultural products, but also in fishery products, namely whale and turtle hunting. With respect to whales, Camara lists several mistakes related to the killing of the animals and oil processing methods. He points out that "whale fishery in Brazil is subject to infinite errors" and identifies what he believes could contribute to a delay in the development of whaling activities and cause a "greater future ruin" of the sector. Among these, he lists the process of the removal of fat with a significant amount of waste; the melting of fat at high temperatures, resulting in a low quality oil; and finally, the indiscriminate hunting of females and calves, which diminished the number of females and also resulted in a low quality oil, as the oil of the calves was worst (Camara, 1789, 344-346). It is evident to this author that these methods somehow unbalanced the whales' population and the female-male ratio, consequently not guaranteeing the sustainable and continued exploitation of the resource in the long run.

The emotionally bonded relationship between the cetaceans' mother and calf had been already noticed in Classical Antiquity (e.g. Aelian, 1958) and was also reported by the first Portuguese naturalists. Frei Vicente do Salvador (1627, 171), for example, refers to this surprising relationship, emphasising that even after being harpooned, the mother "does not separate from her son". At the time, he probably did not know that harpooning the mother first was a deliberate act, a whaling technique from the Basque whaling culture that persisted in Brazil over time. Yet, unlike Frei Vicente do Salvador, Camara was aware of the whaling methods and their negative consequences and was in a position to provide some suggestions to avoid them:

> 1. Try to kill a larger number of males, and find a way to kill the females, without reducing and eradicating the offspring; 2. Dissect the whale, if possible, in the water, making it strand, extracting every unctuous part, which is easy to do; and when it is not possible to do this with all whales already caught, I believe it is a better solution to salt everything that cannot be melted, than to loose it; (…) 3. the biggest disadvantage in the burning of the oil is its waste together with the greaves, leaving out the oil boiled in the water (…) making the oil more clear, clean and without a suffocative smell. (Camara, 1789, 346)

Camara synthesised and made public issues that were already known to the colonial authorities. The Governor of the Captaincy of São Paulo, Luís António de Sousa Botelho Mourão, had referred to the number of whales killed, the ways of extracting fat and the oil extraction process. In 1766, he

requested the construction of a whale-processing station closer to where the animals were killed, so that they would not deteriorate on the way to the existing whaling station (Mourão, 1766, 77-79). The whales were cut into pieces and transported in very slow canoes and boats, and this drew his attention to the uselessness of killing many whales, which were to be wasted, as they could not be used in good time. Accordingly, it would have been far more convenient "to kill two a day and use them, than to kill four and lose everything for lack of time" (Mourão, 1766, 80-81). We are not sure if this is evidence of the growing notion of sustainable use. But it is certainly a perception of the discarding and waste of resources, which is not necessary and should be avoided. It was probably following this request that the *Armação da Barra Grande* was built. One of the first representations of this *Armação* (Figure 1) shows whales – probably Southern Right Whales (*Eubalaena australis*) – of different sizes, suggesting the possible presence of mothers and calves.

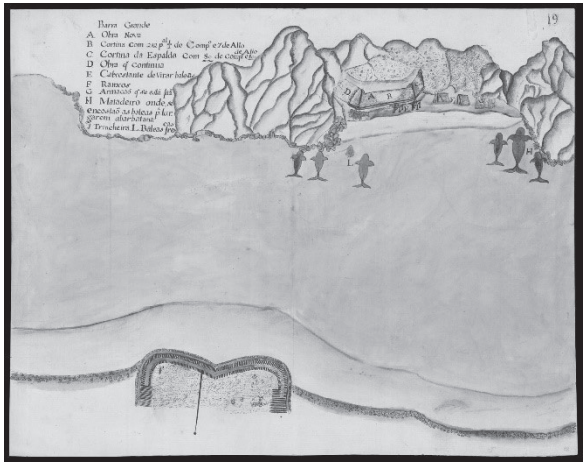

Figure 1. Plan of *Barra Grande* in *Cartas topograficas do Continente do Sul e parte Meridional da America Portugueza: com as batalhas que o Illmo. e Exmo. Conde de Bobadella ganhou aos indios das missoens do Paraguay*, 1775. This is one of the few representations of the whaling industry and whales in Brazil. National Library of Brazil. Available at http://objdigital.bn.br/acervo_digital/div_cartografia/cart1033420/cart1033420.pdf (last accessed 30 July 2015).

The publication of the *Memorias Economicas* must have had a great impact, with a second volume released in 1790. Therein stands out a memoir written by José Bonifácio de Andrade e Silva, a very important Brazilian naturalist and politician (cf. Pádua, 2000). The 25-page text entitled *"Memória sobre a Pesca das Baleas, e Extracção do seu Azeite; com algumas reflexões a respeito das nossas Pescarias"* (Silva, 1790) is one of the few documents on modern whaling in Brazil, and includes detailed information on the methods of hunting animals and processing oil.

Interestingly, a draft of this memoir, with a slightly different title, was first given to the whaling contractor in Brazil (Ellis, 1969). This may, to some extent, be understood as a way of understanding the existence of an articulation between scientific and empirical knowledge, natural history and economics.

Silva wrote this memoir as a young scholar, already committed to the study of nature and the discovery of natural laws on behalf of a better life for people and to indicating practical ways for economic progress (Amzalak, 1941, 6; Caldeira, 2002, 21).

Like other authors, he highlighted the major consequences of killing whales' calves because it would result in a decrease in the "future generation" of whales. He reported whales only give birth to a calf every two years and questioned the benefits of using small calves and nursing mothers, as the amounts of oil obtained were smaller than those obtained from adults. Moreover, this would cause "irreparable damage" to the whale populations, resulting in an unbalanced female/male ratio.

As with Camara, the "pernicious practice" of killing breast-feeding whales was a central issue in Silva's essay, and it was mentioned as one of the main reasons for the decline of the business and "the total ruin of such important fishery" (Silva, 1790, 399).

DOLPHINS AND MANATEES IN THE *VIAGEM FILOSOFICA*

The *Viagem Filosofica*, led by Alexandre Rodrigues Ferreira in Brazil (1783-1792), resulted in a huge collection of natural objects that ended up dispersed in several countries. Vandelli was the mentor of the expedition, and thus the first to receive the materials sent from Brazil, and he enjoyed the privileged position of exchanging specimens from Ferreira's campaign with other naturalists and invited foreign academics to visit Portugal and examine the collections.

Among the several species sent to Portugal by Ferreira, Vandelli received two specimens of dolphins from Mato Grosso and the Amazon (Simon, 1983). One was the Amazon River Dolphin *Inia geoffrensis,*

known as *boto*; the other was *Sotallia pallida*, currently known as *Sotalia fluviatilis* or *tucuxi*, which is probably represented by Ferreira in his expedition watercolours (Figure 2).

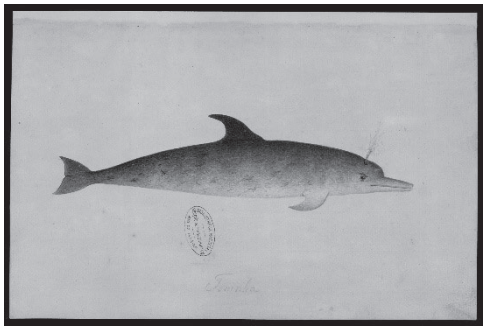

Figure 2. Drawing of a dolphin with the legend "Toninha", presumably from the *Viagem Filosofica* of Alexandre Rodrigues Ferreira to Brazil (21A,1,004 nº029-Manuscritos). National Library of Brazil. Available at http://objdigital.bn.br/acervo_digital/div_manuscritos/mss1255460/mss1255460_29.jpg, (last accessed 31 July 2015).

Most of the specimens collected were identified according to the Linnaeus classification system and are described in *Observações gerais e particulares sobre a classe dos mamiferos no território dos Rios Amazonas, Negro e Madeira* (Ferreira, 1972a). Therein, Ferreira provided information on the physical characteristics of the different species, their habitat and reproduction particularities, as well as how local populations harvested these animals for economic, medicinal and food purposes. The text is a very detailed report on mammals with information on 65 species observed during the expedition, including the *boto* dolphin locally known as *piráiaguara* and erroneously classified by Ferreira as *Delphinus delphis.* Describing the *boto*, Ferreira felt the need to explain the following: "it looks like fish, but in fact it is not, according to the very distant characteristics of this class" and that there were "two distinct varieties: large and small, which they call *tucuxi*", whose liver and fat could be used to produce a large amount of oil for lighting (Ferreira, 1972a, 201-2).

Although manatees were also introduced in his "General observations" (Ferreira, 1972a) with a brief description and illustration (Fig. 3), they would be the subject of another manuscript entitled *Memória sobre o peixe-boi e o uso que lhe dão no Estado do Grão-Pará* (Ferreira, 1972b). Ferreira is very likely to have shipped at least seven manatees (*Trichechus manatus*) from Brazil to Lisbon (Ferreira, 1794, fl. 3v). In this manuscript,

he describes this animal, methods for its capture and its uses. Ferreira stresses that all animals were harpooned, with no distinctions made for size or age.

> They harpoon them in all sizes, without distinction of age. So, it should not cause surprise that it is rare in some lakes where we cannot find them for several years. (Ferreira, 1972b, 62)

Pregnant females were captured and females in oestrus were harpooned first to attract males (1972b, 59). Moreover, calves were harvested to ease the capture of their mothers, leading the author to notice that the inexistence of a policy concerning these practices would cause the number of these animals to diminish.

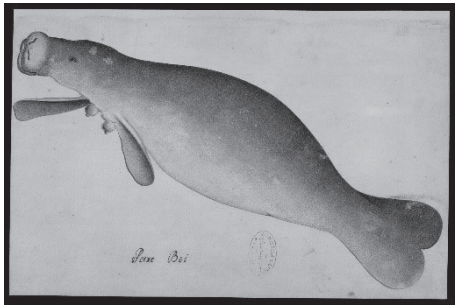

Figure 3 – Illustration of a manatee, known in Brazil as *peixe-boi* or, in Tupi, *iuarauá*, from the *Viagem Filosofica* of Alexandre Rodrigues Ferreira to Brazil (21A,1,004 nº011–Manuscritos). National Library of Brazil. Available at http://objdigital.bn.br/acervo_digital/div_manuscritos/mss1255460/mss1255460_11.jpg, (last accessed 30 July 2015).

WHALES AND MANATEES: DIALOGUES FOR THE CONSERVATION OF MARINE MAMMALS

As Tim Ingold (2000, 61) puts it, "just as humans have a history of their relationships with animals, animals also have a history of their relations with humans". Aquatic animals have a shared history with people; they played their part as agents in the construction of practices regarding the use, exploitation, knowledge, management and conservation of nature. In this respect, it is clear that aquatic animals and their exploitation played an important role in Portuguese Colonial America and in Portugal's scientific, economic and political agenda for those territories.

All the above-mentioned species are currently facing the risk of extinction due to centuries of intensive overexploitation (e.g. Ellis, 2003) and are under national and international protection and conservation acts. But at some moment in the past, the exploitation of aquatic animals was perceived as an action that needed management, ensuring its continuity as a profitable economic resource.

Despite their focus on the economic value of animals, the mentioned works provide us with interesting insights to rebuild the trajectory of changes in attitudes towards and uses of marine mammals (Pádua, 2002; Vieira, 2018).

Silva's work is marked by a worldview based on the economy of nature. Yet, when writing about these animals, he abandons his objective analysis, adopting a literary tone, describing whales as having feelings and motivations like human beings (Pádua, 2000). A sense of the author's emphatic feelings towards the animals emanates from his text. Nevertheless, he focuses on rudimentary forms of exploitation, which would, in the long run, jeopardise the future of those species as a resource. The text reflects both the idea of progress, enhanced by the application of scientific knowledge and new technologies, and the criticism of destructive exploitation practices. This is in line with the questioning of animal rights and the intrinsic value of nature of the 18th and 19th centuries (Pádua, 2000; 2004).

With respect to Ferreira, his attention focuses mainly on the highly predatory fishing methods used in the Amazon freshwater ecosystem, a region currently under great economic pressure. Arguing that local economies and natural populations will be threatened by these methods, Ferreira briefly presents his political awareness of nature conservation (Pádua, 2004; Vieira & Brito, 2017).

In fact, by the late 18th century, these authors were already using a terminology we now relate to the protection of species, such as the expression "future generations", which was one of the flags of 20th-century conservation and environmental sustainability activism. The ideas of an overexploitation of animals and the negative results of humans' impact on the environment very likely emerged for the first time in Brazil in this period. Today, the fact that "whalers, fishermen, [hunters], and sealers have systematically destroyed the fisheries that sustained them (…) [and] could not pass on their legacy to those who followed" is widely acknowledged (Ellis, 2003, 7). We do not know the impact of these authors' concerns. But we do know that, over time, dissimilar visions and life experiences have contributed to changing the dialogue between human communities and nature (Zuppa, 2001, 87).

Hunting may be observed from different angles and concepts, it may be conducted by different peoples, and ultimately it may set the tone of the human relationship with the environment (The Animal Studies Group, 2006; Miller, 2007). The dominance of humans over nature has indeed been a process marked by overexploitation, the killing of animals being a structural feature of all human-animal relations that led to the extinction of species (The Animal Studies Group, 2006). If we take a glimpse at the current conservation status of some whales and manatees, we will find them variously classified from the 'Least Concern' category to 'Critically Endangered'. And, thus, we can read the consequence of the long-term exploitation of aquatic mammals. The impacts of this interaction affected the activities that relied on wildlife populations, and simultaneously left a footprint on natural populations and ecosystems. By addressing specific case studies, we realise that somehow, somewhere, the worlds of economy and aquatic animals overlapped, constructing the beginning of a new dialogue about nature, between people and non-human beings.

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CHAPTER SEVEN

POLLUTION AND MARINE DEBRIS IN PORTUGUESE ATLANTIC HARBOURS DURING THE EARLY MODERN AGE: ADMINISTRATION AND FUNCTIONALITY PROBLEMS

ANA CATARINA ABRANTES GARCIA

INTRODUCTION

Pollution as we understand it today is commonly recognised as a contemporary process associated with anthropogenic actions, much due to the process of industrialisation and the use and consequent intensive disposal of all kinds of toxic substances harmful to the environment (Ryan, 2015, 1-25). This topic is on current environmental concerns' agendas, with a special focus on maritime issues related to ocean pollution and global warming (Rochman, 2015, 117-140). Considering the environmental history approach, this research aims to understand, from a historical and archaeological perspective, how maritime pollution has been seen through the centuries, focusing on the Early Modern Age.

After the 15th century, there was a significant increase in nautical activity that completely changed the prior medieval navigation pattern. A large number of ships, people and goods in movement resulted in an increase of ports and port cities, thus creating pressure on the environment of shorelines and harbours. This growth demanded the attention of local authorities who managed port cities be given to epidemic and public health problems.

Current historiography studies, focused on pollution during the Early Modern Age, are more linked to public health problems such as plagues and diseases caused by dirtiness. However, not many studies focus on maritime and aquatic dirtiness as a consequence of the increased move-

ment of people, which could affect public health, navigation-related security and disease spreading.

Some studies on the Middle Ages focused on towns, particularly on bad smells, consequences of throwing trash into the streets, as well as the failure of local authorities (such as the municipality) to control this problem (Thorndikem, 1928, 192-203). For the Early Modern Age, we can quote sparse studies related to pollution in general, mostly centred on urban aspects.

The goal of this research is to investigate marine environments with human influence such as seaports. Our case studies are the small harbours of Angra (in the Azores) and Funchal (in Madeira), usually dismissed in Atlantic historiography. Written sources such as local archives, documentation related to local authorities and harbour management (including official processes), public rules or normal procedures in case of disobedience can reveal important information regarding concerns about dirtiness, resulting in prophylactic measures to avoid critical situations. Our aim is to understand what kind of perception and consciousness public authorities had on the causes and effects of aquatic space soiling and the possible consequences on daily life. In the selected data, we also included shipwrecks processes, town hall norms for public spaces, harbour functioning rules and disobedience processes.

With this approach, we intend to understand if increased harbour activity due to Atlantic maritime expansion led to specific governance concerns regarding shorelines' and aquatic spaces' cleanness. We expect to identify the types of situations considered dangerous and what the preventive measures were, if any, to avoid them locally. We will also try to address society's and the authorities' perception of dirtiness or "pollution" as something harmful to harbour functioning and local communities.

POLLUTIONS IN AN HISTORICAL CONTEXT

Frid and Caswell, in their chapter "Introduction to marine pollution", recognise that: "Humankind has been putting waste into the sea for as long as people have lived at the coast" (Frid & Caswell, 2017, 2-13). Joachim Beuckelaer's 1563 painting shown in Figure 1 illustrates some of this reality. This transversal idea and routine can be verified since pre-historic times, with its discarded artefacts, middens or shell mound sites, up to nowadays, with the current and serious problem of debris accumulation all over the oceans (Hardy-Smith & Edwards, 2004, 253-289; Shillito *et al.,* 2011, 1024-1038; Aldeias & Bicho, 2016, 530-549; Daggers *et al.,* 2018, 279-292).

Figure 1. Joachim Beuckelaer. The Miraculous Draught of Fishes. 1563. Public domain.

Focusing on urban aspects, the book *The Smoke of London: Energy and Environment in the Early Modern City* addresses the city of London's air pollution during the Early Modern Age (Cavert, 2017). This is a good example of how environmental history can help understand the evolution of pollution perception. Using an interdisciplinary approach to understand how smoke intersected with aesthetics, medicine, naval power, literature, urban space and sensory experiences, the author cross-examined perceptions about smoke and how people related with that on the cultural, social, economic and political levels (Robson, 2017).

Melosi, in his text *The Place of the City in Environmental History*, tries to understand the urban space as a strong nature transforming agent, concentrating on a major number of transformations of the physical environment (Melosi, 1993, 1-23). This author considered several interesting aspects, such as the urban adjustment of water courses as one of the important agents for flooding problems and diseases transmitted by bacteria or other agents found in still waters. Another mentioned aspect was the production and accumulation of huge volumes of waste (Melosi, 1993, 1-23). In this regard, it is interesting to analyse how societies reacted to these accumulations, if they considered them a problem and how they resolved it. All these important perspectives will be taken into account in our study.

ANGRA AND FUNCHAL, TWO ATLANTIC HARBOURS

In this analysis we focus on two case studies – the port cities of Angra and Funchal. Located in the Portuguese archipelagos of Azores and Madeira, respectively, they are positioned in the midst of the North Atlantic Ocean, as shown in Figure 2. Their geographic position was strategic as they were important nodes in the Atlantic navigational support system and were specifically relevant to Portuguese maritime expansion.

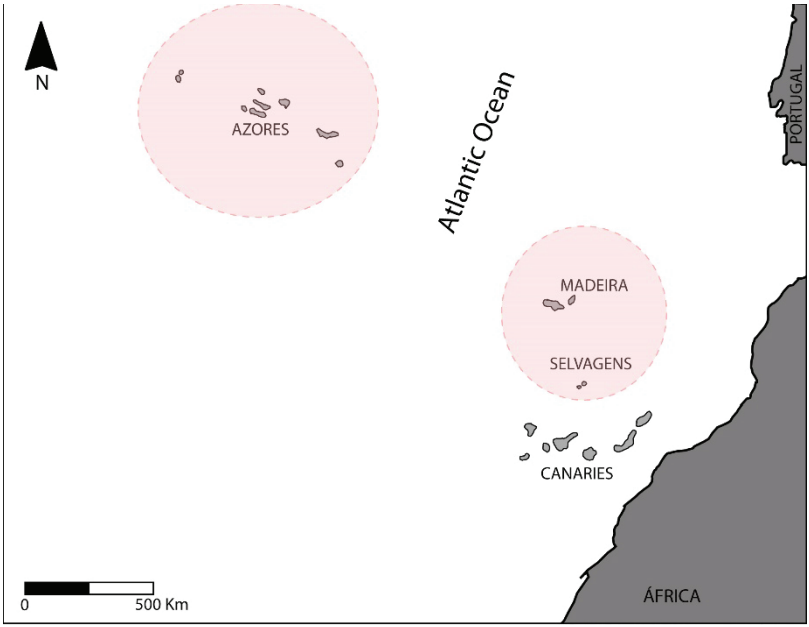

Figure 2. Map with the location of the Azores and Madeira archipelagos. Author: Ana Catarina Garcia.

Positioned on the route of trade winds and currents that led ships parallel to the Azores archipelago, Angra mainly offered support as a port of call. Stressed vessels driven from long voyages from the south to the North Atlantic stopped here for assistance on their returning voyage to Europe. The Angra harbour call was vital for ships and crews after long voyages such as the Indian route (Meneses, 2009, 205-218). The port city of Angra was considered, during the beginning of the Early Modern Age, the best port of call of the entire archipelago, offering the best conditions for ship

protection and repair, assistance, water, or health assistance, among many others (Garcia, 2016a, 59-78). The Madeira archipelago was used more as a natural layover for outbound trips to the Indian Ocean, Africa or the Americas, as its southerly position was more favourable to these routes (Garcia, 2016a, 1-21).

Throughout the 16th and 17th centuries, the number of ships circulating in the Atlantic Ocean intensified and increased. At the beginning, only official Portuguese and Spanish fleets crossed the archipelago. During the 17th and 18th centuries, there was a quick increase in ships coming from all over Europe to trade, establishing all kinds of relationships with different Atlantic harbours.

In the case of Funchal, although it provided water for ships, as Angra did, the port evolved mainly due to the trading of products, such as sugar and wine. The sugar trade gained importance in the Atlantic, up until Caribbean productions gained this market, which only happened in the second half of the 17th century. After that, Madeira (and mainly Funchal) intensified its wine production and this product attracted a strong trade movement to Funchal, leading to the increase of ships and merchants in this port (Silbert, 1997; Vieira, 2004, 21-34; Hancock, 2009).

In this context, the two natural ports of Angra and Funchal developed infrastructures and created local government institutions capable of managing all these port cities' demands. The city hall was in charge of harbour structures' maintenance, regulation and the functioning of the port. Military power, centred in the principal forts, was responsible for the defence of harbours and coastlines. The Customs House supervised the entry and exit of ships and goods, ensuring the payment of taxes (Favro, 1999, 365). In Angra there was also a specific office named the *Provedoria das Armadas e Naus da Índia em todas as ilhas dos Açores* (Purveyor to the Armada of the Islands of the Azores) that was responsible for harbour defence and the security of the official fleets passing through the Azores (Enes, 1984, 147-205).

The management of the Angra and Funchal harbours demanded preventive measures from local authorities related to the increase of ships and, consequently, of people that could spread diseases. Also, the dirtiness inside the harbours was a concern and, to minimise the risks, some preventive measures and rules were established and implemented. This information can be found in the *Posturas*, the town ordinances defined by the Town Hall, the office in charge of their fulfilment. However, normal harbour management demanded from all authorities' permanent appreciations and decision-making related to maritime spaces' order maintenance.

HARBOUR MANAGEMENT. DEALING WITH THE DEBRIS THREAT

Fishing activity

It is recognised in official documents that both Angra and Funchal Town Halls dealt with the increase in the flow of vessels and the consequent dirtiness and dangers that certain types of debris or bad practices caused. These could affect public health and navigation, as well as ships' security and peoples' well-being.

Analysing these municipal norms specifically, we can identify different types of concerns regarding dirtiness and the misuse of harbour spaces. Both in Angra and Funchal, fishing was identified as a common activity practised along the coasts of the islands and was one of the concerns to be addressed.

In the case of Angra, the town ordinances of 1655 determined that fish should only be sold on the main quay of the city, where it should be discharged. The Ordinances determined the sale of fish had to be done on the left quay of the harbour, so, in these terms, it was expressly forbidden to take fish to a port other than Angra (Livro, 1565-1707, 83-88v). It was also stated that "no fisherman shall take the fish that he captured to another port but to this quay", reinforcing the previous rules (Livro, 1565-1707, 83-88v).

These rules denounce concerns related to debris production that could cause coastline dirtiness. Reinforcing the previous rules, they stated that: "no fisherman will scatter fish on the quay, and if he does scale it or break it, he must clean the quay without leaving it behind" (Ribeiro, 1954, 121-182). The dirtiness caused by the fish viscera left outdoors may attract worms and lead to diseases and bad smells, disturbing the spaces' cleanness. Furthermore, this was the main quay and the main sea entrance to the city, and thus should not be left dirty as people and goods crossed through there.

In the case of Funchal, it is possible to identify equivalent rules related to fish cleaning. Rule number four of the 1625-1630 Ordinances, specifically related to fishmongers, ordered that dirty water associated with fish scales should not be left behind, indicating that this water could be a source of contamination and dirtiness (Posturas, 1625-1631, 15-16). Norm number five stated that "no one can buy fresh fish and then sell it again, this behaviour being punished by jail" (Posturas, 1625-1631, 16). Following norm five, norm seven stated that "fresh fish may not be sold on the next day after its capture" (Posturas, 1625-1631, 16). Also, number 72 of the Angra 1655 Ordinances mentioned the same rule, prohibiting the sale

of fresh fish on the day following its capture, punishable by a 200 *reis* fine (Ribeiro, 1954, 133). These norms could indicate a consciousness that this circumstance could bring about public health issues related to spoiled fish.

In conclusion, the analyses of Town Hall norms related to fishing activity in the Funchal and Angra harbours allows the identification of three threatening situations: the accumulation of fish viscera, dirty water from cleaning fish and fish sale control to avoid the consumption of spoiled fish.

Domestic debris

Another unsuitable activity related to the maintenance and cleaning of harbours was domestic debris dumping. Dumping garbage into the streets was a common practice at that time and could lead to serious public health problems. Reinforcing this idea, the Angra Ordinances mention the prohibition of throwing debris in the Old School, *Colégio Velho*, which was located at the top of one of the highest cliffs of the city, directly facing *Praínha*, the main harbour's cove and beach. The norm stated that "no person of any kind shall throw debris into the *Praínha* in front of the *Colégio Velho*, and whomever disobeys shall pay 800 *reis*" (Livro, 1565-1707, 83-88v). Reinforcing the rule, it was said again that: "No person of any kind shall throw away garbage from the tufa stone of the *Praínha* in front of the *Colégio Velho*, and whomever disobeys shall pay 4000 *reis*" (Livro, 1565-1707, 83-88v). Besides the main quay, the second main entrance of the city from the sea was the *Praínha,* and this zone was also referred to as a small shipyard, being an area of great harbour activity, justifying the concerns set out in the norms.

However, in the case of Angra, the testimony of the chronicler Padre Cordeiro in *Historia Insulana* reveals that this city was exceptionally clean and that there was no custom of throwing out water on the streets:

> (…) the streets are always very clean until at night, without needing other cleaners, because they do not throw anything from the windows to the street, and thus you never hear *Agua vay*, because there is no house that on the back side does not have his yard and some of them very big and great and some with fountains inside, and never in the streets you do see any human debris, which is so strange in other lands. (Cordeiro, 1981, 274)

This historical source needs to be critically analysed because these descriptions could also mean to emphasise the city of Angra, and it contradicts Ordinances that pointed out concerns about the practice of dumping debris on the streets indicating, in some way, that this did occur. Comparing the data with official documents of the Town Hall, the *Tombo da Câmara de Angra* of 1699 says for instance about the harbour space:

> (…) considering what the officers of the Town Hall of Angra, Terceira Island will represent to me about it being very convenient to my service to clean the port of that city concerning the ships of the Armies, and *naus* of India, and more vessels of this crown, as also the privacy and security of the royal rights and comforts of the Vassals because of the low cleaning of this port, due to the many shipwrecks that occurred, leaving there their cargoes, some of them loaded with goods (…). (Livro, 1656-1707, 189v-190)

Regarding Funchal, there were also references to the prohibition of dirtiness on pebble beaches, which were precisely the places where small vessels loaded and unloaded cargos to and from merchant ships anchored around Funchal bay. In the 1625-1630 Ordinances, it was stated that: "no person should put anything on the pebble beach on the east side of the harbour, nor make any pigsty either privately on their balcony or on the pebble beach or in the small rivers under penalty of 500 *reis*" (Posturas, 1625-1631, 9).

The concern about the cleanness of the central cove of Funchal, where all the trade activity occurred, indicates this area's relevance to harbour activity and the necessity to control its hygiene and orderliness. However, we do not have any other sources to compare data with that would indicate that this area was dirty. Nonetheless, the rule reflects concern and prophylaxis behaviour to avoid unwanted situations.

Regarding the insular situation, where water supply could be a problem, the contamination of water lines which flowed directly into the bays of Angra and Funchal was one of the main concerns. This vital source for locals and for the refreshment of ships was identified in some norms denouncing how important riverside and fountain cleanness were. Washing barrels in Angra was one of the denounced situations to avoid water contaminations. The Ordinance of 1655 refers specifically to the harbour, main quays and fountains, saying in norm number 111 that: "no person can wash barrels on the main quay of this city or in any fountain of this city and whomever disobeys must pay a fine of 400 *reis*" (Ribeiro, 1954, 136). Regarding the rivers that flow directly into the port, norm 76 of the 1655 Ordinances also mentions that: "no person can dribble dung of horses or tanneries' debris into the riverside of the city" (Ribeiro, 1954, 133), referring here specifically to the mills' riverside, *Ribeira dos Moinhos*, that crosses the city of Angra and flows into the harbour. This water line was very important for the city's functioning throughout the Early Modern Age, and was a driving force for several water mills, tanneries and slaughterhouses positioned along it (Leite, 2014, 58).

Air pollution

Regarding air pollution by smoke or bad smells in Angra, the following reference to tanning prohibition in the harbour area was stated in norm 76 of the 1655 Ordinance: "no one should dry leathers on public streets or in the docks, even if they are dry, and whomever disobeys should pay a fine of 800 *reis*" (Ribeiro, 1954, 133). In this case, the bad smell was considered harmful and a distress factor for population welfare.

Looking at cartography data, we can see in the Praínha shipyard area in Angra, represented in Figure 3, cauldrons boiling pine pitch for ships' 'calefaction'. This could also produce foul smells in the harbour area, but no reference was found regarding this activity in the Angra Ordinances.

Figure 3. Detail of the main quay of Angra. Montanus, 1671. *De Nieuwe en Ondekende Weireld. Detail of the Angrae Urbis Tercerae que insularum quas Azores vocant máxima / et copioso glasti proventu ditisaccurata cum arce delineatio Galerie Agreable du Monde, oû l'on voit en un grand nombre de Cartes très-Exactes Es de Belles Tailles* – Douces, Les Principaux Empires, Roiaumes, Republiques, Provinces, Villes Bouros et Forteresses. Executé a Leiden. B.P.A.P.D. Fundo Ernesto do Canto, IV, 96. Public domain

Maritime pollution

Port space was often used by a multitude of ships for throwing out trash and obsolete dressings, debris that could float on the surface, cover the bottom of the sea, or, eventually, end up on the shoreline. The harbour could shelter small boats for fishing near the coast and connect big ships to land, facilitated the permanent movement of caravels, *urcas* or pataches carrying out the local small trade between the islands, and even all official ships assisting the port, such as the permanent foreign trade ships or the landings of the Portuguese official fleets.

The local administration identified some situations that contributed to the filth and disorganization, becoming obstacles to the good functioning of the port. In this context, City Halls also had the responsibility of cleaning the harbour's aquatic space, and any consequent expenses should be paid by their own revenues.

Shipwrecks were, in fact, one of the main reasons for the aquatic space's dirtiness. These accidents contributed not only to the deposition of broken hulls, artillery and all kinds of loads at the bottom of the harbour, but also to floating objects such as wood, moorings or sails, which represented hazards for ships' manoeuvres.

The harbours' intense use also contributed to the accumulation of a large number of lost or abandoned objects, both on the surface and on the bottom, which could also endanger navigation. To address this problem, the City Hall needed to regularly clean the bottom of the harbour. In a 1699 process attempting to resolve this problem, the Town Hall of Angra hired divers to clean the port. A public act on October 26 referenced the hiring of two men to dive, who received all they recovered or could get from the bottom of the sea as payment. This way, the local authority did not have to spend any money on this act:

> To grant power and faculty to the same officers of the municipality of the City of Angra, Terceira Island with the intervention of the Treasure Ombudsman of this island, they will contract two persons with the capability, at their expense and without expense to the Royal Treasury, to clean the port of this City and to make good profit for them, whatever they find and discover in it. (Livro, 1656-1706, 189v-190)

The permanent anchorage manoeuvres led to the abandonment of anchors. The *Provedoria das Armadas* mentioned, related to this issue: "Clearly we all see that is spent with moorings and how they are, and those that carry the galleons and how they leave and how they get lost, the only thing to do is to get them from bottom of the sea (…)" (Tombo, 1650, 33-34). This could happen in different situations: in an emergency like a sud-

den storm, when it was necessary to cut the moorings or, in cases of breakages due to the violence of the sea, their being abandoned because they were not in very good shape, or due to shipwreck. All these facts were confirmed by archaeological artefacts identified in the Angra bay. More than 42 anchors were found in the old main anchorage. These artefacts revealed many situations such as broken or twisted anchors, different typologies (meaning different origins and different time periods) or even ships' tonnages (Chouzenoux, 2012, 645-654). Moreover, to balance ships during loading and unloading manoeuvres, ballasts were frequently thrown overboard, resulting in ballast sinking to the bottom, leading to dangerous situations for ships in low-lying areas.

In both Angra and Funchal, types of waste were a concern to local authorities. The Angra Ordinances of 1660 stated that: "no ship shall leave ballast in the bay" and "no person shall leave anchors placed along the sea in the port of this city" (Ribeiro, 1954, 401). In turn, the Funchal Ordinances from 1572 already mentioned this situation, referring to the need to control ballast and anchor abandonment, saying:

> No ship, natural or foreigner, shall put any ballast in the bay where it is anchored, neither the ballast that it brings nor in another way, for how harmful the said ballast is to the said anchorage, and whomever disobeys should pay 2000 *reis* and go to jail. And if anyone wants to dump the ballast of their ships they must put it out of border on the high sea, in front of the fortress of the city of Funchal. (Posturas, 1572, 57)

This clutter situation was considered a threat that could have consequences for navigation and for people's and vessels' safety.

With this work, we intend to open new research paths that may contribute to an understanding of marine pollution throughout history, and how it was addressed by past societies in different contexts. The two case studies of Angra and Funchal, in the context of the early modern Portuguese maritime empire, have revealed some awareness of dynamics and prophylaxis regarding these issues.

ACKNOWLEDGEMENTS

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CHAPTER EIGHT

FROM HAPHAZARD AND ILLICIT PLANT-HUNTING AT THE DUTCH CAPE (1620-1806) TO RECREATING THE FLORA OF THAT ENDANGERED BIOME IN WALES (2000)

STEFAN HALIKOWSKI SMITH

INTRODUCTION: THE THREAT TO 'MEDITERRANEAN' PLANT DIVERSITY AT THE CAPE

South Africa's Western Cape, the size of Greece, is extremely abundant in biodiversity; to be precise, there are more than 9000 flowering species, of which 65% are endemic, i.e. naturally occur nowhere else in the world (Fraser & Fraser, 2011). This is worth comparing to Britain's 1500 species, of which only twenty are endemic. In fact, South Africa is the third most biodiverse country on earth, with all its implications for cultural diversity (Pievani, 2017), and Afrikaans provides the names for thirteen different plant habitats (Adamson, 1938). The province is generally considered to have a Mediterranean climate (Köppen-Geiger climate classification Csa, Csb) with cool, wet winters and warm, dry summers, although certain areas are classified with a maritime climate and the inland Karoo with an arid or semi-arid climate. Although areas of Mediterranean climate globally make up a very small part of the world's total landmass, as many as 20% of the world's plants are to be found there, while 80% of all European plant endemics are found in the Mediterranean (European Commission, 2008, 23).

The International Union for the Conservation of Nature in its 2009 report singled out 'freshwater systems' as under particularly severe pressure, with 56% of endemic fish species under threat of extinction, but what the future holds for plant life also seems to be in question (Cuttelod,

2008, 89-105). As in California, much of the Overberg on the southern Cape, once covered with *renosterveld*, or Mediterranean woodland scrub, has likewise been largely converted to agriculture, mainly wheat. *Renosterveld'*s high floral diversity is famed and includes such plant types as *Restionaceae* (rush-like flowering plants), *Ericas* (a heathland sclerophyllous *fynbos* plant) and *Proteas* (South Africa's national symbol) (Cowling, Richardson & Pierce, 2003). Besides agriculture, the rapid urbanisation of coastal areas, partly for tourism but also as a product of internal population displacements, the growing risk of desertification, water scarcity and forest fires are other problems. Williams, Crouch and Victor (2013) highlight the harvesting of medicinal plant species to extinction, especially for informal Zulu *muthi* markets, citing the examples of *Encephalartos nubimontanus* and *Encephalartos woodii,* although herbivory's eradication of *Euphorbia clavicola* in the shape of mountain reedbuck is equally at fault (Pfab, 1997). Environmental historians' agenda to "understand (..) the social history of the communities that lived in [the landscapes we see]" (Maddox, 2005, 721) seems altogether to be missing the point. More practical intervention is needed, including lists of threatened medicinal plants informing policy development at all levels, law enforcement and a proactive, alternative supply of market-demanded materials through cultivation (Crouch, 2001; Crouch & Edwards, 2004). A prolonged drought currently affecting the area is forcing farmers away from the area (Muller, 2017; Economist, 2018), reallocating their land for the needs of the burgeoning South African population, currently growing considerably above the world average of 1.2% p.a. (UN, 2017). Micro-initiatives such as the Protea Atlas Project for Conservation, which sets out to catalogue and geo-tag every South African Protea growing in the wild (www.proteaatlas.org.za) also operate in the right direction.

PLANT HUNTERS AT THE CAPE, 1620-1806

In the 17th century, the Cape rapidly became an inescapable port of call on the Indies run. Its location as the 'tavern of the two seas' (Boxer, 1965; Ward, 2007) was paramount, though 'Indies sea shelter' might be a more accurate translation of the sailors' commonplace 'De Indische Zeeherberg'. Taken into "quiet and peaceful possession" by Andrew Shillinge and Humphrey Fitzherbert on 3 July 1620 in the name of "the High and Mighty Prince James", they named the surrounding peaks and planned the establishment of a 'plantation' like that founded several years earlier at Jamestown (Worden, van Heyningen & Bickford-Smith, 2004). It took another 32 years before the initial Dutch settler expedition by van

Riebeeck, but in these early days Cape plants, particularly geophytes, were already finding their way back to Europe. While Klaas van Berkel (1998) has noted that the Vereeinigde Oost-Indische Compagnie (VOC) functioned as a "reluctant patron" of natural knowledge and its interest was primarily that of developing a "farming frontier" (Fleischer, 2011), plant-hunting found its inspiration in a generalised 17th century culture of collecting and curiosity, an attitude of mind involving the fascination and admiration for the rare, novel, surprising and outstanding in all spheres of life (Whitaker, 1996: Lyte, 1983). Thus, Ten Rhyne, working for the Danzig-based botanist Jakob Breyne in the 1670s, mentioned how bulbs had "long ago" been sent back to Holland and probably on to Poland (Szwarc, 1986; Pękacka-Falkowska, 2018). He mentions, for example, the *Haemanthus rotundifolius* Ker., though inconveniently described as a 'narcissus' by Matthias de l'Obel in 1605, as being cultivated in Holland (De l'Obel, 1605, vol. 2, 503). It was the same for *Nerine sarniensis* (L.), another classic South African plant, registered as flourishing by Jean Morin in Paris on 7 October 1634 (Cornut, 1635, tab. 57, 153).

Historians have enumerated the gardens where some of these plants were grown: the Hortus de Flines on the Sparenhout estate, Vijverhof at Loenen, the Akademiese Kruidhof in Leiden, the Hortus Beaumontianus near the Hague and the Hortus Botanicus at Amsterdam. The 1630s of course had been the decade of 'tulipomania', when tulip bulbs like 'Semper Augustus' had attained crazy heights of value. The chronicler Nicolaes van Wassenaer had suggested that, in 1623, 12,000 guilders (the annual earnings of a carpenter in the 1630s were 250 guilders) were not enough to procure ten bulbs (Dash, 1999). Satisfactory, comprehensive lists of European plant hunters at the Cape from this period have now been established (Glen & Germishuizen, 2010).

Revictualling facilities were rapidly developed, as we can ascertain from Riebeeck's *dagboek* (Leibbrandt, 1897; Worden, van Heyningen & Bickford-Smith, 2004). By 1673 the VOC, which then ran the territory, had developed a rich vegetable garden, described by Willem Ten Rhyne as "a lovely site with its plantations of lemons, citrus and oranges, its close hedges of rosemary and its laurels" (Schediasma, 1686 in Schapera, 1933, 97). Next to the citrus trees, other early visitors listed the "herbs and vegetables" grown there, French species like "pretty fine reinette apple-trees" and "bonchrétien pear-trees" (Rennefort, 1688 in Raven-Hart, 1971, 97). We have plans from the head gardener Oldenland before his death in 1699 and another from Peter Kolb in 1719 (Kolb, 1727, 242), although the fascination amongst the colonial elites for exotic flora at the expense of the region's indigenous flora dates to this time (van Sittert, 2003). To be sure,

reports emphasised how this man-made "very essence of greenness" contrasted starkly with the surroundings "set in the midst of thorns and barren thickets" (Schediasma, 1686 in Shapera, 1933, 97).

We also have vivid illustrations of Cape plants, often in China ink and watercolours (Arnold, 2001; Taylor, 1995, *passim*). The finest of these artists (now catalogued in Arnold, 2001) include Heinrich Claudius from Breslau (c. 1655-1697), Hendrik Oldenland (1663-1697, fl. at Cape from 1689), Jan Hartog (1663-1722) and the aforementioned Ten Rhyne (1647-1700), although others like Anthonie van Breda, author of an early 'Herbarium Capense', were drawing from Dutch gardens (Edwards, 1964), or, like Jan and Casper Commelin, from manuscripts sent back to Holland after the Namaqualand expedition of 1685 (Wijnands, 1983). Increasing numbers of Cape plants were made familiar to a European audience this way: 34 Cape plants made it into Paul Hermann's *Horti academici Lugduno-Batavi catalogus* (Leiden, 1687), while Breyne's *Flora Capensis,* collected in the 1670s and 80s, contained 90 figures (Gunn & Du Plessis, 1978).

A third type of collecting was the assemblage of collections of dried specimens, the herbarium or the *Hortus siccus*. Paul Hermann (1646-1695) made the first important collection of Cape plants on his outward journey to Ceylon in 1672 (Britten, 1920-2, 31). James Petiver (1663-1718), a member of the Apothecary Company towards the end of the 17th century, bought it at auction in 1711, and its 66 folio pages now form vol. 75 of the Sloane Herbarium in the Natural History Museum, London. The Danish *opziener* or overseer of the VOC gardens at Cape Town, Hendrik Oldenland, tried to enliven his substantial collection of 24 volumes by casting it as a *Herbarius Vivus*; it was catalogued by François Valentijn (Winquist, 1978). It was taken to Europe in 1722 and thereafter dispersed widely, including to the Sherard Herbarium in Oxford and HS 32, 156, 256 and 329 of the Sloane collection (Jarvis, Spencer, & Huxley, 2012). We can trace in the commodification of these collections a generalised trend of prescient Dutch knowledge being brought to British shores (Jorink, 2012).

