Environmental History 6

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Environmental History in the Making

Volume I: Explaining

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Introduction

Environmental History in the Making contains selected contributions from the 2nd World Conference on Environmental History, held in Guimarães, Portugal, 8–12 July 2014.

It is quite clear that environmental history has been established as a discipline. However, the works presented went far beyond that driver of discussion. Researchers from the five continents presented new problems and further information, and they also formulated new hypotheses and discussed the corresponding results.

A sample of scientific responses within their historical contexts that explain past and present uses of the planet is presented in this book, together with possible proposals or solutions for forthcoming action.

Looking at the complete set of articles, it emerges quite clearly that historical data can be a fundamental tool to plan forthcoming environmental interventions.

As a matter of fact, the underlying theme of this manuscript is about *knowing the past, understanding the present and planning the future*. In other words, *Environmental History in the Making* gives, in practice, environmental historical information about the past and suggests a conceivable better future.

These views are in line with the prevalent interpretation of the *environment*. Despite cultural, economic, political or religious differences, an evolving planetary solution is needed to reverse ecological loss. This new paradigm tempers political and cultural divisions with total respect for cultural diversity. It emerges as the ground for a worldwide future, while religion, capitalism or socialism ceases to be recognised as a possible universal socio-economic-cultural paradigm.

This new paradigm goes far beyond models of resolutions built in the aftermath of the Second World War. Those were conceived under the legitimation of the UN institutions that was framed by the colonial background and thereafter by the Cold War. The environmental paradigm is a quest for the common good, defending human rights and access to basics such as nutrition or medical care. It argues for sharing resources instead of basic monopolistic control on water or power sources.

The articles integrating this book substantiate this new paradigm. The organisation in parts, "Explaining" and "Acting", intends to stress the resourcefulness of environmental history and its vision towards the future.

Thus, in Part I of the book, “Explaining”, the main focus of organisation is about how to think in order to do and how to test cross-data analyses to propose and present new data and stories:

1. Approaches – Social bondage to mathematics, arts or socio-biology
2. Proposing – Concepts, sources and methodologies
3. Clarifying results – Interchange of psico-social with natural and analytical
4. Resetting data – Information upon classic subjects crossing methodologies and producing new interpretations
5. Blurring all – New interpretations, old themes and different outcomes. How multi- and interdisciplinarity allow a confrontation of data proposing quite different interpretations on the same object

In Part II, the main driver of the organisation is about “acting”, offering new insights on new outcomes of classic themes or new interpretations of past uses of resources or changed landscapes. It is also our intention to stress how the awareness of the past helps to promote civic and political agency in the present.

Part II comprises:

6. Using resources – Narratives of resource exploitation in time and its evolution in the long run
7. Transforming in situ – Manipulating, changing and evolving landscapes, waterscapes and airscapes (classical approach of territorial changes, causes, actors and consequences)
8. Transferring (migrations) – Resource exploitation and trade, local to global (native sources, new case studies and transcontinental approaches!)
9. Spreading (aliens, exotics) – Reinterpreting evil to evolving with both positive and negative impacts
10. Conscience of loss and improving – Present awareness of how we have arrived where we are, undoing inappropriate territorial policies with environmental impact
11. Civic and political agency – History as memory of social process, knowing the past and planning the future

A few main ideas emerge when one reads the entire spread of contributions published here.

This book moves ahead from a framework looking for guilt and for whom to blame in the past for ecological loss to a framework of understanding the processes leading to current environmental circumstances and characteristics. This is achieved by analysing the mutual shaping of natural and social factors.

In the long run, natural and human action together gave rise to a wide range of resource uses, displacement, transfer and distribution. The transformations were implemented either intentionally or randomly. The corresponding multiplicity of shaped ecosystems, occupied by a wide diversity of animal, botanic and human populations generating different cultures, offers a transcultural and transdisciplinary set of approaches.

Researching past actions and consequences helps us to understand the present behaviour of nature and the emergence of new landscapes. Understanding past interactions between the human and natural spheres and its results at the local and global levels, it is possible to gain a better understanding and predictive power of how nature behaves. Consequently, hazards may be prevented (or its impacts minimised) and ecosystems managed in order to care for the common good without harming cultural, psychological or anthropological heritage and identity.

Following the universal status that "the environment" has acquired as a solution for life as we know it on the planet, some of the papers presented here clearly launch the knowledge of the past as an operative tool to project actions in our own time. They point to actions that might reverse economic, political, social and cultural environmentally unfriendly drivers. The understanding of the negative results of past interactions between humans and nature might allow the shaping of positive results in the future.

Yet, there is no spark of any intention to disguise the consolidated processes that contributed to damaging many areas of the planet. The research here confirms and unveils stories of ecologically harmful political actions towards mastering the exploitation of natural resources. These policies, in many instances, were accompanied by the monopoly of social control over the populations of, for instance, India, Rhodesia (Zimbabwe), Uganda or Bolivia and Brazil.

There is an ongoing debate to explain why prior analysis, which does not combine historical analysis with all the other sources of data, may lead to misperceptions and the diffusion of history that is actually wrong. Such is the case of the papers analysing themes from pollen distribution to iconography. In addition, there is a wide presence of papers that provide the historical context to explain why conclusions drawn from outside conjunctures and cultural frameworks may lead to a misunderstood history and incorrect interpretations, including how this tension can be resolved.

The insights of psychology, sociology, anthropology and the arts by way of performances and tradition propose new avenues for interpreting bondages to landscape and rooted cultural behaviours, which in turn explain resistance or acceptance of human changes to landscapes.

These approaches might constitute the DNA of human historical processes which in turn translate into a useful grid to read how humans have interacted with the environment and provide a basis to formulate future policies to regulate the relationship between humans and the environment.

Before interfering with deep-rooted cultural heritage, problems of historical origin can explain present conflicts between the biosphere and the human sphere. In addition, a historical context can provide a grid to read the degree of acceptance of territorial change. These changes can be rooted in traditions and can relate to the extraction, use, diffusion and trade of natural resources in different cultures. Finally, the historical context is key to understanding how delicate environmental management can be in different parts of the world, particularly when it comes to unhealed historical wounds.

New insights are then brought to light in environmental history by the stepping in of environmental humanities, social sciences, arts, anthropology and sociology, together with the contributions of natural sciences.

Indeed, this book presents mature analyses combining current problems and historical contexts to address environmental issues when inquiring into the past. There is a very clear attitude of not trying to find "ecological blame" or "indisputable ecological criminals" at any cost. In various stages, both present concerns and then perspectives, actors and limitations of knowledge within given spatial and time coordinates and so avoid misguided interpretations.

Albeit coming across with horizons of hope as much as of fear about the future, the analyses focus on positive and negative impacts resulting from past undertakings, performing studies both on the bad and good environmental management of former periods. Studies that progressively got thicker in this direction balance perspectives by paying attention not only to the crucial space-time contexts but also crossing methodologies and sources of many origins.

The texts stress the pressing need to access local data, translated to more diffused languages in the publishing sphere. Indeed, one of the most important contributions for a wider understanding of transfers of species and natural resources around the world, in the long run, intentionally or unexpectedly, is local information on the historical ground.

Indeed its diffusion and conclusion can change the course of given discussions in international forums, for example, concerning the stories and versions of resource transfers from Russia and China to Portugal, diverting from Dutch, English or French syntheses produced so far, as analysed in some of the papers in this volume.

Examples of new interpretations and reinterpretations of classic theories can be observed in this book concerning, for example, the introduction of botanic and animal species from India and Africa in Brazil; sugar plantations in Formosa Island (Taiwan) by the Chinese in the fourteenth century before the arrival of the Dutch in the sixteenth century; pets transferred as sacred or exotic like apes from India to Europe and America; the mining extraction in Brazil much earlier than the Portuguese "discovery" of Minas Gerais; the mining and trade of metallic resources between Japan and Korea; the fisheries on whales in the Northern Sea by the Russians and the Portuguese as steady but not depleting industries could be drawn, with processes so far unknown and now disclosed; or the importance of arts in stating and producing historical records or using representation to explore meanings of the same subjects and objects in different cultures.

The information unveiled in native languages also provides a new insight on the role of public health calamities and the diffusion of parasites in wet environments, as well as the launching of urban planning, for instance, in Russia.

The story of the abomination of resource depletion analysed as an ongoing horror since "ever" in opinion-making produced in the twentieth and twenty-first centuries becomes quite different when putting the same action in former periods attending to demography and scale of collection. In addition, the records on health and medicine linked to parasite diffusion suggest causes for social displacement and urban projection as what happened in Russia.

Historical analysis is also bringing to light reinterpretation of species transfers and migrations and deals with the positive as well as negative consequences of this process. Insufficient mono-disciplinary historical data was considered to result in misleading conclusions concerning this topic. In this book, a paper on *cannabis* circulation in the world takes this perspective.

Moreover the analysis of botanic or fauna distribution across spaces (solid and water, air) and time also provides information on climate behaviour and natural or manmade shaping of new landscapes through time. This is clear, for example, in the nineteenth-century scientific narrative about Argentina and Australia.

Decisions based on one side of science applied universally to different parts of the world, during colonial administrations for instance, were not only ecologically harmful in regions of India, the Middle East and North Africa, but, at the same, the decision making which disregarded cultural heritage led to huge conflicts in India, the low parts of Eastern Europe surrounding the Black Sea, Maghreb, Central Africa and Latin America, as well as in the USA and Canada.

Regardless of the disciplinary field from where the research starts off, interdisciplinarity, multidisciplinarity and transdisciplinarity are applied no longer as an adventure of attempts, uncertainty of results or a justification of the disciplinary field to make it more scientific but are integrated by their respective methodologies. This perspective allows the crossing of perspectives and sources seeking for better knowledge of the past, of local and collective memory and of the possibilities and limitations of actors to manage territories, ecosystems, religion, politics, power, war and economics.

Multidisciplinary, interdisciplinary and transdisciplinary approaches are almost "taken for granted" while concepts themselves are not. They are carefully posed as the drivers of the approaches from eco-fusion to psychological bondage with nature proposing sustainable approaches.

As a matter of fact, attitudes towards conceptualisation have altered. There is an intention of merging existing or creating new concepts in the framework of an already existing environmental history. There seems to have been a shift from trying to explain what environmental history is to how it is being shaped. It is explained how environmental history uses, copes with and accepts concepts from other sciences, instead of "adjusting" them from other disciplines or fields of work (as in many books/conferences before) to find a rough way of making them usable in historical analyses as also a way to make the discipline (environmental history) credible.

Objects as subjects became free from a dependent mono-disciplinary heritage coming either from natural or social sciences. This programme offers a very good combination of nature and natural "heroes" as main characters of the narratives; indeed themes like aliens, invasive species, naturalisation, degradation and depletion are also put in historical context, even when destruction occurred.

There is, in the papers presented here, considerable clarification of how, when and why action and impacts occurred while looking at several perspectives. There is a shift from “green imperialism” to species transfer before jumping into conclusion of finding the blame on the human side. There is an almost general concern in stressing mutual interaction between natural and human factors about keeping, changing, transforming and shaping landscapes, waterscapes and “airscapes”.

Such development can be quite efficient to produce new data and confirm or deny results of former resources and interpretations moving forward on knowing more and better about historical ground as to inform possibilities of environmental history as applied science for political and civic agency.

Thus *Environmental History in the Making* presents material for a synthesis of tendencies in the making of environmental history bringing light onto the past as a useful intellectual tool for present and future political agenda.

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Part I
Approaches – Social Bondage to Mathematics, Arts or Socio-Biology

Chapter 1
Cognition and Natural Disasters: Stimulating an Environmental Historical Debate

Niki Pfeifer

Abstract Modern cognitive and clinical psychology offer insight into how people deal with natural disasters. In my methodological paper, I make a strong case for incorporating experimental findings and theoretical concepts of modern psychology into environmental historical disaster research. I show how psychological factors may influence the production and interpretation of historical sources with respect to perceptions of and responses to disasters. While previous psychological approaches to history mostly involve psychoanalysis, I focus on (scientific) empirical psychology. Specifically, I review a number of well documented heuristics, biases, and memory modulations as described by cognitive psychology. Moreover, I argue that including investigations on disaster related mental disorders would complement the environmental historical research of natural disasters. My approach highlights a strong potential for interdisciplinary collaborations among environmental historians and psychologists.

1.1 Introduction

Traditionally, environmental history is conceived as "a kind of history that seeks understanding of *human beings* as they have lived, worked and *thought* in relationship to the rest of nature through the changes brought by time" (Hughes 2006, p. 1; my emphasis) or simply as a field which "deals with all the interactions *people* have had with nature in past times" (Worster 1988, p. vii; my emphasis). As a relatively young research field, it is well-known for its interdisciplinarity (see, e.g., Pfeifer and Pfeifer 2013). The domain of environmental history is therefore not clearly delineated against those of neighboring disciplines (McNeill 2003). The recently published *Oxford Handbook of Environmental History* (2014b) can be seen as a survey of the state of the art of environmental history. In its introduction, Andrew C. Isenberg (2014a, p. 5) mentions anthropology, biology, economics, geography,

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and sociology as closely related disciplines to environmental history. Psychology, however, is not mentioned in this list and it is not yet involved in environmental historical debates. This is surprising as psychology is one of the key disciplines for studying *people* and *thought*, i. e. central terms to the definientia of “environmental history” mentioned above. The lack of input of modern psychology in historical research in general has also been criticized by Lynn Hunt (2002).

In this chapter I make a strong case for enriching environmental historical debates by incorporating experimental findings and theoretical concepts of modern scientific psychology. The interaction between people and nature becomes especially salient in the context of natural disasters, as disasters have major psychological impacts on human cognition and may even cause mental disorders. Therefore, I focus on how environmental historical *disaster research* can be informed by cognitive and clinical psychology. On the following pages, I discuss selected cognitive heuristics and biases, memory biases/modulations, and disaster related mental disorders, all of which are well documented in the psychological literature. Of course, scientifically well founded psychological theories and concepts can differ substantially from mere folk psychological considerations. Scientifically justified knowledge has a much higher epistemic value compared with what we derive but not scrutinize from everyday life experience.

An important task of historical research methods is to shed light on circumstances under which sources were produced. It is well known that political, social, economic, and religious factors as well as motivations and *Weltanschauungen* may influence the content of sources and how they were made. I will argue that also cognition and memory can play important rôles in the production of environmental historical sources and should therefore be considered as well when historical evidence is analyzed. This is one key motivation of the present work. Another one is to draw the attention of environmental historians to a research gap: while relatively recent studies started to investigate psychological consequences of natural disasters (for a recent overview see, e. g., Shultz et al. 2013), we nowadays know very little about how people were psychologically affected by them in history, whether they actually developed mental disorders and in how far their memory and cognition was affected during and after historical disasters. These are important research questions for further elucidating the interaction of people and natural disasters in history.

Before I discuss cognition and memory, I would like to make a comment on a research tradition upon which this chapter is *not* built upon. Psychological approaches in historical research are often associated with psychohistory or work by scholars (like Peter Gay) who use psychoanalytic ideas to investigate history. This is not the kind of psychology I propose to combine with environmental history. My emphasis is on modern scientific cognitive and clinical psychology which uses experimental research methods and evidence-based reasoning. My chapter is intended to stimulate an environmental historical debate by focusing on experimentally well founded psychological factors.

1.2 Cognitive Perspectives on Natural Disasters

Natural hazards are potential threats to people, goods, or to the environment (Smith 2013, p. 13). Threats to people involve for instance mental trauma, stress, injury, or death. Threats to goods like buildings, cattle, or economic security are evaluated as less severe than threats to people. Threats to the environment like damages to wildlife or flora is evaluated as least severe compared with the hazard severity when people and their possessions are affected (Smith 2013, p. 13). Thus, the most severely evaluated consequences of natural disasters embrace the two key aspects of environmental history: people and nature. As Christian Pfister (2009, p. 17) pointed out, "[t]he concept of disaster refers exclusively to the human world."

Assessing the *risk* of a natural disaster involves combining the two questions *how likely does it occur?* and *how negative are its consequences?*. Thus, the risk of a natural disaster is seen as a function of the probability and the negative consequences of this disaster. This can be captured by the following (informal) equation, where "×" denotes a multiplicative combination:

$$\begin{gathered} Risk\left(\text{natural disaster}\right) = \\ Probability\left(\text{natural disaster}\right) \times Negative\,consequences\left(\text{natural disaster}\right) \end{gathered}$$

As we will see below, assessing risks of natural disasters can be biased by cognition and memory.

Decision theoretical research on risks involves *normative*, *prescriptive*, and *descriptive* perspectives, which aim to paint a complementary picture of human choice under uncertainty (Fischhoff and Kadvany 2011, p. 6). The study on the normative level typically involves formal analyses of probability and utility, assuming the availability of all relevant information and ideal agents. Bridging the gap between this normative ideal and reality is attempted on the prescriptive level, where prescriptions or behavioral guidelines are investigated. This prescriptive perspective offers stimulating research questions for environmental history. For example, what kind of prescriptions or guidelines for coping with natural disasters were discussed or actually issued in history? Environmental historical research could also be informed by the descriptive perspective: what actual decisions, choices, and actions were made by people in the wake of historical natural disasters? What kind of measures were thought to be effective to reduce consequences of natural disasters or even prevent (further) natural disasters?

1.2.1 Selected Cognitive Heuristics and Biases

One—in cognitive psychology—well-known heuristic is the *availability heuristic*. It denotes the tendency that the probability of an event is modulated by "the ease with which instances come to mind" (Tversky and Kahneman 1973, p. 220). For estimating the probability of a natural disaster, this means that the more salient the disaster is, the higher the degree of belief people will have in the occurrence of that event. For example, if they have read or heard about a recent calamity, they can easily retrieve an instance from memory. Thus, their degree of belief that such a disaster will strike again will be higher than in a case where they need a lot of effort to recall an example of a similar calamity. *Recall* requires active memory retrieval, i.e., the active reconstruction of a mental representation from memory. *Recognition*, however, just requires to identify representations: whether they are stored in memory or not. Recalling faces from well-known movie stars, for example, takes more effort than recognizing the face of a famous movie star among non-famous faces.

The availability heuristic is based on recall. The *recognition heuristic* works in a similar way as the availability heuristic, but it is based on recognition (Goldstein and Gigerenzer 2002, p. 77). Recognizing a substantial drawback of the sea at the beach as a tsunami indicator, for example, can make the danger salient and save life. However, if people do not recognize it, they likely become attracted by the normally not exposed seabed, walk towards the sea, and might subsequently get killed by the wave. This happened, for example, in Hilo (Hawaii) in 1946, where people thought that after such a drawback, the danger had past, but were caught in the subsequent wave, which—also typically for tsunamis—was the larger one (see, e.g., Hyndman and Hyndman 2010, p. 114). If knowledge about tsunamis were available, the natural curiosity could have been suppressed in favor of life saving fleeing action.

The *illusion-of-truth effect* is related to the availability and the recognition heuristics. It states that familiar statements are more likely to be believed than unfamiliar ones, regardless of the truth of the statement (Hasher et al. 1977). Thus, repeating or duplicating exaggerated stories about natural disasters can not only enhance the application of the availability and the recognition heuristics, but also bears the danger of producing mistaken evidence.

Another cognitive effect related to natural disasters is the *normalcy bias*. This bias may lead to an underestimation of the probability of a disaster or downplay of the extent of disaster consequences (see, e.g., Omer and Alon 1994). The normalcy bias can explain the unsuspecting behavior of people in history who faced major natural disasters. As an example consider the disaster of Pompeii in 79 CE, discussed by J. Donald Hughes (2013). When the Vesuvius erupted, Pliny the Elder demonstrated “unwarranted calm in the face of danger” (Hughes 2013, p. 127) by taking a bath, dining and having a nap. Also the younger Pliny and other people denied the hazard of the eruption at first. Not before “the house was shaking violently and threatening to collapse, they decided to flee from the town, along with a crowd of others” (Hughes 2013, p. 128). Hughes points out that even if the Romans were well aware of the possibility of volcanic eruptions—Pliny the Elder actually wrote about other historical cases of volcanic eruptions—the volcanic character of Mount Vesuvius was not recognized or worth to be mentioned (Hughes 2013, p. 122). It is plausible to assume that people thought that it would be a most abnormal situation that such a volcanic eruption would occur. Therefore, they were cognitively biased towards normalcy and behaved accordingly as if nothing would happen. This shows that the normalcy bias is a plausible explanation of the unsuspecting behavior and denial reactions of the contemporaries.

Another example of unsuspecting behavior in the face of disasters, which can be explained by the normalcy bias, can be observed in the context of the severe landslide which happened in Elm (Switzerland) on September 11, 1881 (Bläuer 2002, p. 118–119). At least 114 people died in the landslide of Elm. Although noise from falling stones was heard constantly, neither quarrying of slate was dispensed nor people were evacuated. On the contrary: bystanders were attracted and gathered close to the site "watching the mountain" (Bläuer 2002, p. 118). The contemporary Swiss geologist Albert Heim described the pre-disaster attitude of the people as a "kind of psychological infection or hypnosis. The anxious are mocked […,] the danger [is] negated [… and] pleasant things are preferred over dreadful things" (Heim 1932, p. 207). Heim reports that such attitudes were also present in two further places in Switzerland where disastrous landslides had happened, namely in Plurs—where people who tried to warn others were even beaten up—and in Goldau (Heim 1932, p. 207).

The landslide of Elm was likely caused by irresponsible and excessive quarrying of slate and the authorities of Elm were aware of that (Bläuer 2002, p. 120). In this context, Bläuer (2002) describes another psychologically interesting aspect with respect to the spread of information about the disaster, which can be interpreted as an instance of *selective perception*. Selective perception denotes the well-known phenomenon that expectations can affect perception. While communicating about the disaster of Elm, press and politics deliberately presented the event as a *nature-induced disaster* to enhance fund-raising (Bläuer 2002, p. 120). Fund-raising became a major source to help to overcome natural disasters in the second half of the nineteenth century, and donations were more likely to be made if the disaster appeared to be a strike of nature and not man-made. Thus, it is plausible to assume that selective perceptions were generated in Elm, where the attention was drawn to the disaster consequences and, by doing so, drawn away from man-made causes. Research on selective attention is interesting for environmental historical investigations, as it has a huge potential to explain what information is reported and what information is omitted in historical sources.

The *confirmation bias* is closely related to selective perception. This bias denotes the phenomenon that information or memories that endorse one's preconceptions are preferred (e.g., Nickerson 1998). Medieval and Early Modern Christian sermons on natural disasters often refer to the Bible or to the Last Judgment, especially when a reason why a disaster had happened is mentioned. This practice can be interpreted as an instance of the confirmation bias. Like selective attention, the confirmation bias can be useful for analyses of environmental historical sources on the causes of natural disasters.

The *just-world hypothesis* denotes the tendency to believe that the world is fundamentally just. It allows for rationalizations of inexplicable injustices as "deserved" by the victims (Lerner 1980). Just-world hypotheses are relevant for understanding religious explanations of natural disasters. Jussi Hanska (2002, p. 103), for example, reports historical cases from the Middle Ages, where political/religious adversaries were blamed for the occurrence of pestilence in the year 1285:

> The sword of God's wrath killed Pisans [with pestilence] because they had rebelled against the Church for a long time and captured in the sea the prelates on their way to Council, which was convocated by the late pope Gregory IX. (Salimbene de Adam, *Cronica*, 13th century; cited after Hanska 2002, p. 103)

Here, the rebelling against the church or the capturing of summoned delegates was seen as unjust by the author of this source. Therefore, he apparently rationalizes the pest as God's will and deserved by the victims. In a similar vein, the just cited *Cronica* mentions the following causal explanation of the flood of Venice in 1284: "this disaster happened to Venetians because they were excommunicated at the time" (cited after Hanska 2002, p. 104). This explanation can be interpreted as another instance of the just-world hypothesis.

Illusory correlation is a cognitive bias which occurs if a relationship is inaccurately seen between two events which are actually related by coincidence (Chapman 1967). An example of an illusory correlation is discussed by Katrin Pfeifer (2014, p. 123) in the context of a severe storm which raged over the Dutch city of Utrecht in the year of 1674 (see also Hauer and Pfeifer 2011; Pfeifer 2015). Here, the following lines of an anonymous contemporary tract, as Pfeifer notes, most likely relate the storm of 1674 to another severe storm which heavily damaged an army of King Edward III. in April 1360 (for more information see Sumption 1999, p. 443):

> Thus you have a relation wherein you see how loudly in signs and wonders, in Storm and Thunder, God calls to Earthly Mortals, let not your Ears be deaf, but make some use of it. It is Chronicled that in the time of our victorious Edward the third, being in France and ready to fall upon the French Army, then just by him, there happened such a terrible Storm and Tempest of Thunder and Lightning, that that couragious Warriour being affrighted with it, as taking it to be a sign that God was displeased at that cruel War, he took an Oath presently to make Peace on any reasonable condition, which he accordingly performed. (anonymous tract of 1674 cited in Pfeifer (2014, p. 123))

In this quote, the illusory correlation consists in attributing the cause of the severe weather which battered the army to God's will.

The *rhyme as reason effect* states that rhymes are perceived as more truthful than non-rhyming words (for experimental support see, e.g., McGlone and Tofighbakhsh 2000). Poems about historical severe storms illustrate that rhymed words can serve as important environmental historical sources (see, for example, Pfeifer 2014; Pfister et al. 2010). The rhyme as a reason effect is important for the interpretation of poems on natural disasters. As noted by McGlone and Tofighbakhsh (2000, p. 426), already Friedrich Nietzsche noted in *The Gay Science* (1887) that even the wisest of us can be fooled by the rhythm, that a thought appears to be truer if it is in metrical form. In his words:

> *[…] wird auch der Weiseste von uns gelegentlich zum Narren des Rhythmus, sei es auch nur darin, dass er einen Gedanken als wahrer empfindet, wenn er eine metrische Form hat und mit einem göttlichen Hopsasa daher kommt.* (Nietzsche 2013, p. 97, paragraph 85 of the second book of *Die fröhliche Wissenschaft*)

Given the experimental confirmation of Nietzsche's hypothesis about rhymed thoughts and their implicit appeal to truth, it sounds plausible, that people believed in the effectiveness of strategies against calamities, especially if they were formulated in rhymes. The pastor Christoph Stahlius, for example, wrote a sermon a few days after a fire which destroyed large parts of the center of the hanseatic city of Rostock in August 1677:

Nichts staercker mag auff Erden seyn	Nothing on earth can be stronger
Als frommer Christen Seufzerlein	Than the sights of pious Christians
Denn offt ein schreckliche Feuers = Gluth	As often a terrible fire's glow
Das liebe Gebet außleschen thut.	Extinguishes the dear prayer.

(Stahlius, C., 1678; original and translation cited after Allemeyer 2007, p. 146)

Prayers were a common mental coping strategy for dealing with natural disasters. Sources like the just mentioned one illustrate that religious practices were thought to prevent disasters.

Environmental historical sources were usually written after the disastrous events had happened. Thus, they were produced in hindsight. The *hindsight bias* states that knowledge of the outcome of a past event increases the postdicted probability of its occurrence (Fischhoff 1975). Such "I-knew-it-all-along" effects can be found in causal explanations of natural disasters, for example in sources which identify God's anger as the cause of a natural disaster, because—in the eyes of the writer who had produced the source—people had lead sinful lives.

1.2.2 Selected Memory Biases/Modulations

False memory (or creative confabulation) denotes a memory bias which aims to make the account more complete or more coherent by adding details which are neither experienced nor initially encoded. This memory bias can create wrong historical evidence. False memory can even be enhanced by the *self-generation effect*. As the name suggests, this effect states that a person remembers an information best when the information is generated by herself or himself (Jacoby 1978). If the information is constantly reproduced—for example by copy-paste from and to tracts, pamphlets, or newspapers and possibly further modified by self-generated false memories—then it may enter easily into the public memory but creates a distorted picture of what had really happened there. False memories can also be enhanced by the *misinformation effect* (Loftus 2005). This effect occurs if people are asked to remember some event and are presented with misleading information. It has been experimentally demonstrated that this misleading information can produce false memories: "people come to believe falsely that they experienced rich complex events that never, in fact, occurred" (Loftus 2005, p. 361). Thus, if information becomes available *after* the event, it can change the memory thereof. This can modulate eye witness accounts substantially and may even distort them.

Rogers et al. (1977) observed that if encoded information has some self reference, it is more easily recalled than semantically encoded information, i.e., if it is encoded without self reference. This phenomenon is called *self reference effect*. When interpreting historical sources it is therefore important to bear in mind that contemporaries who actually witnessed the disaster themselves might remember it better than those who only heard about it. However, there is also the danger of an *episodic memory/semantic memory confusion*. This happens when people mistakenly believe that they had experienced the event they recall, but have originally not experienced it, but just encoded it semantically, e.g., from hearsay. Thus, alleged eyewitness accounts could actually be stories learned from other people and not experienced by the producer of the account.

The *Von Restorff effect* denotes the phenomenon that the unusual is remembered more likely than the ordinary (von Restorff 1933). This is of course highly relevant for the environmental history of natural disasters: disasters are usually exceptional and unusual and therefore likely to be remembered. Here is an example. In the first lines of his 139 stanza poem the seaman Gerrit Jansz Kooch points out that the severe storm of 1674 is an unusual occurrence:

Hollans Orkaen	The Dutch Hurricane
1	
ofte verhael van de ongemeene ende noyt diergelijcke stormwint hier te lande gesien […]	or the story of a *strange storm which has not been seen before* [my emphasis] in this country […]

(Kooch, G. J., 1674; original cited after Pfeifer 2014, p. 242)

This quote illustrates the Von Restroff effect: apparently, this storm had been so unusual, that Kooch had remembered it and had written about it.

1.3 Disaster Related Disorders: Environmental Historical Desiderata

According to Shultz et al. (2013, 781), the extent to which disasters impact on people and societies is directly proportional to its destructive and harmful effects. Thus, the more destruction and harm is caused by the disaster, the higher the impact on people is to be expected. The authors list the following five hazard descriptors which modulate disaster effects: intensity, duration, frequency, proximity to the location of the disaster, and the size of impacted territory including the number of affected people (Shultz et al. 2013, 781). Of course, not only characteristics of the disaster but also those of the people and the society influence the severity of the psychological impacts. For instance, lack of social networks, missing warning systems, low income or high age can intensify vulnerability and the negative consequences of disasters (Wisner et al. 2004; Bolin 2007).

The *International statistical classification of diseases*, currently in its 10th revision (short: ICD-10), provides an excellent conceptual framework to investigate disaster-induced mental disorders, readily adaptable for environmental historical research questions. The ICD-10 was developed by the WHO (2008). It is currently the most widely adopted statistical classification system of diseases. In addition to the three volumes containing the classification as a tabular list (volume 1), the instruction manual (volume 2), and an alphabetical index (volume 3), the WHO (1993) published a book on diagnostic criteria for research according to the ICD-10. The diagnostic criteria are characterized with clear inclusion and exclusion criteria for identifying the respective disease.

The diseases are coded by combinations of letters and numbers. All mental disorders, for example, are classified with a code beginning with the letter "F". As an illustration of the diagnostic criteria for disaster related mental disorders, those of the *Post-traumatic stress disorder* (which is labeled by the ICD-10 code "F43.1") and those of the *Enduring personality change after catastrophic experience* (labeled by "F62.0") are reproduced in Figs. 1.1 and 1.2, respectively. Both lists of criteria can be directly applied to historical source material, in order to identify mental disorders as consequences of natural disasters. Ideally, historical prevalence and incidence data could be collected and compared with today's statistics. In analogy to historical climatology, which has become an important discipline to understand and better contextualize today's issues of global warming, historical investigations on disaster-related disorders could provide important insights into psychological

A. Exposure to a stressful event or situation (either short or long lasting) of exceptionally threatening or catastrophic nature, which is likely to cause pervasive distress in almost anyone.

B. Persistent remembering or "reliving" the stressor by intrusive flash backs, vivid memories, recurring dreams, or by experiencing distress when exposed to circumstances resembling or associated with the stressor.

C. Actual or preferred avoidance of circumstances resembling or associated with the stressor (not present before exposure to the stressor).

D. Either (1) or (2):

   (1) Inability to recall, either partially or completely, some important aspects of the period of exposure to the stressor

   (2) Persistent symptoms of increased psychological sensitivity and arousal (not present before exposure to the stressor) shown by any two of the following: (a) difficulty in falling or staying asleep; (b) irritability or outbursts of anger; (c) difficulty in concentrating; (d) hyper-vigilance; (e) exaggerated startle response.

E. Criteria B, C and D all occurred within six months of the stressful event, or the end of a period of stress. (For some purposes, onset delayed more than six months may be included but this should be clearly specified separately.)

Fig. 1.1 Diagnostic criteria for *Post-traumatic stress disorder* (F43.1; WHO 1993, p. 120–121)

A. Evidence [...] of a definite and persistent change in a person's pattern of perceiving, relating to and thinking about the environment and one self, following exposure to catastrophic stress (i.e. [...] disaster; prolonged exposure to life-threatening situations).

B. The personality change should be significant and represent inflexible and maladaptive features as indicated by the presence of at least two of the following: (1) A permanent hostile or distrustful attitude toward the world [...]; (2) Social withdrawal [...]; (3) A constant feeling of emptiness and/or hopelessness [...]; (4) An enduring feeling of "being on edge" or being threatened without any external cause [...]; (5) A permanent feeling of being changed from the others (estrangement) [... may be associated with] emotional numbness.

C. The change should cause either significant interference with personal functioning in daily living, personal distress or adverse impact on the social environment.

D. [...] should have developed after the catastrophic experience and there should be no history of a pre-existing [...] disorder [...] that could explain the current personality traits.

E. [...] must have been present for at least three years. [...]

F. [...] meeting the above criteria is often preceded by a post-traumatic stress disorder [see Figure 1; ...]

Fig. 1.2 Diagnostic criteria for *Enduring personality change after catastrophic experience* (F62.0; WHO 1993, p. 158–159)

impacts of natural disasters on people throughout time. Such research would help to better understand and to contextualize today's interaction of clinical phenomena and nature.

1.4 Concluding Remarks

Is the attempt to apply scientific concepts and theories of modern psychology—which were mainly discovered during the twentieth and twenty-first century—to previous centuries a form of historical anachronism? I don't think so. The investigation of environmental historical sources in the light of experimentally verified and well documented psychological phenomena does not presuppose that people of the past had to be aware of these phenomena. In principle, psychological phenomena can be found from ancient times until nowadays. Moreover, it is more than just plausible to assume that psychological factors had influenced the production of historical sources. My line of argument runs on a methodological level. Method is not necessarily prone to historical anachronism. Using an analogy: utilizing today's methods of dendrochronology to estimate the age of a wooden historical object of a past century, say the 10th, is certainly not an anachronism.

The selection of the illustrative examples taken from different parts of the world, time periods, and various kinds of natural disasters sketches the broad applicability of the proposed approach. The examples discussed above show that environmental historical sources can be biased because people are vulnerable to cognitive and memory biases. This also holds for many historical sources in general. Thus, convergent sources may help to confirm the coherence and consistency of historical narratives, but they are not a sufficient indicator for correctness. As explained above, some of the cognitive and memory biases are even fueled by the availability of multiple information of the same kind. Therefore, convergent sources may still be biased by cognitive and memory factors and this should be kept in mind when written and pictorial sources are interpreted.

To my knowledge, ICD-10 criteria have not yet been applied systematically to mental disorders which had developed during or in the aftermath of *historical* natural disasters. It would be most interesting to investigate the prevalence and incidence of mental disorders in historical populations. This would help to understand how widespread and how probable disaster-induced mental disorders have been throughout time, which in turn would help further to better contextualize and understand today's statistics of these disorders. It is high time for a new psychological subdiscipline of environmental history, which sheds light on the interaction of disaster and mental disorder specifically, and on the interaction of nature and mental health through history in general.

Finally, I would like to stress again that instead of folk psychology or psychoanalysis, one should incorporate insights from scientific psychology into environmental historical research. As mentioned above, scientifically justified knowledge has a much higher epistemic value compared with what is usually derived but not scrutinized from everyday life experience. Therefore, collaborations among environmental historians and psychologists should be intensified.

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Chapter 2
Peopling Landscapes Through Art

Mandy Martin

Abstract Visual art is often integral to environmental history and is used not only as a starting point for research but often is the historical artefact itself. Many environmental historians use visual art references in their work and there are accomplished artists and photographers who are also environmental historians. This article is about the nexus between artistic practice and environmental histories and is about how I use that to people landscape through art. I will discuss, by focussing on four examples, how my pioneering interdisciplinary art and environment projects were driven by a field work methodology which is socially inclusive and broad ranging across land-systems. There is a scarcity of cultural, scientific and historical material about the rangelands and desert regions of Australia where I have undertaken these projects and for a number of these places it is the first time any visual or written documentation has been recorded, making them valuable environmental history documents. This is especially true for the Indigenous stories and images recorded in my co-edited publications and makes them rare Environmental history documents which reveal the connections of people and landscapes through the deep time of Australia's history. They also reveal its more recent histories since second settler societies arrived in Australia and ask questions about its future. Knowledge is to be gained from these stories and images and likewise my own paintings, which are an aesthetic evaluation of those landscapes and contribute to our knowledge and understanding of people, landscapes and their histories.

2.1 Not in arCadia Ego

The Central West of New South Wales in Australia where I live is a landscape that has been utilised for over 200 years since second settler colonisation, for grazing, cropping and mining. Our main family business, established in 1931, is in the cattle industry. Australia like most other countries with bountiful mineral resources, has seen a huge renaissance of mining during the recent mineral resources boom. Prices

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have been high enough for new ventures to start and old ones to be reincarnated. Near where I live, copper, gold, coal and coal seam gas are all mined. Our neighbour is Cadia Gold Mine, owned by Newcrest and it is the largest copper and gold mine in the Southern Hemisphere and apparently, soon, the world. We own property which abuts this mine and lease land from them for cattle grazing as well.

Although we went through the formal process of responding to the Environmental Impact Survey when the mine was redeveloped in the 1990s, having been mothballed for a period and took part in another process where the Environmental Defenders Office put forward a submission on our behalf, I felt that as an artist who had pioneered Art and Environment Projects in Australia in the 1990s, I should respond to the presence and growth of Cadia Mine. I have had a long history of painting industrial subjects and it seemed serendipity in a perverse way to end up living next to a mine.

I was an art lecturer at Canberra School of Art, Australian National University until 2003 and had established the Environment Studio there in 2001. I brought groups of students, lecturers and other stakeholders, out to the Central West of New South Wales, on several week long field trips. Our base camp was on the Belubula River on one of our properties adjacent to the Cadia Gold mine. I also had two university groups from the USA visit as part of the program. The intention was to teach students the methodology I had used in my previous environmental art projects. I also wanted to involve and meet more of the local community as a way of developing support for sustainable land practices and raising consciousness about the impacts of mining, so opened the project to local people. As landowners we have to mount regular responses to wind-farms, dams, subdivision and in the face of an immutable giant like a gold mine, it seemed a good idea to work as a team to examine issues surrounding gold and water.

The project came to be called *Land$cape: Gold & Water*. We produced four exhibitions and two publications[1,2] and in all, after 2 years, 28 people had written essays, made art and taken photographs. Everyone, regardless of whether they were a professor of geomorphology, a local farmer or an environmental historian, made artwork. There were several local artists, some of whom had never exhibited and other established artists who chose to work in new media and a host of others including a biologist, a vet, a gold and silversmith, a ceramicist and local Indigenous Wiradjuri people and three environmental historians.

I've flown over the mine several times and grapple to understand the enormity of its' waste rock and tailings dams which cover prime agricultural land that a succession of farmers have worked for up to eight generations. There were 14 neighbours bought out totally by the mine under confidential agreements, who have disappeared from the region along with their families, workers and sub-contractors. The total permanent workforce for the mine while it is in production, will not be much greater

[1] Martin, M. *Land$cape: Gold & Water* 2003 Goanna Print Canberra, ACT. http://mandy-martin.com/wp-content/uploads/2014/01/landscape_gold_and_water.pdf

[2] Martin, M., Ryan, S. *The Lachlan: Blue-Gold.* 2003 ANU, Canberra ACT. https://digitalcollections.anu.edu.au/handle/1885/41046

than the number of people previously working and living in the region. The open cut mine was defunct after 10 years in 2006, the newly extended underground mine, opened in May 2014 is currently 1.5 km underground and tunnelling east, it will be exhausted by 2030. This could change as they are always surveying for more. We personally live with exploration licences over all our land that might become active at any time. Currently the mine is test drilling on our property and talking about 2050 as an eventual expiry date for their operations. In Australia, we don't own the earth beneath us or the sky above, the mining companies can mine on our property right up to the garden fence.

On a personal level, I responded by making paintings, some of which acted as protest works in a polite and establishment manner but hopefully do give people room for contemplation and some soul searching. They also become a rare record, part of an environmental history. In my *Not in arCadia* series I painted 50 small canvases of the river which runs through our property and which the mine pumps water from. I collected pigments and earths from the river and mixed these with gold mica and oil to make these paintings. The gold signified the fact that the real value of this landscape was in its natural environment and the sand and other materials signified the materiality and textural qualities of the place. I also painted 50 small paintings of the mine in stages of development. I added copper mica, simply signifying the material being dug out of the ground there but also because the mine glows in hues of orange and copper in the evening light, mainly because of light refraction but also the natural soil colour. I mixed the copper mica with oil and tailings and slurry concentrate that I collected at the mine site as the materials for those paintings and a large diptych. These 100 small canvases were hung in a grid, either side of the 570 cm diptych of the tailings dam. It is inscribed with text from the same professor of geomorphology that I mentioned, John Chappell. The text reads;

> *The Rock is grey, without lustre: the ore is dross: only through technical stealth of sag-mill and flotation, something auriferous and smeltable is crabbed from the wretched stuff: less than a gram of gold in a tonne of rock; poorer than uranium in a coral reef. (Field Book, 4.30 P.M. June 21, John Chappel)*

John Chappel's sculpture, *Water-Stress* 2002 was also in the *Land$cape: Gold & Water* exhibition and was his first ever art work. It was a massive undertaking made from found and recycled materials like corrugated iron, water pipes and electrical fittings. The sculpture which was more than 2 m in height, sat in a shallow tray of water which pumped to the top of the structure, then trickled down, tilting the iron plates kinetically as it descended, simulating, the deep geological structure of the valley and its water tables in drought and wet cycles. The Orange Regional Gallery had to replace their parquet floor after exhibiting this piece but they considered the work a triumph so didn't complain!

Placed in between my installation on the wall and John Chappel's floor sculpture was an installation of hand painted stones which snaked across the gallery. My elderly neighbour, who was well into her 19 eighties, and had never exhibited before, painted hundreds of river rocks in the last decade of her life, I collected most of the rocks for her and she loved the anthropomorphically shaped ones which she embellished with the likeness of sheep, dogs, cows, famous sports people, the royal family, local bushrangers and native fauna. They were a wonderful eclectic river of life which represented the European settlement of their property in 1840. The barn and surrounding building were built by Australian convict labour and the original carriages the family came over the Blue Mountains from Sydney to take up the King's grant of land, remain there still while the family has gradually dwindled.

An almost life size canoe, carved roughly out of wood salvaged from the river by local Indigenous man from the Ngiyampaa tribe, Gerry Payne, welcomed visitors to the exhibition and announced that visitors were guests in Country belonging to Traditional Owners.

Environmental Historian, George Main wrote an essay for *Land$cape: Gold & Water* and he contributed a large black and white photograph to the exhibition titled *The view from Bexley woolshed*. His photo is taken from inside the shearing shed, now used to store packets of tailings concentrate samples and the shed, is now within meters of the tailings dam rock wall. The photo is a poignant reminder of the casual way in which we throw away our agricultural and rural histories. These are only a few of the exhibitors and writers in the project, funded in part by a personal Federal government Land and Water fellowship for the publication, personal artist fees from Orange Regional Gallery, our own pastoral company, the Cadia gold mine, a small contribution from the Fenner School of Environment and Society, Australian National University and also by my job at the university. It is a good example of how landscape can be peopled through art and demonstrates how my inclusive, interdisciplinary methodology can be put into action and be used in a novel way to contribute to and even mediate in a polarised and ongoing debate between communities and international mining giants. The exhibition opening in the city closest to the mine, Orange attracted a big audience including the mine administration and personnel and many other local stakeholders, international and national visitors. The publication is available on line and some of the art works are now in public and private collections including my work which is a rare record now of the development and history of the mine.

What also lead to this large ongoing project was the fact that as neighbours and local stakeholders we were required, procedurally, to mount a response to the development of the gold mine, we were then required to cooperate with surveying, hydrological and Environmental Impact Surveys which meant negotiating with the mine frequently, as we still do now. Another part of our response was more speculative and emotional. The EIS for the property showed a number of Aboriginal artefact scatters and a scarred tree. Before we fenced the tree off under EIS requirements, I asked some Wiradjuri people to come and visit the scar tree, then I invited Traditional Owner Alana Harris, a photographer, to photograph the scar tree and the river. I painted large canvases of the river and the tailings dam and we installed our works in a collaborative installation, titled *They have a faith to move Mountains*, 2001. Alana Harris and Mandy Martin. It was exhibited at Bathurst Regional Gallery, New South Wales 12 April–11 June 2001. I exhibited the full series subsequently in *Alchemy. Cadia Hill Gold Mine Art Project* January 2002–February 2002 at Orange Regional Gallery, New South Wales. These works were the precedent for the larger installation *not in arCadia ego* which I painted and exhibited as part of *Land$cape: Gold & Water*. One of the Wiradjuri people who visited with Alana Harris, was her cousin, Trisha Carroll and she became the mentor and one of the artist participants in both local art and environmental projects. She ran traditional knowledge workshops which included welcoming us to Country, introducing us to collecting traditional ochres and binders, making brushes and painting traditional Wiradjuri totems like the kangaroo, goanna and long necked tortoise, in the x-ray style of painting traditionally used in this region. Trisha exhibited a number of artworks in the project exhibitions including *Protecting the gathering*. We still work together in an ongoing collaboration that has included contributing to conferences, most recently the Nelson Institute Center for Culture, History and Environment, University of Wisconsin, Madison's *The Anthropocene Cabinet of Curiosities Slam* in November 2014. Our object for the Cabinet, titled *Davies Creek Road* is in fact a diptych painting, 30 × 90 cm, pigments, ochres and binder on Arches paper. It also depicts a pair of goannas like those in Trisha's painting *Protecting the gathering*. The Goanna, Varanus Varius, is Trisha's totem which means she is forbidden to eat it and has a special association with it. They certainly move around our country in the summer time and are frequent visitors, looking for fledglings and hen eggs to eat. They grow over a metre long and have intricate colours and markings. The Wiradjuri name for the goanna is Girraway and there are many stories about how the goanna got its colours. Our painting alludes to the waves of Anthropogenic extinction which have exacted a slow violence on our valley. Current plans are to build a dam and flood this valley thus destroying local ecosystems, including that of the goanna, a heritage listed cave system with 6000 year old human remains and several neighbours farms and houses, including Trisha's. Where we live is hotter and drier because of Climate Change but building more dams will not make it rain or "drought proof" our region to benefit irrigators and the mining industry. Trisha and I are planning on painting a large diptych at present as a speculative response to this potential catastrophe.

Land$cape: Gold & Water and *The Lachlan: Blue-Gold* were the first environmental projects that I had undertaken where I was able to employ Aboriginal Traditional Owners to be mentors, something very important in Australian landscapes and in a project of this sort. When experts are commissioned to undertake a "View-shed" or aesthetic evaluation, there are many considerations about heritage and indigenous value, which is why working with Traditional Indigenous Owners is important. Import is placed on historic, architectural and cultural values like whether the landscape has inspired poetry or art or entered mythology for some other reason. A Wiradjuri man worked with the men in the group and included the male ceremony of didgeridoo painting and playing. He was also able to paint traditional face masks on both male and female participants.

In one sense I undertake a View-shed when I do an art and environment project. For me, the art I make is the evaluation, however I know that landscapes have many different stories and voices and try therefore to involve as many viewpoints as possible. In *Land$cape: Gold & Water* and *The Lachlan: Blue-Gold* we looked at the deep time of the Lachlan River Valley and its sand sediments which are over 20,000 years old and traced changing climate change patterns and population shifts. The archaeologist who researched Bigga Rocks, an Aboriginal rock art site, near the source of the Lachlan River, said the paintings there are likely to be 600 years old and clearly show Spirit figures or Wandjina, kangaroo and emu, located around the central motif of a long red Rainbow Dreaming snake or river. This seminal image indicates the significance of the Lachlan River to the Wiradjuri people and that it was rich in wildlife which was a significant food source. As I have described, Trisha Carroll still uses all these motifs in her paintings.

2.2 *Haunted*; Wiradjuri Protest in the Lachlan Valley

Shortly after this in, there was a local Wiradjuri protest, centred in another local town, Cowra, which is located on what was a rocky crossing point of the Lachlan River used by Aboriginal people moving and trading across Country. It had been a traditional meeting place for thousands of years and therefore many sacred scar trees occurred around this site. The protest and sit-in lasted months and began after the local government council bulldozed two of the scar trees without permission, with more potentially threatened, for a housing development. As a protest and to allay our grief at this destruction, Trisha and I worked in my studio on a large painting which included a number of these trees and a birthing site. I didn't depict the actual trees because this would not have been culturally appropriate, trees are seen as ancestor spirits but I chose to paint the view looking away from the significant trees. We titled the 7 m painting *Haunted 2* and we painted it using natural found ochres and earth pigments mixed with oil, which themselves are potent signifiers of materiality and spiritual connection to place. Trisha introduced linear motifs in the x-ray style to represent the river and a birthing site and my broad sweeping landscape with trees was cut by a dramatic shaft of light which could also be read as a symbol of spiritual presence. The paintings were exhibited in two major gallery venues.

I continue to paint my local region and have been engaged in a long series of artworks which deal with issues primarily surrounding climate change and human folly. In the painting *Wanderers in the Desert of the Real, The Tailings Dam* 2008 I depicted the land near the Cadia Gold Mine Tailings Dam which my husband's grandfather first bought and built the family house. In the same painting, and just to the right of that property, is where Trisha lives in a tin shearer's cottage. Her grandparents and ancestors before that lived in this country. Under the tailings dam is land that brought up a family of 12 during the depression, I picked up an Aboriginal green stone axe head there as the tailings submerged their woolshed. The deep connections of the Wiradjuri are threatened, evidence now buried beneath the tailings dams and waste rock heaps.

2.3 *Vivitur ex Rapto* (Man Lives Off Greed)

Two hours' drive to the north of where I live in New South Wales, the people of Bulga, in the Hunter Valley, had their latest stand just at the end of 2013, against the expansion of the Warkworth mine. The deed Rio Tinto signed a decade ago was neutered enabling Rio Tinto's to expand the Warkworth coal mine and start mining more of the 550 million tonnes of coal. This includes the ancient Warkworth Sands Woodlands, formed some 18,000 years ago by windborne sands and found nowhere else on earth. I made a large painting, *Vivitur Ex Rapto*, with DVD projection of a sequence of slow moving blasts, as a homage to the struggle and grief of the people of Bulga, whose land and houses, stuck on a thin strip of land between expanding mines, has become rapidly worthless. The wildlife and ancient heritage are to be offset with another bit of land, one that in reality we know does not exist, they have been deemed expendable also it seems. This is happening as I write in 2014.

2.3.1 Environmental Art Projects in the Channel Country

Similarly my interest extends to other parts of Australia, some distance from where I live. Some years ago in 1997, I was asked by an ecologist, why I was involved in the environmental fight to save Coopers Creek in South East Queensland, Australia, from irrigation, rather than just fighting the environmental battles in our own region. My answer was that, although that part of the world, known as the Channel Country, is over a 1000 km from home, I felt I had skills and strategies of use to help the Channel Country community fight their battle and that as part of a community of interest, we might actually succeed there, whereas, in our part of the world, our fight was basically lost some time ago to mining. Communities rarely succeed against huge mining giants like Newcrest, all one can do is minimise impacts.

Three Environmental Art Projects have taken me to the Channel Country since 1995 and I collaborated with number of writers on those projects and publications including environmental historians Jane Carruthers and Libby Robin, environmental consultant and anthropologist, Guy Fitzhardinge, historian, Tom Griffiths, zoologist, Chris Dickman and archaeologist, Mike Smith. We have moved and worked extensively over SE Queensland.[3]

As an artist I paint histories, a painting of course freezes a moment in time but can also speak about changes and transformation. What has proved very effective as

[3] Martin, M., Fitzhardinge, G., Haynes, P., Sinclair, P., Tracts: Back O' Bourke, 1996 Goanna Print, Canberra.

Martin, M., Fitzhardinge, G., Griffiths, T., Haynes, P., Watersheds: The Paroo to the Warrego, 1999 Goanna Print, Canberra.

Martin, M., Carruthers, J., Fitzhardinge, G., Griffiths, T., Haynes, P., Inflows: The Channel Country 2001 Goanna Print, Canberra. http://environmentalhistory-au-nz.org/links/publications/inflows.pdf a way of communicating with audiences is verifying the locally held aesthetic of place. Often that aesthetic takes a while to learn and or see but seeking out these differences helps me to find a common place and from there, other ideas about those landscapes can be introduced. This is a non-threatening, affirmative way of presenting familiar places to communities often polarised, in the case of South Eastern Queensland between those for and against irrigating the last great wild river system in Australia. All reconciliation processes need a point of consensus to start negotiations. So when I worked with a team on the environmental art project, *Inflows: the Channel Country*, I painted Cullyamurra Waterhole, a remote waterhole on Coopers Creek. It has immense significance in both Aboriginal histories and European exploration histories, being a site rich in wildlife, fish and water utilised for millennia by Traditional Owners but near where Burke and Wills perished of starvation and thiamine poisoning, on the ill-fated expedition of exploration of inland Australia. I was painting a highly contested site. Jane Carruthers, eminent South African historian, in her own way performed the same role as an outside voice within the *Inflows: the Channel Country* team because she was able to present comparative environmental histories. She is of course a very knowledgeable art historian as well. She was able to voice issues which in Australia, 14 years ago, were still raw and divisive but she was able to raise them with authority and impartiality. For example, South Africa, as a nation, were ahead of us with reconciliation stories, and Jane was able to talk about the environmental lessons learnt about banishing Indigenous peoples from National Parks and their lands. Blame is difficult to avoid when one looks at the history of Indigenous people who were forcibly removed from landscapes and also when discussing the subsequent degradation of landscapes by Eurocentric farming and grazing practices.

Rachel Carson Center have published a special book honouring Jane Carruthers, *The Edges of Environmental History* edited by Libby Robin and Christof Maulch.[4] At the WCEH in Guimaraes the Portuguese version was launched online including the full PDF of my Inflows paintings and Jane's insightful essay from *Inflows: the Channel Country.*

Environmental historians can offer communities new constructions and positive stories and also stories which help us understand ourselves and the special places we live which for many people are incomprehensible. These places are often invisible and unseen which is where I can help a little by picturing those places.

They are invisible in one sense, because they are often non places, not spectacular as major ticket tourist attractions but they hold unique histories and environments. Visual complexity and drama come from the colour, texture, light and difference of each ecosystem. I painted places in the sand-hills of the desert to the dry raised watersheds of the channels themselves finding beauty in unexpected places. Painting alludes to the complex narratives in a place but doesn't tell us the story in a literal or didactic manner.

[4] Mauch, C., Robin, L., *The edges of Environmental History. Honouring Jane Carruthers*. 2014 Rachel Carson Center for Environment and Society LMU Munich.

2.3.2 *Strata: Deserts, Past Present and Future. An Environmental Art Project About a Significant Cultural Place*

In 2005, Libby Robin, Mike Smith and I were part of the team for and editors of *Strata: Deserts, past present and future. An environmental art project about a significant cultural place*.[5] The field trip out to the Cleland Hills in the Northern Territory was an extraordinary insight into Mike's life and work as an archaeologist working across the deserts of Australia but more so to the ancient history of Puritjarra itself, known also as the Cleland Hills.

The publication headed by Libby Robin, included essays on archaeology, environmental history, art and ecology and then commissioned art works from eight Aboriginal artists; Narputta Nangala Jugadai, Daisy Napaltjarri Jugadai, Molly Napaltjarri Jugadai, Anmanari Napangka Kantawarra, Alice Nampitjinpa, Linda Ngitjanka Naparuula and myself, responding to the site.

We camped some kilometres away from the rock shelter and every day, to protect the site, carted my canvases and art materials, over the dunes rather than leaving signs of our presence overnight. I painted three large, five panel canvases, 76×385 cm. I used found pigments, sand and ochres to capture the panoramic scope of this impressive and ancient landscape.

I also painted four collaborative, five panel works on paper, each work in full 30×200 cm with Libby Robin and each of the scientists, Guy Fitzhardinge, Jake Gillen and Mike Smith.

The content of the collaborative panels was determined by each of my collaborators. Each of us brought our own understanding to the project, mine was an aesthetic response using found natural pigments and working within a European panoramic convention. Libby whose formal training is in environmental and scientific history, designed the interdisciplinary opportunity for collaboration between science and art and between western and traditional ways of knowing in a place. Mike brought his long archaeological perspective and community contacts with the elders and the artists. Guy Fitzhardinge turned his stockman's eye to the health of the country and environmental threats and problems. Jake Gillen, an arid zone plant ecologist identified the bush tucker and assessed the biodiversity.

My painting with Libby Robin focussed on Deep Time and she inscribed her work with a sentence from Mike Smith's book '*Peopling' the Cleland Hills* 2004*, An archipelago of islands in a sea of desert*.[6] She used a fragment of the 14 c carbon from the floor of the rock shelter to draw land shells found at the site which she found reminiscent of when it was a sea. The central panel of the work had large

[5] Martin, M., Robin, R., Smith, M., *Strata: Desert Past, Present and Future. An environmental Art Project about a Significant Cultural Place* 2005 Goanna Print, Canberra ACT. http://learnline.cdu.edu.au/tourism/uluru/downloads/strata.pdf

[6] Smith, M., *'Peopling' the Cleland Hills: Aboriginal history in western central Australia*, 1850–1980. Aboriginal History Monograph, 2005.

letters embedded into the layers of paint; S 23°E 130. The text was like an elaborate copperplate embedded into the colours of the sky and desert. My desert panorama painted from an elevated position depicted a wave crashing onto the desert floor referring to the fact that this had been an inland sea.

Mike Smith began his archaeological work in Central Australia in the 1980s and the artefacts he dug from this site radically changed evidence of the dates people had dwelled in the Central Australian deserts, back to 35,000 years, that is, back into the ice-age. Mike had also studied the rich rock art at the site, the cultural signatures of people who had sheltered at Puritjarra rock shelter in the past over about 1000 years. When we painted together, Mike and I sat down at the half mast easel, in fact an ironing board and Mike began talking about desert palimpsests. I relaxed, palimpsests are the bread and butter of artists, we were on common ground and worked in harmony, Mike's hand merged with mine, I was his amnuenis and painted the actual ochre, sand and carbon fragments of the site literally within the layers creating a portrait of Puritjarra and also an homage to the man who had unravelled the story of this place.

The contemporary artists from the Ikuntji art centre painted the hills, waterholes, clouds and food of Puritjarra in vibrant colours. Theirs is traditional knowledge, interpreted in acrylic on canvas, sharing understandings of the place that affirms who the artists are and their ongoing relationship with country. Indeed either side of the time we were out at Puritjarra there was 5 in. of rain so the bush tucker was plentiful and the country looking beautiful. The women's paintings had performed their task of caring for Country.

2.3.3 Desert Channels. The Impulse to Conserve

Libby Robin, and I went on to work on a very large Environmental Art project in the Channel Country between 2007 and 2010 *Desert Channels. The impulse to conserve*[7]which included nearly 50 local stakeholders, invited writers, artists and scientists. Libby asked each participant to address the question of what drove their impulse to conserve. Some of the key players in the Desert Channels research team camped on several occasions at Bush Heritage Australia's, Ethabuka Reserve and also Craven's Peak Reserve, both on the edge of the Simpson Desert. The team included Libby Robin, arid zone zoologist, Chris Dickman, historian, Tom Griffiths, arid zone ecologist, Steve Morton, anthropologist, Guy Fitzhardinge, Reserve Managers, Nella and Mark Lithgow and sculptor, Faye Alexander. I painted a large series of desert studies at our camp sites, the Channel Country gave me the time and the biggest studio in the world to paint.

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[7] Robin, L., Dickman, C., Martin, M., *Desert Channels. The Impulse to Conserve* 2010 CSIRO Publishing Melbourne.

//play.google.com/store/books/details?id=lptgaItvcJoC&rdid=book-lptgaItvcJoC&rdot=1&source=gbs_vpt_read&pcampaignid=books_booksearch_viewport

CSIRO published the book as hard copy and online and a prologue from David Lowenthal set the tone for this project;

> All environmental concern, if not anthropocentric, is humanly generated, voiced, and valued. Ecology's mission is restoring not just ecosystems, but the human communities that sustain and are sustained by them.[8]

Chris Dickman and his team of Sydney University students and volunteers have worked on these and adjacent properties for more than 30 years now collecting and analysing data. As co-editor of *Desert Channels*, Chris believed that working through non-conventional methods of communication, like collaborations with artists and wildlife illustrators, reaches a wide and popular audience. It is this passion for communicating ideas about conservation that drives him. He has edited books with two artists including me,[9] with the hope of highlighting the plight of Australia's native mammals. Australia has the worst rate of mammal extinction in the world with 56 facing extinction at present. Chris says that many Australians can name endangered species from countries outside Australia but are ignorant about Australia's own wildlife and the threats causing extinctions.

The individuals involved in *Desert Channels* also included many local stakeholders, Aboriginal Traditional Owners, graziers, a mix of professionals from school teachers to civil servants, tourists and then conservation organisations. We included conservation and production groups who were working in partnership, including Bush Heritage Australia ecologists and staff and North Australian Pastoral Company managers. Together they installed mammal monitoring sites on a station adjacent to one of the conservation reserve.

Part of the community of interest which contributed to the Desert Channels project were the partners, benefactors and donors of the conservation groups working in the region. They gave logistical support, money to purchase and look after conservation reserves and the volunteers gave their time to work for those organisations on site and in the cities.

I took several trips out to the Channel Country during the project and over 3 years painted 12 by 4 – panel paintings, all 1 m by 1 m. These paintings reflected the different seasons at Ethabuka and Cravens Peak.

I spent hours and hours in the hot sun, with flies crawling in my eyes and the wind whipping up sand, painting canvases, using natural and often locally sourced pigments, soils and ochres to capture the materiality of the place. The zircon blue is the only non-naturally occurring pigment in my paintings, the green was sourced from a clay-gravel I found just near our house on our farm track that I have pounded down with my mortar and pestle. The red sand from the Simpson Desert is mixed in part with red ochre and copper mica and the deep purple oxide colour comes from the Pilbara in Western Australia.

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[8] Lowenthal, D., (2009) Living with and looking at landscape. Landscape Research **32(5)**, pp.637–659.

[9] Dickman, C., Woodford Ganf, R., *A Fragile Balance. The extraordinary story of Australian marsupials* 2007 Craftsman House, Australia.

While all the *Desert Channels* team spent hours investigating different sites, I painted works within a radius of the base camp and recorded an artist diary also published in the book. I developed a distinctive vocabulary and palette for this arid zone country while I painted. Leaves are not often green, they are round and fleshy, they are more commonly grey spikes. They might even be flat and black, in a dried creek puddle. A landscape – seemingly with ‘nothing in it’ – is actually full of incident. There are marks, small events, dramas. Painting it – selecting what to keep in or leave out – is complex. There are so many accidents of nature that together show the workings of an ecosystem. The sun shifts rapidly and can change everything suddenly and dramatically. Shadow is rarely dappled and soft here. It is sharp, unforgiving. To capture the real colour of sand on canvas, I added a little Metallic Copper Oxide. It contains mica, which always has a flat surface somewhere that reflects light, just as sand particles do in sharp sunlight. My landscape studies are mimetic: they simply aim to represent the particular landscape as I see it at this moment.

Artist diary interlude.

18 April 2009

I am painting a West-East transect at ‘S’ Bend on Mulligan River at Craven’s Peak today. I started my first canvas at 8.00am, somewhat reluctant to leave camp because all our team are there, talking seriously and quietly (and sometimes joking along) with Chris Dickman and Glenda Wardle’s ‘Ratcatcher’ crew from the Zoology Department at the University of Sydney. Last night we had quite a celebration. It was strange about 30 people all camped in a place so remote that a crowd that size could only ever have been there like that in pre-European times.

My first canvas is on the rocky high slope with dead mulga. I have a view down the dry river bed, where zebra finches and crested pigeons are being harried by hawks. I started this morning as soon as the sun became warm enough to dry the water-based pigments on the canvas.

Half an hour later, I am moving on to start the under-painting on the next canvas down below in the rocky creek bed. Then, about 9.30am, I move again onto a gorge on the west, hoping that the cool shade might grow there to protect me for a while later that day as heat builds to the high 30s. Over the next hour I start work on the final canvas. These are four that I will visit repeatedly in sequence during the day either till I’m exhausted or I have enough information to leave them and finish them in the studio.

A Children’s python (Anteresia childreni) hunts tree frogs in the lank grasses on the creek bank high behind me. The last euro or kangaroo footprints, from when water was in this creek, are clearly visible in the dried mud. A caustic vine withers on the rock face on the other side of the gorge. I watch Zebra finches flitting in and out of the Mineritchie (or Red Mulga Acacia cyperophylla) that I am painting. Its elaborately twisted trunks, decorated with dense grey bark curls over a smooth ox-blood red trunk, embrace a tormented Mulga (A. aneura), stripped of its foliage. The mulga has been thrust down the creek in a torrent, and now hangs high in the branches of the Mineritchie. The living and dead trees dance a grotesque duet, something the artist Salvator Rosa himself would not have dared invent. A crow, hangs about trying to spook me. Am I in someone’s place? Should I have sought permission first? I wonder if it will pinch my brushes while I wander off to my next canvas. Will the light move dramatically before I return, so that I’ll have to fudge things? Perhaps the wind on the other side of the valley will whip this canvas off my easel-ironing board, in a gust of disapproval?

2.3.4 Desert Lake. Art Science and Stories from Paruku

Finally I would like to write about my most recent art and environment project, *Desert Lake. Art Science and Stories from Paruku*.[10] The project ran from 2010 to 2014 and the outputs included a publication, a website, blogs, an archive and two exhibitions, the first in 2013 in Alice Springs Northern Territory, Australia. The archive and an exhibition of the artwork purchased and donated by the project donors, is now in the collection of the Center for Art + Environment, Nevada Museum of Art. The Museum exhibited the *Paruku Project* exhibition June–November. In October 2014, four of the Desert Lake team including Guy Fitzhardinge, John Carty and Wiradjuri Traditional Owner, Jamie Brown attended and talked about the project at the biannual A + E conference.

The book is available as hard copy or online. We also made a DVD for the project which can be viewed in full on my website www.mandy-martin.com.

Special places are recorded in all cultures but the connection between place, spiritual being and the living people is especially strong within the ancient and continuous culture of Aboriginal Australians. Paruku is a lake in the Tanami Desert in Western Australia and its dreamtime story or Tjkurpa about *Kiki*, the *Star Falling* belongs to the specific Walmajarri people. In the film, Bessie and Bill Doonday, sing its song, Hanson Pye tells its story and dances it with the school children and also paints its story.

Hanson Pye, gave me permission to paint the *Kiki* story and I was instructed to paint near the Handover Camp on the shores of the ancient Lake Paruku. I painted a series of multi-panel panoramas on paper canvases, incorporating locally sourced pigments and material. Hanson then named the series *Falling Star*, or *Kiki*. Although I was given permission to paint that story and that section of the lake I was not allowed to paint other places which are men's business or too sacred for outsiders to know about. I was given a skin name which tied me to that place also.

My own studio work, often takes off from a point within an environmental art project but is independent to that project. It will often incorporate other layers of meaning and intent. So when I paint the Handover site where the Government handed back the land to the Traditional Owners', two decades ago, I am also documenting the recommencement of their traditional patchy burning practices at the lake again and their caring for their Tjkurpa. My interest in fires and burning specifically relate to the global drivers affecting a community and a landscape like this. These drivers include climate change, mining, total grazing pressure and tourism.

All around the night horizon of the Tanami Desert, the lights of gold mines twinkle and not far away on the ancient coast where the waters of great lakes like Paruku, in paleo times ran out to the sea, there are massive interests poised to drill for gas. At the end of the DVD, Anthropologist Jocelyn Davies asks, if the Walmajarri

[10] Morton, S., Martin, M., Mahood, K., Carty, J., *Desert Lake. Art, Science and stories from Paruku.* 2013 CSIRO Publishing. http://books.google.com.au/books?vid=ISBN9780643108394&redir_esc=y

community, Mulan is not viable, then how viable, is the rest of Australia? How do we explain to Shirley Yoomarie and Megan Doreen Boxer, who sincerely believe that the water came back to Paruku after the government hand over of their land in 2001 enabled them to care for their Country again, that it is not the long cycles of wet and dry that have occurred since Palaeolithic times but anthropogenic forces like climate change created by global drivers like the price of oil, coal and gold that are now more likely to destroy their ability to survive in their desert home. How do we explain that we thought we could live off greed but we now find we can't?

Artists do respond to changing times and anxieties and as I encounter the Anthropocene, not only over my garden fence but right up to the veranda, blowing dust into my house and a chill through my bones, it is only now that many of my thoughts about us all being *Wanderers in the Desert of the Real* in Australia are filtering through I feel to a wider audience. Maybe I can cheer younger thinkers and activists by the observation that there is usually about a 10 year time lag between artists and activists floating ideas and them entering the mainstream. It gives me cause for hope, even when there are setbacks of the sort we are seeing now in Australia with a government lacking the vision to back its scientists, environmental historians and artists, that this will be temporary, it absolutely has to be. The sublime helps me picture the inconceivable and mediate the grief I feel about irreversible global change. The powdery colours, blazing light and chunky texture of my painting are seductive, even though the paintings often refer to burning or to death and extinction.

Western Australian writer, Glenn Albrecht, who has also worked collaboratively with artists, photographers and musicians in the Hunter Valley, responding to coal mining, coined a neologism for the sort of landscape grieving we develop as these landscapes disappear as a result of too much environmental change, *Solastalgia*. The connection between place and spiritual being is especially strong within the ancient and continuous culture of Aboriginal Australians. Using the slow technology of paint and exhibiting in slow media places like museums and galleries, in real time rather than virtual, I hope to cause audiences to search their souls. I want us all to acknowledge our human folly and understand how it unleashes the slow violence causing large scale degradation of ecosystems and concomitant loss of spiritual connection with our landscapes.

Chapter 3
The Power of Stories in the South Moresby Controversy: A Narrative Network Analysis

Alexandra Vlachos

Abstract From 1974 to 1993 a fierce forestry conflict evolved on the remote archipelago of Haida Gwaii, Canada. The South Moresby controversy (SMC) over ownership, use, and management of the temperate rainforests arose between the Haida First Nation, the provincial and federal governments, the forest industry, local residents, and environmentalists. Beside a novel agreement over protecting the area as National Park and Haida Heritage Site in 1993 (leaving open the legal dispute over title and landownership), the SMC produced a rich collection of stories, arguments, statements, and memories that combined into a powerful narrative-network. While political strategy and historical events plaid a prominent role, they have been well analyzed elsewhere. This paper focuses on the role of stories in the narrative-network of the SMC from the perspective of environmental history. According to narrative-network analysis stories figure as actors themselves, and their power, connections and impacts are investigated. In particular, stories connect human and non-human actors in the network, generate collective identity, and trigger action; leading to acts of resistance, protests, and political involvement.

The temperate rainforests of British Columbia have been repeatedly at the center of conflict between First Nations, forest industry, provincial government, environmental groups, and local communities. The "war in the woods," especially the road blockades in Clayoquot Sound (Vancouver Island) and South Moresby (Haida Gwaii) in the 1980s received strong national and international media attention. Scholars from various disciplines have written about British Columbia's natural resource conflicts in the last third of the twentieth century, covering most areas of the province.[1] First Nations' involvement, and the political, economic, and social

[1] Among others: Laurie E. Adkin, ed., *Environmental Conflict and Democracy in Canada* (Vancouver: UBC Press, 2009); Nicholas Blomley, "'Shut the Province Down': First Nations Blockades in British Columba, 1984–1995," *BC Studies* III (Autumn 1996): 5–35; Bruce Braun, *The Intemperate Rainforest: Nature, Culture, and Power on Canada's West Coast* (Minneapolis:

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aspects of the struggle have been particularly well analyzed, yet often isolated from each other. Certain relationships attracted stronger attention than others, for example the relationship between First Nations and environmentalists, while sociological and political analysis clearly dominates the literature compared to historical contributions.

3.1 A Place of "Powerful Spirit"

Haida Gwaii (formerly known as the Queen Charlotte Islands)[2] is a remote archipelago northwest of Vancouver Island, separated from the mainland by the waters of the shallow and often stormy Hecate Strait. The cluster of two large (Graham Island in the north and Moresby Island in the south) and numerous small islands supports outstanding ecosystems and is home to several endemic species.[3] Lush forests grow on fertile, rocky soil, and an abundant salmon population is part of the rich marine life of the surrounding waters. The Haida First Nation and their ancestors call Haida Gwaii their home for at least 10,000 years.[4] Yet Haida Gwaii offers more than natural treasures and a rich human history: It has been described as one of "the earth's prolific places" with a "powerful spirit."[5] Beside its adventurous appeal for outdoor-lovers, the spiritual and mystical qualities of the place have been repeatedly emphasized: "Haida Gwaii marks the beginning of many things. It was here that the supernatural beings lounged in the water before the land rose, it was here that Raven

University of Minnesota Press, 2002); Niamh Moore, *The Changing Nature of Eco/Feminism: Telling Stories from Clayoquot Sound* (Vancouver: UBC Press, 2016); Justin Lawrence Roy Page, *Tracking the Great Bear, How Environmentalists Recreated British Columbia's Coastal Rainforest* (Vancouver: UBC Press, 2014); Richard *A.* Rajala, *Up-Coast: Forests and Industry on British Columbia's North Coast, 1870–2005* (Victoria: Royal British Columbia Museum, 2006); Louise Takeda, *Island's Spirit Rising. Reclaiming the Forests of Haida Gwaii* (Vancouver: UBC Press, 2015); D.B. Tindall, Ronald L. Trosper and Pamela Perreault, eds., Aboriginal Peoples and Forest Lands in Canada (Vancouver: UBC Press, 2013); Jeremy Wilson, *Talk and Log: Wilderness Politics in British Columbia, 1965–96* (Vancouver: UBC Press, 1998).

[2] On June 3, 2010, the original name Haida Gwaii ("Islands of the people") officially replaced the colonial name Queen Charlotte Islands. During the local name-changing ceremony on June 17, the Haida returned the colonial name to the Crown, symbolically stored in a beautifully crafted bentwood box, and respectfully handed over to Premier Gordon Campbell.

[3] Tom Reimchen and Ashley Byun, "The Evolution of Endemic Species in Haida Gwaii," in *Haida Gwaii: Human History and Environment from the Time of Loon to the Time of the Iron People*, edited by Daryl W. Fedje and Rolf We. Mathewes (Vancouver: UBC Press, 2005), 77–95.

[4] Haida oral history, supported by recent archaeological data, suggests that bear hunting went back 13,000, and fishing 10,700 years ago. For a comprehensive collection of Haida Gwaii prehistory and archaeology: Daryl W. Fedje and Rolf W. Mathewes, eds., *Haida Gwaii: Human History and Environment from the Time of Loon to the Time of the Iron People* (Vancouver: UBC Press, 2005).

[5] John Broadhead and Thom Henley, introduction to *Islands At The Edge: Preserving the Queen Charlotte Islands Wilderness*, ed. by Island Protection Society (Vancouver: Douglas & McIntyre, 1984), 15.

found men inside the clamshell and it is here that the Raven and Eagle clans have lived long enough to remember these momentous occasions."[6]

At the very southern tip, on South Moresby Island, lies Gwaii Haanas (often referred to as "South Morebsy" in the SMC) with abundant forest resources and several major Haida heritage sites (SGang Gwaaii Llnagaay/Ninstints, K'uuna Llnagaaii/Skedans, T'aanuu Llnagaaii/Tanu, Gandll K'in Gwaaii.yaay/Hotspring Island, and Hlk'yah GawGa/Windy Bay). In actor-network terms, South Moresby is a truly hybrid place, where totem poles rotting on the ground of UNESCO World Heritage sites like S'Gang Gwaii on Anthony Island effortlessly dissolve the nature/culture dichotomy: Here, it is impossible to tell where culture ends and nature starts (or vice versa).

Mainly during the twentieth Century, a variety of non-native people settled down on Haida Gwaii and established new communities – from the logging town of Port Clemens to the artist's community of Tlell.[7] With less than 5000 residents, Haida Gwaii is home to a wide spectrum of people, including the Haida, loggers, rednecks, hippies, artists, and fishermen. When they fought over the rainforest in South Moresby, they fought about more than trees or money. The SMC was about values, power, identity, lifestyles, and the place they all regard as home.

Contrary to most mainland communities, First Nations are no minority on Haida Gwaii: today, the Haida make up almost half of the inhabitants of Haida Gwaii. The Haida Nation gained fame for its outstanding and distinctive art, and also for its assertive and influential political activity with regard to environmental politics, self-government, litigation, and community-based joint-management. Related to those achievements is the upholding of storytelling, the struggle of keeping Haida language alive, and the maintenance of traditional knowledge, especially through the Haida elders.

3.2 The South Moresby Controversy

The Spruce drive during the World Wars[8] was followed by the enormous commercial interest of multi-national logging companies during the 1950s and 1960s, which had drastic impacts on the state of Haida Gwaii's forests and provoked local distrust and opposition. By the early 1970s, after two decades of heavy industrial logging

[6] Marianne Jones, "Haida Art and Haida Gwaii," in *Raven Travelling*: *Two Centuries of Haida Art*, by Vancouver Art Gallery, 1st pbk. ed. (Vancouver: Douglas & McIntyre, 2008), 29. Raven is the creator in Haida oral history. He figures prominently in the Raven myth telling how Raven released humans from a giant clamshell.

[7] Only very few settlers made Haida Gwaii their permanent home in the nineteenth Century. Most early visitors came for hunting, fishing, and mining, or were missionaries. The first official white settler, Roderick Finlayson Dodd, arrived in 1887, when he purchased a thousand acres of land in Delkatla Slough.

[8] Sitka Spruce was used to build warplanes (mosquito bombers), and Haida Gwaii had some of the tallest and oldest Sitka trees in the province. Through government-controlled and military super-

with marginal local benefit and major destruction,[9] the Haida felt increasingly powerless in the face of decisions taken by large logging companies and supported by a distant government. When Rayonier Canada's contractor Frank Beban planned to expand logging activities even further south, a group of young Haida and non-native environmentalists formed the Island Protection Committee (IPC/IPS)[10] in October 1974. Initiated by IPS, Gary Edenshaw (Guujaaw)[11] and the Skidegate Band Council submitted a draft document called The Southern Moresby Wilderness Proposal (SMWP) to the provincial government, outlining an area in the south of Moresby island to be protected from industrial logging. The main goals were to change the fact that multinational logging companies almost exclusively owned most of the Island's timber rights; to increase local control over the existing Tree Farm Licences (TFL), to receive a share of the $11 million in stumpage taxes, which left the Islands annually, and to protect fish habitat that was being threatened or destroyed by logging-induced land slides on steep slopes.[12]

Between 1974 and 1993 lay almost 20 years of fierce debate, of value battles, of conflict, confrontation, and compromise: two decades of "talk and log"[13] took a high toll on South Moresby's forests, and triggered logging protests and illegal road blockades at Windy Bay/on Lyell Island (Athili Gwaii) in 1985. The protests marked an important turning point of the SMC, and the television images of Haida elders being arrested by the RCMP brought the scene into the living rooms of Canadians nationwide. At Windy Bay, essential Haida stories – especially the narrations of historical land claims and indigenous relationships with nature – were performed and ritualized as demonstrations of resistance and collective cultural identity. With support of environmentalists, media, individual politicians, and public awareness – the Haida reached two main goals to alter the established balance of power: to shift South Moresby from a local into a national topic, and from an environmental to a Haida issue.

The Wilderness Advisory Committee (WAC) discussed South Moresby as a wilderness area in early 1986, based on the ongoing political debate on legislative level about several wilderness areas in British Columbia. The WAC was convened by BC-environmental minister Austin Pelton to advise on the future use and

vised Aero Timber, logging during the Second World War reached new dimension and resulted in severe damages on Moresby Island.

[9] "The Queen Charlotte Islands represented the clearest example of hinterland resources being drawn off without appreciable local benefits," in: Rajala, *Up-Coast*, 7.

[10] Further on called IPS (for Island Protection Society to which it was renamed in 1979).

[11] Garry Edenshaw was one of the key actors among the Haida during and after the SMC. He was in his early twenties when he founded IPS together with Thom Henley, an US-American adventurer and kayaker. Edenshaw later became known as Guujaaw ("drum"). He was president of the Council of the Haida Nation (CHN) from 1999 to end of 2012.

[12] Evelyn Pinkerton, "Taking the Minister to Court: Changes in Public Opinion About Forest Management and their Expression in Haida Land Claims," *BC Studies* 57 (Spring 1983): 76.

[13] "Talk and log" mainly refers to resource conflicts dominated by government composed expert groups, assessed studies and conducted hearings, while logging continued. See: Wilson, *Talk and Log*.

management of those areas. To evaluate South Moresby, the WAC conducted two public hearings on the Queen Charlotte Islands. The first session took place in Skidegate on January 16, 1986, the second on the following day on January 17 in Sandspit. The locations are important to mention, because they attracted a very different audience: mostly Haida and IPS-members based on Graham Island gathered at the Skidegate-hearing, while loggers living and working on Moresby Island dominated the Sandspit-hearing.

The briefs submitted to, and the meetings hold by the WAC marked the narrative peak of the debate, and eventually triggered the involvement of the federal government leading to the so called "federal-provincial-deal" in 1987, when South Moresby gained national park protection status. When Canada and British Columbia signed the South Moresby Agreement (SMA), environmental groups and individual activists celebrated "their" victory. For the Haida, however, the SMA was only a partial victory. While the agreement meant protection from industrial logging, it did nothing to alter the fact that, under the National Park Act, South Moresby still belonged to the Crown. To gain at least partial control over their resources, the Haida continued their fight until 1993, when they reached the Gwaii Haanas Agreement that declared South Moresby as *Gwaii Haanas National Park Reserve and Haida Heritage Site.* This unique joint-management-agreement expressed mutual commitment, responsibility, and respect from both the Haida Nation and the Federal Government of Canada.

3.3 Narrative-Network Analysis

Words have power. In Haida Eagle Treasures, Haida author Pansy Collison[14] claims that stories "reflect the deepest, the most intimate perceptions, relationships, and attitudes of a people. Stories show how a people, a culture thinks."[15] Stories are "all we are," sums up native writer Tomas King.[16] That stories do matter – especially when it comes to the grand concepts of identity, home, and place – is a claim hardly still disputed by environmental historians today. When more than 20 years ago, William Cronon called for "not just stories about nature, but stories about stories about nature,"[17] even more intriguing stories followed, and a rich repertoire of such histories accumulated.

[14] Pansy Collison was born and raised in Old Massett. The Haida women attended the First Nations Educations programme for 2 years at UBC before returning home to get married in 1979. She is a teacher, singer, artist and storyteller.

[15] Pansy Collison, *Haida Eagle Treasures: Tsath Lanas History and Narrative* (Calgary: Detselig Enterprises Ltd., 2010), 26.

[16] Thomas King, *The Truth About Stories: A Native Narrative* (Minneapolois: University of Minnesota Press 2005), 156.

[17] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* (March 1992): 1375.

"Working" with stories raised, however, some tough methodological questions over time: How to deal with the fact that there is fiction in stories (when the discipline of history was bound to find "historical truth")? How to overcome the fact/fiction divide, and the nature/culture dichotomy? Where lies the truth in stories beyond that divide, how can we find it and integrate it into historical scholarship? How to encompass other's stories as well as our own? To what extend should environmental history turn to anthropology for answers about oral history, and aboriginal storytelling? And to what extend can environmental history expect answers from sociology, with its theories like Actor-Network-Theory (ANT)?[18]

With Latour's collectives, non-human actors, and the flat hierarchy of agency-potential throughout the actor-network, ANT promised radically new insights on the role of objects, plants, animals, or systems, on the nature of hybrid places, and the matters of concern as opposed to matters of fact.[19] Moreover, ANT offered an alternative and promising way of comprehending the bottom-down-history of human-nature relationships.

However, ANT comes with baggage. It poses what Nimmo called "considerable methodological dilemmas" when used within the discipline of history.[20] Addressing some of them, Nimmo attempts to combine critical discourse analysis with the ANT principle of generalized symmetry[21]: Using ANT in history, documents themselves become actors, and texts have agency. In other words: stories are actors in the actor-network.

"To understand a network, you must understand its narrative"[22] is the key claim in The Power of Narrative in Environmental Networks. It is also my claim when it comes to understand the SMC in a sense that goes beyond a report of events and a collection of statements. I suggest that narratives, stories, statements, and memories transport values, motivations, goals and emotions. They provide important information about the strengths of networks, about how and how well actors (including non-human actors) are connected, and how they succeed or fail to attract and keep other members. Stable narrative networks enable resistance to ruling power, the

[18] Do network theories like ANT detach environmental history from its parent discipline of history? Murphy, for example, claimed that environmental historians, who work almost by definition interdisciplinary, have long adopted the network approach common in disciplines like sociology, cultural geography or spatial ethnography, whereas "in the field of history, this insight has generally not changed the assumptions and epistemologies of historians who are not in environmental studies." Edward Murphy. "Critique, Practice, and Ecologies of the Future: A Vision for Environmental Studies in the Humanities," in: Emmett, Rob, and Frank Zelko (eds.), "Minding the Gap: Working Across Disciplines in Environmental Studies," *RCC Perspectives* 2014, no. 2: 55.

[19] About hybridity and matters of fact: Bruno Latour, "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," *Critical Inquiry* 30 (Winter 2004); *Pandora's Hope*: *Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999); Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993).

[20] Richie Nimmo, "Actor-network-theory and methodology: social research in a more-than-human world," *Methodological Innovations Online* 6, 3 (2011): 108.

[21] Ibid., 112.

[22] Raul Lejano, Mrill Ingram and Helen Ingram, *The Power of Narrative in Environmental Networks* (Cambridge, MA: MIT Press, 2013), 5.

rediscovery of alternative knowledge, the consolidation of collective identity and connection to a contested place.[23]

Lejano, Ingram and Ingram studied "the role of stories in our environmental behaviour"[24] and argue that "stories shape how we behave,"[25] especially when it comes to our relationship with the environment. A scientific or "factual" description of the environment thus hardly embraces the key factors in environmental conflicts: "In our science-focused society, the environment is often discussed in scientific terms that can obscure motivations driven by memory, feelings informed by tradition, family, and beauty, and other rationales for behaviour that can seem irrational from a technical perspective."[26] Indeed, one of the ongoing disputes during the SMC was the one between scientific or "rational" arguments and traditional native knowledge and feelings. Such feelings, along with values and beliefs, are mainly transported through stories, songs, performance and art.

Concerned with questions over identity, place, and alternative knowledge, Lejano, Ingram and Ingram pose story-actors right in the centre of their Narrative-Network-Analysis: "We focus on how groups of people 'story' themselves into environmental relations, or how they understand their environmental connections whether it is to defend or to exploit."[27] Apart from finding Narrative Network Analysis a useful method in practical terms, it had been the last words of that sentence, "to defend or exploit," that had drawn my interest. Many have written about Haida Gwaii, and the remarkable, outstanding role of the Haida, who were able to lead and influence the struggle for South Moresby by organizing themselves into a powerful, determent, and serious opponent to state power and industrial hegemony.[28] During the SMC, the Haida succeeded in shifting the master-narrative from that of the settler-society profitably managing forestry resources for the benefit of the province, into the dominant narrative of Haida land claims and traditional knowledge towards a more sustainable, democratic, and community based resource management.

However, there have been other stories worth investigating. There were the stories of the non-native loggers,[29] expressing not only concerns about job security, but also feelings, memories, pleads, and beliefs. How did the non-native loggers 'story' themselves into the narrative network, and the place called South Moresby? And why were the (majority of the) Haida predominating the narrative network, and able to form stronger alliances, than those in favour of industrial logging? Some answers may be found by tracing narratives and using the components of Narrative Network

[23] Some of those and similar conclusions are also made in: Lejano, Ingram and Ingram, *Environmental Networks*.

[24] Ibid., 1.

[25] Ibid.

[26] Ibid., 2.

[27] Ibid.

[28] Most recently: Takeda, *Island's Spirit Rising*.

[29] Many Haida worked and still work as loogers.

Analysis as described by Lejano, Ingram and Ingram: Emplotment,[30] Characterization (esp. of non-human actors), Altertiy and the Other, Breach of Convention, Context and Gap (Hermeneutics).[31]

Narrative networks further have a number of functions described by Lejano, Ingram and Ingram that are meaningful to South Moresby: non-humans are part of the narrative approach too, as they can be characters in narrative networks.[32] Stories provoke action and are not simply passively received.[33] Related to that ability, "An overarching story tied people together to a much greater extent than people-to-people associations,"[34] as it happened in South Moresby for example through the performance of resistance. Thus, what the authors conclude as key functions of narration, matches my main interests in regard to South Moresby:

> *By thinking about an environmental issue or object, and by telling stories to themselves and others, actors literally emplot themselves into the network…*Second, it is not just the story that members share. *Rather, they become and maintain their membership in the group by joining in the act of narration…* Third, narratives serve a function beyond that of organization – they are the repositories of what the group knows. *The knowledge that the group seeks to save, the memory of the group, and the foundational history of the group – all that is stored in narrative* [original emphasis].[35]

Between 2010 and 2014, I analysed the SMC thoroughly, analyzing thousands of stories, statements and memories from involved actors, using a methodological background of narrative analysis, elements of Actor-Network-Theory (ANT) and traditional discourse analysis. I was as interested in the stories of the Haida, as in the stories of loggers, experts, locals, environmentalist, and politicians. The following pages outline only a small part of the rich narrative network that constituted the SMC, presenting an example of characterization as well as the all-encompassing narrative concepts of home, identity, and resistance, of which I argue that the SMC was all about (more than it was about trees).

[30] The term emplotment goes back to the works of the French Philosopher Paul Ricoeur. Emplotment creates the "internal of the narrative unity" and "forges a causal continuity from a temporal succession, and so creates the intelligibility and credibility of the narrative." In: Kim Atkins, "Paul Ricoeur (1913–2005)," *Internet Encyclopedia of Philosophy*, http://www.iep.utm.edu/ricoeur/

[31] Lejano, Ingram and Ingram, *The Power of Narrative Networks*, esp. 60–75.

[32] Ibid., 63.

[33] "*Good stories engage readers in active participation – in this sense, narratives are never merely passively received.*" Lejano, Ingram and Ingram, *Environmental Networks*, 58.

[34] Ibid., 46.

[35] Ibid., 20.

3.4 "Logging Our Sisters Away": Characterization of Non-human Actors

The Haida argue that the forests are inseparably linked to their ancestors and history: "Totem poles are history books."[36] History books carved out of trees taken from old growth forests. The most important tree for the Haida is Western Red Cedar (Thuja plicata). Sometimes characterized as "Cedar peoples," cedar trees appeared in the narrative-network as a prominent example of non-human-actors, strongly tied to Haida heritage and identity. Omnipresent in the mature forest of Gwaii Haanas and a highly-valued building material for longhouses, canoes, masks, paddles, boxes and nearly all larger every-day-objects used by the Haida; it remains their most important resource, together with salmon. Also contemporary "west-coast architecture" uses cedar in city halls, homes and public buildings. But the role of cedar went even further: The Haida and archaeologists viewed poles carved from cedar as actors telling their own narrative:

> "Above all, you can build totem poles,
> and the people of the Northwest Coast
> build them in profusion:
> forests of sculptured columns
> between their houses and the sea,
> proudly announcing to all
> the heraldic past of those who dwelt there."[37]

Trees, especially Western Red Cedar and to a lesser degree also Yellow Cedar and Sitka Spruce figured as actors also in their specific function as *art objects*: Haida artist and curator at the Haida Heritage Centre, Nika Collison, explains that Haida art visually expresses *gyaagin.aay* (crests),[38] and she further states: "In its truest function, our art represents who we are and where we come from."[39] But not only carved woodwork, or impressively large cedars with cultural marks; even stumps sometimes told a story.[40] Stumps, for example from an abandoned canoe that still lies next to it on the forest floor, or stumps with visible marks left, could be considered CMTs. In general, culturally modified trees are treated as evidence of land occupation and past human use of wood. In this view, the cedar is pen and paper and the artist the historian.[41] Courts have agreed, "The location of CMT's may in fact provide evidence to support the claim to aboriginal title and their location

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[36] Haida Heritage Centre, "From the Time of Foam Woman," online, directed by Jeff Bear and Marianne Jones (2007; Kaay Llngaay: Urban Rez Productions Inc., 2013.), retrieved from youtube, accessed December 10, 2013, http://www.youtube.com/watch?v=i7qUCw7FST0

[37] Bill Reid, "Out of the Silence," in *Raven Travelling. Two Centuries of Haida Art*, ed. Vancouver Art Gallery, 1st pbk. ed. (Vancouver: Douglas & McIntyre, 2008), 24.

[38] Nika Collison, "Everything Depends on Everything Else," in: *Raven Traveling. Two Centuries of Haida Art*, ed. Vancouver Art Gallery, 1st pbk. ed. (Vancouver: Douglas & McIntyre, 2008), 63.

[39] Ibid., 57.

[40] "Prime Cedar: Cornerpost of Haida Culture," *All Alone Stone*, 4, 1980, 50.

[41] HHC, "From the Time of Foam Woman."

and presence may be an important factor to support any future title claim." Yet ambiguity remains about whether it is necessary to protect such sites.[42]

Many Haida view trees as autonomous beings, as friends, relatives, or spirits. This concept dissolves the human/non-human border between plants, humans and spirits, or treats tress as *hybrids* (to use a western description). According to chief counsellor Terri-Lynn Williams-Davidson many Haida women consider cedar trees as their sisters.[43] April Churchill-Davis, a well-known Haida artist similarly observed: "Every weaver knows that the tree is our sister… They just went up and started logging our sisters away."[44]

As relatives, and fellow claimants of the place Gwaii Haanas, the trees figured prominently as non-human-actors in the narrative network. Also the *forest* as whole, *animals* (especially *salmon* and *marbled murrelets*), and *South Moresby* itself were important non-human actors. Coming from a non-native actor, who regards an archipelago as "best friend," the following submission to the WAC combines key narrative elements of emplotment, characterization, and emotions:

> In my mind the Charlottes is the ultimate place of intrigue, adventure and beauty and it leaves a huge lump in my throat when I think of what it could become. I don't feel I will be able to swallow the lump until I know the Charlottes are protected. They are like a best friend and I hate to see them being destroyed.[45]

3.5 Consolidation of Identity and Belonging Through the SMC-Stories

The characterization of non-human actors shows that conflicts over natural resources arise not only over power, privilege and wealth, but also over values and emotions: the value of nature, of culture, of human and non-human life, of belonging to a particular place, culture and home. Most resource conflicts – especially those with indigenous involvement – revolve around the key issue of *identity*, particularly in colonial or postcolonial contexts, where native groups and "modern" national states are involved. Personal and cultural values, the perception of identities, along with traditional, local and specifically native knowledge are transported through stories. Narrative-network analysis provided further insights on how place was empowered by weaving it into all aspects of the SMC, by adding and stretching connections

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[42] "Decision Rationale," *Haida Laas*, October 2005, 25.

[43] Personal conversation with Terri-Lynn Williams-Davidson on October 1, 2012, at White Raven Law Corporation in Surrey.

[44] April Churchill-Davis, "Speaking about Weaving Cedar," in: British Columbia, Ministry of Forests, Queen Charlotte Forest District. *Cedar Symposium: Queen Charlotte Islands, Proceedings of the Cedar Symposium: growing western redcedar and yellow-cypress on the Queen Charlotte Islands/Haida Gwaii (28–30 May, 1996)*, ed., Greg G. Wiggins (Victoria, BC: British Columbia Ministry of Forests, 1996), 52.

[45] Jenny Broom, to the WAC, Wilderness Advisory Committee, submissions, No. 63, BCA: GR 1601, Box 5.

between actors through emotions, and by emploting *home* and *identity* into the South Moresby master-narrative.

In the SMC-narrative-network, "place" was often emploted as "home," encompassing very different meanings, perceptions, feelings, and identities to different actors or groups. Whatever we feel in a certain location has to do with our own and that location's history. Memory and "powerful" places are closely connected, as the "Lieu de memoire"[46] research showed. Place connects story and identity. It is with stories that the loggers, Haida and other directly involved actors have expressed their values, defined their identity and their claim to the disputed territory.

3.5.1 Home

Home was a strong element in the narratives of most local actors involved in the SMC. Prominently featured in accounts about the long history of the Haida and their traditional relationship to their territory, the idea of home was also used by non-natives living on the islands, including loggers by referring to logging communities and logging camps as their home. In this concept, logging is understood as an integral part of being Canadian, Crown title is a matter of course, and the home in the woods is part of the cultural identity. The threat of having to leave the logging camps thus implied losing home. Similar connections, albeit contrary opinions towards protecting South Moresby, shared many of those who came to Haida Gwaii in search of an alternative lifestyle. Emphasizing the value of their island-home as a worthy place to protect for "itself," for its wilderness-values, uniqueness and spiritual reasons, most of these claims were historically linked to ideas associated with and drawn from the environmental movement of the 1970s.

Home played a key part in the SMC as something unique, irreplaceable and endangered. To most of the actors involved, the kinds of "threats to and loss of home" that Lejano, Ingram and Ingram discovered in Arizona[47] have played a key role during the SMC. As a consequence, actors who would otherwise have little in common, now shared the threat of losing the place they call home:

> We see forests, we don't see dollars. We see it as a home for ancestors, we see it as a home for our children.[48] (A Haida position)
>
> I've come home from each of those trips more intensely British Columbian, more proud to live here and be part of this. But I also come home definitely more concerned about the

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[46] Pierre Nora, "Entré Mémoire et Histoire, La Problématique des Lieux," in *Les lieux de mémoire, vol. I. La République*, ed. Pierre Nora (Paris: Gallimard, 1984), XVI–XLII.

[47] Lejano, Ingram and Ingram described "threats to and loss of home" as part of the plot in the case study of the Arizona-Sonora Border: Lejano, Ingram and Ingram, *Environmental Networks*, 90.

[48] Diane Brown to the WAC, Wilderness Advisory Committee, proceedings, Skidegate, 16 January 1986, 80, BCA: GR-1601, Box 1.

> need to preserve the wilderness, which I've just said is the essence of our culture here.[49] (A non-native resident position)
>
> Now, with no consideration for the massive dislocation of families and sense of community it will cause, those with no loss to sustain of themselves suggest we give up our jobs and our lifestyle and our homes.[50] (A logger's position)

While these references to home speak of very different perceptions, they all have home and the threat of losing home, at their centre. The loggers mourned the possible loss of logging camps that they defined as "happy places."[51] The Haida went as far as to question their existence as a culture, should they lose South Moresby to a future dominated by industrial logging, condensed in Guujaaws statement that "Haida Gwaii is not only where we are, it is who we are."[52]

3.5.2 Identity

Home is a key element of identity, and "identity is constructed against the other."[53] In South Moresby *alterity and the other* appeared in the shape of outsiders. Local actors complained about the interference from outside: those in favour of a South Moresby park complained about far-away decision makers from Victoria or Vancouver, while pro-logging advocates pointed out that the mainly urban-based environmentalists have actually the least connection to South Moresby.

But "the other" existed also within Haida Gwaii – and narrations were used to cement the identity of a group in distinction to "the other." There were prominent *gaps* between communities, especially between communities highly (e.g. Port Clements) or entirely (e.g. Sewell Inlet) dependent on logging, and communities with a more diverse income-source (e.g. Queen Charlotte City) or alternative lifestyles (e.g. Tlell) and less dependent on logging. *Alterity* was further expressed by emphasizing uniqueness – not only as an emplotment into the greater metanarrative, viewing nature as Eden – but also by the Haida demonstrating their particular language, art, rituals and performances.

Culture,[54] or nature-culture, and collective identity are in need of defence because they are vulnerable to change. And home – for most – is the embodiment of stability.

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[49] Keith Moore to the WAC, Wilderness Advisory Committee, proceedings, Skidegate, 16 January 1986, 279–280, BCA: GR-1601, Box 1.

[50] R. L. Smith to the Wilderness Advisory Committee, proceedings, Sandspit, 17 January 1986, 112, BCA: GR-1601, Box 1.

[51] WAC Wilderness Advisory Committee, proceedings, Sandspit, 17 January 1986, 211, BCA: GR-1601, Box 1.

[52] Guujaaw cited in: British Columbia and Council of the Haida Nation. "B.C., Haida Nation Restore Name 'Haida Gwaii' to Islands," News Release, June 17, 2010.

[53] Lejano, Ingram and Ingram, *Environmental Networks*, 67.

[54] *Culture*, explains Satterfield, *"is not a giant symbolic or structural mechanism that imprints itself on the individual and so directs behaviour; rather, it is an overarching, multi-originating, and multi-faceted resource. Individuals draw upon this resource while manipulating it to fit both their*

It is thus only natural to become emotional about home and protecting it against threats from outside. I argue that resistance against unwanted change has been one of the key factors within the South Moresby narrative network, and that resistance is how the actors "performed narrations." You can feel, narrate, and experience place, but you cannot "act" place. Resistance, on the other hand, is an action – combined with emploting it into stories, statements and stands – it becomes a performance of expressing shared values and a collective identity.

3.6 Resistance and the South Moresby Narrative Network

Resistance figured in all of the narrative-network analysis criteria: resistance was *emploted* into the SMC; it connected all involved actors and served as a leitmotif throughout the controversy – starting with the formation of IPS, peaking with the blockades leading to arrests on Lyell Island, and leading to an agreement with the federal government. Resistance was prominently *characterized* by the Haida, standing the line at Windy Bay, physically and figuratively symbolizing resistance. Resistance also played a vital role in *alterity and the other*. Warding off "the other," resistance was an impressive way of defending the *specialness/alterity* of culture threatened by change. When the Haida blockaded the logging road on Lyell Island, using very few words and instead communicating mainly through their presence, songs, dance and drumming, they delivered an impressive performance of their specialness and alterity. Resistance was correspondingly particularly present at moments of *breach of convention*, such as the disregard of Canadian law, the arresting of Haida elders, or the turn of events when the Government of Canada entered the stage of the controversy and acted in favour of a National Park. And lastly, the South Moresby resistance joined a long tradition of similar performances of resistance in the *context* of other resource conflicts. The closest parallel was probably the conflict over Meares Island, where as in South Moresby, an alliance of strong local opposition, vehement First Nations protest, and a deep commitment by environmentalists combined into a history of resistance that reached way beyond the local and national audiences.

The protestors' evident emotional attachment to a wild place and home of vulnerable non-human and human actors, touched others far away, leading to the formation of alliances and strengthening the network through skilled narrations of resistance. Invisible, but crucial actors were thus the journalists, the cameramen, and every actor connected to the media, who enabled the awareness and emotional attachment of off-Island Canadians to what happened on Haida Gwaii. The Haida

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own ends as well as the context and social positions from which they act." In: Terre Satterfield, *Anatomy of a Conflict: Identity, Knowledge, and Emotion in Old-Growth Forests* (Vancouver: UBC Press, 2002), 6.

were deliberately linking First Nation claims to environmental and social issues,[55] and they became increasingly supported by the media and a growing part of settler society. Many Canadians now addressed the land claim topic –especially in direct relation to environmental issues and wilderness areas. Before the WAC in Vancouver, Ken Truesdell argued:

> I believe we must recognize that our past approach to wilderness use has led to the present situation and, in many respects, is responsible for the land claim challenge as well as the land use dilemma. In other words, even though the land claims questions may pre-empt the development/preservation question, there is the possibility, however slim, that since provincial land use policy set the stage for both the land claim and land use confrontation, it is also a possible avenue for their resolution.[56]

And indeed, when even the contested Land Use Agreement was officially to be signed in Vancouver in December 2007, Guujaaw said to the *Observer*: "I'm happy. It basically provides us with a pretty good footing to work on some real reconciliation."[57]

3.7 Conclusion

While non-native environmentalists were keen to preserve South Moresby from industrial logging as a wilderness area, the Haida were seeking to regain control over the land, the sea, and the natural resources of Haida Gwaii. Their rhetoric wove keywords such as "heritage," "ancestors," "land ownership," "connection to the land" and "respect" prominently into the narrative network of the SMC. Their tale of belonging to the land, their ongoing presence on Haida Gwaii, before the media, and in various state-initiated meetings, together with their valiant fight for control over natural resources, dominated a versatile narrative network, which nevertheless also involved counter-stories of loggers, foresters, or politicians.

In contrast with events of other resource conflicts in British Columbia, environmental organizations never dominated the SMC at the expense of the Indigenous people. While they did play a vital part, the Haida made clear at all times, that Haida Gwaii was *their* battle to fight – emploting home firmly into the narrative-network. The Haida thus persistently linked environmental issues with Native issues, and a forestry dispute with land claims, into a successful political and narrative strategy. As an Indigenous Nation, despite existing inner conflict, the Haida demonstrated a

[55] Haida leader and then president of the Council of the Haida Nation (CHN), Miles Richardson, as cited in Gill: "That's why we wouldn't let anybody but Haidas on those blockades. We wanted a crstyal clear, unmistakable message that this was a Haida issue-it was an environmental issue, but it was a Haida responsibility. And that's why we did that. And it worked." In: Ian Gill, *All That We Say Is Ours: Guujaaw and the Reawakening of the Haida Nation* (Vancouver: Douglas & McIntyre, 2009), 120.

[56] Ken Truesdell to the WAC, Wilderness Advisory Committee, proceedings, Skidegate, 16 January 1986, 141, BCA: GR 1601, Box 1.

[57] "Land use agreement signing Wednesday in Vancouver," *Queen Charlotte Island Observer*, December 10, 2007.

strong sense of unity and leadership. Together with environmentalists, visitors to and residents of Haida Gwaii, they developed a strategy, which was highly marked by their presence, resistance, and full control of the protests. Still, the Haida actively fostered alliances and engaged with conservation-advocates, politicians, government officials, and even loggers. Through words, narratives, and stories, they were able to spin a fine and intertwined net of actors that was influential enough to force the end of logging.

Stories are much more than entertainment: They are responsible for connecting actors and maintaining and strengthening their individual and collective identities, along with their ties with each other in the network.[58] As illustrated with the example of the characterization of non-human actors such as trees, or the emplotment of home into the dispute over a contested place, narrative network analysis provides a way to gasp the complexity of connections and ties between people and their environment (or: human and non-human actors). This chapter demonstrates that in a democratic setting, discourse and stories present a major deciding factor. By empowering place and identity in the South Moresby narrative network, and by demonstrating a firm and persistent stand, the Haida and non-native logging-opponents eked out the chance to fundamentally alter ruling power. Environmental concerns for a remote corner of the country, local traditional knowledge, and even Haida land claims were distributed throughout the network, and able to connect more and more distant actors – from international media to the Government of Canada.

The stability of the SMC narrative network became apparent in following resource conflicts such as the logging dispute called "Island's Spirit Rising" in 2005, when the major of Port Clemens along with many loggers joined the protest of the Haida, or the ongoing protests against the Enbridge pipeline-plans. Twenty-five years after protecting South Moresby, Patrick Armstrong[59] from the Moresby Concerned Citizens said to the *Observer*: "It certainly changed my life and changed it for the better. It created the ability to move forward in doing things in BC in a better way than we would have done otherwise."[60] Once a vehement park-opponent, Armstrong concludes: "The war in the woods is over. You might say [South Moresby] is where it started."[61]

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[58] Lejano, Ingram and Ingram argued: "*Narrative-networks, as we have called them, are simultaneously a story and a grouping of actors. A narrative-network is dialectic, where the actual phenomenon we are studying arises from the intimate relationship of the two terms. That is, networks exist, fundamentally, as narratives. Our argument all along has been that stories are used not just to enlighten the listener but also to refresh the ties that bind the teller to the movement. Thus, narratives are part of the glue that binds networks.*" In: Lejano, Ingram and Ingram, *Environmental Networks*, 174.

[59] Once a fierce park-opponent, Patrick Armstrong incorporated Moresby Consulting Ltd. in 1987, moved to Nanaimo and specialized in "the strategic management of natural resources and environmental issues" (according to his homepage). He became a passionate photographer; capturing wildlife and wild landscapes. See: Moresby Consulting Ltd., accessed December 13, 2014, http://www.moresbyconsulting.com

[60] Jeff King, "South Moresby at 25," *Haida Gwaii Observer*, July 13, 2012.

[61] King, "South Moresby at 25."

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Chapter 4
Exploring Environmental Literacy from a Historical Perspective: How Observations of the Arctic Natural Environment by a Nineteenth-Century Scholar Resulted in a Proposal for Establishing National Parks in the Nordic Countries

Seija A. Niemi

Abstract The imminent extinction of the animals and birds of the Arctic was observed by the Finnish-Swedish scientist and explorer Adolf Erik Nordenskiöld (1832–1901) over the course of ten polar expeditions, conducted between 1858 and 1883. During the first of these, an expedition to Spitsbergen in 1858, Nordenskiöld describes in his diary how the eider hunters indiscriminately shot and plundered the eggs of the birds in their greedy pursuit of the marketable feathers. He deemed it a miracle that the bird colonies were not already facing total extermination.

Nordenskiöld was one of the first people in the nineteenth century to show concern about environmental issues in Europe. He also put forward suggestions for preventing and resolving emergent environmental problems. In other words, he was environmentally literate, in the sense that environmental literacy involves the ability to identify harmful developments in an environment, and respond with the formulation of imaginative, effective and preventative measures.

This article will explain how Nordenskiöld's observations gradually led to the production of an essay, entitled *Förslag till inrättandet af Riksparker i de nordiska länderna* (A Proposal for Establishing National Parks in the Nordic Countries), published in 1880, which is considered to be one of the founding texts of modern Nordic conservation history. This article will highlight the importance of one person's environmental literacy by revealing some of the early sources informing Nordenskiöld's philosophy. So far, the concept of environmental literacy has only been applied in studies of the contemporary environment. Here I will be offering an experimental example of using the term in a case study with a historical perspective.

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4.1 Introduction

A history of conservation[1] will reflect the changes which have occurred in a society in terms of attitudes and values with respect to nature. Every individual has their own distinctive relationship to the environment, which will include their needs, values, and attitudes, all of which are constantly changing (Tonder 2005, p. 6). The importance of certain individuals, prominent intellectuals and environmentalists in shaping Western ideas of nature and ecology is well established (Flader 1978; Lowenthal 2003; Worster 2001, 2011) and the Finnish-Swedish scientist and explorer Adolf Erik Nordenskiöld,[2] who discovered the Northeast Passage (1878–1879), is one of the most important pioneers in the history of nature conservation in the Nordic region. He was so concerned with the welfare of his natural environment that in 1880 he produced an essay entitled *Förslag till inrättandet af Riksparker i de nordiska länderna* ("A Proposal for Establishing National Parks in the Nordic Countries"). He recommended that national parks should be established in the Nordic countries in order to preserve the pristine nature he had observed, and to provide future generations with the opportunity also of appreciating the genuine beauty of their native lands (Nordenskiöld 1880a, p.10). He is one of those people, who, according to the British historian Richard Grove, were environmental historians in their own distinctive ways, "*whose field observations and acute historical sense led them to become environmental prophets and, on occasion, prophets of doom*" (Grove 2004, p. 262).

Long before the emergence of the present-day environmental problems, Nordenskiöld understood that humans have a tendency to destroy their environments. During the course of his ten polar expeditions, undertaken during the 25 years between 1858 and 1883,[3] he observed harmful changes occurring in the Arctic environment. He also made suggestions as to how to improve the situation, including the introduction of regulations for hunting and the abovementioned proposal to establish national parks. He was, in other words, environmentally literate in the

[1] The notion of conservation is understood in this article as referring to protection and preservation at a very basic level. There has been plenty of debate about the terminology of preservation and conservation. In order to avoid anachronism it is not advisable to use the word 'conservation' because the concept had not been coined in Nordenskiöld's time. For instance, George Catlin used expressions such as 'preserve', 'preservation' and 'protection' in his proposal for national parks in 1845. But, since the word 'conservation' is commonly used in contemporary texts, I also use it in this article when discussing the history of conservation.

[2] In international literature Nordenskiöld is often called Nils Adolf Erik Nordenskiöld or Nils Nordenskiöld. However, he himself used the name Adolf Erik and his three brothers are also have the Nils as a first name: Nils Gustaf Gabriel (1830–1891), Nils Otto (1834–1916), and Nils Karl (1837–1899) – all named after their father, Nils Gustaf Nordenskiöld (1792–1866).

[3] The two first of Nordenskiöld's ten Arctic expeditions went to Spitsbergen under Otto Torell's command in 1858 and 1861. The rest were under his own command: in 1864 and 1868 to Spitsbergen, in 1870 to West Greenland, in 1872–1873 overwintering at Spitsbergen, in 1875 and 1876 to the Yenisei River in Siberia, in 1878–1880 through the Northeast Passage and around Asia and Europe and the last was a journey to West Greenland in 1883.

sense that the bedrock of environmental literacy is a deep understanding of the systems which form the natural world and the relationships between the living and non-living environments (Roth 1992).

In this article I will explain some of the views which lay behind Nordenskiöld's philosophy and the history of Nordic conservation generally. This article will be an experimental example of an exploration of environmental literacy from a historical perspective. So far this concept has only been applied in studies of the contemporary environmental movement, but here I will be looking at events which took place during the nineteenth century, a period of time predating the current movement's emergence. Most of the studies made of the history of Nordic conservation have focussed on the period following Nordenskiöld's time and particularly on the post World War II era. Whilst Nordenskiöld's expeditions into the Arctic have been – rather sporadically – studied, none of the studies produced so far have been made from the point of view of environmental history.[4]

Nordenskiöld was born into an upper class family in Finland. He was the son of a baron and later he himself became a baron. He was also a scholar, studying mineralogy, geology, chemistry, natural history, mathematics, and physics at the Alexander University in Helsinki, the capital of what was at that time the Grand Duchy of Finland.[5] He is a representative example of those rather few members of the nobility and academia who pioneered the advancement of the early conservation movement in Europe; eventually the idea permeated society as a whole. The American professor emeritus of history and environmental studies, Robert Frederick Nash, has stated that "*environmental history has the potential for displaying the successes and failures of our custodianship of the land in such a way that the present can benefit from the experience of the past*" (1990, p. 7). We can learn from the problems our predecessors faced, and from the ways they formulated ideas for reform. Nash (1990, p. 8) considers also that "*in attempting to advance conservation policies today it is important to know something of the national taste in environment. One of the best places to acquire such information is from an examination of how it was formed*".

Nordenskiöld wrote about the dangers posed to the natural world by technological progress. For instance, he writes in his essay "*[t]he accumulated impact of the great inventions of the last century on the nature which surrounds us is becoming increasingly evident day by day. The farthermost countryside will soon be criss-crossed by railways and telegraph lines*" (1880a, p. 10).[6] He understood that progress brought happiness and wellbeing to millions and represented the true measure

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[4] There are a few biographies by, for instance, Sven Hedin (1926), Henrik Ramsay (1953), and George Kish (1973), as well as articles in scientific journals – mostly on his expeditions or cartographical collection.

[5] In 1809, Finland had become part of Russia following Sweden's defeat in the war between the two countries. Finland became independent in 1917.

[6] The original text that I have translated is: *För varje dag blir det inflytande, det senaste århundradets stora uppfinningar utöfvat på den natur, som omger oss, allt mer och mer märkbart. Den aflägsnaste landsbygd genomkorsas snart af järnvägar och telegrafer.*

of a country's development, but simultaneously he had "*a melancholy feeling that future generations will barely be able to imagine what the land of their fathers was actually like*."[7] He was concerned about woodland wildlife too and suggested that in the national parks "*all but the more dangerous animals should roam safe from the hunter's bullet all the year round*".[8] I suggest that this remark arises out of what he had observed in the Arctic and his concerns that there had been over-hunting of animals in previous centuries when hunters could shoot and kill animals unrestrictedly.

Nordenskiöld undertook his expeditions during a period of technological, economic and environmental change, when the modes of whaling and hunting were transforming from small-scale enterprises into a fishing industry. The ships and their crews grew in size; equipment diversified and the numbers of creatures hunted increased. The inevitable consequence of this was a significant reduction of stocks. Such environmental changes associated with historical modes of production are illustrations of the second level of environmental historical research introduced by Donald Worster (1988, p. 293), which deals with the interaction between social conditions, the economy and the environment, as well as with the social relations that grow out of work and the various modes people have devised for producing goods from natural resources.

4.2 Environmental Literacy in a Historical Perspective

I argue that Nordenskiöld was environmentally literate. In the 1990s the American environmental historian Charles E. Roth – "the father of Environmental Literacy" – defined the concept as "*the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems*" (Roth 1992, p. 3). He introduced the concept in the late 1960s (Roth 1992; Hsu and Roth 1998) and since then there has been an ongoing debate on the topic. The term 'environmental literacy' is a common term within international education studies and it has also been used lately within environmental studies (Eskonheimo 2006; Hares 2006).