Petiver proved a conscientious collector of plants, not just from "that fertile promontory" (Glen & Germishuizen, 2010) but from all corners of the world, and used an enormous network of correspondents. He improved the Society of Apothecaries Physic Garden at Chelsea and made a dried herbarium which he later left to the British Museum. His many works were so esteemed that they were collected and (re)published as a three-volume *Opera Omnia* fifty years after his death. His *Centuria* (1695-1703), a ten-volume catalogue of items from his collection including notes on their origin and intermediary, as well as his 1713 report to the Royal

Society from “several curious gardens about London ”, refer to plants of the Cape that he acquired from correspondents such as the Dutch resident John Starrenburgh (letter of 20 January 1701, Sloane MS 4063, fol. 61), Dr. Fredrik Ruysch of Amsterdam or Hen(d)rik Oldenland, although the nomenclature he adopted has not been easy to ascertain even today (see Figure 1).

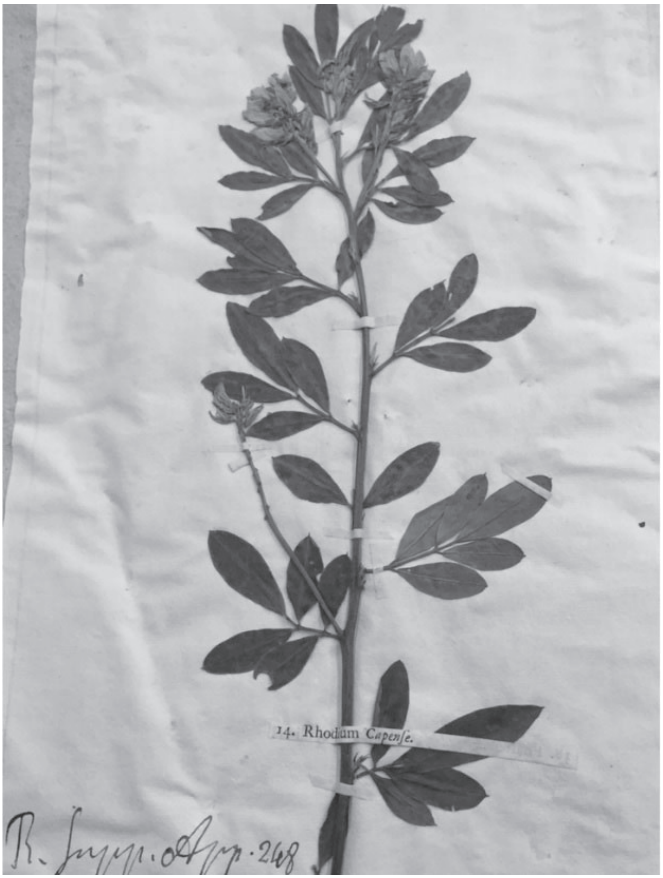

Figure 1. Petiver’s *Rhodium Capense* (Cape Rose), which appears in Ray’s *Historia Plantarum* in 1686 but is absent by the time of Linnaeus’s *Flora capensis* of 1759. Courtesy of the Natural History Museum, London. Note the plant’s waxy leaves, sclerophyllous stem and pastel-coloured flowers. Forensic botanists insist DNA sampling is necessary for identification, although *Chrysanthemoides monilifera* looks like a strong contender.

Petiver's work influenced later naturalists like John Ray (1627-1705) and Hans Sloane (1660-1753), the former including a full catalogue of the *Hortus siccus Peteverianus* in his *Historia plantarum species hactenus editas aliasque insuper multas noviter* (London: Henry Faithorne, 1704, t. III Supplementum, fols. 241-49) (Stearn, 1953; Jarvis, Spencer, & Huxley, 2012; Sprinks, 2017).

Besides his herbarium, Petiver also compiled botanical illustrations in his *Gazophylacii Naturae & Artis* (Treasures of Nature), which recorded one hundred Cape plants presented to the Bishop of London in Amsterdam in 1691, and another fifty "Painted from Growing Plants. Lately Purchased from the CAPE " (Petiver, 1702-6, vol. 2, 9-10). In his first "paper museum of specimens", which he published in 1695 (no. 414, 39), Petiver reported specimens of *Gladiolo affinis* now referred to as *Babiana plicata* Ker. growing from bulbs in "Mr John Tarrant's garden at Hoxton [in London's East End]" and which had already been painted for Breyne sometime earlier (see Figure 2 below). Petiver is a great source for understanding London's horticultural scene at that time and the plants grown there, namely by the Duchess of Beaufort, the Bishop of London, 'Dr. Uredal', Mr. du Bois, and, more generally, in the gardens in Chelsea, Fulham, Enfield, and Queen Anne's 'Stows' at Hampton Court in the care of Mr. Wife (Petiver, 1713).

The subsequent years between 1725 and 1760 were largely "a blank for British natural history" (Allen, 1976, 15-16), hinging upon the composition of the Sloane Herbarium from the 1730s. Rose (2018) draws attention to both its extent and careful polynomial classificatory system imposed by Sloane, though scholars have added to this the careful resurrection of the seventeen unnamed individuals who inputted plants and information into Sloane's collection (Dandy, 1958). Thereafter we must wait until Joseph Banks, who was overseeing the day-to-day running of Kew Gardens from about 1773 in conjunction with the official superintendent, William Aiton, and on the advice of George III (ODNB). He urged professional collectors to bring back live specimens to supplement dried herbarium specimens, but there were problems, namely survival and transportation.

John Ellis, a fellow of the Royal Society, speculated in 1770 that less than one in fifty plants and other natural specimens survived long-distance transportation (Parsons, 2012, 504). South Africa was the right location for the first venture to which he sent the first official 'collector' or plant hunter Francis Masson (1741-1805) with Cook on the *HMS Resolution*, landing in October 1772. Masson stayed until 1775, during which time he sent back to England over 500 species of plants, many from inland, from

Figure 2. *Babiana* sp. in *Iradaceae* fam. From the late 17th century Breyne *Florilegium*, known as 'Flora Capensis', fol. 44. Courtesy of the Brenthurst Library, Johannesburg. *Babiana stricta* today grows in the National Botanical Garden of Wales.

Namaqualand, which had a rather more arid climate. Masson fell in first with Franz Pehr Oldenburg, a Scandinavian mercenary with the VOC, who could show him the country. Together they visited the Swartberg mountain in December 1772. Then, in a longer trek over four months, he went into the Little Karoo (Canaan's Land) with Peter Thunberg, a pupil of Linnaeus and a good scientist from Uppsala, which yielded many famous plants including red-hot pokers (*Kniphofia uvaria*) and gladioli (*Galidiolus*), rose-scented pelargonium (*Pelargonium capitatum*), ixia (*Ixia vividiflora*), with its extraordinary blue-green flowers, Carob tree (*Erythrina carallodendron*), and star-of-Bethlehem *(Ornithogalum*

thyrsoides). Masson was a conduit for plants like *Monsonia*, a colourful genus of undershrub bearing the name of Lady Anne Monson (c. 1727-1776) who prospected with Thunberg at the Cape on her way to joining her husband posted in Calcutta. It was introduced as a hothouse plant by Lee's Nursery of Hammersmith in 1788 (ODNB). Another active London nurseryman was William Rollison Sr., who raised many Cape heath hybrids in Tooting (Hatch, 2011; Desmond, 1994).

Masson's trip was rather overshadowed by the rivalry of natural scientists like Johann Reinhold Forster and his son Georg, who replaced Banks on Cooks' second voyage after it was felt the ship was not adequately furnished to accommodate Banks and his team (Forster, 1772-5 [1982]; Forster, 1778 [1996], xvii). The Forsters sent crates of natural history news back to Thomas Pennant and the Royal Society in London as well as Linnaeus, including several new plants and an entirely new genus of mammal (a 'great Mole'), and put together a year-long expedition into the interior under Immelman (Forster, 1778, lxvii). Forster asked Linnean collectors present in the colony to prepare "great collections for me", hoping to "carry every Spoil from the Cape" (Forster, 1772-5, [1982], vol. 1, 100). The party spent another five weeks in Table Bay when their ship's rigging was refitted in March 1775. The Swedish naturalist Anders Sparrman, following in the footsteps of Linnaeus, was another rival who arrived in January 1772 (van der Cruysse, 2010, 205-9).

It was a golden age of botanical exploration at the Cape, aided by the governor Ryk Tulbagh, who saw to the systematic development of the Company Garden after 1747 from its humble beginnings (Spilhaus, 1971-2; Hill, 1769). Over his twenty-year tenure, Tulbagh corresponded with several botanists including Carl Linnaeus and sent him more than 200 specimens of local plants. Linnaeus named the plant *Tulbaghia* in his honour (Gledhill, 1996, 189). Tulbagh sent multiple and sizeable expeditions to the furthermost corners of the colony to bring back plants, such as one in 1761 to Namaqualand (Spilhaus, 1972, 4-11; 1973). Amongst the expeditionaries was Jan Andries Auge, a German disciple of Herman Boerhaave, a famous Dutch doctor whose engraving of a sugarbush we have reproduced in Figure 3 (Winquist, 1976, 96-119).

Masson's second voyage to the Cape in October 1785 was not so successful: a British expeditionary force had tried to annex the Cape in 1781, and foreigners were restricted to Cape Town and the immediate vicinity. But earlier plant hunters, like George Bell (fl. 1730-34), had also complained of being unable to dispatch specimens back to England (Gunn & Codd, 1981, 55).

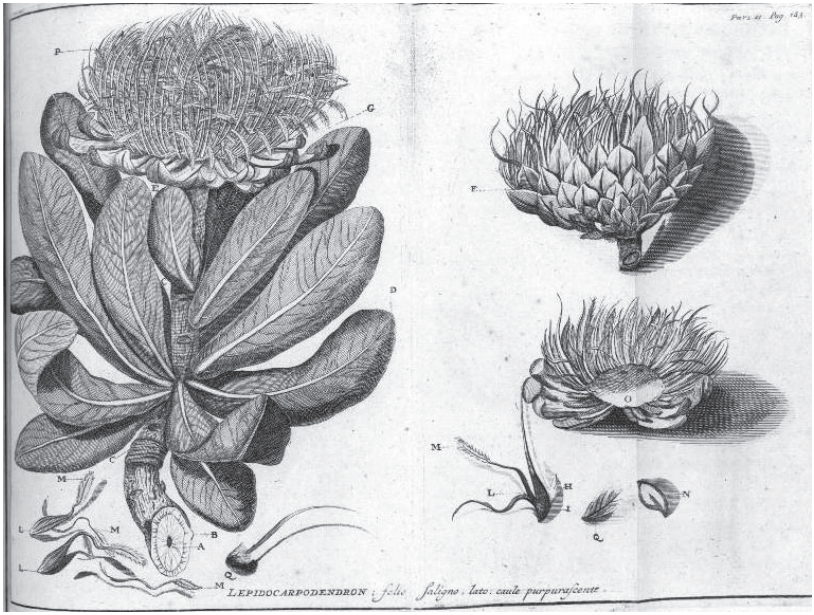

Figure 3. The commonly named 'sugarbush' (Protea), here depicted in an engraving (Boerhaave, 1720, vol. 2, fol. 182v). Courtesy of die Niedersächsische Staats- und Universitätsbibliothek, Göttingen. See also Paterson-Jones, 2001.

Of the 786 plants in the first twenty volumes of *Curtis Botanical Magazine,* an illustrated botanical magazine which has run continuously since 1787, almost one-third were devoted to Cape plants, mostly collected for Kew by Masson. Under British rule at the Cape, plant hunting became easier. This was aided by the appointment of a resident botanist, beginning with Ludwig Pappe (1831-), the "experience of the colonial farmer" and the sealed, protective glass container for plants popularised by Nathaniel Ward (c. 1840) (Green Musselman, 2003; McCook, 2016). Travelling gardeners like James Bowie (c. 1789-1869) discovered novelties like *Aloiampelos ciliaris* (Haw.) (Klopper & Gideon F. Sm. (CBM, 1978)) and the genus *Bowiea*, despite it being, strictly speaking, a scaly desert plant, while William Burchell travelled for four years into the interior producing 500 sketches and was encouraged to describe the Cape as "a botanical garden, neglected and left to grow in a state of nature" (Burchell, 1822, 17). Meanwhile, Arabella Roupell (1817-1914), although celebrated by her biographers as a 'pioneer artist', was providing illustrations (Roupell, 1849) that had been made twenty years

earlier by the Frenchmen F. Mordant De Launay and J.L.A. Loiseleur-Deslongchamps, as the example of *Liparia sphaerica* Herb. Linn. goes to show (Mordant de Launay *et al*., 1817-26, vol. 6, pl. 406).

WHAT CAN WE DO? BRING THE MEDITERRANEAN TO WALES!

Given the very real existential threats to the Cape flora that exist today, as sketched at the outset, the project of transplanting its contents to more secure locations across the globe has everything to commend it. The southern Welsh coastline, known as the 'Celtic Riviera', can perhaps offer one such home: palms, yuccas and aloes were planted along coastal promenades and in 'Italian gardens', as laid out at Penarth in the mid-1920s and at Victoria Park in Swansea, as photos from 1925 testify to (Francis Frith Collection #77381). This was part and parcel of the history of tourism in the region, a phenomenon stretching back deep into the 19th century (Moore, 1905; Boorman, 1986).

Wolfgang Bopp, curator for the Director of Horticulture, and Ivor Stokes, at the National Botanical Garden of Wales, were responsible for ground-work in the glasshouse once the structure had gone up in 2000, the largest single-span glasshouse in the world, sheltering 3500 sq. metres of vegetation (Figure 4). It was decided to concentrate on Mediterranean plants for three reasons – first, the running costs (the heating is provided by a biomass boiler) were considered less than for a tropical garden; secondly, the fact that Mediterranean plants are generally under-represented in botanical gardens; and thirdly, they are currently under great environmental threat. Bopp laid out the planting of the glasshouse and sourced many of the plants: from Fernklof, a nature reserve in Hermannus, South Africa and Kirstenbosch, the National Botanical Garden of South Africa.

Plants brought were quarantined at the NBGW for nine months, totally enclosed in mosquito netting and inspected regularly by DEFRA (Department for the Environment, Food and Rural Affairs) . What pests emerged were killed off. Some 200 species from the West Cape alone are represented in the glasshouse out of a total of 230 from South Africa as a whole, and 3000 species altogether (Gould, 2006).

Figure 4. Mediterranean plants under the glass dome at the National Botanical Garden of Wales. Photo by the author.

The Mediterranean plant collections near Llanarthney might be considered a PMR, or plant micro-reserve, in the parlance of the LIFE programme launched by the European Commission in 2007, a small plot of land of up to 20 ha. that is of peak value in terms of plant endemism or rarity, although the goals of the former are primarily protective, whereas those of PMRs are to inventorize and to monitor plant diversity (European Commission, 2008, 17-19).

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CHAPTER NINE

SOCIOZOOLOGICAL SCALES: HUMAN'S PERCEPTIONS ON NON-HUMANS THROUGH A CONSERVATION PERSPECTIVE

SUSANA GONÇALVES COSTA, CATARINA CASANOVA AND PHYLLIS LEE

WHAT ARE SOCIOZOOLOGIC SCALES?

Social perceptions and how they interfere with the way humans see nonhumans

Social perceptions are composed of two different factors: (i) the individual and his/her cognitive abilities and (ii) the cultural context where he/she lives. This last factor comprises values, norms, beliefs (e.g. religion) and attitudes that were already operating in the society where the subject was raised (Deth & Scarbrought, 1998). To be accepted, one has to learn the features of his/her culture (Giddens, 2000). Therefore, social training is needed in order to transform the 'savage' into a 'civilized' creature (Lévi-Strauss, 1966). Socialization allows us to perceive the objects around us that – once cognitively captured – are organized with respect to our culture's patterns (Yerbyt & Leyens, 2004; Baron *et al.,* 2007; Smith & Mackie, 2007). An individual absorbs what surrounds him/her and organizes his/her perceptions – regarding his/her cultural context – in order to be accepted by the other members of the society (Giddens, 2000). This is how we learn our place in the world and – as a result – how we are positioned in relation to other humans, nonhumans and the environment (Arluke & Sanders, 1996; Serpell, 1996; Costa *et al.*, 2013).

For instance, in Hinduism and Buddhism, the belief in a divinity that exists beyond the Universe and that is present in all living beings and

adopts different shapes and species, is a central idea (Gavin, 2000). Both religions are rooted in reincarnation principles and, as a consequence, in vegetarianism. Non-violence is the key for a good future reincarnation, which happens based on one's previous good or bad behaviour. As such, different lives will occur, depending on the individual's past conduct. No one should kill or injure other living forms since they can be past beloved ones, compromising future 'good' reincarnations and karma. The idea of 'good' and 'bad' reincarnations is not totally free from anthropocentric thoughts. In fact, according to Hindu reincarnation matrixes, a *brahman*[1] murderer has higher chances of becoming a dog, a pig, a donkey or even a *pukassa*[2] (Renou, 1980). Through this perspective, becoming a nonhuman is worse than being a human. Nevertheless, depending on their social status (castes, in the Hindu culture), not all humans are considered 'good'.

On the other hand, for the religions in Judeo-Christian cultures, humans are clearly seen as superior entities. Humans are the bridge between the divine and the profane (Shneider, 1970). Humans are the only creatures made by God 'in His image' who are allowed to rule over the Earth. In Judeo-Christian cultures, there is an obvious preference for humankind (Hertzberg, 1981), particularly for men and patriarchal domination. It is humans' duty to rule over all the other species, taking advantage of them. This is where Western anthropocentrism settles.

Social perceptions and sociozoologic scales in Western societies

Due to its anthropocentric nature, in Western societies[3] peoples' perceptions often organize the animal kingdom symbolically into 'good' and 'bad' animals (Arluke & Sanders, 1996). While zoology classifies animals according to their biological features and affinities, the 'sociozoologic scale' organizes species as a function of their perceived or actual roles in the local society. There is a clear hierarchy of animals, based on moral judgements, that depends on how useful the animal is, how closely it collaborates with humans, how evil the animal can be and how demonic it is perceived to be (Sandøe & Christiansen, 2009). Such a model is based on traditions and prejudices that are often associated with the way we see and deal with other humans, namely people belonging to minority groups or 'outsiders' (Arluke & Sanders, 1996; Nibert, 2002).

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[1] A member of the highest rank of the caste system.

[2] A member of the lower caste, also known as an 'untouchable'.

[3] The expression 'Western societies' in this context refers to the societies of developed countries, mostly located in the Northern Hemisphere.

'Good' animals, for instance, have a high moral status due to their subordinate roles. They accept their status and reinforce the concept that humans are the pinnacle of the animal kingdom. Companion animals, livestock, lab and anthropomorphized animals are examples of nonhumans perceived as 'decent citizens' (Leach, 1964; Morris, 1967; Arluke & Sanders, 1996; Costa & Casanova, 2014). Companion animals seem to like their status in human societies; they appear to be genetically predisposed to be part of the human world. Cats and dogs that are kept as companions are common in Western societies. They are seen by their owners as organisms of affection and, paradoxically, as living beings that are dominated by us (Arluke & Sanders, 1996), which means that companion animals' welfare is not always seen as a priority by humans.

> Despite the fact that the animal's owner wants the best for the animal, he or she may, out of ignorance and unintentionally, treat the animal in ways that jeopardize its health or welfare – for example by treating it as a human being rather than an animal of the species in question with its particular needs. (Sandoe & Christiansen, 2009, 31)

Besides companion animals, nonhumans classified as 'tools' are also part of the 'good' faction. These individuals are seen in a positive way because they are useful for both providing us with scientific data and with food supplies. Laboratory mice or livestock exist for humans' benefit (Arluke & Sanders, 1996).

On the other hand, 'bad' animals are viewed as uncontrolled creatures potentially capable of subverting the sociozoologic scale.

> They may be freaks that confuse their place, vermin that stray from their place, or demons that reject their place. They are oddities that cause repulsion, unwelcome visitors that provoke fear, or dangerous attackers that rouse horror. In turn, society may ignore, marginalize, segregate or destroy them. (Arluke & Sanders, 1996, 175)

There are three different categories of 'bad' animals. First, 'freaks' are the least evil and include all the creatures that do not have a clear status in the social order. Since their place is ambiguous, their moral status puts them on the margins of society. There is no urgency to destroy them, though they are not welcome in our social sphere. Examples of what a 'freak' can be are people that apparently mix human and animal features

due to malformations that remind people of animals[4]. 'Vermin' have a lower status than 'freaks'. They usually cross human boundaries to threaten individuals and their environment. They are thought to be 'dirty'. Rats are frequently perceived in this way, unless they are contributing to our welfare improvements in a lab. Finally, 'demons' are the worst animals of all and are, according to some humans' points of view, able to challenge the social order imposed by us and to reverse the fundamental master-servant relationship present in the traditional order.

> These animals do not fear humans, humans fear them. These animals hunt humans, humans do not hunt them. These animals have power over humans; humans do not have power over them. (Arluke & Sanders, 1996, 181)

Wildlife such as snakes, sharks and wolves are seen as 'demons' due to their untamed and/or dangerous behaviour.

Although such constructs are typically shared by the majority of individuals, the models are sufficiently flexible to allow 'good' animals, for example dogs, to turn 'bad' (e.g. Patronek *et al.*, 2000). For example, pit bulls are seen as 'demons' that kill and eat their victims (Arluke & Sanders, 1996). Since the 80s, this pedigree dog's attacks have been hyperbolically described by the media, perpetuating the negative attitudes people have towards the breed. In fact, there are no data corroborating the idea that pit bulls attack people more often than any other pedigree. Rabbits are also a good example of how an animal, depending on the context in which it is perceived, can be classified either as 'good' or 'bad' (Torosyan & Lowe, 2017). These nonhumans can be seen as a source of proteins, a Guinea pig or even a companion animal. However, in some specific scenarios, rabbits can also be considered pests that invade and destroy crops and jeopardize ecosystems.

Sociozoologic scales have largely been used to reflect Western urban areas' perceptions of nonhumans, portraying the way we relate with other living forms and bringing light to the drivers of our potentially anthropocentric behaviour and the way it may jeopardize nonhumans' welfare (e.g. farm, lab and companion animals). They also help us to understand the ways we relate with other humans, namely minority groups

[4] Such as the 'Giraffe Woman' (who had long limbs), Jo-Jo (the dog faced boy who had hair all over his body and face) and Camel Girl (whose malformed knees forced her to walk like a quadruped); all of them were circus attractions in the United States at the end of the 19th century.

(Nibert, 2002). However, in a more practical and intervening way, these models can be useful to understand how locals living inside and outside protected areas relate with biodiversity and how these relationships potentially jeopardize endangered species' survival (Costa *et al.*, 2013; Costa, 2013). As such, we believe that policymakers, stakeholders, academics and conservationists should consider sociozoologic scales as an essential part of the decision-making processes when it comes to establishing conservation and sustainable development programmes.

SOCIOZOOLOGIC SCALES OF TWO DIFFERENT CULTURAL CONTEXTS

To better understand the functional uses of the sociozoologic scales and how different cultural contexts interfere in the way humans perceive and relate with nonhumans, we present two distinctive case studies: (i) a Western urban area context (Almada, Portugal); and (ii) a protected area in a rural West African context (Cantanhez Forests National Park, Guinea-Bissau).

A survey questionnaire was conducted in the two scenarios (see Table 1). In both cases, subjects were asked to indicate – from a list provided by the interviewer – which species they like/dislike most. Due to potential issues in language interpretation, the list presented in the West African context was made up of photos to guarantee that subjects were all on the same page regarding the species we wanted them to rank (Figure 1).

Due to some important differences in the way we collected data, namely regarding sample size, features used to rank the species and data analysis methods, we will focus strictly on the main conclusions of both data sets[5]. Though lacking methodological details, from a sociozoologic point of view these results are still worth considering because – even from a broad perspective – they show us how different cultures can exhibit similarities in the way culturally unrelated people organize the animal kingdom.

[5] The two data sets were collected with different purposes. Data collection in Almada was conducted in order to accomplish a Master's degree, while the research conducted in CFNP was part of a broader project aimed at protecting chimpanzees. The latter data set was also used to obtain a PhD.

Figure 1. Woman ranking photos of nonhumans in CFNP (Guinea-Bissau). Photo by Susana Costa.

The Western urban case

Almada is a city located on the southern margin of the Tagus River, on the opposite side to Lisbon. 57% of its population live in the more urbanized area, where contact with nature is rare.

As previously mentioned, during data collection (see Table 1), subjects were invited to point out, from a list of species, which nonhumans they like/dislike and the ones they believed to be the most intelligent/unintelligent (see Figure 2).

Regarding the species subjects liked the most, in general, and not surprisingly, Almada's sample mainly showed themselves to be fonder of mammals than any other animals. As part of the nonhumans that subjects felt more affectionately about, cats, dogs, dolphins, chimpanzees and parrots were the most mentioned. Dogs, particularly, are remarkably meaningful to humans. They were the first domesticated animals (Titiev, 1969) and since then, they have been playing the role of our best friends, representing an extension of our identity (Beck & Katcher, 1996; Sanders, 1999). Dolphins are thought to behave kindly and in a friendly way towards humans, and parrots' appearance and behaviour (e.g. flat face and the ability to reproduce human words) makes both species anthropomorphic (Morris, 1967).

Table 1. Summary of data collection.

Cultural context	Year of data collection	Method	Hours of data collection	Sample size	List of species to be ranked
Almada, Portugal	2004	Survey-questionnaire	30hrs total for interviews	N = 120 (60 men, 60 women; age range from 15 to 61+)	Written list that comprised 21 species that - according to the urban Western cultural context - are traditionally considered "good" and "bad" (i.e. companion, farm and lab animals, charismatic wildlife and humans).

Cantanhez Forests National Park, Guinea-Bissau	2008-2009	Survey-questionnaire	64hrs total for interviews	N=257 (133 men, 124 women; age range from 10 to 50+)	List of photos that comprised 26 nonhuman species that live/used to live inside the protected area (11 photos represented nonhuman primates, since the main goal of the research project was chimpanzees' (*Pan troglodytes verus)* protection.

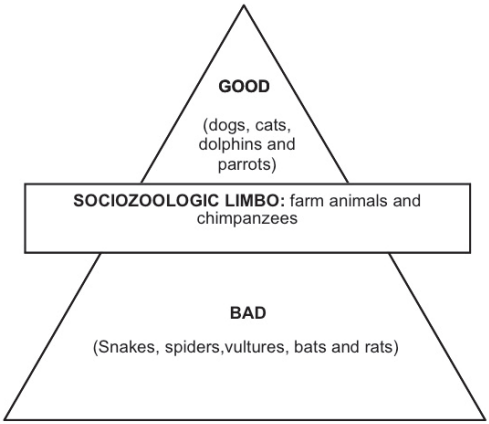

Figure 2. Almada's sociozoologic scale adapted from Arluke and Sanders (1996). Bad animals lie at the bottom due to their low moral status and good animals at the top, due to their submissive and predictable behavior.

On the other hand, the animals that subjects said they disliked were mostly non-mammals. Species reported as dangerous (such as snakes and spiders) or related to death (e.g. vultures) are among the highest ranked animals. There were only two exceptions regarding mammals: rats and bats. Rats are only perceived as good animals in two specific situations: (i) when they are kept as companion animals; and (ii) when they are contributing to research inside a laboratory. Otherwise, they are seen as

eager to invade our territory, spreading potentially lethal diseases (Birke, 2003). On the other hand, bats are seen as very peculiar animals: (i) though they are mammals, they have wings and fly; (ii) they become active only at night; and (iii) they rest upside down. No wonder they have been portrayed as related to vampires, which makes them 'demons' according to the Arluke and Sanders (1996) classification.

In relation to the species' intelligence, though their positioning among the preferred nonhumans was not brilliant[6], chimpanzees' human-like appearance makes them very intelligent in the eyes of these human fellows. Farm animals were consistently ranked as unintelligent. From the perspective of the scale built by Arluke and Sanders (1996), farm animals are supposed to be considered 'good'. They live inside the boundaries of human societies; they seem to like their status; and they are totally dominated by us. Nevertheless, they are food. So, looking at them as being brainless might make us feel less guilty. We need to be able to exploit, kill and eat these animals' corpses without blame (Franklin, 1999).

No significant differences were found in relation to gender, religion and education. The results were consistent throughout the sample.

The rural Western African case

This sociozoologic scale refers to the Cantanhez Forests National Park (CFNP), a patchy tropical rainforest area in the south of Guinea-Bissau (lat.: 11016'42.78"N; long.: 1454'42.30"W), where encounters between humans and wildlife are frequent (Figure 3). From all the species that one can find inside the protected area, chimpanzees are the most charismatic, and that is probably why they were also the most mentioned species during data collection.

Gender and religion appeared to play significant roles in the structuring of the sociozoologic scale amongst the people of the CFNP. Men tend to be more positive than women in their rankings of chimpanzees. Men see chimpanzees mainly as good and intelligent. They were referred to as very wise crop-raiders, since they appear to know exactly when it is safe to steal fruit from farms. Men's perceptions of chimpanzees' cleverness

[6] Physical similarities between humans and chimpanzees – due to our huge genetic proximity – transform the latter in a quasi-offensive human caricature. As such, apart from the intelligence point of view, this might not contribute to their sociozoologic status in the Almada sample. Besides, chimpanzees are too distant from this Western urban context – both geographically and emotionally.

might be related to this species' ability to elude the farmers' crop protection strategies. Women appeared to be less positive towards chimpanzees than the men. According to their testimonies, chimpanzees are seen as a hazard that jeopardizes women's and children's safety. There are several examples of chimpanzees attacking women and small children in Africa (e.g. Hockings *et al.*, 2010; Garriga *et al.*, 2017; Sousa *et al.*, 2018). Although we never confirmed whether this happened in the CNFP, there were reports that some attacks had occurred in the villages of Mejo and Farim.

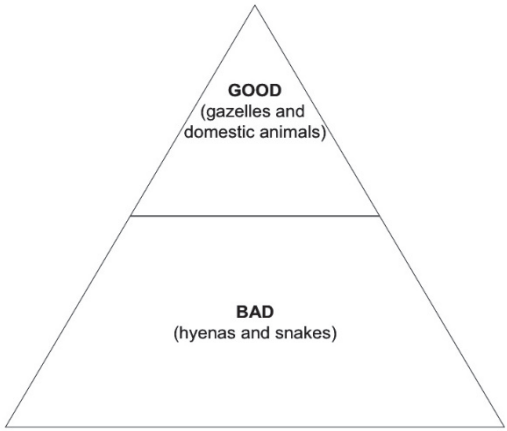

Figure 3. CFNP's sociozoologic scale adapted from Arluke and Sanders (1996). Bad animals lie at the bottom due to their low moral status and good animals at the top, due to their submissive and predictable behaviour

Female respondents appeared to prefer domestic animals. Chickens and goats were rated as good animals by female respondents, probably due to their physical proximity and potential returns. Women are expected to accomplish their daily tasks in – or nearby – villages, which might make them feel closer to livestock. As an exception, gazelles were highly rated by women for their positive attributes, possibly because they are considered 'tasty' and due to their more gentle presence as well. In addition, in a male-dominated culture like this, women are associated with gazelles as being pretty, sexy, and elegant.

Both Muslims and non-Muslims (i.e. Animists and Christians) rated hyenas and rock pythons negatively, possibly due to their potentially dangerous behavior, although sometimes they are associated with the

spiritual and animist world as guardians, shape-shifters and sentinels. These species are not perceived as respecting humans' territorial boundaries; they do not fear humans and, thus, cannot be dominated by us. They are seen as 'demons' (Arluke & Sanders, 1996). Ironically, hyenas – according to some elderly men's testimonies – are extinct in this region, but are still classified as 'bad', which makes us believe that a reintroduction of the species in this territory may fail.

Muslims rated some primate species as bad, namely baboons and vervet monkeys. Since Muslims mainly have fruit and cash crop farms (Temudo, 2009), the conflict between people and these raiding species is potentially more serious than that experienced by non-Muslims. On the other hand, non-Muslims rated primates as edible, especially baboons and vervet monkeys, which suggests that non-Muslims are more eclectic in relation to their dietary habits than Muslims. However, despite Islamic restrictions regarding certain kinds of meat consumption, some young Muslims hunt and trade bushmeat as an extra source of income. While strict religious principles forbid consumption, these appear not to prohibit the hunting or sale of this meat (Arberry, 1996)

MODELS' DIFFERENCES AND SIMILARITIES

Species' appearance, utility and behaviour define both sociozoologic classifications.

Gazelles in Guinea-Bissau are probably the most positively positioned wild animal in this sociozoologic context. Dogs and cats are the most beloved ones in the Portuguese sample. In both cases, these species' tame behaviour, their appealing aesthetic features and their well-defined social status put them in the highest position.

On the other hand, hyenas are believed to have the ability to transform themselves into humans to kill domestic animals and people in the villages – they are 'demons' according to Arluke and Sanders' (1996) terminology. In Almada, snakes, spiders, vultures, bats and rats are among the most feared. In both samples, subjects have very few chances of having real encounters with these nonhumans. In the case of the hyenas from the CFNP, the species have not existed in the protected area for decades, but myths and traditional beliefs have been helping people to crystallize negative perceptions and attitudes towards hyenas. In the urban Western scenario, vultures are associated with death, while snakes and spiders are believed to be capable of spreading lethal venom. In conclusion, whether one is in Africa or in Europe, nonhuman animals that do not respect our territory or bodies lay at the lower level of the sociozoologic scale.

Anthropomorphized animals – such as chimpanzees (Guinea-Bissau) and dolphins and parrots (Portugal) – might also benefit from a higher status, since they are seen as almost human. Dolphins seem to be able to communicate with humans and parrots can actually use words. In the case of the CFNP's chimpanzees, due to their human-like appearance, they are considered ancestors and, thus, the consumption of their meat is a taboo. However, their bad behaviour in relation to farmers and their crops and also some alleged attacks on women and children have been preventing them from going straight to the top of the sociozoologic hierarchy (Costa *et al.,* 2013).

In the CFNP, being edible appears to be a positive attribute[7]. Animals whose meat is considered tasty are valued – this seems to be the case for gazelles. Livestock in Western societies, similar to species hunted for bushmeat in Guinea-Bissau and many other parts of Africa, is very valuable, both economically and from a nutritional point of view. Nevertheless, while edible animals in a context such as the CFNP are undoubtedly considered 'good', in Almada they seem to live in a midpoint between 'good' and 'bad'. Being away from the process of raising and slaughtering livestock might contribute to urban Westerners' blindness regarding these nonhumans. Farm animals are not 'bad' because they do not interfere with our urban nature-free lives, but they cannot be 'good' either, otherwise it would be too hard to use their meat[8].

Farm animals and chimpanzees, due to their undefined status, lay in a kind of limbo where 'good' and 'bad' seem to mix.

FINAL REMARKS

Whether one is willing to implement *in situ* conservation efforts or to raise awareness of the importance of biodiversity protection in an urban context, sociozoologic scales are of high importance. Nonhumans are not all perceived in the same way, and the more positively the species we wish to protect are seen, the better they will suit a successful conservation programme (Costa *et al.,* 2013). This is true for the sociozoologic scales of the locals living in close proximity to wildlife, but also for those living in

[7] Hunting and bushmeat consumption is a major conservation threat (e.g. Rogan *et al.*, 2018).

[8] Flexibility is a well-known feature of the sociozoologic scales (e.g. Patronek *et al.*, 2000; Torosyan *et al*., 2017).

other places where their consumption habits interfere with distant ecosystems.

Besides their capacity to shed light on how inconsistently we relate with other living beings (Arluke & Sanders, 1996), sociozoologic scales can be a useful starting point to figure out ways to change attitudes towards neighbouring wildlife and to get the public to engage in environmental protection measures, adopting more eco-friendly lifestyles worldwide.

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CHAPTER TEN

PRIMATE BEHAVIORAL ADAPTATIONS TO ANTHROPOGENIC HABITATS – THE CASE OF CANTANHEZ NATIONAL PARK IN GUINEA-BISSAU

TANIA MINHÓS
AND MARIA FERREIRA DA SILVA

BEING A NON-HUMAN PRIMATE IN A HUMANIZED WORLD

Non-human primates (hereafter primates) are frequently regarded as special animals to us, humans. When we see them, either in the media, in the zoo or in their natural habitats, we easily empathize with them as we recognize human-like physical and behavioral similarities. They are our closest phylogenetic living relatives, and, as primates, we share a series of traits, such as an enlarged brain, slow development, complex sociality, stereoscopic vision, and a more erect posture (Strier, 2000; Boyd & Silke, 2006). Primates share these and other traits that differentiate their evolutionary trajectory from that of other mammals, but are an incredibly diverse group of species, varying enormously in their socio-ecological, behavioral, morphological and cognitive features (Smuts *et al.,* 1987; Strier, 2000). Body size can range from a couple of tens of grams in the tiny nocturnal mouse lemur from Madagascar to over 150 kg in the male gorillas from Central Africa (Smuts *et al*., 1987; Strier, 2000). Although primates often include more than one type of food in their diet, it is frequent for primate teeth and guts to be adapted to process and digest one main type of food, the species being described as folivore, frugivore, insectivore or gummivore. Some primates are exclusively arboreal while others are mostly terrestrial. Primates are often considered to be highly social, but species vary greatly in the size and composition of their social groups. For instance, whereas several prosimians are solitary primates, orangutans are semi-solitary, and

gibbons and titi monkeys live in pair-bonded systems. In all cases, the two sexes have to disperse after puberty. Some tamarins and marmosets show a less common grouping pattern, where a female shares the territory with more than one male and their offspring and males assume a significant role in parental care (polyandrous). Nonetheless, most primates live in polygynous groups, in which several adult females and their dependent offspring can share the territory with one or several adult males, forming one unimale–multi-female or multi-male–multi-female group, respectively (Strier, 2000; Boyd & Silke, 2006). The high need for social engagement results in very complex social behaviors (e.g. cooperation, altruism, culture), which are only possible due to an enlarged and complex brain that allows all their group members' interactions to be tracked (Tomasello & Call, 1997; Dunbar, 1998) and enables primates to come up with novel answers to novel challenges. The rate and complexity at which innovation appears is imprinted in the evolutionary trajectory of all living primates and our human ancestors and was vital to our evolutionary success.

Primates can explore and adapt to a wide range of environments but are highly vulnerable to extinction when their habitats are disturbed. Most primates inhabit tropical Africa, Asia, and South and Central America, overlapping with human populations that are fast-growing and highly dependent on the exploitation of natural resources for financial income. As a result, more than half of all species are threatened with extinction, exclusively as a result of anthropogenic activities such as habitat destruction and fragmentation, hunting for bushmeat, pet trade or traditional practices or disease transmission (Estrada *et al*., 2017). Living alongside humans has been a reality for many primate populations, for centuries and/or millennia. In many rural communities, primates are part of the peoples' cosmogenies – their myths, legends and folklore. The historical relationship between primates and humans shows that humans have been part of the non-human primates' ecosystems for many generations and co-existence has been possible and sustainable. However, we have been witnessing, over the last decades, a rapid change in this relationship as local human populations are drastically increasing. Global demand for various crops (e.g. oil palm, rice, sugar cane), livestock, timber, minerals or fossil fuels has led to a fast industry-driven conversion and destruction of natural landscapes, dramatically reducing the area of natural habitats available to primates (Estrada *et al.*, 2017). Moreover, forested areas are more accessible to primate-targeting commercial hunters (Fa *et al*., 2015; Nijman *et al*., 2011). As opposed to subsistence hunting, commercial hunting extracts individuals at higher rates and accelerates the extinction of already small and isolated populations.

West Africa is a particularly sensitive region concerning primate conservation. West African primates are among the most threatened mammals in the world (Brashares *et al.*, 2001). Most populations survive in small and isolated patches of natural habitat, surrounded by human-modified environments and faced with high levels of hunting (Conservation International, 2008). As a result, only those species that can display behavioral plasticity facing new conditions will be able to persist in such anthropogenically-dominated landscapes. Others, with a smaller degree of behavioral flexibility, will most likely become extinct in coming decades. For example, the arboreal black-and-white colobus monkey (*Colobus* ssp.) is known to adapt its diet, group size, home-range, and dispersal when forests become smaller and degraded, whereas the less socio-ecologically flexible red colobus (*Piliocolobus* ssp.) tends to disappear faster from disturbed environments (Minhós *et al.*, 2013a; 2016; Onderdonk & Chapman, 2000). Chimpanzees (*Pan troglodytes*) and baboons (*Papio* ssp.) have also been reported to i) increase social bonding with unrelated females as a response to increased intra-group competition (Barton *et al*. 2006; Lehmann & Boesch, 2009), ii) change their diet in order to explore a wide variety of crop foods in crop-dominated landscapes (Hockings & McLennan, 2012; Naughton-Treves *et al.*, 1998) and iii) cross human settlements, such as roads, villages or crop fields (Hockings *et al*., 2006; 2015; Hoffman & O'Riain, 2012).

HOW SOCIO-ECOLOGICALLY FLEXIBLE ARE THE PRIMATES FROM CANTANHEZ NATIONAL PARK IN GUINEA-BISSAU?

Cantanhez National Park (CNP) (total area: 1,067 km^2, Figure 1) is located in the Tombali Administrative Region in the southwest of Guinea-Bissau (NE limit: 11º22′58″N, 14º46′12″E; SW limit: 11º2′18″S, 15º15′58″W). Cantanhez means ‘Mountain of Forest’ and was declared a national park in 2011 (Decreto 14/2011).

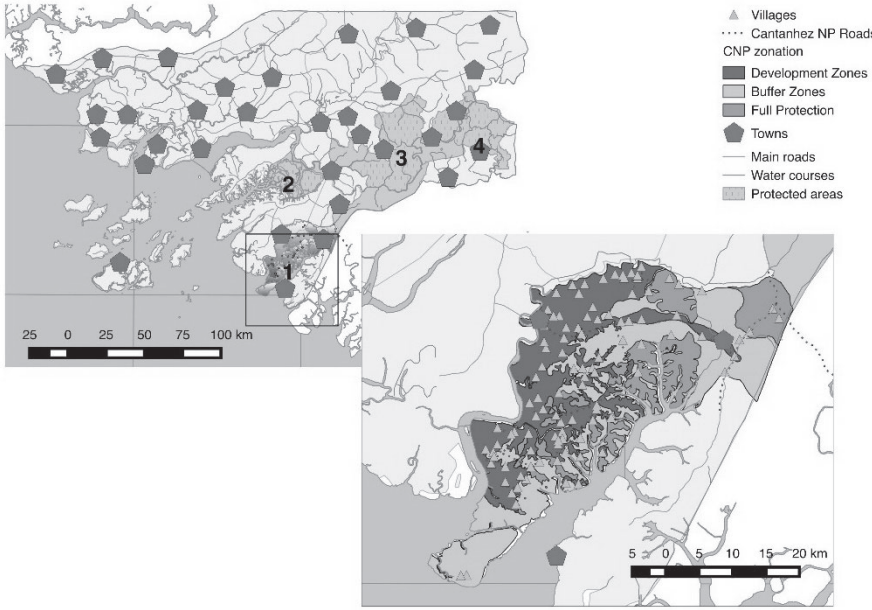

Figure 1. Map of the land cover of Cantanhez National Park, Guinea-Bissau (geographic information for the location of villages and land use data kindly provided by IBAP)

The CNP is managed by the IBAP – Institute for Biodiversity and Protected Areas (https://www.ibapgbissau.org/index.php/pnc) and is a mosaic of sub-humid, dry and mangrove forests and woodland savanna. It is home to eight of the ten primate species found in Guinea-Bissau – the Western chimpanzee (*Pan troglodytes verus*), the Guinea baboon (*Papio papio*), the King colobus (*Colobus polykomos*), the Temminck's red colobus (*Piliocolobus temminckii*), the Campbell's monkey (*Cercopithecus campbelli*), the Green monkey (*Chlorocebus sabaeus*), the sooty mangabey (*Cercocebus atys*), and the Senegal bushbaby (*Galago senegalensis*) (Gippoliti & Dell'Omo, 1996). Despite being a protected area, the CNP is a highly anthropogenic West African landscape. It is the home of over 20,000 people, belonging to 10 different ethnic groups distributed across 110 villages (Temudo, 2009). As a result of a high human population density, habitats are fragmented by human settlements, such as roads, villages, and crop fields (Simão, 1997; Figure 2).

Figure 2. Forest slashed and burned to be converted into agricultural fields (photo by Maria Ferreira da Silva)

The Nalus were the first ethnic group to arrive on the Cantanhez Peninsula in the 16th century, and are considered *the owners of the land*. The Nalus have relied on traditional land-use management practices and religious beliefs that convey some degree of protection to natural ecosystems (Frazão-Moreira, 2001, 2009, 2016a; Sousa & Frazão-Moreira, 2010). The sustainable use of and respect for natural resources are common global features among communities that rely on natural resources for their subsistence. They are incredibly knowledgeable about the ecosystem and its functions and have found ways to coexist with the other sympatric forms of life for many centuries. However, as is the case for many other tropical areas around the globe, Cantanhez has experienced a very rapid increase in the human population. Currently, the local communities inhabiting the CNP are from various ethnic groups and backgrounds, exhibiting practices, beliefs and needs which are less compatible with the sustainable use of the forest's natural resources. During the last decades, the areas occupied by the original forest or that were considered sacred places have been converted to croplands, mainly by slash-and-burn agriculture and the monoculture of cashew trees (Oom *et al.*, 2009), which constitutes a major threat to non-human primates: they lose their habitats, their food supplies, their refuges and come into closer contact with people, increasing the potential for conflicts and proneness to disease transmission (Hockings & Sousa, 2012, 2013). Additionally, all primates, with the exception of chimpanzees and

bushbabies, are commercially hunted for bushmeat consumption (Costa *et al.,* 2013; Gippoliti *et al*., 2003; Minhós *et al*., 2013b).

The primates from the CNP have been consistently studied for the past ten years. The studies have been conducted by a multidisciplinary team of researchers focusing on ecology, behavior, genetics, parasite infection and local people's perceptions, mainly with regard to four primates: the Western chimpanzee, the Guinea baboon, the King colobus and the Temminck's red colobus (Bessa *et al*., 2015; Costa *et al*., 2013, 2017; Ferreira da Silva, 2012; Ferreira da Silva *et al.,* 2013, 2014, 2018; Frazão-Moreira, 2016b; Hockings & Sousa, 2012, 2013; Minhós *et al*., 2013a, 2015, 2016; Parathian *et al*., 2018; Sá *et al*., 2013; Sousa *et al*., 2011, 2014, 2017).

Here, we review the studies on primates from the CNP, namely chimpanzees, baboons and colobus monkeys, that have reported behavioral changes possibly as a response to recent human-induced alterations in the environment. We discuss which environmental driver(s) may be responsible for those behavioral changes and their conservation and evolutionary consequences.

Chimpanzees are terrestrial forest-dwelling animals (McGrew *et al*., 1981). The species is classified as frugivorous but also explores other foods such as seeds, bulks, leaves, flowers, invertebrates and occasionally smaller birds and mammals, including primates (Nishida & Hiraiwa-Hasegawa, 1987). It is thought that its feeding regime has a high impact on its social system. Chimpanzees live in communities of 20 to over 100 individuals, in multi-male–multi-female fission-fusion social groups (Hiraiwa-Hasegawa *et al.,* 1984). As they rely heavily on seasonal and scattered fruits, chimpanzee communities show very high inter-group competition for large territories and high intra-group female competition for food. Although chimpanzee socio-ecology is greatly influenced by a frugivorous regime, this great ape shows remarkable dietary flexibility, being able to adjust and adapt its feeding regime to different environments (Hockings *et al.,* 2009; McLennan, 2013). In the specific case of agricultural-dominated landscapes, chimpanzees can even adjust their grouping patterns and risk assessment behaviors in order to explore the highly nutritious crop foods (reviewed in Hocking *et al.,* 2015). With the CNP being a mosaic of natural and human-altered habitats dominated by crop fields, chimpanzees have altered their behavior in order to explore a wide range of highly nutritious crops (Hockings & Sousa, 2012, 2013; Bessa *et al.,* 2015). Bessa and colleagues (2015) have demonstrated that the chimpanzee community from Caiquene-Cadique in the CNP was able to incorporate nine different fruit and non-fruit crops in their diet, representing a total of 13.6% of all food consumed. They have also shown that such dependence on crop foods is not affected by wild fruit

availability. This suggests that, rather than being forced to explore crop foods as a result of a decrease in wild fruits' availability, these chimpanzees actually prefer to consume cultivated foods in times when they still have wild fruit in the forest. This finding suggests at least two very interesting but alarming facts: i) probably as a result of their high cognition, chimpanzees were able to adapt their dietary behavior, ranging and, most probably, grouping patterns in a few generations in order to explore human-cultivated foods; and ii) the fact that they choose to explore cultivated foods resulted in increased contact with local human communities that may bring serious economic, health and conservation consequences (Hockings & Sousa, 2013; Bessa *et al.,* 2015).

The Guinea baboon belongs to a behaviourally and ecologically flexible but homogenous group (genus *Papio*, cf. Bergman, 2018; Kamilar, 2006) that can benefit from living alongside human communities. They display a set of behavioral responses that enable them to adapt quickly to human-related changes. In human-dominated environments, baboons are often attracted towards areas where human food (crops or provisioned food) is available because of higher predictability and improvement in foraging efficiency (Saj *et al.,* 1999). Baboons may start to explore new diet items (Alberts & Altmann, 2006), change foraging routes and the location of sleeping sites and shift home ranges to overlap with areas of better food availability or to avoid perceived high-risk environments (Dunbar, 1988; Barton *et al.,* 1996; Cowlishaw, 1997). Their cognitive capacities, wide dietary range, and opportunistic and co-operative behaviors make them a very successful species at raiding and consuming human food (Sillero-Zubiri & Switzer, 2001). However, the most frequent response of human communities to raiding baboons is direct persecution and killing (Biquand *et al.,*1992). Baboons may perceive hunters as predators, and thus hunting practices have the potential to precipitate behavioral changes (Ferreira da Silva, 2012; Ferreira da Silva *et al.*, 2018). In other species, individuals reduce the risk of being hunted by becoming more silent (Croes *et al.,* 2006), adopting safer foraging and dispersal routes (Tutin *et al.,* 1997), choosing not to disperse (Isbell & van Duren, 1996) or adopting nocturnal habits (Krief *et al.,* 2014). However, if human-induced pressure overwhelms baboons' behavioral ability to persist, raiding populations may become extinct (e.g. hamadryas baboons: Biquand *et al.,*1992; Guinea baboons: Galat *et al.,*1999-2000).

In Guinea-Bissau, the population of baboons have been reported to decline since 1970-80 (Cá, 2008; Casanova & Sousa, 2006), mainly due to persecution by farmers and poaching (Costa *et al.,* 2013; Ferreira da Silva *et al.,* 2013, 2014; Minhós *et al.,* 2013). CNP baboons show signs of behav-

ioral adjustments to frequent contact with human communities, and presumably, to avoid hunters. Primate-targeted hunting is a nocturnal activity, carried out at sleeping sites (Cá, 2008; Ferreira da Silva, 2012). Contrary to other populations, which choose to sleep in tall trees (Anderson & McGrew, 1984), CNP baboons were observed to sleep in mangrove forests, where trees are short but inaccessible to hunters (Casanova, personal communication). CNP baboons also feature reduced vocalizations when human presence is detected, in contrast to the less hunted Senegalese population (Ferreira da Silva *et al.,* 2018), which is described to be highly vocal (Byrne, 1981). A geographically broad genetic study in Guinea-Bissau revealed a genetic dissimilarity between female baboons from inside and outside the Peninsula of Cantanhez and lower levels of genetic diversity for the CNP population when compared to two other protected areas in Guinea-Bissau – Cufada Lagoons Natural Park and Boé National Park (Ferreira da Silva *et al.,* 2014). These results suggest a recent decrease of the female-mediated gene flow across the land bridge connecting the CNP to the mainland (Ferreira da Silva *et al.,* 2014, 2018). The Guinea baboon is thought to be a female-biased dispersal species (Koop *et al.,* 2015), and these results reflect a modest level of isolation of the CNP population. Most likely, female baboons avoid crossing a large area of croplands and other human settlements currently occupying the narrow land bridge between the Cubucaré Peninsula where the CNP is located and the Guinea-Bissau mainland (Ferreira da Silva *et al.,* 2018). A decrease in gene flow may ultimately lead to the inbreeding of the population and a consequent reduction of its reproductive fitness (Ferreira da Silva & Bruford, 2017).

The socio-ecology of African colobus monkeys contrasts greatly with the previous two primates. Colobines are mainly arboreal and folivore primates, relying heavily on the existence of preserved and continuous forest for survival (Figure 3).

Their digestive systems and behavior (e.g. activity patterns, home, and daily range) are adapted to explore these nutritionally poor and hard to digest food items, and they need large areas of primary forest in order to meet their energetic requirements. Despite sharing many ecological requirements, black-and-white colobus monkeys (BWC) differ substantially from red colobus monkeys (RC) in their social structure: i) BWC live in one-male–multi-female small groups and RC live in large multi-male–multi-female groups; ii) in BWC, dispersal is mainly male-mediated and in RC dispersal is female-biased; and iii) BWC exhibit stronger female-bonding than RC females.

Figure 3. Temminck's red colobus female grooming a king colobus baby in Iemberém forest (CNP, Guinea-Bissau) (photo by Tânia Minhós)

Some of their socio-ecological differences are most likely responsible for their different levels of susceptibility to habitat disturbances (reviewed in Oates & Davies, 1994). Although both primates are regarded as habitat and food specialists, BWC are more resilient to degraded habitats, being able to adapt their diet, group size, dispersal or ranging patterns to smaller forest patches. In contrast, red colobus are usually the first primate to go extinct in disturbed habitats, its presence being a good indicator of the quality of the habitat (Minhós *et al.,* 2013, 2016; Onderdonk & Chapman 2000; Struhsaker, 2010). The CNP illustrates this situation very clearly. Minhós and colleagues (2016), using genetic data, showed that both primates had undergone a recent and strong population decrease, most likely as a consequence of the unsustainable human exploitation of the forest resources. Although both primates currently exist in meager numbers (around 300 reproductive individuals for each species), the red colobus experienced a more severe population decrease and are absent from more degraded areas in the park. The same team of researchers has detected behavioral changes in both primates, which are most likely responses to a poor and highly human-impacted habitat. It was found that the BWC from the CNP have a flexible dispersal system. Whereas dispersal has historically and across long distances been mediated mainly by males, dispersal is currently conducted by

both sexes within the CNP (Minhós *et al.,* 2013a). The fact that females are also dispersing in this population can be a response for either inbreeding avoidance (long-tenure of the dominant male) or increased intra-group female competition for food resources (reviewed in Lawson-Handley & Perrin, 2007). Both drivers for female dispersal can be explained by the poor habitat quality and availability. On the other hand, the less flexible RC from the CNP do not seem to be able to adapt their group size or dispersal to the reduced and fragmented habitat, but we found plasticity in the intra-group female bonding. As a consequence of the female-dispersal system and their folivore diet, RC females are not reported to engage in social bonding with other females in the group (Struhsaker, 2010). We studied the social interactions and estimated relatedness using genetic data for one RC social group from the CNP. For the first time, we described high levels of social bonding among non-related females, showing that kinship does not explain this cooperation. It is likely that these females are experiencing increased levels of intra-group competition as a result of inhabiting a degraded and small forest and from being forced to cooperate with non-related females (Minhós *et al.,*2015).

In this chapter, we have illustrated different behavioral responses that four socio-ecologically different but sympatric primates exhibit in a human-altered landscape. Despite their different levels of ecological/behavioral flexibility and vulnerability to habitat disturbances, the four primate species showed responses to the disturbances as attempts to adapt or cope with the new environment. In the case of the chimpanzees, some behavioral changes emerge as ways to explore new resources, and, although risking increased competition with humans, may reflect their ability to adapt to the new conditions. However, for the baboons and colobus, behavioral changes are probably short-term responses to a deficient habitat and may reflect the species' inability to adapt to this human-altered landscape, which is indicative of high conservation vulnerability. In either case, and despite their behavioral flexibility, all four primates face increased risk of extinction as a result of living in sympatry with a fast-growing human population, with negative consequences for the long-standing co-existent relation between human and non-human primates in the CNP.

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CHAPTER ELEVEN

AMAZONIA: IN SEARCH OF A COMPLEX AND DECOLONIZED HUMAN ENGAGEMENT WITH THE ENVIRONMENT

FRANCISCO J. D. BIDONE

INTRODUCTION: THE "EL DORADO"?

The objective of this chapter is to discuss human engagement with the environment in the Brazilian Amazon from an historical perspective. We start by briefly discussing the construction of the initial Eurocentric imagery, which began influencing the modern perception of Amazonia. We then present a critical analysis of possible alternatives to a future pathway for the region, one that would be characterized by socio-ecological fairness and harmony.

Human engagement with the Amazon rainforest dates back thousands of years (Castro, 2010). For a long period of time, people and the Amazonian environment evolved in harmony with the movements of nature. Indigenous realities were thus conceived in oneness with the motions of natural events. This interconnectedness refers to an ontological vision of the forest as the locus for the reproduction of life, in both its material and spiritual dimensions. However, this relation was eternally changed by the arrival of the Europeans to this sacred environment, which they referred to as "the New World" in the 1500s.

The trail-breaking crossing of the Spanish explorer and conquistador Francisco de Orellana (1540) through the Amazon River, narrated by Gaspar de Carvajal (1955, modern edition), perhaps constituted the basis of Eurocentric narratives regarding the Amazon. Following Orellana, the next centuries saw many other distinguished pioneers envision the territory from a similar perspective. As one can read in the diary entries of voyagers

or fictional stories, early Amazonian travellers built narratives composed by socially constructed imaginaries made up of the region's features, the perceiver's own senses and a fear of the unknown. Examples of such narratives could be read in Carvajal's diaries from 1542 which describe Orellana's initial voyage, as well as in Levi Strauss's or Humboldt's scientific accounts centuries thereafter, or in the works of Brazilian fictional writers, such as Euclides da Cunha or Milton Hatoum. The following extract from Carvajal's diaries shows a conflict between the Spanish and Amerindians whose leaders on the battlefield were named Amazonas after Greek mythology, thus giving name to the river (Carvajal, 1955):

> They [Spanish] fought the Indians who had women in the lead of battle (…) These women were very white and tall and had long hair, wrapped around their heads, they were muscular and walked naked, keeping their shame covered with leather. Bows and arrows in the hands fighting like ten Indians.

Under similar terms, the following extract from Padre Cristóbal de Acuña's *Nuevo descubrimiento del gran Rio de las Amazonas* (1641) ratifies the claim of fantastic reports about endless riches and mythical views around Amazonia:

> If the golden lake has the gold that the general opinion ascribes to it, if the Amazons indeed inhabit among the greatest riches of the planet, as many have held witness; if Tocantins, made so famous by the French for its precious stones and abundance of gold; (…) then, in this Great River everything is enclosed: the golden lake, the Amazons, the Tocantins and the rich Omáguas (...) In it is deposited the immense treasure which the majesty of God has preserved to enrich with that of our great king Philip the fourth. (Acuña, 1994, 103)

What is El Dorado? There are multiple and contrasting meanings of El Dorado. When narrating the enterprises of Francisco Pizarro and Francisco de Orellana, for example, Gonzalo Fernandez de Oviedo (1522) claims that, besides searching for Indian spices, these adventurers were also in search of the ruler of a marvellous country, a prince named *Dorado*. Sozina (1982) claims that the origin of El Dorado resides in the discovery and looting of Aztec gold. After conducting an expedition to the region, Walter Raleigh (1595) believed that El Dorado was located in what is now the Brazilian state of Rondônia. This is to name but a few authors. In any case, despite the disputed veracity of its meaning and origins, the colonization of the Amazon remains tied to the implications of the

mythical subjection embodied by the multiple ideas of El Dorado. In modern days, the ideology within State policies and economic enterprises is still accompanied by such mythological elements (Castro, 2010).

The immense proportions of the Amazon intimidate newcomers. Logistical difficulties posed by natural and geographical features have historically been well documented and described, even in the most heroic and oftentimes embellished tales. The archetype constituted in the myth of El Dorado is perhaps the initial Western vision projected on the Amazon. In this mythical symbolic space, dreams of abundance dwelled in the promise of a fertile land filled with natural resources and riches (Castro, 2010). This vision was intensely pursued in the mercantilist undertakings initiated by Europe's advances into the New World. Nevertheless, geographical obstacles as well as resistance from local populations culminated in hostile situations faced by settlers. Such difficulties served two purposes: on the one hand, they hindered colonial insertion and progress, which preserved the livelihoods of local inhabitants and the conservation of the Amazonian ecosystem in general terms; on the other, they consolidated the leitmotif of the territory to be conquered, broken in, and tamed by colonial powers.

One could attempt to explain the rationale of El Dorado by reading Vieira's (2016) surveys on the different stories created by humans to make sense of the daunting Amazonian environment. For her, these stories serve as portraits of the Western engagement with the region and constitute a response to an utterly foreign landscape, where the interconnectedness of humans within the rainforest— humans, fauna, flora and natural events— emerges with the utmost appeal to Western perceptions. As argued by Vieira, the interconnected character of human interaction within the ecosystem signifies a breakdown of the processes of individuation, delimitation and demarcation, which compose the modern illusion of man as a unified independent subject. Nevertheless, the impossibility of taming and ruling over the Amazonian immensity and complexity is also embedded in the subjectivities concerning this perception.

> In psychoanalytic terms, it evokes the Freudian death drive, at the liminal point where life and death, being and non-being, converge. In contemporary philosophical language, it could be equated to Deleuze and Guattari's idea of a "body without organs", where all hierarchies and totalizations collapse. In political terms, it would amount to pure anarchy, a state in which various elements converge and diverge without any predetermined rules or stable structures. (Vieira, 2016, 119)

Under such terms, a dichotomic character was also assumed by early perceptions of Amazonia, which either identified it as a "green hell" or a "heavenly paradise". The author claims that the vilification and idealization of the Amazon, its representation as either an inimical or a friendly space, are but two sides of the same coin. Faced with the proliferation of fauna and flora in the forest, Western colonizers, intellectuals, and later various governments of Amazonian nations superimposed upon the region the readymade religious fables of hell and paradise, enemy and friend, good and evil, as a response to their inability to come to terms with the complexity of Amazonian life. The very proliferation of travel narratives and fictional literature about the region testifies to its fetishizing as a symbol of wild nature (Vieira, 2016).

In addition, we claim that the concept of *otherness*, as proposed by Bauman (1991), also makes up the mythical psychoanalytical framework within which the Amazon is perceived. Bauman (1991) argues that social identities are set up as dichotomies representative of the power dynamics present in the social order. In this dichotomous framework, one side turns out to be the oppressed or degraded side of the other. The rule of power is reflected differently on each side, as the group enjoying greater political power controls the construction and representation of majority and minority identities within the society. Hierarchy is therefore present in this framework, in which certain groups are socially constructed as being superior to others. In the case of Amazonia, the dominance of colonial narratives has led to the creation of the subordinate *other*.

This *other* might even dwell in a racist conception of sub-people, portrayed in the symbolically constructed figure of the savage—the non-civilized, as coined by Ribeiro (1995). The *other* is constantly re-framed into the dialectics of the social construction of Amazonian space and frontiers. The forest ecosystem is at times portrayed as the *other* that needs to be broken or excluded, so that modernity can emerge. Thus, traditional knowledge and indigenous livelihoods as the *other* do not represent the culture and epistemological models present within the social and cultural identities of hegemonic powers. Consequently, the most recent views on the rainforest (capitalistic conservationism) also address it in a simplistic manner. An example is the economic and utilitarian view present in the modern concept of environmental or ecosystem services (Wilson and Matthews, 1970; Ehrlich and Mooney, 1983).

Narratives reflected in the above-mentioned works reduce Amazonian complexities to economic or tokenized visions. In turn, such visions are representative of a homogenized Amazonia that is deprived of its structural, cultural and social complexities. It excludes other perceptions

that account for the longstanding cultural and historical spatial interaction of humans within the Amazonian *milieu*. Reductionisms create a dichotomy or a binary division, in Foucaultian terms (Foucault, 1977), between: (a) what is accepted by market-oriented political, social and human-constructed institutions—which in most recent times came to be known as neoliberal governmentality—and (b) identified obstacles for the spatial implementation of capitalist or mercantilist enterprises.

COLONIAL POWER AND KNOWLEDGE

Colonial knowledge and epistemologies are a social grammar embedded within the construct of public and private spaces, culture, mentalities and subjectivities. Not only do they facilitate a way of living for those benefitting from them, but they also reveal the harsh realities of those who suffer the effects of their implementation (B. Santos, 2010). Consequently, to decolonize means to break the condition of subordination that resulted from supplanting local knowledge with foreign epistemologies.

Edward Said's *Orientalism* (1991) is seminal research in this connection. His work deals with the West's structuring of the East, or Orient, as the global *other*. For Said, it was this conception that prepared the backdrop for the cultural, social and political take-over of non-Western regions by hegemonic European powers. Said's concept of Orientalism points out that, even if political independence has been reached in Oriental nations, the systems of representation and thinking—and thus the basis of colonial power relations—are greatly maintained. For him, this represents an ontological and epistemological distinction between the European West and the Orient.

The colonial dominance of a capitalistic narrative is value-laden. Under its own terms, it establishes the dominant cultural meaning or understanding of poverty and wealth; what is modern and what is archaic; what is civilized and what is un-civilized. Other means of livelihood and forms of human interaction are therefore subject to be classified through the notions of material scarcity, and the absence of relevant knowledge or civilized manners. It automatically designs and assigns its meanings to poverty, ignorance or incivility. Rather than perceiving other cultures as abundant and plural, inventive and rich, the capitalist perception will define them as poor and disenchanted.

In practical terms, Eliane Brum (2018) claims that, in Brazil and throughout Latin America, such a reversal of values is pre-conditioned by colonial dominance. If a large-scale land-grabber is called a "farmer", "land grabbing" becomes part of "agribusiness" and the criminal origin of

the deed is erased. The protagonists are perceived as performing an important activity for the common good of society, and agricultural producers as solely guided by a common sense of capitalistic production. This so-called "common sense" was instrumental in constructing Brazil's social identity. Such identity legitimates determined elements as positive while casting away others as negative elements in Brazil's social fabric.

Looking at this process from a higher scale, particularly in view of the dominance of neoliberal governments across the global political economy, poverty and disenchantment in the region are closely linked to processes of historical enclosure. The capitalistic appropriation of land causes a massive dispossession of local populations and deprives local inhabitants from accessing the land (Bollier, 2003), precluding the metabolic reproduction of local livelihoods. As explained by Harvey (2004), accumulation by dispossession is a primitive form of capitalist accumulation. It is a process that involves the elimination (dispossession) of rights and establishes capitalist control of collective forms of property—such as nature, water and knowledge—thereby increasing accumulation. He emphasizes how this current expansion is a form of robbery, the "original sin" of primitive accumulation, whereby the current over- accumulation does not cease. Blinded by the multiple narratives that compose human engagement with the Amazonian environment, what is left is a desert of unfulfilled promises for progress. Unfortunately, this is a common reality in today's Amazonia.

Elements within the foundational myth of El Dorado have been present throughout different historical periods and constantly reframed to fit new historical contexts. The maintenance of a colonial imposition of knowledge was present in the era of mercantilism (1500–1750), through national developmentalism (20th century), and later towards the present neoliberal conservationism (21st century). One central argument in this chapter is that this symbolic dimension provides the necessary elements for the making of Amazonian spatial policies. Narratives are constantly evolving to fit new agendas of intervention. In the case of the Amazonian space, they are created by dominant powers to exploit it for particular interests. Such narratives emerge from two disparate visions of the Amazon region: either as an eternal expanding frontier for economic growth (Greenpeace, 2017) or as the lungs of the planet (UNEP, 2017). In both cases, the structural elements of El Dorado are present in the imagery of a vast green territorial void, abundant in natural resources and open for the taking.

The issue of conservationist narratives of the Amazon requires further discussion. Since the 1970s, environmental concerns have led to an increase in ecological movements worldwide and their empowerment. Such movements question and challenge the impacts of capitalism on the

environment and, in some cases, even impede businesses indefinitely. Sustainable development as a concept has been the most practical outcome in development policies emerging from such movements—under the narrative that there are limits to economic growth. For Passetti (2012), sustainable development is the conservative conductor for solving the environmental crisis, the most grievous issue of which is climate change; moreover, it is guided by a consensus on the dilemma between environmental conservation and economic growth. Sustainable development is a solution embedded within capitalism's dominant narratives: economic growth, top-down initiatives, languages and structures.

By applying different forms and instruments, the emergence of sustainability within policy maintains the colonial aspects of previous models of development. An example of such a claim is reflected by the international initiative of "Reducing Emissions from Deforestation and Forest Degradation" (REDD+), a rainforest conservation strategy proposed at the United Nations Forum on Climate Change. Applied to several Amazonian nations' localities over the past decade, it maintains certain colonial aspects: the rainforest is commodified and used to compensate for CO_2 emissions elsewhere; foreign guidelines to halting deforestation are applied to local policies; effects on local peoples and their livelihoods; and outcomes are not necessarily representative of local empowerment bred from bottom-up strategies.

Changes in Brazil's political arena, from right-wing governments of the past decades to the recent progressive "Partido dos Trabalhadores", have not altered the capitalist, colonial aspects of spatial development in the Amazon region. A very recent example of colonial interests is the construction of the dams of Belo Monte, Pará—an enterprise that has caused great socio-environmental impacts, such as an egregious disregard for local populations and massive displacement of people.

The following passages from different historical periods exemplify the perception of the overall structure of Amazonia as El Dorado. First, Euclides da Cunha in his famous series of essays *Um Paraíso Perdido: ensaios amazônicos,* written from 1904 to 1909, claimed that "the Amazon is the last page, to be written, from the Genesis" (Cunha, 2000). Later, President Getúlio Vargas, in a notorious speech given in Manaus, also envisioned the Amazon as the next frontier for Brazilian progress, while proclaiming man's rule over nature in Brazil's Amazonia. Perhaps such a notion of progress could also mean the utmost realization (or the Genesis) of modern development. In the words of President Getúlio Vargas (1941, 229):

> All of Brazil has eyes turned to the north [of Brazil], with the patriotic desire to assist in the emergence of its development—not only Brazilians, but also foreigners, technicians and businessmen. They will come to assist in this endeavour, applying their experience and their capital in order to increment commerce and industries…. Amazonian legends have deep roots in the soul of its people's race and history, marked by heroism and virile audacity. They reflect the tragic majesty of the fights against destiny. To conquer the land and to subject the forest have been our duties. In this secular fight, we have obtained victory after victory[1].

The First National Plan for Development introduced by the Military Dictatorship (1964–1985) was precisely utilitarian in its vision for Amazonian future, as observed below (PND I, 1971, 29):

> The strategy for the Amazon is to integrate its territory for development…. Economic occupation and development will take advantage of the expansion of economic frontiers, to absorb the populational surplus from other Brazilian regions and raise income and welfare levels of the Amazon region[2].

At the dawn of the 21st century, well-intentioned proposals for the conservation of the Amazon rainforest are still representative of economic interests placed by foreign agendas. This is the case of the REDD+ implementation. The following excerpt is withdrawn from a report by the German Federal Ministry for Economic Cooperation and Development, currently a major funder for anti-deforestation projects in the Brazilian Amazon, such as REDD+. The global and economic rationale present within this narrative clearly represents the present discourse for rainforest conservation in the midst of the climate change phenomena.

> The Brazilian Amazon hosts a quarter of the world's terrestrial species, carries out 15% of terrestrial photosynthesis and contains an enormous carbon stock—all of which contribute significantly to global social and economic benefits. (BMZ, 2015)

[1] Translated by the author.
[2] Translated by the author.

FUNDAMENTAL CHANGES IN KNOWLEDGE AND POSSIBLE ALTERNATIVES FOR AMAZONIA

The Amazon rainforest entered the 21st century with great importance in political, cultural and scientific dimensions. In general, narratives continue to describe its immense stock of natural resources and the living experiences of its peoples. These perceptions can be observed in descriptions of the Amazon as "the lungs of the world", as it is widely regarded as the most biodiverse tropical forest on the planet, with the greatest stock of minerals and the largest river, constituting one third of the world's fresh water. Such claims strike the most diverse interests, from environmentalists to scientists, politicians or corporate executives. The context of climate change has also added pressure on the path that the Amazon might take in the coming future. It reaffirms the imminent necessity to halt deforestation and secure the world's carbon absorption and climate regulation "services" provided by the Amazon rainforest.

However, there is far more complexity in understanding Amazonia than such discourses or mottos can clarify. As claimed by Milton Santos (1997), the geographic space is an accumulation of different times. Different temporalities are thus co-inhabiting within the space (Porto Gonçalves, 1999). Over 180 different indigenous populations with their own dialects, hundreds of communities of *quilombolas* and *ribeirinhos*, and settlers from the Brazilian south or northeast compose the rich socio-cultural diversity that constitute different Amazonian realities, apart from the millions of people dwelling in urban centres—centralities that emerged from the massive dislocation of peoples and regional environmental depletion. For this reason, it is imperative to assess the plurality of realities, visions and perceptions that constitute the Amazon as a region.

The work of the geographer Berta Becker (1988) regarding the social production of space in the Amazon is particularly relevant to this discussion. In line with her considerations, to understand the actual frontiers in the social production of space, one should move beyond the dichotomies between the capitalist worldview and its conceptualized Baumanian *other*. Doing so would require a move towards complexity, which can be assessed by applying systems theory.

Systems theory was initially conceived in the fields of theoretical physics and quantum mechanics. While analyzing complex phenomena at the microscopic level, unusual systems and dissipative structures were observed in the processes of breaking the conservation of constituent elements at a larger scale. This concluded in the interpretation that molecular disorder had led to irreversible growth. The evolution of the

system had reached new states of probability. The historic notion of a linear and irreversible growth was counteracted, insofar as micro-scale processes had influenced its redirection. For Becker, such properties might also be inherent and applied to social bodies in the field of social sciences. Hence, the social sciences should be able to incorporate such discoveries to enrich their analytical power (Becker 1988).

Rather than thinking of such a reduced epistemic divide in the development of Amazonian territorialities, as observed with the Foucaultian binary divide, one should assess the dynamics of frontiers as a non-linear process, wherein ongoing tensions in the chain of actions and reactions among the multiple stakeholders are constantly reshaping social relations. Spatial frontiers are in constant motion; they are subject to contexts and uncertainties.

The issue of scales is particularly important, as local realities are also shaped by movements on multiple scales. Therefore, thinking merely of a binary conflict, for instance between peasants and capitalist agendas, would be insufficient for a thorough approach. Under a larger scale of analysis, one might observe how the peasant resistance movement is already embedded within the dominant global neoliberal governmentality. It exerts its dominance to influence regions, states and localities worldwide, both materially and subjectively. Assessments at the local level might not sufficiently allow one to observe and understand how the actual frontiers are being shaped and contoured along upper scales—for example, the changes and evolutions of global geopolitics or the constant tensions set in the Brazilian political arena.

Frontiers function as complex adaptive systems, as they are shaped by different temporal, spatial and social scales, nested hierarchies, irreducible uncertainty, multidimensional interactions and emergent properties (Giampietro *et al*., 2011). In other words, the social production of space and how we assess frontiers in Amazonian territorialities should take into account the imponderable as well as the uncertainties emerging in the Amazonian social fabric. An assessment must pay careful attention to the interplay between scales and how they influence or alter the dynamics in which local realities are developing. In turn, they should also bear in mind the feedback loops emerging from local events exerting pressure on the national or global arenas.

Chico Mendes's claim for an eco-socialist approach to human engagement with the natural environment could also play a significant role in addressing the construct of Amazonian social frontiers. In the 1980s, the so-called "empates" were established by rubber tappers as a means of resistance against the imminent takeover of the forested land by cattle

ranchers and loggers. In northern Brazil, the construction of highway BR-364 had already proven its destructive effects through the states of Mato Grosso and Rondônia. The plans to continue its construction into Acre raised even more pressure on local social movements to secure their land and access to the rainforest.

The rubber tappers' defence of the forest began locally as a workers' syndicate movement. As claimed by Porto-Gonçalves (2009), the resistance's success in the long run can be partially explained by their newly established connection to other scales of power, some even reaching far beyond the forest's frontiers. Chico Mendes understood the formation of a worldwide ecological movement as a break in the dominant system of world power and knowledge. The "Limits to Growth Report" proposed that capitalism's dynamics could not go on as usual. The scarcity of resources and the total failure of global ecosystems became a worldwide concern. Under global narratives for sustainable development and the adherence of international ecological movements, the rubber tappers' movement out of Xapurí, in the state of Acre, gained great prominence. But most importantly, it led to new alliances in the political scenario by broadening social and power relations in the region, and reshaping frontiers and socio-political boundaries (Porto-Gonçalves 1999).

In this present discussion of potential future pathways for Amazonia, we might find a certain resonance with the process of decolonization, as proposed by authors such as Boaventura de Sousa Santos, Enrique Dussel and Edward Said. As we have pointed out, the maintenance of a colonial imposition of knowledge was most present in the era of mercantilism (1500–1750), through national developmentalism (20th century), and towards the present neoliberal conservationism (21st century). The influence of colonialism is further accentuated in a global context that imposes a series of added pressures on the environment (e.g. land grabbing, extractive resources, and corporate political alliances). As advocated by Boaventura de Sousa Santos (2010), it is necessary to decolonize knowledge and reinvent power in order to facilitate the emergence of new epistemologies, particularly those originating in the Global South. For Boaventura, the most advanced struggles of the last thirty years were carried out by indigenous peasantry, female activists and Afro-descendants residing in remote locations, like Amazonia. However, their demands were not translated into colonial languages. Terms such as "socialism", "human rights", "democracy" and "development" were absent in their respective vernaculars. Instead, they spoke of "dignity", "respect", "territory", "self-government", and "*buen vivir*" ("good living") in Mother Earth.

The Amazonian case is not different from other regions of the world that were also profoundly colonized. An imposed model of development designed by top-down dynamics is the historical backdrop of Amazonian contemporaneity. To invert such logic could mean a move towards local empowerment. Important examples of attempts to resist the impositions of the development model have historically been present, not only within the Amazonia of Brazil, but also in other nations of South America. In 2017, most environmental conflicts involving assassinations of local leaders and activists occurred in South America (Global Witness, 2018).

Under these terms, "to decolonize" means to deconstruct the historical myths that have historically shaped the imagery of Amazonia. In addition, it means to rethink the engagement between humans and nature. A new rationale of this relation should demonstrate how far more complex and interconnected the relation of man and nature is after long ago being driven away by the so-called Age of Enlightenment's idea of anthropocentric control over nature. In *The Web of Life,* Fritjof Capra (1996) contributes to this discussion by stating that modernity suffers from a crisis of perception, in which global leaders and the dominant institutions they govern do not realize the interconnectedness between problematic issues currently faced by the global community—i.e. poverty, inequality, climate change, social conflicts and environmental depletion, to name but a few. The world is not a collective of isolated elements, but rather a complex network of phenomena in total interconnection and interdependence.

As Capra claims, only a radical change in perception, incorporated through systemic thinking, might allow humanity to perceive the operation of global systems in a more holistic manner. In other words, we must begin perceiving the interconnectedness of issues faced by humanity at the dawn of the 21st century. Capra could not be closer to ancient Amazonian knowledge: the *other*, as conceptualized earlier in this chapter, historically oppressed by hegemonic power and knowledge.

The words of Ailton Krenak, an important indigenous leader in Brazil, adheres to the idea of the crisis of perception as pointed out by Capra:

> For me, there are still visions of life that sing and dance to raise the sky. When the sky is putting pressure on the world, some humans are singing and dancing to raise the skies…. I don't accept the check-mate, the end of the world or the end of history. In this hard, contemporaneous moment, is when I evoke the necessity to sing, dance and raise the sky[3] (Milanez, 2016).

[3] Translated by the author.

CONCLUSION

This chapter discussed aspects related to changes in human engagement with the Amazonian environment since the arrival of Europeans in the 1500s. First, we argued the importance of the myth of El Dorado as the initial Eurocentric vision of Amazonia. Over time, human engagement evolved into a psychoanalytical framework that is most present in Western epistemologies and ontological perceptions—i.e. the inability to perceive humans and nature as one. Further, we claimed that such epistemological reductionism in envisioning the Amazon is reflected in the construction of the *other*. This construction established relations of power by generating hierarchical social identities, where the *other* is but the inferior of the dominant side. Dominance through hegemony is applied through the effectiveness of a dominant social grammar embedded within the construct of social space and subjectivities. Such application of power and knowledge has been historically present in human engagement with the Amazon. Most importantly, it has determined a model of development by which social relations perceive local forms of knowledge as subordinate while depleting the rainforest ecosystem.

We then moved on to present possible alternatives to such reduced epistemes. In this connection, we offered two key elements: the importance of viewing the social production of space under the prism of complexity, and the importance of decolonizing power and knowledge. We pointed out how complexity theory (within systems theory) might allow us to perceive the social construction of Amazonian frontiers from a broader perspective. Such complexification might allow us to better grasp the actual subjectivities and materialisms shaping Amazonian reality.

Moreover, we offered the idea that in addition to complexifying the way Amazonian reality is assessed, we should also attempt to decolonize the spatialization of colonial knowledge. Decolonization might assist the emergence of local solutions and the adoption of bottom-up visions for constructing the future.

The crisis of perception, as conceptualized by Capra (1996), showed us how indigenous Amazonians have always thought of their lives and their interaction within the Amazonian space—where human engagement with the environment is complex, interconnected and interdependent.

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CHAPTER TWELVE

ENVIRONMENTAL CONFLICTS AND MAN-NATURE REPRESENTATIONS IN THE BUILDING OF THE PORTUGUESE EUROPEAN IDENTITY

PAULO E. GUIMARÃES[1]

INTRODUCTION

In 1901, Eça de Queiroz's *A Cidade e as Serras* [*The Town and the Hills*][2] was published. The novel presents the dilemma of one member of the Portuguese landed elite who rediscovers the beauty and capacity for physical and mental regeneration through the humanized nature of his country, which he contrasts with the comfort and pleasures that cities and technological progress offer the bourgeoisie. His experiences, split between Paris and his village, reflect the dilemmas facing a civilization based on the virtues of science and technology, material prosperity and industrialization as a means of achieving welfare and power. To him, Portugal is a country with a rustic beauty in which poverty is intertwined with the simplicity of people, where happiness is possible due to the ability to enjoy the simple things of rural life and the paternalism of local elites. Thus, the fruits of industrial civilization should be adopted selectively through policies ensuring health and well-being. The debate was marked at that time by a mood of nationalism, with the Portuguese elite divided over the path of economic growth the country should follow (Mendes, 1996). Faced with a choice, Queiroz's protagonist opted for agrarianism.

[1] This research was funded by the FCT (Fundação para a Ciência e a Tecnologia) as part of project UID/CPO/00758/2013.

[2] Eça de Queirós (1845-1900) was a career diplomat and acclaimed realist writer. *A Cidade e as Serras* is considered one of the "must read" 20th-century Portuguese novels and has been recommended by educational authorities for school students.

A book published to celebrate Portugal's participation in Brazil's National Fair in Rio de Janeiro (1908) reinforced that vision, with a description of the country's economic and social life. The chapter about the development of Portuguese industry begins as follows:

> The Portuguese people, who history shows are dashing, adventurous and tenacious, fighting for each span of their kingdom, discovering and conquering new lands, distinguishing themselves as audacious navigators, laborious colonizers, strenuous warriors and unflagging farmers, had never shown a particularly industrial nature. (Simões, 1908, 359)

Portugal was defined as being essentially agrarian against those who considered the country to be mainly rural and who called for it to overcome its 'backwardness'. The debate, which had divided the political elite since the agrarian crisis of the 1880s, deepened during the First Republic (1910-1926) and extended until the end of Salazar's regime (Brito, 1989)[3]. Emerging regionalism and motorized tourism after the 1930s reinforced images of Portugal through stereotyped agrarian landscapes, celebrations of nature transformed by hard physical work by Portuguese peasants, their animals and simple tools. Landscapes intended to be essential, such as the vineyard terraces of the Douro Valley or Madeira, the cork tree forests in the south, or the fishing towns, were, in fact, the result of the close integration of Portuguese capitalism into the British world economy combined with protectionist agrarian policies. Those traditionalist images became iconic for regional identity building (see Queiroz, 2017).

The image of Portugal as agrarian and traditionalist Catholic was consolidated during the Estado Novo. It became part of the nationalist discourse on its peculiarity and was celebrated by decorating railway stations with images of past glories and humanized landscapes painted on tiles as part of a project that was promoted until the 1940s (Lourenço, 2004). This traditionalist corporatism was presented as an alternative to capitalism and communism and their shared belief in science and technology as tools for human progress. This peculiar path to modernity, which resided within Portugal's Catholic and imperial mission, was affirmed at Portugal's contribution to the 1939 New York World Fair. Neo-realist literature challenged the hegemonic narrative by offering counter images of everyday life that celebrated those worked and suffering

[3] The 1940s were considered a turning point for the development of industrial projects (see Brito, 1989), while during the 1960s the growth of industrial exports to Western European countries somehow undermined the African imperial project after Salazar was replaced in 1968.

landscapes. It is unsurprising that it took until the late 1960s until the Marxist historian Armando Castro felt able to speak out about the "industrial revolution in 19th-century Portugal", with his successors speaking of "islands of industrialization" in the country, recognizing Portugal was not completely separate from contemporary industrial growth trends.

Environmental problems affecting industrialized countries could not be farther from the lives and consciences of the Portuguese people. It seemed as if in a country of farmers, fishermen, sailors and picturesque villages that only the cities of Lisbon and Porto would experience the pollution and environmental degradation found in other European cities. Here we see that environmental conflicts both provide a view of competing visions on the appropriation and use of natural resources and the irreversible processes transforming the environment, and help question contemporary representations and nationalist identity constructions. Based on recent contributions and empirical research, this chapter identifies different types of conflict resulting from the expansion of industry in Portugal from the second half of the 19th century.

OTHER RURAL LANDSCAPES

It is often believed environmental awareness came to Portugal either in the late 1960s or in the wake of the Carnation Revolution, and that the environment was not an issue for common people (Soromenho-Marques, 2005). However, the historiography of environmental conflict in Portugal since the late 19th century – a period of liberalization, capital investment and external demand – is changing, or is at least challenging those assumptions. Different geographical case studies of the mining and metallurgical industries, commercial agriculture and industrial fishing offer a view of a country that was concerned with the environmental problems caused by opening up to world markets and agrarian capitalism (Vaquinas, 1990; Freire, 2000; Guimarães, 2016; Silva, 2013).

The appropriation of common land and the destruction of the ancient collective system of production, the extension of rice growing in the Mondego and Sado river valleys that caused an increase in malaria morbidity[4], increased pressure on marine resources due to the growth of

[4] Malaria was endemic in many regions of Portugal due to the marshes that appear during dry summers and affect rivers and streams; it became identified with "rural population" and rice production. State-sponsored initiatives to deal with this major health problem appeared during 1930s, but the disease remained uncontrolled up to the 1950s. See Carvalho (1899) and Saavedra (2013).

the export-oriented canning industry or the advent of large-scale mining and soil erosion and contamination, air and water pollution due to the transformation of pyrites, cassiterites (tungsten), Galena, tin and uranium all became causes of local contention. Violence and protests often erupted after periods of tension between the affected populations and often foreign business groups, caused by environmental disruption. Conflicts sometimes broke out long after the environmental damage occurred. In other cases, such as with uranium mining, conflicts over liabilities and reparations emerged many years after the mines had closed. In the 1950s, radioactive water caused by the extraction method used in the uranium mines was dumped directly into the Mondego river (Veiga, 2014, 57-58). Popular struggles for environmental justice challenge images of the recent rural environment. At the beginning of the 20th century, the three main rivers in the center and south of the country (Mondego, Sado and Guadiana) were contaminated by a modern mining industry promoted and encouraged by the state after the 1930s.