Roth (1992, p. 4) proposed three levels of identification of environmental literacy: nominal, functional and operational. The few examples I will give you will hopefully convince you that Nordenskiöld operated on these levels: he had the "*ability to recognize many of the basic terms used in communicating about the environment and to provide rough, if unsophisticated, working definitions of their meanings*" – the characteristics of the nominal level. He also had "*a broader knowledge*

[7] The original text that I have translated is: *Men det ligger derjemte något nedtryckande i känslan att våra efterkommande knappast skola kunna göra sig ett tydligt föreställning om deras fäders land.*

[8] The original text that I have translated is: *alla djur, som ej vore verkliga skadedjur, året om kunde gå trygga för jägarens lod.*

and understanding of nature and interactions between human social systems and other natural systems", indications of the functional level. And he showed "*progress beyond functional literacy in both the breadth and depth of understandings and skills*", as does a person who has reached the operational level (Roth 1992 p. 4).

In his book *A Primer for Environmental Literacy*, the American ecologist Frank B. Golley (1998, p. ix) presents environmental literacy as "*information on the natural and built environments in a form that will give the general reader an organized way to think about environment*". The trigger for environmental literacy is experience. The best place to develop it is to go out and see, feel, taste and experience the surroundings with a growing understanding. Nordenskiöld went out into the Arctic and saw, felt, tasted and experienced his surroundings, with a growing understanding.

In general, environmental literacy is connected with environmental education. It is something you can learn at school, college, university or other institutions. In some studies it has been used as a tool to interpret the values, attitudes, knowledge, experiences, and so on, of one particular region (Hares et al. 2006). I understand the concept of environmental literacy in an even broader sense, as something which can be developed spontaneously from an early age under the guidance of capable peers. A person adapts his way of thinking, knowing, experiencing, and understanding the environment, as well as his attitudes and values in relation to it, during the course of a lifelong interaction with his family, community, and society. Thus, environmental literacy is a diverse and implicit qualification within a society and a social group: people read their environment in different ways in different cultures.

Nordenskiöld had adult advisers: in the first place his father, Nils Gustaf Nordenskiöld (1792–1866), who was the superintendent of the Finnish Mining Board. Nordenskiöld Senior taught his son to perceive and understand the environment. Nordenskiöld's environmental literacy accumulated over the course of his ten expeditions by virtue of his own experiences and observations and in relation to what he learned from the inhabitants of the Arctic regions. He enjoyed listening to the stories of the fishers and hunters of the Arctic. He learned from them, for instance, that the whales had almost disappeared around Spitsbergen where, in previous centuries, numerous Dutch and English whalers had garnered lucrative catches. Over several decades, he gathered a wide collection of historical and geographical books and maps.[9]

4.3 Animal Protection Paving the Way for Conservation

Hunting is a traditional trade in the Arctic. For instance, the Norwegians have hunted seal, walrus and whale from time immemorial. In earlier centuries, whale meat was used for human consumption, and whale oil for lighting, lubrication, and

[9] Today these books and maps are filed in the Finnish National Library and classified as one of UNESCO's world treasures: http://www.nationallibrary.fi/services/kokoelmat/adolferiknordenskioldinkarttakokoelma.html

making soap. In the nineteenth century whaling yielded five commercial products: ambergris (ambra), spermaceti, and sperm oil from sperm whales; whale oil and whalebone from baleen whales.[10] With the discovery of substitutes for these, such as kerosene and vegetable oils, the use of whale oils declined considerably. Nowadays most countries have banned whaling as well as the sale and use of whale oil (see for instance Isachsen 1929; Davis et al. 1997, pp. 28–29, 33; Szabo 2008 pp. 279–280).

In Europe, the first animal protection laws were passed in response to levels of cruelty towards domestic animals, initially in Great Britain in 1822 and in France in 1824. The world's first animal protection society, *The Society for the Prevention of Cruelty to Animals*, was founded in Great Britain in 1824 (RSPCA 2014).

The Swedish historian Dag W. Scharp (1966, p. 46, 50, 90) names the Danish philosopher Laurids Smith as the first person in the Nordic countries to give expression to human responsibilities towards animals in his book *Försök till en systematisk afhandling om menniskans pligter mot djuren* (1791). This book was instrumental in bringing about more humane treatment of animals. Scharp (1966, p. 14–15) also mentions the old custom on the part of the monarch and nobility of reserving certain areas as their private hunting grounds. In Sweden, the island of Öland was declared a royal hunting park in perpetuity. The island's inhabitants were not allowed to hunt on the island and if they did so they were punished. Another such area is the Białowieża Forest (2011) in Poland, which in the fifteenth century had been in the possession of the king. The forest was declared a hunting reserve in 1541 for the purposes of protecting the wisent (European bison). In Sweden, one of the first people to realize the importance of nature protection was Israel Adolf Ström, Intendent of the Kungliga Djurgården (the Royal Menagerie). He had promoted the hunting regulations of 1808, for instance. Another was Adolf Leonard Nordvall who in 1857 published an animal protection text, *Bör och kan någonting göras till förekommande av mishandling af djuren?* (Should and could we do anything about cruelty to animals?). Following this, the rights of animals were an important item on the agenda: the Swedish Association for Hunting and Wildlife Management (est. 1830) commenced the publication of a journal in 1863. The association campaigned against animal cruelty and for more humane hunting methods (Scharp 1966, p. 76, 90).

The development of conservation has varied from country to country. The Dutch historian Henny J. van der Windt (1999) has found, in a number of countries, several initiatives concerning the establishment of nature conservation organisations such as bird protection acts and the ideas for national parks. But from country to country obvious differences can be observed in terms of priorities, in the precise definition of nature conservation and in the practices and forms of conservation institutions. The Dutch nature conservation movement, for instance, took its models from

[10] In terms of numbers of whales, the harvest of baleen whales reached a peak in 1938, with a catch of 50,769 animals. The total catch, including sperm whales, reached a maximum of 65,966 in 1962. However in terms of weight, the greatest biomass (maximum total weight) of baleen whales was captured in 1931.

Germany, the United Kingdom of Great Britain (UK) and the United States of America (US). Van der Windt considers that, in Europe, it was only Scandinavia and the German-speaking countries who adopted the idea of national parks soon after the US, although in Germany the focus was more on the preservation of plants, animals and cultivated landscapes.

The American historian Douglas Weiner has studied the progress of ideas concerning conservation, both in the US and in the former Soviet Union. He has noticed that the differences in the national experiences stand out dramatically. The American conservation movement's attention became firmly focused, early on, on the protection of recreational amenities; preeminently national parks and game resources, whilst energies in Soviet Union were for a long time directed at advancing a programme for the ecological study of nature in order to guide economic development scientifically. Correspondingly, the Soviet conservation movement for the most part of its existence was dominated to a far greater extent than the American one was by professional scientists, and its fate was more closely linked to that of ecology as a science. The reasons for these significant differences lie in the realms of politics, culture, and social structure. The Russian conservation movement embraced a multiplicity of approaches and positions. Weiner divides these into three main groupings: utilitarian, cultural-aesthetic-ethical, and scientific (Weiner 1988 p. 252–253).

4.4 Nordenskiöld's Concern for Animals

I found the first clues to Nordenskiöld's environmental literacy in his diary of the 1858 expedition to Spitsbergen. Subsequently, he makes the same kinds of remarks on environmental issues in the Arctic in all of his diaries, books and in other texts he produced about the expeditions. At the end of June 1858, Nordenskiöld visited the Dunóyane in the mouth of the Hornsund of Spitsbergen; a chain of low islands bound together by gravel and stones flushed out by the sea. The islands were covered in snow and ice, but most of it melted during the few days of their stay there. Nordenskiöld was astonished at how the poor and scanty vegetation could nourish and sustain the various and rich avifauna. He was most of all surprised because he realized that rapacious hunters could destroy the colony by collecting almost all the eggs and shooting most of the birds every year. He was afraid that the whole bird colony could become extinct if the hunters didn't cease their activities.[11]

Subsequently Nordenskiöld reports (1867, p. 89–90) how the whalers and fishermen kept an open cask filled with eggs on deck. They ate boiled eggs and egg pancakes, and used yolks as cream in their coffee. He thought that this kind of egg collecting and bird killing had greatly increased the level of hunting in the region as

[11] Nordenskiöld's files are at the Centre for the History of Science at the Royal Swedish Academy of Sciences in Stockholm (CHS). The diary of his expedition to Spitsbergen in 1858 is in File F02:1.

compared to the situation 20 years earlier. His solution to this problem was that the hunters should refrain from collecting eggs from the beginning of July, or take only the fresh eggs. The number of eiders would thus increase multifold. He knew that in Norway, where the eider was fully protected, their numbers had multiplied. These remarks evidence his operational environmental literacy.

The hunt for the Atlantic puffins on North Fuglö, a Norwegian island in Finnmark also concerned Nordenskiöld: he calls this hunt a "war of extermination". Every year the mountain-dwelling Samis came over and caught around 30,000–40,000 birds. The owner of the island kept the eggs and feathers and gave the hunters the meat of the birds as a reward. The job was quite perilous: during one season one or more Sami would fall off the high and dangerous cliffs and die. However there were always more, eager hunters available than the owner could hire. Nordenskiöld was worried about the extent of eiderdown being exported from the polar regions to Tromsø: in 1868 it amounted to 540 kg, in 1869 it was 963 kg, in 1870 882 kg, and in 1872 306 kg; the actual total yield per year, presumably, had been three times as big (Chydenius 1865, p. 65–66; Nordenskiöld 1881, p. 119). These observations are examples of his functional environmental literacy.

More examples of functional environmental literacy are found in Nordenskiöld's report on his expedition to Greenland in 1883. Here he notes his surprise at finding rather small numbers of living birds and animals compared to the lower fauna in the sea (1885a, p. 59, 186–187, 411). According to him the numbers of walruses and polar bears south of Waygatt was so infinitesimally small that many Danish colonists had never seen any. He opines that the indigenous people had emptied the waters, having "*recklessly shot every living creature they came across*." In 1883, when, on board the *Sofia*, they approached some islands harbouring numerous eider colonies, he notes "*the rapacious gaze in the eyes of the Eskimos*". He considers that these small islands have so far missed the "plunder fest" because of their faraway location. But "*now the moment of misery had broken*" when the Eskimos and every member of the crew who could obtain permission went ashore and gathered in total 1447 eggs and an abundance of feathers. He had also heard stories about the ancient, by then already extinct, giant auk in Greenlandic *Isaruleitsok*. However, he never managed to find any of that bird's bones in the "kjökkenmöddingar" (rubbish heaps) or on the house remains which otherwise included so abundantly all kinds of bones.

According to the hunter's tales, the waters around Bear Island were full of walruses when the first hunting vessels had arrived there in the seventeenth century. But the region was soon emptied of them after the arrival of the Dutch and English hunters. At the beginning of the nineteenth century, after the whales around Spitsbergen had been hunted almost to extinction, the Norwegians and Russians relocated their whaling activities to Bear Island. There they hunted all kinds of living creatures – birds, foxes, bears and walruses – the whole year around. Huge piles of carcasses lay around the shores so that other animals avoided those places (Chydenius 1865, p. 30).

In the seventeenth and eighteenth centuries in Spitsbergen, in the early days of whaling, every year around 2000–3000 boats with approximately 18,000 seamen from Holland and Great Britain arrived (Mehlum 1990, p. 118).[12] Nordenskiöld (1881, p. 142, 158–159) considers that the profits of this earlier "Polar Sea hunt," is comparable to the profits streaming out from the American oil wells. This remark is quite interesting, since the first oil wells in the United States were drilled at the end of the 1850s. On his third polar expedition, in 1868, he characterises the six hunting vessels which he had seen in the Ice Fjord, as the faint afterglow of a more significant whaling industry which had been here a couple of hundred years before.

The history of the "Polar Sea hunt" illustrates the significance of economic conditions in determining the catch. Both the cost of hunting and the value of the catch influenced the hunters' choice of prey, but cost seems to have been the dominant factor according to the American economic historians Lance E. Davis, Robert E. Gallman and Karin Gleiter. The size of the catch was determined by market conditions and the need for conservation was ignored. Economic expansion poses many environmental challenges, including the survival of species. Early pelagic whaling was an "open-access fishery", which implies that there were no regulations restricting participation. Like so many industries based on living marine resources, the whaling industry grew virtually unchecked until very recently. Open-access fisheries are subject to both biological depletion and economic profit depletion (Davis et al. 1997).

When the bigger whales had disappeared the hunting of smaller belugas became profitable. Nordenskiöld describes how they were caught with large, strong nets on the river mouths where the whales came for sweet water. Every summer 10–12 whaling boats arrived at Spitsbergen from Norway (ÅU 1858 p. 2). Nordenskiöld reports that in 1871 ships from Tromsø carried 2167 belugas back home and in 1880, one ship caught 300 belugas with one net cast in Magdalena Bay. Having found lots of whale bones lying at the mouth of the Yenisei River he concludes that the Russians and Samoyeds near Chabarowa had also caught beluga whales. But east of the White Sea to the Lena River he found no bones of bigger whales (Nordenskiöld 1881, p. 142, 158–9).

The Greenland shark (*Somniosus microcephelus*), which was called "Haakjaering" by the Norwegian fishers and hunters, is one of the largest living shark species. The Norwegians hunted it because of its huge liver: one liver could fill two barrels. They caught also other fish species which had economic value, such as, for instance, godfish (*Gadus morrhua*), halibut (*Hippoglossus hippoglossus*), haddock (*Melanogrammus aeglefinus*), and redfish (*Sebastes marinus*). Near Bear Island, they found as much godfish as were to be found near the Finnmark and the Lofoten Islands. They called these shoals "godfish mountains" (Nathorst 1900, p. 153).

In the book *Svenska expeditionen till Spetsbergen och Jan Mayen, utförda under åren 1863 och 1864* (The Swedish expeditions to the Spitsbergen and Jan Mayen during the years 1863 and 1864) Nordenskiöld reports unnecessary killing and exploitation of walruses: "*The first walrus is very difficult to catch but once the hunters have caught one, and bound it with the harpoon line along the boat, its cry*

[12] Dutch whaling companies, which in the sixteenth and seventeenth centuries sent 14,000 vessels to Svalbard, took a total of about 50,000 bowhead whales.

for help attracts his companions to come close. They come from all directions and gather around the boat … They literally bathe in the blood … After they [the hunters] have extirpated the fat they leave the bodies on the shore."(Dunér et al. 1867, p. 89–90) The blubber was in great demand in the soap industry. Nordenskiöld compared the hunters to gold diggers, with gold-lust gleaming in their eyes. He was afraid that on this evidence walruses would be extinct within the next few years. This is an example of his functional environmental literacy.

Among the caribou, Nordenskiöld (1871, p. 1025, 1881, p. 127, 142) found it rather peculiar that lots of these creatures were living on Spitsbergen, but almost none on the northern Novaya Zemlya, or Taimur Peninsula. Hunting vessels transported 996 caribou in 1868, 975 in 1869 and 837 in 1870, from Spitsbergen to Tromsø. Larger numbers of vessels sailed out from Hammerfest and even tourists shot caribou. Thus, the numbers killed must have equalled at least 3000 every year.

However, Nordenskiöld understood that hunting for wildlife was essential to the hunters since it was the source of their livelihoods. For instance, in an unpublished memorandum (1880b) he recommends the ship captains, who were sailing along the Chukches coast along the north-eastern corner of Asia, to prohibit the hunting of seals or whales if it was done only for fun or for an insignificant profit. They should allow the hunt to happen only in an hour of need. The noise of European guns might frighten the animals away and impact on the livelihoods of the coast dwellers. However, along the coast between the Lena and Novaya Zemlya, the sailors should be allowed to hunt without restraint since the area was totally empty.

The shooting of birds for food was also acceptable according to Nordenskiöld. During the expeditions, a delicious wild game menu, including geese, eider, caribou, and so on, replaced the standard, tasteless ship's food. From the very first expedition to Spitsbergen, in 1858, Nordenskiöld reports to his mother that, in spite of his poor eyesight, he has developed into a quite enthusiastic and clever rifleman; he himself having shot over 100 birds within 14 days. He also describes shooting some seals on the drift ice, and how sad he was when they were forced to leave many seals alive because of shortness of time. In a letter to his father he describes how easy it was to disembark onto some of the bird islands on the Hornsund to shoot eider and geese for their dinner table.[13]

In addition to Nordenskiöld, other explorers also made observations about the extensive and damaging levels of Arctic hunting and fishing (Mehlum 1990; Shoemaker 2005). It is very probable that Nordenskiöld was familiar with the perceptions of his predecessors. I have looked through some books in his extensive library in order to find signs of environmental literacy amongst them, such as remarks about environmental issues, or suggestions for preventative measures or resolutions. In books from the first half of the nineteenth century there are descriptions of the bloody slaughter of animals which do not include any critical comments for or against the fishers and hunters. For instance, in the diary *Tagebuch auf einer*

[13] Nordenskiöld's letter to his mother, Sofia Nordenskiöld from Bell Sund, Spitsbergen, 4 July 1858, and a letter to his father, Nils Gustaf Nordenskiöld, on board of the Lindesnäs, 9 Sept. 1858, in The National Library of Finland, Manuscript Collection, Frugård letters (NLF).

Reise nach Farö im Jahre 1828 (1830), the Danish explorer Carl Julian von Graba (1799–1874) (1830, p. 36, 222–231) describes his expedition to the Faroe Islands some decades earlier. Graba found the birds especially interesting. He describes how the local inhabitants trapped various kinds of birds, and how they prepared them for eating. He does not disapprove of the hunting but rather considers it to be a normal way of life. Graba also describes vividly how a whale hunt filled the whole village community with joy, whilst the harbour's crystal clear waters were dyed a bloody red. Inhabitants were transformed into wild beasts just like soldiers in battle; the bloody work filled them with fiery energy and boldness. In 30 boats on the sea there were 300 people, and they killed 80 whales in the tiny harbour. The community was filled with a wild furore; clothes, faces and hands were painted with blood and the normally mild and pleasant Faroe citizens were now like cannibals from the Southern Seas. In another place Graba mentions, quite by chance, that the shooting of an eider was punished with a fine of two Reichstahler. This was the usual method of regulating the common catch within this community.

The Frenchman Ferdinand de Lanoye (1810–1870) (1865, p. 51), who undertook an expedition to Siberia in the 1860s, some decades later, observed that the Ostyaks, as well as the other Siberian indigenous peoples, no longer engaged in the hunting practices which had earlier provided them with a good food and goods supply alongside that gained from fishing. The valuable fur-bearing animals had dwindled in numbers as a result of wanton destruction and forest fires. Pine martens and foxes, which had once been part of the rich fauna of the country, had almost totally disappeared. The Ostyaks quite often came across bears, elks and wild reindeer, but they refrained from hunting these animals in order to augment their numbers.

Between Graba and Lanoye, we find a difference in attitudes towards nature. Graba simply makes notes without making any criticisms. He is not environmentally literate. Lanoye notes the destructive changes in the natural environment and comments upon them, but doesn't come up with any solutions to the problems. The fundamental basis for arriving at sensible solutions lies in a sound understanding of natural and socio-economic systems, and the impacts of human actions upon them. Lanoye's descriptions could be considered to be at the level of functional environmental literacy.

In a recent research study, the American historian Ryan Tucker Jones (2011) refers to the concerns of early modern European explorers in the North Pacific. He mentions, for instance, Martin Sauer's book *An account of a geographical and astronomical expedition to the northern parts of Russia in the years 1785–1794* (1802), on Joseph Billing's expedition. This book is also in Nordenskiöld's library, both in English and in French, and he even refers to the contents of it in an article published in 1885 (Nordenskiöld 1885b, p. 283). Jones indicates that species extinctions became a European concern much earlier than was previously suspected. He introduces new evidence of animal extinctions in the Russian North Pacific in 1741–1810. On several Russian-sponsored voyages of exploration, European and Russian observers noted the dramatic environmental change which was going on in that area; the numbers of the fur seals and the sea otters having been catastrophically diminished because of ruthless over-hunting. Jones writes that unfortunately the accounts of these early eyewitnesses remained more rhetorical than active, and none of the explorers offered a concrete plan to prevent the extinctions. Some decades later, in the 1860s, the Finnish-born governor of Russian Alaska, Johan Hampus Furuhjelm (*Letters* 2005, 252), mentions some improvements in the Pacific, such as the fact that "*to sustain the colonies' traditional fur trade, sea otters, otters, and several kinds of foxes have been released into various locations. Thanks to earlier protection measures, the fur seal population has increased, allowing a rise of the annual sealing quota on the Pribilof Islands from 60,000 to 75,000 pelts in 1863*."

Nordenskiöld expressed his operational environmental literacy when he wanted to remedy the catastrophic situation in the Polar Sea by reporting his observations in his books and articles and by making suggestions for improving the state of affairs. It is only that it took rather long time before the governments and administrators were ready to take action in the matter.

4.5 Ideas About Animal Protection Which Circulated in Nordenskiöld's International Scientific Network

Nordenskiöld was engaged in an extensive scientific network, within which there were many members who were interested in ideas relating to animal protection, and it is very likely that during the Arctic expeditions, the participants discussed the protection of nature and animals. Afterwards, in fact, many of them wrote essays and books on these issues. For instance, the Swedish zoologist August Emil Algot Holmgren (1829–1888), who followed Nordenskiöld to Spitsbergen in 1868, wrote a book about small birds: *Om småfoglarne. Den nytta de göra och det skydd de behöfva* (1869) (About small birds. Their benefit and protection). This book might be one of the catalysts for the establishment a number of children's small bird protection societies, which spread from Sweden to other countries. The initiators of this project were Professor A. W. Malm, also a colleague of Nordenskiöld, and a schoolteacher, C. G. Svensson. In 1869 they founded *Småfoglarnas vänner* (Society for the Friends of Small Birds) in Gothenburg. The following year the Finnish historian and much loved storyteller, Zacharias Topelius, founded *Vårföreningen i Finland* (the Finnish Spring Society), with an aim of making the idea of the protection of nature more comprehensible to small children. In Great Britain, also, societies such as the Band of Mercy, established in 1875, recruited and encouraged children to make a pledge to be kind to birds and animals (SN 1959, p. 6, 10; Sundin 1981, p. 168–169; Lundgren 2009, p. 25–37).

August Quennerstedt, a Swedish zoologist from Lund, took part in Nordenskiöld's first expedition of 1858 and made one of his own to Jan Mayen Island in 1863. He condemned "the ruthless Polar Sea hunt" (1867, p. 156, 177, 179–185), i.e. whaling, which was practised by the Norwegians. He gave detailed reports of the seal catch, especially the hunting of the small, light, yellow baby harp seals during the spring months. In the 1860s, a catch of around 4000–5000 pieces was considered to be a fairly good catch, but even as many as 8000–10,000 were possible by the first half of May. Gradually, though, the numbers of baby seals declined and then it was the elders' turn to be caught and in the end that catch also declined.

Another Swedish zoologist, Alfred Gabriel Nathorst (1850–1921), who was on the expedition to Greenland in 1883, became an active promoter of conservation politics in Sweden after Nordenskiöld's death in 1901. He published a book *Hafva djuren rättighet att lefva?* (Do Animals Have the Right to Live?), in 1907. He wrote about Arctic animals and the importance of protecting them. He shared Nordenskiöld's opinion that killing for food was acceptable, but killing animals just for fun or because of considerable profits – as was the practice of the trading houses who sent their fleets to catch thousands and thousands of seals – "*then we must ask: do the animals have the right to live?*" In 1909, he was one of the five members of a committee of the Royal Swedish Academy of Science which delivered a statement to the government about which were the most suitable regions and objects in nature to be protected (SN 1959, p. 6, 10; Sundin 1981, p. 168–169).

The Swiss botanist Oswald Heer (1809–1883) also raised awareness of Nordenskiöld's observations of the Arctic natural environment. For instance, in January 1869, in a lecture he delivered in Zürich, he referred to Nordenskiöld's comments on the decimated whale population around Spitsbergen. The lecture was translated into Swedish in the same year. In his book on the Swedish polar expeditions of 1870 and 1872–1873, Heer shared Nordenskiöld's anxiety over the "*endless avarice and destructive orgy of human beings*" causing the near extinction of whales, walruses, seals and eiders in the Arctic Sea (Heer 1869, p. 13, 1874, p. 5).

Nordenskiöld's place in the history of conservation is beyond question in the Nordic countries (Palmgren 1920, p. 53–56; Söderberg 1977, p. 4; Sundin 1981, p. 153; Haraldsson 1987, p. 75–76; Myllyntaus 1991, p. 327–328; Lundgren 2009, p. 38–50 etc.). In Finland he is considered to be the first noteworthy pioneer of the issue of conservation, but in Sweden he is just one among several other such characters. For instance, Pehr Arvid Säve (1811–1887), a schoolteacher from Visby, has acquired a rather significant position in the history of Swedish conservation. He wrote an article, 'Sista paret ut!' (The last pair out!) (1877, p. 70–86) in *Svenska Jägareförbundets Nya Tidskrift* (the New Journal of the Swedish Association for Hunting and Wildlife Management), in which he recommended a new law be enacted to ratify the relationship between mankind and animals (Säve 1877, p. 83; SN 1959, p. 5; Söderberg 1977, p. 4). So far I have not found any researcher who has mentioned that Nordenskiöld had already written about environmental damage in the Arctic in his earlier accounts of his expeditions, i.e., before Säve and that Säve referred (1877, p. 76) in his own article to Nordenskiöld's descriptions on the expeditions of 1861 and 1864.

Nordenskiöld and Säve were acquainted and they shared the same opinions on animal protection. In a letter dated 1882, Säve asked Nordenskiöld for help to organize an international congress on animal preservation. A congress would be good forum for discussions on laws concerning animal preservation. Both men believed in the imposition of hunting restrictions, and Säve relied upon Nordenskiöld's eminence and influence in putting on the congress and introducing the new law.

Nordenskiöld visited Säve in Visby in 1885, an event which was the source of considerable satisfaction for Säve. Unfortunately, however, they never did organize an international congress together.[14]

Nordenskiöld received regular enquiries from abroad, too. For instance, in 1892, after the Government of the United States had selected C. Hart Merriam "*to investigate and report upon the condition of the Fur Seal rookeries on the Pribilof Islands in the Bering Sea, with special reference to the causes of decreases and the measures necessary for the restoration and permanent preservation of the seal herd*",[15] Merriam asked Nordenskiöld for his opinion about a report on his investigations of the Pribilof Islands. In his reply Nordenskiöld agrees with Merriam: "*[the] description of the life of the northern Fur Seal corresponds generally with similar descriptions by former authors … and, also with our own personal experiences of the animal life in the arctic sea, and with the information one of us gathered from the inhabitants during a short stay in the Bering Sea*."[16] He said that Merriam's recommendations "*should serve as a basis for the regulations necessary to preserve this gregarious animal from its threatened extinction in a comparatively short time*." Nordenskiöld divides the regulations into two categories:

1. *Regulation of the killing*, etc., *of the Fur Seals on the rookeries in order to prevent the gradual diminution of the stock.*
2. *Regulations for Pelagic Sealing, or for the hunting of the Seals swimming in the ocean in large herds to and from the rookeries, or around the rookeries during the time when females are suckling their pups on land.*
   As to the former question – the killing of the Seals on the rookeries – it seems at present to be regulated in a manner suitable for the effectual prevention of the gradual diminution of the stock … . It is evidently in the interest of the owners of the rookeries to take care that this source of wealth should not be diminished by excessive exploitation. Nor will there be any difficulty in studying the conditions for health and thriving of the animals during the rookery season … . We are therefore persuaded that a prohibition of Pelagic Sealing is a necessary condition for the prevention of the total extermination of the Fur Seal.[17]

Sometimes Nordenskiöld received critical or negative feedback. For instance, in 1880, after his successful voyage through the Northeast Passage, he received a letter from American artist and naturalist Henry W. Elliott. Elliott kindly remarked that there must have been an obvious error in the numbers of the annual cull of the Northern fur seals on Bering Islands, as reported by Nordenskiöld. Elliott himself had spent 2 years on the American or Alaskan Seal Islands, on behalf of the Smithsonian Institution and a friend had kindly directed his attention to the numbers. Whilst Nordenskiöld had reported that "*Between 50,000 and 100,000 of these animals (C. ursina) [the Northern fur seal] are killed yearly on this and the neigh-*

[14] Säve's letters to Nordenskiöld, 9 May 1882, and 2 September 1885, in CHS E01:26.

[15] C. Hart Merriam's letter to A. E. Nordenskiöld, 2 April 1892, in CHS E01:16.

[16] C. Hart Merriam's letter to A. E. Nordenskiöld, 2 April 1892, in CHS E01:16.

[17] A. E. Nordenskiöld's letter to C. Hart Merriam, 14 May 1892, in CHS E02:5.

bouring Copper Island",[18] Elliott had been told that no such number could have been taken there, and that the annual catch was actually between 15,000 and 25,000; sometimes as high as 40,000, and at others, as low as 10,000. He also noted, with great interest, what Nordenskiöld had said in regard to the Rhytino [Stelleri] and he hoped that the results would soon be authoritatively published under the auspices of the Institute to the satisfaction of the large number of American readers who awaited them. He also sent a copy of his work on the Pribilof group of seal islands. He was preparing "*a series of water-colour drawings, illustrations of the wonderful fur-seal rookery on the Prybilov Islands, which will be exhibited in the next April at the International Fish Culturalists Exhibition by our representatives to the Congress*."[19] Henry W. Elliott produced some of the earliest images of the Pribilof fur seal harvest, and he also wrote the first detailed account of the northern fur seal's life history, and many regard him as the man who saved the northern fur seal from extinction.

Elliott's friend who had "*kindly called his eye to the numbers*" was most probably Leonhard Hess Stejneger (1851–1943), a Norwegian zoologist who spent most of his life in the US. He worked for several decades at the Smithsonian Institution, first under Spencer Fullerton Baird and latterly as the Director of the Biological Department. Stejneger and Nordenskiöld exchanged their experiences and opinions on the Steller's sea cow, which had formerly lived in the northern Bering Sea (Nordenskiöld 1885b, p. 199–226; Stejneger 1884, 1886, 1887).

One interesting topic with which Nordenskiöld was also occupied was the status of Spitsbergen in respect of its nationality, natural resources and its flora and fauna. These questions were for a long time unsettled. In 1871 he had made attempts to bring Spitsbergen under the Swedish crown but at that time the Russian government had protested against the proposition. In the summer of 1896, the issue was again under discussion. Count Ludvig Douglas (1849–1916), Sweden's foreign minister, then contacted Nordenskiöld asking for his opinion on an international treaty for Spitsbergen and a bill on closed seasons for certain animals there. In a letter, Douglas explained the proceedings: first he wanted to send a proposal to the Swedish Academy asking for their opinion, both on that question and on which animal species should be included in the game law. After that, the Swedish ministers would contact those states which had been engaged in the question of the defence of Spitsbergen in 1871[20] in order to get their preliminary approval. It was anticipated

[18] Henry W. Elliott's letter to Nordenskiöld, 15 Jan. 1880, in CHS F01b:3. Henry W. Elliott (1846–1930) was an artist, explorer, and conservationist. From 1869 to 1871 he served as an artist on the United States Geological and Geographical Surveys of the Territories under Ferdinand Vandeveer Hayden. In 1880 he worked at the Smithsonian Institution.

[19] Henry W. Elliott's letter to Nordenskiöld, 15 Jan. 1880, in CHS F01b:3.

[20] These states were Germany, Belgium, Denmark, the Netherlands, Great Britain, France and Russia. In a memorandum in May 1892, Nordenskiöld explained the content of his apply in February 1871 to the Foreign Minister of Sweden and Norway in which he asked for a permission to build a colony on Spitsbergen. Before the approval, the application passed the governments in Berlin, Brussels, Copenhagen, The Hague, London, Paris and St. Petersburg. Memorandum of A. E. Nordenskiöld in 1892, in CHS.

that the proposed game law would obligate all the powers to sign an international agreement, and the king of Sweden-Norway would oversee the implementation of the law.[21] So far I have not found Nordenskiöld's answer to this enquiry. In 1914, a German pioneer of nature conservation, Hugo Conwentz (1855–1922), continued this process when he launched an initiative to protect the landscape, flora and wildlife of Spitsbergen. In 1920, the Treaty Concerning the Archipelago of Spitsbergen was signed by a group of western nations, including Sweden. According to its second article, second section: "*Norway shall be free to maintain, take or decree suitable measures to ensure the preservation and, if necessary, the re-constitution of the fauna and flora of the said regions, and their territorial waters*." The union of Sweden and Norway was peacefully dissolved in 1905 and Spitsbergen came under Norwegian sovereignty (Wråkberg 2006, p. 21).

Conwentz and Nordenskiöld knew each other. They had become acquainted in the early 1890s. Since then they had met several times either in Germany or in Sweden. In 1904, in an article on nature conservation and animal protection in Sweden, Conwentz expressed opinions rather similar to Nordenskiöld's. Conwentz respected Nordenskiöld and considered him to be "*a brilliant initiator of conservation ideas in the Scandinavian countries*" (Conwentz 1904, p. 42).

Nordenskiöld and his abovementioned fellows in this international network of scientists were seeing their environment in a new, more comprehensive way. They were bringing in a new set of values, ethics and scientific theories. They told stories about the fragility of nature. "*People tell stories in order to make sense of their world, and some of the most frequently repeated narratives contain a society's basic assumptions about its relationship to the environment*", says David E. Nye in his article *Technology, Nature, and American Origin Stories* (2003, p. 8). If we want to change our relationship with nature we need to change our stories. Nordenskiöld and his colleagues continually acquainted people with their observations on the problems in the environment; gradually this new way of telling stories about nature began to change people's attitudes towards it.

4.6 Environmental Literacy and Conservation

"*Experience in the natural world is both an essential part of understanding the environment, and conducive to good thinking*," opines Professor Orr (1992, p. 91), and Nordenskiöld experienced the Arctic world intimately over the 25 years of his ten expeditions to the polar regions. Before each expedition, he also undertook a careful study of the history and natural features of the target area. During the expeditions themselves he made keen observations and he also benefitted from and often relied upon the knowledge of the local fishermen. By listening carefully to the

[21] Douglas' letter to A. E. Nordenskiöld, 17 June 1896, in CHS E01:5. Ludvig Wilhelm August Douglas was the Foreign Minister of Sweden 1895–1899, Governor of Uppsala region 1893–1895 and Governor of Östergötaland region 1901–1912. Count Douglas was one of the founders of the Swedish Society of Conservation.

inhabitants of the Arctic, he deepened his knowledge of the region. He also relied on the knowledge and experience he received from a network of natural scientists, and from national and international contacts. He combined all this scientific knowledge and local knowledge with his own observations and experiences and, with the help of his environmental literacy, he composed a vision of the impact of changes to the environment. He acquired a comprehensive understanding of the environment by means of active experiencing and making observations, as well as through the acquisition of knowledge, values and attitudes, all of which are the basic elements of environmental literacy. He demonstrated that he had progressed beyond functional literacy by virtue of both the breadth and depth of his understanding and skills, to become a person who has reached the operational level of environmental literacy (Roth 1992).

The geographer Yi-Fu Tuan argues that a person's natural environment and their world views are closely related (1974, p, 59, 79). In order to understand a person's environmental preferences, it is useful to examine their biological heritage, upbringing, education, job and physical surroundings. At the level of group attitudes and preferences it is necessary to know a group's cultural history and experience in the context of its physical setting. There are differences in attitudes between the visitor and the native and in the evaluation of the same environment by colonists and explorers of disparate backgrounds and experiences. It is in this vein that Ari Nevalainen, who has studied the history of American conservation, considers the relationship of the Native Americans, based on their interactions, with the environment: traditionally nature has taken care of the human beings and human beings have taken care of nature. The settlers, on the other hand, had a different relationship to the environment: they saw the natural world as the source of raw materials which would make the material progress of their society possible (Nevalainen 1992 p. 102–3, 106).

Most people see their surroundings in the way they have been habituated to do so as a member of their own particular community, culture and time: the environment is a part of the culture, from within the terms of which it is read. Environmental knowledge reflects the local circumstances upon which the everyday livelihood of the inhabitants depends. Some knowledge is relevant everywhere, whilst some is particular to a certain place, area or region, so that – for example – a casual tourist or visitor perceives the surroundings in a different way compared to the local inhabitants. The outsider's view and evaluation of the environment is essentially aesthetic. He judges according to appearance, according to some formal idea of what is beautiful. A special effort is required to empathize with the lives and values of the inhabitants (Tuan 1974, p. 64; Hares et al. 2006, p. 129–130).

The Swedish historian Bo Sundin (1981, p. 153) introduces Nordenskiöld as a modern natural scientist who, being a geologist and biologist, wanted to protect nature from the point of view of a scientist. Sundin refers to Nordenskiöld's abovementioned essay, *Förslag till inrättandet af Riksparker i de nordiska länderna* (A Proposal for Establishing National Parks in the Nordic Countries). But if you read Nordenskiöld's text a little more carefully, Nordenskiöld's reasons were more aesthetic and cultural-historical than scientific. A capacity for aesthetic appreciation is one of the essential features of environmental literacy (Orr 1992, p. 87).

Nordenskiöld was most concerned about protecting the ancient landscape of the Nordic countries, with its historical and aesthetic values. He wanted to preserve the forests for future generations in the same way as old buildings are preserved in open-air museums.

Nordenskiöld combined his own environmental knowledge with that of his colleagues and of the inhabitants of the Arctic, as well as the knowledge he received from the books in his library. This holistic environmental knowledge augmented his environmental literacy and helped him to see and understand the dangers of excessive hunting and fishing, which were threatening the natural environment. This in turn prompted him to offer proposals for resolving environmental damage. His concerns about environmental problems were pioneering at this time in Europe. He was one of the first individuals who 'spoke up' for nature. Many of his colleagues, both in Sweden and Finland and abroad, shared his concerns and, after him, continued to argue for conservation. Moreover, his insights are still leading the way, as they inspire people to gain an understanding of the role of individuals in the history of the environment, of the fact that everybody has a chance to have an impact on history and on the environment. His story emphasizes the importance of one individual in the interpretation of environmental problems and in the promotion of environmental awareness.

At present, environmental education is an important means of encouraging people to act in sustainable manner in relation to the environment. Measures ensuring that citizens are conversant with the causes and consequences of environmental damage are a necessary component of any strategy to resolve environmental problems. If people understand the critical issues at a personal level, they may be more willing to support the protection of environmental quality, biodiversity, and the natural ecosystem.

History is not only about understanding the past; historical knowledge is important for creating a better future: policy makers use assumptions about history to make decisions concerning our future. In the long view of history every individual has his own place and meaning. Nordenskiöld's proposal to establish national parks was a product of his thoughts, experiences and knowledge. He wanted to influence his fellow citizens by publishing the opinions he had arrived at, based on his observations and experiences. He wanted to make people to realize and confront the dangers, just as he was confronting them. He is an example of a man with ideas which were ahead of their time. Nordenskiöld is an important pioneer in the history of the nature conservation.

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Part II
Proposing – Concepts, Sources, Methodologies

Chapter 5
Eco-fusion of Alien and Native as a New Conceptual Framework for Historical Ecology

Ian D. Rotherham

Abstract Rapidly emerging, often-critical issues of changing ecology and ecosystems result from urbanisation, globalisation, climate change, and human cultural influences. Long-term nature-human interactions in agriculture and forestry, and increasing influence of urbanisation and other environmental changes (Freedman B, Environmental ecology – the effects of pollution, disturbance and other stresses, 2nd edn. Academic, San Diego, 1995), force and facilitate hybridisation of nature. With accelerating globalisation and human-induced and natural climate changes, hybridisation speeds up. Anthropogenic influences cause disturbance, nutrient enrichment, habitat replacement (through formation and destruction), and planetary-scale species dispersal (Rotherham ID, Eco-history: an introduction to biodiversity and conservation. The White Horse Press, Cambridge, 2014a; Douglas I, Goode D, Houck MC, Wang R (eds), The Routledge handbook of urban ecology. Routledge, London, 2011). Ecological processes driving the changes are '*natural*' mechanisms of ecological succession and changes, and species and ecosystem hybridisation and adaptation. Mixing of species now occurs at a rate unprecedented in the history of biodiversity evolution. The so-called '*Anthropocene*', the latest great evolutionary epoch is upon us with nature adapting to a new canvas and a changed template (Steffen W, Crutzen PJ, McNeill JR, AMBIO 36(8):614–621, 2007). Ecological fusion or '*eco-fusion*' describes the dynamic and ongoing process through which species deemed to be '*native*' or '*alien*' in particular locations or regions, interact to form newly combined ecological groups. Some species are acquired into these novel communities and others, formerly established, are displaced (Hobbs RJ, Higgs ES, Hall CM (eds), Novel ecosystems. Intervening in the new ecological world order. Wiley-Blackwell, Chichester, 2013). In this chapter, these issues are introduced and discussed with particular reference to the case study of the British Isles. The novel concepts of recombinant ecologies, ecological fusion and hybrid nature are explained and the concepts are considered in relation to current debates about future ecologies and ideas of so-called, re-wilding.

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5.1 Introduction

We are faced today with critical issues of changing ecology and ecosystems on scales from local, parochial, to global and planetary (Adams 2003; Barker et al. 1994; Gaston 2010; Rotherham 2014a). Key issues and drivers of these processes are urbanisation, globalisation, climate change, and human cultural influences (Sukopp and Hejny 1990; Agnoletti 2006; Agnoletti et al. 2007). The ecological processes driving the changes are '*natural*' mechanisms of ecological succession and changes, hybridisation of both species and ecosystems, and consequent adaptation. Many of the changes can be predicted though an understanding of ecosystems and species strategies (e.g. Grime et al. 2007; Hodgson 1986). Mixing of species now occurs at a rate unprecedented in the history of biodiversity evolution. The '*Anthropocene*', is characterised by human-driven dominating influences and nature responding (Steffen et al. 2007; Rotherham 2014a). Increasingly, there is an urgent need to relate environmental history studies to those of mainstream ecology in order to understand better the drivers of change and the potential outcomes for future ecologies (Hall 2009; Jørgensen et al. 2013; Samojlik et al. 2013; Smout 2000). The desire to understand changing ecologies and thus to inform planning processes, has been developing over several decades (e.g. Sukopp et al. 1995; Douglas et al. 2011; Niemalä 2011) (Fig. 5.1).

The diversity of natural life, known most widely as '*biodiversity*', reflects underlying ecology and ecological processes. For a particular region, in this case the example of the British Isles, the diversity in total reflects a matrix of geographical spaces or habitats with parochial sets of environmental conditions in varying stages and states of flux and stability. The overall '*biodiversity*' reflects the summation of these myriad sites, some species rich, some species poor, and together amounting to a national ecology. However, shifting, drifting and fluxing with human influences and natural changes in forces such as climate, in contexts of time and space, this resource is not a fixed entity. Over longer timescales, evolutionary processes help generate new species and drive to extinction many of those existing today. In even longer periods, geological shifts force massive movements of continents around the planet with major extinctions and times of rapid evolution. These other changes occur against a backdrop of this '*bigger picture*' of a dynamic ecology (Rotherham 2014b).

Over countless centuries, humans have interacted with nature in ways that modify and sometimes destroy the environmental resources (Rotherham 2013a; Rackham 1986). However, much human management has led to recognisable '*cultural*' landscapes, which merge natural and anthropogenic, and typically, many of these have been managed according to customary or traditional ways. The result in the pre-petrochemical age was traditional landscapes often with species-rich habitats maintained by long-established techniques varying little in method or timing from year to year, and from decade to decade. These traditional, '*unimproved*' landscapes have for centuries held a biodiversity, and ecology, descended from analogous '*habitats*' in the ancient, primeval, '*natural*' landscape of Europe (Rotherham

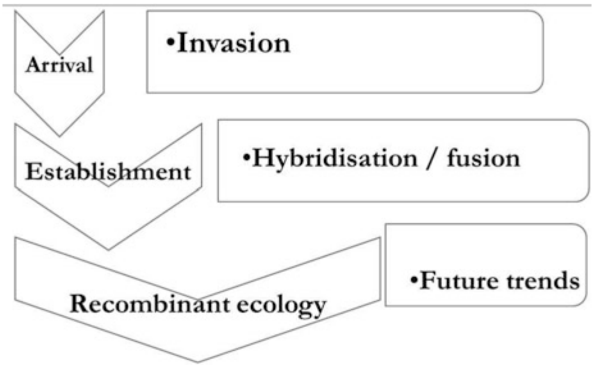

Fig. 5.1 Schematic representation of the process of eco-fusion

2009b, 2013b, 2014a). The complex inter-relationships and ecologies of these habitats and their ecosystems result from this interaction and the longevity of the nature-human interaction.

Dramatic and largely unrecognised consequences of these human influences are hybridisation of both species and of ecology itself. Whilst '*eco-fusion*' is most easily observed and recognised in increasingly urban environments, it occurs more widely, in forestry and agricultural landscapes. With new environmental conditions forged, plants, animals, and fungi move and mix beyond natural distributions and limits, so old and new, native and exotic, become enmeshed in recombinant communities and hybrid ecosystems. Here, and especially in the urban heartlands of this new ecology, native and alien jostle for position and novel interactions and dependencies form (Rotherham 2014a; Gilbert 1989, 1992a).

In this discussion a new approach to environmental change and its history is applied to debates on exotic and native species to present challenges to current alien species paradigms and to raise critical issues of perceptions and judgements. Novel concepts of recombinant, hybrid ecology and eco-fusion are presented in the chapter, alongside the implications for future ecologies. With debates on '*wilding*' and so-called '*re-wilding*', ecological fusion and hybrid ecology, provide key conceptual frameworks within which future landscapes and ecologies may be considered (Taylor 2005; Rotherham 2014b) (Fig. 5.2).

5.2 Hybrid Ecologies

There is little doubt that in some cases, introduced species have changed landscapes and indigenous ecologies (Rackham 1986; Gilbert 1989). Furthermore, these changes are often dramatic and even fundamental to the ecology observed today. Nevertheless, the trends and changes must also be considered in the context of wider fluxes in climate, in land-use, and in the way that landscape and ecology interact with people. This is often not the case, with judgments made based on subjective assessments of '*worth*' and '*value*' and even an almost xenophobic fear of native

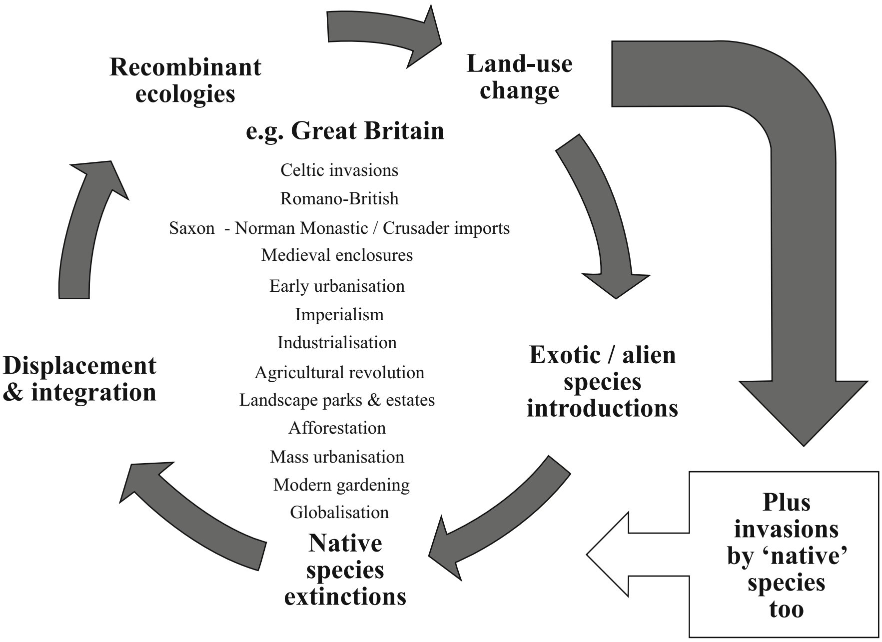

Fig. 5.2 The flow of recombinant ecology

wildlife under threat from alien invaders. Yet even the most cursory view of a British landscape will demonstrate there is often little that is truly '*natural*' or '*native*'; most is a '*cultural*' or '*eco-cultural*' landscape (Rotherham 2007a, 2008a, 2009b, 2011). Our ecology has been acquired through centuries of interactions between people and nature. At best, it has elements that can be considered '*semi-natural*' and traditional, and large areas of farmland for example, which themselves are exotic in character and mostly of modern origins. Therefore, it is against this backdrop that the problems of invasive species must be considered if we are to have any hope of prioritizing effective and valid actions for conservation. We need to understand that our ecology has been hybridising for a very long time, and the process of '*ecological fusion*' runs deep. Clearly, species invasion triggered by human-induced environmental changes and globalisation, can wreak havoc on established ecologies, push species to the brink of extinction, and in some cases, cause huge economic losses. However, behind this trail of destruction and disruption there are processes going on which ultimately change ecosystems in the longer-term.

The roles of both people and nature are identified as interactions at the core of biological invasions (Johnson 2010). This chapter notes two specific aspects of the invasion paradigm in Great Britain, firstly that of the deliberate introduction of plants and animals around the world by the Victorian Acclimatisation Societies, and secondly the Wild Garden Movement (Rotherham 2005; Rotherham and Lambert 2011). These two nineteenth-century phenomena led directly to many of the issues and challenges, which face conservation today. Important within this consideration are the changing perceptions and attitudes of people towards nature, and especially to the exotic, over the period from the early nineteenth century to the end of the twentieth century. Whilst Davis et al. (2001) addressed the changing attitudes towards exotic plants and animals in Britain consequent on the writings and broadcasts of Charles Elton, this wider influence of fashion and taste in shaping responses to aliens has generally been overlooked. Furthermore, the critical role of the practical manifestations of fashion, such as the accidental or even deliberate introduction of now invasive species to the countryside has not been recognised.

This chapter provides insight into the importance of human cultural facilitation of invasions, and into how perceptions and attitudes have affected this (e.g. Rotherham and Lambert 2011). Crossing boundaries of ecological science and history, it considers two specific British examples, which together created many of the invasions of the twentieth, and twenty-first centuries (e.g. Rotherham 2009a; Rotherham and Lambert 2011). The problem of aggressive and invasive plants and animals is not new but the scale of impact, combined with rapid climate change and other environmental fluxes, is dramatic. A starting point for discussion must be in deciding what is alien and what constitutes a problem. An alien species is a plant, animal, or microorganism not '*native*' to an area, but introduced by humans, accidentally or deliberately. It may or may not be invasive and in fact only about 0.1 % of aliens are damaging. Furthermore, the spread of species across the planet is not new but recent horror stories have stirred up a debate amongst ecologists, politicians, industry, and the public. Indeed there are good reasons why this is so. Some 15 % of Europe's 11,000 aliens have environmental or economic impacts; with damage to the UK economy from invaders estimated at £2bn *per annum*. Nevertheless, underlying the headlines are deep-seated questions of what is native and where, what is alien and when (Rotherham 2009a; Rotherham and Lambert 2011). From Spanish bluebell, to eagle owls and Canada geese, and from big cats, beavers and signal crayfish to wild boar, which ones should get a free pass to a new hybrid future?

5.3 The Mixing Pot of Empires, Acclimatisation and Wild Gardening

Observations in Europe and discussions with ecologists and landscape historians from Continental Europe are informative (Agnoletti 2006; Rotherham et al. 2013). In many cases, it seems that the Europeans worry more about '*problem species*' rather than necessarily '*alien*' ones (Rotherham and Lambert 2011). In Britain we are an island race, (or at least a collection of races now on a collection of islands); but the boundaries of the land and sea give clear definition as to what should be '*in*', and what should be '*out*'. Yet British perceptions of this, and attitudes, and responses, which stem from it, are surprisingly recent in origin. Until the 1940s, the British travelled the globe collecting and selecting plants and animals to bring back to

Britain. Not merely content with collecting this mixed bag of species, they deliberately set about their release into the landscape to '*improve it*' for people and for economic benefit too.

This movement spread around the world, with European Acclimatisation Societies established first, seeking to introduce and test new crops for economic purposes and especially their potential for food. However, these organisations developed in other ways and in Britain and the colonies, they looked to the introduction of animals and birds to new places in order to improve economies, gastronomies, and landscapes. The impacts of Acclimatisation Societies had huge effects on New Zealand and Australian ecologies for example, and today on conservation, particularly in New Zealand.

The *Acclimatisation Societies* and the *Victorian Wild Gardeners* (Rotherham 2005) were manifestations of processes that had occurred to greater or lesser degrees for centuries. We know that through history the waves of settlers or conquerors of Britain had done just the same. The Romans and then the Normans imported huge numbers of animals and probably plants too, many of which are keystone species in modern ecology. The most obvious example is the humble rabbit, but we can add the fallow deer and the brown hare to the list to consider later when we examine issues of perception and attitude (Rackham 1986). We also accidentally, unwittingly and uncaringly released many other animals and plants to make their own ways in the world. Many of these species went on to become an intimate part of what we now see as '*British*' ecology. The Romans and Normans imported herbs and food-plants from southern Europe and the Mediterranean, as did the returning Crusaders and the various monastic dynasties that controlled much of the productive landscape for several centuries. Many of these species have been absorbed or hybridised into the mix of native ecology. Most of these species are now tolerated, and many (such as the Brown Hare for example), are celebrated and conserved.

By the 1500s, seafarers from Britain and Holland for example, were beginning to chart their ways around the globe. From all the corners of the world, they brought back exotic plants and sometimes animals; many of these introductions perished but others did not. Accidental imports had already included black rat and brown rat, plus a dash of bubonic plague, and in return, the later explorers spread these around the planet along with dogs, cats, and much more. The cultural homogenisation of ecology was speeding up, the collection and dissemination of alien species accelerating as travellers went in search of exotic plants and animals for gardens and for menageries. As landscaping, forestry, and gardening emerged in Britain through the 1700s and 1800s, the impacts on the environment increased. This process continues today with sometimes-catastrophic consequences (Rotherham 2014a).

However, it should not be imagined that these changes to '*native*' ecology were isolated from other impacts. At about the same time, in the eighteenth and nineteenth centuries, the wider landscape was traumatised by the parliamentary enclosures with commonland wrested from the commoners, the peasants and the poor, and converted into intensive food production units. Much of the more natural landscape and its ecology were swept away by this sea of change (Rotherham 2014a). Traditional coppice woods were converted to high forest plantations, and industrialising cities began to sprawl across the countryside (Rackham 1980, 1986). Lands, which remained relatively untouched by this, were often blended into leisurely landscapes for the pleasure of the landowners and industrialists, and were generally populated by the exotic plants and animals imported from around the world (Rotherham 2014a). Associated with the changes was a seminal undercurrent of transformation, from ecology dominated by native '*stress tolerators*', often to exotic species of '*ruderal*' and '*competitive*' plants. This trend was noted for the twentieth century by Davis et al. (2001), but in reality began much earlier as landscapes flexed and changed, and disturbance plus nutrient enrichment came to the fore (Rotherham 2014a).

5.4 Ecology Transformed

The uncomfortable truth, which emerges from these observations and the compounding effects of the abandonment of traditional countryside practices throughout the 1800s into the late 1900s, was a radically transformed ecology. '*Cultural severance*' (Rotherham 2009b, 2013a, b) which is this ending of traditional uses, values and management of the landscape and its ecological resources has been a final compounding factor. Many areas, released from the subsistence exploitation of centuries have rapidly gained biomass and nutrients and stress tolerant species, often of high conservation value, slip quietly away (Webb 1986, 1998). Either abandonment or pulses of macro-disturbance replace micro-disturbance associated with traditional management (Rotherham 2009a). These stresses in the ecosystem are most obvious in urbanised zones, where combined with the exotic species described earlier, they are forming new ecological associations, the so-called '*recombinant ecology*' (Barker 2000); different and distinctive from what went before. Long-term trends in flora for example, can be discerned at a regional scale (e.g. Hodgson 1986), and these confirm the declines and replacements expected from cultural severance.

There are glimmers of the former landscapes in what we generally call '*semi-natural*' (= *eco-cultural*) habitats but even here the cultural drivers for these areas over centuries of human exploitation have changed and often ceased (Rotherham 2009b). Some of the results are subtle, long-term blurring of the ecology, and in other cases, consequences that are rapid and dramatic. One remarkable fact is that so much of the former landscape and its ecology are indeed visible through the modern veneer. Some aspects of the ancient ecosystems are surprisingly resilient unless totally swept aside by modern mechanisation (Rotherham et al. 2013). Nevertheless, there are major issues for conservation, such as the latter-day recognition for example of the importance of remnants of medieval parks (Rotherham 2007b) and their links to the '*Frans Vera primeval landscape*' (Vera 2000); for decades these areas received little recognition or protection.

We are now searching for the so-called '*shadow woods*' etched in the landscape from perhaps pre-Domesday but still surviving though often unrecognised (Rotherham et al. 2013). Similarly, many relict heaths and commons hark back to this antique ecology and yet are sadly abandoned and neglected (Rotherham and Bradley 2011). A point to emerge from these observations is that what we value is not an ecology, which is necessarily truly native, but one perceived to be so (e.g. Rotherham and Lambert 2011; Rotherham 2014b). Some of our most ancient landscapes still have little protection and often very unsympathetic management. On the other hand, some of the landscape features and their ecology that now passionately protected, such as eighteenth- and nineteenth-century enclosure hedgerows, are actually imposed exotic features. Many of the '*native*' oakwoods from which school children carefully collect '*local*' acorns to grow and then plant into '*local provenance*' woods were actually not native at all. These are frequently, as the estate accounts confirm, imports from Dutch nurseries in the eighteenth century. Indeed, a forester today can often spot the distinctive manifestations of genetic traits that distinguish native trees from Dutch. There are wonderful ancient hedges from pre-Domesday and these cross ancient landscapes to link patches of wood, common and heath, but they are different and distinct from the imposed barriers that separated commoner from common.

5.5 Polluting the Air

Air pollution is another obvious consequence of industry and urban life (Carson 1965), and in past times in many British cities, was devastating to people and to ecology (Bornkamn et al. 1982). Although some recovery is now taking place, the impact of two centuries of air pollution annihilated populations of pollution-sensitive species both in the cities and in a wide footprint around them. In Great Britain for example, lichens and plants such as ferns were removed from whole areas of the landscape. The ecology and associated biodiversity of many areas was irreparably changed. Acid rain and other acidic fallout from industry and from domestic coal fires removed arboreal lichens, also sensitive trees, and other species. However, more long-term perhaps, they transformed soils with decreased pH and loss of nutrients such as bases. In cities like Sheffield (Bownes et al. 1991), this has undoubtedly transformed entire ecosystems and caused the massive loss of sensitive plants and animals. Other effects such as seen widely across former industrial cities are the deposition in watercourses and on land of large amounts of air-borne, long-residence pollutants such as lead. The implications of such widespread and long-lived pollution are unknown, though so long as they are biological inactive, they are believed to be benign. Some of the other post-industrial legacies of more active and biologically available toxins, especially heavy metals, in river sediments such as along the River Rother in both Yorkshire and Derbyshire, remain elusive.