Environmental conflict offers a nuanced view of this bucolic image of a landscape populated by a hard-working people and crossed by railways – images often captured in photographs and paintings and shared in the press in celebration of this agrarian matrix of capitalist development. Simultaneously, conflicts reveal the unequal distribution of power in society and the clash of interests between dominant groups communicating an ideology that accepts progress but analyzes costs and options. This debate came to Parliament during the First Republic, when deputies stood up for the people against the interests of the mining companies or spoke in their own interest as farmers or landowners affected by the high levels of acid in watercourses. The environmental aspect was therefore recognized in the debate between agrarians and industrialists at the end of the 19th century.

These debates also reveal that early environmental concerns in liberal industrial legislation, created by an enlightened elite to deal with the problems of overfishing and pollution since the Regeneration (1852-1889), were not only motivated by a vague desire to adopt models prevailing in advanced industrial countries. In the case of mining, the elite followed the Spanish Mining Review (*Revista Minera*) and understood the rights that held back the mining industry. The mining laws of the 1850s gave companies the right to use common land and prevented local communities from interfering.

Figure 1. Map of Portugal (mainland) showing the locations of towns, villages and rivers that are mentioned in the text.

The institutional system limited the power of local landowners by creating a mining sector encouraged, managed and supervised by the mining administration and centralized by the government. By the time the conflict between landlords, farmers and miners and Rio Tinto led to the death of protestors in Huelva in 1889, Portugal had experienced several serious conflicts caused by mining and the roast-leaching of pyrites.

From the historical point of view, these conflicts are crossroads allowing us to document the interest groups, mediators and arguments accounting for social and environmental change. Following the destruction of their fields and rivers, farmers and fishermen found work in the mines or activities resulting from the expansion of mining.

MINING CONFLICTS AND NEW ACIDIC LANDSCAPES

The first environmental mining conflict in Portugal resulted from the interruption of environmental services generated by mining works in antiquity. One night in 1855, people entered the mines at São João do Deserto, near Aljustrel. By cutting off the waters used to treat skin problems, stomach ailments and malaria at the nearby spa, the mine had infuriated the crowd and offended the spa's management and employees. The origins of the waters date to pre-Roman mining operations. Such situations were not exceptional for modern miners in Portugal, who used their presence to identify potentially valuable deposits. The toponymy also suggested another area with potential – the Ribeira do Roxo, so named for its purple water. Visitors arrived during the summer, and tensions between local activities and foreign workers exploded when the mine was flooded by those acidic underground streams. Local authorities intervened only when placed under pressure by the civil governor, but the company (Lusitanian Mining Company) failed soon after. Nonetheless, by way of compensation, it was forced to supply the "sacred waters" to the spa by hand. A decade later, a new company (Companhia de Mineração Transtagana) was forced to build new thermal water facilities.

More serious were the events leading to the flooding of the Braçal mines in Sever do Vouga in 1862. The pattern of collective behavior followed those of earlier peasant rebellions: church bells called people to the churchyard from where they made their way to the mine where they challenged the troops stationed there, forcing them to withdraw, before destroying the blast furnaces and mining equipment. The mine closed for several months and took two years to recover. The locals claimed the burning of Galena and arsenical pyrites in furnaces released gases that

destroyed their vineyards and their land, but the government insisted the culprits acted out of superstition and malice. The mining company was using common lands and cutting down the pine trees for their exclusive use while pressing the authorities to privatize the land (Justino, 2016).

The mining operation at Braçal had been headed by a German merchant, Mathias Feuerherd, since 1845, who contracted the work to miners and metallurgists in the Hartz region of Germany. The project was considered a model and the metallurgical establishment was appointed to the Portuguese king Don Fernando. The affair came to Parliament, which decided to compensate Feuerherd for his losses with the construction of a mining road linking different deposits in the region that were being exploited then. Local tensions continued to intensify until 1866.

In the 1870s, similar tensions ended in violence at Feuerherd's mine at Telhadela in the same region. The army's presence at times of tension and the intervention of a local Member of Parliament drew attention to the miserable conditions of the people that brought no practical result other than an obligation on the concessionaries to provide farmers with free lime with which to fertilize their soil. While the mines occasionally employed farmers, tensions remained high, and there were acts of sabotage such as drilling the miners' canteens, preventing them from being lowered into the mine.

At the Algares mine just outside Aljustrel, a Portuguese company installed a furnace that caused villagers to complain to the authorities, which forced the mining company to redesign its project. To achieve this, it had to increase its capital on two occasions, from 300,000 to 750,000 reis, as much capital as that owned by the Alentejo's two regional banks. Consequently, the company, Transtagana, focused its furnace operations in Pedras Brancas, about 7 kilometers away. As a result, it had to buy extensive farm properties (*herdades*) and build a railway to transport the raw ore, all of which increased costs. With the price of copper falling, the company eventually collapsed, and the mines closed in the 1880s.

Mason & Barry, a British family-owned company with a mine at São Domingos, had more success processing poorer grade pyrites when the price of copper minerals began its steady decline in global markets in the 1860s. By the early 1870s, it had altered its mining methods to combine income from the richer mineral exploitation with the poorest ore processing (with less than 2.5 percent of copper). James Mason then combined open-pit mining with the old system of galleries and wells and established a metallurgical plant in nearby Achada do Gamo. In the early 1870s, the company engaged in metallurgical experiments and abandoned the use of closed ovens because of their prohibitive cost in large-scale

operations. The alternative method was to use open ovens (called *telleras*), a solution the company feared not so much because of the financial costs and the prospect of paying substantial compensation to large landowners in a poor region, but rather out of a fear of conflict with neighbors (Guimarães, 2016). The directors of Mason & Barry knew about the compensation paid by mining companies to large landowners in neighboring Spain. However, on the Portuguese side of the Guadiana, the key concern was to get government approval for plans to treat pyrite and to obtain an "expropriation for public utility" license, which was easy to get once the plans were authorized. Lists of the confiscated properties do not include any influential and large landowners.

Roasting pyrites in open ovens allowed most of the sulfur to escape into the air; however, the discovery and development of a hydrometallurgical system during the 1870s made it possible to solve that technical issue and overcome any potential conflicts with farmers and locals due to the release of sulfur gases in large-scale operations. Official government approval for the new ore treatment system was obtained shortly after a nocturnal raid on the mining camp to extinguish the burning ore piles. Meanwhile, the population increased substantially and changed in composition, and the number of police officers doubled to 50 at a time when observers noted the mine had a seditious appearance.

Another serious incident remains unexplained. The Caveira mine, granted to Ernesto Deligny, closed for two years following fires in the galleries and was abandoned soon after. Despite the existence of large amounts of salt in nearby Alcácer, this mine was not used for the production of soda, and its viability depended on the railroad built many years later, in 1912. The complaints of farmers in Alcácer, Grândola and Aljustrel from the end of the 19th century concerned the reopening of the mines at Caveira, Lousal and Aljustrel (São João and Algares), all of which used hydrometallurgy (natural cementation).

Hydrometallurgical ore processing at São Domingos gave rise to recurring complaints from fishermen on the Guadiana and at Vila Real de Santo António regarding the discharge of polluted water. The company had to build large tanks for storing acid waters and, to limit the impact of discharges that now only took place during winter, had to purchase land on which the water could evaporate. The victims of pollution were mostly poor fishermen who used traditional *art xávega* methods. They claimed the sardines disappeared from the coast and that the Guadiana, in which they fished in winter, was "dead". James Mason made a "voluntary" payment towards Algarve maritime commitments during the early 1880s, paying more than 1,000 reis as compensation, while launching a public

campaign to minimize his responsibility for the pollution of the Guadiana. After all, the Spanish mines also released acid water into the Guadiana through its tributary, the Chança[5].

An unexpected and long-lasting result of the hydrometallurgical system was the outbreak of malaria pandemics and deaths. The problem was so serious that senior staff, administrators and soldiers living in company houses had to move from the mining town. The eucalyptus plantations on the edge of artificial lakes, which gave "a picturesque air" to the mining landscape (in the words of contemporary observers), were the result of recommendations by the commission created for that reason (Guimarães, 2016).

The social landscape also changed. The land that had been acquired for roasting operations, and which was no longer required, was leased to sharecroppers (*seareiros*) and local farmers. Mason became a large landowner, and to celebrate his entrepreneurial success the crown offered him two peerages. The exploitation of tin by dredging the Gaia Valley in Guarda from 1914 led to a conflict between locals and the Portuguese-American Tin Company (Silva, 2013), with members of the local elite leading political resistance to mining. Conflict and political mobilization intensified after 1922, leading to Parliament debating a proposal to ban mining on agricultural land. The movement was unable to stop the American company, but it did prevent new firms from dredging. The authoritarian regime halted the attempt to ban mining on agricultural land while championing the mining industry through the Mining Development Service (Serviço de Fomento Mineiro) in the late 1930s, which helped identify valuable deposits that were licensed to private investors.

TRADITIONALISM AND FORESTATION

The traditionalism that emerged at the end of the 19th century and fascinated the middle classes and elites after the First World War is somehow related to a key period in the advancement of agrarian individualism. The sale of common land that supported ancient agrarian systems continued during the First Republic and Estado Novo with them being appropriated by the state and then privatized or offered to individuals (Freire, 2000). In the name of progress, liberalism defended the privatization of common lands that represented one of the pillars of peasant society. The movement began during the 17th century but had free

[5] For more on the communication strategies of large companies, such as Rio Tinto in Spain, see Garrido and Perez Cabada (2016) and Perez Cebada (2014: 157-220).

rein from the mid-19th century (Melo, 2017, 80-93; 102-113). Local resistance often consisted of civil disobedience and involved the destruction of walls, fences, crops and grazing cattle. From the 1880s on, there was a move to plant industrial forests in the highland commons (*baldios serranos*), a move that received new impulse during the first four decades of the 20th century. The debate over uncultivated land (*incultos*) was most active during the First Republic, which established a rural police force, thus satisfying an old demand from farmers to stop the "misuse of the people". It also encouraged municipalities to sell common land, or those lands that "belonging to all, belonged to no one".

The authoritarian state associated issues of uncultivated land, the exploitation of communal lands and the physiocratic project to promote the resettlement of land in the south with people from the northwest, and agricultural intensification through major hydraulic works. For that, the corporatist state took it upon itself to manage and exploit common land through the Internal Colonization Board. Technicians defended the forestation of those lands and committed to the development of mines as a way of solving the problem of "rural overpopulation". Consequently, the alienation of uncultivated land by local authorities increased during the 1940s and 1950s, following the publication of the Law of Forest Settlement (Law 1971, June 15, 1938) (Freire, 2000; Estevão, 1983). Forestry services then banned grazing on forestry land, a decision that harmed the poorest and accelerated the abandonment of agriculture and the desertification of the interior (Devy-Vareta, 2003). In this way, the Estado Novo "carried out the most cunning and repressive campaign against communal lands, reserving more than 400,000 hectares of vacant land for forestry", ending the traditional use of this land with a direct impact on the herds (Baptista, 2010). The political "openness" of the last years of the regime supported the "people's struggle for the appropriation of the commons", and so their restitution was included in the political agenda after April 25, 1974 (Barros, 2012; see decree-law 39/76, January 19).

INDUSTRIAL FISHING AND IMPOVERISHED GROWTH

The image of Portugal as a land of sailors and fishermen painted by French sociologist León Poinsard in the early 20th century was reinforced by the expansion of the canned fish industry and the policies on cod introduced by the Estado Novo. The increase in fishing catches during the late 19th century and the periodic crises forced a state interested in the high income generated from fish taxes to regulate sardine fishing and promote scientific research on fish resources. This legislation set limits on

the size of fishing nets used in Valencian and American style nets and on the distance between them. It also promoted a concessions regime that threatened small independent fishermen and older shipowners.

In Setúbal, shipowners called for "the prohibition of trawlers known as *bugigangas*, or at least limiting them to an area or season" (Setúbal, 1903, 14). The Republic established an open fishing regime as early as 1910, eliminating fears maritime concessions would be imposed (Machado, 1951). However, the provisional government's 1911 decree protected trawling and encouraged the overexploitation of marine resources. This policy was counteracted by fishermen who, on December 8, 1910, took strike action to protest the government's protection of steam trawlers that "devastate the seabed, destroying fish nurseries" (Costa, 2011, 212). The struggle for control of the fisheries market involved industrialists and harbormasters, who began pursuing, fining and arresting fishermen under any pretext. A decisive strike involving all fishermen lasted seven months.

The increasing demand for fish during the First World War created an opportunity for fishermen to enhance their power. Through the fishing ships and equipment (*cercos*) controlled by their union, they took control of the fish delivered to the factories. When the journalist Adelino Mendes (1878-1963) visited what he called "the city of the anarchists", the power of the sailors was at its peak (Mendes, 1916, 163-164). They were the highest paid workers in the country and had substantial percentage shares of the fish (that they later traded in the towns and factories), greatly reducing the shipowners' profit margins. The social economy then seemed to be the inevitable evolution of this business, once they had more than twenty fishing boats (*cercos*) registered under the union's control. The fisherman was then considered to be the real boss, regardless of whether he worked for a shipowner or a cooperative. In that context, the behavior of fishermen changed, limiting their catches when prices were low. "Being well paid", a shipowner said, "he does not need to fish so much" (Mendes, 1916, 170).

However, the industrialists were able to reestablish control of the market in 1922, after 74 days on strike, when a "lot of fishes were thrown into the sea". Fishing with dynamite, a method used by steam fishing boats, was once again banned in 1924. Industrialists had not resolved the "fish supply and price" issue (less than 10 percent was for national consumption) by the end of the First Republic. In other words, the problem of the subordination of fisheries to industrial interests had gone through a period marked by a periodic shortage of fish and a sharp decline in industrialists' profit margins. In the early 1930s, the corporatist organization imposed "a class dictatorship" under the guise of national

collaboration between social classes, while at the same time enabling overfishing and low prices at the factories just as observers declared the canning industry to be going through an agonizing period. In 1951, Falcão Machado described the results of that policy:

> The proletarianization of the fishing class aggravated by the fishing crisis has reduced the standard of living of fishermen, not only in their modes of existence but all its aspects.

He then linked the social crisis to the ecological crisis: The disharmony of these conditions (geographic, that is, guaranteeing the sustainability of the resources) caused by the alteration of any of them, mainly fishing techniques that cause the destruction of feeding grounds used by shoals, results in a lack of fish as they starve or move away in search of food.

In short, Machado claims it was the deliberate use of the most productive type of net, the trawl net, which caused "the destruction of fish feeding grounds on the continental shelf and the consequent disappearance of the shoals" (Machado, 1951, 197).

In the first two decades of the 20th century, Setúbal fishermen set their face against those "technical advances" and fought against the use of trawl nets and trawlers. These technical advances also led to the disappearance of estuary fisherman and the independent way of life of "individual fishing, family boats and small workshops" (Machado, 1951, 197).

CONCLUSION

The cases presented here emphasize the social conflict resulting from imposed environmental changes in a way that challenges traditionalist images and narratives embedded in the nationalist discourse at the end of the 19th century and reinforced by Salazar's regime. By supporting mining developments, heavy chemical and resinous wood industries, "irrational" extensive cereal farming and industrial tree plantations, capitalist farming and industrial fishing, the regime profoundly altered the social and environmental landscapes it so praised in its propaganda.

Those cases also illustrate the environmental aspect of the agrarian versus industrialist debate dividing Portuguese elites from the beginning of the 20th century. Industrialists clearly understood this aspect of the traditionalist discourse during the Estado Novo. In 1958, Ferreira do Amaral[6] presented his defense of industrialization as follows:

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[6] Ferreira do Amaral (1909-1995) was an electrical engineer, a 1940s and 1950s' director of the Industrial Administration, and a major figure within Estado Novo.

> Maçãs de D. Maria is a happy rural parish (...), it does not have any industry apart from the more pastoral than factory activities, which are born and develop in the villages of the interior (...). Olive mills, the village blacksmith, terracotta pottery, sawmills, the harmonious and fresh mills or windmills (...). Paio Pires (...) is as content as Maçãs de D. Maria, but it is not a rural parish. (...) It is in the group of the most industrialized counties of the country (...). These parishes are both picturesque. One is picturesque to mark time, between the water-mills and the green (...), the other in the lives of the industry that is born in Portugal [steel industry]: the surrounding fields are less green and are gradually becoming contaminated with the pollution of the factory chimneys. But the fumes and dust are not properly a layer of gold that will cover Paio Pires. They will perhaps be silver gold – but they are certainly evident progress (...). (Amaral, 1958, 16-17)

But the history of D. Maria, as of thousands of other rural parishes, was already changing in the 1940s with a new cycle of emigration, depopulation, agricultural stagnation and forestation. Portugal's elites were turning to industrial progress and "modern Europe", but a new image of Portugal had to be constructed after the 1974 Revolution.

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PART 4

LANDSCAPE AND HERITAGE

CHAPTER THIRTEEN

SADO PALAEOVALLEY CONFIGURATION: IMPLICATIONS FOR THE MESOLITHIC SETTLEMENT DURING THE HOLOCENE SEA-LEVEL RISE

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INTRODUCTION

The Sado valley surroundings, upstream of Alcácer do Sal, display a relatively high density of Late Mesolithic sites, dated between ca.8400-7000 cal BP (e.g. Arias *et al*., 2015, Peyroteo-Stjerna, 2016; Figure 1). Those sites are described in the archaeological literature as shell middens by the abundance of remains of estuarine invertebrates such as *Scrobicularia plana* and *Cerastoderma edule* (e.g. Arnaud, 2000; Carvalho, 2009; Diniz and Arias, 2012; Arias *et al*., 2017), despite its location more than 25km upstream of the current outer estuary. Besides shells and shell fragments, fish remains from coastal waters species such as *Argyrosomus regius*, *Galeorhinus galeus*, *Dicentrarchus labrax* and *Sparus aurata* were also found in some of these middens (Gabriel *et al*., 2012).

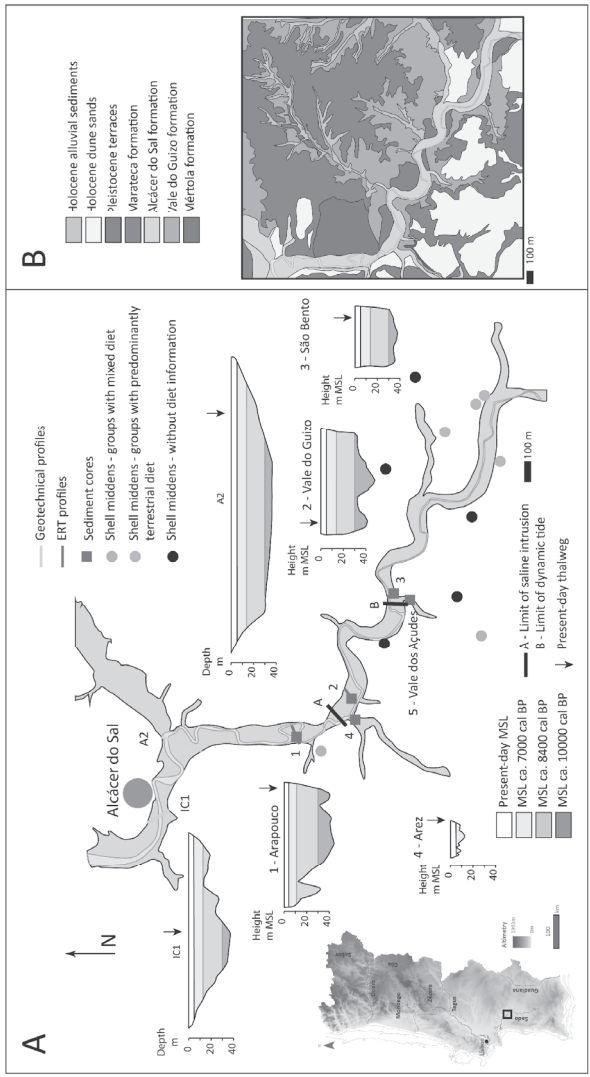

Figure 1. A: Location of shell middens, geotechnical profiles, ERT profiles and sediment cores; palaeovalleys morphology derived from ERT with representation of mean sea level at ca.10000 cal BP, ca.8400 cal BP and ca.7000 cal BP according to Vis *et al*. (2008) and Costas *et al*. (2016). The Vale dos Açudes palaeovalley was not drawn (see discussion). B: Geology of the studied area adapted from Gonçalves and Antunes (1992).

More than 100 Mesolithic burials (Umbelino and Cunha, 2012; Peyroteo-Stjerna, 2016) were recovered from the Sado shell middens. $\delta^{13}C$ and $\delta^{15}N$ analyses performed on bone collagen extracted from skeletal human remains demonstrate the systematic consumption of marine resources by these communities. According to isotopic data, two dietary groups can be identified in the Sado valley: one located further downstream presents a mixed marine-terrestrial diet; the other, located further upstream, has a predominantly terrestrial diet (Umbelino and Cunha, 2012; Peyroteo-Stjerna, 2016; Figure 1).

The high concentration of shells and the results of the isotopic analyses led several authors to hypothesize the existence of an estuarine environment in this section of the valley coeval with Late Mesolithic occupation, similar to the ones found today in the outer estuary (e.g. Arnaud, 1989; Larsson, 1996; Araújo, 1995-1997). However, the extent of marine flooding has never been studied.

Since the end of the Last Glacial Maximum, the mean sea level (MSL) has been rising, favouring the inundation of the pre-incised Sado valley and other major depressions of the Portuguese coast (Andrade *et al*., 2013). Freitas and Andrade (2008) describe the Sado estuary after the maximum marine transgression as an embayment developed in an indented coast with a direct connection with the sea. According to the curves drawn for the Holocene (Vis *et al*., 2008; Costas *et al*., 2016), the sea level was rising at a high rate until ca.7000 cal BP and decelerated from that date onwards.

The only geomorphologic data on the Sado valley Late Quaternary incision resulted from the interpretation of geotechnical cores performed at Alcácer do Sal (*GRID*, 1989; *ENGIVIA*, n.d.; Figure 1). Here, a deep incised valley reaching ca.38m is interpreted from alluvial sediments deposited above Palaeogene and Neogene materials (Figure 2).

This work aims to characterize the palaeomorphology of the Sado valley upstream of Alcácer do Sal using Electrical Resistivity Tomography (ERT) and sediment cores to depict the palaeoenvironment during the period when Mesolithic hunter-gatherer communities occupied and exploited the valley.

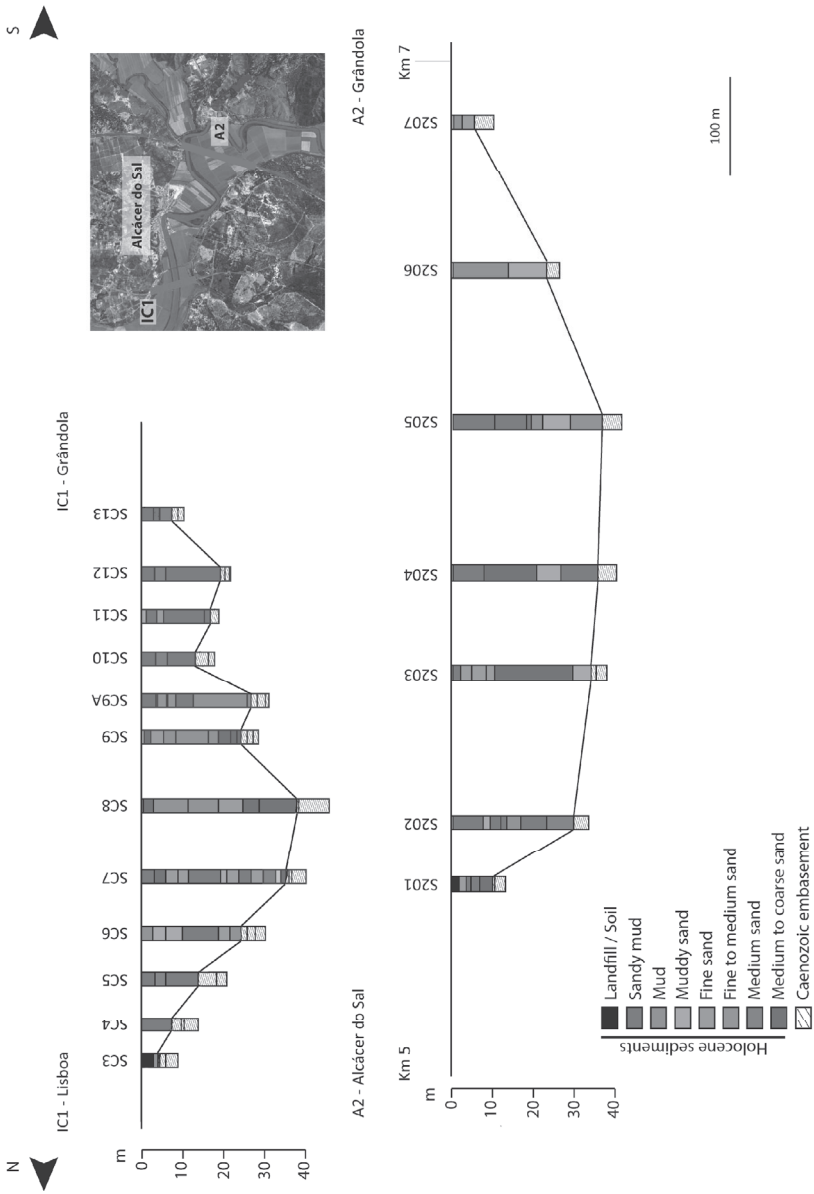

Figure 2. Sado palaeovalley morphology and characterization of the alluvial sediment at Alcácer do Sal (adapted from *GRID,* 1989*; ENGIVIA,* n.d.).

REGIONAL SETTINGS

The Sado river has a maximum length of ca.175km and drains an area of ca.7700km^2 (INE, 2007). The terminal area corresponds to a bar-built estuary occupying about 140km^2 (Bettencourt *et al*., 2003) protected by the Tróia sand spit. The estuary has a length of 50km, reflecting the maximum marine intrusion, or 57km if the upper limit of the tidal dynamic is considered (Bettencourt *et al*., 2003). Estuarine tides are semi-diurnal, the tidal range varying between 1.5m and 3.9m during neap and spring tides, respectively (Bettencourt *et al*., 2003). At present, the river thalweg is anthropically-controlled and the alluvial plain is used for agriculture, particularly rice production.

In the study area, the river channel cuts mainly sediments of the Palaeogene "Vale do Guizo" formation, composed of alluvial pinkish sandy conglomerates and marly clays (Pimentel, 2002). These rather consolidated rocks are the basement of the Late Quaternary alluvial infill of the Sado river, upstream of Arapouco. Downstream of Arapouco, the Miocene "Alcácer do Sal" formation, with coastal yellowish biocalcarenites and marly sandstones, outcrops in the left margin of the river, corresponding to the basement of the alluvial infill, while slaty pelitic rocks and greywackes of the Palaeozoic "Mértola" formation outcrops at the right margin (Antunes *et al*., 1991, Gonçalves and Antunes, 1992). The *plateaux* surrounding the Sado valley and its tributaries are occupied by a decametric cover of fluvial orange sands and clays of the Pliocene "Marateca" formation (*ibidem*; Figure 1B). Aeolian quartz-rich sands dated from the Pleistocene-Holocene, resulting from the remobilization of the Pliocene sands, extend over the *plateaux* and some slopes of the study area (mostly to the south), while Quaternary sandy terraces are present at both margins (Gonçalves and Antunes, 1992). All these Plio-Quaternary sediments, as well as the Palaeogene sandy clays, are probably the main source for the Late Quaternary alluvial infill of the Sado river.

MATERIALS AND METHODS

The electrical characters of the materials differ from each other, and the electrical resistivity measures the degree to which a material resists to the electrical current flow (e.g. Smith and Sjogren, 2006). Electrical Resistivity Tomography (ERT) consists of producing an electrical field on the ground by introducing into it an electrical current with two electrodes and measuring the voltage drop across the surface with two other electrodes, a procedure that yields information about the distribution of

electrical resistivity below the surface. The different behaviour of the material to electrical input allows the identification of different types of materials. Such a continuous procedure along a line with several dozens of electrodes materializes an ERT profile, which can be performed with different electrode configurations. Five ERT profiles using the dipole-dipole configuration were gathered in the studied area oriented perpendicular to the present-day channel: three on the Sado channel and two in the Carrasqueira (Arez) and Vale dos Açudes tributaries (Figure 1). The resolution of ERT profiles depends on the distance between electrodes (e.g. Baines *et al*., 2002) and is different between profiles due to the extension of the surveyed area (Table 1). An ABEM resistivity meter equipped with a Lund system was used to collect resistivity data. Data was processed with the Res2Dinv software. Topographic data (coordinates and altimetry), collected using a Global Navigation Satellite Systems (Topcon Geosystem with field controller FC-25) operating in real-time, was incorporated in resistivity data processing.

Table 1 – Location of the ERT profiles and their main characteristics

Location	Reference	Dipolar distance (m)	Maximum depth (m)	Profile extension (m)
Sado channel	1 – Arapouco	20	102	800
	2 – Vale do Guizo	20	102	800
	3 – São Bento	10	51	400
Sado tributaries	4 – Arez	4	26.2	160
	5 – Vale dos Açudes	6	30	240

Five sediment cores were collected in the Sado alluvial plain overlapping ERT (Figure 1). In Arapouco, the entire core was collected; however, at the other locations only the sediment from the core base was recovered. Despite the collection of sediments, the whole sedimentary column was characterized macroscopically for texture. The texture and the analyses of environmental proxies on the collected sediments provide information for ERT calibration.

$\delta^{13}C_{VPDB}$ was determined in the sediment after the removal of inorganic carbon using HCl 10% in i) a FlashEA1112 combustion elemental analyser (ThermoFinnigan) coupled online with a Delta Plus Finnigan MAT IRMS at the University of A Coruña; and ii) on a Sercon Hydra 20-22 stable IRMS, coupled to a EuroEA elemental analyzer for online sample preparation by Dumas-combustion at the Stable Isotopes and

Instrumental Analysis Facility, University of Lisbon. Delta calculation was performed according to $\delta=[(R_{sample}–R_{standard})/R_{standard}]*1000$, where R is the ratio between the heavier isotope and the lighter one. $\delta^{13}C_{VPDB}$ values are referred to PDB (Pee Dee Belemnite).

For diatom identification, smear slides were prepared by placing 15–20mg of sediment in distilled water, stirring it, and letting it settle for approximately 10s. The suspension was then removed placing a pipette just above the bottom of the vial. Naphrax (refractive index: 1.73) was used as a mounting medium. Diatoms species were observed and identified using an Nikon Optiphot with phase contrast at a magnification of 1000× (oil immersion). In this study, for each sample diatom valves were counted and identified in at least three random transects across the slide. Partial valves were counted according to the method of Schrader and Gersonde (1978). Diatoms were identified following the published taxonomic descriptions of Witkowski *et al*. (2000) and Álvarez-Blanco and Blanco (2014). The diatom-based reconstruction of sedimentary environments was based on Vos and Wolf's (1993) methodology. Salinity trends were constructed specifically to capture potential palaeoenvironmental information from sediments using autoecological information by summarizing the relative frequencies of occurrence in all *salinity* classes described in Vos and Wolf (1993).

Nine organic samples (Table 2) were selected for AMS radiocarbon dating at the Beta Analytic (USA) laboratories. The radiocarbon ages determined were calibrated using OxCal v.4.3 (Bronk Ramsey, 2009) and the IntCal13 calibration curve (Reimer *et al*., 2013). Samples date the base of the cores and, at Arapouco, the sedimentary sequence.

RESULTS

1. Electrical Resistivity Tomography

ERT values for the studied area, both for the Sado channel and its tributaries, were always lower than 400ohm.m, with many values as low as 5ohm.m on the top layers. In the Sado channel, lower resistivity values are present until depths of ca.-40m MSL, while in the tributaries resistivity values increase at ca.-15m MSL at Arez and are very superficial at Vale dos Açudes (Figure 3). Resistivity values increase upstream, from Arapouco to São Bento (Figure 3). In Vale do Guizo and São Bento, ERT profiles show higher resistivity layers within the area filled with sediments with lower resistivity values (Figure 3).

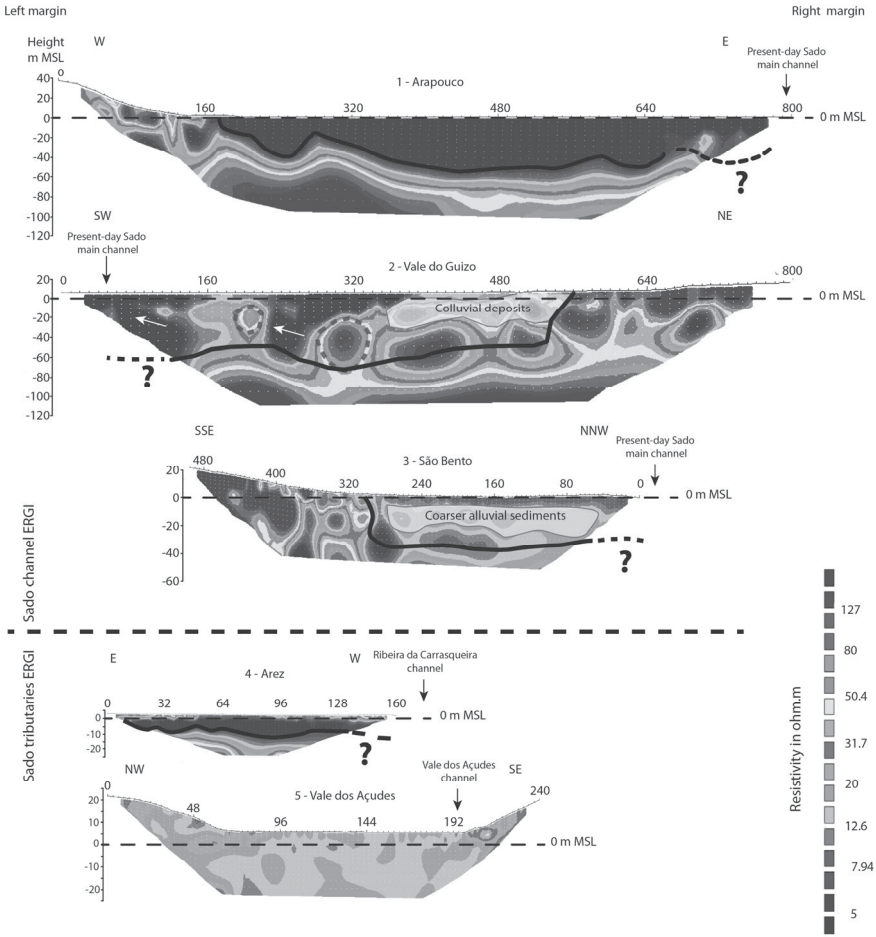

Figure 3. ETR profiles of the Sado channel and tributaries and interpretation. The white arrow (Vale do Guizo profile) indicates the channel's SW migration. The black line indicates the proposed palaeomorphology for the valleys.

2. Sedimentology and chronology

Sediment cores are essentially made up of mud with occasional intercalations of sandy mud, except for the Vale dos Açudes core where intercalations of fine to coarse sand were identified (Figure 4). At the base of most sedimentary sequences occur coarser sediments, constituted essentially by sand. Due to their depth and the collection methods, those sediments could not be recovered.

The results of radiocarbon dates and calibrated ages are presented in Table 2. Radiocarbon ages at the base of the Sado channel cores are younger than the ages for the base of the tributary's cores. In the Sado channel, calibrated ages are all younger than ca.3570 cal BP (median calibrated age value for the sample Arapouco#5 635-637), and sediments only represent the infilling of the valley during the Meghalayan. The median calibrated ages for the base of the cores collected on the tributaries are older, and the sequences represent the sedimentation occurring since the Greenlandian-Northgrippian transition (Holocene stages named after ICS 2018). At Arez (-10.6m MSL), the median calibrated age is ca.8590 cal BP, while in Vale dos Açudes the median calibrated age is ca.7300 cal BP (Figure 4; Table 2).

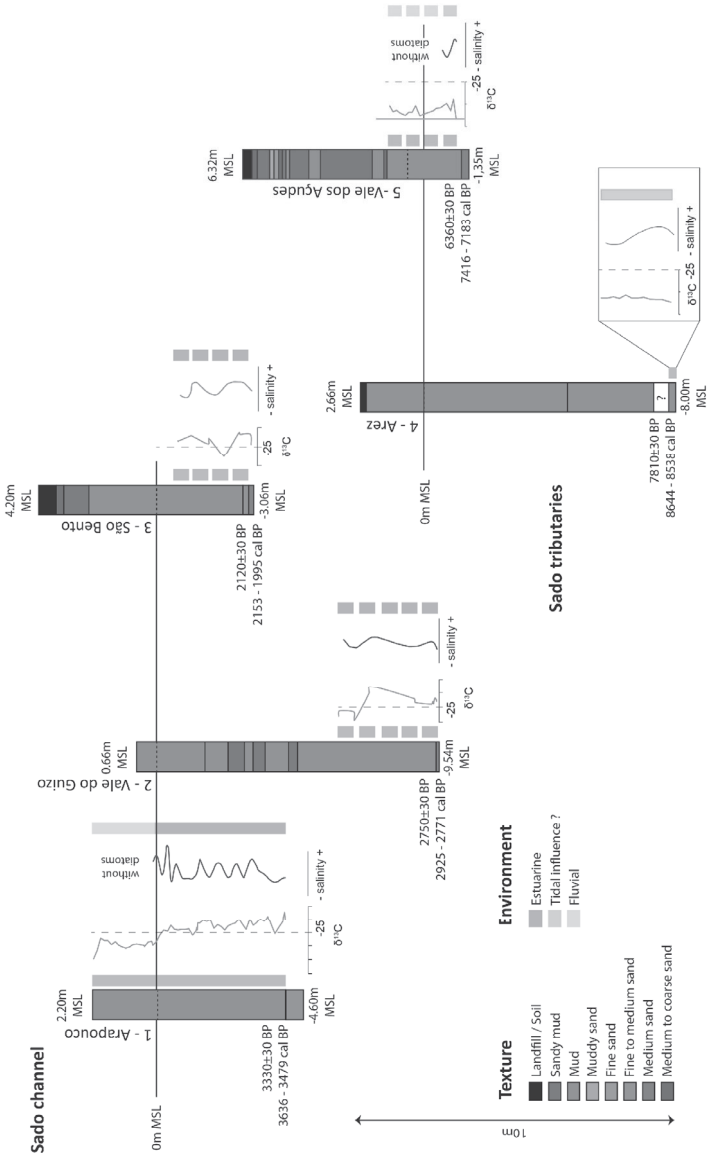

Figure 4. Variation in texture, $\delta^{13}C$ and salinity (derived from diatom assemblages' data) against depth relative to MSL. Grey rectangles represent the samples collected for environmental proxy' analysis.

Table 2 – Radiocarbon determinations for the sediment cores. The dates have been calibrated with the IntCal13 curve (Reimer *et al.*, 2013) using the Oxcal v.4.3 program (Bronk Ramsey, 2009).

Loc.	Sample reference	Lab code	Material	Core depth (cm)	$\delta^{13}C$ (‰)	Conventional ^{14}C age BP	Calibrated age BP (95%)	Reference
Sado channel	Arapouco2#9 152-154	Beta-436176	Organic sediment	153	-25.4	2620±30	2778-2726	Costa *et al.*, 2019
	Arapouco2#10 200-202	Beta-408535	Organic sediment	201	-25.4	3170±30	3452-3349	Costa *et al.*, 2019
	Arapouco3#2 354-356	Beta-393523	Organic sediment	355	-22.7	3100±30	3379-3235	Costa *et al., 2019*
	Arapouco3#4 552-554	Beta-408534	Organic sediment	553	-23.5	3400±30	3711-3573	Costa *et al.*, 2019
	Arapouco3#5 624-627	Beta-431370	Organic sediment	625.5	-23.4	3210±30	3542-3368	Costa *et al.*, 2019
	Arapouco3#5 635-637	Beta-431371	Organic sediment	636	-23.5	3330±30	3636-3479	Costa *et al.*, 2019
	VG1 1010-1011	Beta-457795	Organic sediment	1010.5	-24.2	2750±30	2925-2771	This work
	Sado3A 719-720	Beta-457793	Organic sediment	719.5	-24.3	2110±30	2153-1995	This work
Sado tributaries	Arez1 1062-1063	Beta-343145	Organic sediment	1062.5	-25.9	7810±30	8644-8538	This work
	Sado3AC1 766-769	Beta-457794	Organic sediment	767.5	-26.0	6360±30	7416-7183	This work

3. Environmental conditions (organic chemistry and diatom assemblages)

The origin of organic matter preserved in sediments is frequently inferred by $\delta^{13}C$ (e.g. Lamb *et al*., 2006 and references therein). Sediments collected in the Sado channel and in its tributaries present different $\delta^{13}C$ values. The results from the Arapouco core are published in Costa *et al*. (2019). In Arapouco, $\delta^{13}C$ values vary with depth. Values of ca.-24‰ were determined for the sediment between -4.25m MSL and 0m MSL, while values between -25‰ and -27‰ were determined for the sediment collected above the MSL. $\delta^{13}C$ values of the cores collected at Vale do Guizo and São Bento present mean values of ca.-24.7‰. For the samples collected in Arez and Vale dos Açudes tributaries, the mean $\delta^{13}C$ values are -26.3‰.

The bottom of the Arapouco record shows the development of brackish diatom assemblages, dominated by *Cyclotella meneghiniana*, a brackish/freshwater planktonic species. In the mid-core section, diatoms show an assemblage almost exclusively composed by marine planktonic *Thalassiossira* species, similar to those found today in the Sado estuary, along with some brackish forms. In the uppermost part of the record, diatom assemblages show a return to brackish conditions, characterized by marine, marine/brackish and brackish/freshwater diatoms, with *Cocconeis* spp. and *Nitzschia* spp. as the dominant taxa.

Diatom assemblages in Vale do Guizo are dominated by the marine tychoplanktonic *Cymatosira belgica,* while an epipsammic diatom, *Opephora mutabilis*, is the most frequent taxon in the Arez record. The diatom content in both cores is cosmopolitan and widespread in brackish waters. *O. mutabilis* is common in intertidal sandflats.

In São Bento sediments, diatom assemblages are composed by planktonic species common in fresh and brackish waters. The marine tychoplanktonic *C. belgica* is also present. This is also a cosmopolitan species found both in plankton and in the benthos, frequently found in sandy beaches but also very abundant in silty sediments. Upper core São Bento diatom assemblages are dominated by planktonic estuarine species.

At Vale dos Açudes, all samples above -0.98m MSL depth are almost barren of diatoms. Whole valves were rare. Epipelic diatoms are the most frequent taxa. The diatom content at the core's base shows the highest abundances of cosmopolitan epipelic species, common in marine to brackish waters.

DISCUSSION

1. Palaeomorphology of the valleys

One of the most important characteristics of ERT is the ability to accurately identify and map sand and gravel deposits from silt and clayey sediments (Baines *et al*., 2002), as it is widely used to reconstruct the geometry of fluvial channels and river valley infillings (e.g. Baines *et al*., 2002; Maillet *et al*., 2005). In similar environmental conditions, silts and clays present low electrical resistivity while sands and gravels show high electrical resistivity (e.g. Gourry *et al*., 2003). ERT profiles performed in the studied area revealed contrasts in electrical resistivity, pointing to different geological formations. It is important to mention that the Sado palaeovalley is embedded in Palaeogene sediments constituted mainly by conglomerates, sands and pelites (Antunes *et al*., 1991; Gonçalves and Antunes, 1992) and that the surrounding Caenozoic formations are the ones that mostly provide sediments to the fluvial area. In this context, similar resistivity values can be achieved for the encasing sediments and for the coarser accumulations of the fluvial/estuarine area that can make the interpretation of ERT profiles more difficult. However, it has been possible to identify a strong contrast between the Caenozoic basement, with its higher resistivity (represented by warm colours in Figure 3), and the recent Sado alluvial infilling, with its lower resistivity (represented by cold colours in Figure 3).

ERT profiles therefore allowed different incision depths in the Sado main channel and in its tributaries to be distinguished. The different ERT resolutions achieved in the Sado channel and in the tributaries lead to anomalies in the profiles that can be misleading. For example, at Arapouco and Vale do Guizo, where the resolution is lower, there are low resistivity values (valley sediment infilling; see Discussion point 2.) positioned ca. -50/-60m MSL at some points (Figure 3). Considering that the geotechnical descriptions of the cores collected at Alcácer do Sal place the Caenozoic basement at ca.-40m MSL, it is very unlikely that the valley presents higher depths in upstream areas, unless tectonics had played a role in the area. There is no clear evidence of recent tectonic activity in the Sado valley, and so the deeper low resistivity values are considered anomalous. Despite the different resolutions of ERT, resistivity values show that the Sado palaeovalley is deeper than the Sado tributaries. It reaches ca.-40m MSL (assuming the depth considered at Alcácer do Sal), while at Arez it only reaches ca.-15m MSL (Figure 3). At Vale dos Açudes it was not possible to draw the palaeomorphology of the valley

due to the similarity in the electrical resistivity response, however a shallow valley is expected. Considering the base of the cores, younger ages were obtained at higher depths in the Sado valley in opposition to older ages at shallower depths in the tributaries (Figures 3 and 4; Table 2).

2. Infilling of the Sado and tributaries' palaeovalleys

Arapouco ERT profile reflects a palaeovalley ca.40m deep filled with mud (low resistivity) embedded in sediments with higher resistivity corresponding to the Caenozoic basement (Figure 3). This profile was performed in a cross straight section of the valley (Figure 1), probably controlled by the occurrence of a fault that raised the Palaeozoic block of the "Mértola" formation (Antunes *et al*., 1991). Slightly coarser sediments seem to occur near the river's right margin where the Sado thalweg is at present. The mud sediments correspond to the infilling of the valley, and the slightly coarser sediments reflect the proximity of the thalweg that, in this section and due to old tectonic constraints, could always have been located at the right margin of the river.

Vale do Guizo's ERT profile crosses a sharp bend of the Sado valley (Figure 3). The depth of the valley was assumed to reach ca.-40m MSL considering the above discussion, however high resistivity areas (Figure 3 – dashed dark grey lines) were detected above that depth and within the fine sediment infill of the valley. Those areas are interpreted as old active channels that changed position due to meander migration by extension to the southwest and as a result of an accumulation of sediments derived from colluvial processes to the northeast (Figure 3). Meander migration in meandering systems is the most common type of channel change (Brown, 1997), however those high electrical resistive areas could also be the consequence of avulsion processes that result from the rapid abandonment of a channel and the adoption of a new course, generally at lower areas of the floodplain (Brown, 1997). Both hypotheses favour the accumulation of sediments eroded from the opposite margin. The hypothesis of the higher resistivity values being derived from a Palaeogene residual relief cannot be discarded.

At São Bento, ca.8km upstream of Arapouco, the valley reaches depths higher than -38m MSL, reflecting the slope profile of the fluvial valley, but due to the uncertainty of ERT data no accurate depth was determined. A high electrical resistivity area was found on the ERT profile (Figure 3), reflecting the accumulation of coarser sediments that are probably related to coarser fluvial accumulations. The sediment core collected at São Bento

does not reach the depth of the coarser deposit, preventing its characterization.

At Arez, the ERT profile reproduces a valley filled with fine sediments (reflecting the low dynamic of the small Carrasqueira stream), corresponding the higher resistivity values below -15m MSL to the encasing formations.

It was not possible to draw the palaeomorphology of the Vale dos Açudes valley as ERT data provides similar electrical values. That is interpreted as being the result of a proximal source contribution to the sediment valley infilling in a very shallow valley.

3. Palaeoenvironmental conditions

In general, terrestrial and freshwater organic materials present lower $\delta^{13}C$ values (<-25‰) than marine organic components (>-25‰; Lamb *et al*., 2006 and references therein). The $\delta^{13}C$ values determined for the lower section of Arapouco (below the MSL; Costa *et al*., 2019) and for the sediments recovered from Vale do Guizo and São Bento reflect an estuarine area receiving organic matter from marine (marine dissolved organic carbon [DOC]) and terrestrial (C3 land plants)/fluvial (freshwater DOC) environments during the Meghalayan. The top section of Arapouco (above the MSL), with lower $\delta^{13}C$ values, reflects an increase in the contribution of organic matter from terrestrial plants and freshwater phytoplankton to the sediment as a response of the valley's infilling, the decrease of accommodation space and the aggradation of the alluvial plain.

In the Sado tributaries, the $\delta^{13}C$ values are lower (mean values of ca. -26.3‰ for both locations), pointing to a terrestrial (C3 land plants)/fluvial (freshwater dissolved and particulate organic carbon) source for the organic matter.

The overall environmental trend reflected by the salinity pattern inferred from diatom assemblages indicates variability between an estuarine and a river-influenced environment. A comparison of the diatom-based salinity record from all cores with the $\delta^{13}C$ record reveals close similarities in terms of both timing and the interpretation of proxy records (Figure 4).

The radiocarbon data for the analysed sediments in these cores points to deposition since the end of the Greenlandian (ca.8590 cal BP at Arez; Figure 4; Table 2) or the beginning of the Northgrippian (ca.7300 cal BP at Vale dos Açudes; Figure 4; Table 2).

CONCLUSIONS AND IMPLICATIONS FOR THE LATE MESOLITHIC COMMUNITIES

Combining organic chemistry and diatoms' palaeoenvironmental information, and considering the depth of the Sado palaeovalley (ca.-40m MSL), the MSL stipulated for the Greenlandian (ca.-30m MSL at 10000 cal BP and ca.-13m MSL at 8400 cal BP; Vis *et al*., 2008; Costas *et al*., 2016) and for the early phases of the Northgrippian (ca.-4m MSL at 7000 cal BP; Costas *et al*., 2016), when Late Mesolithic communities occupied the surrounding Sado areas (between ca.8400 and 7000 cal BP), it appears that estuarine conditions prevailed in the studied area, at least up to São Bento (Figure 1). During that time-span, the estuarine environment, and the extent of the salinity conditions, were most probably dependent on changes in sea level rise rates, climate variations and river flow. The high sea level rise rate during the Greenlandian allowed for the inundation of the studied area since at least 10000 cal BP, promoting the development of estuarine environments. The attenuation of the sea level rise rate during the Northgrippian and the consequent infilling of the valley led to the aggradation of the alluvial plain; however, estuarine conditions were present in the area until the Meghalayan, long after its abandonment by the mesolithic groups.

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CHAPTER FOURTEEN

THE PRIMACY OF GOODNESS: THE NATURALISATION OF SPECIES AND THE WILL TO DO WELL IN THE 19TH CENTURY

CRISTINA JOANAZ DE MELO

INTRODUCTION

One of the most controversial examples of a change in perception over the last two centuries towards a tree species is the one regarding *Eucalyptus globulus*. In the nineteenth century, it was discussed in scientific essays as a potential substitute for quinine, a substance crucial in preventing malaria, independently of its forthcoming overexploitation for other purposes. In the 1800s, the guiding line for its plantation in Portugal, as across the Mediterranean, was the primacy of goodness, under the will to prevent or even eradicate epidemics.

Although eucalyptus became an unwanted tree in the twentieth century, magnolias, for example, which were brought to Europe from the Americas in the seventeenth century, did not provoke a similar environmental backlash. Did that outcome result from the latter being considered a decorative species or because the scale of planting was not seen as large enough to harm the local ecosystems?

My main goal is to discuss the process under which the same ecological object, exotic trees, suffered a huge change in symbolic value from the nineteenth to the twentieth century. Some of them passed from being considered very adequate for the improvement of health and civil protection to becoming perceived as very harmful to life-supporting systems. Thus, to understand how the perception about the very same tree species changed so much, it is relevant to analyse what differed in their contexts, time, space, and the driving civilizational paradigms.

SETTING THE STAGE

Nowadays, when studying the historical perspective regarding the transfer of trees across the world, some conclusions tend to be quite negative towards past human actions (Grove, 1995; United Nations, 2015). Reasoning from the current perspective under the battery of huge environmental global knowledge, some interpretations regarding the past have emerged which have been influenced by disciplines such as environmental studies, ecology and even climatology, thus providing less space for environmental analyses that consider the proper historical contexts. Some perspectives have, in my view, almost obliterated other interpretations that could shed a different light on the process of species transfer across the globe as the motivation for their circulation reached beyond a vision of profit at any cost.

Perceived through a lens of a social-environmental-ecological approach of degradation, these interpretations would conclude, fairly, that the plantation of *exotic* botanical elements, namely trees like *Eucalyptus globulus* and *Acacia podalyriifolia* (mimosa), would become invasive in Europe, namely in Portugal.

Prior to these approaches, economic-social or imperial history had offered a wide range of interpretations about how Europeans explored many locations in the colonies with no regret about their transformation, focusing merely on financial profit at the social and ecological expenses of destruction (Melo *et al.,* 2017; Vaz *et al.,* 2017). And the transfer and naturalisation of tree species – across continents and seas – was also verified under the framework of European imperial domination.

If a process of degradation of landscapes did occur mostly from the 1800s onwards, however, the process of ecosystems' change since then, as of resources depletion, was neither homogeneous nor synchronised in all regions of the world. The naturalisation of exotic trees was attempted at different rhythms.

Throughout the nineteenth century, the husbanding and plantation of woodlands to heal environments was encouraged from the Alps and Pyrenees to Portugal. Trees were planted across different chronologies on the slopes across the mountain chains in Europe to prevent torrential floods; along sandbanks to block the invasion of dunes over farmed land; as well as to convert degraded wetlands, where epidemics like cholera, typhus or yellow fever spread, into healthy areas. In fact, eucalyptus would only be considered harmful and labelled an invasive species in Portugal after the Second World War.

A long process of perceptual change around exotic tree species took place gradually, moving from admirable to invasive. In this sense, my hypothesis is that perceptions of exotic trees first evolved from being regarded as ornamental elements to instruments of public policies which could serve the community. This was largely because of the scientific achievements in chemistry, medicine, forestry and biology that informed these views. Furthermore, the scale of the implementation of policies regarding these species was vastly shorter than the one verified at present. Experiments could be tested and improved in each territory motivated by the desire to improve social conditions not to destroy ecosystems. And those aims responded both to notions of public duty as to religious beliefs.

Thus, by considering the proper historical context, in this chapter, instead of thinking of environmental degradation through the wide spread of invasive plants, it is proposed to tell a story of landscape transformation and the nursing and plantation of exotic trees in Portugal from the point of view of the coeval agents that implemented the *naturalisation* of those natural resources. These agents, scientists and politicians based their assumptions on the leading knowledge of their era exemplified through tested scientific experiments, in Portugal and elsewhere. This led them to believe that strategic-scientific afforestation of a given exotic species in degraded wet areas and stagnant waters would grant positive social benefits through environmental ameliorations.

MOTIVATIONS TO IMPROVE THE SOCIETY AND TRANSFORM GEOGRAPHY

Ecology and the Common Good: Great Issues of Environment (2014), edited by Richard A. Houghton and Allison B. White, offers many examples concerning the improvement of the common good through history. This is a concern that, in my view, can already be found in thinkers of the eighteenth and nineteenth centuries, namely in Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* of 1776.

As Smith proposed in this seminal work, economic growth would help to eradicate famine, and the wealthier nations ought to help the poorer ones to eradicate misery and poverty (Smith, 1983 [1776]). In his opinion, reflected by being a Presbyterian Pastor, the richer nations had a moral duty to improve production once they had acquired scientific and technological results that other regions of the globe had not. Producing more cereals, raising more cattle and more sheep, developing further techniques for building houses – all of these would aim at providing something to those who did not have it: food, clothing, shelter.

According to the theologian Elena Lasida, Smith would have thought about how economic development could help humans to reach salvation (Lasida, 2011). The ongoing process of naturalization of agriculture, increasing numbers of cattle, textile production and other naturalized European achievements suggest, to that author, ideas not to exploit and enslave human lives or create what later on would be known as capitalism but to amend unbalanced realities by doing as Jesus Christ had commanded, through the practice of the works of mercy (Lasida, 2011).

This Presbyterian Pastor lived under a tenet of belief where sinners would have great difficulty in obtaining salvation easily, but the practice of works of mercy could help to reduce the weight of transgressions when meeting the Lord; thus Smith, as the Pastor he was, had found a universal way of redeeming the actions of humanity.

The development of natural sciences and technology would have allowed Europe to increase production. Wilderness was tamed and farmed. Technology helped to transform wild areas where food was not produced into controlled fields. With the food surplus a market was generated, and competition was seen as a means to increase productivity and promote lower prices. And all of these actions would have been about providing for the ones that had less. However, this reasoning would later on be almost imposed from above, under the liberal period, on populations as the framework of a moral economy, in nineteenth-century Spain for instance (Vaccaro, 2007). For Adam Smith, those who could not afford food, clothes and shelter would be given what they needed according to the commandments of Jesus, made possible by the surplus in production. Moreover, in my view, economy and human relations, for Smith, were quite intertwined (Smith, 1781). Thus, profit was about redistribution:

To feed the hungry;
To give water to the thirsty;
To clothe the naked;
To shelter the homeless;
To visit the sick;
To visit the imprisoned, or ransom the captive;
To bury the dead.

From my perspective, and pushing Lasida's interpretation further, I am reflecting on the extent to which transforming landscapes in order to increase food production or eliminating the risk of widespread epidemics through technology and forestry would be embodied in the same paradigm: development to improve living conditions.

In reality, epidemics of disease and malaria in wetland areas were a huge problem and an almost permanent threat throughout the 1800s in Portugal and other European regions, for example, around the Mediterranean Basin (Pimentel, 1876). As will be discussed below, for the Portuguese nation, the State's moral duties and religion (Christianity) were thought of as being intertwined by the members of the elites and ruling classes (Soares, 1862; Pina, 1881).

The primacy of goodness, in the quest to grant civic protection and to fulfil moral Christian duties through public works or the economy, would always have been in the background when planning and building waterworks, particularly the naturalization of exotic trees at a scale wider than for the ornamentation of gardens.

Considering the above, some questions can be addressed with the purpose of better understanding the process of exotic trees becoming widespread. Firstly, what was the scale of the diffusion of exotic species in the nineteenth century in Portugal? Did some exotics become planted on a massive scale or did nature take its course and *naturalization* get out of control, because science could not predict such an efficient nor a later effect of a widespread predator which pushed along other ecological damage?

In order to analyse these questions, this chapter attempts to place the diffusion of exotic trees in Portugal in the nineteenth century under the needs felt at the time, using the knowledge available about the *good uses* that exotics could fulfil. This will not erase the later impact of, for example, acacia and eucalyptus on a massive scale in Portugal in the twentieth and twenty-first centuries. However, it will place actions in their own era where much later environmental impacts could by no means have been predicted.

EXOTIC TREES, FROM ORNAMENTAL TO HEALERS: AN UPDATED REQUIREMENT

In 1914, Fernando Bello would entitle his degree dissertation *Essências Florestais Exóticas a Cultivar em Portugal* [*Exotic Forestry Essences to Cultivate in Portugal*]. Trees coming from all continents – Australia, America, Africa, Asia and North Europe, such as the Blue Gum tree, *Eucalyptus globulus*, from Australia; the Lawson Cypress, *Chamaecyparis lawsoniana*, from northwest USA; *Acacia* species; Cedar of Lebanon, *Cedrus libani*; *Cryptomeria japonica*; *Pseudotsuga douglasii*; and *Pycea* species (now *Pseudotsuga menziesii*) – were praised as being very important for a wide range of purposes. The purposes included: economic crop production, ecological preservation (against soil erosion) and health control. Some of the

species were revealed to have multiple uses: aesthetic, aromatic, prophylactic and in forestry timber products and other goods (Bello, 1914).

In a way, Bello's dissertation could be seen as being rooted in ideas developed since the eighteenth century, where seigneurial farms had acquired fame due to their beautiful forested and aromatic roads, lined by ornamental and therapeutic trees (Barbosa, 1799).

Acacia and eucalyptus species were judged to be decorative as much as sensorial places of pleasure; the perfumes emitted by them were quoted as examples of exquisite taste, with the wisdom of using them placing the owner of such *fresco* at the cutting edge of civilisation and knowledge (Barbosa, 1799). But from being ornamental in the eighteenth century, they would come to be seen as a precious asset for dealing with public health issues in the wetlands in the second half of the 1800s in Portugal (Junior, 1871; Pimentel, 1884).

In the 1800s, cholera, malaria and yellow fever were present from Russia to Portugal. If epidemics worried rulers across Europe in the 1830s, in the 1850s concern increased for public health as crises escalated. The destruction of food caused by massive rainfall gave rise to undernutrition, which added to the lack of hygiene in slums and tenements in the cities. Faecal contamination of waters became dramatic (Baldwin, 1999; Saavedra, 2014). In the Portuguese capital, Lisbon, between 1857 and 1858, 10% of the population perished due to yellow fever, typhus and cholera. The need to stop this calamity was more than evident. In the following three decades, mostly during summers, intermittent fevers would reappear year after year in wetlands and other dank farming areas near to fields of still and stagnant waters, such as rice fields (Leite, 2005; Rodrigues, 2008).

At the time, the most current knowledge stated that epidemics (malaria) could arise and proliferate from bad smells that were frequently, but not solely, associated with degraded waters, wetlands and marshes. In France and Italy, the contemporary scientific knowledge proposed that the antidote to the noxious-smelling areas would not only be in afforestation (Temple, 2011) but in providing aromatic settings (Pimentel, 1876). In Portugal, similar problems were occurring for which equivalent solutions were proposed.

There was an increasing need to eliminate the sources of widespread epidemics that affected human lives as much as fauna (cattle) and flora (Ribeiro, 1868; Brantz, 2011; Saavedra, 2014). The solutions advocated would be through eradicating smells by planting trees on the one hand, and draining or irrigating wetlands and stagnant waters on the other (Ribeiro, 1868).

Very mindful of all these problems, in 1860, the Portuguese General Director of Agriculture, professor in agronomy and editor of the journal *Archivo Rural* [*Rural Archive*], Rodrigo de Moraes Soares, argued that areas

of permanently tainted waters should be transformed into productive lands or artificial pastures. But his main argument was against the rice fields. These, he contended, although producing food, should be replaced by other types of cultivation as those areas were responsible for epidemics and the killing of many peasants. Hence, legislators had the moral duty of stopping that situation, which they were able to because technology and science had provided them with solutions. If they did not do so, they would be disobeying the commandments of their Lord Jesus Christ, not practising the works of mercy in providing care to the needy and therefore risking the salvation of their souls:

> *Para quem não põe em dúvida os dogmas da religião Cristã, e os princípios da moral universal, a cultura do arroz é o desprezo desses dogmas, a prostergação desses princípios. Engrossar os cabedais á custa da vida e saúde alheia é a negação da caridade, virtude fundamental do cristianismo.* (Soares, 1862, 306)[1]

In 1859, in the report about rice fields and marshlands, the commission advised quite strongly for the extinction of rice cultivation. It took seven years for it to be abolished by the Act of 1st July 1867 (Melo, 2017). In that same year, in June 1867, though it was only printed for the public in 1868, the Report on the Forest Estate of the Portuguese Mainland, ordered by the Minister of Public Works, João de Andrade Corvo, was finished. This document concluded that there was an urgent need to plant trees in areas with a dramatic risk of flooding and in wetlands, which contained optimal conditions for the widespread transmission of epidemics (Melo, 2017).

In that report, the engineers Carlos Ribeiro and Nery Delgado clearly stated that the first areas that should be forested were the coastal lagoons, marshlands, sandbanks, river margins and banks. All seemed to be a priority (Ribeiro, 1868). And yet, if estuaries at the mouths of rivers, whether of private, public or common property, were identified as needing immediate afforestation, that report did not once mention the introduction of exotic trees to achieve this. Indeed, the forestation of mountain summits, river margins, marshlands, swamps and bordering lagoons were mainly advised to be *cleaned* with pine species (Ribeiro, 1868). This report became one of the most quoted documents as a reliable source in the underlying reports of

[1] "For those who do not question the dogmas of the Christian religion, and the principles of universal morality, the culture of rice is the contempt of these dogmas, the postponement of these principles. Getting wealthier at the expense of the life and health of others is the denial of charity, the fundamental virtue of Christianity" (translation of the author).

the Forestry Administration Bureau in the 1870s, which, until the 1880s, did not give a clear direction on eucalyptus in the National Woods.

Moreover, after the new cycle of inland flooding, which was evidenced all over the territory, occurring in 1867 and again in 1872, the rulers decided to deal with the origin of the problem. The memorandum written about the urgent need to control the major inland floods provoked by the international river, the Tagus, basically repeated the previous advice: the afforestation of river margins, wetlands, marshlands, fens and lagoons. And again, neither eucalyptus nor acacias were mentioned as being part of the solution (Eça, 1877).

This absence of information in technical reports seems to contrast with the increasing diffusion of knowledge about eucalyptus's marvellous characteristics towards an improvement of rotten or decomposed landscapes. It was praised by other coeval authors, amazed by eucalyptus's properties, as Radich has shown (Radich, 2007). Indeed, in 1876, the forestry engineer Sousa Pimentel was determined to convince the public about the goodness of eucalyptus. In his opinion, eucalyptus was an amazing essence that could be explored through a giant range of possibilities. His insight towards this natural resource was driven greatly towards its medical properties. These could be exploited both by public and private agents once they had been proven useful beyond any scientific doubt for many purposes.

It seems the list of good things to be obtained from eucalyptus was paramount in this thinking, and all were proven by science. First of all, it would be a substitute for quinine, which was a crucial medicine to fight yellow fever in Portugal, to be used amongst the swamps and productive rice fields and just as importantly, or even more so, in the colonies. Being part of a solution for epidemics and pandemics, the tree and its leaves could be used as medicine with propaedeutic and therapeutic properties for the eradication of miasmas, exhalations, flus and colds. The cure would be obtained through its aroma. The understanding was that this would purify soul and spirit. Concerning its use as an intervention in degraded ecosystems, it would help the drainage of mixed and unhealthy waters by converting lagoons, marshes and rice paddies into productive fields. Finally, it would cover the needs of timber and charcoal production.

In 1884, Sousa Pimentel published a second edition of his work, now further stressing eucalyptus's capacity to produce timber, sustain river banks, slopes and help prevent soil erosion (!), and then its therapeutic properties. In 1884, however, it was chemically proven that eucalyptus could not replace quinine (Radich, 2007). Nonetheless, Sousa Pimentel was amazed by the examples of eucalyptus plantations. Overall, there were

44,200 mature eucalyptus plants in Portugal in 1884, and a further 4,500 in nurseries. But many specimens had been lost, given the lack of protection from wind and drought (Pimentel, 1884).

In this 1884 work, Pimentel stressed a very important conclusion, which was that eucalyptus could not survive in wetlands where the root was permanently waterlogged as it would rot and die. It could drain irrigated areas, maybe mobile dunes, but not lagoons or similar. Thus, the possibility about eucalyptus healing swamps requires further research before mapping those areas once the experiments on different types of soils and areas with more or less irrigation produced different outcomes. There is no clear answer on its abilities to drain permanent or occasional watered fields from the sources of the period accessed so far. What is known is that, in the wetlands, malaria persisted in the 1880s.

Still, in 1881, the Bishop of Coimbra, D. Manuel Pina, was addressing the Ministry of the Public Works in strong terms. Coimbra is a diocese located in the centre west of the Portuguese territory, near to the mouth of the longest national river, the Mondego. He was voicing the citizens' views and advocating on their behalf, accusing the government of not fulfilling its duties towards the citizens. The intermittent fevers were not diminishing, mortality was huge and could be observed locally near to the swampy, damp and degraded areas in the wet fields.

By addressing the Ministry in such an aggressive fashion, Pina was providing a statement and a challenge. Through the laicisation of affairs traditionally mastered by the Church, in a context where the political elite were trying to push back the influence of the Church in social life, namely in assistance issues, the question was: "Why were the public works and public policies not being developed accordingly"? Since the Constitutional Chart in article 9 had nominated the Executive Power for that responsibility – defending the population from public health risks – the ecclesiastic was exhorting that the government should set out its prior competence, according to the law!

> *Não é caridade nem ministério parochial só a esmola que se dá, os sacramentos que se administram, e a doutrina Chiristã que se ensina; são-no também a vida agrícola, social e doméstica que se melhora (...); a salubridade e condições hygienicas das povoações que se promovem; as doenças e enfermidades que se acautelam (...); o egoísmo e as ambições desordenadas que se combatem.* (Pina, 1881, 4-5)[2]

[2] "It is not charity or parochial ministry just to give alms, or the sacraments that are administered and the Christian doctrine that is taught; it is also about the agricultural,

According to Pina, defending the populations from governmental inaction was the real duty of the bishop. In the end, were there the praised solutions of afforestation with exotic species? Were they mere samples of possibilities?

In the context of the tremendous effects of torrential flooding, erosion of the slopes and very scarce forest cover in the mountains and generally across the land (Melo, 2017), eucalyptus, according to the aforementioned three enthusiasts, indeed seemed quite promising. As Maria Carlos Radich (2007) has stated, the greater knowledge about eucalyptus that Sousa Pimentel had in 1884 than had been available for Oliveira Junior (1871), and which would be even greater for Pereira Coutinho (1887-8), is evidence of the short time it had taken for the tree to reach a very great height. That is to say, its amazing capacity for producing timber testifies that eucalyptus plantations were developing steadily. The three authors were absolutely passionate about this tree (Coutinho, 1887-8).

Sousa Pimentel recorded statistics about it in 1884. These started to reveal a promising development. This very fast growing species was offering a promising possibility of an alternative energy supply as timber for navy and house building, and Portugal was lacking mineral coal/charcoal resources. Moreover, eucalyptus was adjusted to sustain river margins and prevent erosion on the slopes, providing protection against torrential floods. It was necessary for the idea of health control to be better tested. However, Radich has pointed out that it was not until the 1880s that eucalyptus trees were introduced into the National Woods nurseries (Radich, 2007).

CONCLUSIONS

Introducing and testing the behaviour of botanic jewels transferred across continents and far-off seas resulted from a profound and inner will of doing well for the sake of humankind, towards an improvement in human living conditions. The perception of intervention and the scale of controlled plantations of trees, woodlands and forests was totally different from that of today.

Through the nineteenth century, “exotic” did not mean bad, it did not mean invasive or causing degradation and depletion. On the contrary, the transfer of “exotic” tree species around the world occurred mainly, while considering their potential for performing well, with a view to transforming

social, and domestic life that improves; (…) the salubrity and hygienic conditions of the villages that are promoted; diseases and illnesses that are cautioned; (…) the selfishness and the disordered ambitions that are fought” (translation of the author).

areas to improve health and degraded environments. Scientists were by no means seeking to harm nature but to heal areas where living conditions were at risk.

Without any intention of denying the impacts that Europeans and the human factor had in changing ecosystems profoundly in the long run, I have avoided reading the past from the current twenty-first-century perspective. That view, from an historical perspective, becomes methodologically distorted, for it does not allow us to understand the motivations and actions of coeval actors that encouraged science to invest in the "naturalisation" of exotics as the possibilities and limits of science from their contemporary times and geographies.

Summing up, the intentional transfer of species of exotic trees, in the nineteenth century, *was to do well***,** to improve the common good, to protect the communities. The intentions behind the planting of eucalyptus, and similarly for acacias, were to safeguard the human population from epidemics and to repair the environment. It was not to provoke ecological disasters.

Eucalyptus was originally introduced slowly and in modest ways. Gradually, it became exploited for several purposes which eventually ended up with it being used to manufacture paper, but only after science had made this possible and recommended. The real problem was the scale of implementation, resulting in the ornamental becoming invasive, but this only happened after the 1860s.

Thus, it is important to keep in mind that approaches to environmental changes, in the long run, need to give greater insight into their historical contexts, for that is the only path to understand coeval motivations, and also that the human factor, in spite of its errors, in former times has already tried to improve nature and grant its protection.

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CHAPTER FIFTEEN

WORKING WITH NATURE: 19TH CENTURY VINEYARDS IN THE ALGARVE

ANA DUARTE RODRIGUES

INTRODUCTION

Focusing on the Algarve winescapes of the 19th century, this chapter argues that the farmers of this region have adapted to their environmental conditions based on traditional knowledge, artisanal practices and resilience. The Algarve is the most southern region of Portugal, and although not geographically part of the Mediterranean basin, it has a Mediterranean climate, marked by long and hot summers and cool and wet winters. Therefore, the Algarve vegetation is typically Mediterranean. In the 19th century, several descriptions made by both foreign and national authors who were travellers, naturalists, botanists, and agronomists portrayed the Algarve landscape as a wide-ranging garden. However, the wine production was criticized, especially when compared with the region of Douro, whose winescapes were considered 'scientific landscapes' (Macedo, 2011).

The history of science has focused its interest on the cultivation of vines from the perspective that wine is largely a product scientifically built by viticulture and winemaking (Paul, 1996). Science invaded vineyards in the late 19th century, largely due to the diseases that hit these crops, such as phylloxera. The study presented here argues for a change in perspective: to look at the Algarve vineyards' culture and wine production as artisanal practices, which nevertheless denote an empirical knowledge of nature and adaptation to the environment.

Additionally, focusing on the Algarve winescapes of the 19th century through the lens of the conceptual framework of the interrelated topics Identity, Memory and Landscape (known by its acronym IML) (Yoffee, 2007), this chapter shows how an important part of the country's landscape

heritage is completely lost, including certain varieties of vine, traditional horticultural processes and, consequently, the region's identity.

The history of landscape gained momentum with the emergence of both heritage values and environmental ones, which endowed the landscape with a great social visibility, even contributing to the creation of specific instruments of protection and regulation of the landscape. This increased the diversity of perspectives and contributed to the reinforcement of values of 'cultural authenticity' and the idea of landscape as heritage (Yoffee, 2007).

Vineyards, wine-making processes, and wineries shape the landscape to such an extent that they convey identity to certain regions or countries, then labelled as 'wine regions' or 'wine countries'. International historiography has already consecrated Italy, France, some regions of the USA, and Portugal as such (Peters, 1997; Sommers, 2008; Sereni & Litchfield, 2014). Historiography has also enhanced some regions of Portugal as winescapes, showing how they have shaped the landscape and embodied the region's distinctiveness. The unique vineyards of the Azorean island of Pico, planted in lava ground, were already classified as a World Heritage site by UNESCO in 2004 (Sousa, 2004). In the surroundings of Lisbon, the rebirth of the wine produced in the villa of the Marquis of Pombal in the 18th century, known as Carcavelos wine, also stands out (Pereira & Cabral, 2007). However, the most celebrated Portuguese winescapes are the scientific Port wine landscapes in the Douro region, which received the contribution of many English landowners who established themselves in Portugal in the 18th and 19th centuries (Macedo, 2011).

Although historiography has already addressed the Algarve vineyards and wine production from a historical point of view (Bernardes & Oliveira, 2006), based on unpublished documents and novel primary sources, this chapter tackles the descriptions and reports of the Algarve winescapes made by foreign and national experts and the region’s potential for wine production. Moreover, it argues that although the most advanced scientific methods of growing vines were not applied in the Algarve, the Algarvean farmers succeeded in growing vines based on specific artisanal practices. It also offers data on the vine varieties cultivated in the Algarve between 1822 and 1872, which enhanced the region’s biodiversity and identity. Finally, stemming from different opinions on the quality of the Algarve’s wine, this chapter re-evaluates this question by arguing that the wine did not lack quality but additives for preserving wine.

Stemming from the perspective of the history of science and the IML conceptual framework, I argue that the Algarve winescapes used to contribute to the region's identity, parallel to the natural products that are usually associated with the Algarve, such as oranges, figs, almonds, olives and carobs. However, the research presented here demonstrates that the traditional varieties of vine cultivated in the Algarve in the 19th century and the beginning of the 20th century have disappeared from the commercial circuit and wine producers and, in present times, they are nothing more than a collection on a seed bank.[1] In recent decades, French varieties have invaded the Algarve's vineyards. Based on these findings, I argue that for a more ecologically balanced future for the Mediterranean region, the awakening of landscape heritage is necessary.

THE ALGARVE WINESCAPES

Winescapes have been predominant in the Algarve and wine production has contributed to the region's prosperity since medieval times (Bernardes & Oliveira, 2006). In the 19th century, both Portuguese and foreign travellers who wrote about the Algarve stated that vineyards were one of the chief features of the region's landscape.

In 1846, the German botanist Heinrich Moritz Willkomm (1821-1895) travelled in southern Portugal and published a book on his travel memories (Willkomm, 1847). He pointed out the vineyards as one of the chief features of the Algarvean landscape, and he concluded through the observation of the wine producers' houses that they were prosperous farmers. Indeed, he described the Algarve landscape as one in which olive and carob trees "cover almost the promontory of the Algarve mountains, alternating with large plantations of fig trees and orange trees, with vineyards and vegetable gardens" (Willkomm, 1841, in Wilhelm, 1988, 187-188).

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[1] The research project 'Sustainable Beauty for Algarvean Gardens: Old Knowledge to a Better Future' (IF/00322/2014), funded by the Portuguese Foundation of Science and Technology, addresses the lack of sustainability of the Algarvean gardens and argues that a deeper knowledge of autochthonous species and ancient horticultural practices could benefit current practices (see Rodrigues, 2017). In this context, pilot experiments are being carried at the Faculty of Sciences of the University of Lisbon, and although, based on historical findings, the project foresaw the importance of performing experiments with a traditional vine variety, this was not ultimately possible as it could not be found in nurseries or wine producers.

Furthermore, the French civil engineer Charles Bonnet (1816-1867) came to Portugal between 1844 and 1846 to study the geomorphology of a copper mine in the Algarve (Mesquita, 1990, 10). In 1847, he returned to the Algarve and collected a lot of data to write his *Mémoire sur le Royaume de l'Algarve*, having also become a member of the Royal Academy of Sciences. Bonnet points out that vineyards occupied a lot of terrains, especially in the surroundings of Monchique (Bonnet, 1850, 81).

Although foreign authors have provided important hints to understand how winescapes were common in the Algarve in the 19th century, the most important source to appreciate the layout and geographic dissemination of vineyards in the Algarve in this period is the Report of the Agricultural Society of the Algarve (1872). The Portuguese military officer Gerardo Augusto Pery (1835-1893), a member of the Society of Statistics of France and of the Royal Academy of Sciences of Lisbon, reported that the regions of Tavira, Olhão, Lagoa, Vila Nova de Portimão, Faro, Castro Marim, Vila Real de Santo Antonio and Albufeira were winescapes in the second half of the 19th century (Pery, 1872, fl. 24-25). Wine landscapes were also to be seen in other regions before the appearance of powdery mildew of the vine. This disease devastated the best part of the Algarve vineyards in the 1860s (Pery, 1872, fl. 23). After that, the Algarvean farmers took two different paths: some decided to cultivate fig trees rather than vineyards, but the farmers from Loulé, Monchique, Lagos and Alzejur decided to replant their vineyards, thus maintaining the winescapes and the landscape's identity (Pery, 1872, fl. 24-25).

Therefore, winescapes continued to prevail in the Algarve and farmers have shown resilience towards the negative impact of vines' diseases. Nevertheless, Pery was disappointed with the Algarve wine production's performance as, in his opinion, the region's potential was underappreciated. He stated that "keeping in mind the region's favourable climate and the great portion of terrain which gather the best conditions to the good development of vineyards, it's a shame that the area occupied by such culture is diminutive" (Pery, 1872, fl. 23).

Furthermore, Pery argued that any of the three geologically distinctive Algarve regions – the mountain, the Barrocal[2] and the coast – provided adequate climatic and topographic conditions for growing vines. This was the reason behind Pery's disappointment, as one could grow any kind of vine and produce different wines throughout the region: in the schistose region of the mountain range terrains like those of the cliffs of the Douro,

[2] The Barrocal is the Algarve's inland area, between the mountain and the coast. Its name derives from the geology due to the presence of irregular hills, which are called '*Barrocos*' in the Portuguese language.

"where the best wines of the world are produced"; in the coastal zone, in clayey soils, similar to those of Bairrada; in the sandy ones by the ocean, like those of Lavradio, Cartaxo, which he argued were "regions well known for their portly wines so sought after for boarding"; and finally, in the region of Monchique, where the soil was "very similar to that of the vineyards of Dão, Fundão, Alto Mondego, and several Alentejo wine-growing centers" (Pery, 1872, fl. 23v.).

Although the region's potential was not fully explored, and most vineyards were concentrated in the coastal area from Sagres to Quarteira (D'Avillez, 2006, 192), the 19th century Algarve landscape can be considered as an outcome of nature and people through the continuum process of land cultivation. These are the foundations on which landscape identity is built.

GROWING VINEYARDS

In general, the processes for vineyard cultivation practiced in the Algarve are similar to those employed elsewhere and have not been considered pejoratively by the Agriculture Society's experts who produced the 1872 Report, as it was pointed out that "some owners treat their vines carefully" (Pery, 1872, fl. 24). However, three major differences in the cultivation process can be pointed out: they did not use a plow, they did not make the *empa* – the process in which the vine sticks are folded and tied to living or dead tutors, and which is the only way for the vine to stand vertically and allow the sap to be distributed throughout the plant – and the vine grew on the ground, thus clearly contradicting the appearance of the Douro's scientific landscape as a result of the almost 'laboratorial' processes of its cultivation (Macedo, 2011).

In 1841, the president of the city council of Lagos, João Baptista da Silva Lopes (1781-1850), described both the horticultural process of growing vines, as well as its wine production. He observed that, earlier, vines were planted in an irregular manner and quite close to each other, within a distance of about three spans (one span equals ca. 22 cm). However, the modern vineyards of the 1840s followed an improved cultivation method. Strains were aligned and separated by about five-six spans (Lopes, 1841, 139). Thirty years later, the vineyards were all cultivated in a regular way, from which we can deduce that the method must have been generalized between 1840 and 1870.

In the 1872 Agricultural Report, Pery described the cultivation method thus: the rooted cuttings were planted at a distance of 1.10 m or 1.20 m in equidistant parallel lines, so that the arrangement was in perfect harmony

with the climate of this region. Each thousand strains occupied, therefore, a surface of 1225 m^2, which corresponded to 8160 roots per hectare (Pery, 1872, fl. 27v.).

The process of vine cultivation in the Algarve included the harvest, the *alumia* (excavating the strains at a depth of 0.10 or 0.15 m), the pruning, the *plantação ao covato* (planting in an open hole at the bottom of the trunk, where the rooted cutting is fixed), and the *redra* (the second digging operation in vineyards to remove the impurities or weeds) (Pery, 1872, fl. 27v.).

The harvesting of grape vines was done in September, as it is in current times, followed by the *alumia*, which should be done immediately before the first rains. The next procedure – pruning – was, according to Lopes' description, supposed to take place in January (Lopes, 1841, 139). Pruning was probably not done according to the best practices, since it has been criticized by several authors. For example, Constantino Botelho de Lacerda Lobo (1754-?), sent by the Royal Academy of Sciences of Lisbon to the Algarve between November 1790 and January 1791, stated that the Algarve's farmers cut all the vines, and the consequence of this malpractice was that the vines did not produce half the grapes they could in the following year (Lobo, 1994, 237). In his opinion, the Algarve's farmers should therefore have promoted the improvement of their vineyards with the pruning and grafting of the best grape varieties, so that the strain retained a proportional number of canes to keep sturdy (Lobo, 1994, 237). Moreover, around forty years later, the president of Lagos city council made the same kind of observation. Lopes considered that pruning could be improved by leaving more canes for the grape sprouts and that this should be done before the rise of the sap (Lopes, 1841, 139). If this practice was observed, vineyards would produce more.

The reason that lies behind these critiques is the expertise revealed by Porto and Lisbon wine producers, to whom the Algarve farmers are compared and supposed to do the same (Lobo, 1994, 237). For example, a landowner of the Municipality of Faro, Mr. Barrote, a man with an entrepreneurial spirit, and who was very active and a lover of progress, began to experiment in his vineyards, populated with the best castes, with pruning and the *empa* system used in the outskirts of Lisbon, where the best castes were grown. Only his disease prevented him from drawing any valid conclusions concerning his experiments (Pery, 1872, fl. 28).

However, the 1872 Report gives another explanation for the kind of pruning technique used in the Algarve vineyards. It is called *póda raza* (shallow pruning), and the farmers argue that it is the most adequate process for the kinds of soil they have in the region (Pery, 1872, fl. 27v.).

When this method is used, the strain is kept very low, cranes spread onto the ground, and bunches of grapes ripen on the ground (Pery, 1872, fl. 28). Certainly, shallow pruning did not allow the *empa* to be practiced, as it was in other regions of Portugal throughout the same period. Other voices argued against this explanation, stating that in this warm region this practice was unnecessary and that in many other regions with similar soils, farmers did not follow this method (Pery, 1872, fl. 28).

The *redra* was done in April and May and at that time manure was also sometimes added. In some places, farmers usually sowed vineyards every three years by pouring manure into each strain (Pery, 1872, fl. 28v.). Near the coast it was totally different. In perfect synchrony with the surrounding environment, farmers applied sea plants and algae mixed with fish waste as manure to fertilize vineyards (Pery, 1872, fl. 29). The exploitation of the resources that the land gave them was so ingenious that in years of scarce pastures they fed the oxen with sardines (Pery, 1872, fl. 42).

The oenologists of the Algarve consider that nitrogen fertilizers, such as fish manure and sea plants, may have opposite effects. If, on the one hand, they favor the development of the strain and give it more vigor, on the other hand, they impair the quality of the grape, making it less aromatic and sweet (Pery, 1872, fl. 29).

In poor lands where it is very convenient to add composts to the vines, it is recommendable that vegetative manures are used (Pery, 1872, fl. 29). To do this, the most cost-effective and best solution was for farmers to sow rye or lupine into the vine and bury their crops as the vines are dug (Pery, 1872, fl. 29). In the poor lands of Barrocal, for example, when it was necessary to fertilize the vineyards, farmers planted rye seed or lupine and buried this harvest at the time they dug all the fields. Therefore, I argue that the adaptability of horticultural practices in the Algarve stems from the wise approach to the stewardship of the land and the region's resources, in which natural manures could not easily be replaced by chemical fertilizers – although these were already available in the 19th century.

Parallel to the traditional horticultural practices, this research has revealed more than sixty of the traditional grape varieties – red and white – that were cultivated in the Algarve between 1822 and 1872.[3] However, none of these vine varieties can be found on the commercial circuit or amongst wine producers. In current times, these vine varieties are no more than a collection in a seed bank of the Algarve Department of Agriculture, located in Tavira.