The effects of pollution on biodiversity are not simply to reduce or even remove particular species, but sometimes to set in train a longer-term displacement of some species by others. Therefore, the contamination of soil and water by nitrogen-rich, inorganic fertilizers for example, produces conditions, which suit the more aggressive and faster-growing competitor species, and these displace the stress-tolerators, which require lower levels of available nutrients. One of the most elegant examples of this process is the impact of air pollution on lichens in urban areas (Richardson 1992). Drastic air pollution in English industrial cities progressively removed the pollution sensitive species such as *Usnea* and *Ramalina* and facilitated the appearance and ultimately the dominance of species such as the '*pollution lichen*' *Lecanora conizaeoides*. Indeed, through assessments of the selective impacts of air pollution they can be used as environmental indicators or '*bio-indicators*' (Richardson 1992; Rose 1976). If air is badly polluted, particularly with sulphur dioxide given off as gas by burning of mineral coal, then there may be zones with no lichens at all. At the other extreme, if the air is clean, then a range of shrubby, hairy and leafy lichens may be abundant and the diversity of lichens increases dramatically. Some lichens are able to tolerate relatively high pollution levels. These species are commonly found in urban areas on pavements, walls and the bark of trees. However, any evaluation of air pollution levels also has be set in the context of the trees and bark available since acid bark of trees such as pedunculate oak (*Quercus robur*) are rather poor for most lichens whereas those with more alkaline bark like ash (*Fraxinus excelsior*) or willow (*Salix* sp.) are far more suitable.

The lichens which are most sensitive to air pollution are shrubby and leafy since their '*branches*' protrude out into the pollution-laden atmosphere. Those that are most tolerant tend to be the somewhat structurally reduced forms or crustose lichens. Following the emergence of heavy industry in the late 1700s and 1800s, the more sensitive shrubby and leafy lichens (such as *Ramalina*, *Usnea* and *Lobaria*) species, had very limited geographical ranges and were largely removed from anywhere near to or down-wind of an air pollution source. By the 1970s, they were confined to regions of Britain with unpolluted air and today are especially abundant in northern and western Scotland, west Wales, Devon and Cornwall. Since the decrease in atmospheric sulphur during the 1980s and 1990s, many of these species have expanded back into their original ranges (Richardson 1992).

In terms of biodiversity, human impact has had clear effects on lichen communities around cities. The results of air pollution and modifications to substrate availability have generated lichen zone patterns, which can be seen around most big towns or cities, and around individual industrial complexes. The driving force here is the mean level of sulphur dioxide in the atmosphere and in rain. There are zonal indices such as that produced by Hawksworth and Rose (1970). This has a scale of 1 (poorest air quality) to 10 (purest air) and is a good general '*index*' of ambient air quality. An interesting observation of human impact on biodiversity is that whilst the Hawksworth and Rose zonation applies well in situations with rising sulphurous air pollution, the reverse does not apply as levels fall. As sulphur dioxide decreases with air pollution controls, with a shift from coal burning in domestic fires, or with the closure of heavy industrial factories, the lichens do not re-colonize in the same sequence in which they were lost. The more random effects of propagule dispersal and substrate suitability probably have greater influence on the subsequent distribution patterns.

In the early to mid-twentieth century in most British towns and cities, air pollution was greater than it is today. Sulphur dioxide pollution was worst in the inner city and declined out to the suburbs. In this situation, a scale for lichen pollution zones would highlight *Zone 1* as the inner city, with progressive improvement to the cleaner air at the transition to the countryside beyond the town. However, since the 1970s, sulphur dioxide concentrations have been falling in both the inner and outer city zones with far less difference between them. This reduction in sulphur dioxide from the 1970s to the present day has triggered the re-colonization by a number of lichen species. Interestingly too, it has meant a drastic reduction in the pollution indicator *Lecanora conizaeoides* which is now once again becoming quite rare and is generally confined to very acidic tree barks such as those of Scots pine.

5.6 Polluting the Waters and the Land

The precise impacts of river pollution depend on many factors from the type of pollutant to the nature of the river and hence its capacity to absorb or to recover from a pollution incident (Mellanby 1967). Furthermore, the impacts of pollution on biodiversity vary with the season and hence the vulnerability of particular organisms, and between regular repeated pollution releases and one-off incidents. The range of pollutants and their effects is infinitely wide and varies from relatively benign materials such as sewage, which simply use up available oxygen in their degradation, to highly toxic chemicals such as mercury, arsenic and dioxin. This means that the effects on aquatic ecosystems are similarly varied. However, just as with the air pollution zonation found with lichens and sulphur dioxide, there are specific and predictable patterns of biodiversity, which occur in polluted waters. Through detailed understanding of these patterns, quite sophisticated assessments can be made of the levels of water pollution occurring at a site over time. These effects are seen in microorganisms such as bacteria, algae, blue-green algae, and fungi. However, they are especially obvious in aquatic arthropods such as crustaceans and insects with larval stages in water, and in fish. Just as with air pollution in cities, the pollution can squeeze species out and then if conditions recover, a process of re-colonization may occur (Mellanby 1967). Agricultural pesticides have had and still have widespread and pernicious impacts on ecological systems through land and water (Carson 1965).

Human impact on rivers and streams is not simple and physical disruption through canalisation, culverting, diversions and increases in sediment loads can all affect the ecology. In some cases, these impacts may be at least as significant as the levels of pollutants. However, the effects can be dramatic as well as unexpected. In industrial cities in northern England, such as Bradford, Sheffield, Leeds, and Manchester, the combination of chemical, physical and biological pollution plus the structural manipulation and modification of many urbanized watercourses led to the almost total removal of all biodiversity from entire stretches of river and stream. In some cases like the Derbyshire River Rother, slugs of long-term industrial pollution can be tracked as they move slowly downstream (Rotherham 2008b). These systems and the banks immediately adjacent were generally degraded and despoiled and in some cases biologically dead (Bownes et al. 1991; Gilbert 1989). Industrial degradation, contamination and despoliation have transformed entire landscapes, removing much of the former ecology, but in the post-industrial era, creating opportunities for new recombinant ecosystems (Rotherham 1999; Rotherham et al. 2003, 2012). Even the construction of walls, in urban and other environments, creates analogues for natural features and the opportunities for new and ecologically fused communities (Gilbert 1992b).

However, as the pollution levels dropped, and plants and animals re-colonized there was a further human twist to the biodiversity mix. Exotic species of plants sometimes escaping from the former Victorian '*wild*' gardens to which they had been introduced by plant collectors, slipped out almost unnoticed into the new wilds (Rotherham 2005). In some cases, they were assisted in this by deliberate introductions by exotic plant enthusiasts. Therefore, these urban watercourses, once almost devoid of life in the same way urban areas had become lichen deserts, received a new recombinant flora. This is dominated by alien trees such as sycamore (*Acer pseudoplatanus*) with aggressive perennial herbs like Japanese knotweed (*Reynoutria japonica*), robust biennials such as giant hogweed (*Heracleum mantegazzianum*) and vigorous annuals particularly Himalayan balsam (*Impatiens glandulifera*). As Oliver Gilbert demonstrated in the 1980s (Gilbert 1989, 1992a), these dense stands of exotic trees and herbs were forming new and distinctive urban plant communities, though perhaps with more human influence than Gilbert imagined. However, what he did show was the re-colonisation of native plants typical of ancient woodland environments, washing downstream from wooded sites in the headwaters and establishing an '*ancient woodland*' flora beneath the pseudo-canopy of the dense knotweed and balsam (Gilbert 1989).

There is a further demonstration here too of the intimate relationships between human influences and contemporary biodiversity. These urban rivers suffered not just chemical pollution and massive inputs of human sewage effluents, but they became artificially heated too. Rivers such as the Don in Sheffield were used to cool the great industrial processes such as steel manufacture and as such had their ambient temperatures raised to a more-or-less constant 20–23 °C, winter and summer. This situation continued until the 1970s, when many of the factories closed and the remaining sites became more self-contained and more rigorously controlled. However, the combination of thermal pollution and the widespread sewage pollution, which occurred, again until the late 1970s, brought together the seeds of the Mediterranean wild fig (*Ficus carica*) with the conditions they require for germination. They require a consistent high temperature, and imported from the Mediterranean, and having passed through human gut and so into the abundant raw sewage, they were able to germinate and grow along the urban rivers. These figs now sucker and grow and in some areas have formed unique '*urban fig forests*' along our most urban watercourses. In Sheffield, these trees are protected as an especially iconic symbol of the Industrial Revolution and their very special impact on regional biodiversity (Bownes et al. 1991; Gilbert 1989).

5.7 Managing the Land

There is a widespread acceptance that whilst there are many nature conservation projects which are hugely successful and worthwhile, overall, conservation is still failing (Rotherham 2009b, 2014a). Declines in landscape quality and in biodiversity have not been halted. In this context, there is increasing interest in alternative approaches to managing the environment, from major environmental re-construction works, to so-called '*re-wilding*' (Taylor 2005; Monbiot 2013a; Rotherham 2014b). It is even suggested that the response to intractable declines in ecology should be to allow nature to be free and '*free-willed*' (Carver et al. 2012; Fisher 2006, 2013). There are aspects of these arguments that have some merit but others are scientifically weak, misinformed (Vidal 2005), and politically naïve. Most worryingly perhaps is that some of these ideas in reality amount to abandonment i.e. cultural severance (Rotherham 2009b, 2014b), and others lead to over-intensive grazing and damage to sites (Denton 2013).

Simply '*releasing*' sites and their ecology from obvious, direct human influence will not achieve the benefits that the proponents suggest (Rotherham 2014a, b). Affected by air pollution and eutrophication, and derived from centuries or millennia of human–nature interactions, much of our landscape and most conservation sites are still eco-cultural (Agnoletti 2006). In most cases, lacking keystone species like beaver or large carnivores, successional changes will be dynamic and exciting, but not '*natural*' in any historical sense. We begin to see some of the remarkable potentials for a freeing up of nature in projects such as Oostvaardersplassen in the Netherlands and say, Knepp Castle estate in southern England. However, these are not '*natural*' systems, but a new form of human, culturally determined landscape, and as such part of a toolkit of possibilities. Just like Ennerale in Cumbria, these two landmark projects are in fact very carefully designed, implemented, and monitored (Rotherham 2013c, 2014b).

Whether to abandon sites to feral nature, to intervene with planned release of large herbivores, or to fence out wild (feral) herbivores such as the Highland red deer to allow trees the freedom to regenerate, are all human determined interventions (Rotherham 2014b). Ayres (2013) welcomes the idea that '*When you let go of control of the land and let nature run its course it is unpredictable*, *often with surprising and positive outcomes*.' This is fine in principle, but what happens if you get a bracken stand, which will dominate the landscape for decades if not for centuries? Furthermore, do you intervene to control feral red deer numbers or let nature take its course with animal starvation and impacts on local woods and tree regeneration? How do you respond if the last vestiges of rich biodiversity and conservation priority species are lost? If we decide to intervene, then who does it, why do they do it, what do they do, where do they do it, and when do they do it? In addition, who decides and who pays? Will land managers, conservationists, and even the public, accept exotic plants such as rhododendron, sycamore, larch, spruce, Japanese knotweed, Himalayan balsam and giant hogweed spreading feral across the landscape. Free feral nature is composed significantly of these species with others such as

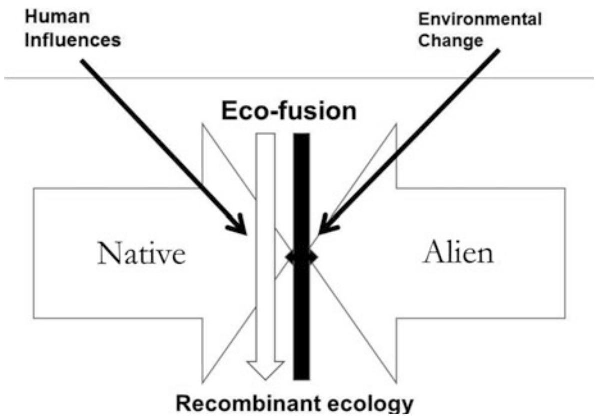

Fig. 5.3 Eco-fusion with eco-cultural influences on native and alien ecologies

mink, rabbit, grey squirrel, Canada goose, ruddy duck, ring-necked parakeet, signal crayfish, and various deer making up a heady ecological mix (Rotherham 2014b). We are already witnessing a recombinant ecology through ecological fusion processes, but many are reluctant to accept this, even when much of it may be inevitable. Who says that a released, feral ecology will not be dominated by these species along with invasive natives like birch and bracken (Fig. 5.3)?

5.8 Science, Politics and Environmental Democracy

It is important to set problems of alien invasive and exotic species into broader contexts of environmental change, conservation, and politics (Rotherham and Lambert 2011). Whether we like it or not, we have a hybrid ecology and inevitably, this will become more so, and concepts of recombination and eco-fusion are important considerations (Rotherham 2014a). Understanding the interrelationships between ecology and politics in terms of reactions to biological invasions is important. In bringing together science and politics it is necessary to acknowledge that many conservation decisions are not based on '*truths*' and often not even on science, and are not objective. Nevertheless, these are subjective decisions based on the best scientific understanding we have blended with an emotional response to situations based on and twisted by many social, cultural and historical influences (Rotherham and Lambert 2011).

Unfortunately, this applies to both the professional conservation manager and to the wider public alike. Even the language used to define and to describe the issues is loaded with bias, and the decisions are political and social. Why for example do we seek to eradicate Himalayan balsam as a riverside and roadside invader but not sweet cicely an alien from the mountains of central Europe first recorded wild in Britain in 1777? In the Peak District and South Pennines, the latter is spreading rapidly and its impact is dramatic. So if control is based on science and objectivity, then why one and not the other. *Buddleia davidii* causes millions of pounds of damage to services and buildings, and is now expanding into woods, hedgerows and other habitats such as cliff-tops, but we welcome it as '*The Butterfly Bush*'. In contrast, conservationists dislike rhododendron, which they seek to bash and eradicate (Rotherham 2005, 2009a).

5.9 Summary Thoughts and Conclusions: Emerging Paradigms and New Concepts

It is important that environmental change and its history engage with debates on exotic and native species. In doing this, there are major challenges to current alien species paradigms, and the approaches raise critical issues of perceptions and judgements. To more effectively relate environmental history to past, present and future ecologies needs new concepts to be developed. Indeed, the application of environmental history research to ecology has triggered novel ideas of recombinant, hybrid ecology and eco-fusion. From the emergence of these concepts there arise significant implications for visions of future ecologies, and the work then meshes with ideas of '*wilding*' and '*re-wilding*'. Such paradigms are presently subject to debates triggered largely by the ideas of Frans Vera (Vera 2000), and now entering wider, more popular audience through the writing of authors such as Taylor (2005), and particularly Monbiot (2013a, b). Ideas of both cultural severance and ecological fusion are important in understanding how past ecologies have changed, and how future ecologies may be shaped.

At the core of these debates are critical questions of what is natural and what is cultural, what is native, and what is alien or exotic. For the British case study, devolution in the (dis)-United Kingdom raises further issues (see Warren in Rotherham and Lambert 2011) where conservation managers are trying to decide whether a species should be native to England, Wales, Scotland or some lesser region. In the face of climate change and the inevitable fluxing of species distributions, this is a nonsense and misunderstanding of the serious matters at stake. It is also totally missing the point about the palimpsest nature of historic landscapes and the value of cultural and historical aspects of the environment. Is it relevant that a plant found in Carlisle was not '*native*' in Gretna or beyond; and should it be eradicated if it spreads north? This is a formalising of the old idea of beech being only native to southern England and so treated as an alien in the northern regions. It has now been found in the early pollen records for North Yorkshire, and so was native anyway. However, a further point is that in the centuries since the closing of the English Channel, beech would colonise northwards anyway, and would now be native in the north as well the south. There is certainly a case for celebrating and conserving where possible, local and regional distinctiveness and character, but regional ecological xenophobia is a dangerous route down which to travel. A denial of environmental change, either natural or human-induced, is unrealistic.

Another major problem in dealing with the apparently simple matters of alien and exotic invaders is in the difficult relationships between conservation and (1) the cultivation of exotic trees for forestry and for amenity, and (2) with farming, horticulture and gardening. In all situations, there is blending of nature and culture that makes many assertions of native or exotic status fraught with problems. Both (1) and (2) are major causes of the undoubted problems caused by alien invasions. Nevertheless, this does not mean that all the impacts are negative, or even that the bad effects are significant or important in all cases and in all situations.

A lesson of the British experience is also that perceptions of what is a problem, what is alien or native, and even who is responsible for any management or control, varies dramatically over decades and even over centuries. Furthermore, issues of exotic and invasive cannot be separated from the wider fluxes of society, economy and environment; so where and when we examine a particular species, has a huge effect on our perceptions of it as a positive or negative influence on ecology, economy and on society. It can be argued that as Western imperialism spread globally during the 1800s and into the 1900s, many of these attitudes and a lot of '*native*' plants and animals from '*home*' were exported. The twin desires to '*improve*' and to '*adorn*' created many of the invasion and extinction problems witnessed today. However, the human footprint on eco-cultural landscapes and the spread of species around the planet goes back much further. In Europe for example, this is to the first waves of human migrants across the continent who brought plants and animals with them, and who modified the environments where they settled.

Ecological fusion or recombination has driven ecosystem change and associated biodiversity since life began. Indeed, these processes will continue so long as life is maintained. However, to separate humanity from nature is foolish and misconceived, since modern-day nature is not natural. In this context, the concepts of eco-fusion and recombinant ecologies are important to understanding environmental history. Furthermore, the insight of environmental history is an element missing from many discussions of future landscapes and particularly the potential for re-wilding. In the absence of rigorous environmental history and robust science, visions of future landscapes and sustainable, future ecologies remain dangerously misinformed. A conceptual framework within which future landscapes can be more effectively considered is provided by the combined concepts of cultural severance, the eco-cultural nature of landscapes, hybrid ecology, ecological recombination and eco-fusion. This approach helps identify critical future paradigms and assists in providing guidance for necessary decision-making.

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Chapter 6
Sustainable Development in Brundtland and Beyond: How (Not) to Reconcile Material Wealth, Environmental Limits and Just Distribution

Iris Borowy

Abstract Industrialization and massive use of fossil fuels made large-scale poverty unnecessary for the first time in human history. In the course of the twentieth century three goals emerged as broadly accepted central purposes of socioeconomic development: to increase the material well-being of people everywhere, especially of the poor (wealth), to improve global equity (distribution) and – beginning approximately in the 1960s – to safeguard the physical basis of all development by staying within the global environmental carrying capacity (limits). The inability of development theories prevalent in the 1970s to reconcile these goals gave rise to the concept of "sustainable development." The Brundtland Commission struggled with the question of how to simultaneously address all three goals, integrating them to different degrees into their list of recommendations. Over a period of almost 3 years Commissioners met eight times to discuss relevant issues, ranging from population to energy, industry, international economic relations, and biodiversity. Most disagreements were tied to different views on how to deal with discrepancies of living conditions in different parts of the world. All Commissioners agreed that poverty was key to any solution. But this unanimity did not make the central dilemma go away: if poor countries needed to enjoy economic growth in order to reduce poverty but the growth of the entire global economy was eventually constrained by physical limits on a finite planet, logically questions of redistribution of income and wealth became part of agenda. However, this idea was patently unacceptable in industrialized societies where the concept of deserved wealth was deeply ingrained and where people's expectation, political careers and the economic system relied heavily on ongoing economic growth. Perspectives also differed on the reasonable development choices for Southern societies. Should they reject the highconsumption routines practiced in the North or were they, on the contrary, entitled to enjoying similar material living standards before being lectured on low-impact life-styles? The idea of retaining a reformed system of "development" by making it "sustainable" was an effort to find a way out of this impasse. Subsequent international development initiatives have alter-

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natively adopted and discarded different elements of this concept. Wealth has been the dominant goal to be endorsed, which often turned “sustainable development” into mere greenwashing. Limits were initially ignored but inevitably returned as the evidence regarding the reality of physical limits kept mounting, especially with regard to climate change. Distribution has received relatively least attention, but has also refused to disappear. Consumption, transfer of finances and technology and methods of automatic financing have been recurrent themes of discussions, both by those endorsing and those rejecting the need for redistribution. Thus, 30 years after the creation of the concept of “sustainable development” its key challenge of reconciling three conflicting goals remains as relevant as in the beginning. This paper argues that much of the fate of the twenty-first century will depend on how well humanity will succeed at finding a solution for this challenge.

6.1 Introduction

At the beginning of 2016, the Sustainable Development Goals (SDGs) have replaced the Millennium Development Goals (MDGs), which came to an end. This move will represent the latest shift in twentieth and twenty-first century considerations about international development, and it is another effort in finding a solution to the ever-more acute challenge of global development: how to provide good living conditions for a maximum – ideally the totality – of people in the world without in the process destroying the bio-physical systems on which their lives depend. It also demonstrates the continuing use of the concept of “sustainable development” as a guideline for discussions on decisions on the global future. This fact is hardly self-evident, since the concept has frequently been denounced as too vague, as an oxymoron, as camouflage for maintaining rich countrie’s privileges over the world economy or for allowing the current destructive form of growth-oriented industrialization economy to continue, or as a meaningless cliché. (Mebratu 1998; Brunel 2004; Hopwood et al. 2005) At the same time, paradoxically, the term has also been widely endorsed in politics, in academia as well as in the public discourse, even though – or because – its meaning often remains amorphous. Clearly, as its use for the forthcoming SDGs demonstrate, for all the violent debates about the terms and despite an impressive number of publications on the topic, discussions on “sustainable development” are far from over. In fact, if the SDGs are seriously accepted for implementation as envisaged at the moment, discussions may only just have begun.

The idea of sustainability is deeply rooted in man’s interaction with nature, i.e. of the need to balance the current exploitation of natural resources against the need to avoid overuse in order to allow its regeneration and long-term availability (du Pisani 2006; Grober 2010). However, while the challenges of sustainability are not new, the term of “sustainable development” is, having been virtually non-existent until the 1980s. In the face of accelerating economic and political globalization, the growth of international institutions and the rise of both local and international civil society movements, the age-old struggle for the reasonable use of nature was transformed into an interdisciplinary struggle to balance contradictory expectations of global development that arose from the specific exigencies of perceived circumstances from approximate the 1970s onwards. This paper explores the reasons for and repercussions of the sudden emergence and rise of the concept of "sustainable development." Why was is born and why do negotiations for future policies still make use of it even though its recent record is extremely modest? What are the lessons, if any, to be learnt? In the process, this paper revisits the creation and constant reinterpretation of an idea that appears to have been as difficult to endorse as to reject, and whose context has become key to understanding global environmental policies.

6.2 Background: The Goals

This paper argues that the idea of sustainable development is closely linked to three core demands on world development: to increase (or at the very least to maintain) wealth, to improve the distribution of wealth, and to safeguard the life-support system of planet Earth by making sure this creation and distribution of wealth stays within environmental limits. Each has had its own long-term history, going back centuries or more. But only sometime between the 1950s and the early 1980s all goals became relevant on a global scale and their distinct paths crossed so that they could no longer usefully be pursued separately. This intensive and extensive interrelatedness fundamentally changed both the nature and the gravity of these challenges. They became key requirements for any development to stand a chance of long or even mid-term stability. Any developmental theory in the late twentieth and twenty-first centuries (and possibly beyond) has had to and will have to address those three demands: sufficient **wealth**, fair **distribution** and the respect of **limits**.

The most obvious example of a long-term goal is wealth. For the large majority of people during the vast majority of times, having more or less wealth was not a question of luxury but of survival. In overwhelmingly agricultural societies, any weather calamity or other natural disaster or any plant, animal or human disease could throw people into situations of misery and poverty, threatening starvation and death. More wealth, i.e. more material comfort and more storage of food and other requirements, provided more security against the risks of life. Comfortable wealth formed a goal for many, but for a long time it was achievable only for the lucky few. Only after industrial revolution and its exponential economic growth based on fossil fuel energy, outpacing population growth, did mass poverty become unnecessary (McNeill and McNeill 2003, 232). Fossil fuels made human labor infinitely more productive and enabled those people, who had access to coal and oil and to the technology to make use of them, to produce, own and store far more than any generation before them, effectively shielding them from many insecurities of life. This economic growth of the decades after 1800 and, especially, after 1950 has been unprecedented as it was unrepeatable (McNeill 2002). By changing in quantity and, thereby, also in quality, this wealth accentuated two other goals of similarly long standing.

First, increasing wealth reframed the challenge of distribution. The distribution of wealth within societies has been unequal since Neolithic times, often grossly so. But the nature of inequality changed with industrialization. For one thing, inequality between different countries surged, depending on whether they were part of the high energy development or not. Thus, the ratio in per capita income between the richest and the poorest regions of the world rose from 5:1 in 1870 to 15:1 in 1950 (Maddison 2001). At the same time, public awareness of this inequality increased while it became more difficult to rationalize according to broadly accepted principles. Liberal revolutions of the late eighteenth and the nineteenth century, especially in Europe and North America, had given rise to the idea of human rights, of meritocracy taking the place of aristocracy, and of all men being created equal. The underlying principle assumed that all men were similarly deserving of economic success if they strove similarly hard, and in the twentieth century a mixture of international institutions and declarations, revolutions, warfare and decolonization spurred its worldwide spread (Osterhammel 2009, 736–817). This model made it increasingly difficult to justify that a world that was sufficiently wealthy to provide enough food and comfort for everyone should still leave millions of people to misery and starvation. Potentially, the "growing inequality of wealth and power required either that the less well off remain in ignorance, that they meekly accept their fate, or that they be bludgeoned into accepting it." With ignorance and meek acceptance being unrealistic options in the long run, and continuous bludgeoning neither appealing nor – probably – feasible long-term strategies either, the promise of a rise to wealth and comfort for everyone became essential for the existing political system to retain its legitimacy and for the rich to remain rich. Thus, violent unrest on a large scale seemed avoidable only if a critical mass of people believed that they would be able to follow the footsteps of high-income countries of Europe and North America, and this, in turn, required there being credible evidence of such economic growth in Africa, Asia and South America.

Thus, the mainstream modernization concept of "development", as proposed by key development organizations like the World Bank or the OECD and by virtually all governments, capitalist as well as communist was crucial to a global acceptance of the rise to unprecedented levels of wealth in the rest of the world: as long as there was hope that industrialization, modernization and economic growth could lift all people everywhere to these levels, this system retained credibility and the affluence of the people in the North was not seriously challenged. The idea that global physical limits might make such a repetition impossible, therefore, created a fundamental threat to the existing world order.

However, physical limits had generally been a fact of life. In the course of human history, settlements repeatedly had to be given up and societies broke down when all trees had been cut, all land degraded through erosion or salinization and crucial water sources polluted (Diamond 2005; Ponting 1991/2007). But until recently, those disasters, while traumatic for those concerned, were mostly local and often allowed potential victims to seek a solution to their problems by migrating elsewhere. But, the unprecedented economic growth brought these environmental burdens onto a global scale, from where migration was impossible. After industrialization, driven by enormous amounts of concentrated energy and by unprecedented population growth, more materials were transformed into productive infrastructure, consumer goods and, ultimately, waste than ever before in human history (Pfister 2010;

Steffen et al. 2007). In 1986, Peter Vitousek, Paul and Anne Ehrlich and Pamela Matson calculated that all the productivity of lands devoted entirely to human activities amounted to 30.7 % of terrestrial and 2.2 % of aquatic net primary production (biomass). Thus, according to this calculation, almost one third of everything that grew on land was used strictly for human purposes. Increasingly, it seemed that humanity was approaching global limits and that remaining within those limits was relevant to everybody's wellbeing everywhere.

Understanding those goals and their interaction was difficult, since they had no absolute and clearly definable nature. There is no such thing as ideal wealth, distribution or scale that can be envisaged in order to guarantee functioning systems. But nor are they totally arbitrary. There are degrees of poverty, inequality and environmental degradation that most people would consider morally and politically "wrong." Given their interdependence, there is a certain trade-off between different goals. Distribution, in particular, takes a crucial role mediating between wealth and limits. Extreme poverty, both of poor countries and of poor people living in rich countries, requires an increase of wealth for the people afflicted. This goal can be reached by increasing overall, global wealth until the limits of the global carrying capacity have been reached. If further overall growth is ruled out, redistributing existing wealth is a second option. If redistribution of income and/or wealth is ruled out, economic growth becomes morally imperative in order to improve the lives of the poor, thus creating an ethical dilemma of either accepting continued poverty or increasing destruction of global life-suppost systems. But trade-offs are also limited. Eventually, in some combination all goals need to be taken into account unless humanity resigns to living in shared poverty or in violent tension between the rich and the poor or in a world without essential life support systems of air, water and biosphere.

After World War II, as international organizations and core countries adopted the wellbeing of people and societies of the world as a shared task, they sought orientation in developmental theories, proposing different combinations of goals and different strategies to reach them.

6.3 Background: The Politics of Development

The mainstream model, endorsed by virtually all post-war organizations and governments, involved some variation of modernization theory, based on the industrialization experience of countries in Europe and North America between approximately 1750 and 1950. Classically expressed by Walt Rostow (1960), it viewed wealth as the central goal which would increase with developmental stages and would automatically increase equity. This theory benefitted from its past record. Its feasibility appeared credible since it had already been proven. But there was also room for serious doubt. This path was obviously based on the long-term availability of numerous finite resources, whose supposed endless supply was counterintuitive, and its historical record, especially during early industrialization, had been sufficiently dismal to provoke the emergence of Marxist theory.

To an extent, these concerns were answered with concepts inherent in the theoy itself. Thus, considerations of environmental limits were countered with the idea of technological progress, which promised a seemingly painless technical fix. It was a powerful idea, since the impressive results of modernizing technology were plainly visible. But so was its limitation. The Jevon's Paradox had been known to economists since the 1860s, and it was revived as the "rebound effect" in the 1980s, drawing attention to the way increased efficiency lowered prices, thereby encouraging further consumption (Alcott 2005; Sorrell 2009). In addition, technology tended to exacerbate distributional inequalities since it further privileged those countries that could afford research and investment in technology and had the power to control the transfer of knowledge from wealthier societies, notably through patent rights. Concern about rising distribution indqualities could be mitigated up to a point with the theory that inequality would increase with rising incomes up to a peak and then fall again, as incomes continued to grow, a theory put forth in 1955 (Kuznets 1955). The underlying idea was that things would get worse before they would get better (supposedly to remain good then). However, the empirical basis for this theory was thin, to say the least, and for many years belief in the curve would rely on cross-country comparisons rather than on – scarce or non-existent - data depicting developments in time (Gallup 2012).

After 1950, the so-called Great Acceleration increased the odds, increasing both the promise and the doubts. By the late 1960s, the wealth gap between industrialized and many Southern countries remained – or increased –, often despite appreciable growth rates (Commission 1969). Meanwhile, the experience of visible, sometimes spectacular, environmental destruction caused by economic processes through ongoing pollution or repeated accidents, combined with fears about the upcoming exhaustion of resources continued to raise concern about physical limits (Paley Commission 1952; Haw and Paul 2012; Mahrane et al. 2012). Doubts regarding modernization theory grew sufficiently strong to give rise to alternative minority developmental concepts. The most important were dependency theory and steady-state economics.

Dependency theory grew from concern about socio-economic inequality, evolving from the teaching and research of economists such as Hans Singer, Raúl Prebisch and Gunnar Myrdal. Joining with a Marxist tradition, this concept saw Southern poverty not as a result of a lack of modernization development in Southern countries but, on the contrary, as a function of the power asymmetries inherent in modernization development (Jolly et al. 2004; Rivarola and Appelqvist 2011). Concern about the environmental limits to economic development produced steady-state theory, aimed at improving technology and wellbeing while keeping production and consumption on a stable scale (Boulding 1966; Daly 1973).

These theories differed in their choice of which goal they considered supreme, to which the others were subordinate. While the modernization/industrialization model focused on national wealth but was weak on distribution and limits, the steady-state model emphasized limits but was weak on wealth and distribution, and dependency theory highlighted distribution and welcomed wealth but was weak on limits. Consequently, all these concepts harbored the potential for substantial conflict, unless some way could be found to reconcile these various elements.

Goal	Strategy	Problem
A. Wealth	1. Increase of production and consumption (economic growth)	Contradiction to C.1.
B. Fair distribution	1. Increase of production and consumption	Contradiction to C.1. Empirically doubtful effect
	2. Redistribution of existing wealth	Rejection in North
	3. Technological progress	Economic inequality; patent rights
C. Life within environmental limits	1. Restriction of production and consumption	Contradiction to A.1 and B.1.
	2. Restriction of population	Rejection in South
	3. Technological progress	Rebound effect

In the late 1960s, this conflict between contradictory goals and development theories came to the forefront of the international agenda during negotiations surrounding the UN Conference on the Human Environment (UNCHE) in Stockholm 1972. While the environmental movement in the North, energized by the 1972 publication of the Club of Rome study on the *Limits to Growth*, sought a recognition of environmental limits, representatives of Southern countries demanded changes in income distribution, and all participants coveted economic growth. Above all, negotiations revealed the profound distrust of Southern governments, who suspected that this new-found interest in the environmental repercussions of industrialization might be a thinly disguised neo-colonialist strategy to prevent Southern countries from gaining the material affluence already enjoyed in the North. The final result mirrored those various concerns.

Thus, the conference report, while acknowledging the burden of economic growth, explicitly rejected the idea of a non-growing economy (UN 1972a). By contrast, the Action Plan for the Human Environment included recommendations regarding a better distribution of environmentally relevant scientific knowledge and technology (UN 1972b). Subsequently, this redistributory approach was substantially reinforced by negotiations for a New International Economic Order demanding, among other points, easier technology transfer, more advantagious terms of trade through buffer stock of commodities, better access to international transportation and to markets of industrialized countries, increased development assistance and a reductin of the debt burden of low-income countries (UN 1974a, b). This initiative tied into dependency theory, but after several years of fruitless negotiations between demanding Southern and stonewalling Northern delegates, the initiative faded (Stokke 2009).

By the early 1980s, development discussions were at an impasse. The "postwar 'modernization theorists' had come under attack from a number of mutually hostile quarters," including demographers, economic historians, sociologists (Bayly 2004, 10.) Neo-liberalism was on the rise, once more upgrading growth and wealth as priority goal. Globally, however, issues of limits and distribution remained. This situation provoked efforts to look for a new theory that would supposedly reconcile all three goals in a broadly acceptable way.

6.4 The Emergence of "Sustainable Development"

In 1980, the International Union for the Preservation of Nature (IUCN) teamed up with several public and private agencies, notably UNEP, to produce a comprehensive *World Conservation Strategy*, which included a chapter named *Towards Sustainable Development*. As policy recommendations it listed the main NIEO demands, adding disarmament and mutually supportive economic and environmental policies while emphasizing better health, housing, and education (IUCN 1980). Clearly, it prioritized distribution with a subfocus on limits. The report introduced the expression of "sustainable development" but otherwise remained largely unknown and had little effect.

Another initiative emerged in the OECD. In the early 1970s, the Executive Committee of the OECD had established a Sub-committee of Economic Experts to study ways to reconcile environmentalism and free market principles. During the following years, commissions, studies and conference reports repeatedly concluded that economic growth could and should be made compatible with safeguarding the environment, if properly managed and if all economic stake-holders integrated environmental concerns into their planning at an early stage (OECD 1974, 1979, 1984). These proposals represented substantial progress regarding the integration of wealth and limits, as development principles, but largely ignored distribution, clearly not a prominent concern in the countries that, between them, produced and owned the vast majority of global GDP.

In reality, the supposed happy coexistence of economic growth and environment improvements affected only some sectors that reacted well to end-of-pipe measures. Thus, despite some improvements in Northern countries, rising CO2 levels in the atmosphere, acid rain, ozone depletion, water and air pollution, the destruction of the rain forest, rising energy needs and the loss of fertile soil through desertification, salinization and the contamination through toxic chemicals all pointed to environmentally problematic consequences of economic growth (Holdgate et al. 1982). Taking inspiration from previous international commissions, which had studied intractable developmental issues, the UN initiated a commission in charge of making recommendations for sustainable development.

6.5 Brundtland Commission

The World Commission on Environment and Development (Brundtland Commission) consisted of Commissioners from 21 countries in different parts of the world, with a majority being from Southern countries. Their task was to discuss problems and possible solutions, based on written and oral information provided by international experts in the field, supported by a well-staffed secretariat. Ideally, they would produce recommendations which would satisfy the contradictory development needs while being so uncontroversial as to be broadly acceptable. The Commission represented an impossible task but also an immense opportunity to reach a lot of people, including those who had not previously given much thought to the dilemma.

All Commissioners had in some way or the other worked with or in international organizations. It was clear that they believed in international cooperation and that their proposals would somehow involve international structures and coordination. But otherwise they were sufficiently different to ensure lively debate. Members included the Mexican Marxist intellectual and long-time critic of Northern imperialism Pablo González Casanova as well as the William Ruckelshaus, two-times head of the US Environmental Protection Agency, member of the Republican party and on good terms with the Reagan administration. It included the Yugoslav Janez Stanovnik, one of the founding members of UNCTAD, and Susanna Agnelli, heiress of the Fiat company, Guyanan Shridath Ramphal, long-time Secretary-General of the Commonwealth, Vladimir Sokolov, member of the Soviet Academy of Sciences, and Maurice Strong, Canadian environmental activist and entrepreneur.

Over a period of almost 3 years Commissioners met eight times to discuss relevant issues, ranging from population to energy, industry, international economic relations, and biodiversity. Most disagreements were tied to different worldviews: generally speaking, Northern Commissioners tended to focus on local economic weaknesses and environmental burdens for which local societies deserved support, while Southern Commissioners were more likely to see local problems as tied to a global economic system which forced Southern societies to engage in environmentally destructive processes. Perspectives also differed on the reasonable development choices for Southern societies. Should they reject the high-consumption routines practiced in the North or were they, on the contrary, entitled to enjoying similar material living standards before being lectured on low-impact life-styles? These questions evaded simple answers. All Commissioners agreed that poverty was key to any solution. But this unanimity did not make the central dilemma go away: if poor countries needed to gain more wealth through economic growth but the growth of the entire global economy was eventually constrained by physical limits on a finite planet, logically questions of redistribution of income and wealth became part of agenda. However, the idea of are distribution of existing affluence was patently unacceptable in industrialized societies where the concept of deserved wealth was deeply ingrained and where people's expectation, political careers and the economic system relied heavily on ongoing economic growth. Meanwhile, restricting wealth in order to stay within environmental limits was similarly unacceptable to people in the South, especially when preached in the North. Meanwhile, a steady stream of experts and members of environmental NGOs left no doubt that environmental descruction was real, in terms of urban pollution, irreversible biodiversity loss and many other perspectives, local regional and global. Disasters like the accidents of the chemical factory in Bhopal 1984 and of the nuclear power plant in Chernobyl 1986 highlighted the challenge (Borowy 2014).

There were no easy answers and no real solution, and not all conflicts were resolved. In mid term, González Casanova found that he could not reconcile his belief in dependency theory with the direction the discussions were taking and left the Commission. While he remained the only one to take this step the fragility of the endeavour was obvious. Eventually, the success of the Commission depended on a certain degree of pragmatism. Even within this group of well-meaning, motivated and determined people, it was not possible to find a way out of the impasse of contradictory goals, and clarifying the challenge to the end would have doomed Commission work (Borowy 2014). So, like in a lot of global diplomacy, some things were better left vague, as Commissioner Ruckeshaus later commented:

> …if you didn't accept the concept of development as being a good regardless of the pressures it might put on the ecosystem or the environment then you would lose very quickly the fourteen developing countries who were participating on the Commission. So, the whole concept of development seemed to all of us, was something that was not going away. People who had not yet seen the benefits of development were not about to abandon their desire for a more prosperous life on the grounds that there were some limits to growth. There was a recognition that that might be true, there may be some limits to growth, but we hadn't approached them yet and in any event all that meant was a redistribution from the wealthy world to the developing world. And that was not something that the developed world was ready to embrace … We had a lot of discussions about that but I think we finally concluded that it was not an issues that we were going to be able to resolve, and that what we needed to do was to emphasize the environmental stability part of the equation, so that we did not lose sight of the fact that there might be some limits to growth and, at the same time, encourage economic growth as well as economic equity. (Ruckelshaus 2012)

Commissioners decided that the stakes were high enough to warrant painful compromise where possible and to remain vague where it was not. This strategy gave rise to the often-cited definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" while recognizing the priority of the needs of the poor and technologically and socially imposed environmental limits (WCED 1987, 43). Despite these important qualifiers, this definition was sufficiently vague to leave room for adaptation and interpretation. Depending on what constituted "needs", in particular, this phrase could have very easy or, on the contrary, quite radical consequences for future developmental policies. Generally, Commissioners focused on those aspects on which they could agree: on environmental pressures resulting from poverty, requiring poverty reduction, and on the need for more modern, more environmentally friendly technology. By contrast, they downplayed the environmental pressures which resulted from wealth and from high-consumption lifestyles. This strategy led to a certain pro-growth bias, which observers criticized afterwards (Trainer 1990; Sachs 1993). Far less noted was the way the report connected growth with redistribution, stating, for instance, that timely progress towards sustainable development required "a minimum of 3 % per capita national income growth" as well as "vigorous redistributive policies" (WCED 1987). At its final press release, the Commission insisted that it was possible "to build a future that is prosperous, just, and secure" but that the transition to this future would require "a massive shift in societal objectives" (WCED 1987).

A long list of recommendations spelled out the Commissioners' idea of such a dramatic transformation. Many of these proposals called for increased international planning and coordination, centered at the UN through suitable agencies and by an agreed action plan. Similarly, environmental limits were to be built into political systems through a Global Risks Asessment Programme, designed to identify critical threats to survival, provide authoritative advice and to foster multi-sectoral co-operation, on the international level, and through reformed legal structures and a multi-sectoral policy of considering all major new policies in light of their effect on sustainable development. Regarding distribution, the report called for substantially increased international support for environmental restoration, protection and improvement, organized, in part, by a special environmental banking facility linked to the World Bank. More innovative, the report adopted the idea of automatic fund raising, first presented at the UN Conference on Human Settlements in 1976, by taxing the exploitation of international commons, like the oceans or Antarctica, or international financial transactions, such as IMF drawing rights. Somewhat more hidden in the text, the report also criticized "disparities in economic and political power" as causes of environmental degradation and indirectly endorsed NIEO demands for changes in the international economic system. Also, implicitly but clearly, the text spelled out the need for high-income countries to adapt their lifestyles to a level of consumption to which all people in the world could aspire (WCED 1987).

Thus, the report integrated traditional redistributive ideas of NIEO origin with new ideas of international taxation and the idea that rich countries and people would have to reduce their consumption. Their implementation would have changed the world.

6.6 The Reception and Reinterpretation of Sustainable Development

The report met with a remarkable response in virtually all UN organizations and numerous other organizations, universities, national governments and NGOs, many of which held workshops, organized classes or issued special publication specifically dedicated to the Brundtland report (Brundtland Bulletin 1988–1989). Arguably even more impressive, the term of "sustainable development" entered everyday language in English as well as in other languages. However, this broad reception and endorsement came with the heavy price of selective interpretation of what sustainable development meant. Some observers felt that the Brundtland Report contained enough "creative ambiguity" to bridge the "gap between no-growth environmentalists and pro-growth developmentalists." (Mitcham 1995, 317) This was certainly the intention of the Commissioners, but, given the subsequent reactions, it is doubtful to what extent this really happened. During the official presentation of the report at the UN assembly in late 1987, the overall response was still remarkably comprehensive, acknowledging the variety of aspects which, collectively, constituted the concept of sustainable development (UNGA 1987). But soon, discussions became more narrowly focused on the aspect of economic growth, both in positive as in negative terms. It was the point which most appeared to distinguish the approach of the Brundtland Commission from that of the *Limits to Growth*, and, depending on the views of the observers, this difference either commended or discredited the report.

Thus, vehement criticism was voiced by groups who considered environmental limits a tangible reality and who, consequently, felt that staying within those limits self-evidently constituted a priority goal. To them, integrating economic growth, which would take the world further towards or beyond those limits, was taking the world onto a totally wrong track, betraying the most basic of environmental principles. In a scathing critique, Ted Trainer called the Brundtland Report a "highly regressive document" which ignored that "it should be abundantly clear that our chances of achieving a just, peaceful and environmentally sustainable world order depend on how soon we can shift from the growth and greed society to a conserver society" (Trainer 1990, 84). Frequently, commentators perceived "sustainable development" not as a new concept but as a qualified version of the traditional modernization theory of "development." As a case in point, Wolfgang Sachs commented, derisively, that the Brundtland Report definition of sustainable development "pointed to the future, but to a bleak future of scarcities rather than a bright future of progress." (Sachs 2001, 11).

By contrast, James Baker, then US Secretary of the Treasury, who represented his government at a 1987 workshop by the International Wilderness Leadership Foundation, flatly rejected the possibility of renouncing the goal of increasing wealth in the interest of safeguarding environmental limits. On the contrary, he argued that further growth was a prerequisite to getting people to agree to conservation, making the increase of wealth an essential prerequisite for the respect of limits. Besides, he declared any other approach politically impossible:

> No U.S. political leader who wants to remain in office will endorse a slow-growth platform. In the same way, no leader in the developing world is going to tell his countrymen they cannot aspire to the same standard of living as Americans simply because their ambition strains the ecology of the rain forest. Those of us who care about conservation will not persuade anyone with a "Limits to Growth" philosophy. (Baker 1988, 245–246)

With few exceptions, commentators tended to overlook the important qualifiers to the definition that noted a priority for the needs of the poor and a respect for limits (von Moltke 1996). Even more important, the controversy regarding growth diverted attention from distributional questions. Generally, out of the broad range of issues and recommendations, listed in the Brundtland Report, stake holders tended to focus on those most compatible with their interests, often the supposed compatibility of poverty reduction, economic growth and environmental protection, while ignoring the manifold changes in the nature of economic poliy considered necessary to bring about such compatibility. By 1992, when the concept was endorsed at the United Nations Conference on Environment and Development in Rio and its programmatic action plan *Agenda 21*, some observers saw the concept of sustainable development devalued to the point of a cliché, unthreatening to mainstream stake holders (Holmberg and Sandbrook 1992, 20). The potential of sustainable development to radically transform public and private lives could only be sensed in the vehement attacks of conservative fringe groups, the tea-party and other non-mainstream associations, mainly in the USA. They condemned sustainable development and Agenda 21, as its most tangible manifestation, as a ruse to foster global government and to destroy freedom, private property and the American Way of Life (DeWeese 2004; Kaufman and Zernike 2012; Morris 2014). While most of the accusations had little connection to reality, the underlying concern that sustainable development, if taken seriously, would result in profound societal changes with winners as well as losers, was reasonable enough.

Meanwhile, on the international development agenda, sustainable development was increasingly reinterpreted as a purely environmental issue with only tangential relevance for global development at large. The understanding of development, in turn, shifted from a global concern to a component of a challenge related to Southern deficiencies. This tendency showed clearly in the Millennium development Goals (MDGs), suggested in 2000 and subsequently transformed into eight specified goals with quantifiable indicators. Goal seven referred to ensuring "environmental sustainability", and its targets list health issues (sanitation and drinking water) and a crucial but unquantifiable integration of "principles of sustainable development into country policies and programmes", while some indicators (land covered by forest, per capita CO_2 emissions and species extinction) were clear markers of environmental limits. The question of distribution was, to some extent, addressed in goal eight, to "develop a global partnership for development". Its targets and indicators took up old NIEO demands of an "open, rule-based, predictable, non-discriminatory trading and financial system" measured by the access of low-income countries to markets and in tariff reduction, in overall ODA and in ODA dedicated to social services. It also included debt management and universal access to essential drugs. They were the only part of the goals which involved high-income countries. (Millennium Project.) More sensitive issues like consumption or automatic financing were excluded from the agenda. Focusing on poverty and ways to end it, the MDGs clearly adopted increasing wealth as the primary goal (UN millennium goals)

Accordingly, global improvementswith regard to this goal was strongest, though probably not entirely due directly to MDG policies. But regardless of reasons, advancements in increases of wealth and poverty reduction has, indeed, been impressive. According to the World Bank, the percentage of people living in extreme poverty declined from 36 % in 1990 to 14.5 % in 2011. This decline affected millions of people, a substantial achievement, although this evolution has overwhelmingly been driven by poverty reduction in Asia, notably China and India, with a far smaller reduction of 56.6–46.8 % in Sub-Saharan Africa (World Bank 2015, 1–3). The picture is bleaker for the other two dimensions. Despite a considerable decline in global poverty, global economic inequality remains high, estimated at a gini-coefficient of around 0.7. Most inequality is still due to differences between countries, though they have decreased since 1988. But the decrease of this gap appears to have been compensated by a rise of within-country inequalities (Lakner and Milanovic 2013). Meanwhile, events like the market failures and major financial and economic crisis erupting in 2008 provoking, among other effects, the occupy movement, and publications such as *Capital in the Twenty-First Century* (Piketty 2013) and *The Spirit Level* (Wilkinson and Pickett 2009/2010) rekindled discussions on global distribution as a crucial development issue. Piketty's calls for a "global progressive tax on individual net worth" implemented through international cooperation appears unrealistic at the moment, as he himself admits (Piketty 2014), but it is eerily reminiscent of the automatic financing concept suggested in the interest of sustainable development in the 1980s.

Besides, the improvements in poverty reduction have been achieved at the price of living beyond global limits. Every year, the world population uses the resources and the waste absorption capacities which the Earth needs 18 months to reproduce or regenerate (WWF 2014). Analyses of the possible repercussions of this form of development make dispiriting reading. In 2005, the Millenium Ecosystem Assessment warned of "an increasing risk of non-linear changes in ecosystems, including accelerating, abrupt and potentially irreversibly changes" with potentially "a catastrophic effect on human health." In the long run, it saw the possibility for a "sustainability transition" but cautioned that in the near future, the global ecological footprint would inevitably "expand further due to population growth, poverty reduction goals and the parallel expansion of affluence and consumption." (Corvalán et al. 2005, 7, 50) In recent years, concerns have focused on climate change. CO2 emissions, the waste product of the energy which fuels much of global economic growth, poverty reduction as well as climate change, increased by 46 % between 1990 and 2013, roughly the period in which "sustainable development" became famous. Studies have warned that"[i]ndirect effects of global climate change threaten the health of hundreds of millions of people" (Myers and Bernstein 2011). In 2009, the UCL-Lancet Commission on Climate Change, simply called climate change "the biggest global health threat of the 21st century" (Costello et al. 2009).

By 2013, goal one of the MDGs (poverty reduction) had already been achieved while the record of goal seven (environmental sustainability) was dismal and that of goal eight (global partnership) was mixed (UN 2013). In terms of underlying goals, this meant substantial progress for wealth, some rudimentary effort towards improved distribution and failure regarding limits.

This situation formed the background for the Colombian-Guatemalan proposal, presented at the Rio+20 conference in 2012, to replace the MDGS with Sustainable Development Goals (SDGs) in 2015, thereby returning sustainability considerations to the center of development thinking (Rio+20 2013). The initiative aimed at integrating sustainable development thinking into the MDGs: the goals would take up central elements of Agenda 21 but would adopt the shape of existing MDGs, being underpinned by target and supported by strong, multi-institutional engagement. A working group, established to discuss possible SDGs, declared advancing and completing "the most off-track MDGs … the starting point, the *sine qua non*, of the SDGs", but, in addition, SDGs would "need to be more comprehensive, balanced, ambitious and transformative, also addressing the challenges ahead". The 17 SDGs proposed were less overwhelmingly geared towards challenges specifically of low-income countries, though they remained dominant and combating poverty remained the foremost demand. But distribution received a comparatively high profile: the working group repeated prior demands for improved access to the benefits of advanced science and technology, public and private, and recalled existing calls "on developed countries to lead the shift towards sustainable consumption and production patterns, supporting others with their example and lessons learned". In addition, in a paragraph of unprecedented clarity, the working group declared that "[i] nequalities between countries … the major form of income inequality in the world" so that "equalizing growth, that is, differentially high growth rates in poorer countries to enable them to catch up with higher income countries' living standards, should be a shared objective". Environmental limits were addressed in goals 14 and 15, dedicated to conserving the oceans and terrestrial ecosystems, including putting an end to desertification, land degradation and biodiversiy loss (Open Working Group undated). In this form, the SDGs were accepted and have since formed the basis for numerous activities and programs (SDGs website).

The World Bank followed suit. In 2014, it adopted the reduction of extreme poverty and the promotion of "shared prosperity" as central goals, using the MDG/SDG definitions of the percentage of people living on less than $ 1.25 per day and, respectively, the improvement of the living standards of the bottom 40 % of the population in every country (World Bank 2015, 1). Thus, for the first time the World Bank specifically added an improvement of distribution to its goals, without, obviously, giving up its goal of increasing wealth. Environmental concerns were also included, albeit in the form of "green growth", not as limitations to growth. These are important approaches to the idea of sustainable development, but still a far cry from a true reconciliation of its key goals.

6.7 Conclusions

Sustainable development, as a developmental model, emerged in the 1980, as it became impossible to overlook the tension between three central goals of the global management of human economic and social lives: to increase or safeguard wealth, to improve a fair distribution of wealth and to remain within environmental limits. The Brundtland Commission proposed a series of policies that both reflected and required a fundamental change in the approach to socio-economic decision making and that, collectively, should result in a reconciliation of the three goals. This synthesis had weaknesses even on a conceptual level, and its imperfection was further exacerbated through high selective receptions of the idea, both by its supporters and its opponents. Full endorsement was prevented by a widespread unwillingness to accept the profound changes that a serious approval would entail and by the fact that different groups prioritized different goals and that, so far, no broad societal discussion on their relative importance has taken place. Negotiations about the meaning of the term have also been burdened by the efforts of major stake holders to interpret sustainable development according to their specific economic and political interests and by the fact that one actor, the physical environment, does not negotiate on the same terms as the human partners in this triangular relation. Consequently, of all goals, wealth has been most successful at appropriating the meaning of sustainable development, with distribution coming second and limits a distant last. Then as now, environmental limits have represented the most inconvenient element and the most threatening to the very tenets of the existing socio-economic world order.

After 30 years, the goals appear as unreconciled as before, and the re-emergence of "sustainable development" for a second generation of global development goals, endorsed by major international organizations and governments, testifies to the continued perceived need for a concept that promises a solution to potentially contradictory exigencies. Arguably, it also testifies to the lack of serious alternative in the face of increasing challenges.

Early information about the SDGs suggests that distribution is being upgraded as a central element of sustainable development. By contrast, a full integration of environmental limits is still outstanding.

This lack of integrated approach affects not only the understanding of developmental exigencies for the future but also of the environmental record of the past. Maybe existing concerns about limits will one day turn out to be exaggerated. Maybe mankind will find a way to increase wealth without increasing the exploitation of scarce environmental resources and without increasing the production of waste material. But until then, the scale and distribution of wealth remain a crucial component of environmental history. Every political measure, which has prevented a more equitable distribution of global wealth, has also contributed to an unsustainable exploitation of ecosystems, notably to global climate change. By the same token, a developmental concept, aiming at the reconciliation of the three goals, forms part of the record of human interaction with the environment.

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Chapter 7
Hidden Treasures: Challenging Traps of Historical Sources for Environmental History

Klára Woitschová

Abstract Traditional archive sources relating to environmental history are of fundamental importance not only for historians. They are and should be also used by climatologists, physical geographers, and other natural scientists. Notwithstanding these sources are very rich and sometimes easily accessible, they are usually underestimated or considered unreliable especially compared to "hard data" e.g. palynological analyses etc.

Based on several very concrete examples from Central Europe, obviously having far more general validity, the article shows major advantages and weaknesses of using archive (mostly written and pictorial) sources from early modern period in environmental historical research. E. g. weather records provided in the 18th century by the Moravian Brethren served as an important source of various analyses of climate changes in the Arctic, records of the guild of Prague fish merchants provided crucial information about European trade with Baltic fish since the 17th century, economic data from municipal and manorial books of accounts helped to reconstruct climate changes in the Central Europe from the 16th century onwards etc.

The case studies were chosen with the intent to show (1) how the archive sources may improve and so far correct current research projects, (2) demonstrate those approaches in environmental history, which are based on excellent usage of them and finally (3) discuss more generally some "traps" of written sources and current misunderstandings between historians and archivist on the one side and natural scientists on the other.

The aim of the paper is to show and explain further potential of archive findings and their interpretation. The article focuses on general characteristics of written sources related to the history of climate, landscape perception, and landscape transformation and management. It also challenges the traditional approach to environmental history sources since, in the authors's view, environmental history should take into account various historical concepts of archive keeping and the selection of sources that was implemented by their authors and providers. Within this particular framework, the paper shall focus on the role of modernity, science, and ideology.

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Finally the paper highlights several crucial epistemological and discursive differences between historians and natural scientists and their approaches to the written sources, which should be overcome in order to achieve more sophisticated collaboration on the field of environmental history.

7.1 Introduction: Conceptual Background

Archival research and work with archival sources of all types is traditionally connected with classic historical disciplines (mainly political history, then, more slowly, economic and military history rose to prominence, but also the history of culture and art; most recently, archival sources are also used for the history of everyday life/Alltagsgeschichte). Within these disciplines or specializations, a complex typology of archival sources has been elaborated over the past decades and centuries, based on their formal properties and potentialities for utilization. Since the 1970s, more and more emphasis has been put on the metanarrative and discursive (rhetoric) characteristics of sources and the method of dialogue that the historians and other researchers are "conducting" with them, while this method of asking new and novel questions can produce unforeseen information even from seemingly featureless documents (Schmidt 1997; Iggers 1997; Dülmen 2000).

As regards recent approaches to archival sources as they stabilized especially in the Central European milieu (Austria, Germany, the Czech Republic), there are several systems for their classification. These sources can be divided within the external aspect into the following groups: (1) material sources (remains left after the person and all subjects of the material culture); (2) written sources (official sources – e.g., charts; private sources; narrative sources – memorial, historiographic, biographical, travel sources, hagiographic, journalistic, literary and scientific works); (3) visual and audio sources (pictorial of its own and symbolic sources, pictorial and audio sources as outputs of modern technologies); (4) information preserved in the memory and passed on verbally, i.e., traditional sources (legends, songs, proverbs, folk sayings, historical songs). This typology of sources originated as early as in the second half of the seventeenth century in works written by the first auxiliary science historians such as Jean Mabillon, being gradually merely adapted to the newer types of sources (Hroch et al. 1985; Bartoš 1999; Bartoš and Kovářová 2004; Brandt 2007). There are, however, other, less frequently used systems, which acknowledge the purpose for the origin of the source (remains, sources, monuments or reports) (Droysen 1868; Bernheim 1889) as well as combinations of various approaches to the classification of historical sources. Nonetheless, it is always true that when describing sources and determining their utilization, archivists work with a precision approaching botanic taxonomies.

I work with the first mentioned classification further in the text. In the evaluation of individual sources and their groups, I proceed from the position of modern archival and heuristic theory and approaches that search for hitherto hidden information levels in written sources where historical anthropology or environmental history can serve as a typical example. Today's principles of archival work originated in the late nineteenth century (Muller et al. 1898) and were later only modified or refined for other types of sources (Brennecke 1953; Papritz 1976).

It is apparent that even for the newer or boundary historical disciplines, traditional and historical memory institutions such as archives with their deposited documents and other sources have much to offer. One such "new" discipline is the mentioned environmental history, which, on the current global scale, represents one of the most important revisionist discourses standing in intentional or unintentional opposition to certain approaches to traditional, especially political, history (Bayerl et al. 1996; Dann and Mitman 1997; Radkau 2002; Krech et al. 2004; Freytag 2006; Winiwarter and Knoll 2007). At the same time, it is necessary to understand that historians can (and should) reflect and utilize the outstanding potentialities that the broad archival network in many European countries offers through elaborated registration methods, heuristics and criticisms of the sources. At first glance, such a statement may appear trivial, but if we look at important handbooks dedicated to the theories and methods of environmental history (Winiwarter and Knoll 2007: 78–86), it becomes clear that they count on knowledge of certain historical methods and archival work at some sort of meta-level, while quite a lot of environmental historians lack formal historical training and can subsequently very easily fall into various traps in archival research. These researchers can find support, though from other disciplines rather than environmental history, in archives which present their resources on the internet, especially through large digitalizing projects. Some of them focus on a specific historical discipline and are limited to the territory of a single state (portals opening up sources for genealogists and demographers, such as Acta publica),[1] others cross borders (Monasterium)[2] and publicize various types of sources. However, even in all these cases, good availability of written sources is no guarantee of their trouble-free utilization, which particularly applies to documents concerning older history where the respective specialists are unable to utilize the general knowledge acquired in other disciplines. However, the first chrestomathy of the sources and specialized guides for archives have been created even for environmental history (Bayerl and Troitzsch 1998; Steinsiek and Laufer 2012). Nonetheless, they are mere drops in the ocean of gigantic early modern and modern-day sources.

Thus, although environmental history refers to historical study directly through its name, it is apparent that the central point of thus oriented researchers covers in particular the twentieth century, i.e., recent history or de facto present-day issues, leaving the field of research to sociology, political science, etc. This, of course, cannot be opposed, because these issues frequently concern very acute problems of contemporary ecosystems, but at the same time, we can assume that focusing on new and the latest environmental history is caused by the difficulty in capturing older sources by some environmental historians, who, for clearly practical reasons, thus choose different themes. The presented text thus intends to show that a glance

[1] Acta publica: http://actapublikca.eu. Accessed 26 December 2014.

[2] Monasterium. International centre for archival research/ICARUS: http://icar-us.eu/cooperation/online-portals/monasterium-net. Accessed 26 December 2014.

into deeper history can have great value in unveiling various unexpected aspects of temporary problems and direct us to their roots. The fundament in the given case can be a strict inter-discipline with an almost definitional feature of the EH, but which has not been much applied in archival sciences so far. The “research ground” of the essay covers environmental history in the Czech Republic, where it has been developing for the last 25 years (Jeleček 1994, 1999). Existing experience shows that archivists’ and environmentalists’ paths have not sufficiently met in the Czech Republic, which is a pity for many reasons. Perhaps the only exception is the outstanding inter-disciplinarily research team working at Masaryk University Brno, which studies the history of the climate on a world level (Brázdil et al. 2011, 2012, 2013). It is also a shame that foreign researchers show little interest in outstanding Czech sources.

7.2 Sources for the EH in the Example of the CR and Their Potentialities for Study

One of the reasons for the good exploitability and searchability of sources relevant for the EH is the transparent and well-accessible archival network in the Czech Republic, which has long and sometimes slightly problematic roots, but which eventually brings mostly positive aspects. Czech archival science organically emerged as early as during the Habsburg Monarchy, when its foundations were laid. As the Lands of the Bohemian Crown were incorporated into the Habsburg Monarchy since the sixteenth century, many of the older sources are in German, which can present a certain advantage for foreign researchers (Beck and Henning 2004; Pauser et al. 2004), and the older EH could or even should proceed on a unified territorial comparative base covering (at least) today’s Germany, Austria and the Czech Republic. The definite form of the Czech archival network, however, emerged with the 1954 reforms (Government Decree No. 29/1954 Coll. on Archives; Babička 1995; and a short overview in English – Kaďorek 2004).

The first reform involved the introduction of the so-called Uniform State Archival Fonds into which all Czech archives and archival groups were incorporated, many of them after nationalization and confiscation from the original owners (especially monastic, but also secular institutions). These Uniform State Archival Fonds can be imagined as a single associating virtual set of all nationalized documents in the former Czechoslovakia which fell under the central administration of the ministry of the interior. Such a radical step can certainly be questioned from the perspective of democratic principles, but it is true that thanks to this handover of all important extant documents to the care of a state archives, a serious breach of integrity of the written documents was prevented. At the same time, it ensured equal access for all interested people. The effect of the totalitarian ideology thus paradoxically proved positive for the development of later research in the field of EH.

The second point of these reforms involved the development of a comprehensive network of archives in Czechoslovakia. The chief institution was the Central State Archive (Státní ústřední archiv), which has deposited documents of central offices since 1158. Of course, not all of them are preserved as compact, which is particularly true for the older period; yet, we can find a good many sources extremely suitable for utilization in environmental studies. Some of the most classic sources coming from the early modern period are the cadastres (from 1654, 1748, 1790, 1860) used for example in research on historical land use (Bičík et al. 2010) or more generally when studying the formation of the cultural landscape (Mackovčin et al. 2011). One of the features is the fact that the newer cadastres (especially the so called stable cadastre, Franciscanian, of the mid-nineteenth century) were prepared in the same design for the entire Habsburg state system, thus offering huge potentialities for comparisons. The sources usually represent pictorial-symbolic materials (especially map works) and official documents (letters, official books, records).

Another level of archival hierarchy covers State Regional Archives (for former individual regions; there were six of them in the whole country and their seats were in the former regional towns or in areas where archives of important dominions were placed in the past). Their significant sources include documents from former noble dominions and manor farm estates, where we can often find truly gigantic numbers of documents on forest and water management, old maps, etc. (manors of South-Bohemian noblemen from the Schwarzenberg family can serve as a classic example). Once again, we can utilize official written documents, but occasionally we can also find sources of a narrative biographical character (personal memoirs, diaries, calendars, etc.) or pictorial sources (maps, forest or water plans). The lowest level of the state archive network is the District Public Archive, where we can find documents from villages and towns covering their business activities from the Middle Ages to the modern period (field work, construction works, etc.). The types of sources following the typology mentioned in the opening section are analogous to the State Regional Archives (Šamberger 1968). In addition, the archival network also incorporated so called specialized archives, where many important sources could be found, for example, the ANM and Eichler's Topographic Collection, which maps the settlement structure in Bohemia until 1848.

After the change of circumstances in 1989 (the Velvet Revolution in the former Czechoslovakia), some of the sources returned to their original owners (especially the church or some family archives), but in most cases, these documents have stayed in the original state archives as permanent deposits and their accessibility is preserved. After 1989, when the communist regime broke up and the path to democratic society was taken, the network of archives experienced only cosmetic modifications (for example, the Central State Archive was renamed the National Archives and, since 2004 it has been possible to establish private archives, which, however, have to meet strict technical parameters). However, the principle of a Uniform State Archival Fonds has been preserved. As the name had undesired connotations of the past regime, it was renamed the National Archival Heritage (so called Archive Law – Act No. 499/2004 Coll.). It incorporates all the existing archives, and newly established archives in the Czech Republic mandatorily become its component (whoever their holder); for several years, their content has been published on the website of the Ministry of Internal Affairs, which administers Czech archives.[3]

As regards general scholarly epistemology, it is thus possible to recapitulate that the modernizing processes, ideological impacts and developments in science (in our case archival theory) were essential not only for the development of the living environment, the landscape, etc., as the subject for the study of the EH, but also fundamentally affected the potentialities for the study of these subjects in the Czech Republic as well as other comparable countries. To sum up, without the establishment of a modern archival network (whose unity and strict unification borders on the extreme in the Czech Republic), without a clear modernistic idea about the archive as a place for storing information on the past that needs to be somehow arranged, processed and opened up for specialists, no credible historical research would be possible and the EH would be seriously impoverished. From the interdisciplinary point of view, this finding alone can be considered an important benefit for the relation between environmental historians and archivists.

However, the question is whether the actual researchers in the field of the EH sufficiently realize the necessity to acknowledge the clearly practical, but thus deeper ideological and other issues connected with the method and quality of the preservation of historical sources and the potentialities of their exploitation in the EH, as well as the fundamental limits which this utilization possesses. The principal limit is of course the fact that until relatively recent (the eighteenth century), which once again coincides with modernizing processes and the scientification of society, historical sources refer to nature, climate and landscape mostly indirectly, i.e., their origin had a purpose different from direct documentation of its condition and development. This can be another reason why EHs concentrate on less recent history, where the sources are much more plentiful and much more easily identifiable.

7.3 Hidden Treasures

Now, let us look at several particular cases in which hitherto hidden archival sources play a role. Although the aim for their creation was completely different, they served very well as a basis for the study of environmental history. This is a typical situation when seemingly non-parallel sources were used in the field of EH with examples in which we can document that sporadic cases of thus interdisciplinary approached research have already been implemented – the author of this essay has participated in some of the below-described cases, the other cases were selected with a view to model utilization of Central European written sources.

[3] Archive groups in the Czech Republic. Http://aplikace.mvcr.cz/archivni-fondy-cr/default.aspx. Accessed 26 December 2014.

7.4 The Moravian Brethren at the End of the World (Example 1)

Records by the Moravian Brethren, which originated during their missionary work on Labrador in the second third of the eighteenth century, represent one of the most important examples where relatively old archival records were utilized in modern research into climatic changes. The Moravian Brethren came into existence as one of the Protestant churches in Bohemia in 1457 as a consequence of the Hussite movement and after 1620, most of its members were forced to leave Bohemia. The most important seat of the church was Herrnhut (Ochranov) in Saxony, where the archive of this church is still deposited. The archive contains reports of brethren who performed missionary activities in very distant places, such as Greenland. Their practice of making meteorological observations was done alongside their missionary activities. The observations were carried out under standard conditions by observers well trained in natural sciences at their theological seminaries and pedagogical schools. The observations were recorded in a hand-written book and extracts of these meteorological records were published in local newspapers and scientific journals in the core region of the Herrnhuters in eastern Germany. One of the most important persons who place these meteorological observations within their historical and climatological context is Gaston Demarée (Demarée and O'Gilvie 2008, 2010; Demarée et al. 2010). The mentioned example thus concerns Greenland and the Moravian Brethren, but other, very detailed reports, which may contain climatologist observations, were also sent by the Jesuits from their missions to the Rome headquarters, where they can be studied in their archive. However, comments on the weather and especially its extreme conditions can also be found in less well-known sources. We can exclude mediaeval chronicles in this respect, but they frequently represent the only existing source of information on the older period as memoirs of noblemen or burghers who recorded events of big or local politics, but very frequently also mentioned facts that immediately affected their lives – the weather. Such records can exist continuously for many years over which the work was created. And one more example concerning the climate – Jan Jeníšek of Újezd was the Prague Registrar of Extraordinary Taxes who ran a farm in the foothills of the Bohemian Forest and recorded his farming activities in the so-called White Registers between 1539 and 1561.[4] The section "About farming" is particularly interesting for the study of the climate. It is thus a typical "hidden" source, which, for the common historian, might be interesting as a document on the mentality of an early modern knight or for the study of his everyday life. Even with the best will, nobody would systematically look for reports on the weather in it. Nonetheless, even a fleeting glance suggests that chronicles, memoirs or business reports of people from any social level, living at any time, express man's relationship to nature perhaps unintentionally, but all the more candidly.

[4] Archiv Národního muzea (Archive of the National Museum), Manuscript Nr. 288.

7.5 What Did Pickled Herrings Sold in the New Town Reveal? (Example 2)

Another rather untypical example of a source that can disclose unexpected information on the history of man's relation to nature is a book of the New Town guild of herring sellers (Woitsch and Woitschová 2011).[5] It covers the more or less private activities of a New Town guild and its establishment was clearly motivated by an effort to preserve information for future generations. This "*Stambuch*", or *album amicorum*, comes from 1600 to 1679 and contains entries from 160 merchants, most of whom included their place of origin and business and their trademark. "Common" historians or researchers in auxilliary historical sciences have held this beautifully decorated source in their hands many times, but they considered it a mere solitary source for the heraldry of town people, or in an even worse case, an interesting source containing several vulgar rhymes, which the intoxicated merchants wrote there upon admission to the guild (Vojtíšek 1919; Schreiber 1944; Janáček 1972). Thus, we can see that the relatively limited outlook in searching for the exploitation of a source is indeed a problem even for classic historians, who, nevertheless, can benefit from new approaches. The environmental historian's eye can also find other information in this source; for example, he can identify the routes fish was transported on to Central Europe, based on the geographical origin of individual merchants. Most of them came from central Germany, thus being middlemen – Leipzig, Magdeburg, Breslau, Pirna, Dresden, Berlin. Only in sporadic cases were there merchants directly from the Baltic and North Sea (Hamburg, Stettin).

The second logical step in a detailed study involves the books of accounts of New Town city councillors,[6] i.e., sources of a diplomatic nature. Again, this is a source which at first glance cannot be clearly connected with EH. Nonetheless, we can very easily follow the varieties of imported fish (primarily of course herring, but also kipper, clinic, salmon, lamprey, cod, rarely halibut or hake. Fish oil is also a very frequent item.) and of course its quantity. By combining seemingly almost obscure written sources, which exist in a similar spectrum in many other Central European towns, we can thus reconstruct the significance of North Sea fishing for people living in the interior and the long-distance trade in food in the early modern period. Comparison with sources from northern Europe can allow us to estimate the quantity of fish consumed directly in seaside regions and the quantity of fish preserved for long-distance transport, etc. (Hoffmann 2001; Poulsen 2008).

[5] Archiv hlavního města Prahy (Prague City Archives), Manuscript Nr. 7962.

[6] Archiv hlavního města Prahy (Prague City Archives), Registra hlavní příjmů a vydání Nového Města pražského 1667–1723 (Manuscripts Nr. 2290a–2349) and Registra počtů hlavních Nového Města pražského 1754–1759 (Manuscripts Nr. 2350–2385).

7.6 What Can Rafts Floated to Prague Reveal? (Example 3)

A similar example of the non-traditional interpretation of known sources is a study of the Prague River Transport accounts (Holec 1971). Even a mere grasp of this topic and its processing on the clearly historiographic level can serve as a textbook example of the complexity and exactness of archival research: it was necessary to work with sources from more than ten Prague and non-Prague archives, using a broad spectrum of written sources, especially of an office nature – documents, city books (especially of a financial character), guild documents, various documents from central Prague and Viennese offices, accounts of the Bohemian Forest foothill dominions, other accounts, etc. These records provide accurate records on all the wood transported to Prague by the Vltava River, its quantity, type, age of the wood, etc. As the Vltava waterway was the only transport route from large areas of south Bohemia and especially the Bohemian Forest region until the nineteenth century, and consumption of the wood directly in the logging area was negligible, these sources provide essential information on logging in the given region and the deforestation process. On their basis, it is possible to reconstruct transformations of the forest species composition, preferences in the logged types of wood, etc. The customs entries also document the long-distance wood trade, when its substantial part was exported to Germany, etc. (Woitsch and Woitschová 2013).

However, that is not all. The mentioned source can be regarded as sufficiently objective for its neutrality and the quite different purpose for its creation. It provides indirect information on the development of the climate and climatic catastrophes (there is a proven correlation between floating the wood and floods or extreme droughts; the quantity of floated wood can also refer to large disturbances in forests, e.g., wind calamities) as well as accurate data on the canalization process of the Vltava and Labe Rivers as key Central European waterways. Information on what, how and how successfully the floating proceeded is much more reliable than frequently fabricated information on the canalization of these rivers in memorandums.

7.7 What Can and Cannot Maps Reveal? (Example 4)

Old maps represent a very popular source for environmental history, especially in the study of historical land use. We can find a relatively large number of maps in Czech archives and libraries in the form of complex collections or individual documents deposited more or less randomly or as part of different material. The most frequently used maps within EH research are maps of the so-called stable (Franciscanian) cadastre from the 1820s to 1840s, which have been preserved on the same scale of 1:2880 for the entire Habsburg Monarchy. Other frequently used maps include so-called military mapping and forest maps. This seemingly trouble-free symbolic pictorial material is usually relatively well known to the natural sciences concerned with environmental history, but the main problem for its exploitation lies in the correctly executed internal criticism and interpretation of this source. When using old maps, it is necessary to consider the means available to their authors, the circumstances and purposes for their usage during their origin. This consideration is an essential step for traditionally working historians without which nobody dares to deduce anything. Forest maps and water maps in the collections of individual domains can serve as a classic example. If we ignore the particular author's ability to illustrate the reality or the contemporary technical or aesthetical limits and potentialities of the cartographic work, it is important to ask about the purpose of the map. In many cases, the map work does not illustrate the reality, but wishful thinking (if, for example, it was to present the author's results in the administration of the entrusted forests) or, conversely, the illustrated values deliberately fail to reflect the reality on the territory (especially if the purpose of the mapĺs creation was the calculation of taxes – state offices were used to this type of cheating and inspectors travelled around the whole kingdom; nevertheless, we cannot count on this inspection method very much on the level of a domain). It is thus often very tricky, or indeed downright impossible, to take the information from old maps as an accurate reflection of the reality. Yet, our literature has examples of the literal adoption of this information from maps and, without further criticism, its transformation into the digital environment through the GIS system, statistical evaluation and interpretation. However, the resulting "accurate" statistics represent a load of nonsense from the historian's or archivist's perspective.

Written comments accompanying some map works represent another separate chapter. Researchers often intentionally miss them (mainly because they are usually written in the cursive Gothic script, illegible not only for the natural scientist; however, these very comments can often correct or explain incorrect information (e.g., detailed description of the border, exact areas of the plots, etc.). Thus, it is frequently possible to find detailed information on the inaccuracy of a particular work for the particular, seemingly reliable map. The oldest forest maps (until ca. the 1960s) of the Bohemian Forest can serve as a typical example. They were used as a basis for the publication (even in highly prestigious journals) of several papers that determined the alleged age of some of the Bohemian Forrest's "primeval forests" (Brůna et al. 2013). These, however, never existed, because, as is documented in the written comments to the maps, the corresponding assessors simply fabricated them for various reasons (Jelínek 2005).

7.8 Conclusion: Ay, There's the Rub…

The basic problem for me personally and the Czech Republic milieu in general, if we can talk on such a general level (because a few honourable exceptions can always be found), is finding a mutual language between natural scientists and archivists or indeed environmental historians. In the Czech Republic, where EH is still little developed despite the 25-year tradition, a certain “double-trackness” can be observed in this discipline. However, I believe that such double-trackness represents one of the most serious problems of the EH as a whole on the global scale and somewhat limits the chance, just like with other specializations standing on the border between the humanities and science, to make the EH perhaps even a dominating discourse of current historiography. In the Czech Republic, only very few historians are concerned with the EH and if they are, they represent almost entirely historians oriented towards the twentieth century[7] and, with several honourable exceptions, no archivist (i.e., specialist in disciplines which have good predispositions to understand the historical sources, their deposition, the degree of their (non-)survival, the ideological background of their emergence and the reasons for their deposition in the archives). These specialists, however, lack sufficient knowledge of natural scientific methods. On the other hand, the dominating branch of nature scientific research on EH in the Czech Republic often depends on the contract and half-heartedly processed recherche, without sufficiently deep knowledge of the historical sources. This, on the one hand, leads to their rejection and underestimation and, on the other hand, to frequent errors, misinterpretations or blind trust in seemingly “objective” information in written sources deposited in the archives. These sources, as we have shown, can be preserved randomly, non-representatively, and can include complete nonsense, which only the archivist’s eye can detect.

If natural scientists and archivists ready to cooperate are ever found, it is merely the start of a long journey to an understanding accompanied by a series of obstacles. I consider the following obstacles the most serious for research into the older period:

1. Terminology – terms used in older sources, which were created for purposes other than accurately recording quantity or quality, may seem too vague to a natural scientist used to exact interpretation (the barrel was different in each town, the terms for individual fishes greatly varied). However, I believe that this should not be a reason to resign to archival research into older periods of environmental history, however much the ambiguity of historical terms can inspire a priori distrust. This fact, however, can also serve as a prompt to apply sophisticated models and statistical methods, as, for example, we can observe in research into the history of the climate, which has succeeded in coming to terms with contemporary information on the climate and weather.

   On a slightly different level, we have to realize that not only historical terms, but also contemporary scholarly terminology throughout the disciplines can fundamentally differ and individual specialists simply may not understand each other although they are discussing the same issue. As a typical example, we can mention terms for the biogeographical sectioning of Central Europe (Hercynicum, Polonicum, Panonicum, Carpathicum) by which natural scientists frequently refer to certain phenomena connected with the development of the cultural land-

[7] For example Environmentální dějiny. Webová stránka pro českou a slovenskou komunitu environmentálních historiček a historiků: http://environmentalni-dejiny.org/. Accessed 26 December 2014.

scape, while to historians, these terms are completely incomprehensible. And vice versa, without proper training or a willingness to dialogue, it is difficult to penetrate the complicated terms connected with, for example, historical ecclesiastical administration districts (e.g., the Prague archdeaconry).

2. Discourse – the humanities and natural science differ; besides the apparent differences in terminology, they differ also in the overall concept of the scholarly writing, the level and method of acknowledging scientific theories, the emphasis on experimental verifiability of the research outcomes, non-transferable methods of argumentation and varied levels of "trust" in various types of data, etc., i.e., the overall argumentative and gnosiological set-up, which we can mark as differing and mutually non-transferable scholarly discourses. The differences between these scholarly worlds, reflected for example by the traditional classification of Neo-Kantians (i.e., nomothetical sciences vs. idiographic sciences), are well known and frequently discussed. As a matter of fact, the mutual collaboration of natural historians with historians and archivists in the field of environmental history offers a unique chance to overcome dissimilar discourses. Based on a detailed historical description based on various archival data (i.e., the methods and level of the idiographic discourse of the humanities), it is possible to create generally valid models or even predictions for the development of the climate, the landscape, etc., which constitutes a typical approach of nomothetical natural sciences. The dissimilar discourse thus remains a trap on the one hand, but on the other hand, it represents one of the greatest challenges for the EH, which, in certain researches can be oriented from mere interdiciplinarity towards transdiciplinarity, still little seen not only in Central Europe.
3. The mutual distrust between the human and natural sciences coincides with both mentioned problematic circles, but it also has considerable roots reaching outside the actual science to the level of national and global policies of scientific management and the competition for sources. It can also be dramatized by personal animosities, etc. At least in the Czech Republic, this is a phenomenon lasting for several decades and both sides are to blame – both the natural sciences and humanistically-oriented researchers. Thus, we frequently hear the natural scientist referring to the humanities as "pseudoscience" and ramblings, while the humanistically-oriented scientists criticize natural scientists for "excessive empiricalness" and total insularity from human society and its ethics and problems, labelling them laboratory rats. For true collaboration, it is thus necessary to reach a certain compromise on both sides and to free oneself from certain stereotypes. However, the financing of scientific research in the Czech Republic and other post-communist countries does not encourage the overcoming of these stereotypes, which leads to their withdrawal and sectarian fighting in the competition for points and money rather than fruitful collaboration across the disciplines.

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Chapter 8
Vegetation Analysis as a Source of Historic Information – The Case of Madeira Island

Sandra Kiesow and Klaus Dierssen

Abstract The Island of Madeira is situated in the Atlantic Ocean (32°23′N–33°07′N, 16°15′W–17°15′W) and has officially been discovered in 1419 by captain Zarco and his crew. The abundant vegetation cover they encountered upon arrival promised fertile soils and sufficient water supply for prosperous agricultural activity, which led to a quick colonization of the island in the following years.

In 1469 Manuel Afonso de Sanha received land for colonization in the central north of Madeira Island nowadays know as Ponta Delgada, where thick native woodland covered steep mountain slopes reaching from the sea shore to altitudes of more than 1000 m above sea level. Settlers transformed the steep slopes, which were difficult to access, from wooded into arable land, thereby causing profound changes in site characteristics: extensive terrace and complex irrigation systems were established. Land owners desired to extend the agricultural terrace systems until the base of vertical rock sections above the village of Ponta Delgada.

The scarcity of accessible crop land in combination with the absence of public land close to the houses forced numerous inhabitants to use natural resources provided by the mountains to earn a living. The indigenous mountain forests provided fire wood, construction material and alimentation to raise sheep, goats and cattle. Over more than 500 years intense human – landscape interactions have changed the evergreen island ecosystem "Laurisilva" that fascinated it's discoverers. Between heights of 700 and 1600 m above sea level some woodland areas, located in remote gorges, are classified today as remnants of undisturbed autochthonous woodland. Scientific projects of vegetation mapping have been carried out in these zones, providing a large number of plant species lists showing the composition of the natural vegetation cover. These data compared with current vegetation mapping data

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obtained in the research area of Ponta Delgada is a rich source of information to address a variety of questions on the environmental history. Systematically conducted vegetation mapping can reveal the extension of past human influence in the landscape and locate different intensities in past use of mountain resources. Which altitudes were used for which purpose? Has there been a division between areas for collection of forage, for cutting of firewood and for felling timber? Furthermore the living and working conditions of peasants can be investigated: how far would they have walked from their living space to collect necessary resources from the mountains? How much time would they spend to fulfill these tasks? What kind of infrastructure was in the hills, were there main footpaths and places next to springs, which were used as places for rest? A study of local toponymy completes information on former land use and activities within the mountains. For quick visualization of results thematic maps have been elaborated using a Geographical Information System.

8.1 Introduction

The abundant vegetation of Madeira Island has fascinated visitors, explorers and scientists since its official discovery by Captain João Gonçalves Zarco in 1419. In the sixteenth century various chroniclers mentioned the extremely dense woodland covering most of the island. It was predominantly laurel woodland, named Laurisilva. In later years many well-known scientists used to visit Madeira and spent time investigating it's unique ecosystem.

Over centuries the Laurisilva ecosystem has undergone essential changes due to human activities, either directly by removing wood and turning it into agricultural land or less rigorous by using plants for construction of buildings, for naval purposes, for firewood and certain species even as animal fodder. Furthermore settlers introduced new species to the island occupying niches formerly used by native plants. These species were many times crop plants like cereals and vegetables, but included also fruits and nuts. Over centuries the landscape has been transformed from a wild native woodland into a man-made countryside. Botanists have studied the remaining native Laurisilva areas on Madeira Island in detail, namely the species distribution, range of species and status of extinction danger (Neves et al. 1996).

This study focuses on the role of vegetation mapping as a source of information to unravel details of the environmental history within Ribeira da Camisa valley nearby Ponta Delgada in the north of Madeira Island. Many historical details of the vegetation cover cannot be accessed by common methods like interpretation of aerial photography or other means of remote sensing. According to Jacobi (1989) one of the most important steps in the preparation of vegetation maps is in-field survey. Detailed in-field vegetation survey with its high resolution of local heterogeneities is a unique source to fully understand the dynamics of interaction between humans and landscape over time. It provides locally refined information on species distribution (Capelo et al. 2004) and builds a differentiated picture of anthropogenic influence to this former native ecosystem. This might improve our understanding of the interactions of past generations of islanders with their environment. It can show distances that peasants covered searching for appropriate areas for chopping firewood or for collecting animal fodder or construction material. Moreover former agricultural terraces and the spatial extension of cropping activities are discovered during fieldwork.

Until present days the catchment of Ribeira da Camisa has not suffered huge modification constraints like modern infrastructure measures or big scale development projects like construction of apartment blocks, and industrial facilities. The landscape around Ponta Delgada still preserves what inhabitants built up over roughly 600 years (Pereira 1989) and thus is ideally suitable for this research project. Comparisons of the range of species in disturbed areas with the range of species in relatively undisturbed areas permit an integral perception of local and regional environmental history. In order to get a first idea on former activities in the mountains and location of access routes interviews provided basic information for efficient fieldwork activities.

8.2 Environmental Characteristics of the Area of Investigation

The archipelago of Madeira consists of the main island Madeira with an area of 758,52 km^2, the inhabited neighbor island Porto Santo (42,59 km^2) and the small uninhabited island groups of Desertas and Selvagens (Direção Regional da Estatística da Madeira 2013). The archipelago is entirely of volcanic origin, dating back to the Miocene, when the islands emerged above sea level. The island of Madeira is situated on the African plate. Its highest point is rising roughly 5.5 km from the bottom of the sea with only 1/3 above sea level (Mata et al. 2013).

Madeira Island has an elongated shape extending in east-west direction, with a central mountain chain separating the island into a northern and a southern part. A rugged central mountain area characterizes the eastern section of the island with the highest peaks being Pico Ruivo (1862 m), Pico das Torres (1851 m) and Pico do Arieiro (1818 m). Excerpt from the west the slopes from the central mountains extend down to the seashore with a few small plateaus, especially in eastern direction. To the west the central mountain area continues as a mountain ridge with various peaks linking to the high plateau Paúl da Serra, characterizing the western part of the island. The lowest point of this ridge is at Encumeada (1007 m), where deeply cut valleys reach out to the south coast to the town of Ribeira Brava and to the north coast to the town of São Vicente, thus dividing the island into an eastern and a western section. The high plateau in the west ranges from altitudes of 1200–1600 m slightly inclined to the west, the highest point of this plateau is Pico Ruivo do Paúl

(1640 m). Into the western part of the plateau a deep valley has been carved by the longest river of the island: Ribeira da Janela. In general terms the island is characterized by very steep slopes, vertical walls and deeply carved canyons. Roughly 90 % of the islands surface is located on altitudes above 400 m a.s.l and the average slope inclination is 56 %.

These extreme relief conditions result in various microclimates on the island. There are quite strong variations in pluvial and temperature regime, causing different environmental conditions namely between south and north slopes. In comparison with the slopes facing south the northern slopes of the island are characterized by higher amounts of annual rainfall increasing with altitude, stronger winds since the prevailing wind direction is northeast and lower temperatures. Precipitation ranges from 641.2 mm (Funchal, southern side at 58 m a.s.l.) to 2966.5 mm (Bica da Cana, northern side at 1580 m a.s.l.). Average annual temperature varies from 18.7 °C mean annual temperature at Funchal (58 m a.s.l.) and of 9.1 °C at Pico do Arieiro (1610 m a.s.l.). These conditions with a huge number of microclimates created divers habitats for a large variety of plant species.

8.3 Native Vegetation and Actual Land Use Situation

Madeira's geographical position allowed unique ecosystems to develop. The flora includes species from tropical, subtropical, Mediterranean, Atlantic and even mountainous zones of the world (Sjögren 2000). According to the climate conditions at different altitudes four altitudinal belts of vegetation have been identified (Quintal 2005). On the south side the belts representing cooler vegetation zones start about 100 m higher than on the north side (Fig. 8.1).

The above shown altitudinal vegetation belts represent the natural distribution of indigenous and endemic plant species according to physical conditions. The coastal xerophilous habitat where climatic conditions are hotter and drier has naturally been dominated by Dragon Trees (*Dracena draco ssp. Draco*) and Wild Olive Trees (*Olea madeirensis*), main shrub species were Fish-stunning Spurge (*Euphorbia piscatoria*), Globe Flower (*Globularia salicina*) and Pride of Madeira (*Echium nervosum*). On herbal level the following species were common: Andryala (*Andryala glandulosa ssp. glandulosa*), Madeira Sea-Stock (Matthiola maderensis), Lotus (*Lotus glaucus*), Viscid Houseleek (*Aeonium glutinosum*), Hawkweed (*Tolpis succulenta*), Narrow-leaved Mustard (*Sinapidendron angustifolium*) and Carline Thistle (*Carlina salicifolia*).

The second bioclimatic altitudinal vegetation belt is a transition woodland, some species of the coastal zone and also a few species of the Laurisilva zone can be found next to a number of species only growing within this habit. In many national Portuguese publications this altitudinal belt is referred to as Laurisilva of the Canary Laurel (*Apollonias barbujana*), since this is the dominant specie within this woodland association (Capelo et al. 2004; Quintal 2005; Neves et al. 1996). Other very common species are: Canary Holly (*Ilex canariensis*), Wax Myrtle (*Myrica faia*),

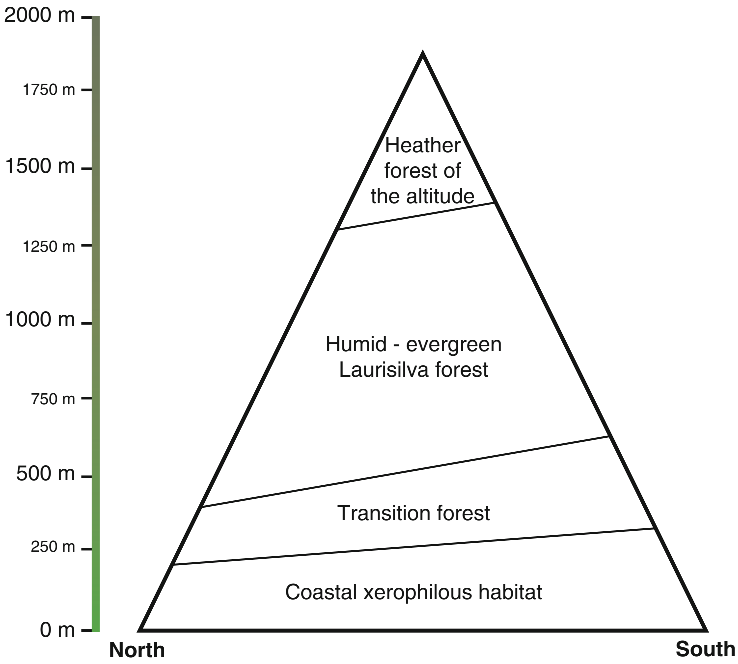

Fig. 8.1 Natural altitudinal belts of vegetation communities on Madeira Island (Adapted from Quintal 2005)

Canary Willow (*Salix canariensis*), Ironwood (*Sideroxylon marmulano*) and Besom Heath (*Erica platycodon ssp. maderinicola*).

The Laurisilva bioclimatic belt is the most diversified one, with a high number of endemic and rare endemic species in tree, shrub and herb layer. Some of the most characteristic tree species are: Madeira Laurel (*Ocotea foetens*), Bay Tree (*Laurus novocanariensis*), Madeira Mahogany (*Persea india*), Lily-of-the-valley-tree (*Clethra arborea*), Picconia (*Picconia excelsa*), Beefwood (*Heberdenia excelsa*) and the Madeira Holly (*Ilex perado ssp. perado*).

In the shrub layer there are a number of indigenous species wide spread. Next to many others the following are very common: Bastard Hares's Ear (*Phyllis nobla*), Madeira Blueberry (V*accinium padifolium*), Besom Heath (*Erica platycodon ssp. maderincola*), Shrubby Sow Thistle (*Sonchus fruticosus*), Shrub Trefoil (*Teline madeirensis*), Wax myrtle (*Myrica faia*), Meliferous Spurge (*Euphorbia mellifera*), Soft broom (*Genista tenera*), Madeira Mountain Stock (*Erysimum bicolor)* and Crysanthemum (*Argyranthemum pinnatifidum ssp. pinnatifidum*).

The Laurisilva has a distinct herb and moss layer, covering a wide range of microclimate conditions from humid valleys to dry conditions on volcanic dikes reaching above the treetops. It is consequently rich in endemism and very divers, some of the most common species are: Festuca (*Festuca donax*), Madeira Moneywort (*Sibthorpia peregrina*), Selaginella (*Selaginella denticulata*), Pteris (*Pteris* *incompleta*), Big Leaved Thistle (*Cirsium latifolium*), Large-Leaved Saint John's Wort (*Hypericum grandifolium*), Anemone-Leaved Storck's bill (*Geranium palmatum*) and many types of mosses. In Madeira there are references for 540 taxa of bryophytes, of which 70 % correspond to mosses and 30 % to liverworts and hornworts (Fontinha et al. 2006).

The highest altitudinal vegetation belt is named heather woodland of the altitude [*Urzal de altitude* (Quintal and Vieira 1985; Quintal 2005)]. It covers the high areas of the island reaching its highest point at 1862 m above sea level at Pico Ruivo. Main species are: Tree heather (*Erica arborea*), Besom Heath (*Erica platycodon ssp. maderinicola*), Madeira Blueberry (*Vaccinium padifolium*), Crysanthemum (*Argyranthemum pinnatifidum ssp.montanum)*, Pride of Madeira (*Echium candicans*), Soft broom (*Genista tenera*), Madeira Mountain Stock (*Erysimum bicolor*), Madeira Heather (*Erica maderensis*) and Thyme (*Thymus micans*).

In present days this native vegetation cover is restricted to areas of extremely difficult access or to the highest peaks where climate conditions do not favor agricultural activity or animal husbandry. The disturbances are highest at low altitude, where people settled first and used the land for living space, for crop and animal farming as well as for infrastructure like paths, roads, irrigation channels and threshing places. The expansion of villages and towns over half a millennium combined with population growth and a limited available area for settlements due to various factors like orography and climate conditions resulted into a nearly total elimination of native plant communities from the Xerophyll-layer. The second altitudinal belt of transition forest has been altered remarkably and shifted by humans to a mix of crop and native plants. Along the south coast most areas within this vegetation zone are terraced crop land, where farmers produce grapes (*Vitis vinifera*), lemon varieties (*Citrus spp*.), all kinds of vegetables and in the upper regions fruit trees like Cherry (*Prunus avium*), Apple (*Malus domestica*), Pear (*Pyrus communis*), Walnut (*Juglans regia*) and Quinces (*Cydonia oblonga*).

The third and most extended altitudinal belt represents the indigenous Laurisilva woodland. On the south side this ecosystem was eradicated and replaced by fast growing alien tree species like Acacias (A. mearnsii, A. longifolia, A. meanoxylon, A. dealbata, A. elata), Pine (P. pinaster) and Eucalyptus (E. globulus). On northern slopes the Laurisilva ecosystem was also modified by human activities, but never eradicated. Certain species furnishing wood of superior quality were preferentially logged. Very popular for domestic construction purposes was Picconia (*Picconia exelsa*), for construction of vine barrels Beefwood (*Heberdenia excelsa*) was popular and Madeira Mahogany (*Persea indica*) was selected to build wooden storage boxes for households (Pereira 1989). Only in very remote and inaccessible areas, often on close to vertical slopes at altitudes between 400 and 1300 m above sea level the Laurisilva ecosystem remained basically in a nearly natural status (Menezes et al. 2004).

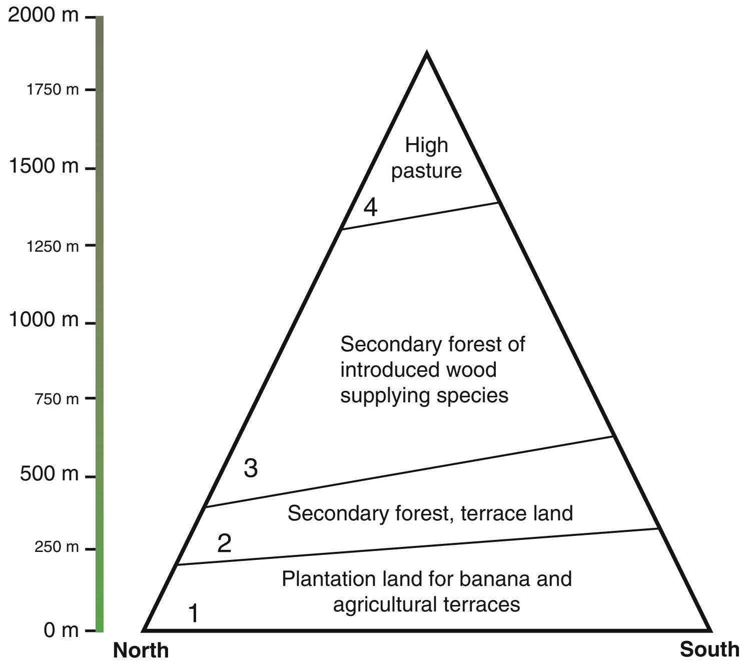

Fig. 8.2 Human land and resource usage in the four main altitudinal vegetation belts on Madeira Island (Adapted from Kegler 1993)

The highest bioclimatic belt consists of the heather woodland, covering most of the north facing slopes of the high mountains and plateaus. Over centuries the heather forests provided wood for domestic use as fire wood and for small constructions like roofs on stables, benches and chairs (Gouveia 2008). During World War I and II pit coal transport to the island was limited and people installed charcoal kilns in the high country areas. Huge amounts of heather forest have fallen victim to this mostly illegal charcoal burning (Pereira 1989). Moreover, the highest parts of the island were used for raising sheep, goats and in more level areas even cows.

On the formerly wooded areas neophytes are found frequently, so that semi-natural plant associations prevail in most parts of the island.

As seen in Fig. 8.2 land use and vegetation patterns change with altitude, at low altitude human impact is highest. Not only has the natural distribution of plant communities been changed by human activities, but the topography, too. At lower altitudes people established large terrace systems, covering most of the slopes near the coast, excluding only the vertical or near vertical sea cliffs. In Table 8.1 common crops for the different altitudinal belts and their microclimatic characteristics are listed.

Table 8.1 List of common crops in the four main altitudinal vegetation belts

1	2	3	4
Banana, mango, custard, apple, avocado, papaia	Acacia, pine, eucalyptus, pittosporum, avocado, grapes, cherry	Sweet chestnut, cherry, apple, pear, walnut, acacia, pine, eucalyptus	Prickly gorse, bracon, soft broom
Terraces with subsistence horticulture crops	Terraces with subsistence horticulture crops		

8.4 Methods

To achieve essential basic information on traditional agriculture and forestry practices two approaches were applied: First an extended literature study in the local archives was conducted to provide knowledge that would be indispensable to correctly interpret vegetation data and secondly personal interviews were held with local farmers. The literature studies included descriptions from early seafarers, historians, botanists, geographers, hydrologists and travel reports from British visitors in the early nineteenth century. Next to these poems, classical Portuguese literature, historic romances and newspaper reports were consulted. It was important to identify the crops used in agriculture to understand, which species were planted. Special focus was put onto fruit and nut trees since they persist over a long time after the abandonment of agriculture (Figueiredo 2008). Especially high growing species like Walnut or Sweet Chestnut resist over a long time in secondary forests. Invasive non-native crop plants that had been introduced into the agricultural economy of Madeira were important to detect remains of formerly used land within areas that are covered with forests today. Furthermore traditional use of plants had to be researched to know, which species were procured for medical purposes. Often this can be a reason for species to be less frequent close to houses and paths then in places of difficult access. Other species have been used to make small ropes to tie loads together that had to be transported off the mountains. Another concern were local preferences for certain tree species, which used to be popular for certain purposes and thus experienced more intensive logging than most other tree species.

The research area is characterized by very steep terrain, in some parts close to vertical mountain faces more or less covered by forest. This terrain seems absolutely inaccessible and certainly is without prior knowledge of old footpaths used by peasants for centuries. To collect information on these formerly used infrastructures and on the environmental history of the research area personal interviews with local farmers and shepherds were held. The aim of theses interviews was to learn more of traditional agriculture and especially of areas where two or three generations ago family members used to work land in the mountains and how they got there. Furthermore information on traditional use of forest resources and access to remote areas was provided.

Some pre-field campaign reconnaissance was conducted. The aerial photos provided by Direção Regional de Informação Geográfica da Madeira at a scale of 1:10000 together with the land use classification map gave a generalized overview on the present plant associations, on the type of land use and on infrastructure. This documentation was the basis for the selection of the vegetation mapping plots, trying to cover all mountain slopes framing the village. This approach has been successfully applied in forest ecosystems (Franklin 1995; Hasmadi 2010). This selection was than combined with the information from the interviews, especially on the accessibility of the terrain. The field reconnaissance was to check the actual condition of described paths and in many cases to open it again with a machete to allow easy passage during the mapping campaign.

The vegetation mapping method had to be adapted to the specific needs of environmental history. The first decision had to be taken on the scale of the map. The research area of Ribeira da Camisa and Ribeiro do Velho has a size of about 15 km^2. Any small-scale map would be too generalized to detect human-landscape interactions on a detailed level. Taking into consideration that plant associations and individual trees have to be shown the map needs a high resolution. Thus a scale of 1:10000 was chosen.

Furthermore the vegetation survey was conducted according to the specific territorial setting of Ribeira da Camisa and Ribeiro do Velho catchment area. The catchment of Ribeira da Camisa is facing mostly northward. Ridges of relatively easy access and slope segments with nearly vertical rock walls are common. Rock walls not only create natural divisions between altitudinal vegetation belts but they offer very specific habitat conditions. To detect natural and anthropogenic variations within the forest vegetation a number of plots have been placed close to territorial boundaries. In total 45 plots were surveyed on altitudes between 97 and 1315 m above sea level.

Species inventory assessments executed in the traditional way of vegetation ecology encompass total listing of all plant species present. To sufficiently understand the interaction of past generations of farmers, loggers and shepherds with the landscape the focus shifts from a listing of all present plant species to an assessment of indicator species, who's long-term development reflects anthropogenic disturbances or absence of anthropogenic activities. The survey plots have to vary in size due to the ecosystem characteristics (Dierssen 1990; Buck and Paysen 1984). Open terrace land area with a low vegetation cover density can be described with smaller plots than a forest ecosystem with larger structures.

The plots investigated in open terrace and shrub land vary between 10×10 m and 25×25 m. The plots were adapted to characteristics of terrain, avoiding vertical or instable places, which lead to rectangular and in some cases circular plots. Under forest canopy the plot size was extended to 50×50 m as proposed by Dierssen (1990) and in the national field guide for forest inventory of Guinea-Bissau (Instituto de Investigação Científica Tropical 2009).

For vegetation survey a huge number of publications has been helpful for the determination of species (Neves et al. 1996; Quintal 2005; Capelo et al. 2004; Fontinha et al. 2006, 2011; Costa et al. 2004; Menezes et al. 2004; Franquinho and Costa 2008; Mendes Ferrão 1999; Jardim and Francisco 2000).

Visualization of survey plots and interference intensity classes have been done with ArcGIS on orthofoto maps with a scale of 1:10.000 provided by Direção Regional de Informação Geografica da Madeira.

8.5 Results

Vegetation survey clearly mirrors varying intensities of past and present human activities. Several areas of distinct use of either land or forest resources have been identified. In general the delimitations of cropping activities reach very high into the mountainous sections of Ribeira da Camisa. Within the valley the arable terrace area is fragmentary, on the less inclined areas atop the ridges are terrace systems extending to nearly vertical terrain. This situation is found along most parts of the slopes near the north coast (Ribeiro 1985), but very refined within the research area. During vegetation survey remnants of former terraces with alien species have been found up to 650 m above sea level, which is surprising due to the fact that these terraces have a northern exposition and thus a very limited amount of sunshine per day. These zones are less productive and not suitable at all for a large number of crops (Quintal and Vieira 1985; Kegler 1993; Leça 2011) requiring higher temperatures and less rainfall. From east to west going clockwise around the village of Lombadas terrace remnants and their respective exotic vegetation were found as high as in the areas of Fio dos Terreirinhos (433 m), Lombo do Falso (608 m), Sítio do Viveiro (548 m), Rabo do Burro (503 m), Caminho dos Lamaceiros (561 m), Lombo das Coches (507 m), Terras José Mendes (410 m), Ladeira (456 m) and Caldeira (553 m). The laborious establishment of agricultural terraces at such marginally productive and remote sites is a silent testimony of the harsh living conditions and the scarcity of cropland that people had to deal with. On the lower terraces surrounding the village of Lombadas cropping still takes place, farmers continue with century old agricultural practices on terraces extending from 100 m above sea level to average of 350 m above sea level. A great number of common crops of tropical and subtropical origin and only a few adapted to colder climates are grown there. During the vegetation survey on cropland surrounding the Pico of Terceira Lombada (170 m) the following cultural plants were identified: Common fig (*Ficus carica*), Avocado (*Persea americana*), Taro (*Colocasia esculenta*), Custard apple (*Annona cherimola*), Strawberry Guava (*Psidium guineense*), Guave (*Psidium guajava*), Sweet potato (*Ipomoea batata*), Sugar cane (*Saccarum officinarum*), Peach (*Prunus persica*), Lemon (*citrus ssp.*), Pepinella (*Sechium edule*), Plum (*Prunus domestica*), Maize (*Zea mais*), Potatoes (*Batata ssp.*), Pumpkin (*Cucurbita ssp.*), Turnip

(*Brassica rapa*), Loquat Tree (*Eriobotrya japonica*), Carrot (*Daucus carota*), Banana (*musa ssp.*), Papaia (*Carica papaia*) and Beans (*Phaseolus spec.*).

At higher altitudes the amount of tropical and subtropical crops diminishes suddenly, already at Chapada – Terceira Lombada at an altitude of 350 m above sea level crops such as Banana (*Musa spec.*), Custard apple (*Annona cherimola*), Peach (*Prunus persica*), Papaia (*Carica papaia*), Guava (*Psidium guajava*) and Lemon (*Citrus spec.*) are not successfully cultivated. They are substituted by plant species with lower thermal comfort zones, like Grapes (*Vitis vinifera*), Apples (*Malus spec.*), Willow (*Salix viminalis*), Walnut (*Juglans regia*) and Sweet chestnut (*Castanea sativa*). Amongst field crops most often Potatoes (*Batata spec.*), Sweet potatoes (*Ipomoea batata*), Beans (*Phaseolus spec.*), Maize (*Zea mais*), Carrots (*Daucus carota*) and Pumpkin (*Cucurbita spec.*) are present.

In the higher altitudes around 500 m above sea level at places like Sítio do Viveiro, Poço Fetiçeiro or Nougeira only a few crop plants remain within the secondary forest. Small species are not competitive when the canopy of the succession forest closes more and more. So they are most probably underrepresented regarding their former extension and quantitative appearance. Species indicating former land use even within a recent succession forest are Loquate Tree (*Eriobotrya japonica*), Apple (Malus spec.), Peach (*Prunus persica*), Bastard passion fruit (*Passiflora x exoniensis*), Sweet chestnut (*Castanea sativa*) and Walnut (*Juglans regia*). Due to their size they can compete successfully in a growing secondary forest and preserve the information on human – landscape interactions for decades, maybe even centuries.

Above these high terraces the information on former land use is less obvious, only a few indicator plant species for human activities and a diverse forest survived. In many places steel cables for cargo transport were mounted and people obviously used forest resources for living. Around many of these "Sítios do fio" a fiber rich plant, known as New Zealand Flax (*Phormium tenax*), is found. According to the local population this neophyte was introduced for its strong, fibrous and long leaves. Planted next to beginnings of cargo cables the flax provided natural rope material for all kinds of cargo that had to be sent down into the valley.

The existence of these cargo cables underlines the dependency of the rural population on forest resources. It was a very challenging and time consuming building project to mount a single cable like the one shown on Fig. 8.3 in a forest ecosystem. A ridge top had to be cleared from vegetation and a thin light cord with a stone at its beginning had to be thrown from this place towards the place where the cable should go to. According to local farmers this task alone was complex since many times it did not work out the way people had hoped for and the line had to be removed from the forest canopy several times before it finally got to the predefined place. Often the thin cord had to be cut, when it was not possible to remove it from the trees and not seldom it took several days to get the line in place and start tying steel cable pieces, one by one onto the line and slowly sending them down to the valley until the entire length of the line was replaced by a steel cable. This tremendous work was only

Fig. 8.3 Cargo steel cable and New Zealand Flax planted below it

justified when the "fio" was used frequently for heavy or voluminous cargo transport. In the high altitudes vegetation mapping revealed areas full of rare, mostly endemic plants in some spots in an unexpected abundance and the absence of species that should be present within the natural Laurisilva (Neves et al. 1996; Vieira 2002; Menezes et al. 2004).

An example of a typical but lately not very frequent species is Picconia (*Picconia excelsa*). Over centuries the wood of this tree with high resistance to abrasive forces has been used for vine presses (Pereira 1989) and other equipment that required strong and lasting wood. Apart of some well-protected spots, where access is nearly impossible and even fewer spots, where the growth itself did not permit copping, adult trees are hardly found in the forest around the Lombadas. Comparing the presence and frequency of species with vegetation surveys carried out by Neves (1996) in areas of little human disturbance within the Nature Park of Madeira (Parque Natural da Madeira), for example in the strongest protection zone Reserva Natural Integral in Caldeirão do Inferno, it becomes obvious that species like Madeira Beefwood (*Heberdenia excelsa*) and Madeira Mahogany (*Persea indica*) would be present in the zone of the Lombadas without human impact. Physical growing conditions for these trees are excellent, but only a small number of plants are present in the area. Small trees of Madeira Beefwood are relatively common, adult trees rare. This is an additional indication to former use of forest resources and the selectiveness, which was applied in the logging process (Fig. 8.4).

In the highest vegetation zone, the heather forest of the altitude, local toponymy already indicates former land use. Place names like Chão do Milho (the flatish place

Fig. 8.4 Picconia growing on a rock fissure

of maize), Topo das Vacas (top of cows) or Topo das Queimadas (top of forest fires) remind people of former activities that took place in the high sierras. According to some interview partners the ridgelines to the west and to the north of Lombadas village have been used for raising livestock. Furthermore Besom and Tree Heather were valuable firewood for domestic purposes, since they have a high energy density and thus burn down slowly giving heat for a prolonged period of time. It has been reported in various sources (scientific and contemporary romantic literature) that most of the high mountain zones of the island have been exploited for their wood resources (Silva n.d.; Gouveia 2008; Branco 1989). This can be proven by vegetation survey results listed in Tables 8.2, 8.3, and 8.4. Young trees dominate existing heather forests. Some areas are results of very recent natural succession processes.

For a comparable and easily understandable overview of species composition in the research area three tables for different altitudinal belts are presented. The first table shows five representative survey plots from 98 m up to 450 m above sea level. This belt suffered strong alterations during the past 500 years, which is clearly visible in the vegetation composition. Many open land species are present and in no other altitudinal belt higher rates of neophytes in the vegetation composition were registered. Next to a variety of crop plant species there are several species of ornamental value present. Furthermore the amount of endemic plants is found to be very low, with less than 20 % in all survey plots.

The surveyed plots in the altitudinal belt of the Laurisilva between 550 and 650 m above sea level contain a few introduced tree species like Walnut (*Juglans regia*), Loquat Tree (*Eriobotrya japonica*), Cryptomeria (*Cryptomeria japonica*),

Table 8.2 Vegetation list from plots at altitudes from 50 to 550 m above sea level

Sites at altitudes beween 50-550m above sea level					
Caminho do Lombo	317 m				
Terceira Lombada [Chapada]	342 m				
Caminho do Cabouco Cascat	97 m				
Caminho do Bardo	430 m				
Cam.d B. / Ribeira da Camisa	452 m				
Plant specie / Place	1	2	3	4	5
Adiantum capillus veneris	O	O	O	X	O
Ageratina adenophora	N	O	O	O	X
Agrimonia eupathoria	X	O	O	O	O
Amarillis belladonna	O	O	N	O	N
Annona cherimola	O	O	N	O	O
Arundo donax	N	N	N	O	N
Asparagus umbellatus	O	M	O	O	O
Athyrium filix-femina	X	O	O	O	O
Atricum tenellum	O	O	O	X	O
Barbula unguiculata	X	O	X	O	O
Bidens pilosa	O	O	O	O	X
Brachipodium hirsutum cf.	O	X	O	O	O
Brachipodium spec.	X	O	O	X	O
Brachitetium rutabulum	O	O	X	X	O
Briza maxima	X	O	O	O	O
Bryum capilare	O	O	O	X	O
Calla aethiopica	O	O	O	O	N
Castanea sativa	N	N	O	N	O
Ceratodon pupuraeus	O	O	O	X	O
Clethra arborea	M/C	O	O	M/C	M/C
Conocephalum conicum	X	O	O	O	O
Convolvolus cf. massonii	M/C	O	O	O	O
Conyza canadensis	O	N	O	O	N
Cucurbita spec.	O	O	O	X	O
Cyperus spec.	N	O	O	O	N
Dicranum scoparium	O	O	O	X	O
Digitalis purpurea	O	O	O	O	X
Digitaria ischaemum	O	O	O	O	X
Digitaria sanguinalis	X	X	O	O	O
Dryopteris austriaca	O	N	O	O	O
Duchesnea indica	N	N	O	N	N
Erica scoparia	M/C	O	O	M/C	O
Erigeron karvinskianus	N	N	N	N	O
Eriobotrya japonica	O	N	O	O	O
Erysimum bicolor	O	M/C	O	O	M/C
Eucalyptus globulus	O	O	O	N	O
Euphorbia mellifera	O	O	O	M/C	M/C
Eurynchium praelongum	O	X	O	X	O
Ficus carica	N	N	N	O	O
Fissidens luisierii	M	O	M	M	O
Fragaria vesca	X	O	O	O	O
Fuchsia boliviana	N	O	O	O	O
Geranium madeirense	O	O	O	O	M
Geranium robertianum	O	O	O	X	X
Globularia salicina	M/C	O	M/C	O	O
Hedichium gardneranium	N	O	O	N	O
Holcus lanatus	O	O	O	O	X
Hydrocotilae spec. Cf.vulgan	O	O	O	X	O
Hypericum grandifolium	M/C	M/C	O	M/C	O
Hypericum perforatum	X	O	O	O	O
Hypnum cupressiforme	O	O	X	X	X
Laurus novocanariensis	M/C	O	M/C	M/C	O
Lobaria pulmonaria	O	O	O	X	X
Madoteca laevigata	X	O	X	X	O
Malus spec.	N	O	O	O	N
Mercurialis annua	X	O	O	O	O
Montbretia crocosmiiliflora	N	O	O	X	X
Myrica faia	M/C/P	M/C/P	M/C/P	M/C/P	M/C/P
Ocotea foetens	O	M/C	O	O	M/C
Oxalis pes-caprae	N	O	O	O	O
Oxalis purpurea	N	O	O	O	O
Passiflora x exoniensis	N	O	O	O	O
Peltigera canina	O	O	O	O	X
Persea americana	N	O	N	O	O
Persea indica	O	O	O	M/C	M/C
Philonotis fontana	O	O	O	X	O
Phyllis nobla	M/C	M/C	O	O	M/C
Pinus pinaster	O	N	O	N	N
Pittosporum undulatum	N	O	N	O	O
Plagiochila spec.	O	O	O	X	O
Plantago coronopus	N	O	O	O	O
Plantago major	X	O	O	O	X
Polygonum capitatum	X	O	O	O	O
Polygonum mite	X	O	O	O	O
Polygonum persicaria	O	O	O	X	O
Polytrichum serratum	O	O	X	X	O
Prunella vulgaris	X	O	O	O	X
Prunus	O	O	O	N	N
Pseudoscleropodium purum	X	O	O	O	O
Pseudoscleropodium purum	O	X	O	O	O
Psidium guineense	N	N	N	O	N
Pteridium aquilinum	X	X	X	O	O
Ranunculus repens	X	O	O	N	O
Rubia peregrina agostinhoi	O	M	M/C	O	M/C
Rubus spec.	O	O	N	N	N
Salix canariensis	O	O	O	M/C	M/C
Salix cf. viminalis	N	O	O	O	O
Salvia spec.	X	O	O	O	O
Sellaginella spec.	X	O	X	X	X
Semele androgyna	O	M/C	O	O	O
Setaria spec.	X	O	O	O	O
Sibthorpia peregrina	M	M	O	M	M
Solanum mauritianum	O	O	O	O	N
Stellaria media	X	O	O	O	O
Syzygium jambos	N	O	O	N	O
Teline madeirensis	O	M	O	O	O
Tortula muralis	N	O	O	O	O
Urtica spec.	O	O	O	X	O
Vaccinium padifolium	O	O	O	M	O
Vitis vinifera	O	N	N	O	O
Woodwardia radicans	O	O	O	M/C	O
Zymbalaria moralis	X	O	O	O	O
Number of neophytes	21	11	10	10	12
Numer of endemic species	10	10	5	12	11
Total number of recorded sp	54	26	22	33	36
% of neophytes	38,9	42,3	45,5	30,3	33,3
% of endemic species	18,5	38,5	22,7	36,4	36,4

Legend	
Neophyt	N
Species endemic to Madeira	M
Species endemic to Madeira and Canaries	M/C
Species endemic to Madeira, Canaries and Portugal	M/C/P
Species of unknown origin	X
Non present in this plot	O

Sweet chestnut (*Castanea sativa*), Apple (*Malus spec.*) and Pine (*Pinus pinaster*). The relatively high altitude, where these species were planted, proves how strong past generations of humans depended on the scarce land they managed to cultivate. Just to reach the land by foot signified a climb of around 300 m in height from the living area and took a long time to pass on the small and steep footpath linking the houses to the mountain areas. For the children this was particularly difficult since they had to bring lunch for the men working on the fields.