[3] Data comes from Girão, 1822, and ANTT, MOPCI, mç. 870, nº 74, fls. 25, 26.

However, some of the ancient varieties, such as Espadeiro, Chaparro, Caroncha, Bocalrão, Languedor, Citima, Pão-ferro, Godlho, Penso, Tendeira, Alvilha, Mespigas, or Vale de Barreiros, cannot be found in this seed bank and may constitute an irreparable loss of biodiversity, if they are not found in other seed banks.[4] All the other ancient vine varieties that vanished from the landscape, but which can still be found in Tavira, should be submitted to pilot experiments to test their quality, resilience to disease and productivity.

The restructuration of vineyards in recent decades introduced French varieties into the Algarve landscape. The Algarve winescapes hold castes such as Aragonez (Tinta Roriz), which currently represents 25% of the cultivated area, Syrah (7%), Cabernet Sauvignon (6%), Touriga Nacional (5%), Alicante Bouschet, Merlot, Petit Verdot, Alfrocheiro, Tinto Cão, Grenache, Verdelho and Viognier. Vineyards presently occupy 2140 ha, especially concentrated in the areas of Silves, Lagoa, Portimão, and Lagos (D'Avillez, 2006, 195). The reasons behind the predominance of French varieties in the Algarve might not be only related to productivity. For example, Lopes considered that there were a lot of vines of both varied and excellent quality, from which the Portuguese were able to produce good wine and in abundance, to such an extent that there was none for exportation as it was all consumed inside the country (Lopes, 1841, 138). Therefore, the reasons for the abandonment of the traditional Algarve vine varieties require some doubts. Furthermore, as recent trends privilege the uniqueness of some wines rather than the ones that hold a more standard palate, this research argues for the recuperation of some of the Algarve's traditional vine varieties.

WINE IN THE MAKING

The Algarve was considered in the 19th century as "one of the most promising regions for the production and commerce of the best and most precious wines in the world" by the agronomist Alexandre de Sousa Figueiredo who wrote a book on the improvement of the Algarve's wine production in 1873 (Figueiredo, 1873, 3). The region's climate and soils were the most adequate for the growth of vines. In addition, its important harbors could facilitate its exports. However, the vineyard culture was far from being profitable in the second half of the 19th century. The stipulated reason was the low quality of the wine, as the producers could not guarantee the wine's conservation during its travels (Figueiredo, 1873, 3).

[4] Following information given by the Algarve Department of Agriculture in 2018.

As for the quality of the wine, the opinions were divergent. For example, at the turn of the 19th century, Link had eulogized the wine by stating that "The wine of this province is white, contrary to the general custom of the country, but is good, and supplies a part of Alentejo" (Link, 1801, 454). The wines called 'da Fuzeta' were considered the best in the Algarve,[5] but the wines from Moncarapacho, Quelles and Pechão in the regions of Olhão, Lagoa and Portimão were also famous (Pery, 1872, fl. 24). Finally, and within this time frame, the Algarve's wines were present in international exhibitions, such as in the Great Exhibition of London in 1874, in the Exhibition in Berlin in 1889, and in the Universal Exhibition in Paris in 1900 (D'Avillez, 2006, 190) – evidence of the wine's quality as well as its international acknowledgement.

On the contrary, for some experts, the wine was not made according to the best processes. For example, Figueiredo claimed that the harvest should be done as early as possible, and grapes should enter the mill straight away (Figueiredo, 1873, 5). Yet farmers sometimes left the grapes on the ground for some time, and although this was a practice that could be tolerated in cold climates, it was not recommended in the Algarve (Figueiredo, 1873, 5). Sometimes, farmers by the seafront began the harvest in September and in the mountains by the end of that month (Bonnet, 1850, 82), which was already quite late for this region.

Following the harvest, grapes were placed in baskets; then they were trampled under the feet of men, and water was added to grape musts when placed in kettles or barrels, most of the time without using any scale or preparation. Despite water being poured into musts, at least two or three *almudes* per pipe, the president of Lagos city council considered the wine to be fine and delicate (Lopes, 1841, 139). In the end, they used a glucometer, which is an artisanal device to measure the amount of glucose (sugar) in grape musts (Figueiredo, 1873, 6).

Figueiredo makes a series of scientific recommendations to overcome the deficiencies of the artisanal processes of wine production and secure the improvement of the wine's quality in the future. He suggests the use of the system of enclosed fermentation in barrels, such as the ones invented by Michel Perret Ainé in *Cuves à étages et appareil de distillation* (1870) or described by António Augusto de Aguiar in *As balsas dansantes: considerações ácerca dos processos de vinificação* (1867). During the fermentation process, a lot of carbonic acid is created and it has to be driven to the exterior of the barrels. Otherwise, it will explode. To avoid

[5] The wines of Fuzeta gained this name because they were exported from Fuzeta, however they were not all from that region.

this, Figueiredo recommends the use of the Payen hydraulic batch mixer or the universal batch mixer described by João Inácio Ferreira Lapa in his *Technologia Rural* (1871) (Figueiredo, 1873, 11).

In the period considered, the traditional techniques of the Algarvean farmers in the cultivation of vines proved to be effective because they knew how to make the most of the resources they had around them. In contrast, their peripheral situation regarding the main development of wine growing and winemaking proved to be more negative because, although many authors consider the wine to be of good quality, the Algarvean wine could not last a voyage and therefore be sold elsewhere or even exported, as Port wine could.

FINAL REMARKS

Focusing on vineyards, this chapter has tackled the problems of the Algarve horticultural processes of cultivating vineyards and the total amnesia concerning traditional grape varieties of the 19th century, which themselves constituted a major feature of the identity of the Algarve's landscape at the time.

This case study has enabled us to enrich the narratives on agriculture through the lenses of identity and sustainability rather than 19th-century agricultural progress. Additionally, it allows the comparison between regional and national horticultural and agronomic practices, highlighting the co-construction of a regional and national landscape identity, from the process of which emerges the idea of working with nature rather than dominating it.

The problems of sustainability faced by the Algarvean landscape in current times are interlinked with problems of identity, and a better understanding of Mediterranean landscape history and traditional species cultivated in the region is needed. Moreover, traditional horticultural practices would benefit current choices of landscape construction and protection. Irreversible losses of this heritage can already be traced. This chapter's goal is to contribute not only to a deeper knowledge of this *story*, but also to create an impact on current practitioners and act as a springboard for the rebirth of traditional varieties of grapes that have been cultivated in the Algarve for centuries.

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CHAPTER SIXTEEN

ASSESSMENT TO NEGOTIATE CULTURAL ECOSYSTEM SERVICES OF PLACES

CHRISTINE ROTTENBACHER

INTRODUCTION

As a landscape architect, I developed an assessment method (Moved Planning Process, MPP) to negotiate the use and maintenance of places that build our cultural landscapes. I reviewed the effects of walking together over shared used places on negotiation processes within my PhD ‘Moved Planning Process MPP’, focusing on communication structures of heterogeneous groups and how emotions are an important part of these communication interactions. Further, I used the theory of the contact process to structure those interactions, community building processes and analysed how shared experiences can lead to shared constructed realities (I have already published articles about those results). In further practical work and reflection periods as well as research, the focus on decision-making and negotiation processes led to investigations about the attachment to places and how human experiences are expressed within a public participation process. We start with the sensing and reflecting qualities of places and with an exchange about the meaning of places. Subsequently, cultural ecosystem services can be identified together, and the ongoing negotiation about the use and maintenance of land is supported by the dynamic of shared experienced place relationships.

Cultural ecosystem services can range from recreation, experiencing relaxation, and even spiritual qualities, to everyday work activities in the landscape. Concepts like territory concepts (Janz, 2002), perception and action concepts (Kepner, 1999; Goldstein, 2000; Damasio, 1999) as well as phenomenological insights (Merleau-Ponty, 1945 (1966); Casey, 1997) need to be integrated into the assessment method. Places get meanings, which are defined by relationships. These relationships are expressed with-

in the special social context and influenced by personal and shared experiences and knowledge (‘here and now’ within the assessment). The naming of the qualities of place takes a big part, as it is related to the visible particulars of local topographies, biographical associations, and socially given systems. In repeated contacts with places, the relationships of humans within the social-natural context can be strengthened. I would like to show how these relationships can grow to a shared reality, a construction of the past as ‘what happened here?’, and lead to a reflection of maintaining habits. As social identities are situated in places and landscapes, this can contribute to negotiating their use and maintenance for the future.

Both individual personal knowledge and shared communal knowledge are incorporated throughout the socio-cultural frameworks and subsequently shape the use, behaviour and maintenance of place and land. The concepts of place making and the meaning of place, with a focus on human-nature relationships, can help to structure the negotiation processes that combine biological as well as cultural diversity.

In my practical work I started to investigate cultural ecosystem services together with participants to enable an expression of the nature-human relationships. Thereby the definition of cultural ecosystem services is enlarged from recreational values, aesthetic values, values of identification and ethical-spiritual values to existence values and knowledge systems about landscape and place, as they are integrated into everyday work and existing.

Using the dynamics of expressing values and meanings of place in participation processes can help with working with the relationships humans experience and developing stewardship programs. The approach presented in this article assumes that the negotiation of a sustainable stewardship is based on an identification and emotional attachment to a place (Saar & Palang, 2009). The relationship between the community and their places has significant effects on the landscape with its life-supporting processes.

The next section discusses how it is possible to create a base for negotiating emotions as relationships to places, to ground them in place attachment concepts. Thereby I will introduce the Moved Planning Process to show how I enable contact processes to develop amongst the participants.

MEANING OF PLACE – HOW TO NEGOTIATE EMOTIONS

Place meaning and place attachment are complex and multifaceted phenomena which involve the interplay of affects and emotions, as well as

knowledge and beliefs, and behaviours and actions about a place. Scannell and Gifford (2010, 5) described place attachment as

> …a bond between an individual or group and a place that can vary in terms of spatial level, degree of specificity, and social or physical features of the place, and is manifested through affective, cognitive, and behavioural psychological processes.

A substantial amount of research has been conducted on how place meanings are created and how they are expressed and observed (narratives, mental maps) in place attachment and humans' sense of belonging to a place, a community (Manzo, 2005). Current research deals mainly with meanings that humans attach to places on individual levels and how this process can contribute to their identity in enabling ongoing reflection and self-understanding. So they can attach meanings to places to gain continuity in an ever-changing environment with its cycles and rhythms and can change meanings as an adaptation to new insights or forces (Smaldone & Sanyal, 2005). Insights describe the connection between cultural landscape as a means for maintaining and renewing identity with a sustainable use of land (Bianca, 2008), as the connection between emotional attachment and mental concepts, as the perception of the environment and adapted behaviour leads to shaping and organising the land (Olwig, 2002).

The meaning of places represents various phenomena of emotional relationships to places (positive and negative). The range reaches from concepts of rootedness, belonging, protection, appropriation, the sense of possession and control over a place (Jorgensen & Stedman, 2001) and of comfort to humans' experiences with nature (Kyle & Chick, 2004) and wilderness (Frederickson & Anderson, 1999). One result points out that significance or importance for single persons need not correlate with aesthetics or scenic beauty (Manzo, 2005). Often, they are ordinary places of routines and everyday life where people experience opportunities for self-understanding and emotional development.

At the same time, the protection, management, and planning of cultural landscapes have attracted broad attention from scientists, policymakers, and the general public according to the adoption of the European Landscape Convention (ELC) in 2000[1].

[1] The interest in cultural landscapes also finds its expression in the UNESCO World Heritage Convention and the IUCN Protected Landscape Approach. Both

There are interesting investigations about humans' values and meanings (Höppner *et al.*, 2008) in relation to place attachment, and how they determine self-efficacy and outcome-efficacy in participation processes. For landscape assessment, a distinction is made between perceptual and aesthetic experience and what the ELC (European Landscape Convention CoE, 2000) calls the "opinions and expressions" of social stakeholder groups. Usually, perceptual and aesthetic investigations are done by experts and then combined with opinions and expressions. We can find two fields of perceptual landscape studies (Heijgen, 2013):

- studies on visual and multi-sensorial perception and aesthetic values – visual preferences belong to this field, the 'classic' approach in land management issues;
- studies on social perception – the intangible values of which the landscape is an expression for a certain society or social group; we can identify at least two groups of these values: the cultural value (for example memorial, identity) and the fruition value or use (for example producing, living, recreating).

Social attachment to place needs to be directly incorporated into planning procedures. Their single needs and interests must be transformed into a more comprehensive understanding, as participants cannot transcend their particularity (Young, 2000), but they can develop shared 'particularities' of their special places (Haraway, 1991).

This article tries to contribute to the necessary discussion on how to enter a discourse of negotiating these emotionally biased personal meanings, because negotiating emotions needs different approaches and 'emotional' communication structures (Rottenbacher, 2004b).

In negotiating the use of land in a planning process, it is first necessary to help express those emotional relationships by using the dynamic of the mutual experiencing of meanings. To do so, we have to enlarge our theoretical concepts about human-nature relationships.

One theoretical concept, considered here, is the "Human Theory of Action" (Goldstein, 2000), where a human is described as an organism-environmental entity. A human is embedded as a body-mind person in a social-ecological environment. Experiences and knowledge are stored up in the body and mind and used in each situation with other humans and

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policies promote the protection, management, planning, and governance of cultural landscapes.

places (Gustafson, 2001). These structures and social realities are reconstructed, confirmed and extended with everyday experiences within the everyday living space (*lebensraum*[2]). Simultaneously, the modalities of perception orientate individual feelings, emotions and thinking patterns. The capacities for environmental concern lie in how we perceive (feel, discover and invent) nature and place, and how values are manifested in the ongoing behaviour, engagement and maintenance of place.

'I' perceive 'my' place with my senses, 'I' experience it through my feelings, and 'I' organise my actions within my world with my mind. Different disciplines deal with emotions and embodiment (a term used in cognitive science). It was recognised that cognitive and emotional states are not necessarily binary opposites. Cognitive phases are not always logical and emotive phases can be rational and logical (Ledoux, 2001). Through feelings we are embedded in the 'here and now'. Feelings are accompanied by immediate physical reactions, which are expressed by face play and body motion. Feelings can give an awareness and knowledge of the situation, providing an orientation (Clynes, 1989) within the environment. At the same time, humans need to express their emotional and cognitive knowledge about place to create reliable relationships with places. Within these expressions, they confirm and correct their relationships.

NEGOTIATING ATTACHMENT TO NATURE AND PLACE WITH THE MOVED PLANNING PROCESS

Different concepts of the relationship between culture and nature shape societal views and actions towards the world. There is a broad field of place attachment studies and how they could be incorporated in the development of assessment methods for sustainable land use (Buchecker *et al.,* 2007). As place attachment studies mainly concentrate on individual attachment, the focus here deals with the process of expressing meanings and values by a group and negotiating shared attachment within a landscape planning context.

Nature and place can be understood and interpreted differently according to the relationship within which it has significance, interweaving the social experience of being in a place with the symbolic meaning of the qualities of a place (Healey, 2001) and experiencing natural processes.

[2] The concept of *lebensraum* deals with the personal knowledge of individuals about the meaning of place and the shared knowledge of communities.

Place attachment emerges through the process of experiencing those constructions and functions, a place which can fulfil, and of emotional and social meanings (Leith, 2006). This process is vivid and spirited by the 'lived bodies' that live, use, and maintain place; at the same time, this place animates these same bodies as they become emplaced here.

> (…) as bodies expand into places, so places exfoliate through (built and given) things into (social and natural) regions, and regions expand in turn into worlds. From body and thing and region we come to world, but we do so only insofar as the event of place is active throughout. (Casey, 1997, 336)

Scannell and Gifford (2010) differentiated psychological process dimensions like affect, cognition and behaviour and functions of place attachment, related to aspects like survival and security, self-regulation and continuity emplaced in the social system. It also can be described with the concept of "being-in-the-world" as a phenomenological thought (Merleau Ponty, 1966; Goldstein, 2000), as humans with their body and mind are considered within each moment a profile of the becoming and being. It is the connection of all that has effects on 'me' and what 'I' am causing at the same time. 'I' am embedded within socially, historically and spiritually determined layers at a place (Goldstein, 2000).

Place attachment concepts can work together within a local community-driven 'bottom-up' approach, which seeks to enhance the existing social glue within communities, encouraging them to come together towards a common vision of a resilient and diverse life.

To enhance points of view, letting in new insights, I try to open the interaction patterns to combine personal perception with new learning processes (understandings) and initiate encounters with one's own living space (*lebensraum*). Participants are regarded as experts of their own ecological-social environment and, through acknowledging their personal experience, they themselves recognise their involvement and responsibility for the place and land.

1. The Moved Planning Process (MPP)

To develop a base for decisions within a planning group, it is necessary to get knowledge about the social and physical usage of space. Therefore, planners create a process of encounter among participants to start an exchange of information. In this process, information has to be emotionally and cognitively perceived and accepted by the group of participants; it has to be integrated to arrive at decisions on future plans. The MPP is structured in several meetings to find decisions on organising physical space.

One important term for the MPP is the shared constructed reality (Rottenbacher, 2006) between the participants. Our civilisation is based on the construction of meanings, which appear in the daily acts and ideas of people. These constructions document the personal processes of perception, appropriation, identification and integration. If participants are walking together, they experience their behaviour and actions on site more and pay more attention to the exchanged expressions (nonverbal behaviour) than to the expressed constructions (verbs) of the others. Therefore this can contribute to the emergence of a shared constructed reality and enlargen the previous presets (constructions) of the participants.

Shared reality emerges out of interaction and communication. To start the communication and interaction, each meeting begins by walking together through the physical space the participants own, maintain or use. Afterwards the group sits together and reflect on the experienced topics and make their first decisions about maintenance before the next meeting. This is called a moved planning process.

2. Phases of One MPP Meeting

Each meeting during the MPP is structured into a phase of walking and a subsequent phase of sitting together to reflect. The arrangement enables a process of contact within the group. Following is the phase structure of a meeting of the group.

- Welcome: Each meeting starts with a welcome, where the aim is explained as is the structure of the meeting. Participants are asked to show and explain their daily environment. Then we start and walk through the space to be planned.
- Arrival: The participants arrive mentally in the situation, at the location and meet the other participants. Then they experience movement and space. They get familiar with the situation, find their style of interaction and take over their roles as experts of their daily life and show their meanings and usages of space.
- Attending: While walking, we identify the important topics and speak about them. We participate in a process and integrate new experiences and information.
- Common decisions: While walking, we see what has to be done. At the end of the meeting we sit together and reflect on the experiences, collect ideas, recognise the needed activities and decide on the next steps we have to do before the next meeting.
- Sharing of responsibilities: Everybody is assigned a task to complete before the next meeting. The previous experience of a joint

activity creates the motivation to contribute to the participative process. The participants immediately experience the outcome of their first decisions and actions.

THE CONTACT PROCESS

These phases of the single meetings can be related to the contact process described in the 'Gestalt theory' (Dreitzel, 1992; Kepner, 1999). Within the contact process of a human with a place, or of humans with each other at a place, we need to pay attention to this process as it represents experiencing, learning, integrating, communicating and more. How do the expressions of meaning and a mutual understanding happen? These communication structures have to be enabled holistically: to get and give non-verbal and verbal information (Rottenbacher, 2004a), as the main negotiation happens first on non-verbal levels (Argyle, 2002).

The MPP was used in different contexts for public participation for about 20 years. Then it was possible to conduct scientific investigations within an interdisciplinarily built framework to analyse the effects of walking through the places and organising this emotional-cognitive communication. Within a field-experimental setup, the expressions of stakeholders (of single persons, subgroups and the whole group) were documented with videos. A subsequent video analysis by three independent analysing groups (planners, psychologists, ethnologists) related non-verbal (emotional) to verbal expressions. The results brought insights into how the concept of a contact process gives a useful framework for structuring the negotiation:

- in contact with nature and place, our senses give us information about our inner and outside world at that special place;
- our emotions 'tell' us how we want to act towards the situation, as an orientation;
- our mind organises the next action (Dreitzel, 1992).

The theory of contact (Gestalt therapy) specifies how we contact our environment, and change as well as are changed during this process (Köhler & Pratt, 1971). The contact process starts with an awareness of a situation. According to familiar or interesting contacts, a person 'turns' towards the most currently relevant information. This awareness is an ability to react selectively with emotional and cognitive resources to inside and outside impulses.

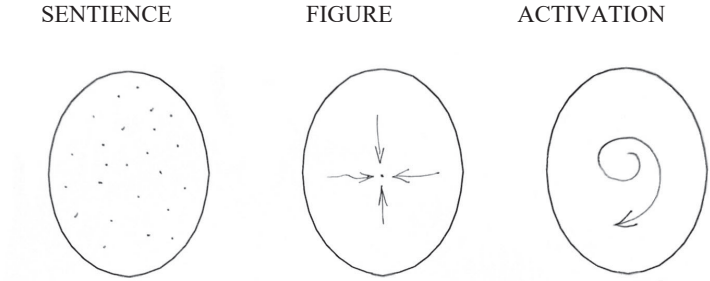

Figure 1. Start of Contact Process, according to Kepner (1999).

The first drawing of Figure 1, "Start of the Contact Process" about sentience, shows a balanced phase. Feelings and thoughts pass, and no feeling is dominant. The second drawing sketches how one figure (Gestalt) emerges, which is focused on one interest, and leads, as shown in the third drawing, to an activation of awareness. Organism and environment touch and melt into each other at that moment.

The activation is observable (for example in a video analysis; see Rottenbacher, 2004a); this mobilises a sharpening of perception and interpretation. The emotional-cognitive system develops an action.

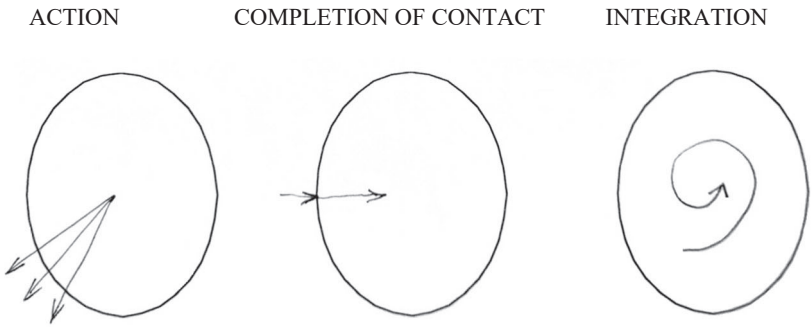

Figure 2. Completion of Contact, according to Kepner (1999).

The activation leads to a movement, an action. The movement is observable as small or big changes in eye gazes, postures, or moving the head or the whole body. Upon the completion of contact, we open ourselves to integrate ('digest') new information. The last drawing of the

second figure reminds us of the process of integration and the appreciation of the contact – stakeholders are touched and appreciate the shared experiences; this effect also contributes to the motivation to participate in the negotiation process about the using and maintenance of place. It is very important to give place to this phase of integration and appreciation for the success of the public participation process.

The group of participants walk literally through a constant process of self-development, perception, acceptance, and annexation. The shared attachment is constantly reviewed and confirmed again.

Within the MPP, the group experiences changes in the human- environment interactions as the effects of their actions:

- they gain new emotional and cognitive experiences;
- they express their knowledge about their world in movement, which can be seen and be understood more easily;
- they experience and reflect the world by moving and negotiating.

In walking, the change of the environment is already integrated in the act of the moved perception. Therefore, negotiations and actions are initiated and supported by walking in the planning process.

Through movement, all persons meeting in this situation simultaneously perceive, decode, and make decisions about maintaining place. Recognising the shared place attachment happens in parallel with a growing group identity that enables an ongoing shared knowledge construction about place.

EXPRESSION OF CULTURAL ECOSYSTEM SERVICES

Ecosystem services are ecological processes or functions that provide benefits to human society.

Cultural ecosystem services are regarded as the "environmental settings, locations or situations that give rise to changes in the physical or mental states of people, and whose character are fundamentally dependent on living processes" (Haines-Young & Potschin, 2013). Over millennia, these environmental settings have been co-produced by the constant interactions between humans and nature (Haines-Young & Potschin, 2013). Although the general concept of ecosystem services is often associated with a broadly instrumental view of ecosystem-human relations, the idea of cultural ecosystem services is designed to recognise that ecosystems are full of cultural value and require a holistic understanding of the contributions ecosystems make to human well-being. In relation to negotiation and

decision-making within a community, I use the concept of cultural ecosystem services more to raise awareness about the effects of natural processes; for example, in the context of urban planning, we value the effects of urban green infrastructure.

Figure 3 represents a map of a small town where we assessed place values and natural processes in neighbourhood groups.

In principle, the cultural ecosystem services concept provides a method in which the cultural dimension of ecosystem contributions to human well-being can be utilised in decision-making through standardised comparisons with other ecosystem services:

- to assess local knowledge and place-based values in conjunction with biophysical parameters;
- to understand humans, with their cultural diversity, as an integral ecosystem component – services are indispensable to the quality of everyday life.

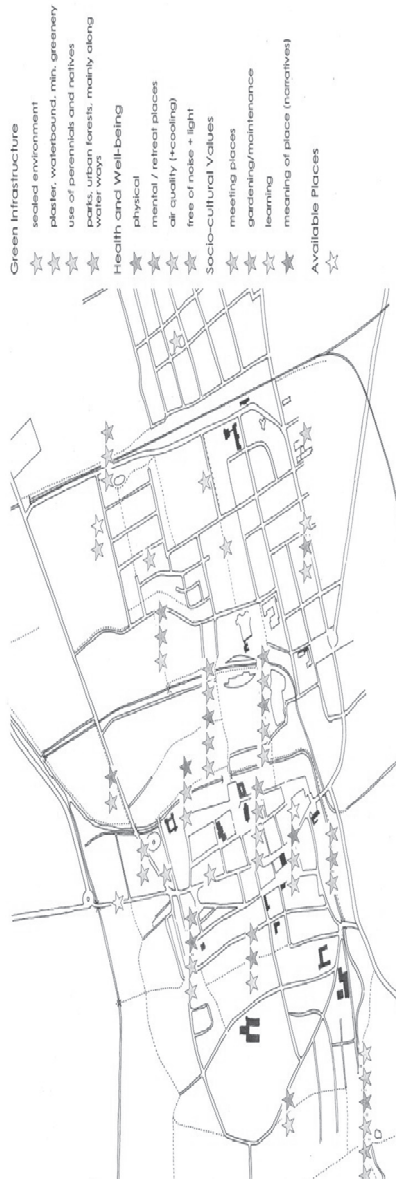

Figure. 3 Attaining values to place and natural processes in public participation

FINAL REMARKS

The objective of participative planning processes is to develop a common goal in organising physical space. The transition from personal meanings to a shared attachment of place can be supported by consciously working with set-ups, like an organised walking contact process, to express emotions, meanings and attachment to a place while negotiating cultural ecosystem services. The community-nature relationship is experienced and expressed in walking, movement, and the naming of shared values and actions:

- walking supports the expression of individual and collective impressions, which promotes human communication;
- expressing what occupies me during the walk allows me control of my social reality and helps to distinguish emotions, imaginations and agreed facts;
- expressing during walking raises the capability of personal expressiveness and with it the possibility to be understood;
- walking together over the sites to be used, monitored and maintained renews human-nature relationships.

In a participatory planning situation, individuals meet more than once. They can recognise previous interactions and remember outcomes of earlier negotiations and actions. The back and forth between self-interests and group interests determines the dynamic of the meetings. Within repeated contacts with places, the relationships of the humans within the social context are strengthened, corrected and extended. These relationships grow to a shared reality, a construction of the past as ‘what happened here?’, a construction of social traditions, and a construction of personal and social identities. We progress from personal values and attitudes to a shared attachment to place. This ultimately touches upon the feeling of identity of the people affected.

They are able to recognise in which relationship their attachment to nature and place stands with the attitudes of society at large, which are manifest in the use of place and in the use of land. Their single needs and interests can be transformed into a more comprehensive understanding, and shared ‘particularities’ in the human-nature relationship can be developed.

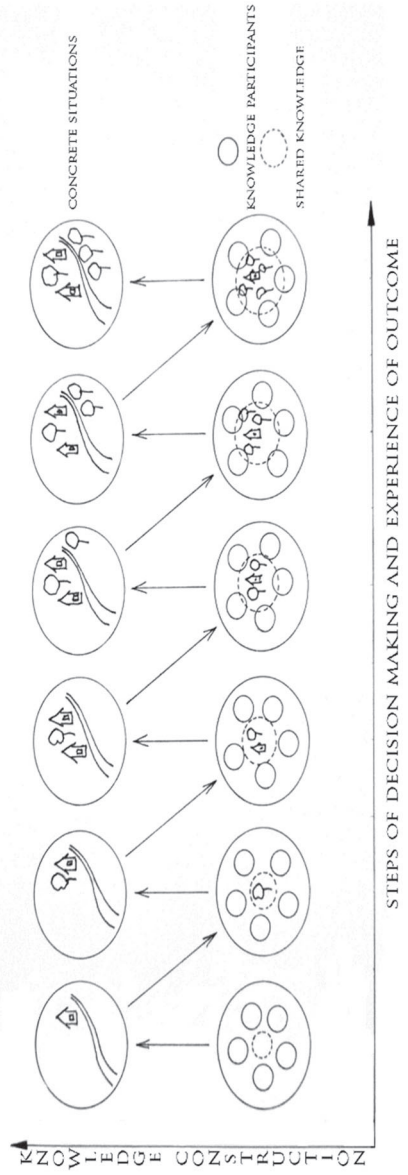

Figure 4. Shared knowledge construction and growing of identity

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PART 5

SCIENCE AND NATURAL HISTORY

CHAPTER SEVENTEEN

SILENT PASSENGERS – ON THE LONG-DISTANCE TRANSPORTATION OF PLANTS ACROSS OCEANS IN THE ERA OF NAVIGATIONS

MANUEL MIRANDA FERNANDES

INTRODUCTION

Exotic plants are present everywhere we look. Whether in gardens, parks, fields, forests or uncultivated land, plants of exotic origin have become a key feature of 'globalised landscapes' (Ricciardi, 2007). Human perceptions towards these plants range widely from curiosity and ornamental appreciation to scientific interest, and from usefulness as sources of food and raw materials to a sense of threat arising from invasive processes (Mack, 2001). However, many of these plants are not newcomers: their presence is a result of 'piloted migrations' over the past six centuries (Sloterdijk, 2008, 107), if we only consider the era of European navigations. Seaborne transportation between distant locations, such as the New World, East Asia or Australia, required the development of specific logistics enabling seeds, rhizomes, tubers, bulbs, saplings and cuttings to reach their destinations alive. The way these 'silent passengers' – a term used here to evoke Dupré & Lüthy's *Silent messengers* (2011) – endured shipboard conditions for long periods of time was certainly dependent upon practical experience gained through trial and error. Recent research has focused on the conditions required for specimen transportation from America to Spain (Figueroa, 2012; Pablo Núñez, 2015), on transportation and cultivation by the French and British in the Early Atlantic (Allain, 2000; Laird & Bridgman, 2014; Parsons & Murphy, 2012; Romieux, 2004), and on the evolution of plant containers (Keogh, 2017; Klemun, 2012; Nelson, 2018). The broader context of plant transfers, in historical and cultural terms, is addressed by a wealth of

literature, a significant part of which is summarized by Beinart & Middleton (2004).

Nevertheless, most of the published research on the logistics of plant transfers is focused on the context of the 17th century onwards, emphasizing natural history expeditions that looked for natural objects of scientific interest. Correspondingly, previous efforts to transport plants by sea are generally overlooked, despite relevant information found in maritime travel accounts and other sources.

The aim of this chapter is to review a selection of examples of transoceanic plant transfers by way of human mediation from the 15th to the 18th centuries, highlighting the practical organization and other conditions required for success. Considering the silence of the plants transported aboard ships, we constructed an approach to this topic involving textual and iconographic research.

We share the view that it is not possible to fully understand the current processes of landscape transformation at a global scale without considering the conditions of the introduction and diffusion of exotic plants over the long term. To a certain degree, this might also be applied to the conditions under which plants were transported aboard ships and to the underlying practical knowledge that allowed these transfers. All these aspects are crucial in reshaping the plant world, and their consideration might open new perspectives to meet the challenges of living together in a globalized world.

EARLY ATLANTIC EXCHANGES

The maritime explorations of the Atlantic by Italians, Portuguese and Spanish during the 15th century led to a social and ecological experiment, more specifically in inhabited islands such as Madeira and Porto Santo where the first settlers arrived in c.1420, “fully equipped with all seeds and plants, as one who hoped to settle in that land” (Barros, 1628, 7r, author's translation). Among the plants that were introduced, wheat (*Triticum* spp.) prevailed, being used to test the agrarian aptitude of the newly discovered islands that would allow for settlement (Godinho, 1987). Wheat bread, along with wine, also played a fundamental religious role in Christian rituals, central to the life of the settlers’ community (Margarido & Henriques, 1989). Not surprisingly, both the cultivation of wheat and the vine (*Vitis vinifera*) were developed in Madeira and Porto Santo around 1455, when Alvise da Cadamosto, the young Venetian merchant and traveler, arrived there (Peres, 1988). Cadamosto explicitly refers to the cultivation of *malvasia de Candia*, a vine variety probably introduced

from Crete (APH, 1988, 93), which implies the ability to transport vine cuttings from the Eastern Mediterranean, overcoming contrasting difficulties from the seaborne transportation of cereal seeds. Sugar cane (*Saccharum officinarum*) was also introduced into Madeira, possibly from Sicily, along with practitioners in its cultivation (Barros, 1628, 30v); it acclimatized perfectly in the temperate climate of the island (APH, 1988, 93), which made Madeira a 'launching center' of the sugar culture for other Atlantic islands, such as the Azores, Cape Verde and São Tomé, and later also for Brazil (Magalhães, 2009). The Atlantic 'pilgrimage' of sugar cane during the 15th century shows that, as with vines, it was already possible to organize its transportation by sea in order for it to be introduced successfully into new geographical areas, albeit dependent upon the utilization of slave labor.

In the opposite direction, one of the first endemic plants from the Atlantic islands introduced in Europe was the dragon tree (*Dracaena draco*), cultivated in Lisbon monasteries in 1494, according to the German physician and humanist Hieronymus Münzer (Vasconcelos, 1930). It is not clear, however, how this medicinal plant, highly praised for its red resin – the dragon's blood – could have been transported aboard, whether as seed, sapling, or both.

This early exchange and plant cultivation was accompanied by a drastic transformation of the islands of Madeira and Porto Santo through fire, timber exploitation and the introduction of herbivores such as rabbits (APH, 1988, 93; Barros, 1628, 7r-8v). In order to grow the newly imported crops, the insular ecosystems were forced to renounce their pristine forest cover, becoming units of settlement and production (Margarido & Henriques, 1989). The introduced plants, as agents of ecological change, promoted the substitution of one nature for another, a process common to other Atlantic islands during the 15th and 16th centuries, condensing over a period of a few decades a process that had evolved in mainland Europe over millennia.

ACROSS THE OCEANS: BETWEEN THE NEW WORLD AND INDIA

The European maritime contacts with the New World (1492-93) and India (1497-99) that led to the establishment of the first network of sea routes circuiting the globe imposed new challenges for the transportation of living plants: sailing to the Antilles or Brazil from an Iberian port could take about two months and a one-way navigation to India via the Cape route more than six months (Benassar, 1984). However, wheat, vines and

sugar cane were readily introduced in Hispaniola during the first voyages of Columbus, as well as fig trees (*Ficus carica*), pomegranates (*Punica granatum*), melons (*Cucumis melo*) and citrus trees (*Citrus limon*), among other crop plants (Colmeiro, 1892). During the 16th century, some crops introduced in Brazil from Old World locations used the Atlantic islands as stopovers, e.g. Cape Verde for rice (*Oryza sativa*) and São Tome for bananas (*Musa* spp.) (Gândavo, 1576). Also significant are seeds of vegetables and condiment plants sent from Portugal to Bahia (Brazil), where some 30 species were cultivated around 1587 (Varnhagen, 1851). As in other colonial territories, these crops played a role in controlling local society and contributed towards the reorganization of the native landscape (Dean, 1991).

The early transfer of New World plants into Europe and its diffusion is well documented in 16th-century herbals and in the catalogues of the first botanical gardens. Nevertheless, the earliest known images of maize (*Zea mays*), pumpkins, and squash (*Cucurbita maxima* and *C. pepo*) from the New World are artistic depictions painted around 1515-17 by Giovanni da Udine in the Villa Farnesina (Rome), providing evidence of the rapid transfer of these crops (Janick, 2012). Plants like the globe amaranth ("amarantus purpureus", possibly *Gomphrena globosa*), chili peppers ("siliquastrum", *Capsicum annuum*) and maize ("turcicum frumentum", *Zea mays*) were described and illustrated *de visu* by the German physician and botanist Leonhart Fuchs and his collaborators (Fuchs, 1542); the prickly pear ("opuntia", *Opuntia ficus-indica*) was reported in the European context by Pietro Andrea Mattioli (1558) from plants that were already circulating in Italy and elsewhere in Europe. In Portugal and Spain, plants introduced from the New World were recorded by the Flemish naturalist Carolus Clusius during his journey to Iberia (1564-65), namely avocado ("persea", *Persea americana*), agave ("aloë americana", *Agave americana*), sweet potato ("batatas", *Ipomoea batatas*) and Indian shot ("canna indica", *Canna indica*) (Clusius, 1576). A tangible example of the logistics of seaborne transfer is provided by the Sevillian physician Nicolas Monardes, who describes how jalapa ("mechoacan", possibly *Ipomoea jalapa*), a Mexican medicinal herb, was carefully brought onto a ship inside a barrel, arriving alive in Seville (Monardes, 1565). A similar example, regarding the transfer of the purging cassia ("cañafistola", possibly *Cassia grandis*) inside barrels from Hispaniola to Spain, had been mentioned by Oviedo y Valdés (1535). Of the American plants introduced early on in Europe, maize greatly contributed towards changing the cultural landscape, as it also did in Africa (Ferrão *et al.*, 2008; Henriques, 1989), and easy travelers like chili peppers have been widely diffused,

becoming one of the world's most consumed spices (Halikowski Smith, 2015).

In the Indian Ocean region, where the spices that propelled early Iberian navigations originated, we also find significant examples of plant exchange, namely ginger (*Zingiber officinale*). It was first introduced into Brazil during the 16th century, possibly via São Tomé, and was also introduced into Hispaniola (De Vos, 2006; Varnhagen, 1851); its rhizomes were usually covered with clay for seaborne transfer, as described by the Portuguese physician and botanist Garcia da Orta in his *Colóquios* (Orta, 1563, 116). Arriving from America, one of the first plants cultivated in India was possibly the pineapple (*Ananas comosus*), a 'pilgrim fruit' recorded by Cristóbal Acosta (1578, 350); together with the cashew tree (*Anacardium occidentale*), both were soon integrated into the Indian cultural landscape, as represented in 1596 by the Flemish traveler Jan Huygen van Linschoten (Pos & Loureiro, 1997). Other American plants such as the guava tree (*Psidium guajava*), papaya (*Carica papaya*) and amaranth (*Amaranthus tricolor*) were depicted in c.1610 by Manuel Godinho de Erédia, showing evidence of its transfer to Asia (Everaert *et al.*, 2001). A late attempt to transfer a single plant by sea is provided by the Jesuit priest António Gomes, regarding a specimen of mango tree (*Mangifera indica*) transported in 1647 from Goa to Mozambique; placed aboard the ship's castle, it showed good signs of vitality during the journey, but would not reach its destination due to shipwreck (Axelson, 1959).

THE LOGISTICS OF PLANT TRANSFERS IN THE AGE OF ENLIGHTENMENT

A new stage in the logistics of long-distance plant transfers emerged from the late 16th to the 17th century, when the Dutch and British powers arrived in the Indian Ocean. As a consequence, Portuguese commercial interests shifted to the Atlantic area, followed by proposals for transferring spice cultivation from India to Brazil (Macedo, 1817). After 1680, pepper (*Piper nigrum*) and cinnamon (*Cinnammomum verum*, syn. *C. zeylanicum*) plants were repeatedly sent from Goa to Brazil, together with handwritten instructions on how to care for plants on board and how to grow them; also sent were ginger, jackfruit (*Artocarpus heterophyllus*), mango trees, saffron (*Crocus sativus*) and Arabian jasmine (*Jasminum sambac*). To reduce failure, seeds were transported in glass jars, young trees were transplanted with their own soil, containers were firmly attached to the

ship and a sufficient supply of irrigation water was guaranteed (Almeida, 1975).

The first printed pamphlets on the survey and long-distance transfer of useful exotic plants are probably those of Boyle (1665), Sprat (1667) and Woodward (1696), contributing to the emergence of a new topic in Natural History literature. Detailed instructions would later be published in a notice by Duhamel du Monceau and La Galissonnière (1752); this notice had a second enlarged edition the following year and a reprint in Turgot's *Mémoire instructif* (1758). Engravings of boxes and wired cases for seaborne plant transportation, namely breadfruit (*Artocarpus altilis*) and mangosteen (*Garcinia mangostana*), had been printed in two of John Ellis' pamphlets (1770; 1775) (Figure 1); these containers may have been commissioned from John Burnham, a carpenter in the Holborn district of London. Of these engravings, one was reproduced in Gómez Ortega's *Instrucción* (1779) and others included in the third edition of *The Naturalist's and Traveler's Companion* (Lettsom, 1799, 1st ed. 1772). This pamphlet had been translated into French (Lettsom, 1775) and was also quoted by the Portuguese Jesuit and botanist João de Loureiro in an account of the long-distance transfer of spices (Loureiro, 1789). The final purpose of these diverse though interconnected pamphlets was, of course, to help plants of economic and scientific interest to be successfully transferred from their native homelands to botanical gardens and plant nurseries, surpassing the hazards of sea voyages.

In the late 18th century, official expeditions regarding seaborne transfers such as clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans*) from Moluccas to Mauritius (Brixius, 2015), or breadfruit from Tahiti to Jamaica (Smith, 2006), showed an unprecedented degree of organization, probably facilitated by printed instructions, but most certainly embodying practical knowledge acquired through previous experience. In such missions, ships could be specially adapted for plant transportation, as exemplified by the French gardener Hyppolite Nectoux, regarding the delivery of plants from the East Indies to America (Nectoux & Thouin, 1791) (Figure 2). Logistical developments allowed the transfer of plants over ever greater distances, the maritime exchange between Europe and Australia, also known as 'antipodean exchange', being an outstanding example (Frost, 2010).

This era would come to an end during the early 19th century due to progress in maritime navigations and the introduction of the Wardian case, an improved container for seaborne plant transfers (Ward, 1842). A new era in plant exchanges was about to begin, enhancing transfer rates and propelling horticulture as never before.

Figure 1. Wired case for seaborne transportation of breadfruit, mangosteen or other useful plants. From Ellis (1775). Wellcome Collection. CC BY.

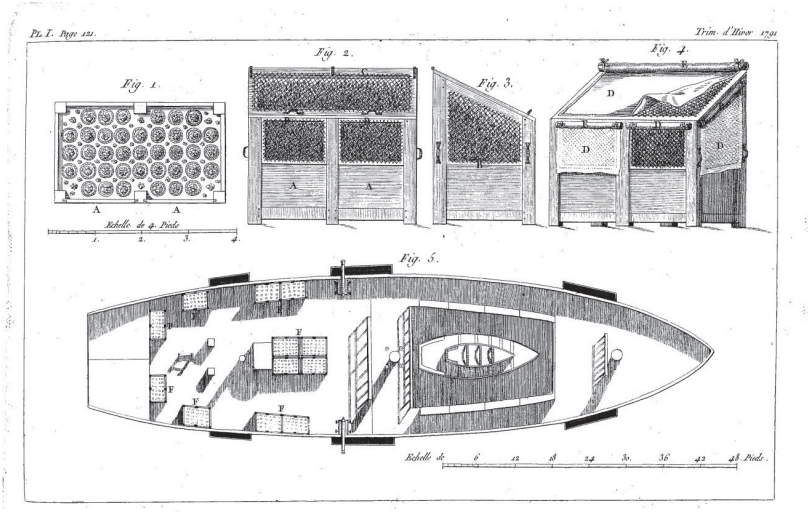

Figure 2. Containers for the sea transport of plants and their arrangement on the deck of a ship. From Nectoux & Thouin (1791). Gallica / Bibliothèque Nationale de France.