The highest vegetation survey area includes plots at altitudes between 650 and 1350 m above sea level. Species well adapted to open land conditions are frequently registered on the ridge tops and in huge areas the absence of high growing tree species still proves the disturbance and possibly even the eradication of forest with creation of patches of open land.

Table 8.3 Vegetation list from plots at altitudes from 550 to 650 m above sea level

Sites at altitudes beween 550-650m above sea level	
Sitio do Viveiro	548
Cascata do Viveiro	542
Poço Fetiçeiro	482
Caminho dos Lamaçeiros	695
Nogueira	508

Plant specie / P	1	2	3	4	5
Pseudoscleropodium purum	O	O	X	O	O
Ageratina adenophora	N	O	O	O	O
Aicrysum divaricatum	O	O	O	O	X
Asplenium adiantum nigrum	O	O	X	X	O
Asplenium cf. onopteris	O	O	X	O	O
Athyrium filix femina	X	X	O	O	O
Atrichum undulatum	O	O	X	O	O
Blechnum spicant	O	O	X	O	O
Carex cf. avenalla	O	O	O	X	O
Castanea sativa	O	O	N	O	O
Cedronella canariensis	M/C	O	O	O	O
Clethra arborea	M/C	M/C	M/C	M/C	M/C
Conocephalum conicum	O	X	O	O	X
Cryptomeria japonica	N	O	O	O	O
Dryopteris austriaca	O	O	O	X	O
Dryopteris filix-mas	O	O	N	O	O
Erica scoparia ssp. Platycodon	O	M/C	O	O	O
Erigeron karvinskianus	N	O	O	O	N
Eriobotrya japonica	N	O	N	O	O
Erysimum bicolor	O	O	O	M/C	O
Eucalyptus globulus	O	O	X	O	O
Euphorbia mellifera	O	O	O	O	M/C
Eurynchium praelongum	O	O	X	O	O
Festuca donax	M	M	O	M	O
Fissidens luisierii	O	M	M	M	O
Gennaria diphylla	O	O	M	O	O
Geranium madeirense	O	O	O	O	M
Geranium palmatum	O	O	O	O	M
Geranium robertianum	X	O	O	O	O
Heberdenia excelsa	O	O	M/C	O	M/C
Hydrangea macrophylla	N	O	O	O	O
Hymenophyllum peltatum	O	X	O	X	O
Hypericum grandifolium	M/C	O	O	O	O
Hypnum cumpressiformae	O	O	X	X	O
Ilex perado	O	M	O	O	O
Juglans regia	O	O	O	O	N
Laurus novocanariensis	M/C	M/C	M/C	M/C	M/C
Lejeunea carvifolia	O	O	X	X	O
Leucobryum glaucum	O	O	O	X	O
Lobaria cf. Pulmonaria	O	O	O	O	X
Madoteca laevigata	X	X	X	X	X
Madoteca laevigata	X	X	X	X	X
Malus domestica	N	O	O	O	N
Montbretia crocosmiiliflora	O	O	N	O	O
Muschia wollastonii	O	O	O	O	M
Myrica faia	O	M/C	M/C	O	O
Ocotea foetens	O	M/C	O	M/C	M/C
Passiflora x exoniensis	N	O	O	O	O
Persea indica	M/C	M/C	O	O	M/C
Phormium tenax	N	O	O	O	O
Phyllis nobla	O	O	O	M/C	O
Pinus pinaster	N	O	N	O	O
Plagiomnium undulatum var. M	O	M	O	O	M
Polypodium macaronesicum	M/C	O	O	O	O
Polypodium serratum	O	O	X	O	O
Pteridium aquilinum	X	O	O	O	O
Quercus ilex	O	O	O	O	N
Rubia peregrina ssp. agostinhoi	M	O	M	M	O
Rubus grandifolius	M	O	O	O	M
Rubus spec.	N	O	N	N	O
Ruscus streptophyllus	O	M	O	M	M
Salix canariensis	M/C	M/C	O	O	M/C
Sambucus lanceolata	O	O	O	O	M
Selaginella spec.	X	X	X	X	X
Semele androgya	O	M/C	M/C	O	O
Sibthorphia peregrina	M/C	M/C	M/C	M/C	M/C
Teline madeirensis	O	O	O	O	M
Thamnobryum allopecurum var	O	M	O	O	M
Usnea cf. Articulata	O	M/C	O	M/C	O
Vaccinium padifolium	O	M	M	M	O
Viola cf. Hirta	O	O	X	O	O
Woodwardia radicans	O	M/C	M/C	O	M/C
Number of neophytes	10	0	6	1	4
Numer of endemic species	11	18	11	12	18
Total n° of recorded species	26	23	30	22	27
% of neophytes	38,5	0	20	4,55	14,8
% of endemic species	42,3	78,3	36,7	54,5	66,7

Based on the vegetation lists, inclination of terrain and in-field verification of interpretation of the orthofoto maps three classes of intensity of human activities in the landscape could be defined. The first class includes urban areas, terrace land under cultivation, abandoned terrace land and planted stands of Pine and Eucalyptus. All parts of the landscape that have been totally transformed by human actions are included in this class. The second class includes areas of former logging, collecting of animal fodder, high mountain pasture and places where remains of cargo cables were recorded. The third class includes all areas with very little or no traces of human intervention (Fig. 8.5).

It is remarkable how most of the mountain area has been used as a natural resource securing human survival. Only very few areas are not part of the used landscape, mostly due to terrain conditions, that did not permit any logging or transport activities. The more accessible zones above these areas were reached by detours and have been exploited for wood resources as well.

Table 8.4 Vegetation list from plots at altitudes from 650 to 1350 m above sea level

Sites at altitudes beween 650-1350m above sea level					
Fio Lombo da Carapuça	717				
Rib. dps da Laje Negra	890				
Fonte Vermelha	785				
Trilho Rabo do Burro - Poço das	652				
Urze Escanchada	1015				
Pl / Plant specie	1	2	3	4	5
Adiantum reniforme	O	O	O	X	O
Ageratina adenophora	N	O	O	O	O
Aicrysum divaricatum	O	M/C	O	M/C	O
Argyranthemum pinnatifidum	O	O	O	O	M/C
Athyrium filix femina	O	X	O	O	O
Atrichum undulatum	O	O	X	O	O
Blechnum spicans	O	O	X	O	X
Cedronella canariensis	O	M/C	M/C	O	O
Clethra arborea	M/C	M/C	M/C	M/C	M/C
Conocephalum conicum	O	X	X	O	O
Culcita macrocarpa	O	O	O	X	O
Diplazium caudatum	O	M/C	O	M/C	O
Erica arborea	O	O	O	O	X
Erica scoparia ssp. Platycodon	M/C	O	M/C	M/C	M/C
Erigeron karvinskianus	N	O	O	O	N
Erysimum bicolor	M/C	O	O	M/C	O
Euphorbia mellifera	O	M/C	O	M/C	O
Eurynchium praelongum	O	X	X	O	X
Festuca donax	M	M	M	M	M
Fissidens spec.	O	X	X	X	O
Geranium palmatum	O	M	O	O	M
Heberdenia excelsa	O	M/C	O	M/C	O
Hymenophyllum peltatum	O	X	O	O	O
Hypericum grandifolium	O	O	M/C	O	O
Hypnum cumpressiformae	O	X	O	X	O
Ilex perado	O	M	O	O	O
Isoplexis sceptrum	O	M	O	M	O
Laurus novocanariensis	M/C	M/C	M/C	M/C	O
Lobaria cf. Pulmonaria	O	X	O	X	O
Lunularia cruciata	O	X	O	O	O
Madoteca laevigata	X	O	O	O	X
Melanoselium decipiens	O	O	O	M/C	O
Myrica faia	M/C	O	M/C	O	M/C
Ocotea foetens	M/C	M/C	O	M/C	O
Persea indica	O	M/C	O	M/C	O
Phormium tenax	N	O	O	O	O
Phyllis nobla	M/C	M/C	M/C	M/C	M/C
Picconia excelsa	O	O	O	M/C	O
Plagiomnium undulatum var. M	O	M	O	M	O
Polypodium macaronesicum	O	O	M/C	O	O
Polytricum commune	O	O	X	O	X
Pseudoscleropodium purum	X	X	O	O	O
Pteridium aquilinum	X	O	X	O	X
Ranunculus grandifolius	O	M/C	O	O	O
Rubia peregrina subsp. agostinl	M	M	M	M	O
Rubus grandifolius	O	O	O	M	M
Rubus spec.	N	O	O	N	N
Ruscus streptophyllus	O	M	M	M	O
Selaginella spec.	O	X	O	X	O
Sibthorphia peregrina	M/C	M/C	M/C	M/C	M/C
Tamus edulis	O	O	O	M/C	O
Teline madeirensis	M/C	O	O	O	O
Thamnobryum allopecurum var	O	M	O	M	O
Usnea cf. Articulata	M/C	M/C	M/C	M/C	M/C
Vaccinium padifolium	M	M	M	O	M/C
Woodwardia radicans	O	M/C	O	M/C	O
Elaphoglossum semicylindricur	O	O	O	M/C	O
Number of neophytes	4	0	0	1	2
Numer of endemic species	13	23	14	25	11
Total number of recorded speci	20	33	21	32	19
% of neophytes	20	0	0	3,13	10,5
% of endemic species	65	69,7	66,7	78,1	57,9

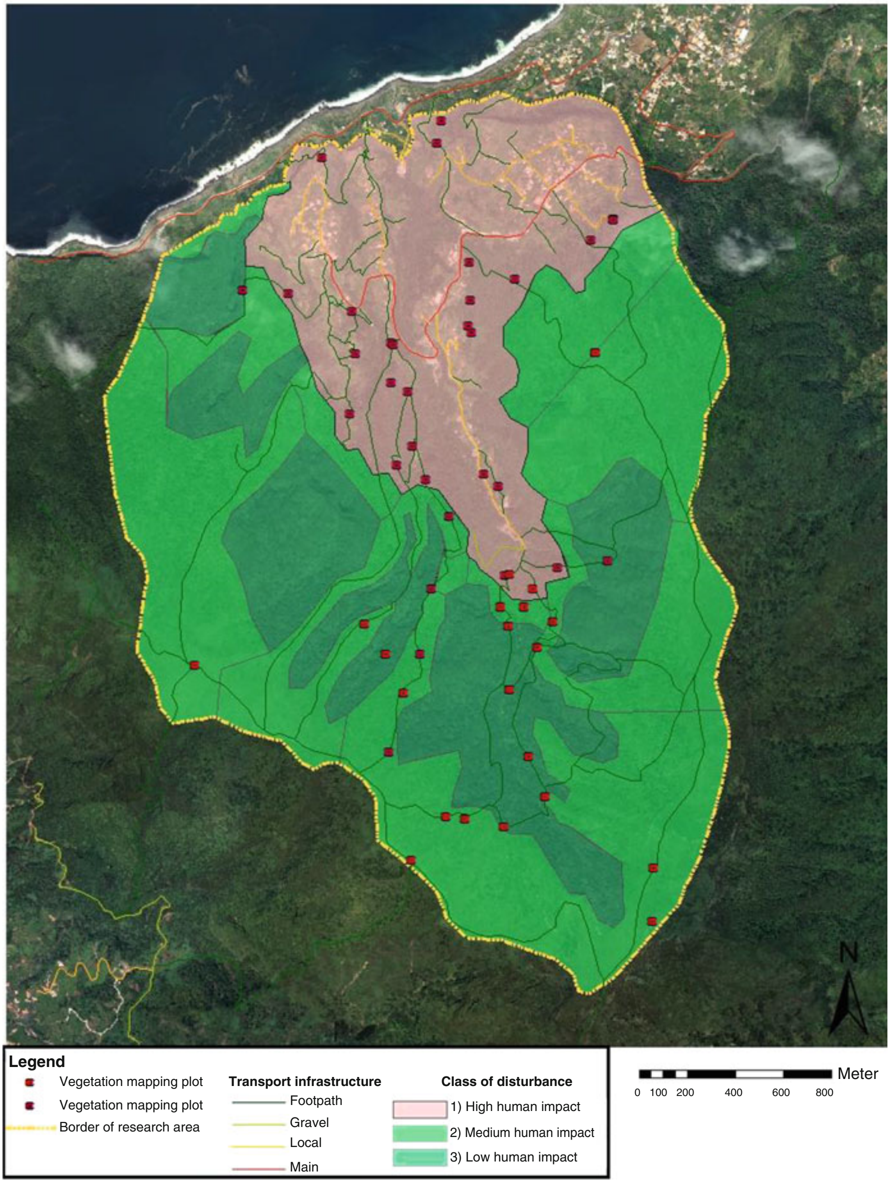

Fig. 8.5 Intensity of human impact in the vegetation

8.6 Conclusions and Discussion

In the frame of this study, where the focus is to understand the dynamics of interaction between humans and landscape over time, the combination of the study of written sources and personal interviews with methods from ecology and geobotany offered a new perspective. Until it's discovery in 1419 the vegetation on Madeira Island was not affected by human activities and only in 1469 when Manuel Afonso da Sanha received the land of Ponta Delgada for colonization the transformation process of natural woodland in the research area began. This process was gradual, starting with the beginning of settlement on the relatively flat headland of Ponta Delgada, slowly extending into the mountains. New agricultural crops were introduced over the following centuries and accidentally weeds came along with them. Other species were introduced on purpose like fruit trees, flowers for ornamental use and wood species like Pine (*Pinus pinaster*), Cryptomeria (*Cryptomeria japonica*) or Blue Gum Tree (*Eucalyptus globulus*). Many of them only arrived on the island in the early twentieth century, but are nowadays well established in habitats that were formerly covered by Laurisilva woodland. The native vegetation was progressively altered by selective use of woodland resources and extension of agricultural land. Since the late fifteenth century this process was intensified by population growth. Only in the late nineteenth and early twentieth century it was slowed down by massive emigration, which resulted in abandonment of agricultural land and establishment of secondary woodland, which represents huge areas of the zone classified as "high human impact". The decrease in land use continues in present days causing farther extension of secondary woodland.

The market situation of agricultural crops has strongly influenced land use and land use practices. In the decades following the foundation of the village the main cash crop was sugar, offering substantial gains for its producers and thus causing a quick extension of terraced land for crop cultivation. With diminishing prices for sugar in the mid sixteenth century the economy was primarily oriented towards production of subsistence crops and to small extends towards grape production, which is visible in many vegetation mapping plots at low altitude: on some recently abandoned terraces wild growing grapes (*Vitis vinifera*) were found. Presently low market prices for agricultural crops foster further abandonment of terrace agriculture.

Traditional methods do not allow determination of the exact spatial extension and location of past human activities in the landscape. Written sources might mention the type of activity performed or the area, but will rarely be precise enough to give a spatially correct geographical picture. Any anthropogenic change in the landscape inevitably caused disturbances in the vegetation; detailed survey permits an understanding of past processes at a high spatial resolution and is independent from the uncertain quality of written records. Ideally it can be supported by interviews to capture local knowledge and chose the survey plots in a way that identifies borders with a smaller number of survey plots. For future research and questions on the spatial relations of former settlements and their agricultural resources this method can help answer key questions: after establishing the map with GIS any question on distance between places, travel time to reach sites, possible advantages of certain locations considering their exposition, altitude and wind shelter can be correctly addressed. The biggest disadvantage of this method is the time efficiency, to deliver detailed geographical information a huge number of plots have to be surveyed and statistically evaluated.

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Part III
Clarifying Results – Interchange of Psico-Social with Natural and Analytical

Chapter 9
Fire on the Hills: An Environmental History of Fires and Fire Policy in Mediterranean-Type Ecosystems

Mário Gonzalez Pereira, Jack P. Hayes, Char Miller, and Daniel E. Orenstein

Abstract Human impacts on natural landscapes through urbanization and agricultural expansion have left a deep and enduring imprint on almost every dimension of the natural world. Throughout history, fire has almost always been associated with this human expansion, from field clearance and the burning of fossil fuel biomass to human-induced conflagrations. “The arrival of a fire-wielding species,” observes Stephen J. Pyne, “was a monumental moment in the natural history of Earth” (Pyne 2010, xvii). These fires, whether anthropogenically sparked or lightning-ignited, have not only shaped where and how humans have settled, but how ecosystems themselves function in fundamental ways. This chapter examines the role of fire in the socio-ecological history of Mediterranean-type ecosystems, with an emphasis on the dynamic interaction between fire and climate, and the efforts of humans to live with and control fire regimes.

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9.1 Introduction

Case studies from the northern Mediterranean basin, China's Shangdong Province, Southern California, and Israel, will be used in this chapter to explore some of the varied historical attempts to master, marginalize, and manipulate fires in Mediterranean and Mediterranean-like ecotones. The chapter begins by exploring the historical-environmental context of fires in the northern Mediterranean basin, including an overview of the spatial distribution and temporal evolution of recent fire history and of the region's fire regimes and fire-weather patterns. Then the focus shifts to the first of three case studies, with an analysis of the fire history in the Chinese Province of Shangdong. In particular, it probes the relationship between climate, historical agricultural and silvicultural management schemes, and recent urban development patterns to characterize the frequency, causes, costs and administrative perceptions related to destructive fires in China's recent environmental history. These issues also form the basis of this chapter's examination of the complicated evolution of recent firefighting policy in Southern California's Mediterranean ecotone; as the 2009 Station Fire demonstrates, the politics of fire in Los Angeles are as controversial and contested as anywhere in the western United States. They are explosive in Israel, too. The charred aftermath of the 1989 and 2010 Carmel fires revealed the complex character of that country's fire science and its policy regimes, as well as some of the flawed responses they subsequently generated.

By setting this cross-cultural analysis of recent fire histories in Mediterranean-like ecotones into the wider context of climate change, shifting land-use patterns, and rapid population growth, this chapter makes the case for a multi-disciplinary approach to the study of fire globally. Doing so will deepen our understanding of the history, science, and policy of firefighting such that we might forge more effective strategies for living sustainably in the fire-prone and dynamic landscapes of Mediterranean ecotones.

9.2 The Recent Fire Environmental History in the Mediterranean

The Mediterranean countries are the most affected by forest fires in Europe (Pereira et al. 2014). In fact, according to the Burned Areas Perimeters (BAP) dataset of the European Forest Fire Information System (EFFIS), Portugal, Spain, France, Italy and Greece accounts for 78 % of total burnt area (hereafter, BA) and 84 % of total number of fires (hereafter, NF) registered in Europe in the 2000–2013 period (Table 9.1). Furthermore, the spatial distribution of fire incidence (number of fires and burnt area) is not uniform between these countries or within each country (Pereira et al. 2011).

The analysis of the EFFIS's European Fire Database (EFD) reveal that, in absolute terms, the most affected countries in the 1980–2013 period are: (i) Portugal

Table 9.1 Fire incidence in European countries. Total and relative number of fires and burned area for the countries contemplated in the European Forest Fire Information System (EFFIS) fire database for the 2000–2013 period

	Burnt area		Number of fires	
Country	ha	%	#	%
Portugal	1,564,400	32	5211	37
Spain	1,052,295	21	3334	24
Greece	593,396	12	653	5
Italy	530,969	11	2382	17
Albania	273,128	6	687	5
Bosnia	181,772	4	286	2
France	118,208	2	377	3
Other	605,197	12	1230	9
Total	4,919,365	100	14,160	100

Adapted from Pereira et al. (2014)

(37 %) and Spain (31 %) in respects to the burnt area; and (ii) Spain (37 %), Italy and Portugal (24 %) in terms of the number of fires. In relative terms, taking into account the size of the countries to overcome the extensive character of these measures of fire incidence, Portugal has seven times more NF and three times more BA than the second most affected country (Italy). Using MODIS dataset to extend the analysis to the southern border of the Mediterranean discloses the high magnitude of the fire activity in North Africa, particularly in Algeria. Recognizing the high fire activity in this region, the EFFIS include, since 2011, fire information from the Middle East and North Africa (MENA) countries in its annual reports (Schmuck et al. 2014).

Land use and population statistics (FAOSTAT 2013) may explain the differences in the fire activity statistics in the Mediterranean countries. In 2001, Portugal, Spain and Greece had the highest percentage of forest cover (37–34 %) and, consequently, the lowest percentage of total area of arable land and permanent crops (17–26 %). The remaining two Southern European countries presents precisely the opposite proportion. In addition, the percentage of rural population is very similar in Portugal, Greece and the MENA countries but much higher than in the other Mediterranean European countries.

Fire activity, however, is not conditioned by national borders. In fact, the most affected regions in Europe are: (i) the NW region of the Iberian Peninsula (IP); (ii) the southern regions of France and Italy, (iii) the islands of Corsica, Sardinia and Sicily; (iv) the Greek regions of Peloponnese (Pereira et al. 2014); and (v) the coast of Algeria. At the global scale, there is a very high correlation between spatial patterns of the pyrogeography and the Köppen climate classification (cp. Krawchuk et al. 2009; Peel et al. 2007). The same similarity is noticeable at a smaller scale in the Mediterranean regions with large NF or BA and hot (Csa) or warm (Csb) summer Mediterranean (temperate) types of climate (Fig. 9.1).

This similarity between the spatial patterns of fire incidence and climate classification can be easily interpreted. The climate determines the existence, type and life

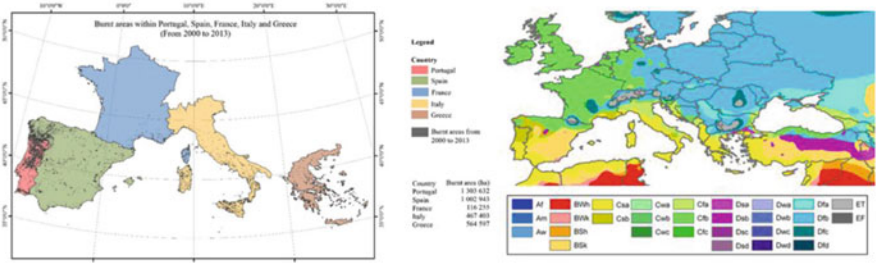

Fig. 9.1 (**a**) Perimeters of burned areas in Southern Europe (Pereira et al. 2014); (**b**) updated world map of the Köppen-Geiger climate classification (Peel et al. 2007)

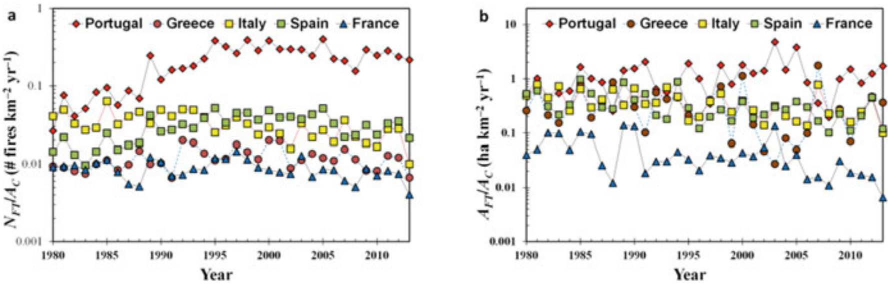

Fig. 9.2 Rural (wildland) fires in Portugal, Spain, France, Italy and Greece, 1980–2013. For each country, the temporal evolution of (**a**) fire occurrences density (number of fires per year NF (#) normalized by country area A_C (km^2)); (**b**) percentage of country land area burnt by rural fires (burnt area BA (ha) per year normalized by country area (km^2)) is given

cycle of the vegetation, whereas the weather conditions determine the state of the vegetation and play a fundamental role in all stages of fire, ignition, behavior and extinction (Benson et al. 2009; Pereira et al. 2013). The temperate climate of the Mediterranean is characterized by mild and rainy winters, favoring the vegetation existence, type and growth, followed by warm and dry summers leading to high vegetation thermal and hydric stress.

Climate and weather conditions also help to explain the temporal distribution of the fire activity. In the Mediterranean, the fire incidence/activity measures present large intra-annual variability with much higher values during the summer season, mainly in the months of July and August (Pereira et al. 2011; Schmuck et al. 2013). However, in some regions a second peak of fire activity is also observed in spring (March). For example, BA in the NW region of IP present a large peak in August and a much smaller one in March while in the N region there are two peaks, one in spring (March) and another in late summer (September), and they are of similar (although small) magnitude (Trigo et al. 2013).

There is also a large inter-annual variability in NF and BA in the Mediterranean countries (Fig. 9.2). This variability is related to the climate variability and to weather conditions that at different spatial and temporal scales may increase the

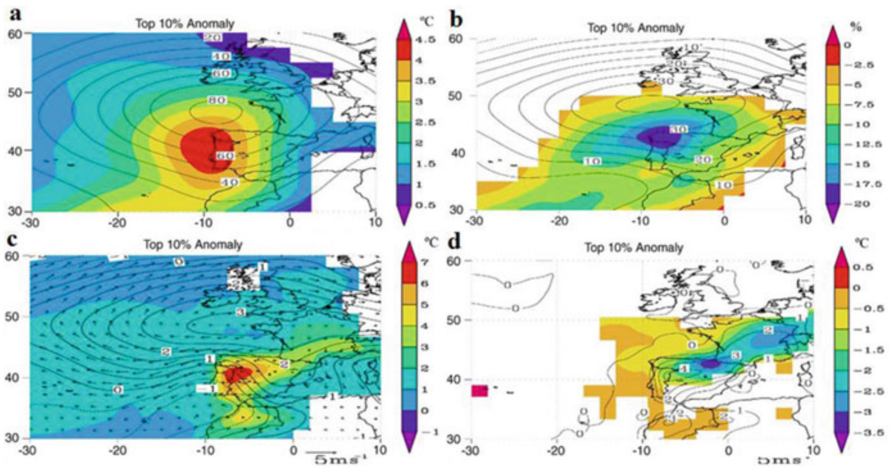

Fig. 9.3 (**a**) Air temperature at 850 hPa and geopotential height (gpm) at 500 hPa; (**b**) relative humidity (%) at 850 hPa and geopotential height (gpm) at 850 hPa; (**c**) maximum air temperature at 2 m height and sea level pressure (mb) and 10 m wind field; (**d**) precipitation rate (mm/day) and temperature range (T_{max}–T_{min}) at 2 m height anomalies for the 10 % summer days of high burnt area (Adapted from Pereira et al. (2005))

fuel's flammability and, therefore the fire danger and risk (Pausas and Paula 2012; Sousa et al. 2015). For example, the occurrence of drought before the fire season (between the end of winter and the beginning of summer) – climate anomaly – and extreme weather conditions (e.g. heat waves) – weather anomaly – have been identified as being associated with large fire activity within the Mediterranean region (Pereira et al. 2005; Trigo et al. 2006; Amraoui et al. 2013; Sousa et al. 2015).

To better understand the relationship between fire, weather and climate some authors studied the meteorological conditions during days of extreme fire activity (burnt area) using, among other techniques, the composite analysis (Pereira et al. 2005; Trigo et al. 2006; Amraoui et al. 2013). Composite analysis consists of computing two arithmetic averages, one using the entire sample or data period (reference, long term or climatological mean) and the other for a subsample (composite), and the anomaly defined as the difference between composite and the reference mean. Thus, positive (negative) anomalies are associated with values above (below) the average. Typically the anomaly is only plotted where it is statistical significant. This approach is motivated and justified by another important feature of the Mediterranean fire regime; like in many other biomes, a small number of large fires is responsible for the major proportion of total burned area (Strauss et al. 1989; Pereira et al. 2011). Pereira et al. (2005) identified and characterized the synoptic patterns associated with large summer forest fires in Portugal by studying the large-scale climatic and dynamical meteorological fields at different levels of the atmosphere for 10 % of summer (June–September) days with the highest values of burnt area (Fig. 9.3).

They found that synoptic patterns of the meteorological fields in days of extreme BA present statistically significant anomalies over western Iberia (Fig. 9.3). Positive anomalies in the (maximum, average and minimum) air temperature and geopotential height fields are observed at surface and at lower (850 hPa) and in the mid (500 hPa) troposphere, associated with negative anomalies of air relative humidity at 850 hPa, precipitation rate, cloud cover and temperature range at surface (Fig. 9.3). These climatic patterns are coupled with anomalous circulation from East (in altitude) and Southeast (at surface) forcing an also anomalous advection of hot and dry air respectively over the continental shelf and from North Africa, which are further heated and dried when crossing the Iberian plateau. These results led to the development of models of the fire incidence based on meteorological parameters. In this case, the best linear model was obtained combining the identified wildfire prone atmospheric patterns (short term heat waves control – weather anomaly) with monthly precipitation (long term precipitation control – climatic anomaly) and was able to simulate about 2/3 of the inter-annual variability of observed summer BA (Pereira et al. 2005).

Similar studies with consistent results were performed on other Mediterranean countries. Amraoui et al. (2013) also used composite analysis to identify and characterize the synoptic patterns associated with large fire activity over the eastern Mediterranean European countries of Italy and Greece. For the Iberian Peninsula, Trigo et al. (2013) used: (i) cluster analysis to identify and characterize four different pyro-regions within IP;(ii) composite analysis to provide an overview of the typical synoptic patterns related with the occurrence of large BA in the IP's pyro-regions; and, (iii) regression analysis to develop the relationship between monthly BA with both long-term climatic pre-conditions (temperature and precipitation from 2 to 7 months in advance to fire peak season) and short-term synoptic forcing (synoptic weather patterns derived from 11 distinct weather types classifications).

These fire-weather relationships can be used to estimate potential impacts of future climate change on Mediterranean fire regimes. For example, Pereira et al. (2013) used regression analysis to develop a Burnt Area Model (BAM) to estimate the decimal logarithm of the monthly burnt areas in July and August using a fire weather index (the Daily Severe Rating, DSR) before and during the fire season. Then the BAM was used to estimate future distribution of BA in summer months based on projections of the DSR for future climate scenarios. Sousa et al. (2015), used different approaches to model future burnt area in the four pyro regions of the Iberian Peninsula identified by Trigo et al. (2013) using outputs from an ensemble of four Regional Climate Model (RCM) and developed models (to simulate the inter-annual variability) which also take into account the extreme meteorological conditions during the fire season and specific meteorological backgrounds (such as prolonged droughts).

Large fire occurrence is dominated by the weather/climate in spite of the current reinforced resources to manage, control, suppress and fight the fires (Sousa et al. 2015). In extreme cases, such as the exceptional fire season of 2003 in Portugal, the associated atmospheric conditions proved to be able to explain not only when but also where large fires occurred (Trigo et al. 2006). Nevertheless many other societal and natural factors contribute to shape the fire regime in the Mediterranean. For example, in this biome fires are essentially human caused by accident, negligence or arson (Pereira et al. 2011) and, consequently, human behavior and socioeconomic activities controls the fire ignition in the Mediterranean region (Costa et al. 2010; Moreno 2014). The morphology of the landscape, land use-land cover can also strongly control some characteristics of the fire activity (Amraoui et al. 2013; Barros and Pereira 2014; Moreira et al. 2011; Pereira et al. 2014).

9.3 Fires and Policy Regimes in Shandong Province China

On May 29, 2014, the city of Weihai on Shandong Province's north coast faced a spectacularly visible fire. With journalists and city residents taking pictures of flames that came perilously close to the urban environment, the Weihai fire created a great deal of media coverage. A small fire in absolute terms, considering the fragmented and small forested areas of eastern China, it was a severe fire for coastal China. It started around 3 pm on Thursday and the main complex was contained by late Friday morning, though small spot fires were not contained until Saturday evening. In the primary complex, a two by seven kilometer swath of a protected area, Xianguding National Park, and parts of peri-urban northwest Weihai City burned in less than 6 h, with numerous stringer fires up canyons and spotting up to three and four kilometers away. Some spectacular long flame-lengths and crown fires were caught on film. Fanned by strong winds, the fires were burning a buildup of dry grasses, leaves, forest litter and trees. The fire burn pattern was caused by strong afternoon coastal and evening foehn-like winds. Visually, the fires were a mix of low intensity surface fires that shifted in and out of crown fires depending on slope and vegetation. In all, some 800+ local people were displaced, most into local shelters. More than 2000 firefighters, soldiers and three helicopters were dispatched to put out the fire. Steep slopes, extremely hot-burning fuel and high winds (at time 60 + km/h) were particularly challenging for fire crews and the helicopters were primarily used to fight the spot fires until crews could later reach and contain them safely. (*Xinhua* 2014; *China Daily* 2014a, b)

This particular fire (and many Shandong fires) acted like Mediterranean-type Climate (MTC) fires. Shandong is not considered an MTC zone, but the fire regime and vegetation system largely act like one. To make some sense of the Weihai fire complex as a Mediterranean zone-like fire regime, unpacking the nature of this region becomes a story of vegetation development, drought and fire activity, and above all, human factors in promoting and managing fires. The vegetation burned in the Weihai fire was dominated by evergreen sclerophyllous leaf development: at higher altitude, *pinus*-dominated conifer forests, broadleaved forests in non-urban and agricultural areas, and a preponderance of multi-stemmed shrubby *phanerophytes*—or in the parlance of some fire-fighters in MTC California, litter-bug shrubs and trees in a patchy network of rural and peri-urban areas. Drought and wind were also important factors, as were local land management systems and contemporary fire policies, a pattern that is reflected in other similarities between Shangdong and traditional MTC fire-prone ecosystems. These include patterns of fuel consumption and fire spread nearly identical to MTC chaparral/shrublands, fire intensity (commonly ground to crown fires), and the influence of high and steady winds.

There are some significant differences between traditional MTC and vegetation zones and this one in Shandong Province. The classic MTC regions are the Mediterranean Basin, California, central Chile, and sections of South Africa and Australia. Evergreen broadleaf shrublands dominate most MTC zones, with some evergreen woodlands of low broadleaf *Quercus* and *Pinus* trees and annual grasslands. The MTC regions also have extreme seasonal wind events (katabatic and foehn winds) that typically last a few days and may occur many times a year. When these winds coincide with droughts and ignitions they are associated with extreme fire events, characterized by high rates of spread, long flame lengths, and long-distance spotting (Keeley et al. 2012).

There are several key elements to fire frequency and severity in Shandong. To begin with, the landscape of Shandong is highly fragmented, dominated by agriculture and fruit tree silviculture, with intermittent grasslands and urban/peri-urban areas. The province is also split by a low mountain range, with a slightly drier and windier north coast and more humid southern half. Deforestation, scrublands, and erosion have been serious issues for much of the province since at least the 200 s CE based on extensive agriculture in lowlands and on marginal hillsides, and especially increasing with the extensive demographic expansion of the region after 1700 CE (*Shandong shengzhi: renkou* 1994). The resulting vegetation and human map of Shandong is one of fragments, a mix of grasslands, rangelands, regrowth timber, upland marginal areas, protected areas, fields, and urban areas—and much of it is fire-prone.

Humans have had a multitude of impacts on fire regimes that include changes in frequency and timing of ignitions and changes in fuel load and landscape patterns of fuel distribution. (Keeley et al. 2009b) In MTC regions where natural ignitions are frequently limited (or limiting), large human populations and population growth have generally been associated with increased fire frequency. But human ignitions are only part of the story—they have also shifted the season(s) of burning to periods of severe fire weather and high winds and high temperatures.

In terms of land use, burning has a clear logic and long history in agricultural Shandong. In effect, historical firing of terrestrial vegetation cleared, defended or recycled plant (nutrient) material. Regular firing could help protect against unpredictable or destructive wildfires, burn off stubble, protect from shrub and tree encroachment, or simply clear new land. The largely protected and peri-urban area that burned in the Weihai fire complex had been at different times crop land, meadow/grass range, covered by heavy forest (regrowth) exploited for timber, shrub wasteland, and it is now moderately forested and shrubland, closed and protected forest reserve and national park. But field burning in particular corresponds with the worst possible time(s) for severe fire weather, high winds and temperatures. In Shandong (as in the Mediterranean Basin and parts of California) repeated burning of shrub lands to expand range and agricultural land has to some degree been

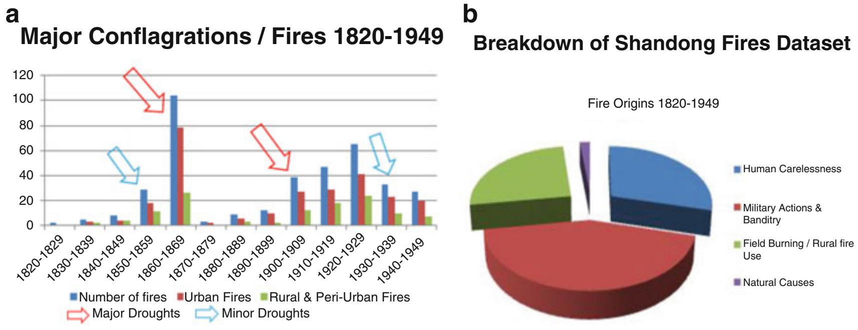

Fig. 9.4 (**a**) Fire and drought cycles; (**b**) fire origins in Shandong Province, 1820–1949

replaced beginning in the late twentieth century by the abandonment of traditional rural lifestyles as well as the outlawing of such burning. Resulting recolonization of previously cleared landscapes by woody species has resulted in increased fuel loads that have contributed to greater frequency of larger and higher intensity fires.

Common commercial and shrubland tree species in Shandong include oak, cedar, elm, pistachio, a variety of pine (especially on hillsides and at higher elevations), as well as bamboo and cypress (especially in the southern half of Shandong). The most fire prone vegetation complexes form a kind of chaparral of largely sclerophyllous vegetation with several key species in common with MTC areas and fire regimes (including and especially *Fagaceae, Rosaceae*, and *Ericaeae* among others), and its patterns of fuel consumption and spread are very close to chaparral shrub, pine, and eucalyptus fire intensity. The shrubland/forest area fuel structure has been altered in diverse ways over the long history of Shandong. When policies of suppressing fires have been successful in excluding fires over broad regions for periods of time (particularly since the late 1980s), fuels have accumulated. This was and is particularly the case in many protected areas of China, including the forest reserves in Shandong (as the example of Weihai demonstrates). Historically, selective and indiscriminate timber harvesting have also had their influence on fuels as some tree species that were once common (*pinus* in particular) have become rare or are missing from plant communities, and others have emerged as common secondary growth (bamboo and cypress in the south in particular) though they do not appear in historical descriptions (*Shandong shengzhi: linye zhi*, 1996).

The vast majority of historical fires in Shandong's MTC-like fire regions were (and remain) human ignitions; those in the pre-1949 period were especially attributable to warfare and human carelessness (Zhong 2005). Although annual summer droughts (climate) contribute to large fire events in all MTC areas, warfare is a rather unique fire factor for Shandong and in this regard, warfare and climate impacts often colluded to facilitate major conflagrations. In the pre-1949 period, severe droughts in Shandong usually coincided with major peasant revolts, including the Taiping and Nian Rebellions of in the 1860s and Boxer Rebellion of 1900–1901 (see Fig. 9.4). Based on available historical data, the fire return interval for

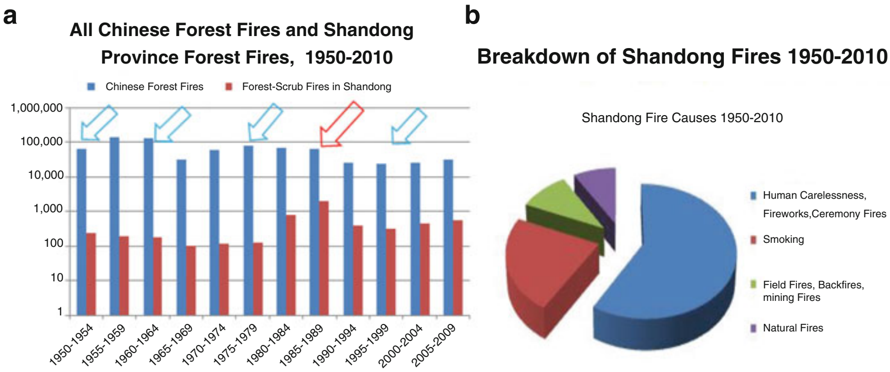

Fig. 9.5 (**a**) Fire and drought cycles; (**b**) fire origins in Shandong Province, 1950–2010

drought-fire-military events was roughly 60 years with minor events between 23 and 27 years (Hayes 2012).

Despite some minor droughts, fire incidence did not rise in Shandong for much of the post-1950 period until the late 1980s when the incident and severity of fires increased significantly. As with other fire prone areas of China's southwest and northeast, Shandong's central mountainous areas and northern chaparral-like shrublands burned in the mid and late 1980s. At the same time, human-related ignition rose, especially from smoking, accidental fires from funeral or other ceremonies, and fireworks, which increased and regularly exceeded earlier fire intervals (see Fig. 9.5).

Part of this trend was driven by the post-1950s expansion of metropolitan population centers into rural and shrub lands. This urban sprawl has placed more and more people and structures at risk and created a very vulnerable wildland-urban (or peri-urban) interface that totals millions of homes and periurban/rural areas while raising the risk of human related fire ignition (Gao 2002). This is a greater problem in the northern half of Shandong, where urban sprawl is increasingly occurring in high-fire-risk vegetation on steeper hillsides. In response to this human growth pattern, fire management in Shandong consists primarily of rapid deployment of fire suppression forces against all unplanned fires. Despite this policy, the total area burned in coastal and foothill landscapes has slowly increased over the past 60 odd years.

Fire management strategies in China, from the late imperial period to the present, focused on minimizing the impacts of fire hazards to human population centers. More recently the Chinese government has ostensibly added to the goal of sustaining natural ecosystems through forest protection to fire management, but sustained attention to this aspect of fire management has been marginal. In post-1949 China, the Forest Protection Office (later Ministry of Forestry) and a suite of forest protection laws have dealt with fire management through rapid deployment of fire suppression forces (almost always elements of the Chinese military) and severe punishments of real or perceived arson or fire accidents. Fire suppression forces until the 1970s usually had little training in actual fire management. However, the basic tools of firefighting were in place and included fighting the fires where they happened (rapid response), creating and maintaining firebreaks, and afforestation (creation of forest fire resistance belts) (Zheng 1991; Du and Wang 2007).

While this "classic" approach helped prevent some fires, and even seems to have helped slowly decrease the overall level of fire incidence prior to the 1980s, droughts and massive and costly fires since the late 1980s have led to new policies and strategies. A salient and important element of the "classical" and contemporary fire-mitigation approach has been the development of generally uniform firefighting policies and strategies across the entirety of China. These policies have been framed around how firefighting has been conducted in China's southwest and northeast with very different kinds of fire regimes (Zheng 1991; Hu 2002). What worked well enough in those regions has proved problematic elsewhere.

National fire issues aside, the 1970s and 1990s in Shandong saw major fuel buildup with related and more severe fires. In the 1970s, forest silviculture and harvesting techniques led to a tremendous amount of slash and forest litter prone to combustion during spring field burning. The 1990s policy reaction, in the wake of the costly Black Dragon Fire (1987), ironically saw a fuel buildup and regular fires because of very rapid response (less fuel load burning off) and incorporation of sections of "forested" (often shrub) lands in regional and national parks. Massive funding was dumped into these fire prevention systems (RMB 56 billion nationally since 1987; RMB 30 million for Shandong c. 2005–2006), and have included since the 1990s an improved forest fire forecast system largely based on Köppen-Gieger vegetation and climate models, synthetic indexes, moisture variants, and US fire danger models. In Shandong there has also been increased concern with wind speed index and patterns, and concern with (but no policy) on fuel moisture and fire behavior standards. These recent policy initiatives have resulted in more monitoring and some prepositioning based on fire danger rating and wind(s) and long standing rapid response reactions to fires when and where they happen.

Shandong's fires are increasing, and especially on the north coast of the province, they usually look and act like Mediterranean type climate fires—and while these fires are usually not BIG fires in relative terms, they are destructive and costly in a highly populated and utilized landscape. Yet fire management and prevention in Shandong continues to be modeled on fires that occur outside of the province. The historical solution to solving Shandong's fire problem focuses on fuels and people who ignite them and the organizational framework persistently frames the urban/peri-urban fire prone interface fire problem in terms of fire suppression and control. Rapid response has helped prevent the spread of many fires, but when severe weather conditions have intervened (as in the 2014 Weihai conflagration), destructive fires have spread rapidly out of control. In the rapidly expanding urban and peri-urban areas of Shandong, especially on the north coast, there is little or no alteration of urban zones to create buffer zones around buildings or other basic fuel treatments along wildland-urban interfaces. Certainly, part of the solution to dealing with the fires is related to land planning decisions—but an equally powerful model might be to look at the nature of major fires in MTC fire zones for additional ways forward.

Buffer zones, strategic land planning decisions, and integration of regional and national fire management teams and forces (the majority of fire management teams are trained for vastly different fire regimes) might help in this process. Even considering avoidance of high fire hazard areas might help in planning decisions—but given historical trends, demographic and economic determinants in Shandong's regional planning, and the province's social and political restraints will likely prevent major shifts in dealing with perennial and dangerous fire situations.

9.4 Los Angeles Is Burning! Los Angeles Is Burning!

The 2009 Station Fire was the largest in the history of Los Angeles County (USA), scorching nearly 65,000 ha in its 2-month run (Fig. 9.6). Late that August, an arsonist ignited the blaze on a steep and inaccessible slope deep in the Angeles National Forest, whose 283,000 ha drape over the San Gabriel Mountains ringing Los Angeles to its north. Because conditions at the site of ignition were so dangerous—very high winds, very low humidity, elevated temperatures, thick brush, and unstable soils—it proved impossible to put firefighters on the ground. In hopes of containing the rapidly growing blaze, the U.S. Forest Service (USFS), which manages the Angeles National Forest, sought to contain the fire through aerial water and flame-retardant drops, even though it knew that such action was most effective only when done in coordination with active management on the line. Moreover, and by policy, it was not allowed to keep its fleet of helicopters and fixed-wing aircraft flying after sunset; as soon as these resources were pulled back at twilight on August 29, the fire blew up (a consequence that ever since has been contested in the U.S. Congress and federal courts). Over the next 60 days, the raging fire forced the evacuation of thousands of residents living in the foothills, canyons, and ridgelines, many of whose homes lacked defensible space. Two county firefighters died while defending structures in the wilderness, a striking decision that was never communicated to the fire's incident commander. Adding to the complexity of the firefighting response, the USFS, The California Department of Forestry and Fire Protection (CalFire), and the Los Angeles County Fire Department joined forces with many local fire departments (GAO 2011). Finally, Los Angeles being *Los Angeles*, the massive conflagration that illuminated the night sky, and whose smoke plume swept as far as Denver, Colorado, more than 800 miles east, was captured by every kind of media, new and old, creating an ongoing, meta-analyses of the fiery event.

As such, the Station Fire offers a unique opportunity to discuss the complicated evolution of firefighting policy in Southern California, a Mediterranean ecotone in which fire is an expected event. Nothing about this evolution—from fitful (and unsuccessful) twentieth-century efforts to establish suppression as the sole response possible to early twenty-first-century strategies that have called for a more varied set of managerial reactions—has been uncontested. These debates, academic and public, have escalated as a result of the Station Fire, as well as from pressures associated with Los Angeles' increased population density, outward sprawl, and the brutal

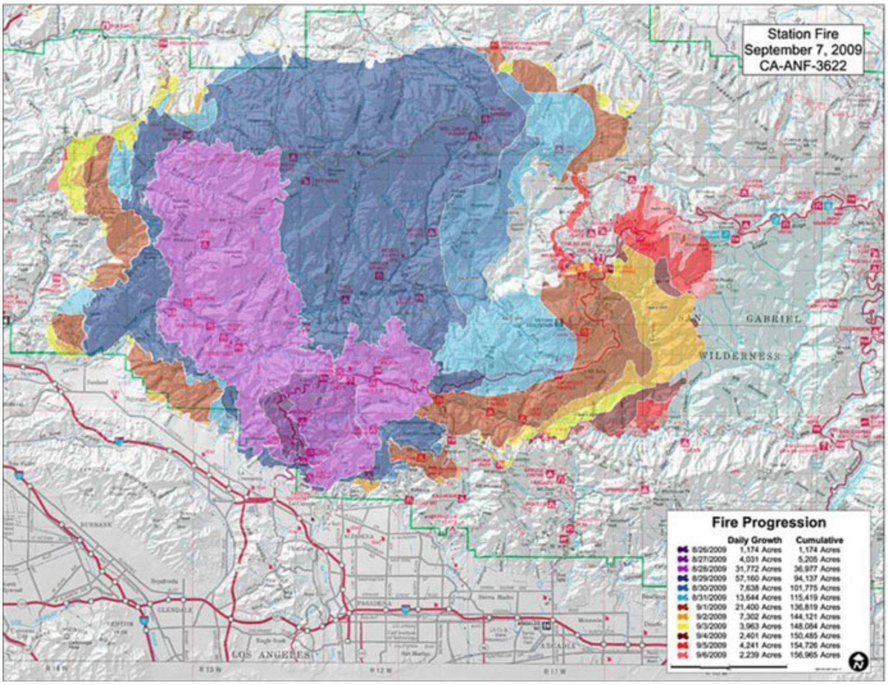

Fig. 9.6 Progression of the Station Fire through September 4, 2009. Note the huge expansion on August 29 (Map courtesy of the USDA Forest Service)

dry spell wracking the region since the mid-2000s (Miller 2013). Because these conditions are not expected to abate any time soon, the politics of fire in Southern California should continue to be as intense as a wind-driven blaze racing through tinder-dry chaparral shrubland.

It was just those sorts of conflagration, and the fears they generated, that led to the creation of the Angeles National Forest in the first place. Forest advocate and real estate developer Abbott Kinney was among the first to urge the protection of these mountainous watersheds. "Native growths of brush and chaparral, scrub oak, greasewood, sagebrush" increasingly were being "removed from the land by clearing and fire," he wrote in 1880, adding that all the "mesas are bare of verdure." These environmental alterations left downstream communities and agriculture more vulnerable to winter flooding and summer drought. Kinney concluded in an 1886 report from the State Board of Forestry, on which he served, that "the destruction of the forests in the southern counties means the destruction of the streams, and that means the destruction of the country" (Robinson 1946) (Fig. 9.6).

Six years later, prominent citizens, grassroots organizers, irrigation districts, and chambers of commerce, as well as local congressional representatives, successfully appealed to U.S. Department of the Interior Secretary John W. Noble to address this problem. The Secretary submitted to President Benjamin Harrison a proclamation creating the San Gabriel Timberland Forest Reserve (in 1908, it was renamed the

Angeles National Forest under the management of the USFS in the U.S. Department of Agriculture). It became one of 15 reserves Harrison established using the Forest Reserve Act of 1891 that had granted the chief executive authority to designate "public reservations."

In so acting, the president was setting the stage for a radical new conception of the purposes of the public domain, those federal lands the government owned in the Western states and territories. Hitherto, Congress' ambition had been to sell or give away these many millions of acres to homesteaders, farmers, loggers, and miners—not to say railroad corporations—to encourage settlement and development. By the late nineteenth century, this policy had gained an array of detractors. Communities worried about the rapid depletion of local forests and grasslands, for example, found common cause with conservationists and scientists concerned that damaged environments could not be regenerated, with a corresponding loss of a sustainable economy (Miller 2012).

These and other engaged citizens advocated for a more robust nation-state to intercede to protect the public lands and the resources they contained. The government's protective presence would produce important results, asserted one of the petitions submitted in favor of the San Gabriel Reserve. The reserve's creation would insure that "the water would be preserved in the mountains, the snow saved from being speedily melted, the waters protected from pollution by large droves of cattle and sheep" (Robinson 1946).

The ideas that managing nature upstream to sustain human interests downstream, and that Washington could and should resolve local disputes over resource allocation and consumption, signaled a broader desire for a more efficient and effective federal government. The call for making public life more orderly, rational, and manageable was a hallmark of Progressive Era reform and activism. Emblematic of this era's ethos was the establishment of the initial forest reserves, as well the 1905 formation of the Forest Service to manage them.

Emblematic, too, was the 1909 creation of the Los Angeles County Forestry Board, forerunner of the county's Fire Department. Stuart J. Flintham, the organization's third head, is credited with developing the department's mission and launching many of the infrastructural initiatives that since have become essential to fighting forest fires in Southern California. He was its first trained forester, having received his bachelor's degree in forestry at Cornell University and M.S. in forestry from the Yale School of Forestry, which Gifford Pinchot, the first chief of the U. S. Forest Service had endowed and whose curriculum the legendary conservationist helped devise. After serving as a forest inspector for the Forest Service in California, Flintham moved to Los Angeles and in 1912 took over the county' fledgling forestry outfit (Miller 2012).

Drawing on his forestry education and subsequent field work for the USFS, and making immediate use of some of the lessons that he and his professional peers learned in the wake of the devastating Big Burn of 1910, which torched nearly 1.2 million hectares in Washington, Idaho, and Montana, Flintham devised a systemic approach to identifying, monitoring, and, where possible, suppressing fires in the San Gabriel foothills.

This included building firebreaks that snaked up foothills and ridgelines, using horses, mules, and vehicles to mount patrols during fire season, and constructing lookout towers to increase surveillance capabilities. First utilizing the telephone to speed up communication between firefighters on the ground, by the early 1920s the county force was making clever use of a mobile radio unit to coordinate its efforts. Even the local U. S. Army air squadron offered its bi-planes to conduct aerial-mapping services and fire overflights. In 1924, Flintham's deft administration earned the praise of one of his Yale classmates, William B. Greeley, then-Chief of the Forest Service. After inspecting the Los Angeles County's forestry program, he reported to *American City Magazine* that it was "exceptionally well organized and eminently progressive" (Miller 2012).

The topography and ecology of the San Gabriel Mountains have conspired against the human desire—however well organized—to exclude fire from this rugged landscape. John Muir, during a 3-day hike in 1875, recorded some of the features that have frustrated firefighters ever since: sheer-walled canyons, treacherously loose soils, and ridges "weathered away to a slender knife-edge," the whole thickly covered in a "bristly mane of chaparral." Its hazards carried a warning, Muir wrote. "The whole range, seen from the plain, with the hot sun beating upon its southern slopes, wears a terribly forbidding aspect. From base to summit all seems gray, barren, silent—dead, bleached bones of mountains" (Muir 1918).

This terrain comes alive when it erupts in flame. At lower elevations, the dominant plant community is California sage shrub and at midlevel elevations, chaparral habitat dominates. These landscapes provide a combustible fuel that if ignited on days of high wind, low humidity, and intense heat can create firestorms of immense and swirling power. Not everyone who has lived within the Los Angeles basin has seen these flames as detrimental to their way of life. The native peoples used fire to manage hillside ecosystems to produce more highly prized plants and animals. The Spanish did the same to promote grasslands for their livestock. These two groups knew enough not to live within the fire zones—the foothills, notched canyons, and upland slopes. Not so for late-nineteenth-century Euro-American outdoor enthusiasts and those seeking domestic solitude from the burgeoning city below. For these newcomers, fire became a problem that had to be solved.

Public concern in the fiery aftermath of major fires from the 1880s to the early 1900s turned political, generating demands for more robust firefighting forces at the local, state, and federal levels. Across the twentieth-century, as major fires continued to erupt, the U.S. Forest Service and the Los Angeles County Fire Department spent much of their budgets each summer and fall trying to stamp out these blazes. That this remains the case indicates that the dream of full-on fire suppression in Southern California has been and remains an unrealized policy aspiration. An aspiration that comes with even greater pressure in the early twenty-first century: more and more people now live in close proximity to the Angeles National Forest, making the protection of their lives and property critical to all firefighting forces in the region. Yet these residents' burgeoning presence—the metropolitan region contains more than 18 million people as of 2014—may be negating the effectiveness of firefighting tools such as bulldozers, chainsaws, and flame retardant-dropping aircraft, of Landsat imagery, drones, and other related high-tech resources (Cermak 2005; Keeley et al 2009a).

Since controlling fire in Southern California remains as partial a solution today as it was a century ago, this in turn raises a direct challenge to the prevailing argument that fire suppression is the source of such mega fires as the 2009 Station Fire. Minnich and others assert that fire suppression has disrupted historic forest-stand structures, allowed an unnatural buildup of fuel, and thus this is why the U.S. West has experienced an increase in fire intensity and size (Minnich 1983, 1995, 2001). Countering this claim is more recent scholarship that probes the ecological record and historical data of fires in the west, and factors in such drivers as drought and climate change. One study of ponderosa and mixed conifer forests concludes that mega fires occurred within these forest types long before the era of suppression emerged in the aftermath of World War II and that subsequent conflagrations were (and are) not therefore "abnormal" (Odion et al. 2014). Another study drawing on historical and ecological data for fires in montane forest of the Colorado Front Range reached the same conclusion (Sherriff et al. 2014). These findings hold true for Southern California's sage brush and chaparral ecosystems: "over the last 130 years there has been no significant change in the incidents of large fires greater than 10,000 ha," note Keeley and Zedkler (2009); "fire suppression activities are not the cause of fire events."

This new evidence of the challenges, past and present, that firefighters have confronted in Southern California is why the future of fire management in the San Gabriel Mountains will remain problematic and continue to evolve. As with China's Shangdong Province, so in this fire-prone landscape: Southern Californians need to learn to live with fire and craft public policy to reflect this new reality. Planning and zoning commissions at the local and county level must stop approving construction of houses in fire zones. Residents living within the San Gabriels' stiff folds must build defensible space around their homes to protect their property and the firefighters who are called upon to defend it. And firefighting agencies at every level of government will need to adopt an array of strategies that includes setting fires and fighting them, "letting them roam and shutting them off, cultivating, if coarsely, the combustibles that sustain them" (Pyne 2004, 191). Learning to tend fire in the Mediterranean ecotones is the essential, first step toward living more sustainably within them.

9.5 The 2010 Carmel Forest Fire – A Historical Policy Snafu

In December 2010 no rains had yet fallen on Israel, even though precipitation in the Mediterranean ecosystem usually begins at least 2 months earlier. Then, over a 4-day period, a wildfire charred approximately 2500 ha of Israel's Carmel forest, including oak scrub and pine forests. While small in absolute terms, the fire's size was much more significant in relative terms: 10 % of the entire Carmel Forest (and 1.5 % of Israel's total forested area) burned. By US standards, this would be the equivalent of a 5 million hectares forest fire (the 2013 Yosemite Rim Fire, by comparison, burned approximately 100,000 ha). Israeli firefighters were caught off-guard and ill-prepared. By the end of the first day of the conflagration, officials interviewed on the radio, when asked "how much of the fire is contained?" answered bleakly "None. It is completely out of control." Four days later, with the help of an international fleet of fire-fighting aircraft, the fire was brought under control.

Had the fire only blackened vegetation, the outcome may have been similar to the many fires that had preceded the 2010 fire. After all, fire is considered an intrinsic and periodically-occurring characteristic of Mediterranean scrublands in general, and in this area of Israel in particular (Naveh and Carmel 2003; Tessler 2012). But, unlike previous fires, the 2010 fire also claimed the lives of 44 people. Most of the victims were prison guards recruited from the south of the country to help evacuate the Damon Prison, located in the midst of the Carmel Forest. A bus carrying the prison guards headed up a steep two-lane road accompanied by a police escort. On a hair-pin turn, the bus and police cars found themselves surrounded by flame on both sides of the road. In a desperate attempt to turn back, the vehicles became trapped and the bus caught fire. Journalists and photographers, who were in the caravan, also documented the tragedy. It was not long before families of victims and scientific researchers alike were suggesting that the fire – and the deaths – may have been preventable had the government followed the recommendations of its own previous inquiries.

Could the tragic results of the 2010 fire been avoided? Did Israeli policy makers and land use managers have the knowledge required? Within the Israeli scientific community the answer is unequivocally, "yes." Pulling no punches, the post-2010 fire scientific report opens with the following statement:

> The committee used documents produced by previous committees (that were set up after the 1989 Carmel fire and the 1995 Shaar Hagai fire) and research conducted after past fires in the Carmel, the Biriya Forest and in the Jerusalem hills. From appraisals of those works, it is clear that the central problem concerning fires is the implementation of the recommendations and the management of forest and maquis shrubland, particularly with regard to fire prevention and not due to the absence of data, professional or scientific. (Perevolotsky et al. 2011), p.4 (*author's translation*)

The Carmel Forest sits on Mount Carmel, a triangular coastal range approximately 30 km long parallel to the Mediterranean coast and 13 km wide (Fig. 9.7). The city of Haifa (pop. 272,000 in 2012) sits on the northern tip of the mountain, straddling the forest to its south. The forest itself is a mosaic of land cover types, including planted pine forests, oak-dominated forests and scrub, fruit orchards, and several settlements, both urban and rural. Likewise, the forest is managed by diverse agencies. The Carmel National Park is managed by the government Nature and Parks Authority (NPA, which was, prior to 1998, two agencies – the Nature Reserves Authority and the National Parks Authority) and areas around the park are managed by Keren Kayemet L'Israel (KKL), which is a private land-owning organization and, since 1960, the country's quasi-governmental forest service (Amir and Rechtman 2006. Within the matrix of natural and forested areas are several human settlements, including two towns and several exurban and rural settlements. The mosaic of land managers is displayed in Fig. 9.7).

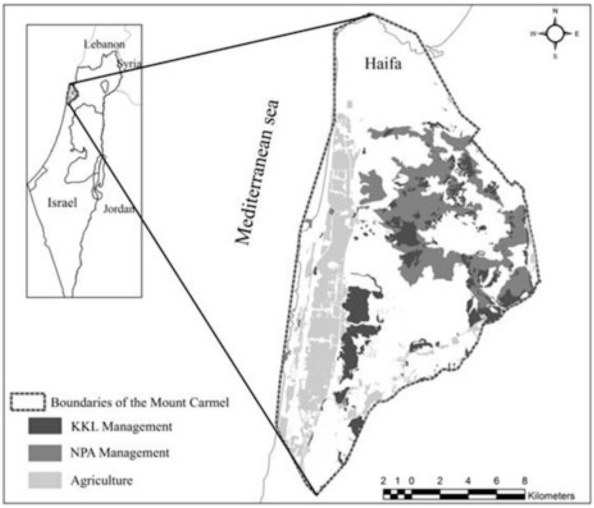

Fig. 9.7 Land management agencies responsible for the Carmel Forest on Mount Carmel and adjacent coastal plain (Map courtesy of Semion Polinov)

As referred to in the quote above, the 1989 Carmel fire was a watershed, Israel's first "national fire," (A. Perevolotsky, pers. interview, 17 June, 2014). The fire had been one of the biggest to date, slightly more than 500 ha (Tessler 2012), and it damaged a popular national park. The KKL turned the event into a trigger for a fundraising telethon that raised an unprecedented amount of money for forest restoration and research. But the fire also catalyzed the creation of a government-appointed scientific committee, which included representatives from the relevant land management organizations, and which was charged with delivering science-based recommendations for Carmel forest restoration. This would be the first of successive investigative panels that would issue similar recommendations following periodic fires all the way through the 2010 fire.

The recommendations, according to participants in the committee, were novel at the time of issue in the early 1990s, and some were even considered controversial, although they have since become routine. The recommendations focused on three spheres of activity: firefighting, fire prevention and restoration. According to Professor Uriel Safriel, ecologist, committee member and chief scientist of the Nature Reserves Authority (NRA) during and after the'89 fire, recommendations to allow more effective firefighting were largely heeded. They included the creation and maintenance of access roads and the establishment of a new fire station. Research on firebreaks was also initiated, but actual firebreaks were not created (pers. interview, 2014). Recommendations concerning restoration focused, controversially at the time, on allowing for natural regeneration and avoiding the replanting of trees (planting of Aleppo pines and other conifers are a historically significant and controversial topic in Israel; see Tal 2013). Following the'89 fire, this recommendation would also be gradually adopted, especially in light of research documenting successful forest regeneration without replanting (Ne'eman 1997; Ne'eman et al. 2004). Equally controversial, according to range scientist and later chief scientist of the NRA, Dr. Avi Perevolotsky, was the introduction and use of domestic animal grazing as a fire-prevention strategy to reduce the fuel load in the forests and to maintain firebreaks. Use of grazing as a fire prevention strategy took much longer to gain acceptance and up until 2010 was not widely practiced or encouraged (A. Perevolotsky, pers. interview, 2014). Safriel (1997) notes an additional management strategy introduced in light of the'89 fire: establishment of a Biosphere Reserve in the Carmel as a mechanism for fire prevention.

Between the 1989 and the 2010 Carmel fire, there were eight large (>100 ha burnt) fires in the Carmel (Tessler 2012) and additional fires in hills west of Jerusalem. Following most of these fires, the State Comptroller and other agencies investigated the factors leading to mismanagement of fire prevention and firefighting. Scientists involved in the various post-fire investigations emphasized that the recommendations were always consistent with former reports, particularly with regard to creation of firebreaks, facilitating natural regeneration, and use of grazing to reduce fuel load. The salient question, then, remains. Why, after so many fires and so many subsequent investigations, did the 2010 fire occur and cause so much damage? Why didn't government and relevant agencies listen to their own scientific committee recommendations?

In the aftermath of the disastrous 2010 fire, national finger pointing was rampant. Various government ministers, ministries, agencies and local governments were blamed. The historical culture of forestry was brought into question, as was the desire of local residents to live near forested areas. Amidst the finger-pointing, the most comprehensive overview of the bureaucratic snafu that characterized the policy landscape of firefighting and prevention was produced by the government Comptroller's Office in the form of an official report entitled "Carmel Fire of December 2010 – Failures and Conclusions" (Comptroller 2012). Weighing in at more than 500 pages, the report spends half of its ink reporting on the specific incident of the bus tragedy in which the prison service personnel and police were killed, a 50-page section on fire ecology in the Carmel, and the rest on the performance and responsibility of various government agencies in fire prevention and fighting.

The Comptroller's report explicitly supports the assessment of scientists that recommendations were never implemented, and it points many fingers via its description of multiple, systemic failures up and down the bureaucratic chain of command. In effect, the report somewhat vindicates the atmosphere of mutual recriminations so prominent in the post-fire discourse. For instance, the report draws attention to no fewer than four government ministries responsible for some aspect of fire prevention. The Ministry of Interior was responsible for the fire service and the roads authority, the Ministry of Environmental Protection was responsible for the oversight of the Nature and Parks Authority, the Ministry of Agriculture and Rural Development was responsible for overseeing the activities of the Forest Administrator (a representative of KKL), and the Ministry of Finance was responsible funding all of these ministries and their agencies. Figure 9.5 summarizes some of the bureaucratic complexity in firefighting and fire prevention policy in Israel. Further, the

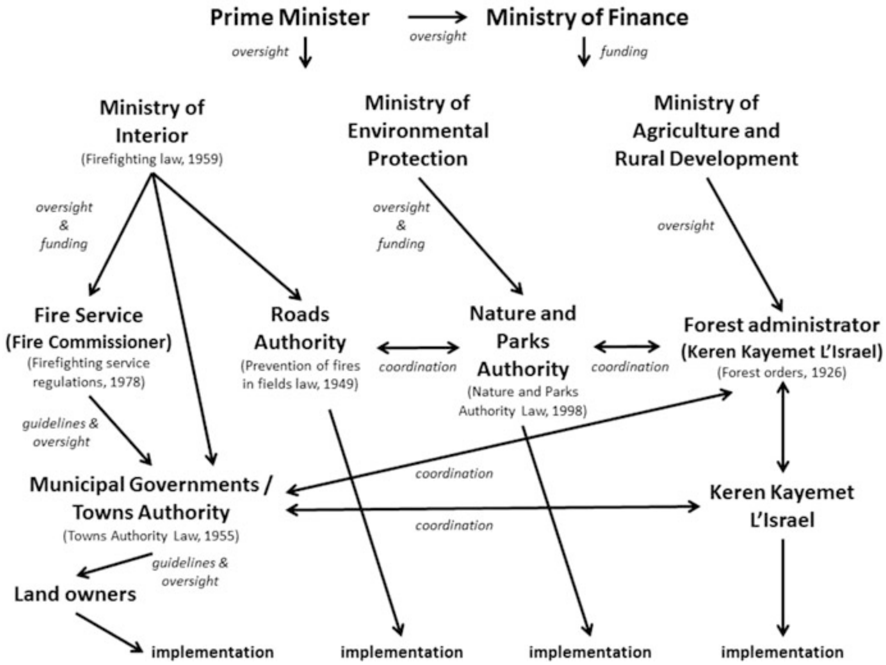

Fig. 9.8 An overview of policy making and implementation including governmental bodies responsible for various aspects of fire policy, the relations between them and the laws and regulations for which they are responsible

Carmel Forest includes areas administered by the NRA (under the aegis of the Ministry of Environmental Protection), the KKL, and several municipalities (Fig. 9.8).

Administrative fragmentation is a known environmental policy challenge (Carter 2007), and more so in Israel, where the peculiarities of its parliamentary democracy lead to coalition governments of parties and ministers that both cooperate and compete to advance their own narrow sectarian interests. Elsewhere in the policy literature, confoundingly complex bureaucratic structures are considered a problem of environmental management that often set up policy for failure (Cohen 2006). The comptroller's report also notes forthright that Israel lacks a comprehensive national-level fire prevention policy.

The comptroller placed his primary emphasis in the report on the chronic budget deficit of the fire service and the finance ministry that refused to address this deficit until the Interior Ministry initiated budget reforms. Further down the bureaucratic ladder, the comptroller points out that various government agencies are responsible for issuing directives to other agencies and then responsible for seeing that those agencies carried out their tasks. For instance, the fire service issues directives to municipal governments for thinning trees and maintaining buffers along roads. Municipal governments pass this responsibility on to individual communities and landowners. In any case, removing trees requires the approval of the forest administrator, who is answers to the Ministry of Agriculture and Rural Development. The comptroller uncovered situations in which directives were given and not followed due to lack of budgets, disagreements or for no particular reason. Considering the length of the bureaucratic chain of command, entangled decision making, and perpetual claims of lack of funding at each link, the lack of preparedness for the fire becomes evident.

The comptroller also concluded that multiple authorities, charged under multiple laws with various aspects of fire prevention, had simply not fulfilled their duties according to the law. These include the fire service, the Towns Authority (representing municipal government), the NPA, and private landowners.

Discussions with participants in the successive scientific committees revealed partial fulfillment of scientific recommendations, but also failures in implementation. For instance, the Nature Reserves Authority (NRA) did not engage in the creation and maintenance of firebreaks following the'89 fire for two reasons. First, there were no budgets available to conduct not only the initial work, but the long-term maintenance of the firebreaks as well. Second, the NRA decided to embark on the establishment of a Biosphere reserve in the Carmel. NRA scientists believed that a properly functioning Biosphere, predicated on active stakholder involvement, would take responsibility for the forests and for fire prevention and even plan and implement firebreaks. While a properly functioning Biosphere reserve may have indeed integrated physical and social tools for fire prevention, the Carmel Biosphere, while recognized by UNESCO, does not function as it should (Gasol 2010) and is accordingly undergoing a major reassessment.

Although funding was invested in the study of grazing as a fire management policy, no action was taken in this regard by any of the relevant management agencies. According to one contributor to the scientific committees' work, grazing "was already in the'89 recommendations, and also in'95, but up to 2010 no one took it seriously. There were all sorts of excuses but primarily no one thought that it was something that had to be done."

Both in 1989 and again in 2010, much of the post-fire budgets for exploring forest restoration and fire prevention went to scientific research. Multiple research projects explore the ecological, lithological, social and hydrological aspects of forest restoration. Much of the research is applied, as in considering how best to manage grazing regimes, how to maximize social value without compromising ecological integrity of the forest, and how to best manage for soil retention. As such, most scientists assert that there is no lack of knowledge regarding what has to be done. The scientist's exasperation is shared in the State Comptroller's report, which notes that all of the conclusions noted in their post-2010 fire report were known for the past two decades and that were reported repeatedly in successive investigation. In short, this is an "ongoing failure that must be stopped" (Comptroller 2012).

The mundane answer to the recurring question regarding why scientific knowledge was not translated into policy implementation is that several key recommendations were lost in the bureaucratic policy snafu, with no one to implement them and with those ready to implement short on the necessary funds to so. This short analysis suggests that current fire prevention policy is spread across too many agencies with too many interlocking and conflicting responsibilities to be effective. In order to determine whether the lessons of the past have been learned and their recommendations fulfilled, the following questions are crucial:

1. Is there a funding mechanism and management plan for the long-term maintenance of firebreaks?
2. Is the Carmel forest being managed using the recommended grazing regimes to reduce fuel load?
3. Are planners working to distance urban and rural development from areas of high fire risk?

Additional exogenous challenges, common to Israel, Shandong and Southern California, will further complicate fire policy: climate change and population growth. According to the IPCC, climate change will likely increase fire frequency and extent, as has already been noted in the Mediterranean Basin (IPCC 2014). Meanwhile, Israel's population continues to grow and more people will live in closer proximity to the forests. Although these two factors suggest that the threat to lives and property by fires in Israel will increase, they are not yet prominent issues on the Israeli policy agenda.

9.6 Conclusions

Climate change is expected to have considerable impact on Mediterranean ecotones; they will be among the most altered biome on the planet (IPCC 2007). Large scale declines are expected in vegetation types endemic to the northern Mediterranean basin, from the Iberian Peninsula east to Italy and Greece. On the north coast of the Chinese province of Shangdong many of those same plant types are beginning to appear (*Shandong senlin* 1986; Yu and Guo 2005). While in Southern California, desert and grasslands are anticipated to expand into mid-elevation shrubland; at higher elevations, mixed deciduous forests will replace conifer stands (IPCC 2007).

These alterations, underway or predicted, when combined with warming temperatures and the potential for extended drought cycles, are setting the stage for shifts in fire regimes across Mediterranean-type ecozones (Arca et al. 2010). Fire seasons are projected to lengthen and the incidence and intensity of fires is expected to increase in the regions this chapter has examined, as well as in Australia, Chile, and South Africa. When setting these transformations within other contexts—land use and land cover changes as well population migration into fire zones—it becomes clear that managing fires will become more complicated and so will the policies and politics that define firefighting in this biome. Making this process even more complex is what historian Stephen J. Pyne calls the "cultural paradigm" of fire: Human "stewardship over fire is the signature of our unique ecological agency. Until we openly acknowledge our firepower, we cannot effectively exercise that stewardship" (Pyne 2010, 86). Nowhere has this stewardship been more complicated, nowhere will it be more tested than in the Mediterranean-type ecosystems.

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Chapter 10
Beyond Colonialism: Towards a New Environmental History of India

Arivalagan Murugeshapandian

Abstract In India, most studies on environmental history focus on diverse themes in the colonial period but fall into a stereotypical explanation. Nature's degradation is mainly depicted from the archival documents. However, forest subjects glorify the colonial past even though the colonial authority destroyed the forests and uprooted their habitation. To question this stereotype, two questions have been drawn from the memory of Kanikkaran community; why does the community glorify the colonial past? If the community has positive light on the colonial past, what is their conception about nature? If these questions are addressed, the static understanding about the forest subjects and the unidimensional understanding of nature could be avoided in the historiography.

10.1 Introduction

During the 1970s and the 1980s, India witnessed a range of popular protests. The popular protests were directed against the forest policies of the Indian state. On the one hand, the policies restricted the forest dwellers' and peasants' access to forest resources and, on the other, led to rapid environmental degradation. During this period, the Indian state's efforts to build big dams also led to large-scale displacement of indigenous people from their native lands and resulted in organized protests and movements. This volatile political context not only provided the backdrop to establish environment as a self-standing sphere of social science enquiry, but also gave rise to environmental history as a sub-genre of writing Indian history. The environmental history, extremely influenced by the agrarian studies of the 1980s, dealt with a variety of themes. These include colonial forest policies, access to common property resources, ecological imbalances, and protests by the locals on environmental issues. The first wave of environmental history placed its focus almost exclusively on colonialism and its 'negative' impact on the Indian environment/eco-system. The more recent studies have however taken up a more complex themes

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such as how policy implementation shapes the formation of identities and acts as ways of state-making, and how strategies of representing nature and landscape lead to political control by means of legitimizing state intervention. The first wave of Indian environmental history may be termed as 'nationalist' since its concern was what colonialism did for national/natural resources. The second wave of writings may be called as 'revisionist' as it revises many of the shortcomings of the nationalist school.

In this paper I critically review the literature produced by these two schools of Indian environmental history. This paper engages the critical political ecology frame work to bring the multiple voices in the environmental historiography. I argue that a more nuanced understanding of Indian environmental history is possible only by a specific way of placing center-stage the environmental subjects, i.e. communities which work the environment for a living, their practices and world-views. So, this paper suggests the ethnographic method to move away from the archival sources.

10.2 The Nationalist School

The nationalist school of environmental history primarily argues that the ecological and environmental ills of different regions of India are a direct outcome of the exploitative colonial policies. The policies were motivated by concerns such as revenue augmentation, expansion of agriculture lands, and attaining of sleepers for railways, etc. Focusing exclusively on the causality of the ecological disorder this school falls into the 'cause-effect' model analysis.

One of the first works to examine the impact of colonial policies on the environment was Elizabeth Whitcombe's well-known study (1995) on irrigation. It examines how the irrigation investments and dam-construction activities of the British Raj led to ecological degradation, salinity and malaria in the regions of Sind and Ganges basins in north India. Likewise, Micheal Mann's detailed study (1999) on the agricultural transformation in the region of Ganga-Jamuna Doab during the early nineteenth century focuses on the salinity and mass destruction of woodlands due to the impacts of colonial forest policy. It forced the villagers to convert more than 70 % of forest areas into agricultural lands to pay out the revenue. Irreparable natural catastrophes like high level of moisture reduction in the air, spread of the saliferous soil by the sand carrying winds due to deforestation and the salinity level increased as a result of water logging in the agricultural fields. Subsequently, stringent famine and drought hit these areas. People could not endure diseases like malaria because of malnutrition. Villagers were forced to shift production from food to cash crops, leading to malnutrition. Moreover, they sold the agricultural lands to meet the tax payment requirements.

M.S.S. Pandian's study (1990) on agrarian transformation in southern Travancore during the late nineteenth and early twentieth centuries, argues that the activities of the colonial state such as construction of dams (which was meant to expand agricultural lands) and the policy of reserving forests altered permanently the pre-existing relationship between forest resources and peasant communities. This forced the peasant communities to depend on the market for to buy inputs and sell the agricultural productions. He shows such commercialization of agriculture destroyed the earlier agrarian stability in the region. Further, he argues that the central concern of colonial policies was to augment revenue. Likewise, Laxman Satya (2004) shows that the colonial regime severely disturbed the pre-existing equilibrium between forests, common and grazing lands, and agriculture in the Berar region of Central India. As a consequence, it damaged the local ecology, made human life more vulnerable, and resulted in epidemics.

A number of studies which falls within the nationalist school of environmental history deal with deforestation. Rangarajan (1996) and Guha (1989) have shown that during the early phase of colonialism, the British indiscriminately cut down forest trees for laying roads, ship building and railway sleepers. This resulted in considerable deforestation in different parts of British India. Subsequently, the British policy of sourcing the forests for wood became more systematic. The forest woods were classified based on quality. The superior quality woods were axed for commercial purpose by the colonial state (Rangarajan 1996). Rangarajan has also argued that while the forest-dwellers were hunting animals merely for food and survival, the colonial conducted hunting as a leisure sport recklessly killing an unprecedented number of animals (2001).

Within the nationalist school, Michael Mann's study (1998) focuses on the use of famine for profit making by the colonizer in the region of Chambal-Jamna in north India, where the scheme of food for work (felling and plantation) was implemented to counter famine conditions in the 1890s. The scheme was used as an instrument to control the famine-hit people and to involve them in other criminal activities. Furthermore, the episteme of 'scientific conservation' was strategically deployed to enhance the control of the colonial state.

The nationalist school taken up another important theme for analysis is how the British restricted the access of tribals and peasants to different kinds of natural resources on which their survival depended. While Madhav Gadgil and Ramachandra Guha (1995) examine how the 'eco-system people' (who make use of nature for their survival only collect those resources from their vicinity) have been exploited by the 'omnivores' (who can get natural resources from wherever they want, which is not only from the surroundings but also across the world through their political and economic clout). This categorization is made based on the concept of consumption. According to them, it helps to understand the socio-ecological classes of the natural resource exploiters. Bina Agarwal (2004) analyzes how the domination of man in local conservation institutions restricted the access of subaltern groups to natural resources and excluded women from administering the common property resources. Velayutham Saravanan's study (2001, 2003) examines how tribals were alienated from cultivable forest lands during the colonial and the post-colonial periods in Salem District of the Madras Presidency.

In the nationalist school, uprisings of forest dwellers against the colonial regime are registered by Saldanha (1998). It is noted as an earlier form of protest. The uprising was in varied forms when they were not allowed into the forest to access forest resources. Likewise, Guha (1985, 1989) examines the collective resistance and different forms of protests of the forest communities in the region of British Kumaon. The formation of collective resistance evolved from cutting across the communities. Guha tries to establish the resistance genre against colonialism.

Many of the studies within the nationalist school map out in detail how the colonial regime brought large areas of forests under its control and excluded the locals from them in the name of so-called 'scientific conservation'. The 'scientific conservation' was little more than an euphemism for the exploitation of forest resources for colonial needs. Significantly, the claim to 'scientific conservation' often took the form of 'desiccational discourses'. According to Saberwal (1999: 1), 'desiccational discourses' denote

> …a specific, interconnected set of ideas, centered on the connections between deforestation on the one hand, and increased erosion, flooding, and overall aridity on the other. A key characteristic of this discourse is the simplification of complex ecological phenomena, and, in turn, the attribution of culpability for land degradation to pastoralist, shifting cultivator, and other 'marginal' communities.

In other words, 'desiccational discourses' argued that the dependency of the environmental communities such as pastoralists and shifting cultivators on natural resources damaged the environments of other communities elsewhere. As Saberwal shows the colonial discourse on Himalayan degradation is an important case in point. It argued that forests served as some kind of sponge soaking up the rainwater, and claimed, 'Decreasing forest cover, as a result of wrong-use of land resources in the Himalaya is seen responsible for the annual flooding mayhem in the Indo-Gangetic plains…' (1999: 204). However, the theory of 'forest-acting-as-sponge model' has subsequently been questioned scientifically. Similarly, the so-called causal connection between shifting cultivation and soil erosion was also used to execute forest management principles. These management principles played major role brought large areas of forests under the colonial control. Such alarmist discourses were systematically used by the colonial authorities to have the traditional rights of the environmental communities over natural resources of different kinds.

As we have seen on a different but interconnected register in the nationalist school that claims the colonial regime as the singular source of environmental degradation in India. But, it celebrates the pre-colonial environmental practices of forest-dwellers and peasants as based on a symbiotic and non-exploitative relationship between humans and nature. This school also claims that the different streams of Indian religious thoughts were environmentally sensitive (Gadgil and Guha 1993). At one level, they argue that during the pre-colonial period, the forest dwellers, cattle grazers and peasants used natural resources primarily for their own survival without causing harm to the local environment. At another level, it is argued that Indic religions such as Hinduism, Jainism and Buddhism never endorsed wanton destruction of nature. In contrast, Christianity and Islam as religious thoughts and practices are claimed to have led to large-scale and indiscriminate destruction of the Indian environment. Some pigments of environmentalism are applied in the canvas of environmental history for romanticizing of the Indian religious traditions by the nationalist school. Gandhian politics is a case in point. For instance David Arnold and Ramachandra Guha (1995: 19) note, 'Gandhi's environmentalism has its roots in a deep antipathy to urban civilization and a belief in self-sufficiency, in self-abnegation and denial rather than useful consumption.'

In environmental history, the commodity aspect of forest is largely focused in the analytical domain of forest laws (Ravi Rajan 1998). Ravi Rajan's primary concern is to reveal the origin and politics of forest laws and how shifting cultivation, soil erosion, forest protection and development of forests were used as instruments to execute the forest management principles, to collect the revenue from people and to bring the areas under colonial control. The colonial regime had started the execution of those principles, which had been already implemented by the colonizer in the African continent, from where; without any modification it was put in to practice by the colonial state in British Raj. The exploitative nature of colonialism is primarily explained in his study.

The nationalist school has added exceedingly to our understanding of the environmental history of India. The factors that shaped it during the colonial period, they are marked by a number of important analytical problems. First and foremost, this literature gives centrality to colonialism as the cause of environmental degradation in India. By and large, it views environmental change as mono-causal. As a result, even while the literature addresses environmental concerns and changes, for most part, it turns out to be a history of colonialism. Second, the views and voices of the environmental subjects are to a large degree silenced; in a sense, the historians of the nationalist school speak for them instead of allowing the environmental subjects to speak out. If at all the environmental subjects figure in this literature, they figure only as responding to the oppression of colonialism by means of different forms of protests. Their subjectivity is thus treated as though defined only in relation to the colonial regime and its exploitative practices. Thirdly, being nationalist in orientation, it produces an environmental golden age out of the pre-colonial past and uncritically celebrates Indic religious thought and practices.

10.3 The Revisionist School

The revisionist school evolved along with the nationalist school yet found its fuller articulation only during the 1990s and after. Instead of treating the colonial regime, the local communities and the environment as pre-given, fully-formed and homogenous, this school primarily treats all these entities, which in their complex interaction account for the environmental changes, as evolving, heterogeneous, and following multiple historical trajectories. In other words, it unsettles the binary opposition between the colonizers and the colonized which is central to the nationalist school.

The works of Sivaramakrishnan (1999) and Agrawal (2006) conceptualize the relationship between the colonial state and the environmental subjects as mutually constitutive and changing. Sivaramakrishnan explores the dynamic changes and contestations between the forest dwellers and the colonial authority in the eastern India over a period of one-and-a-half centuries. He shows that the colonial forest principles were evolved in the intersection between the colonial administrative discourses and discourses of protest produced by the forest-dwellers, who showed their aggressive protests against British interventions in forests during the early phase of colonialism, the colonial state did withdraw the implementation of its forest principles. Subsequently, it had to introduce them in modified forms. As Sivaramakrishnan shows, '…through conflict and co-operation between a differentiated society and a heterogeneous colonial state in the making, rural social relations and colonial power were mutually transformed' (Ibid: 4–5). He treats the colonial state not as pre-given and as something which was being made and re-made in its interaction with the environmental subjects. Moreover, he argues that the process '…not only highlights the ecological and social peculiarities of the regions, but, more importantly, shows how the manner in which culture, nature, and power are spatially constituted and expressed, influenced processes of state making' (Sivaramakrishnan 1999: p. 2). In other words, Sivaramakrishnan's methodology deftly sidesteps the 'cause-effect' model of the nationalist school. In keeping with the spirit of pluralizing the ever-changing practices of state-making, he traces the origin of colonial forest policies within the colonial bureaucracy to at least three sets of competing and mutually influencing of practices: firstly, '…as a set of material technologies imposed on trees, grasses, and wild animals; second, as a legal regime aimed at appropriation and monopoly in the extraction of natural rents; and third, as a system of rational knowledge that, ironically, became the site of a struggle among technocrats who vied for professional recognition at the upper levels of bureaucracy' (Ibid: p. 3). We shall see more on this theme soon.

Arun Agrawal's research on the Kumaon region also argues that the formation of the colonial forest principles as well as the environmental subjects was caused by multiple and contesting influences. He argues that during the early twentieth century, the forest principles were used as instruments to bring the forests under the control of colonial authorities. However, faced with protests, the colonial state formed a committee which recommended that '…villagers should be permitted to govern their forests under a general set of framing guidelines' (Agrawal 2006: 5). These forest councils which were formed based on the recommendations of the committee, had been taking environment-related decisions since the 1920s. Agrawal calls them as regulatory communities. At present, there are more than 3000 village forest councils in the Kumaon region. As Agrawal argues, the environmental subjects thus created were a product of a range of processes. They '…emerge as a result of the involvement in the struggles over resources and in relation to new institutions and changing calculations of self-interest and notions of the self. These three conceptual elements- politics, institutions, and identities – are intimately linked' (Ibid: 5).

Studies by Akhileshwar Pathak (2002) and Gunnel Cederlof (2005a) which analyse the contradictions in the processes of implementing colonial forest laws, also fall broadly within this rubric of studies which treats the colonial state and forest laws not as pre-given but evolving. The implementation of colonial forest laws (which were, as mentioned earlier, treated as scientific, neutral, and meant to conserve the forests) was shaped with multiple and unforeseen difficulties. This was not merely because of the protests made by the forest dwellers whose traditional rights over natural resources were violated by these laws, but also because of the differences in understanding among the colonial officials about the nature of the pre-existing property rights among the indigenous communities. While the District administration adopted the local customs as the basis of law-enforcement and established a conflict-free relationship with the pastoralists in the Nilgris in south India, the Presidency level administration took a different view. It claimed 'absolute right' over communal land in the name of so-called 'national interest' and 'sovereign rule' by one sections of colonial administrators. These contradictory approaches to the rights of the local communities produced a chaotic situation on ground. The local custom was however abandoned over time and '…the South Indian hills were slowly integrated into the dominant administrative principles of the plains' (Madras Presidency) (Cederlof 2005a: 77). The implementation of the common law order thus produced much confusion even while it eventually alienated the local communities from accessing natural resources.

Cederlof's study of the Nilgiris significantly departs from the narrative of 'violent conquest and organized resistance'. This genre is central to the arguments of the nationalist school of environmental history. Nature of the relationship between the colonial regime and the local communities was contradictory. In unraveling the fuzzy and multi-faceted, she productively uses the categories such as 'contact zone' and 'transculturation'. While 'contact zone' stands for how 'the interaction between colonizer and colonized displays internal conflicts of the two parties, and different interests and identifications transgressed and blurred the major divide', 'transculturation' is 'a phenomenon of how subordinate groups select and invent from material transmitted by a dominant culture (in norms, language, institutions, hierarchies, etc.)…' (Cederlof 2005b: 250). On the basis of these categories, she shows that the 'confrontation [between the colonial regime and the local communities in the Nilgris] did not appear in open revolt but in various forms of resistance. This was articulated in petitions, depositions, refusal to appear for questioning, delaying of investigations by being absent, refusal to accept payment (or 'compensation') for loss of land, ruling out the validity of earlier agreements, filing court cases, and so on' (Ibid). In other words, they deployed everyday forms of protests against the British forest policies instead of open organized protests.

On a different register, Anand Pandian (2004) argues that the sources of the self of the environmental/agrarian subject cannot be reduced to the colonial encounter alone, though the colonial encounter did play a critical role in shaping local identities. In other words, he argues that the process of self-making by environmental/agrarian communities cannot be reduced to colonialism and its practices. The Kallar reclamation programme was initiated by the British government in the Cumbum Valley during the 1920s. The reclamation programme tried to 'reform' Piranmalai Kallars, a most backward caste branded by the colonial administration as a 'criminal tribe', by means of agricultural development and education. Dam irrigation and sedentary agriculture were conceptualized as the right means to make Kallars give up their old ways of ‘crime’ and to fashion a new modern selfhood for them. Foraying into history, folk and classical literature and ethnography, Anand Pandian (2004: 16) shows that the refashioning of the Kallar selfhood exceeded the language of reform deployed by the colonial state and found its articulation in a language of Tamil interiority and affect. As he notes, the problem of rural selfhood was ‘elaborated between the procedures of colonial administration and moral outlook of the cultivating citizenry, a modern endeavor that won its intelligibility in an order language of Tamil interiority.’ He also shows that the Kallars’ relation to the landscape and the very activity of cultivation were key sources of the agrarian moral universe and that of the environmental/agrarian self.

The revisionist school has also traced the different ideological influences that contributed towards the competing perspectives that the colonizers held about the Indian landscape/environment. In pluralizing the colonial moment, the work of David Arnold (2005) is important. He shows that, being totally different from the romanticized views of the Orientalists, the ‘traveling gaze’ of the colonial officials, as evident from travelogues, botanical studies and diaries, depicted Indian landscape as full of both disease and deceitfulness. The beauty of the Indian landscape was, thus, never pristine. Such negative discursive construction of what Arnold terms as ‘tropicality’, gave the colonial authorities the mandate to rework the Indian landscape or environment. Christianity and Benthamite Utilitarianism too had contributed towards such a mandate for colonial intervention though different from the ‘traveling gaze’ of the colonial officials. The key Utilitarian concept of ‘improvement’ helped in legitimizing the colonial regime’s desire to rearrange the Indian landscape.

If the revisionist school has conceptualized colonial power as varied, evolving and refashioned by local communities, it has also captured the relationship between natural resources and the indigenous communities during the pre-colonial and the colonial period as not merely one of non-exploitative symbiotism but also of power and exclusion. In other words, it looks at the indigenous communities not as homogenous but internally divided. Using the categories of ‘ecological zone’ and ‘cultural economy’, David Ludden (1978) has shown that the fertile lands in river belts of Tampirabarni, in the Tamil-speaking region were controlled and cultivated by the upper castes for a millennium. He underscores the role of cultural economy in such land control and argues that it was the caste system that enabled the upper castes to exercise control over fertile lands for such a long stretch of time. In a perspective differing from that of the nationalist school, David Ludden shows that the cultural economy of caste which was part of the indigenous social arrangement was unsettled by the colonial regime and, as a consequence, agrarian resources were reallocated to other communities lower down in the caste hierarchy. Similarly David Mosse’s (1997) study of the indigenous irrigation institutions and systems of water management and distribution within and across villages shows that the management of common property resources was not merely based on environmental consideration and notions of equity. They were shaped by multiple considerations based on caste, religion, and local-level politics. Thus, the resource management practices of the local communities were informed by caste and gender disparities and the systematic exclusion of subaltern communities.

The work of Vasavi (1996) shows how the social memory of the environmental subject is used to explain the expertise of colonial administration when it handled the famine relief programmes successfully in Bijapur district, Karnataka, in the early eighteenth century. Initially, it was negated because of other reasons (Already, the subaltern people had been getting relief from the traditional distribution system; it had a close relationship with caste hegemony. Moreover, people hesitated to get food from the outer cultural sphere particularly from the colonizer and feared that the religious conversion might take place if they get the famine relief from the colonial regime), later, locals hugely participated when it implemented with locals' understanding (It had broken the villagers' dependency on the traditional distribution system) and initiated public works (bonding and laying roads) at the regional level. Here, oral literatures are used to interpret the colonial administration from the colonized people's perspective.

In a significant methodological move to recover the environmental subjects as varied and diverse, Sivaramakrishnan and Gunnel (2005) of the revisionist school have argued that enframing environmental history within larger binaries such as metropolitan vs. nationalist (an analytical frame which is common in the nationalist school) will be inadequate for the task. They note that only local histories of particular communities can recover the environmental subjects. Thus, one needs 'to persuade historians and natural scientists to embark not just on grand themes in environmental history and discourse analysis, but on very local, small scale histories of single communities and their experiences of ecological pressures and change overtime, as part a broader social agenda aimed at local empowerment and environmental awareness' (Grove et al. 1998: 17).

In the spirit of treating the local communities as dynamic and not static, Sumit Guha (1999) offers us a different picture of the pre-colonial period. His study conceptualizes the pre-colonial period as one of people 'changing, adopting, and innovating' (Ibid: 6). The forest had been used by different communities for different purposes. And the pre-colonial period was marked by migration in search of economic prosperity, tribute extraction by local chieftains, interaction among different communities, and crossing of boundaries between castes and 'tribes' by communities. Given such a complex set of practices, he argues that the colonial categories such as tribal or aborigine, which treat the forest communities as static and tied to fixed localities, are analytically more constraining than illuminating. Further, he notes that the linear teleological account of treating societies as evolving from forest dependency to agricultural dependency or from the food-gathering stage to food-production stage does not capture the actual dynamics of pre-colonial society. For him, there was '… no single trajectory through historic time', but instead many. In critical ways, Sumit Guha's argument moves off from the depiction of the pre-colonial period as an environmental golden age by the nationalist school of environmental history.

Likewise, Agrawal's detailed work (1999) on the negotiating skill of a migrative agro-pastoral community, Raikas, with peasants and bureaucrats searching other alternatives for livelihood in a drought prone area of the northern district of Rajasthan in the post-colonial period. Dependency on the village grazing lands for cattle grazing was broken by the arrival of modern agricultural technological advancements (like chemical fertilizer, tube-well irrigation and fencing around the fields) and the conversion of the common grazing lands into the cultivational lands of the individuals. The complexity of collective migration (It is conducted based on multiple causes like the process of decision making to select the routes to go along with their cattle for grazing and to avoid the roadside cattle robbery, prospects of economic gain, hierarchy in informal organization of the community and mobility also play an important role) of the community is explained instead of the common rhetoric of "mobility is natural to risk". The study moves away from the essentialist categorical explanation to fragmented agency to portray the adoptive and active role of the subjects.

The struggle over natural resources between locals and the state is prevalent in the literature on environmental history. In it, the locals were portrayed as sympathetic beings or molded in the resistance genre whether in the colonial or postcolonial period. But, the study of Sundar (2007) gives a different picture of the dynamics of the resistances of forest dwellers (it took place when the development projects are implemented by the state to control and displace the forest community from the forest area. Since the pre-colonial period, it has been used for their livelihood) and encounters of state administration to map out the genealogy of the state from colonial to the post-colonial period, in the Bastar region of central India. Sundar studies the social memories and rituals to explain the resistance activities of the foresters and to map the changing the modes of resistance and resisting agents against the state over the time, be it colonial or postcolonial. The economy, society and politics of Bastar region were changed by colonialism 'through the imposition of alien structures of government, through unequal integration into larger capitalist processes, and through epistemological means' (Ibid: 11). In the colonial period, the state had floated the epistemologies of 'development', 'tribes', aboriginals' and 'frontier areas' to control the forest communities and forests. 'The policy followed by independent India did not differ substantially from that of the colonial state, either in its benevolent or repressive aspects' (Ibid: 189). To address the 'tribal question', Nandini Sundar emphasizes the need to move away from 'the idea of harmonious pre-capitalist village communities which are as much a myth as the notion that activists are motivated by a desire to keep tribals in museums. The question today is one of the effects of capitalism and the struggle for democracy at large, which is fought in culturally specific ways. In the process, culture too is created anew' (Ibid: 189–90).

As mentioned before, not only does the postcolonial state use pre-given notions on the forest communities such as 'aboriginals', 'tribes' 'wildness' to denote the so-called 'backwardness' and 'uncivilized', but, a self claming (In pre-colonial period, to valorize, people willingly called themselves as *Jangali*) phrase, *Janglijati* – the 'wild caste' or 'forest caste' is also used by the foresters of the Dangs in the forested region of the western India. The self claiming and ascribing phrase of wildness has heterogenic characteristics. The work of Ajay Skaria (1999) looks at 'constructions of wildness which were so inextricably linked to the notions of civilization as to make any opposition between the two pointless and misleading' (Ibid: viii). According to the classical Indian texts, not only was wildness 'central to kingship and authority' but was also catalyst to the state-making process in the pre-colonial period that is totally absent in the historical exercises. In the mid-nineteenth century, it 'had become the negativities through which the civilizing processes of colonialism and nationalism defined themselves in the age of modernity [due to settled agriculture, centralized state power and so on]. The wildness of *jangal* and the *jangali* had come to be contained within Kiplingesque exoticism or caste-tribe sociologism' (Ibid: xii). In the postcolonial period, wildness is coupled 'with marginality, social and ritual inferiority, and political powerlessness' (Ibid: xi). This characterization was made by British Raj. In the historical exercise, the forest communities are interpreted by the themes of colonialism, imperialism and nationalism. So, it could not capture the subaltern voices properly. To address the methodological issue of critical historiography ('the subject of Indian history usually speaks from within a metanarrative that celebrates the nation state; of this metanarrative the theoretical subject can only be a hyperreal "Europe", a "Europe" constructed by the tales that both imperialism and nationalism have told the colonized' (Ibid: 3)), Skaria explores the storytelling performance of the communities because, "Storytelling is a major aspect of Dangi life, and the past provides a means to reflect on and socialize the present". The cultural memories are cautiously used to capture the present meanings instead of the past alone. Both the studies of Nandini Sundar and Skaria identified the epistemological continuum of the colonial animation; it continues to be exercised by the 'development regime'.

In important ways, the revisionist school has provided us with a much more complex and nuanced account of the environmental history of India and revised several misconceptions of the nationalist school. To sum up, first, it has captured empirically how both the colonial regime and the local communities were mutually constitutive of each other. In other words, it shows that the will to power of the colonial state was not all that absolute but was constrained by the responses of the local communities. Second, the local communities were neither mere victims of the colonial rule nor valiant protestors. Their relation to colonialism was rather one of multiple negotiations which ranged from open protests to cooperation. Third, the revisionist school also unsettles the nationalist historian's romanticization of the pre-colonial indigenous community as informed by environmental virtue. Instead, the indigenous communities emerge in these studies as based on heterogeneity, power, and exclusion, and static but highly mobile and dynamic. Finally, in the name of developmentalism how the colonial epistemology continues in the postcolonial period is also captured.

10.4 Towards a New Presentism

It is more than evident from the above account of the revisionist school's forays into India's environmental history that it has succeeded in restoring the environmental subjects as significant and heterogeneous players in such history. Their subjectivities and identities are no longer represented as the direct result of colonialism. Yet revisionist school suffers from the important problem of reading the presentist concerns of the historian into the past, instead that of the environmental subjects.

It may be useful here to begin with a critique of a state initiative programme. In the present context, post-colonial state provides lots of funds for Agro projects in 'dry land' (It had been used for cattle grazing, collecting of green manures, taping palm juice from palm trees and collecting fire woods by the pastoral, peasant, palm juice dropper communities and agricultural laborers by villagers] to convert them into greens on the impact of environmental protective discourse. Pandian's micro-level study (1996) examines how the scheme alienated the dry lands from the land holders and helpful to the big agro companies to earn huge profits through the project in Kalakad and Cheranmahadevi blocks, Tirunelveli district.

The second account of the critique of the present-day environmental activism made by Amita Baviskar (2005a, b). According to her, motivated by their own middle-class understanding of the environmental issues and framing their concerns in grand global thematics, the activists miss out on the everyday issues of the local people and their perspectives on them. Often, this leads to the alienation of the local communities from the activists. As she notes, '…to remain 'ideologically pure' and undertake a politically more ambitious and risky strategy [by the activists] is seen by many tribal leaders as arrogance, made possible by the economic security that activists can always count upon due to their literature skills and middle-class family background' (Baviskar 2005a: 63). Similar to the position of the activists, the shaping of history-writing, even in the case of the revisionist school, is informed by the historians' own presentist concerns. In a certain sense, this is inevitable since writing the past is always informed by the concerns of the present.

However, if we look into the past by taking into account the concerns of the environmental subjects of the present-day, the very nature of the environmental history may undergo a different kind of transformation. The pressing post-colonial situation encountered by the Kani community compels us to persistently propose unusual explanations to understand 'their' problems that go beyond simple explanations such as those that suggest that they were uprooted for their development or to protect forests. These 'limited' explanations have also led to the privileging of ecological concepts such as 'eco system,' 'deforestation,' 'balance of nature,' and 'ecological equilibrium.' Demeritt (1994: p. 174) points out that 'environmental historians rely upon ecological science for explaining concepts like ecosystem and equilibrium that organize their narratives.' Ecological science concepts force environmental historians to reproduce the logic of existing environmental policy or the concept of forest conservation without questioning them, and to portray the marginalised community as 'destroyer' or victim of forest conservation initiatives. To get away from this conundrum, the critical political ecology framework has been adopted for two reasons, i.e., to question the dominant implementation of environmental policy and to retrieve local perceptions of nature in opposition to mononaturalism dominating the concept of forest conservation. The critical political ecology framework is helpful to unravel the influence of environmental science because it tries 'to address these two problems by exploring the links between science and society in order to avoid the replication of inadequate science, and to enable the production of more biophysically accurate, and socially relevant science.' (Forsyth 2003, p. 2). Further, critical political ecology seeks to contribute 'new forms of environmental explanation by providing more inclusive means to acknowledge local environmental concerns, and how such concerns have been addressed under the existing science' (Ibid: p. 9). According to Latour (2007, pp. 4–5), 'political ecology has nothing at all to do with nature, this jumble of Greek philosophy, French Cartesianism, and American parks.' It articulates nature through the modernist ideas of 'mononaturalism' and 'multiculturalism.' To transcend the modernistic ideas, Latour recommends pluralistic ideas of 'multinaturalism' in political ecology. The focus of this study is on the forest subject's perception of nature. Hence, this study enriches the field of environmental history by bringing on board multiple voices.

Let me give an example from my on-going field work in Tirunelveli district among the forest community of Kanis. From the late nineteenth century onwards, Kanis were subjected to immense hardships by the colonial regime. Their movement within the forests was increasingly restricted and they were forced to migrate from one place to another to carry out plantation work. Yet the community today remembers the colonial period in a positive light and celebrates it, even then, the colonial government remodified the forests commercially. Speculatively, the reason for such a representation of the colonial past could be the postcolonial misery of the environmental subjects. This seems to be true at least in the case of the Kanis. The forest areas of Kalakkad and Mundanthurai which are located in the hill inhabited by the Kanis were proclaimed as wild life sanctuary in 1962 and 1976 respectively. In 1988, both these areas were brought together and jointly notified as Kalakkad–Mundanthurai Tiger Reserve Forest. After this announcement, the Kanis are being systematically harassed by the forest authorities of the postcolonial Indian state. To borrow a phrase from E. P. Thomson (1968: p. 297), Kanis as today's environmental subjects are 'haunted by the legend of better days'. If the environmental history of India is written by taking into account the postcolonial misery of the environmental subjects and their presentist concerns, we will get at a history which is truly subaltern.

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Chapter 11
Where Many Rivers Meet: River Morphology and Transformation of Pre-modern River Economy in Mid-Ganga Basin, India

Vipul Singh

Abstract Looking at the changing nature of river economy this paper tries to examine the relation between economy and environmental history. Bihar province in mid-Ganga basin has the natural advantage of many rivers converging the Ganga. During the seventeenth and the eighteenth century the province went on to get linked with the maritime economy and trade, and the center of commercial activities shifted from Ganga-Yamuna doab to eastern part of the Ganga basin. Using Patna as the case study, the paper argues that region's orientation from west to east had grave implication on the river morphology. After 1765 when the British East India Company got the land revenue rights of the region it sought permanence in the administrative and revenue policies and to achieve this it encouraged construction of embankments and railways. It created obstruction to the natural flow of the flooding Ganga.

11.1 Introduction

'Water system' has been the central theme over the recent years for the environmental historians interested in understanding the impact of natural phenomenon on a region, specially the river.[1] In many of these researches, river historians often see

[1] Till very late the social scientists integrated nature, specially water, in analysis of historical and social development as a background only, because they believed that social science is a subject concerned with social facts, and a social fact could only be explained by another social fact. But now environmental historians have begun to deconstruct the non-social facts such as water to explain the society. See Terja Tvedt and Richard Coopey (eds.), *A History of Water*, *Series II*, *Volume 2*, *Rivers and Society*: *From Early Civilizations to Modern Times*, (London and New York: I.B. Tauris, 2010), pp. 3–26. Donald Worster is also very critical of the creation of some sort of wall around history as he says 'Somewhere, it seems, a great lawgiver has inscribed on a tablet of stone that water cycles, deforestation, animal populations, soil nutrient gains and losses are reserved for Science, while History must confine itself to tariffs, diplomatic negotiation, union-management conflict, race and gender. Science is supposed to deal with Nature; the scientists even

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'economic, social, and political currents' as crucial factors in the landscape transformation.[2] In early modern India, since land revenue was the most important source of income, ownership of land underwrote eminence and power in the society. It is, therefore, essential that while doing an analysis of the natural occurrences such as flooding which tend to shake the geography of a region, a linkage be established between economy and environmental history. At the same time, an analysis of the degree of human interference and control of the river system, and its influence on economy in turn is also pertinent. If we try to understand the transformation of the Ganga, as Mark Cioc sees in the context of the Rhine, 'from a free flowing to a harnessed river' over a long period of time, we may get a fresh light on the 'river system' perspective. The present study argues that river is perceived differently with economic and political changes. Attempt to create more sustained revenue mechanism and growing commercial interest led to increasing intervention of authority in river management, despite the fact that revenue extraction has been the characteristic of all early modern societies.[3] The commercial and trading activities of the East India Company during the seventeenth and eighteenth century steered a new body of professional intervention of river management. Contrary to the views of some scholars that economy declined with political weakening of the Mughals in the eighteenth century, the study argues that Bihar had its own trajectory of regional growth in the transition period. Patna emerged as the hub of saltpeter, opium and cotton trade and it engendered its orientation from Delhi/Agra in the west to Patna/Calcutta in the east. This transformation had important implication on the river system and its morphology in mid-Ganga basin. The annual inundation in the basin began to be perceived as flood events in the administration and scientific circles.

The Ganga basin forms one of the world's most extensive alluvial plains. It is home to hundreds of millions of people, mostly dependent on agriculture. Large rivers traverse the Ganga plains, and among them the Ganga itself is the largest that

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have a journal proclaiming that fact in its title. History, on the other hand, must deal with People, Society, and Culture'. See his 'The Two Cultures Revisited: Environmental History and the Environmental Sciences', *Environment and History* **2** (1996): 5.

[2] In depth analysis has been done for all major rivers of the world in the recent past, be it the Mississippi in United States, the Rhine and the Rhone in Europe, the Yellow river in China, the Amazon in South America, the Nile in Egypt, the Brahmaputra and the Mahanadi in India. Few of the most persuasive studies on rivers include, Donald Worster, *Rivers of Empire*: *Water*, *Aridity*, *and the Growth of American West* (New York: Oxford University Press, 1985); Lyman P. Van Slyke, *Yangtze*: *Nature*, *History*, *and the River Time*: *Environment and Society in Chinese History*, (Cambridge: Cambridge University Press, 1998); Mark Cioc, *The Rhine*: *An Eco-Biography*, *1815–2000*, (Seattle: University of Washington Press, 2002); Candace Slater, *Entangled Edens*: *Visions of the Amazon*, (Berkeley: University of California Press, 2002); Terje Tvedt, *The River Nile in the Age of the British*: *Political Ecology and the Quest for Economic Power*, (London: I.B. Tauris, 2004); David Blachbourn, *The Conquest of Nature*: *Water*, *Landscape*, *and the Making of Modern Germany*, (New York: Norton, 2006); Also Petri S. Juuti, Tapio S. Katko and Eija M. Vinnari (eds.), Special issue of *Environment and History*, 16/2 (2010); Pierre Claude Reynard. 'Explaining an Unstable Landscape: Claiming the Islands of the Early-Modern Rhone'. In *Environment and History*, 19 (2013): 40–61.

[3] James A. Galloway, 'Editorial Introduction', *Environment and History*, Vol. 19/2 (2013): 129.

flows from northwest towards east, finally descending in the Bay of Bengal (length: 2510 km; catchment area 980,000 km^2). The river originates in the Himalayan orogen, but when it reaches the mid-Ganga section the direction is from west to east and many rivers meet its natural channel. The Himalayan rivers – Gomati, Ghaghara, Gandak and Kosi meet the Ganga from the north, whereas Betwa, Chambal, Ken, and Son rivers that originate in the 'Central Indian Craton' feed the basin on the south.[4] Due to the gradual descent from the Himalayan Mountains, the rivers draining the Ganga basin have formed a 'large conduit of sediment transfer' from the Himalaya to the Ganga delta that gets accumulated in the Ganga plains.[5] It generates a thick fill of fluvial sediments useful for agriculture.

Bihar province covers a major portion of the mid-Ganga basin where many rivers meet the Ganga. Here the flow of water is more spread out due to congregation of different rivers from both north and south. Pre-modern evidences suggest that the Ganga and other rivers of the basin did not change its course permanently much in the mid-Ganga section, and because of its stable character a number of ancient towns and settlements remained in existence for long. The Persian and non-Persian documents nowhere talk about the changing course of the rivers, although they do mention about the temporary and reversible shift in the river course in the form of avulsion. James Rennell mentions how the Ganga had the tendency to form new islands in one part and sweep away other part of its course, meaning thereby that the shift in the Ganga at that time was temporary and cyclical.[6] In contrast, the tributaries of the Ganga in the mid-Ganga basin have undergone erratic changes in their course.[7] Last 500 years in particular have witnessed major shift in the river channels. The shift in the Ganga is more recent, but the Son and the Kosi have continued to shift in the northwest and west directions respectively. The Son has shifted some

[4] R. Sinha, S.K. Tandon and M.R. Gibling, 'Shallow sub-surface stratigraphy of the Ganga Basin, Himalayan Foreland: Present Status and Future Perspectives', *Quaternary International* 227 (2010): 81 accessed September 10, 2012. doi:10.1016/j.quaint.2010.07.015.

[5] R. Sinha, S.K. Tandon, M.R. Gibling, P.S. Bhattachargee, and A.S. Dasgupta, 'Late Quaternary geology and alluvial stratigraphy of the Ganga basin', *Himalayan Geology*, Vol. 26/1 (2005): 223. Also see Lewis A. Owen, 'Himalayan Landscapes of India' in Vishwas S. Kale (ed.) *Landscpaes and Landforms of India*, pp. 4–52 (New York and London: Springer, 2014).

[6] James Rennell, 'An Account of the Ganges and Burrampooter Rivers', *Philosophical Transactions of the Royal Society of London*, 71 (1781): 100.

[7] The Ganga has also shifted some 7 miles towards north from its earlier position over the last few decades. For recent shift near Patna see Vipul Singh, 'Gangetic Floods: Landscape Transformation, Embankments, and Clay Brick-making', in Ursula Münster, Shiho Satsuka and Gunnel Cederlöf (eds.), *Asian Environments*: *Connections Across Borders*, *Landscapes*, *and Times*, (Munich: Rachel Carson Center, 2014), pp. 23–28. For shift of the Kosi see Christopher V. Hill, *Rivers of Sorrow*: *Environment and Social Control in Riparian North India*, *170–1994* (Michigan: Association for Asian Studies, Michigan, 1997). The fluvial tendency of the Ganga has also been discussed by Nitin Sinha, 'Fluvial Landscape and the State: Property and the Gangetic Diaras in Colonial India, 1790–1890s', *Environment and History* 20/2 (2014): 209–237. In lower Ganga basin (East Bengal), Iftekhar Iqbal gives a fascinating description of the phenomena of shift and emergence of *diara* or *char* land. See Iftekhar Iqbal, *The Bengal Delta*: *Ecology*, *State and Social Change*, *1840–1943* (Basingstoke: Palgrave Macmillan, 2010), pp. 28–29.

3.5 miles from its earlier location, whereas the Kosi river has moved roughly 80 miles. Babur in his autobiography mentions that the Son flowed from Maner, whereas its present location is beyond Rampur *diara*.[8] Geologists link the changes to 'geomorphic diversity and tectonic history', which impact sediment supply into the basin slope.[9] The geomorphology of the region suggests that the long term changes in the course of the Ganga and its tributaries could be due to tectonic uplift, but it may also be suggested that the shifting of the river course got intensified in recent past due to embankments along the rivers in this mid-Ganga section.