FINAL REMARKS

Exotic plant propagules are silent passengers aboard ships, but their introduction into distant locations, when successful, may have far-reaching effects on cultural landscapes. In early navigations, transported plants would ensure food supplies and help organize daily life in previously unknown lands, but plant transfers readily became a matter of imperial concern, within a context of rivalry between nations. Nevertheless, plants easily cross political boundaries, as does ethnobotanical knowledge. During the European era of navigations, the transfer of a huge amount of exotic plants from distant continents relied on specific transportation logistics, assisted by a network of botanical gardens and colonial nurseries that enabled exchanges between more and more distant regions. Reshaping the plant world with human help has transformed landscapes, e.g. the Mediterranean region (Gade, 1987; Sermet, 1973), where exotic plants like the prickly pear or Australian acacias and eucalyptus became ‘characteristic’. On a wider scale, the diffusion of cash crops like sugar, coffee, tea or bananas are emblematic of this process, its results being on display on the shelves of any nearby supermarket.

Many aspects of plant transportation logistics require further research, bringing together perspectives from different disciplines. Special consideration

must be paid to the early stages of seaborne plant transfers, before printed instructions appeared. An effort to better understand human-mediated plant transfers may help current perceptions to embody an environmental history background, particularly in the case of those exotic plants that became weedy or invasive. Instead of blaming them, would it not be wiser to fully recognize the human role in their transfers? It is likely that such a point of view might lead to more inclusive policies and better practices in landscape management.

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CHAPTER EIGHTEEN

FROM FIELDWORK TO BOOKS: THE GATHERING OF INFORMATION BY PORTUGUESE IMPERIAL AGENTS AND ITS CIRCULATION IN EARLY MODERN BOTANICAL TREATISES

TERESA NOBRE DE CARVALHO

INTRODUCTION

Following Vasco da Gama's arrival in Calicut, Portuguese officials were tasked with identifying the main markets, products, routes, ports and cities of the East. Able technicians and practical men, they surveyed the local peoples and recorded their observations in detailed reports. Politicians, prelates, physicians and merchants trusted the accuracy of these classified findings. The reports of navigators, factors, overseers and apothecaries often proved to be decisive in strategic decision-making and in the reformulation of knowledge relating to drugs, spices and other Asian products. This essay, by highlighting the relevance of the work carried out by these informants, focuses on some of the records which, at the time, contributed to the most comprehensive knowledge of Asian natural resources.

EARLY DATA RECORDS

The records from what is today known as the *Roteiro da primeira viagem de Vasco da Gama* are a copy of the report attributed to Álvaro Velho. His account describes a long ocean crossing which connected cities across the world never before united by a single sea voyage. In his journal, the writer sought to establish points of contact between the world he knew and the one that was being revealed to him (Figure 1).

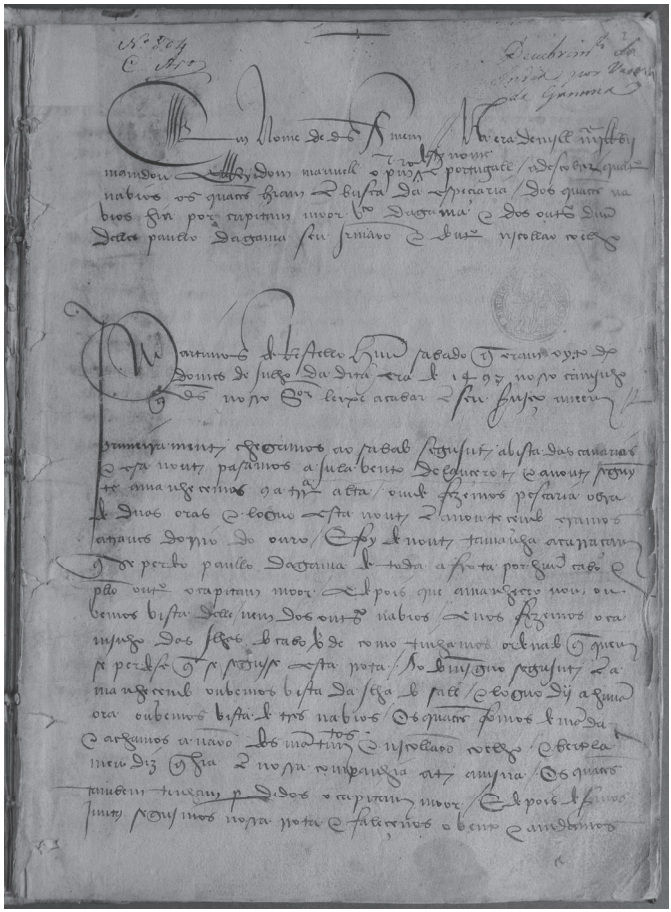

Figure 1: Journal of Vasco da Gama. At the end of the *Roteiro da primeira viagem de Vasco da Gama à Índia* (c.1500-1550), the author included a detailed geo-commercial appendix (Biblioteca Pública Municipal do Porto, ms 804).

At the end of the manuscript, the author included a geo-commercial appendix. The information collated in this document located, with the greatest accuracy the age permitted, the provenance of diverse spices and drugs, gums and resins, stones, fabrics and Eastern dyes. Even without knowing the coordinates which would allow one to pinpoint the location of the ports and islands referenced, the informant recorded a vast amount of data. With this report, the *Corte de Lisboa* learnt the geographical

origin of a wide variety of Asian products. Little by little, references to new ports, cities, kingdoms and islands of the East were added to European maps.

Apart from being of interest to monarchs, prelates, scholars and investors, this information was also valuable to navigators, merchants and cartographers, who welcomed with manifest interest the data recorded during each voyage. Upon disembarking in Lisbon, recently arrived navigators and voyagers were questioned about the details of their ocean crossings. Their observations were recorded and entrusted to the officials of the *Casa da Guiné e da Índia*. As a result, information allowing capes, bays, coves, freshwater stopping points and islands to be located, and records about winds, currents and tides, were noted down in logbooks and on maps which, away from prying eyes, were constantly updated.

From 1492 onwards, a vast amount of data about the New World arrived in Seville where a similar institution was established in 1503, the *Casa de Contratación.* There, the information was duly analyzed by Spanish physicians, cosmographers and pilots. In addition to regulating overseas trade, the officials of the *Casa de Contratación* were tasked with training pilots, drawing maps and charts and collecting information about the New World from amongst pilots, soldiers and travellers.

The Cantino Planisphere (1502) is one of the age's most noteworthy Portuguese maps known today. This chart was commissioned by Alberto Cantino, an agent of the Duke of Ferrara sent to Lisbon at the beginning of the 16th century. Produced by an anonymous cartographer of the *Casa da Guiné e da Índia*, it was based on the *Padrão Real* and contained sensitive information about the latest Portuguese maritime advances. Along with territorial records, the chart contained, in its meticulous captions, information about Asian products. In these brief inscriptions that the cartographer positioned next to islands, cities and ports of the East, information about the provenance or trade of spices, drugs and luxury goods was included. This planisphere abandoned some of the conventions promulgated by Ptolemy's *Geography* and attested to the immense value that Asian natural resources held in the eyes of Europeans.

This information was kept far from covetous eyes and the regulations established by Dom Manuel I (r.1489-1521) included severe punishments for those who shared it inappropriately. The importance that the king attributed to the collection of data about the East is widely attested to in contemporary documents. In the letter that scribe Álvaro Vaz sent to the monarch in 1504, we read:

> Your Lordship has asked that I very briefly describe all the islands and places which lie in this sea of India and along the coast between here and

> Malacca, as well as the goods to be found, and which of ours are best for there, and the prices of both. (Andrade, 1972, 1, 344)[1]

Despite the interest of the monarch in learning of the riches of Malacca and the apparent desire of the scribe to fulfil this request, the truth is that, in this text, Álvaro Vaz provided no news about the local peoples or their values. It is likely that this information was sent in a separate, now lost, report. Years later, in 1506, Dom Manuel ordered two surveys to be conducted, firstly by Viceroy D. Francisco de Almeida (Viceroy 1505-1509) and then by his successor, Diogo Lopes de Sequeira (Governor 1518-1522), with which he hoped to learn about Malacca. In these we read:

> …work to learn about the things of those parts [of Malacca], to learn: of its riches and rewards and of the size of the land and by whom it is governed… (Andrade, 1972, 2, 559)[2]

The king was certain what type of information he intended his emissaries to collect. The reports sent to Lisbon therefore reflected this interest in identifying strategic geographical locations which would allow the movement of luxury goods to be controlled[3].

In addition to reports, descriptions and samples of goods, other items were sent to the king by his agents posted to the East. Jorge de Albuquerque, who served as Captain of Malacca in 1514, sent a letter to the monarch the following year. Along with news of inestimable strategic value, it also contained a branch with leaves and floral buds from the clove tree (*Syzygum aromaticum* (L.) Merrill & Perry).

Probably aware that he lacked the competence and authority to depict the plant, Albuquerque instead opted to send the branch itself. By foregoing sketches and textual descriptions, he allowed the court physicians to contrast the morphological details of the sample with the features described in circulating botanical texts. In addition, possessing this branch at such an early date suggests royal dominion over the route and trade of goods originating from the highly-coveted Spice Islands. The appropriation of both the physical space and the nature of the East were inseparable features in the imperial narrative (Carvalho, 2017).

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[1] Author's Responsibility Translation.

[2] Author's Responsibility Translation.

[3] An analysis of contemporary documentation suggests that the same instructions were given to all voyagers, whether they were travelling to the Atlantic islands, Brazil, the African coast or India.

Until the early 16th century, most Europeans only knew about the plants, drugs and spices of the East through traded goods, the medical-botanical texts in circulation or the testimony of voyagers and merchants. With the return of Gama's fleet and the establishment of regular journeys between Lisbon and the East, it became commonplace to see many Asian goods and vegetable species unloaded at Lisbon's Ribeira dock. This allowed doctors (both residents and those passing through the kingdom's capital) to observe these tropical specimens in more detail. It is likely that Portuguese scholars would have gone to the port to question the voyagers and ask those aboard ships to bring plants, branches, fruits and seeds from India. In this way, Lisbon gardeners could see whether these plants, far from their regions of origin, could acclimatise to life in the royal gardens. By observing the plants grown there, the doctors could not only challenge, correct or confirm the botanical knowledge in circulation, but also, if they so wished, test the properties of new products recorded by the physicians and apothecaries in Goa. Similarly, in Spain, during the 16th century, new gardens were created in Seville, Aranjuez, Escorial and Madrid to cultivate American plants and to test the medical properties recorded by travellers (Goodman, 1988; Lopez-Piñero, 2002).

The setting up of hospitals in the cities and fortresses of the East and the establishment of mixed medical teams, composed of European and Asian physicians and surgeons, enabled the Portuguese doctors based in Goa to adopt practices and medicines successfully used by local practitioners. This openness to new ideas based on "reason and experience" facilitated the emergence of a *hybrid* medicine in Asia (Grove, 1991, 160-176; Pearson, 2001, 100-113; Varajadaran, 2007; Carvalho, 2015, 190; Walker, 2016, 161-192). It was not, however, seen as necessary or desirable by most Lisbon-based specialists. This fact dismayed the apothecaries of the East, who looked on with consternation at the reluctance of the *Boticário-mor* and *Físico-mor* (Chief apothecary and Chief physician) to order, in the *Cartas Gerais* sent annually by the *Casa da Índia*, medicinal drugs used by the locals. An exception to this was, for instance, the use of guaiacum, the efficacy of which is described in N. Poli's *De cura morbi gallici* (1517), L. Schmauss' *De morbo gallico tractatus* (1518) and Ulrich van Hutten's *De guaiaci medicina et morbo galico liber* (1519); its virtues were praised by Oviedo in *Sumário* (1526) and its effectiveness by Monardes in *Historia Medicinal* (1569). The use of guaiacum in the treatment of syphilis in the infirmaries of the Hospital de Todos-os-Santos in Lisbon is documented from an early stage. From the 1530s onwards, at the suggestion of the Portuguese living in India, there was a growing use of *Smilax china* – a species used in the East by

local physicians with recognised success and which was highly praised by Amato Lusitano in *De Materia Medica* (1553) and Garcia de Orta in *Colóquios dos Simples* (1563).

LISTS OF DRUGS, LETTERS AND REPORTS

Every year the so-called *Rol de Drogas* (List of Drugs) was sent from Lisbon in the *Cartas Gerais da Índia*. Upon arriving in the East, the official responsible for preparing and packaging the order would immediately set about acquiring the products so that, when the ships were being readied to return to the kingdom, all the drugs being sent had been duly packed. In Cochin, the *Vedor da Fazenda* (Overseer of the Treasury) would supervise the loading of the drugs and ensure that the requests made by Lisbon physicians and apothecaries had been satisfied. The orders were normally prepared by the apothecaries (or possibly the physicians), with the quantities and prices recorded by the *vedores da fazenda* (Andrade, 1971).

The knowledge of many of these Portuguese officials very often resulted from vast on-the-ground experience. Visits to local markets and bazaars where drugs abounded, port inspections of goods, surveys conducted in the regions under their jurisdiction in order to better know the natural riches that surrounded them, and the regular inspections of hospital and fortress drug stores provided these officials with a practical understanding that proved to be of great importance for the appropriation of knowledge relating to the natural world. In a document dated to 1509, Afonso de Albuquerque (Governor 1509-1515) ordered Diogo Pereira, then Factor of Cochin, to hand over to Gaspar Pires, apothecary at the Hospital of Cochin, any drugs that he requested. In November of the same year, overseeing the delivery of the drugs requested by Albuquerque, the pharmacist sent a receipt to the administrator (Vasconcellos e Meneses, 1987). This document proves that factors and other administrative officials were tasked with listing and acquiring in local markets the drugs which supplied the fortress and hospital drug stores.

Other men of action included Duarte Barbosa (c.1480-1521) and Tomé Pires (c.1465-c.1540). Both spent long periods in the East serving the Portuguese administration. It is highly likely that the scribe at the factory of Cannanore (Barbosa) and the apothecary of Cochin and Malacca (Pires) based the reports they sent to Dom Manuel on their readings and observations and on the testimonies of local informants. Thanks to the efforts of these two authors, the kingdom was informed of the regional contours of the East, of its ports and markets, of the lives of its peoples, of

the eating habits of its societies and its wealth of natural resources. The texts of these royal officials unveiled a part of the world hitherto unknown to the West. More than a mere record of geographical, political and economic information, the reports contained references to an enormous variety of tropical fruits, the peculiarity of Asiatic plants, as well as extremely important descriptions of spices and aromas (Figure 2).

Through the reports and letters of royal officials, the Portuguese elites became increasingly aware of the geographical dispersal, distribution routes and therapeutic qualities of the natural resources of the East. Some of this information remained in handwritten form and therefore had a more restricted circulation. Reports, like those of Barbosa or Pires, due to their greater scope and informational value, reached a wider European readership through Ramusio's *Delle Navigationi et Viaggi* (1550).

It seems to have been in the 1540s, probably under the governorship of Martim Afonso de Sousa (Governor 1542-1545) or D. João de Castro (Governor 1545-1548) that overseers, factors and apothecaries based in the East were more systematically called upon to provide information about Asian natural resources. Some of these officials responded promptly to their leaders' requests and the data supplied was compiled in the *Elvas Codex,* a volume bringing together 25 texts. The subjects covered were of obvious strategic significance, ranging from lists of drugs, goods and products to the identification of routes and markets and descriptions of the provenance of certain drugs or spices[4]. The reports were recorded by apothecaries[5], overseers of the treasury and treasurers[6], chief navigators[7], factors[8] or secretaries to the Governor[9]. The information collected resembles that requested years later by the Spanish Crown from the

[4] The Codex can be found in the Biblioteca Municipal de Elvas (Cod 5/381).
[5] Simão Álvares, *Emformação* […] *do nacymento de todas las droguas que vão pera o Reyno* (Calado, 1960, 50-57).
[6] Rui Gonçalves de Caminha, *Emformação* […] *sobre os mantimentos, ferro e outras muytas cousas que vem a Guoa* (Calado, 1960, 42-67).
[7] Nicolau Gonçalves, *Estes são os nomes dos ryos que Cochym pera o Norte per onde vem ter a madeyra a Cochym e os nomes dos Senhores e Caymays e Reys* (Calado, 1960, 43-48).
[8] António Pessoa, *Emformação das cousas do Ceylão* (Calado, 1960, 36-38); Bastyão Lopes Lobato, *Enformação do enxofre que vem de dentro do estreyto de Ormuz* (Calado, 1960, 117-120) and *Enformação do rendimento da cidade e reino dUrmuz, dada per Bastyão Lopes Lobato, feitor que foy na dita terra* (Calado, 1960, 128-130).
[9] Coje Percolim, *Emformação dalgumas cousas da Persia* (Calado, 1960, 132-133).

administrators of the New World and which came in the form of the *Relaciones Geográficas*[10].

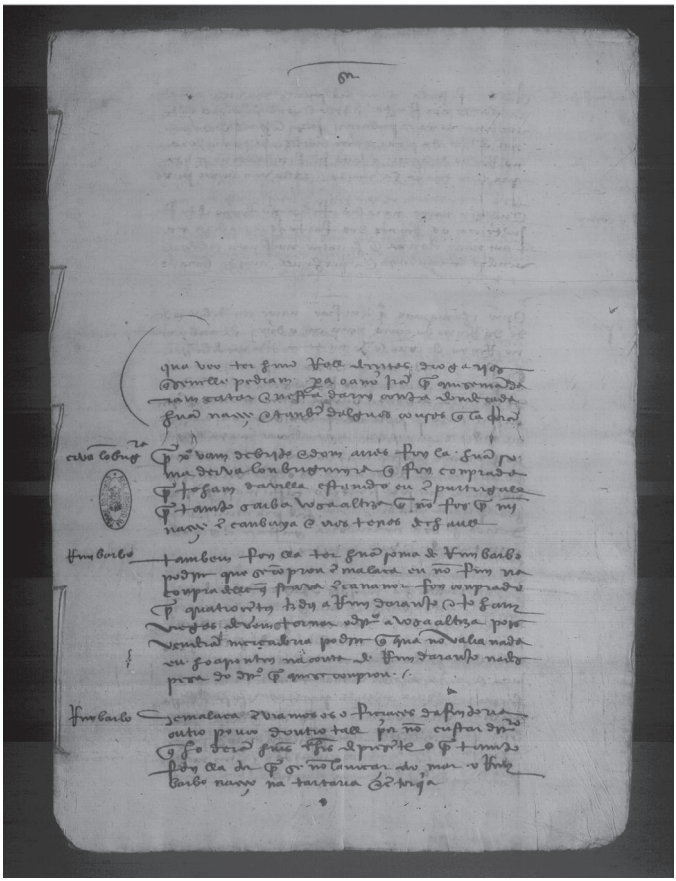

Figure 2. A letter for the king. In January 1516, Tomé Pires sent a detailed letter to Dom Manuel I. In this *Carta*, the apothecary identified the provenance, local uses and main markets of the Asian drugs and spices being sold (ANTT, *CC* – 1/19/102).

[10] On these surveys see: Álvarez-Pélaez, 1993; Bustamante, 2000; Mundy, 2000; Barrera, 2006 or Pardo-Tomas, 2016.

In addition to the information collected by specialists and administrative officials, the volume also includes information about Japan and China gathered by the priests Francis Xavier and Nicolau (Lanciloto)[11]. Years later, in the 1550s, more systematic information-gathering about mission lands in overseas territories would be carried out by religious officials. In the case of the Society of Jesus, in a missive sent from Rome on 24 February 1554 to Father Gaspar Barzeo, who was serving as Vice-Provincial of India, the Jesuits' interest in gathering information about the everyday life and natural world of the Indies is revealed[12].

> Some important persons of this city [Rome], read with great interest the letters from India and expressed their desire to read about the cosmography of those regions where ours live; for example, how long are the days in summer and winter days, when the summer begins, if the shadows fall to the left or to the right. Finally, they wish to know if there is anything else that seems to be extraordinary, as it may be about animals and plants not known in Europe or not with their size. (Udiás, 2015, 105)[13]

This letter, sent by the founder of the Society of Jesus, reveals the interest in collecting data relating to mission lands, the daily lives of the people and curiosities of the region. The subsequent publication of versions containing some of this information served to edify the readers, to awaken vocations and proved to be a more effective way of acquiring mission patronage, upon which the missionary work so heavily depended. In addition to the surveys conducted by Society of Jesus priests and brothers, members of other religious orders also assisted with the regional

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[11] *Emformação da ilha do Japão dada por Mestre francisquo que soube de pessoas muy autemtiquas; Mais emformação das cousas do Japão* (Calado, 1960, 88-112); *Emformação da Chyna mandada por hum homem a mestre francisquo* (Calado, 1960, 113.117); and *Mais emformação sobre o Japão a qual deu o Padre Niqulau* (Calado, 1960, 121-125).

[12] A similar letter was sent in the early 1550s to Father Manuel da Nóbrega S.J., the Provincial of Brazil.

[13] "*[…] Algunas personas principales, que en esta ciudad leen con mucha edificación suya las letras de las Indias, suelen desear, y lo piden diversas veces que se escribiese algo de la cosmografia de las regiones de onde andan los nuestros, como seria quán luengo son los días de verano y de invierno, cuando começa el verano, si las sombras van sinistras, ó à la mano diestra. Finalmente si otras cosas ay que parezcan extraordinarias, se dé aviso, como de animales y plantas no conocidas ó no in tal grandeza […]*" (*Documenta Indica*, 1954, III, 61-63).

use of local plants[14]. The existence of other documents, which remained unpublished for many decades, confirms the Portuguese rulers' interest in surveying natural resources and the commercial potential of each region. In these surveys and investigations, practical, religious or simply adventurous men became vehicles in an innovative discourse on the world they observed. In fact, several contemporary works on the Eastern natural world remained unpublished until the 19th or 20th centuries: António Galvão's *Tratado das ilhas Molucas* (c.1544), Gabriel Rebelo's *Informação das Cousas de Maluco* (1561) and Manuel Godinho de Erédia's *Suma das Árvores & Plantas da Índia Intra Ganges* (1612).

SEEDS, LEAVES AND FLOWERS: FROM FIELDS TO LIBRARIES

During the first half of the 16th century, whether through strategic choice or the absence of printing houses in Goa, it was difficult to record, in printed form, the new information relating to the natural world of the East. Beyond handwritten documents, only oral testimony could make up for the absence of new information on Asian drugs and spices. A printed book on this theme would contribute to a stabilisation of medical practices, to a firming up of knowledge relating to the markets and distribution routes of goods and to a more effective exploitation of natural resources. The publication of a volume on the medicinal products of India became, then, a priority for rulers, royal officials, investors and technicians. Added to this was the intensifying pressure that the European scholarly community was applying on Portuguese doctors to consolidate their knowledge of the natural resources of the East. For European scholars like Pier Andrea Mattioli (1501-1577), it was up to Portuguese physicians to validate or challenge the knowledge regarding Eastern drugs and spices established by Pliny, Dioscorides, Galen, Avicenna, or Razi.

In 1563, Garcia de Orta (c.1500-1568) filled this gap. With comprehensive clinical experience in the East and a profound understanding of the scholarly texts, this Portuguese physician took advantage of the information given to him by informants or that he came across in the numerous reports and letters that he consulted. These documents were the result of the surveys conducted by practical men who, over more than half a century, travelled through Asia in search of samples and information on

[14] The moral interpretation of the natural world was a concern of all religious orders. More than just an aspect of appropriation, recording nature was part of an attempt to interpret the work of the Creator. The complexity of this fascinating subject places it beyond the scope of this analysis.

the origins and properties of Eastern goods. The decision of the doctor to make use of the information supplied by these agents is one of the innovative aspects of the volume that he published: *Colóquios dos Simples e Drogas e Coisas Medicinas da Índia* (Goa, 1563) (Loureiro, 2012; Carvalho, 2013; Carvalho, 2015).

Carolus Clusius (1526-1609) reworked Orta's book. From the publication of *Aromatum et Simplicium* (Antwerp, 1567) to *Exoticorum libri decem* (Leiden, 1605), the botanist published several Latin versions in which he gradually perfected and refined the accuracy of the textual and pictorial descriptions. Following the methodology of appropriating knowledge on the tropical natural world as first proposed by Garcia de Orta and then by other Iberian physicians, Clusius hired the services of informants. As they departed for the East, he would give these voyagers detailed surveys to be completed. On their return, in addition to conducting thorough debriefings, he would collect reports, testimonies and samples (Egmond, 2015).

Cristóvão da Costa (c.1525-1594), the physician of D. Luís de Ataíde (Governor 1568-1571), also included in his *Tractado de las Drogas* (Burgos, 1578) the observations that he collected in Goa and Cochin. In addition to his clinical experience in the East, his work also disseminated sketches of plants *drawn from life*, information collected by royal officials as well as data provided by local informants and local physicians. The latter, thanks to their broad knowledge of the plants of the region, were well qualified to provide information about the virtues of Asian species.

But this method of gathering information on tropical natural resources was not limited to Asia. In *Historia Medicinal de las Indias* (Seville, 1565-1574), the Spanish doctor Nicolás Monardes recorded information about the natural world of Spain's colonial possessions on the American continent. Relying on the information sent by missionaries, voyagers, merchants and imperial agents on the ground, his book shared, from his office in Seville, images and descriptions of the natural world of the Americas. However, perhaps realising the need for the presence of doctors *in loco*, in part to ensure a more effective assessment of the information being collected, Francisco Hernández's expedition to New Spain was organised (1570-1577). Under the patronage of Philip II (r.1556-1598), the doctor undertook a wide-ranging survey of knowledge relating to the American natural world. In order to accomplish this scientific mission, Hernández relied upon the collaboration of numerous informants, religious officials and local experts.

Under the influence of this new methodology established by the Iberian doctors for constructing knowledge relating to the natural world of

the Indies, the collection of specimens for the production of "firsthand" sketches and written descriptions of plants and animals became commonplace among Europeans posted to the tropics, as did the practice of surveying the local peoples and the gathering of samples. Sent to the offices of erudite Europeans, these materials were observed, analysed and compared to scholarly texts. With this work conducted in different continents, by various voices and by different hands, new knowledge of the nature of the tropics was gradually constructed (Pimentel, 2001; Barrera, 2001; Bleichmar, 2009; Leitão & Sánchez, 2017).

As Europe moved into the 1600s, a new methodology for appropriating the tropical natural world, which relied heavily on local informants and agents on the ground, was finally sanctioned.

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CHAPTER NINETEEN

SYNCRETISM AND SHARED PRODUCTION OF KNOWLEDGE IN 18TH CENTURY PORTUGUESE INDIA

FABIANO BRACHT

INTRODUCTION

This chapter analyses the early text *Medicina Oriental*, written by the Goan physician Luís Caetano de Meneses[1]. The analysis is expected to improve our understanding about the production of medical and pharmaceutical knowledge in Portuguese India during the 18th century. The fundamental questions in this article are related to the construction of knowledge in colonial spaces and the relevance of local contexts to the processes of knowledge production.

The problems addressed in this chapter – the processes of the construction, circulation and reconfiguration of scientific knowledge within the Early Modern colonial empires – are in line with the historiographical dynamics that have been developing during the last decades. These dynamics encompass primarily the field of History of Science, but also the domains of Social History and Cultural Studies.

In August 2004, in Halifax, Canada, James A. Secord gave the opening lecture of an international conference on the History of Science which had the suggestive central theme of '*circulating knowledge*'. Beginning with this intervention, he tried to take stock of the tendency that, according to him, was winning ground amongst historians, sociologists and science philosophers:

[1] ACL (Academia das Ciências de Lisboa), Cod. 21 and 22.

> There are many clues that we [science historians] are beginning to face, from a fundamentally historical perspective, knowledge not only as an abstract doctrine, but as a communication practice (…). (Secord, 2004, 671)

From an historical point of view, the notion that the production and circulation of knowledge are closely linked to the establishment of communication processes has several meanings. I would like, however, to direct my reasoning towards one that interlinks the transmission of knowledge, techniques and concepts across *frontiers*[2]. There is a high degree of plausibility in the assumption that most of the formative elements of a given culture, from the material goods it possesses to the intricate networks of meanings, rituals, beliefs, knowledge, linguistic tools, and pieces of intangible heritage, are elements that, at some point in the past, were incorporated despite the great variability of the circumstantial conditions resulting from the contact with other cultures (Burke, 2009). Besides the existing differences among different cultures, each cultural complex may itself contain many dimensions. These differences are related to specific aspects, such as stratifications of religious and social origins, contrasts given by environmental diversity and even by random circumstances, which result from the imponderability that is inexorably intrinsic to the historical processes.

In recent years, historians of science, mainly those who are dedicated to the study of the colonial empires, have attributed increased importance to the idea that, during the Early Modern Age, such spaces sheltered an intense construction, extension and reconfiguration of knowledge dynamics[3].

The adoption of this perspective has provided an opportunity for deep historiographical reviews to be processed, especially with regard to understandings about the development of scientific knowledge throughout the Modern Era, and the role of local communities and their sets of practices and knowledge. Previously consolidated perspectives, which are now being heavily discussed, tended to consider the role of the local communities in the construction of knowledge just as a secondary form, as mere receptors and reproducers of a linearly diffused science, from their

[2] The term *frontier* can be understood as being not necessarily a place, but much more as the boundary of a cultural encounter in which both sides are clearly defined, and at the same time endowed with a selective permeability, whose nature is shaped by specific factors and a historical dimension.

[3] For further reading about processes of the construction and circulation of knowledge see: Hsia, 2009; Raj, 2009, 2013; Walker, 2007, 2013; Furtado, 2011; Bastos, 2010; Dias, 2007; Pardo-Tomás, 2014; Bracht, 2018.

irradiation centers, in Europe, or through the colonial institutions and the missionary actions of the religious orders (Raj, 2013). However, new approaches have contributed to the broadening, in historiographical terms, of the understanding that the production of scientific knowledge resulted from a series of processes of cultural mixing and shared construction. From these perspectives, historians, sociologists and science philosophers sought to understand the production of knowledge throughout the Modern Era as a sum of several processes, which involved the colonial spaces in a multidimensional manner and from multidirectional pathways (Raj, 2013; Bracht, 2018). The true construction of knowledge took place by means of exchanges and negotiations, within a locus defined by Mary Louise Pratt as the contact zone, which consisted of:

> (…) colonial encounters, spaces in which people previously separated, in historical and geographical terms, come into contact and establish continuous relations, usually involving conditions of coercion, extreme inequality and insoluble conflict. (Pratt, 1992, 6)

Much more than the simple result of an understanding process, the production of knowledge in the colonial spaces also emerged from conflicts and cross-interests through sensible negotiation processes. Points of common interest arising from these processes were, to a large extent, the result of incomplete understandings with respect to each other, but, at the same time, a continued establishment of "mutual and creative misunderstandings" (White, 2001). The concept of "creative misunderstandings" has become the key concept of the most recent understandings of the production of knowledge in the colonial universes. Not for nothing did Harold John Cook, author of several important works on this subject, use the same expression in one of his most recent contributions to the matter (Cook, 2013).

The 18th-century Portuguese colonial spaces can be understood as places of intense and dynamic processes of the construction, extension, and reconfiguration of scientific knowledge. In these spaces, there were multiple and complex processes of the syncretic production of knowledge which were deeply related to the many local specificities and idiosyncrasies and strictly connected to the circulatory channels established by the imperial institutions. In this way, it becomes evident that these processes are, on the one hand, inseparable from their local contexts and, on the other, intrinsically related to the global contexts.

THE *MEDICINA ORIENTAL* MANUSCRIPTS

Between 1740 and 1772, Luis Caetano de Meneses, a native Catholic Goan, wrote the two volumes of *Medicina Oriental* (ACL, Cod. 21 and 22). The two voluminous manuscripts, held since the 1780s by the Science Academy of Lisbon, are in fact two tomes of a single opus. The first book, *Socorro Índico aos Clamores dos Pobres Enfermos do Oriente*, with 1396 pages, contains medical theory and analyses of medicinal drugs. The author himself indicates, in several passages, that the book resulted from the collection of information from diverse local *masters of medicine*. However, these always remained anonymous and hidden as passive contributors, and the offered practical knowledge is always validated by a subsequent citation of a European intellectual authority. The first tome contains seven books, each one written in the form of a discourse or treatise about a given category of nature. In the discourses, the medicinal, animal and mineral drugs are analysed in regard to their physical appearance and their medicinal properties. In this sense, the treatises expose the medical and natural philosophical characteristics of plants and roots, fish and marine mammals, birds, quadruped animals, reptiles and crawling animals, as well as metals, alkaline minerals and precious stones.

Under the title of *Pharmacia Indiana*, the second volume is a compilation of more than three hundred pages containing pharmaceutical prescriptions, some of them including a considerable number of local drugs. Indeed, we have here a pharmacopoeia, filled with instructions for preparing and manufacturing a myriad of remedies in accordance with both chemical and humoral theories.

Meneses' works can be considered deeply hybrid in the way in which they incorporate European medical and pharmaceutical literature and by the detailed local information that was collected, processed and reconfigured. To write his work, Meneses resorted to some of the most important Portuguese pharmacopoeias of the 18th century, such as the *Pharmacopeia Lusitana* by Caetano de Santo António (1704); *Âncora Medicinal* by Francisco da Fonseca Henriques (1721); *Historiologia medica* by Joseph Rodrigues de Abreu (1733); *Divertimento erudito* (1734) by friar João Pacheco (1734); and, lastly, the *Materia Medica*, published in London by Jacob de Castro Sarmento (1735).

Among the seven treatises that make up volume one, the first one, *Da Historologia das Plantas*, is by far the longest. This part contains instructions on the medicinal uses of 782 plants and other diverse substances of vegetal origin. In this treatise, there is at least one quote from a European author for 294 (37.6%) plants. The remaining treatises,

which are considerably shorter than the first one, contain descriptions and classifications of 146 fish[4], 131 birds[5], 114 quadrupeds, 81 *reptantes* (crawling animals)[6], 54 metals and metallic salts, and 130 precious stones. Treatises two to seven, thus, describe a total of 656 entities, with reference to European sources in 258 (39.33%). Altogether, the first volume describes 1,438 items, with an average percentage of references to European sources of 38.39%.

After analysing the quotations in the first volume, it is possible to conclude that Luis Caetano based his work on a relatively limited number of authors and that most of them are of Portuguese origin. However, regarding the second tome, references are far more diverse. This book includes a total of fifty references from different authors. In most cases, precisely, 144 of a total of 306 formulas (47%), the references are associated with recipes that were copied from several authors.

Due to these characteristics, the *Medicina Oriental* is keenly marked by the European standards that can be found in other contemporary medical treatises. But if in this particular respect the two tomes do not differ considerably from most books on medicine and pharmacy published in Europe in the mid-18th century, their contents are nonetheless considerably different. Through the analysis of Meneses' work, one can infer that not only Indian physicians were consulted but also apothecaries and herbalists, with the clear intention of obtaining more accurate information about the local drugs described and analysed in volume one. Similarly, it is reasonable to assume that, for volume two, he consulted diverse local apothecaries and even village healers. This clearly characterises the hybrid nature of the *Medicina Oriental*, engaged in the processes of cultural syncretisation, bringing together components of Asian and European origins. However, it is a challenging task to follow this path of unheralded clues about the real Indian producers of knowledge and why they were consulted. For although both books have enough reliable information about the European authors called to validate the knowledge produced, the same cannot be said about the local sources, since not a single name is mentioned. Therefore, for a more accurate understanding of how the author incorporated local-based knowledge in his opus, it is crucial to deepen an analysis that recognises which elements

[4] In fact, this category deals with aquatic animals, given that some amphibians, molluscs, and crustaceans are also included, as well as mammals like the dugong (*Dugong dugon*), dolphins and whales.

[5] In a similar fashion to the previous category, this one describes flying animals, including insects and bats.

[6] All crawling animals, such as worms and some non-flying insects, are included.

are effectively of Indian origin. This is fundamental to a better understanding of how this knowledge has been incorporated and transformed through contact with the European matrix. For by doing this, one can follow the evidence the author provides himself.

In both volumes, two almost identical passages are found. As a warning to his readers, Meneses wrote that "*In order to be readily understood by Indian readers, I wrote many names in the language of the Country"*[7]. In this sense, it can be said that it is through the presence of the words in Konkani that it is possible to detect the data that allow us to perceive how much the *Medicina Oriental* was inserted into the universe of local knowledge. The two warnings mentioned above were accompanied by a small set of rules on the pronunciation of several terms and syllables in the local language when written in the Latin alphabet. Counting the elements described in the first tome and considering the languages in which the different names were written, we can note that of the total of 782 plants described in the first book, 462 (58.84%) were not identified by Western names. Among those 462 plants, 338 (43.22%) were identified only by their Indian names. Among these, 245 names (31.33% of the total) are exclusively Goan designations, while 93 (11.89%) are combinations of the different names in Konkani from Goa, from Salcete, Bardez and Balgate or even from other Indian languages. These names were part of the local culture, even when related to exotic plants, as for example the many African specimens described. In the case of African species, and because of the historical link between the eastern coast of Africa and India, these drugs came mainly from Mozambique and, when they were incorporated into the Goan medical culture, their original names were lost or reconfigured.

The plants were part of the medical repository of the various categories of agents, notably midwives, village healers and herbalists, who sold them on the local markets, as well as apothecaries from the Congregação do Oratório and Goan hospitals and literate *Panditos* who served the colonial elite. Therefore, it is possible that Luis Caetano de Meneses obtained from these groups the knowledge that he compiled, analysed, and categorised.

This knowledge was not supported by quotations from other works because, for him, there were no expert authors of European books who could validate it. Perhaps it was for this reason, in the second volume, that Luis Caetano established criteria to facilitate the substitution of European components found in pharmaceutical formulae for these plants, originating

[7] "*Como para mais fácil percepção dos Leytores Indianos escrevo muitos nomes em lingoa do Paiz*" (ACL, Série Azul de Manuscritos, COD 21, our translation).

over 1,200 derived formulae, containing elements known to the local medical culture. Thus, the *Pharmacia Indiana*, as an example of *historologias medicas*[8], presented itself as part of a broad process of the construction, extension, and reconfiguration of knowledge.

FINAL CONSIDERATIONS

To conclude this analysis, an important question remains. What place would the *Medicina Oriental* occupy in relation to the epistemological transformations that were taking place in 18th century European medicine and natural sciences? Most of the analyses and classifications of plants and animals included in the *Medicina Oriental* followed criteria that had been widely recognised in Europe since the first decades of the Early Modern Age. However, from the second half of the 18th century onwards, these standards gradually changed (Papavero *et al*., 1996). In this period, Linnaeus', Buffon's and Tounefort's ideas progressively added new dynamics to the universe of classificatory theories. As an indirect effect of these developments, much of the subjectivity of Early Modern Humoralism was drained, little by little, of its explanatory range (Hankins, 2002).

According to the new classification models, plants and animals were to be classified taking into account their morphological and reproductive characteristics, mostly based on the binomial framed by the communion between the new understandings of the concepts of shape and function. These new models sought an opening of the possibility of classifying plants and animals from standardised patterns, a task to be performed by anyone, regardless of their place of observation. The slightest difference between two individuals, plants or animals, should demand their classification as two totally diverse beings (Margócsy, 2014, 29-73). In this regard, the *Medicina Oriental* was written from a different perspective. Following humoral theories and the Doctrine of Signatures, Luís Caetano de Meneses – as well as most Early Modern natural philosophers – used the principles of sympathy and emulation in order to classify plants and animals as well as some selected inanimate beings. Although Meneses dedicated an entire volume to chemical pharmacy, the visions and interpretations found in his book no longer fitted within the new developments taking place at the end of the 18th century, especially those dealing with the problematics of phlogistic chemistry and the studies on the properties of gases (Hankins, 2002). Hence, when the *Medicina*

[8] "Medical historiologies" (our translation).

Oriental arrived in Europe in around 1770, it was probably considered as conceptually outdated by the "armchair savants" of the Academy of Science of Lisbon.

The *Medicina Oriental* is quintessentially a hybrid, directly resulting from the multiple hybridisation dynamics occurring in the *contact zone* (Pratt, 1992) between Europeans and Indians. The work fuses not only the knowledge of the Portuguese and the local elites, but also the popular Christian and Hindu traditions, filtered while passing through the *middle ground* (White, 2001) between these two universes. Each piece of knowledge contained in the book was, within this process, reconfigured through exchanges and negotiations.

Because of the connections with local cultures, the *Medicina Oriental* deals closely with local medical and pharmaceutical demands and knowledge, while maintaining a close connection with the European references. Strategically, this kind of intellectual approach was largely necessary due to the challenges of being accepted, recognised and validated by both colonial and metropolitan "armchair savants". In this context, the Academy of Science of Lisbon was definitively an important keystone in the processes of the validation of knowledge, being both a guarantor and an instrument of power.

Finally, considering the elements analysed in this chapter, combined with the theoretical perspectives focused in the *frontiers* of cultural dynamics, we perceive that such processes of the construction of knowledge largely depended on negotiation, and that the resulting knowledge was indelibly marked by deep cultural relations and inherent power imbalances. Therefore, when dealing with the *contact zones* in which the Europeans were forced to adapt to the pre-existent systems in the East, one also must deal with the central concept of cross-cultural trade. The strengthening of social bonds and networks of knowledge was thus a *sine qua non* step, without which the consolidation of all kinds of cultural transfers would be considerably more difficult. Such a process played an essential role in the building of this global world[9]. Knowledge of drugs, diseases and pharmaceutical recipes was one of the most prolific areas in which these transfers took place. In a sense, it was from this shared construction of knowledge that, between conflicts and negotiations, both colonisers and colonised could reach acceptable levels of coexistence. In other words, it is possible to say, conditionally at least, that they learned to live together. The circulation and shared production of knowledge are thus core concepts for a more precise understanding of the historical

[9] On this, see Polónia, 2017.

processes of the production of knowledge within the world of the Indian Ocean that was, in this sense, a syncretic pool of ideas.

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CHAPTER TWENTY

BRAZILIAN NATURE AND THE LOCAL PRODUCTION OF KNOWLEDGE: SOME ISSUES ABOUT NATURAL HISTORY IN THE PORTUGUESE EMPIRE IN THE 18TH CENTURY

GISELE C. CONCEIÇÃO

INTRODUCTION

The 18th century was marked by a growing interest of the Portuguese Crown in Natural History. Throughout this period, it is possible to observe an increase in the number of studies on the colonial Natural World which, in turn, supported processes of the production and circulation of knowledge encompassing the entire Portuguese Empire. This new interest in colonial nature, following the paradigms of the Enlightenment and boosted by the wide circulation of texts, led to the emergence of various science-diffusing institutions such as the Academies of Sciences, the Botanical Gardens and private collections as well as Cabinets of Natural History. Funded by patrons and *maecenas* of Science and Natural Philosophy, wealthy nobles or bourgeois, these institutions promoted the publication of books, memoirs and catalogs of collections of exotic plants and animals as well as medical books.

One of the main consequences of this renewed interest in knowing the natural environment of the colonies was the recognition of the need for a systematic investigation to improve knowledge not only on the colonial world but on the parts of the globe hitherto unheard of. Everything was to be observed, experimented, cataloged, described, classified and, finally, analyzed concerning their uses, whether connected to science or economic purposes. Therefore, to a large extent, it is possible to assume that these

processes contributed to the promotion of scientific production throughout the 18th century.

The Portuguese Crown, especially from the second half of the 18th century, considered the application of these principles, at least partially, in the investigation of the natural environment of their territories. In this process, there was an intense participation of individuals with different intellectual backgrounds. Frequently, even without an academic background in philosophical-natural studies, these agents produced works on the Natural World of the colonies (Conceição, 2017).

In quantitative terms, these individuals produced a larger volume of work than those executed in the scope of the *Viagens Filosóficas* (lit. 'Philosophical Voyages') coordinated by Domenico Vandelli at the University of Coimbra (Conceição, 2017). Therefore, the main objective of this chapter is to demonstrate, through works produced by militaries and physicians, how these policies concerning assessments and the exploration of Brazil's natural potentialities also fomented the production of knowledge, our main focus being to comprehend the processes of the construction of natural philosophical knowledge in the colonial territory.

THE PHILOSOPHICAL EXPEDITIONS AS INSTRUMENTS OF POWER

From the beginning of the 18th century, and especially during John V's reign, there was an increase in the circulation of agents, books, ideas and letters between Portuguese agents, whether they were in Portugal, in northern Europe or in the colonies. In the first half of the century, a significant part of Portuguese scientific thought circulated through letters exchanged between diplomats, Crown officials, and intellectuals (Furtado, 2012). The content of these letters was most diverse, and through them, scientific thinking circulated and was validated. This form of circulation not only persisted during the second half of the 18th century but clearly increased during this period (Conceição, 2017). The amount of works from the mid-century onwards, in relation to political, economic and scientific questions concerning the potential of the natural environment of the colonies, especially Brazil, is arguably bigger. The obvious interest of the Crown stimulated an increase in the number of agents studying colonial nature in order to provide mechanisms that could be used to improve the knowledge and use of natural resources for both scientific and commercial purposes.

From 1750, the Crown encouraged a policy of territorial expansion towards the interior of Brazil, especially in relation to the regions bordering the Spanish territories (Kantor, 2012). The main objective was to acquire a

greater knowledge and mastery of these geographic spaces, in view of the very expansion of agriculture and commerce, strategic and key areas of colonial exploration. To a certain extent, it was in this context that philosophical-natural studies about Brazil were thought out and put into practice. This process was not exclusive to Portugal. Similarly, Spain undertook several voyages and studies of territorial recognition as well as scientific journeys to their colonies in America, the Philippines and the Pacific (Domingues, 2013, 369).

In this sense, the project of the Philosophical Voyages demonstrates the commitment of the Portuguese Crown to the implementation of policies aimed at the development of Sciences, even in the colonial territories. The Philosophical Voyages project was the conclusion of decades of studies, criticism and attempts to form a group of naturalists qualified to develop a systematic and scientific study of the natural potentialities of the colonies. As an instrument of power of the construction project of the Portuguese Empire, the Philosophical Voyages involved both politicians and diverse sectors of the imperial economy and boosted the scientific scene throughout the Empire. From the Crown to the University, going through the local administration in the colonies, a commitment to the development of such studies was an assumed policy (Brigola, 2003; Domingues, 2013; Conceição, 2017).

Thus, the Philosophical Voyages should be seen as shared workflows between various agents, including engineers, the military, naturalists, physicians, state officials, politicians and clergymen. Initially, there was a certain convergence between political-economic targets and scientific objectives regarding the recognition and definition of territory, as a result of which we can find engineers, physicians, military and even governors of captaincies cataloging and describing animal and plant species.

Many works were written by the non-academic men who ventured on the expeditions. The natural world of the colony became a source of inspiration and interest for a wide range of agents who, in turn, developed and promoted research on the potential of the natural resources of the territory. Following these initiatives, science was to be central to the economic development of the colony.

The expeditions then carried out encompassed all the Portuguese Colonial Empire. The expeditions sent to Goa and Mozambique were led by Manoel Galvão da Silva (1783-1793), the ones in Angola were undertaken by Joaquim José da Silva (1783-1808) and those to Cape Verde by João da Silva Feijó (1783-1790). However, it was the Brazilian branch of these expeditions, headed by Alexandre Rodrigues Ferreira (1783-1792), which gained greater notoriety.

In the context of these expeditions, Ferreira's voyage was, from the financial, political and scientific points of view, the one of greater importance if compared to those carried out in other territories.

The expedition itself had monumental dimensions, especially if the distance covered in very little explored territories is considered. Approximately 39,372 km were covered in the Amazon Basin and the Captaincy of Mato Grosso (Ferrão and Soares, 2007; Simon, 1983). The volume of information collected over almost ten years in the Amazon Basin Rainforest was also great. Detailed drawings of tropical fauna and flora as well as numerous reports, which also demonstrate a deep interest in rivers and the tidal regime, attest to the interest and importance of the information on the natural environment. Despite the subsequent misunderstandings that caused the plundering, loss and deterioration of much of the collected material, Ferreira's expedition demonstrates the strategic importance attached to the study of nature within the Portuguese Empire.

Other expeditions, however, had considerably smaller resources, with obviously different results in terms of the production of knowledge and its validation by the scientific community. A good example of this situation is that of the expedition of the naturalist João Machado Gaio in 1784 (a year before the beginning of the expedition of Ferreira), who, under the command of the Governor of the Captaincy of Ceará (José Telles da Silva), organized and carried out an expedition in the Ibiapaba mountain range.

Gaio's expedition resulted in the work *Viagem filosófica que por ordem e despesa do Ilmo. e Exmo. sr. José Telles da Silva fez João Machado Gaio na serra da Ibiapaba, capitania do Ceará Grande, termo da Vila Viçosa Real, desde 13 de julho de 1784 até 6 de agosto do fito ano*[1]. Little is known about his life. In 1784, the year in which he produced his philosophical work about the Serra da Ibiapaba's nature, he was promoted to captain of the 6th Company of the Auxiliary Cavalry Regiment of that captaincy. But, unlike his contemporary Ferreira, who was named as a correspondent partner of the Lisbon Academy of Sciences in 1789, Gaio never reached this position.

From Gaio's text, it is possible to perceive that his work was, from the methodological point of view, very similar to that of Ferreira. Gaio sought to focus on the kingdoms of nature, native populations, and products that could be economically useful, but obviously on a smaller scale than Ferreira, considering the extent of the territory and the number of species.

The report about the Serra da Ibiapaba begins with a geographical location of the territory followed by a physical-geographical description. Gaio reports everything he observes regarding the four kingdoms of nature,

[1] ACL (Academia das Ciências de Lisboa), Série Azul de Manuscritos, COD 374.

though without great details about possible species. He emphasizes the quality of water, the large number of rivers (according to him more than forty) and the possibility of them being navigable, while pointing out that most of these rivers, wells and cisterns were little used by the native population. Curiously, in relation to the *Animalia* kingdom, he states that he rather chose to describe the native peoples of the Serra da Ibiapaba instead of reporting or cataloging species. As for the *Plantae* kingdom, the naturalist is more precise. He underlines the importance of botany to naturalists and informs the reader that he uses the Linnaeus system to classify species, while also noting observations on timbers useful for shipbuilding or on the medicinal plants

Alexandre Rodrigues Ferreira and João Machado Gaio can be considered as examples of naturalists whose work was intrinsically associated with the policies to encourage studies on the natural world of the colonies. Both can exemplify the general character of the Philosophical Expeditions undertaken in the different territories of the Portuguese Colonial Empire which, like other examples that will be presented, not only had a scientific character but clear political, economic and social dimensions.

The relationship between Science and Power is clearly expressed in the implementation of the scientific expeditions. However, the works developed in the Philosophical Expeditions are not the majority of the philosophical-natural works produced in the second half of the 18th century. In fact, the studies produced by the naturalists trained at the University of Coimbra by Domenico Vandelli are numerically insignificant when compared with the works produced by other individuals who were not naturalists.

The diversity of agents involved is significant, and the works they produced about Brazilian nature are quantitatively superior to those produced in the scope of the Philosophical Expeditions. Even so, historians still tend to consider Philosophical Expeditions as a model for the understanding of scientific production in the 18th century. However, if one intends to make an analysis that aims at a better understanding of the different actors in the processes of construction of knowledge in Portuguese America, other aspects must be considered; in this context, the scenario of producers and works written about the Brazilian Natural World represent a much more complex panorama, in which the Philosophical Expeditions are nothing but one of the elements of this process.

From a documentary sources analysis, it is possible to say that a typologically diverse range of agents participated in the production and circulation of scientific works. There was a significant circulation of knowledge between Europe and the colonies, and the production of

knowledge in colonial territory went far beyond the simple use of a manual of instruction made by intellectuals who never left Europe. The local and empirical component in the production of knowledge was also fundamental, generating works with different characteristics (Conceição, 2017).

In his book *Putting Science in its Place*, David Livingstone takes as one of his central arguments the questioning on whether or not place could influence scientific production. On the same line of thought, this chapter analyzes if locality can be considered as a factor of influence in the production of knowledge. The influence of local factors, as well as of the place itself, could have influenced the agent's choices on how to collect, identify, describe and classify species. In this case, it is not only geography that matters, but also agents and mechanisms associated with the transmission, production, circulation and validation of knowledge (Livingstone, 2013; Conceição, 2017).

Therefore, within the complex of agents that produced works about the Brazilian natural resources, we can also include other individuals who demonstrate the diversity of the production developed in colonial territories, namely the military and the physicians/surgeons

The role played by the military was equally vital to the construction of the image of the colonial territory. These agents worked on the elaboration of maps and borders' demarcation, on the edification of forts and villages, and the reconstruction of cities. The military of medium and higher ranks constituted a literate class, with an all-encompassing education that involved knowledge in diverse fields of practical and utilitarian nature and, in some cases, even in Natural History (Silva, 1999, 65). Oftentimes, the professional activities of the military converged with other fields of knowledge, and many of the works concerning Natural Philosophy were authored by them.

Physicians and surgeons usually cataloged and analyzed the natural elements that could be useful for medicinal and pharmaceutical knowledge. Throughout the eighteenth century, there was a significant circulation of knowledge among physicians and apothecaries about medicinal drugs. The trade of drugs, medicinal plants and knowledge about medicinal practices constituted an important part of the colonial economy (Dias, 2007, 129-173).

During this period, both the military and physicians/surgeons promoted a substantial production of knowledge about the natural environment of Brazil, and part of this production was developed according to the directives coming directly from the Metropolis. The Academy of Sciences of Lisbon, the University of Coimbra (in the person of Domenico Vandelli) and the policies of the Crown were fundamental to stimulating these groups to

develop works converging towards the same object: the inventory of Brazil's natural potentialities. Considering the role of the two distinct groups of agents mentioned above, we will now address the specific contribution of each of them to the production of knowledge about nature in colonial Brazil, through the examples of the physician Francisco Antonio de Sampaio and the soldier Domingos Muniz Barreto.

LOCAL AGENTS AS GO-BETWEENS AND PRODUCERS OF KNOWLEDGE

The case of Francisco António de Sampaio – Physician

Francisco António de Sampaio was born in Vila Real, Portugal, and moved to Brazil, possibly in 1748. He later settled in Vila da Cachoeira (a small village of the Captaincy of Bahia)[2] and never returned to Portugal. Despite the fact he never attended a medical school, he was authorized to practice as a surgeon and physician in 1762 and worked at the two Faculties of the Senate and at the Hospital of St. John of God ("*partidista em ambas as Faculdades do Senado e no Hospital de São João de Deus*"), one of the oldest in Brazil. This fact leads us to assume that he would be the official physician of Vila da Cachoeira, and probably the only one. Of the little information about his life and professional trajectory, some was given by himself through his correspondence with the Lisbon Academy of Sciences (Conceição, 2016, 2018a). Sampaio was named correspondent member in 1798, fifteen years after sending his first letters and presenting his works to the savants of the Academy[3]. His work *História dos Reinos Vegetal, Animal e Mineral pertencente à medicina, Tomos I and* II[4], sent to the Lisbon Academy of Science, is not unknown, having been quoted by authors such

[2] The Vila da Cachoeira gained the administrative status of Vila (lit. town) in 1698 and experienced its golden period in the late 18th century with an increase in economic activity and a considerable population growth. Its fluvial harbor's importance was mainly due to the trade of diverse important local goods such as gold, tobacco, cassava root flour, and dried salted meat. It was from Vila da Cachoeira that, in 1817, the German naturalists Carl Friedrich Philipp von Martius (1794–1868) and Johann Baptist von Spix (1781–1826) started their scientific expedition towards the hinterland of the Captaincy of Bahia.

[3] For further reading about the correspondence between Sampaio and the Academy see Conceição, 2016, 142-179.

[4] FBN (Fundação Biblioteca Nacional/Rio de Janeiro), manuscritos, I–12, 01, 019 and FBN, manuscritos, I–12, 01, 020.

as Timothy Walker (2018), William Joel Simon (1983) and Lorelai Kury (2018).

Simon emphasized the fact that Sampaio was developing studies based on the principles of Linnaeus even before Alexandre Rodrigues Ferreira arrived in Brazil to develop his philosophical studies. In fact, Sampaio was aware of the *Systema Naturae*, and he used Linnaeus's work in many of his descriptions of animals, trying to find connections between the species described in the Linnaean system and the ones he was observing in Vila da Cachoeira. And whenever he could not find them, he warned his readers that they were species not classified by Linnaeus, which justified his own description. In addition, he always tried to record the virtues and uses of plants. As for the animals, besides the Linnaean classification of species, he described them anatomically, specifying their medicinal uses, when applied.

Apart from Linnaeus, Sampaio mentions two more authors and their works, widely known in the scientific community, which by the end of the 18th century were being openly challenged: the physicians Manoel Rodrigues Coelho and his work *Pharmacopeia Tubalense* and Francisco da Fonseca Henriques and his *Ancora Medicinal*. In these cases, instead of using the works of these authors, Sampaio joined in with the discussions of the time, criticizing them and showing that his own knowledge about some plants was better and more precise than that of Coelho and Henriques. Even living away from the important urban centers of colonial Brazil and never having been in a European university, Sampaio's work clearly reveals his interaction with Enlightenment science.

This scenario allows us to understand how the Crown's incentives stimulated the production of works on Brazilian nature, involving a large number of agents in the colony. Sampaio was not an academic but, although far from the centers of the producers of science, he maintained contact with these centers, knew the concepts of Linnaeus, and had access to the instructions issued by the Academy of Sciences, namely those that encouraged individuals inserted in colonial contexts to describe and classify the natural environment in which they lived.

The case of Domingos Alves Branco Muniz Barreto – Military

In such a scenario, in which a wide range of agents, whether linked to the Crown or not, were involved in the recognition of the regional natural resources and in the construction of philosophical-natural knowledge about Brazil, the military affirmed themselves as examples of the production of natural-philosophical works, especially in the field of Natural History. One of these examples is Domingos Alves Branco Muniz Barreto and his works

about Bahia's medicinal plants. Considering the military training of Muniz Barreto, what would be a useful knowledge of nature for him? How should he perform the work in order to provide such knowledge? Who was this work for and why was it necessary? These were probably some of the questions Muniz Barreto was trying to answer when he began his own research and to which he sought to respond throughout his work, thus providing his readers with more than a simple knowledge about medicinal plants.

Muniz Barreto was born in Bahia in 1748 and died in Rio de Janeiro in 1831. He was a military man who wrote several texts on the political, social and economic situation in Brazil as well as on the exploitation of Brazilian natural resources. In addition, he also wrote about natural products that could be grown or extracted from Brazilian nature, such as plants locally used as medicines, and other natural resources with commercial and economic potential. In the second half of the 18th century, he traveled through an extensive territory, from the Captaincy of Bahia de Todos os Santos to the Captaincy of Rio Grande de São Pedro (Conceição, 2018).

Although Muniz Barreto dedicated his work to the illustrious members of the Academy, there is no record that he had been accepted as a member of the Lisbon Academy of Sciences. However, the work of Muniz Barreto clearly shows that, like Sampaio, he was aware of the scientific policies of the time and the incentives given to works on the Brazilian natural environment.

Two works are known that resulted from his research in Ilhéus (Southern Bahia). One, which combines the *Viagem a parte da Comarca dos Ilheos na Capitania da Bahia*[5] and the *Plantas do Certão do Gram Pará*[6], is now in the archives of the Lisbon Academy of Science; the other, which combines the *Descripção de parte da Comarca dos Ilheos da Capitania da Bahia dirigida à Academia R. das Sciencias de Lisboa*[7] and *Ervas Medicinais do Brasil*[8], is kept in the Public Library of Porto. Both manuscripts are identical. Besides these works, in the Historical Archive of the Museum Bocage (Bocage Museum), there is still a list of natural products that Muniz Barreto sent to Portugal[9].

The work of Muniz Barreto is very interesting from the point of view of the importance of Brazilian natural philosophical knowledge. His

[5] ACL, Série Azul de Manuscritos, COD 374 (25).
[6] ACL, Série Azul de Manuscritos, COD 627.
[7] BPMP (Biblioteca Pública Municipal do Porto), reservados, 3ª série – Brasil, Cota: MS 688.
[8] BPMP, reservados, 3ª série – Brasil, Cota: MS 436.
[9] For further reading about this work see Conceição, 2018, 98-125.

observations include geographical descriptions and information on the navigability of local rivers and soil fertility, on mineral resources and agricultural crops, on indigenous groups and, most importantly, on local medicinal plants and indigenous knowledge associated with their use. In this context, Muniz Barreto did not neglect the process of data collection and the construction of knowledge about medicinal plants and, from his own understanding, sought to inform about the usefulness of some of these plants for those who could use their writings as the basis of other fieldwork.

Thus, his botanical works start with an explanation about how he drew the species, followed by what was, in his opinion, the best way to verify the qualities of those plants and an explanation on the best method to gather the selected plants. To this explanation he adds the drawing and the description of the specimens.

Muniz Barreto developed his own system for cataloging and describing specimens, mostly based on indigenous knowledge. According to him, the observation and acknowledgment of the native American knowledge was the best way to ensure the ability of any person to use his works, by recognizing each plant that was being cataloged. Nevertheless, the descriptions of the plants were made by comparing the native plants with other known plants of the European botanical complex and, thus, the work can be considered as a kind of technical manual on medicinal plants, which could be useful for and used by anyone.

As for his philosophical observations, the place of prominence was given to the geographical description, with some emphasis laid also on the question of the navigability of the rivers, as João Machado Gaio had already done. But unlike Gaio, he warned the savants of the Academy that he would not describe the indigenous populations because they were not relevant for the Academy.

Contrary to many works by his contemporaries, organized in alphabetical order or thematic axes, the work of Muniz Barreto is organized from the collection process itself, and the specimens appear in the same order in which they were brought by the natives or by the local population. Thus, at each collection site, there is a differentiated process of data collection that includes both the individuals involved and the different modes of knowledge transmission. As a result, the knowledge acquired acknowledges the participation of natives as informers as well as the importance of indigenous knowledge.

Muniz Barreto's works resulted from his direct contact with the indigenous populations living in the villages he visited, presupposing a process of a reconfiguration of knowledge that recognizes and incorporates the indigenous knowledge component. In turn, the local character of his

works can be analyzed not only from the perspective of the cataloged specimens but also by the type of knowledge itself, as a very particular result of a reconfiguration of indigenous and popular knowledge and the use of local technics and materials (Conceição, 2018).

Therefore, in Muniz Barreto's work, we can observe a complete process of the reception, assimilation and integration of knowledge, associating both European and indigenous knowledge. In his own opinion, this interaction was paramount, and the construction of specific knowledge about local medicinal plant species should be built through interaction with local populations. In this dynamic, whenever possible, he sought specific knowledge from European authors, providing his readers with a full comprehension about Brazilian medicinal plants (Conceição, 2018).

In requesting help from the native Americans to collect plants, and recognizing the importance of this same aid, Muniz Barreto established a biunivocal relationship of knowledge exchange based on the assumption of the construction of an inclusive scientific knowledge.

FINAL COMMENTS

In the second half of the 18th century, the interests of the Crown ended up shaping the dynamics of the production of knowledge on Brazil's natural resources, as well as its diffusion within the Empire and beyond. Social, economic, political and scientific issues were, in most cases, decisive factors not only in the choice of studies to be carried out but also in the choice of the territories and natural products to be considered with an economic, commercial and even potential medicinal use. However, this scientific production was not merely and exclusively based on works which enjoyed the direct support of funding from the Crown. Many agents produced studies aimed at their acceptance in the upper political and scientific circles.

It was due to the involvement of the Crown and the scientific institutions involved in the initiatives to assess the natural potentialities of the colonies that a large number of individuals, with various educational and professional backgrounds, became central to the process of the construction of knowledge about the Brazilian natural environment

This can be considered as a characteristic of a model of production of knowledge, transversal to the entire Portuguese Empire; a model with its own characteristics in relation to the scientific community of the time and the works produced on the natural environment of the colonies, which gave a very particular character to the relationship between man and nature in the different colonial spaces of the Empire.

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CHAPTER TWENTY-ONE

HISTORY AND NATURE IN THE COLONIAL AMAZON: ANIMALS AND PLANTS IN THE CONQUEST OF THE NEW WORLD

WESLEY OLIVEIRA KETTLE

INTRODUCTION

> Many of the members of the boundary commission remained in the Amazon, being in charge of several technical services to which they could contribute, such as Sambucetti, Sturm, Galuzio, and Landi, who made maps, explored rivers, studied Amazonian nature, committed to main political activities, such as building fortified settlements and urban nuclei, as well as subsequent action against the Spanish. Outcomes of the Treaty of Madrid were rewarding. Efforts regarding the intensive valuation of Amazon and steady maintenance of Luso-Brazilian sovereignty (…) became a steady guideline of the Portuguese political elite. (Reis, 1948: 111-2)

The conclusions presented by Arthur Cezar Ferreira Reis in this work follow a historiographical tradition that interprets the colonial past of the Amazon from the perspective of the "Portuguese political elite" and, in this context, the action of agents involved in the process of demarcation is taken as a reflection of the elites' commitment and involvement in this process.

This historiographical approach considers the knowledge produced by the colonial agents as a consequence of the intellectual context of the Enlightenment, developed in important European centres of the time such as Spain and Portugal, which had Natural History as one of its main concerns (Falcon, 1993) and, to a certain extent, defended the role and

importance of the knowledge and appropriation of the natural world for the process of colonial occupation.

On the other hand, traditional interpretations also enhance the importance of the planning elaborated by the Portuguese government, which would have been efficiently and conscientiously executed throughout this period, as expressed in Reis' discourse, according to which the "Portuguese political elite" would be totally in control of the border demarcation in the region.

Considering these interpretations as well as the specific context of the border demarcation process, this chapter aims to show how the visions of nature recorded by the participants in this process help us broaden the scope of our understanding of the wider process of the colonial occupation of the Amazon.

To do this, our research focused mainly on historical documents, especially the eighteenth-century travel reports related to the Amazon region during the process of border demarcation, seeking to contribute to a reflection on the way in which historiography interprets this period of Amazonian history.

HISTORY, NATURE, AND SCIENCE IN THE AMAZON

The overvaluation of the contributions of the demarcation commissioners, especially regarding the works of Natural History, reinforces the argument that the Portuguese Crown, as the producer of the colonial policy guidelines, was responsible for the entire process of territorial occupation and conquest. Accordingly, the success of the conquest was intertwined with the knowledge of nature, and the Portuguese political elite was primary responsible for its successful implementation. This type of narrative construction excludes all proposals based on the recognition and incorporation of local indigenous knowledge.

We cannot deny that the Portuguese political elite was responsible for directives and negotiations in the process of Amazonia's colonial occupation. However, considering indigenous knowledge to understand the Amazonian past allows the possibility of increasing our knowledge about the period of the European occupation of the Amazon.

Interactions of Europeans with the nature of the New World created demands that rearranged previously conceived plans. Despite the efforts to keep everything under control, colonial agents were constantly in need of responses to the challenges presented by forests, rivers, natural phenomena and animals which were previously unknown. This reinforced the need to study nature through the perspective of Natural History, ensuring not only

a scientific connotation to such a practice, but also a political one. José Padua (2010) highlights the importance of this interaction in the construction of a dynamic narrative that brings together biophysical, cultural and social factors.

Dangerous animals such as snakes, jaguars and alligators were registered as grounds for the suppression of demarcation journeys. Difficulties caused by natural features such as waterfalls forced Europeans to rework their expedition plans. New instruments for hunting, paddling and collecting animals and fruits were added to the luggage assigned to the scientific expedition. The specificity of the conditions of the Amazonian environment, hitherto unknown by the men of science, imposed changes to the list of objects that should be part of the luggage and challenged the mathematical knowledge learned at the European universities (Kettle, 2015). But, most of all, these conditions changed the worldview of colonial agents.

It is worth remembering that authors such as Arthur Cezar Ferreira Reis (1948) were to a certain extent aware of the importance given to the natural world by the Europeans; how rivers, mountains and other natural features were used as key elements of the territorial demarcation process, and how the production of albums, research and periodicals or the organization of herbaria and animal specimens were also performed to be used later as gifts in diplomatic actions attesting to the occupation of the territory.

Visions of nature by men of science, clergymen, military men and colonial administrators involved in the European conquest of the Amazon, especially during the second half of the 18th century, should be understood on the basis of their experiences in the New World, and not exclusively as a reflection of the orientations of the Portuguese government, inscribed in the 'civilizing' project of the Enlightenment and guided by the Natural History methodologies.

The accounts of the life experience of the men of science hired for boundary expeditions in the Amazon region also served to establish relations with other scientists who held high positions in Europe; this was a stimulus for Commissioners to develop activities and produce reports attesting to their awareness of the language and appropriate scientific practices used in the most important European cities (Kettle, 2010), which could enable them to be recognized as men of science among their European peers.

In line with this possibility, a letter written in 1767 by Angelo Brunelli[1] to Ferdinando Bassi[2] shows the attempt to establish an information network based on the work with 'things of nature'. Such a network presupposed, on the one hand, that colonial administrators would receive data on the conquered lands as well as the identification of who could participate in the project of territorial occupation (Kettle, 2010) and, on the other hand, that the persons responsible for the research on nature could legitimately claim the recognition of his position as a "naturalist" in the Portuguese Empire.

> (...) once you dedicate yourself entirely to contemplation of things of nature and through this dedication you achieve high praise and you interact brilliantly with Natural History itself, with discoveries which are not insignificant, it seemed to me that it would not be by any means unpleasant by writing to you about something which has to do, somehow, with your own studies, and which, at the same time, is fascinating and worthy of being known. (Brunelli, 1767 (2010), 517)

Brunelli's statement testifies that he understood Natural History was a critical element of the border demarcation process and how the results of works in that area of knowledge would be most welcomed by the European Academy. Therefore, knowledge of the natural world was not an option but an essential part of the strategy of the Iberian Empires to perform territorial occupation, and while reflecting on the complexity of that period we should not ignore either the environmental issues or the way colonial agents perceived nature. Conversely, as Donald Worster (1990) points out, the environmental perspective in history allows us to

[1] Astronomer. Born in Italy, probably in Bologna, on January 22, 1722. He was a secular priest who graduated in astronomy and came to work at the Astronomical Observatory of the Academy of Sciences of the Bologna Institute. At the age of 28, he was hired by Father João Álvares de Gusmão to be part of the Amazon Basin Demarcation Commission. He remained in Grão-Pará until 1761. Once in Portugal, he became professor of Arithmetic and Geometry at the Royal Academy of the Navy and was appointed professor of Philosophy and Mathematics at the Royal College of the Nobles by King José I. He retired from the College of Nobles in 1769 and returned to Bologna. He died on February 25, 180..

[2] Responsible for the botanical exchange in the city of Bologna. At the Botanical Garden of Bologna, he held the position of director of the rare and exotic plants sector from 1763 to 1774, the year of his death. He was involved with different fields of science, such as Physics, Chemistry, Paleontology and especially Botany. He made important trips to collect new plants and exchanged messages and species with Linnaeus.

consider the different driving forces of the construction of the narrative based on the reports about nature.

In the 18th century, Lisbon was the great metropolitan centre of the Portuguese Empire. The relation between the increase in conquests and the promotion of the knowledge of the territories conquered based on Natural History became increasingly noticeable. The need for explorers to recognize the territory and describe new species of animals and plants, indigenous people's behaviour, climate and hydrography provided a concrete setting from which various philosophical concepts could be conceived. This sort of effort was related to a prominent political scenario in Portuguese history, in which the issue of colonial borders was featured (Raminelli, 2008).

Discussions on the boundaries between the domains of Spain and Portugal in the Americas dragged on over the centuries, and in 1750 a more effective work on knowledge of the conquered territory was still needed. The advance to the west of the Portuguese in America was so evident that it made diplomatic relations with the Spanish increasingly delicate (Cortesão, 1965). At the time, the need for an economic and technological renewal by both Portugal and Spain made effective control of overseas territories an essential factor in this context, which the historian Manuel Giraldo called "border reformism" (Giraldo, 1782 (1991), 8-9).

In fact, conflicts concerning the establishment of settlements and the circulation of natural products exploited in America, especially in the borderlands, also created demands which contributed to reforming the border policy. Descriptions of nature then played an important role in diplomatic negotiations, attesting to the successful conquest of a given territory. In addition, it would be misleading to assume that the indigenous peoples, who had a secular knowledge of the region, did not contribute to this knowledge about the natural world (Pratt, 1999).

Another misconception would be to assume that there were no changes in the way European colonial agents sought to understand the world once they had interacted with the New World biosphere, which influenced their work on Natural History. At this time, Enlightenment reformism was carried out in a moderate manner, mixing tradition and innovation, described by the German historian Sebastian Merkle (1909) as "Catholic Enlightenment", a term later appropriated by the French historian Bernard Plongeron (Rosa, 2010, 215-18)[3].

[3] The original expression conceived by Sebastian Merkle is "*Katholisch Aufklarung*", which was used at an International Congress of History in 1909 in order to highlight non-conservative characteristics of Catholicism throughout the

NATURAL HISTORY AND BORDER DEMARCATION IN THE AMAZON

The works on Natural History made in the scope of the borders process in the Amazon region were initially carried out under the guidance of Sebastião José de Carvalho e Melo[4] (1699-1788), the Portuguese Secretary of State under the government of King José I (1750-1777), which followed mercantilist guidelines in order to ensure positive revenues for the kingdom's finances (Falcon, 1993). Later on, under the rule of Queen Maria I (1777-1816), despite the opposition of some noble sectors, Enlightenment guidelines were also behind the foundation of museums as well as the creation of the Royal Academy of Sciences of Lisbon (1779) and the botanical gardens of Coimbra (1772) and Ajuda (1768). In this way, a greater development of science was sought in the context of a dialogue between the knowledge produced in the university and the economic interests, or others of possible benefit to the Kingdom (Carvalho, 1987), and the knowledge of nature.

Those institutions also played an important role in establishing communication with science and knowledge produced abroad, considering collection methods, studying the different Natural History collections, drawing the collected samples and analyzing and comparing the various descriptions of nature in the Portuguese colonies. Men of science wrote about agriculture, geography, botany and other topics while Crown agents were given the responsibility of discussing and evaluating the results, applying methods according to their own interests. In doing so, it was expected that the results of the link between scientific studies and economic practices could give Portugal a new financial boost (Brigola, 2003).

The acknowledgement of the complexity of the political thinking that guided the activities related to the demarcation of borders in America is essential to the construction of a narrative composed by individuals of different natures and origins that, in turn, give this process a distinct social dynamic.

It is necessary to avoid explanatory frameworks which consider Enlightenment thinking as an instrument strong enough to transform and transmute the reality of the everyday life, livelihoods and mindsets of the colonial subjects. Such an explanatory structure would conceive colonists

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century of Enlightenment, therefore going against perspectives of Protestant historiography.

[4] Sebastião José de Carvalho e Melo is also known as the Marquês de Pombal, a title he received in 1769.

as passive actors in such a context. Assuming "as a chameleon, the colors and shadows dictated by the Enlightenment" (Brigola, 1988, 75), colonial agents would apply only a single, pre-established model that would guide both the demarcation process and their own visions of nature.

However, considering the particularities of “life in colonies”, as plaintively described by Luís Vilhena (1969, 218)[5] in the 17th century, we can approach this question from a different point of view, which considers the reactions of the settlers as a result of epistemological exchanges with the indigenous populations, as well as of their experiences and expectations (Falcon, 2001). This perspective is important to broaden our observations on the different social groups involved in the occupation of the Amazon Basin, while recognizing that the visions of nature in that region resulted mainly from the concrete experiences of those living there.

On the other hand, we could even consider the existence of a project of conquering the nature of the New World. The attempt to “domesticate” and “dominate” the natural world through the scientific knowledge produced at universities and organized at museums, academies of science and botanical gardens was part of the politics which characterized the Portuguese Enlightenment itself, aiming at making a profit for the kingdom’s economy. Knowledge possessed by local inhabitants was never devalued, even though it was not explicitly presented in the works elaborated by colonial agents. This is an important interpretative key for studying the accumulation of knowledge by all those involved with the project of colonization, registering flora, fauna and regional landscapes, and pointing out suggestions for land cultivation or the exploitation of natural products (Reill, 2005).

Topics such as agriculture and mining began to be discussed by Enlightened Luso-Brazilian men from a technical perspective, noting the existence of knowledge that could be applied to benefit the Kingdom's trade. The evaluation of the raw materials of each region as well as their potential exploration were part of the agenda of the Enlightenment groups; therefore, the studies published included analyses of natural products such as timber, indigo dye and cotton from a scientific perspective conforming to the Enlightenment concept (Raminelli, 2000, 27, 34).

Despite the importance of Enlightenment thinking and the scientific matrix of Natural History in relation to the production of knowledge about the nature of the New World, the episodes of the demarcation process

[5] Luís dos Santos Vilhena was a professor of Greek in Bahia between 1787 and 1799. He wrote important accounts of the colonial society. Among other issues, he complained about the reduced number of whites in comparison to African blacks in Salvador.

show that, throughout the 18th century, colonial agents made use of indigenous knowledge. The indigenous population, who are still neglected by a significant part of the historiographical works dedicated to this period, were nevertheless fundamental to the process of occupation (Kettle, 2015). They were essential not only as a labour force in the expeditions, but also as the custodians of information essential to a good description of nature. They had knowledge on the territory and its resources, they knew how to use and where to find medicinal and edible plants, they knew all about the forests, the rivers and the creeks, the dirt tracks, the climate, the tides….

The border demarcation team had to wait in Lisbon until 1753 before travelling to South America. During this time, the news coming from the Amazon caused some uneasiness and discomfort among the members of the Border Commission. Reports on food supply problems in the interior of the Amazon and on the quality of the technical instruments to be used in the measurements (Brunelli, 1751 (2003), 652-3) raised serious doubts as to the feasibility of the expeditions. Still, the information coming to Lisbon far from matched the situation they would find in the interior. There, everything was different from what they knew, and the Amazonian world would contribute to profound changes in perceptions about the natural world

In fact, the interaction with the Amazonian world resulted in the emergence of a new scientific knowledge, mixing European and indigenous references, although the incorporation of indigenous knowledge has never been clearly assumed and recognized in the periodicals, research, descriptions or other types of documents in which the works of the demarcation Commissioners were reported.

It is true that a significant part of the Western historiography supported the idea of a purely European science that not only devalued the importance of this Luso-Brazilian knowledge, but completely disregarded the secular native knowledge (Safier, 2008). However, our research reveals that it would be misleading to assume that indigenous peoples only served as rowers or forest guides, clearing out pathways for the European demarcations through Amazonian rivers and forests.

The indigenous population released their knowledge about the Amazonian world by providing access to information on the local topography, the regional distribution of fauna and flora, the healing properties of plants or the preparation of food, but also on tides, stars and the hunting that, otherwise, the colonial agents would hardly have had

access to (Taladore, 2017)[6]. Thus, it is fair to consider that historiography is still in debt to these indigenous peoples, since it did not recognize them as active subjects in history.

In the course of our research, it was possible to identify complaints made by European explorers because of the refusal of the indigenous peoples to cooperate with the colonial agents during the demarcation activities. During the journey, travellers had to rely on the knowledge of the indigenous people about the plants found along the way, especially when their medicinal value was at stake. And getting this information almost always required great negotiation skills. In addition, reports from colonial agents also reveal their lack of knowledge about the existence of tides in the Amazon and how they were dependent on indigenous information about the tidal system (Lima & Moreira, 2005).

These difficulties provided an opportunity for indigenous peoples to negotiate their knowledge in exchange for advantages in colonial society and thereby also to strengthen their role in the expeditions. As shown by Karl Offen (2003), for instance, the natives will have negotiated information for European cartographic production in exchange for a guarantee for survival against the violence of the process of domination of the conquerors.

Recently, studies carried out by Mauro Cezar Coelho (2016) have emphasized an historical interpretation considering indigenous populations as drivers of changes in the Portuguese colonial policy for the Amazon. As shown by this author, the Portuguese legislation for the Amazon, while presenting a set of norms designed to face the indigenous resistance to the social model imposed by the Portuguese administration, revealed, in between the lines, the strategies conceived by the indigenous peoples in relation to the violent measures of the colonial agents, thus enhancing their active role in the process of colonial occupation.

Following the same type of argument, Eric Taladore (2017) examines how the Amerindians demonstrated their ability to negotiate their survival

[6] Indigenous knowledge is valued in most written accounts of border expeditions. Natives are presented as specialists in navigating techniques in the upper Rio Negro waterfalls, and their experience regarding the knowledge of the tides was even recognized by Governor Mendonça Furtado himself. As Landi emphasized, they were indispensable for reporting the locations of plants and animals of scientific or economic interest to colonial agents. Health problems such expeditions had to face could not have been resolved without the information of the natives about local medicinal plants and how to apply them. Moreover, the learning of their hunting techniques, widely documented by the "*riscadores*" (designers) that integrated the expeditions, also testifies to the recognition of the importance of indigenous knowledge and practices.

with the European conquerors by considering the entire colonial space; this, ultimately, could mean the possibility of moving to European cities. This author highlights the protagonism of the indigenous peoples as interpreters and farmers, as well as their technical skills in the construction of buildings, gardening, and the domestication of flora and fauna. His argument draws attention to the reductive interpretations that regard indigenous Amazon peoples as passive actors who only reproduce European standards of culture and technology.

In turn, Mary Louise Pratt (1999), in her investigation on the colonization process of the Americas, also emphasizes how tools, construction technics, religious rituals, and other areas of European knowledge were permeable to the incorporation of indigenous knowledge. Pratt uses the concept of 'transculturation' as a way of critically understanding the appropriation of indigenous materials by the Europeans. By doing so, it is possible to conceive native peoples as characters who have managed to rework the technoscience possessed by the conquerors. Nevertheless, Pratt recognizes the difficulties of the natives because of their subaltern position in an asymmetrical power relation, but she uses this very scenario to evaluate the strategies of resistance performed by them.

The construction of knowledge in the Amazon throughout the 18th century is also the subject of an analysis by Neil Safier (2008), who underlines the lack of information on the participation of indigenous peoples in the reports written by the Western explorers. According to this author, this 'effacement process' was part of a broad political project to impose Western Enlightenment values without, however, neglecting the self-promotion of those involved in the colonization process.

Moreover, the analysis of colonial historical documentation has also revealed the extent to which the knowledge gained about the New World has been manipulated in order to ensure successful individual careers and, as Safier (2010) points out, how the circulation of knowledge produced in the colonized regions was perceived in the scientific world, internalized and reconfigured under different forms.

LANDI, MABÉ AND CACUHI IN THE AMAZON

In one of his journals about the travels in the Amazon, António Landi, a member of the Border Demarcation Commission, writes that, other than the Portuguese officers, the expedition included two indigenous leaders: Mabé and Cacuhi. According to Landi, Mabé and Cacuhi "were not good friends" of the Portuguese "and their people were not subject to any

person and did not want to submit to any sort of servitude" (Landi, 1755 (1885), 166).

The diary, referring to one of the journeys in the region of Marié, provides a possible explanation for the fact they were not very friendly to the Portuguese. During the trip, Landi was very surprised by what, in his own words, were "the most curious plants" he had ever encountered. Wanting to describe them, he asked Mabé and Cacuhi for more information. However, both were uncooperative, responding that they had never seen those plants before. Whether or not this was true, the fact is that both refused to help him in this task (Landi, 1755 (1885), 166).

The task of describing Amazonian flora and fauna depended on indigenous testimony for both the identification and names of the different species. In an unknown region, indigenous knowledge was the only form of mediation between Europeans and the Amazonian natural environment, and indigenous peoples were the only ones who could provide information on where plants and animals could be found as well as on their identification and use, which reminds us of the importance of considering the 'mestizo' component of the reports produced (Domingues, 2001).

Landi's diary contains either perceptions about nature or the obstacles the team had to overcome. Its pages testify to the surprise with "the height of a waterfall" where they could observe an "extremely beautiful perspective", or two cliffs, "one of which was quite high, and it would be possible to pass it as long as it had enough space". In turn, as they sailed up the river, they observed new species that caught their eye and described them:

> Over rocks, which were on the water's surface, as well as around them, a certain herb grows, somewhat thick, though tender and well tissued, with the shape of a crosier. Both indigenous people and soldiers asserted that it was great for the condiment of *manjares*, and they ate it where there was no abundance of meat, nor of fish; we ate a huge amount of greens, and due to a flavoursome acid which it carries, it becomes pleasant to taste. (Landi, 1755 (1885), 167)

FINAL CONSIDERATIONS

From what has been written above, it can be concluded that the exploration travels carried out by the Commissions for the border demarcation of the Amazon region created opportunities for the European commissioners to interact with the indigenous peoples and the Luso-Brazilian community already in the territory by putting into contact different systems of knowledge. This interaction was the basis of

epistemological exchanges that allowed the Westerners to learn and use knowledge and practices as well as tastes hitherto unknown.

In this process, the information on the plants given by the indigenous leaders was not random; it was given or not according to their own interests. The reports of António Landi support this thesis as they mention both situations. On the one hand, as shown above, he records when it is not possible to obtain information; on the other hand, he provides detailed descriptions derived from indigenous testimony intertwined with his own direct experience with the new species, which allow him to point out that a certain "herb" had an "acid and pleasant" taste and could substitute meat and fish (Landi, 1755 (1885), 168).

Therefore, knowledge of the natural world also had a practical and immediate aspect: the acknowledgement and identification of edible plants to ease the daily difficulties of the commissioners in charge of going through the Amazonian hinterland.

If, on the one hand, the work produced during the process of demarcation frontiers during the colonial period justifies the pertinence of an approach from the perspective of environmental history, then on the other, they unequivocally testify to how indigenous peoples and their knowledge of the Amazonian natural environment were crucial to the construction of a scientific knowledge in which European references were not exclusive or prominent.

Despite the strategic orientations of the Portuguese administration and the interest and commitment of the Academy, the knowledge acquired by the Europeans about the Amazon was produced far from its offices, *in loco*, through the experience of the forest, rivers and streams as well as the experience of new flavours and feelings, the weight of oppressive moisture and the fear of storms, the shipwrecks and contact with new plants and animals. In this context, considering the colonial past from an environmental perspective can broaden our perception of the Portuguese occupation process of the Amazon region, and contribute to a better perception of the complexity of the emergent colonial society, as well as of the interactions with the indigenous world and the key role that indigenous peoples played in this process; all essential factors for a better understanding of the history of the Amazon.

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