11.2 River Morphology

The major rivers of the Ganga basin emanate from the Himalayan range of mountains. The formation of the Himalayas is quite recent phenomena in terms of geological formation. It was formed as a result of the geological process of the drift of the continents due to lateral pressure of the southern landmass on the Asian mainland. The Ganga basin was formed as a result of this 'uplift of Himalaya after the collision of Indian and Asian plates'. The longitudinal and transverse faults along with the basement configuration of the Ganga plains have long been considered to influence the fluvial processes and sedimentation.[10] The geological scientists, therefore, argue that the active faults impact deformation at local level, and thus, influence the geomorphology of the region. But seen from historical perspective, constructing our understanding on archival and textual references, the effect sounds intriguing. It also seems stimulating, as the phenomena of changing courses are very recent. So what could be the possible reasons? What are the additional factors involved other than the faults underneath the river basin? Another important enquiry would be to understand the changing political economy of the region, which induced changes in the river system.

The Himalayas is still in a nascent state and because of this it is largely a mountain of loose soil. The melting of the glaciers on the higher reaches of the Himalayas in the months of June, July and August, and the monsoon rains during these months wash down the loose soil into the rivers flowing from here. The upper section of the Ganga basin is very steep and so the loose soil that it carries in the form of sediments come down to the lower reaches with river water. These sediments deposited in the lower areas obstruct the flow of rivers in the succeeding monsoon season.

[8] Zahiru'd-din Muhammad Babur, *Baburnama*, *II*, tr. A.S. Beveridge, First published 1922 (Delhi: LPP, Reprint 2014), p. 667.

[9] Ancient channels of the Ganga, the Son and the Punpun and their avulsion have been shown through remote sensing technique by N.K. Maitra and N.C. Ghose, *Groundwater Management* (New Delhi: Asish), p. 28.

[10] R. Sinha et al. 'Late Quaternary geology and alluvial stratigraphy of the Ganga basin', *Himalayan Geology* 26/1(2005): 223. Accessed 6 November 2012. http://home.iitk.ac.in/~rsinha/PDF's/2005_HimalGeol.pdf

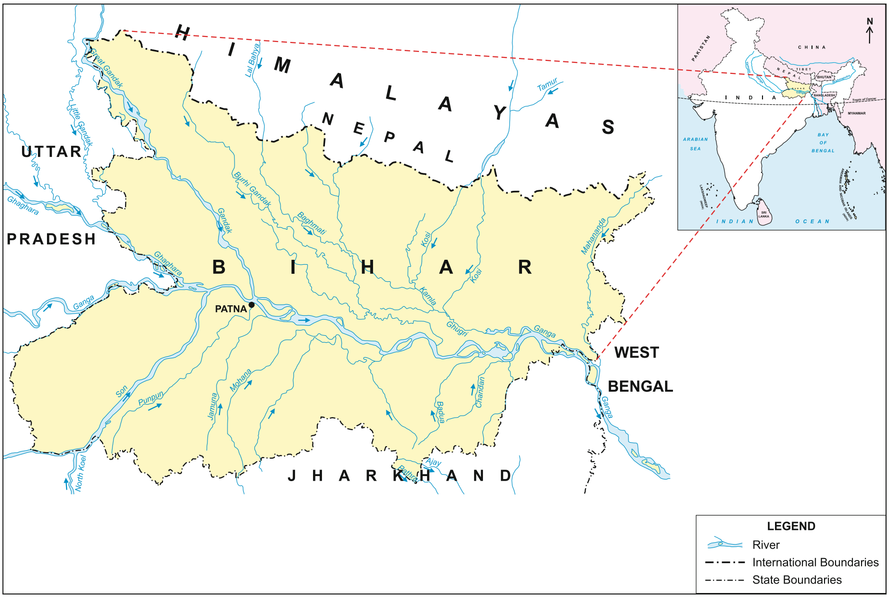

Fig. 11.1 Confluence. Bihar Province in the mid-Ganga plain fed by the rivers originating in the Himalaya to its north and the rivers originating in Indian Craton to its south, with confluence of many rivers in the Ganga around Patna. The Ganga divides Bihar province into north and south Bihar

Resultantly, the rivers often cut a new path in the hugely spread-out riverbed through the deposited sediments. So 'frequent avulsion of rivers' is very common in the region (Fig. 11.1).[11]

11.3 Pre-modern Traditions

The mid-Ganga basin has been the most populated region of the subcontinent ever since the Aryans settled down in the region. Largely because of the vast flood plain with huge production possibilities that many ancient settlements such as, Pataliputra,

[11] R. Sinha et al. 'Late Quaternary geology', p. 235. One of the British travelers of the mid-nineteenth century, W.W. Hunter has also recorded this character of the Indian rivers in contrast to the European rivers. 'In its [river] first stage it runs on a lower level than the surrounding country, winding through mountains valleys and striking the base of the hills. During this long part of its career, it receives innumerable streams and tributaries from the higher country on both banks. So far it answers to our common English idea of a river. But no sooner does it reach the delta than its whole life changes. Instead of running along the lowest ground, it gradually finds itself hoisted up until banks form ridges which rise high above the adjacent country….presents a completely different set of phenomenon from those we are accustomed to in European rivers.' Cited from Rohan D'Souza, *Drowned and Dammed*, (Delhi: Oxford University Press, 2006), p. 26.

Varanasi, Hastinapur, Kaushambi etc. came up.[12] Ancient Indian literatures have various mentions of flood phenomena, and in fact at one place the *Narada Purana* (an ancient literature) says that the Ganga does not overflow beyond its known boundaries, what it calls as the riverbed. And roughly 70 m on both sides beyond the riverbed is the riverbank. Further, the literature is also emphatic on the fact that up to 5 km on both sides beyond the river bank is the river belt. The *Purana* prohibits people from residing within the river bed and river bank and recommends dwelling only in the river belts and beyond. Similarly, medieval chronicles such as *Baburnama* and *Akbarnama* also underline the 'turbulent hydrograph of the rivers', which has historically been causing floods, erosion and avulsion. However, the turbulent nature of the rivers in the mid-Ganga section causing inundation also has a fertilizing impact on the agricultural field.[13] The late eighteenth century sources also talk about the turbulent Ganga.[14] The flow of the river also has the tendency to carry away soil and deposit it on the wide riverbed itself. This leads to shift of the river course leaving behind islands called *diara* land that is used for cultivation. In the initial year the new land is filled with white sand that is not very productive, but in subsequent years it gets leveled by productive silt.[15] After 8–10 years the river course normally comes back to the original position, thereby characterising the shift as temporary and cyclical.[16] This is something that I know as priori because of being born and brought up in the region.

Flood is quite common in the zone. Buchanan in his account that he wrote in 1811–1812, clearly mentions that 'there are no embankments for excluding floods of considerable size', and few of the low lands were 'secured from superfluous water by banks of no great height' that normally surrounded the land.[17] In his notes regarding embankments, the Under Secretary to the Government of Bengal writes that embankments have existed for long and they must have been erected in order to prevent the spread of the rivers into the cultivated land. 'Originally Bunds must have been constructed at different intervals of time, and in detached pieces…by different individual cultivators to prevent their cropped land from inundation'.[18]

[12] The grammarian of second century BCE, Patanjali in his *Mahabhasya* mentions these cities. Cited from Dieter Schlingloff, *Fortified Cities of Ancient India*: *A Comparative Study* (London: Anthem Press, 2013), p. 33.

[13] James Rennell, 'An Account of the Ganges': 100–101.

[14] Meena Bhargava, 'Changing River Courses in North India: Calamities, Bounties, Strategies-Sixteenth to Early Nineteenth Centuries', *The Medieval History Journal*, 10/1–2 (2007): 200–201.

[15] Extract of the Letter from the Collector Benares to the Board of Revenue, 5 Dec. 1808, Proceedings of the Board of Commissioners: Ceded and Conquered Provinces, 18 May 1809, Uttar Pradesh State Archives, Lucknow.

[16] In the local parlance the cyclical process of river is termed as *karari* (that goes inside the river) and *barkarari* (that emerges after the receding of water flow).

[17] Francis Buchanan, *An Account of the Districts of Bihar and Patna in 1811–12* (Patna: The Bihar and Orissa Research Society, 1934), p. 537.

[18] Ibid, pp. 27–28.

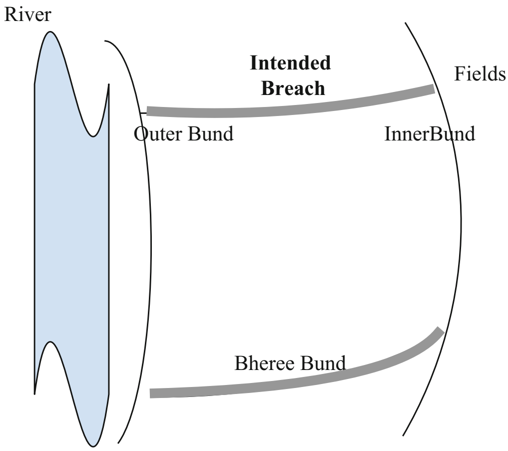

Fig. 11.2 Traditional Bund. Rough sketch as presented by the Under Secretary to explain the types of bund in various Districts of Bengal (After Bengal Government asked for Certain Papers Related to the System of Embankment, Home Department, Revenue Branch, 28 march 1851, 20/21, NAI, 36)

There were various types of embankments in Bengal, and they were built along the rivers mainly to protect the fields.[19] There were certain embankments that were cut in the rainy season in order to adjust to the inland drainage. The main embankments were filled again when the rains have ceased. *Bheree* bunds were generally small interior bund in the villages useful for the daily requirements of water in the villages, and were connected with the main river. The *bheree* bunds run at about right angles from the outer to the inner bunds subdividing the space between the two, and are intended, in case of a breach in the outer bund, to retain the water within the subdivision where the breach takes place, instead of allowing it to overflow the whole of the space. Traditionally, the people of the region also constructed large reservoirs for conserving water. Buchanan mentions that small canals were used to bring water from the river and these were maintained by the zamindars. It enabled the farmers to 'bring the crop of rice to maturity' and also to 'rear a winter crop of wheat and barley'.[20] The cultivators also used wells – *inara* and *kunya. Inara* were lined with brick and were constructed by the zamindars, whereas *kunya*, which were not lined were made by the cultivators themselves. The peasants in the mid-Ganga basin produced two major types of crops- *aghani* and *rabi*. Rice was the main *aghani* crop which was sowed in June–July during the monsoon and reaped in November. Rabi was the spring crop which included wheat, barley, gram and pulses, and was sown in December and reaped before the onset of the monsoon.

Broadly speaking two major assumptions could be derived on the basis of the traditional pre-colonial agrarian practices. First, the inundation of the cultivable field was as important as the drainage so that the floodwater recedes without obstruction, and the heavier silt goes back to the main riverbed. Secondly, in a floodplain

[19] Bengal Government asked for Certain Papers Related to the System of Embankment, Home Department, Revenue Branch, 28 march 1851, 20/21, NAI, 32–33.

[20] Francis Buchanan, *An Account of the Districts of Bihar and Patna*, p. 535.

like the Ganga basin land revenue administration may not be separated with river system. In other words, flood may be understood as part of geomorphological process and may not be seen as calamity of sort to control it.

The administration couldn't realize the significance of these conventional embankments along the rivers in the Ganga basin, which had evolved over a long period of experience of flooding. Since the Colonial government was more concerned with the collection of fixed and sustained revenue from the fields it felt that these conventional embankments 'have failed to answer these objects [objectives] effectively.'[21] The official correspondence often reports of the damage done by floodwater due to failure of the bunds.[22] The officers believed that the bunds were not effective because they were not continuous on the banks of the rivers, which to them was necessary for the protection of a tract of country from inundations. They were perturbed by the erratic and perpendicular designs as is evident from the Under Secretary official note – 'Sometimes they follow the course of the river upon the banks of which they are constructed and sometimes they are placed further in the land. This disposition may have been adopted in some cases by their constructors. However, in most instances it has been attributed to the natural consequences of uncontrollable changes in the course of the rivers'.[23]

In 1851, the Under Secretary to the Government Bengal forwards copies of the documents related to embankment matters to the Under Secretary to the Government of India in the form of a report of the damage done in certain provinces by the failure of the bunds. The Military Board, in fact, recommended for the general abandonment of the bunds and construction of entire new lines of bunds parallel to the main river channels for being more effective.[24] A section of the of the bureaucracy, quite contrary to the view of the military department that handled the public works, had a clarity on the real situation of the region and they argued that how the overflowing fresh water of the rivers possesses a fertilizing quality and the silt that is deposited by them improves the land and increases its productiveness –

> Rivers rising in the mountainous tracks of country bring down stones, gravel, sand and other materials…that the heavier of these substances are first deposited, and the farther we get from the hills the finer is the deposit. The light rich soil or silt also carries along with these streams is chiefly held in suspension in the upper part of the column of water and the sand is generally some depth below its surface and this accounts for the fertilizing effects of the Ganges…The fact of the fertilizing deposit is shown in the frequent cutting of the Bunds by the cultivators for the purpose of irrigation; these lands and lands that are irrigated by the natural inundation of the Rivers, are more productive than those that are not overflown by their waters.[25]

There were conflicting opinions on the recommendation of the Military Board. Major Garstin suggested that not to abandon the bunds altogether on the ground of

[21] Bengal Government asked for Certain Papers, 37.

[22] Bengal Government asked for Certain Papers, 13.

[23] Ibid, 38.

[24] Ibid, 13–14.

[25] Bengal Government asked for Certain Papers, 53–54.

revenue loss to the state. He wrote – 'The evils of this would now be, to throw thousands of square miles out of cultivation for the greater part of the year, and cause a consequent loss of revenue'. Similarly, Captain Green suggested that '…now that they have been made, my opinion decidedly is that such a measure would be cruel to individuals and injurious to the state'.[26]

By mid nineteenth century the government had started realizing the ill effects of the embankments that were constructed during the last 50 years, specially after the Permanent settlement. It was well conceived in 1851 by some officials that '…by confining Rivers between Bunds the measure has effect of gradually silting up their beds above the level of the surrounding lands'. This would mean that the rivers would gradually quit their beds when they had arisen above the level of the land, specially when the water level decreases in the river. But there were dominant opinions in favour of continuance of the embankments. Captain Smyth, who was considered an authority on these matters, remarked that 'in the first place it is a mistake to suppose that embankments cause the level of Rivers to rise.' He argued that although many rivers do heighten the level of their bed, but this is caused by the deposition in the channel of stones, coarse sands brought down during floods, and this occurs when the velocity of water is diminished. So to him, these obstructions gradually accumulate and raise the riverbed leading to frequent inundation, and eventually a change of course for some lower level. To prove his point Captain Smyth also cites the example of many of the rivers in Italy where '…embankments have been constructed to confine the water to their existing bed', and therefore, 'the heightening of the bed from natural courses rendered the embankments necessary'.[27]

In the case of the Kosi in mid-Ganga basin, Christopher V. Hill while discussing the impact of the shift argues that the colonial government's attempt to define populations and map the land was problematic as the land often moved into the river and went out of cultivation with the changing course.[28] He stresses on the difficulty in having stable systems of tenure, ownership, or exploitation in such changing landscapes. The implied conclusion that emerges from Hill's argument is that the British rule with its European perceptions tried to extract maximum revenue even from such a hostile Kosi floodplain. For a more stable floodplain of the Ganga it might have been more rewarding for the state machinary. And precisely because of this the Ganga floodplain in Bihar, which was more stable and did not have the history of permanent shift, was looked at by the colonial dispensation with more materialism during the eighteenth and the nineteenth century.

[26] Ibid, 67.

[27] Ibid, 52–53.

[28] Christopher V. Hill, *Rivers of Sorrow*, pp. 13–14.

11.4 Transformation of River Economy

The archaeological and literary sources indicate that present city of Patna located on the banks of the river Ganga actually stands on the ruins of the ancient city of Pataliputra, which was the capital of the Mauryan empire.[29] The Greek ambassador of Seleukos Nicator, Megasthenes, who visited the court of Chandragupta Maurya around 300 BCE, reports that Palibothra (Pataliputra) lay at the confluence of the Ganga and Erranoboas [Son]. The city was very huge and had a defensive moat around it. It was the largest city of its time, as Alexandria comprised only one third and Rome half of its size.[30] Other than Pataliputra, the mid-Ganga basin also had few important urban centers such as Champapuri, Vaishali, that grew as political centers and Nalanda, Vikramshila, that were centers of learning.[31] The powerful territorial states such as Magadha, Anga, and Vrijji listed in Buddhist texts were also located in the Ganga basin.[32]

During the rule of the Mauryas, the Kusana and the Guptas mid-Ganga region continued to exist as agriculturally surplus-producing zone for the ruling authorities. After the establishment of the Turkish rule, the center of power shifted to Ganga-Yamuna doab – first in Delhi and then to Agra under the Mughals. Resultantly, the mid-Ganga region of Bihar lost its stature as political center and as nerve center of learning. The region began to be treated largely as favorably productive agricultural zone because of the annual occurrence of flood. Bihar came under the control of Akbar in 1574 and it was made a separate *subah* (province) by him with Patna as its capital.[33] *Subahdars* (Governors) were appointed to look after the revenue collection. Like the earlier Sultanate dispensation ruling from Delhi, the Mughal empire too depended on exploitation of the agricultural surplus.[34] In Bihar province, Abul

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[29] Anant Sadashiv Altekar, Vijayakanta Mishra, *Report on the Kumrahar Excavation*, *1951–55*, (Patna: Kashi Prasad Jayaswal Research Institute, 2005); Earlier it was James Rennell who proved that Pataliputra, as recorded by Megasthenes and Strabo is identical with present day Patna. See his *Memoir of a Map of Hidoostan*, p. 49.

[30] Dieter Schlingloff, *Fortified Cities of Ancient India*: *A Comparative Study*, (London: Anthem Press, 2013), p. 32.

[31] Romila Thapar, *The Penguin History* of *Early India*: *From the Origins to AD 1300*, (New Delhi: Penguin Books, 2002), p. 139.

[32] Magadha corresponds to modern Patna and Gaya districts, and was bounded on the north and west by the rivers Ganga and Son, on the south by the Vindhya mountains and on the east by the river Champa. Rajagriha or Girivraja, surrounded by five hills, was the Magadhan capital. Anga in the east of Magadha roughly corresponds to the modern districts of Monghyr and Bhagalpur. The Vrijji territory lay north of the Ganga and stretched as far as the Nepal hills. Its western limit was the river Sadanira i.e. modern Gandak, and Vaishali was the capital of the Vrijji confederacy. States such as Kasi (capital at Varanasi), Kosala (capital at Shravasti), and Vatsa (capital at Kausambi) in modern day eastern Uttar Pradesh were also situated in the Ganga basin.

[33] Abul Fazl, *Ain-i Akbari*, *Vol II*, tr. H.S. Jarrett, First published 1927 (Delhi: LPP, Reprint 2011), p. 162.

[34] Irfan Habib has discussed in detail about the oppression of the peasantry under the Mughals, and how the appropriation of land revenue created the wealth of the ruling class. The revenue demand was designed to such a level that peasants were left with grains barest minimum needed for subsis-

Fazl very emphatically mentions, ‘agriculture flourishes in high degree’ in the province with gross revenue of approximately Rupees 5.5 million.[35] Trade of grains from the east was mostly carried to the west to Agra, and from here to Lahore and Multan. River was the cheapest means of transport. Salt was shipped to Patna downward during the rainy season, and during rest of the year grains was shipped up the Ganga to Agra.[36] Thus, before the advent of the European trading companies trade and commerce from Bihar was mainly agro-based.[37]

Seventeenth century saw the coming of the European companies to Bihar for the export of calicoes, saltpeter and opium. By mid seventeenth century the Dutch East India Company established its factory in Patna with two saltpeter collection agencies at Chuprah and Singia.[38] In the next two centuries the region got firmly linked with the maritime economy and trade, and the center of power shifted from Ganga-Yamuna doab to eastern part of the Ganga basin. Patna surfaced as an important trading and commercial center because of its location on the confluence of rivers both from north and south.[39] It had huge natural advantage of connection from all parts of India through the Ganga, the Gandak, the Punpun, the Son and the Kosi and the roads from Lahore via Delhi and Benares provided overland trade routes to Central Asian land and West Asia as well.[40] An Indo-Persian text of mid-eighteenth century, *Bayan-i Waqi* of Khwaja Abdul Karim, mentions that Patna emerged as important commercial center, and the Franks (Europeans) had built large trading houses.[41] The emergence of Patna as a center of export for saltpeter, opium and cotton led to the inclination of Patna towards Calcutta (in the east) and gradually it lost its trading linkages with placed to its west.[42]

Calcutta was the main port of the East India Company, and from here links with various production centers were established through river transport. During the

tence. See Irfan Habib, *The Agrarian System of Mughal India 1556–1707* (Delhi: Oxford University Press, First published 1963, Third edition 2014), pp. 366–378.

[35] Abul Fazl, *Ain-i Akbari*, *Vol II*, pp. 164–65.

[36] Irfan Habib, *The Agrarian System*, pp. 70–71.

[37] Ranjan Sinha, ‘Patna as a Manufacturing and Trading Center (1765–1865)’, in Qeyamuddin Ahmad (ed.), *Patna Through the Ages* (New Delhi: Commonwealth Publishers, 1988), p. 179.

[38] Om Prakash, *The Dutch East India Company and the Economy of Bengal*, *1630–1720*, (Princeton: Princeton University Press,1985), p. 39 and f.n. Irfan Habib says that an important sea-borne trade also developed in Bengal silk through the agency of the Dutch. See Irfan Habib, *The Agrarian System*, pp. 78–79.

[39] In a different region of the mid-Ganga basin, Gorakhpur, Meena Bhargav has shown how under East India Company the existing economic prosperity of pre-modern times continued throughout the eighteenth century. Meena Bhargav, *State*, *Society and Ecology*: *Gorakhpur in Transition 1750–1830* (Delhi: Primus Books, 2014), chapter 7 and p. 190.

[40] Qeyamuddin Ahmad, ‘Commercial-cum-political Activities of the Patna Factory of the East India Company (1707–1739)’, *Journal of Bihar Research Society*, XLII/1–4 (1976): 168–83.

[41] Muzaffar Alam and Sanjay Subrahmanyam, *Indo-Persian Travels in the Age of Discoveries 1400–1800*, (New Delhi: Cambridge University Press, 2007), p. 282.

[42] Nitin Sinha, *Communication and Colonialism in Eastern India*, *Bihar*, *1760–1880s*, (Delhi: Anthem Press, 2013), p. 79.

entire eighteenth century and first half of the nineteenth century the colonial government, although spent much funds to build and maintain a system of roads in the hinterland to overcome what Fernand Braudel calls ‘tyranny of distance’ of the pre-eighteenth century period, it considered the Ganga, which was navigable throughout the year, as the principal river highway across the vast Ganga plain.[43] The Ganga as a ‘channel for trade’ was suitable to the British because of its natural links as it was connected to all the major rivers and streams in the entire agricultural plains of north and south Bihar. It was used for shipping huge amount of saltpeter and grains to Calcutta port. This transformation had important implication on the river system and its morphology in mid-Ganga basin. The annual inundation in the mid-Ganga basin began to be perceived as flood events in the administration and scientific circles. Rivers thus played the role of primary highways once the British began to govern the region, and roads could develop as connections to the riverbanks and later to railways only during the late nineteenth century. Many of the roads of pre-modern times situated along the Ganga faded in importance because the new focal point had shifted from Delhi to Calcutta.

11.5 Embankments as Solution to Flood

The annual occurrence of flood lead to deposition of very fine silt in the agricultural fields of Bihar. The beneficial mud rich in organic matter gets deposited in the fields, and relatively heavier sand particles harmful to the fields got swayed away with receding water level to the main river bed. It is because of this reason that rice was the most popular crop here, and this has been specifically mentioned by the sixteenth century Persian text *Ain-i Akbari*.[44] The cultivators traditionally tried to harness flood, and produced rice to reap the maximum benefit of the wet field. We also get evidence in the medieval chronicles that pre-modern regimes never tried to challenge the river ecology and tried to adjust with the flood.

Once the commercial interest became the dominant motive of the ruling authority in the region under the East India Company, the age-old idea of not to disturb ‘natural flow regime’ went into the background.[45] The archival records suggest that

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[43] Anand Yang, *Bazaar India*: *Markets*, *Society*, *and the Colonial State in Gangetic Bihar*, (Delhi: Munshiram Manoharlal Publishers, 2000), pp. 26–27.

[44] Abul Fazl, *Ain-i Akbari*, *Vol II*, p. 162.

[45] The crux of natural flow regime thesis is that the natural flow of a river varies on time scales of hours, days, seasons, years, and longer. The proponents of the thesis argue that many years of observation are generally needed to describe the characteristic pattern of a river’s flow quantity, timing, and variability, i.e. its natural flow regime, and the first step toward better incorporating flow regime into the management of river ecosystems is to recognize that extensive human alteration of river flow which has resulted in widespread geomorphic and ecological changes in these ecosystems. So the history of river use is also a history of flow alteration by humans, and it is through it that we can better manage the rivers. See N. LeRoy Poff et al. ‘The Natural Flow Regime: A Paradigm for River Conservation and Restoration’, *Bio Science*, 47/11 (1997), pp. 769–784.

the colonial dispensation looked for permanence in its administrative and revenue policies, and for that it sought permanence in the ecological setting as well, and that is why it encouraged the construction of embankments. Historians who tend to argue that control mechanisms evolved under colonialism in response to Indian experiences need review.[46] The ecological condition of the region was not on priority while homogenizing the law (Embankment Act) for the entire river system. Although any assumption for a 'strong standardization' would be ambiguous, but it is also possible that because of their environmental ignorance the colonial state took ecologically disastrous measures that were geared towards revenue maximisation.[47] After the East India Company got the *diwani* (land revenue) right in Bengal in 1765, a major worry for them was flood, which occurred annually in the mid Ganga basin. It altered the very nature of land revenue from erstwhile emphasis on the gross output to a rent on the land. The Mughal land revenue system was gradually undone and substituted by the zamindari tenure system. The idea of constructing embankments was floated for protecting cultivated land as property as the inundation of the land was treated as loss of rent. In the process the river morphology of the province took the back seat.

The region already had the history of protection from floods through traditional bund or embankments. The Kosi in Bihar was embanked in the twelfth century by a king, locally known as *Birbund*. The remains of the embankment are still seen along the eastern bank of the Kosi. Francis Buchanan (1810–1811) considered this embankment as a 'line of fortification' that ran along the western bank up to Tiljuga, a river that came from west to join the Kosi.[48] The Nawab of Bengal earlier in 1756 had constructed 158 km long Gandak embankment. As is evident, the construction of embankments in the Ganga basin has not been a new phenomenon, but they were not continuous and were very small as they were built to protect settlements. They were 'erected in order to prevent the incursions' of the rivers into the cultivated land when the waters were raised 'to an unusual height'.[49]

The Mughal revenue administration of the sixteenth and the seventeenth centuries was based on share of the produce. The grant of revenue rights of Bengal to the East India Company in 1765 led to the exploitation of tenants by the zamindars and various other officers, as there was no control over these officers by the administration. And in 1770 came the famine in Bengal and Bihar and all the areas of the

[46] Peter G. Robb, *Ancient Rights and Future Comforts*: *Bihar*, *the Bengal Tenancy Act of 1885*, *and the British Rule in India* (Richmond: Curzon, 1997); P.J. Marshall, *Bengal*: *The British Bridgehead*, *Eastern India 1740–1828*, (Cambridge: Cambridge University Press, 1987); Michael Mann, 'A Permanent Settlement for the Ceded and Conquered provinces: Revenue administration in north India, 1801–1833', *IESHR*, 32/2 (1995): 245–269.

[47] In a recently published paper the flawed and environmentally ignorant mechanism of the colonial state has been highlighted in the context of fluvial *diara* land. Nitin Sinha, 'Fluvial Landscape': 225–226.

[48] Francis Buchanan, *An Account of the District of Purnea in 1809–10* (Patna: Bihar and Orissa Research Society, 1928), p. 72.

[49] Home Department, Revenue Branch. 28 March 1851, NAI, 20/21: 27.

Gangetic basin were terribly affected. Measures taken by the administration to improve the revenue system did not work and so finally in 1793 Lord Cornwallis came up with idea of Permanent Settlement. But this one time settlement with the zamindars led to enhancement of rent, and 'unauthorized exactions, evictions and other kinds of oppression' against the tenants continued.[50] The Permanent Settlement was a point of departure for the traditional system of flood management.[51] Initially, for almost a century, after getting the revenue rights of Bengal, the main effort of the colonial company government was to pressurize the zamindars to maintain and strengthen the existing embankments. This they did with intention of avoiding any kind of difficulty in the collection of revenue due to destruction of crops every summer with inundation. The intention of the government is clear from the terms of the permanent settlement of 1793.[52] If we look at the very core of the Permanent Settlement scheme of 1793 it states that no remission was to be claimed or granted on the claim of loss from inundation. Thus, although the Zamindars might have been the forerunners of building flood control structures, the colonial government was responsible for strengthening them. The Zamindars were forcefully appended to it.[53] William Willcocks has suggested that the colonial engineers were possibly

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[50] R.N. Sinha, *Bihar Tenantry* (*1783–1833*) (Bombay: People's Publishing House, 1968), p. 147.

[51] Michael Mann's conclusion on the implication of permanent settlement that 'the methods of revenue assessment' altered 'very little from the Mughal era' is questionable as we find that the Mughal revenue administration was intense at the local level with officials like *qanungo*, *chaudhuri*, *taluqdar* etc., and it also 'incorporated a degree of flexibility'. For the two contrasting views see Michael Mann, 'A Permanent Settlement for the Ceded and Conquered provinces' (as above); Irfan Habib, *The Agrarian System* (2005); Asiya Siddiqi, *Agrarian Change in a North Indian State: Uttar Pradesh 1819–1833*, (Oxford: Oxford University Press, 1973). Rohan D'Souza has also done a survey of literatures on the Mughal and Colonial system of revenue administration. See his *Drowned and Dammed*, (Chapter 2) pp. 51–96. In one of the recent works, however, Permanent Settlement has been shown as not been implemented in eastern Bengal because it was criticized within the colonial bureaucracy itself. See Iftekhar Iqbal, *The Bengal Delta*: *Ecology*, *State and Social Change*, *1840–1943* (Basingstoke: Palgrave Macmillan, 2010), ch. 2.

[52] The legislation bearing on the subject is to be found in Regulation XXXIII of the Code of 1793, and in two sections of Regulation VIII of that Code, which contained that provision should be made for the annual repair of embankments. For details see Henry Leland Harrison, *The Bengal Embankment Manual*: *Containing An Account of the Action of the Government in Dealing with Embankments and Water-Course since the Permanent Settlement* (Calcutta: Bengal Secretariat Press, 1875), p. 2.

[53] It would be erroneous to consider the role of Zaminadars in the embankment affair as that of significant partners as Praveen Singh has shown in the case of Kosi region in Praveen Singh, 'The Colonial State, Zamindars and the Politics of Flood Control in North Bihar (1850–1945)', *The Indian Economic and Social History Review*, 45, 2 (2008), p. 243 (hereafter IESHR). Although the obligation of the Zamindars to construct and maintain all other embankment and drainage works was distinctly recognised by the Regulations and by the particular covenants, no machinery was provided to enforce attention to these duties, and the Zamindars continued to carry on with earlier system. The government was optimistic that in their own interests the Zamindars would look after these works. As the agricultural land at that time was too much interlaced, and so in reality the Zamindars did not get involved in maintenance work. It was later in 1806 with the Embankment Regulation that the Zamindars were bound, under the conditions of the permanent settlement of the land revenue, to maintain embankments at their own expense. Henry Leland Harrison, *The Bengal Embankment Manual*, p. 4.

mistaken by their success of the flood control projects that worked wonders in Punjab and the United Provinces. The geomorphology of the mid Ganga basin was completely different, and therefore, they 'blundered badly' here. In Sind, the changeable nature of the river was primarily an impediment to navigation and the shifting and flooding of the Indus valley rivers continued to have significant implications for public works efforts in irrigation, transportation, flood protection, and so the scheme to redirect rivers into channels better suited the government. Flood control by embankments, diversions and other physical barrier methods remained a chief concern of engineers in the Indus valley. Contrary to Indus basin experience, in Bihar and most of Bengal, the local communities had dug up breaches and canals on various points all along the main riverbed. The British engineers mistakenly considered the silted up canals to be 'dead rivers'. The government became firm on the Zamindars to cease such breaches.[54]

The change to modern strong and heightened embankments also led to loss of traditional knowledge and increased the vulnerability of the local populace.[55] The cultivators in pre-colonial eastern India evolved a tradition of flood utilization and dependence on it. They learnt to live in the situation of annual flood. A seventeenth century French traveller to India, François Bernier, in his memoir, comparing the situation of the Nile with that of the Ganga, mentions that the excessive rains in the midst of summer obviated the necessity of cutting of long canals in Bengal for irrigating the cultivable field.[56] The Zamindars used their own resources to control the rivers locally in the form of embankments or *bund*.[57] There are evidences of *bund* in existence even before 1765, when the East India Company got the revenue collection right from the Mughal ruler. The papers in the Bengal office of the period are related to reports from the Resident Collectors and other local officers, and they present the 'dilapidated condition of the bunds' asking the authority to repair them.[58] William Willcocks, a renowned engineer of late nineteenth century, did a through study of the problem of irrigation and maintained that the traditional *bund* had been

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[54] William Willcocks, *Ancient System of Irrigation in Bengal and Its Application to Modern Problems* (Delhi: B.R. Publishing Corporation, First Published 1930, Reprinted 1984), p. 59.

[55] Christof Mauch, 'Introduction', in Christof Mauch and Christian Pfister (eds.), *Natural Disasters, Cultural Responses* (Lanham: Lexington Books, 2009), p. 13.

[56] Bernier spent 8 years in India, primarily at the court of Mughal emperor Aurangzeb, from 1659 to 1667, with the intention of acquiring an encyclopedic knowledge about the country. He gained employment as a medical doctor and eventually attached himself to Dara Shikoh, brother of Aurangzeb, who was keen to learn more about Europe and its sciences. He undertook trips to Gujarat (his point of entry and exit), Kashmir, Bengal, Golkonda and Delhi, and thus developed a good understanding of the climate and ecology of India. For details see Joan-Pau Rubiés, 'Race, Climate and Civilization in the Works of François Bernier', *L'Inde des Lumières*: *Discours*, *histoires*, *savoirs* (*XVIIe-XIXe siècle*). eds. Marie Fourcade and Ines G. Zupanov (Paris: Collections Purusartha, École des Hautes Études en Sciences Sociales, 2013), pp. 53–78.

Retrieved from www.icrea.cat/Web/GetFile.asmx/Download?idFile on 18.12.2014.

[57] Vipul Singh, 'Gangetic Floods', p. 24.

[58] Henry Leland Harrison, *The Bengal Embankment Manual*, p. 1.

laid down in positions according to a plan and designed to carry flood water of the Ganga and that they could be restored to their former prosperity at reasonable cost and effort. He says that in the old system of irrigation the flood water was able to enter the cultivable fields by inundating the dug up canals carrying with it rich, organic, and silty sediments.[59] The inundated water also carried fish swam into the ponds that fed on the larva of mosquitoes. Malaria was the unknown earlier, but it became common once permanent embankments replaced the traditional bund.[60]

A fresh thrust was given to the concept in 1882 by giving embankment construction a legal status.[61] Although the Military Board submitting its report in 1851 had recommended for the 'general abandonment' of the bunds, the government continued with major embankment plan.[62] The Embankment act empowered the Collector to alter the railroad and construct the water courses, and this was later repealed by the Indian Railways Act, 1890 (Act IX of 1890).[63]

A section in the government did believe that embankments on a river with a lot of silt load would slowly raise the riverbed gradually. But contrary to it, the engineers from Public Works Department overlooked this aspect and emphasized on the benefits that embankments would have for the government. The deliberations in the official accounts indicate that the British administration had a proper understanding of the condition in the mid-Ganga section. Officials undertook that many of the older and existing embankments on the banks of the Ganga were abandoned because of changes in the course of the rivers. And therefore, in the long run this in turn would necessitate 'appropriate increase in the height of the embankments'.[64] One of the main reasons as to why the colonial state opted for embankments was that it wanted permanence in its administrative and revenue policies, and to ensure that, it encouraged the construction of embankments. At places like Patna there were other interest as well, such as protecting the large military cantonment of Dinapur (modern Danapur).[65] The long-term implication of the embankment on the southern side of the Ganga in Patna has been a permanent shift of the river course several miles to the north.[66]

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59 William Willcocks, *Ancient System of Irrigation*, pp. 7–17.

60 Report on Ganges Canal Committee, Major Gen. Sir Arthur Cotton, Public Works Department, Government of India, February 1866, NAI.

61 Bengal Embankment Act, 1882: 464, NAI.

62 Home Department, Revenue Branch. 28 March 1851, NAI, 20/21: 14.

63 Bengal Embankment Act, 1882, p. 469.

64 Home Department, Revenue Branch. 28 March 1851, NAI, 20/21: 39–40.

65 Vipul Singh, 'Gangetic Floods', p. 26. Dinapur was a completely new settlement that had come up as military cantonment to protect the commercial interest of the English East India Company. A comparative study of places mentioned in the *Ain –i Akbari* of the sixteenth century with that of Francis Buchanan's account of 1811–1812 has been done by Vipul Singh, 'Professional Brotherhood and Change in Physical Environment: The Colonial Factor in Administrative History of 18th Century Patna District', *The Geographer*, 47/1, (2000: 72–73).

66 Paradoxically, one of the contemporary Persian literatures, *Tarikh i-Daudi*, dealing with sixteenth century Afghan ruler Sher Shah mentions that the ruler believed the bank near Patna, where the Gandak river joined, was the most strategic place for the construction of a fort. The reason that

The colonial government erroneously perceived the low-height traditional embankments that were in existence for long. So instead of strengthening and improving upon the system, it mistook the shallow and wide cuts as abandoned navigation channels. The engineers of public works named them ‘dead rivers’. The reality was that the villagers deliberately used to make cuts in the embankments for irrigation. Government contemplated the idea of filling up the earlier cuts and strengthening the embankments along the river as a flood protection device. The British administration realized that due to floods crops were being destroyed every year, and therefore, there were complications in the collection of revenue. So in order to avoid this uncertainty of revenue collection they came up with idea of encouraging construction of embankments by the zamindars. In fact, if we look at the very core of the Permanent Settlement scheme of 1793 it states that no remission was to be claimed or granted on the claim of loss from inundation.

11.6 Proposal for Ganga Canal

After 1765, the East India Company administration had to face a lot of resistance from the native rulers, and to counter this they planned roads, bridges, canals, barracks and cantonments to facilitate the movement of their troops.[67] Such infrastructure was also required for penetration into the revenue generation area and to carry on trade. In fact, within 20 years after the grant of Diwani in 1765, the East India Company made its first biggest investment in ‘New Military Road’ and declared a ‘Road Fund’.[68] However, navigation through the Ganga remained the main route for trade for next 100 years until railways were introduced. Long-distance trade and the export of saltpeter, opium and cotton from Patna to Calcutta for shipment to Europe were dependent on the Ganga navigation.[69] In the early decades of the nineteenth century a Ferry Fund Committee was also formed. The ferry collection in Bihar was so numerous that out of the ferry collection roads were also maintained.[70] In 1841, a report was submitted by D. Mcleod, the Chief Engineer, and W. N. Forbes with a view to ascertain the practicability of forming a permanent line of inland navigation

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he gave was that flow of the Gandak from the north would not allow the Ganga to move away northward from its place on the southern bank, and thus protect the fort permanently from one side. In fact, the fort could not be captured by the Mughal emperor Akbar despite a huge contingent sieged it from the south. Abul Fazl in his *Akbarnamah* describes that the fort was supplied from Hajipur fort located across the Ganga. Akbar could not cross the Ganga because of its two *kos* (2.2 miles) width and flow in great force and turbulence. This justifies Sher Shah’s observation. Cited from Syed Hasan Askari, ‘The City of Patna – Etymology of Place-Names’, in Qeyamuddin Ahmad (ed.), *Patna Through the Ages*, (New Delhi: Commonwealth Publishers, 1988), p. 72.

67 Vipul Singh, ‘Gangetic Floods’, p. 24.

68 Nitin Sinha, *Communication and Colonialism*, pp. 80–83.

69 Kumkum Chatterjee, *Merchants*, *Politics and Society in Early Modern India Bihar*: *1733–1820*, (Leiden: E.J. Brill, 1996), p. 51.

70 Nitin Sinha, *Communication and Colonialism*, pp. 170–171.

in the Ganga.[71] They recommended for 5 ft water to be preserved throughout the year to make it navigable for vessels as they believed that apart from providing irrigation it would provide 'means of conveying safely, cheaply, and speedily to the ocean outlet of 'the agricultural and mineral produce of the entire region' and the same line would 'serve for supplying these regions with augmented amounts of the sea-borne products or manufactures of other countries'. It may be emphasized that almost 30 years before this, an engineer called Telford had noticed the possibility of uniting the upper parts of the River Narmada with a branch of the Yamuna, and he also intended that besides intersecting the adjacent plains, the branches of the Indus might be connected with those of the Ganga, and thus inland navigation could be started between Persia in the West and those of China in the East. Macleod and Forbes also believed this scheme of embanking the river would provide 'irrigation to the entire extent of land situated on each side of the Canal', and would be advantageous for the 'cultivation of sugar, tobacco, oilseeds, flax, and other varieties of crops'. All such products could then be carried to Calcutta, or to the best markets, through the canals at the lowest possible rates.

From the official noting we come to know that water communication was an important issue.[72] It was argued that Calcutta was the 'sole outlet of a population of about 100 millions of people', and the traffic depends entirely upon its water-carriage. The concern was that if the existing river transit stopped three-fourth of the present trade of Calcutta would be destroyed.[73] The engineers mooted the idea that if a 'perfectly fair water communication' capable of passing large boats would be formed then it will allow the movement in all seasons.

11.7 Railway Track Parallel to the Ganga

The canal scheme could not take off on ground of feasibility, and railways were instead introduced. However, the tragedy was that the East India Company engineers designed railway line parallel to the Ganga.[74] There was almost unanimity among the early promoters of the railways to connect Calcutta to northwest India at that time and it was considered to be more profitable. Opinion, however, differed over the route of the railway line.[75] There was one suggestion of line alongside pre-

[71] Report on the Rajmahal Canal, Revenue Department Record, Revenue Branch, 13 January 1844, NAI, 1–3: 1–29.

[72] Memorandum between Water Communication between Calcutta and the Ganges, 31 July 1858, Government of India Collection, National Library, Calcutta, 12.

[73] Ibid, 12.

[74] Secretary to the Government of Bengal writes to the Secretary to the Government of India, dated 19 April 1845, Home Department. Revenue Branch, NAI, 1–3: 1–2. The letter is about construction of a railway line between Calcutta and Mirzapur – to substitute a railway line on the earlier planned canal line.

[75] Nitin Sinha, *Communication and Colonialism*, p. 213.

modern Grand Trunk Road. The other suggestion was circuitous route running along the Ganga. The Ganga circuitous route was preferred having 'potential commercial benefit'.[76] Political and military considerations were also significant in the tilt towards the East Indian Railway along the Ganga.[77] The shorter route would have been parallel to the Grand Trunk Road directly connecting Calcutta with Banaras, but it was planned that from Calcutta the line would connect Bhagalpur, Monghyr, Patna and Shahabad en route to Banaras.[78] Resultantly, all these cities reaped the benefit of falling on the railway line as well as located along the Ganga and emerged into greater prominence as trading centers in the nineteenth century.

Railways were mainly introduced for the consolidation of the British rule and penetration further into the interiors for revenue. Although most of the early writings related to transport network on India, eastern India in particular, fell in the trap of debating the public works that should have been given the priority by the colonial government, and resultantly, history of the growth of railways has been examined as isolated phenomena in terms of pros and cons. Recent historiography has, however, tried to look at the transport history in relation to economic development of the regions in India.[79] Railways served three immediate purposes of Government – it protected the agricultural field from flood enabling revenue collection throughout the year; it protected the railway line from flood water as the railway track ran parallel to embankments; and it was also in tune with British investors interests. Introduction of railway, however, had long-term implication on the natural flow of the rivers in the Ganga basin. Now the agricultural fields located on the south of the Ganga river lost its earlier advantage of annual inundation and this allows us to assume that agricultural fertility on the field located on southern side of the Ganga was lost.

11.8 Conclusion

The geomorphology of the region suggest that the shifting of the Ganga could be due to tectonic uplift, but it may also be argued that the shifting of the river course got intensified due to embankment of the rivers. Pre-modern regimes were prudent and never tried to challenge the natural flow of the river despite having the

[76] Ibid, p. 214.

[77] Anand A. Yang, *Bazaar India*, p. 46.

[78] Ibid, p. 46.

[79] Few of the early works are Elizabeth Whitcombe, 'Irrigation and Railways: Irrigation' and John M. Hurd, 'Irrigation and Railways: Railways' in Dharma Kumar (ed.), *Cambridge Economic History of India*, *C. 1757–1970*, *Vol.2*, (New Delhi: Cambridge University Press, 1983), pp. 677–737 and pp. 737–761. Recent works include Anand Yang, *Bazaar India* (2000); J. Ian Kerr (ed.) *27 Down*: *New Departures in Indian Railway Studies* (New Delhi: Orient Longman, 2007); Ravi Ahuja, *Pathways of Empire*: *Circulation*, '*Public Works*' *and Social Space in Colonial Orissa*, *c. 1780–1914* (Delhi: Orient Blackswan, 2009); Nitin Sinha, *Communication and Colonialism* (2013).

exploitative agricultural motives. Provinces in mid-Ganga basin existed as agriculturally surplus-producing zone for the ruling authorities centered in Delhi and Agra. When during the seventeenth and the eighteenth century the region became commercially more significant in terms of cash products such as saltpeter, opium and cotton, the center of commercial activities shifted from Ganga-Yamuna doab to eastern part of the Ganga basin. This transformation had grave longstanding repercussion on the river system and its morphology in mid-Ganga basin. The colonial dispensation began to perceive annual inundation as flood disaster. So the predilection of Bihar province from west to east was one of the prime movers in landscape transformation.

The cultivators traditionally tried to harness flood, and produced rice to reap the maximum benefit of the wet field. We also get evidence in the medieval chronicles that pre-modern regimes never tried to challenge the river ecology and tried to adjust with the flood. Mughal revenue administration was exploitative and intense at the local level but it was flexible in contrast to rigid ecologically disastrous colonial revenue efforts. The British East India Company for permanence of revenue policies came up with Embankment act of 1882. Largely with the intention of retaining the commercial dominance of the river economy the railway line was laid along the Ganga instead of the shorter route cutting across the southern Bihar parallel to old Grand Trunk Road. This also goes on to ascertain that the erstwhile principal route of the pre-modern era was no more that much significant since the center of activity had shifted to Calcutta, and thus the mid-Ganga river economy was positioned from west to east. Construction of railway line was like a double chain of embankment that created obstruction to the natural flow of the flooding Ganga. The attempt of the colonial government to homogenise the embankment plan in a flood prone area for maximum revenue generation proves that local condition was not taken into consideration. Around Patna, where many rivers meet, the Ganga had unique river morphology, and therefore, needed its own one-off policy.

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Chapter 12
Notes from the Edges. Environmental History Writing in a Mediterranean "Periphery"

Vaso Seirinidou

Abstract Associated with the emergence since the 1970s of an environmental consciousness and activism among the middle classes of Western Europe and North America, environmental history has been constituted as an academic field of the "core" not only institutionally but also epistemologically. For it was mainly the historical experiences of the so-called developed world, with the industrialization as central process, that laid the theoretical ground and shaped the agenda of the field.

But what about environmental history writing in the "periphery"?

Based on the Greek example, this paper examines the impact of specific socio-economic, political and historical realities and of the epistemological traditions on the ways historians deal with the environment. While "nature" and its derivatives has served both as one of the main categories of perceiving Greece and the Greeks in Europe since the eighteenth century and as a means of self-promotion in the world tourism market, the environment has rarely been the focus of historiographic reflection and research in Greece. Recently, and especially after the outbreak of the financial crisis in Greece, this situation seems to be changing. The rapid privatization of natural resources has provoked protests that rendered the environment and the concepts of the "commons" and the "public" into central notions of a political vocabulary and turned some scholars' attention to environmental history.

The paper presents some first samples of this new research activity and discusses the methodological and theoretical issues that a Greek environmental history is confronted with. Inscribed in the broader Mediterranean context, Greek environmental history is marked by the bipolar way in which the environmental history of the wider Mediterranean region has been conceived, namely either as a history of degradation and disaster, or as a history of continuity. Both disaster and continuity serve as keys for understanding environmental, economic, social, political and cultural phenomena in the region. In this prospect, environmental degradation or/and continuity, economic and technological backwardness, social and cultural primitivism are seen as interrelated versions of a Mediterranean essence. On the other hand, the strong impression of the modernization schema in the Greek and overall

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Mediterranean historiography reduces the environmental history to a search for differences and divergences from an "ideal type", namely to a history of absences and negativities.

Finally, using as case of study the Greek forests during the Ottoman era (fifteenth – nineteenth century) the paper attempts to offer an alternative reading of the environmental history of the area that rejects the disaster narrative and, instead of the idea of continuity, it promotes the study of the various adaptions to the environmental challenges of the region. In this perspective, the environmental history of the "periphery" is not conceived as "what it's not" in comparison to the environmental history of Western Europe and North America, but as a paradigm that could enrich or question some of the fundamental assumptions of the discipline.

Associated with the emergence of an environmental consciousness and activism among the middle classes of Western Europe and North America since the 1970s, environmental history has been constituted as an academic "core" field not only institutionally but also epistemologically, for it was the historical experiences of the so-called developed world, such as capitalism, colonialism and industrialization, that laid the theoretical ground and shaped the agenda of the field. As a result of its founding condition, environmental history, even in its global version, has an inherently limited chronological and geographical scope. The vast bulk of scholarly production in the field is concentrated on the environmental imprints and trajectories of these master processes of the modern era. Pre-capitalist formations occupy a rather marginal position within the research scope of environmental history and the same holds true for those parts of the globe that did not follow the (ideo-typical) path of the western world, nor did they undergo the experience of colonialism.

This article deals with these chronologically and geographically "peripheral areas" of environmental history. Focusing on the Greek example, it examines the impact of specific socio-economic, political and historical realities, and epistemological traditions on the ways historians deal with the environment in a terra incognita on the environmental history map. Consequently, this paper presents some first samples of the recent historical research on the environment in Greece and discusses the methodological and theoretical issues that a Greek environmental history is confronted with. Finally, centering on the early modern instead of the modern period, it proposes an alternative reading of the area's environmental past that distances itself from the main lines along which the Mediterranean environmental history has been traditionally perceived

12.1 The Environmental Vacuum

Greece is land of nature. From Winckelmann's interpretation of the Greek classical culture as intrinsically linked to climate and the romantic travel literature of the nineteenth century to the contemporary tourism advertising, film industry and literature "nature" and its derivatives has served as one of the main categories for perceiving Greece and the Greeks abroad, either in a positive, or a pejorative sense (Tsigakou 1981; Lepenies 1986; Gaschke 2006). Within Greece, the emphasis on the beauty and the intactness of the native nature served as a means of self-promotion in the world tourism market, whereas Greek nature, identified with sunny weather, the sea, the landscape variety and the consequently "hot" temperament, constitutes one of the two basic sources, along with classical Antiquity, that privilege the Greeks' feeling of superiority over the economically and technologically developed North.

Unlike "nature" that traditionally enjoyed a salient position within the popular, literary and mass-culture discourse in Greece, the environment as a field of interaction between human and nonhuman, but also as a field where policies and institutions are practiced was, at least until the 1980s, completely absent from the public and scholarly discourse. There were numerous reasons for this absence.

Until the late 1950s the structures of Greek economy and society were predominantly rural. According to the census of 1961, more than half (56 %) of the working population was engaged in the agricultural sector. The great bulk of exports was composed of agricultural goods and the agricultural processing industry dominated the industrial sector (Franghiadis n.d.; Petmezas 2009). Concomitant to the above condition was the low level of technologic development and infrastructure. In 1958 more than one third of the country's road network was consisted of dirt roads and the mechanized means of transport were relative few (Franghiadis n.d.). The effects of the reconstruction programme of the Greek economy, which has been prompted by the adoption of the Marshall Plan, and a set of economic measures taken in the early 1950s (Kandilis 1968; Stathakis 1993), became noticeable in the 1960s In the course of this decade and up to the fall of the military junta (1974) the Greek economy experienced a boost characterized by rapid industrialization, urbanization and high growth rates (Leontidou 1990, 89–126; Franghiadis n.d.).

In the euphoric climate of the "Greek economic miracle" era, as the period between the early 1950s and the early 1970 has been labeled, and despite the social tensions and the political oppression, there was no space for environmental concerns. The demand for "development" and economic growth was proclaimed as national ideal by the hegemonic public discourse, while the environmental perspective was almost entirely missing from the civil society milieu. Unlike Western Europe and the USA where the critique of technology, economic growth and consumerism played a crucial role in the formation of the ecology movement, the consumer-oriented middle class that emerged during the dictatorship (1967–1974) was unconcerned with environmental matters. On the other hand, the domination of the anti-imperialistic discourse and of the struggle against the dictatorship in the protest agenda of the 1960s and the 1970s lead to an underthematization of issues such as gender, culture, sexuality and the environment (Louloudis 1986, 7).

This "environmental vacuum" was emphatically reflected on historiography. Unfolded across the axis of continuity in time, the Greek national historiography had traditionally paid little attention to place and space. The latter was treated rather as a witness of the past that attested its continuity (Liakos 2007, 208–209). The fresh wind that blew in the social sciences after the fall of the military junta brought the question of the incomplete Greek modernization to the forefront of scholars' interest. Searching for the causes of economic backwardness, marginal industrialization, class vagueness, clientelism and patronage (Liakos 2004, 360–365) historians and other social scientists were least preoccupied with the perspective of the environment. Where this appeared, it was for confirming the fact of the country's backwardness and the deviation of Greece from the Western and North European standards.

Despite the increasing awareness of environmental problems (Athens' smog, Chernobyl) since the 1980s and the increasing number of environmental mobilizations that put in question the Greek developmental model (protests against Athens Olympics and tourism-related environmental damage, protests against dams, public forest land encroachments and arsons for real estate) between the 1990s and the 2000s (Botetzagias 2001; Kourouzidis 2006; Alexandropoulos et al. 2007; Kousis 2007), the environment was not among the topics that renewed the Greek historiographic agenda after 1990 (such as gender, nationalism, culture and identities). On the contrary, the emphasis of the post 1990 historiography on constructionism and discursive regimes was associated with a trend of relinquishing the materiality of history that pushed the environment into the background of historiographic concerns.

12.2 Bringing the Environment into Greek History

A research interest in the environment, though with no historiographic or institutional relation to the field of environmental history, has been manifested since the 2000s. This became more systematic at the end of the decade. Although no direct association can be inferred, the "fast track" privatization of natural resources and public property and the ongoing politization of the environmental mobilizations after the outbreak of the Greek finance crisis in 2009, played a role in redirecting historians' attention towards the environment.

Environmental history is being taught at postgraduate level in the Department of History at the University of Athens since 2009 and a series of related workshops have been held there. A critical introduction to the field and a collective volume with environmental history approaches to ancient and contemporary Greek history have been also published (Seirinidou 2009; Vlassopoulou and Liarakou 2010), while an interdisciplinary project on the environmental macrohistory of the Halkidiki peninsula (Mines, Olives, and Monasteries: Towards an Environmental Macrohistory of Halkidiki) has been recently completed. Since 2011 Greece is represented in the European Society for Environmental History (ESEH).

In actual research practice, the environmental history perspective is currently confined to the medieval (Byzantine) and mainly to the early modern (Venetian and Ottoman) periods. The environmental history of Antiquity that had attracted the interest of (mainly) Anglo-Saxon scholars (Meiggs 1982; Weeber 1990; Sallares

1991; Hughes 1984, 2007, 2013, 2014; Thommen 2012), does not seem to enjoy a similar popularity among Greek historians -publications come rather from forest scientists than historians (Tsoumis 2007)-, while the environmental perspective is still missing from research on modern and contemporary Greek history. The thematic scope of the current research activity includes issues such as rural landscape transformations (Gasparis 1994), environmental policies of the past (Panopoulou 1994, 2009; Troianos and Pitsakis 1998; Papadia-Lala 2000; Sinakos 2003), the property regimes of nature and the management of natural resources (Dimitropoulos and Olympitou 2010; Seirinidou 2014), the interaction between humans and animals (Anagnostakis et al. 2011) and the urban environment (Avramea 1989). However, a synthetic and methodologically consistent monograph is still a desideratum. Definitely, environmental history in Greece is still far from approaching the institutional and internationalized status of the Greek landscape and survey archaeology (Bintliff et al. 2004-2005).

In their attempt to establish a coherent environmental history paradigm, Greek historians are faced with some fundamental problems. The first is that of sources. Unlike Western and Central Europe, where environmental historians can take advantage of a solid corpus of written material dating from the late medieval period onwards, the environmental history related sources for the medieval and early modern period in Greece are scarce and fragmented. The major exception to this are the territories that used to be under Venetian dominion (Crete and the Ionian island mainly), where rulers left a large amount of records concerning the management of natural resources. The "silence" of the sources about the environmental history of the Eastern Mediterranean during the early modern period has been already underlined by environmental historians. Referring to the forest history of the region, Joachim Radkau has noticed that the silence of the sources attested by the actual stage of research, may imply the absence of authorities that exercised power over forest resources (Radkau 2008, 136). Recent works on Ottoman environmental history, however, have shown sophisticated provisioning methods and a great concern on behalf of the state for the management and distribution of natural resources (Mikhail 2011; White 2011). On the other hand, the highly localized and specific nature of the Ottoman administrative practices does not permit generalizations. In any case, a better knowledge of the Ottoman archives by Greek historians would offer a more accurate picture. Still, environmental historians can take advantage from the large body of scientific literature on landscape and survey archaeology in Greece that has offered significant insight into landscape development, vegetative regimes and climate fluctuation.

The second problem is the very conceptual frame within which the environmental history of the region has been located and conceived. We are used to approach the history of the Mediterranean environment in a bipolar way, either as a story of continuity, or as a story of degradation and disaster. Despite their claim for neutrality and objectivity, continuity and degradation are value-laden terms with strong metonymic capacity. From the "majestic immobility" and the "eternal unchangeable landscape" of the Braudelian Mediterranean to the "out of time" temporality of Club Med, continuity is implied as an inherent Mediterranean quality, a key for understanding environmental, economic, social, political and cultural phenomena in the region. In the same vein, environmental stability, technological backwardness, economic underdevelopment, social and cultural primitivism constitute interrelated versions of the Mediterranean *essence*.

The degradation-and-disaster rhetoric that has traditionally dominated the study of human-environment interaction in the Mediterranean, especially in its eastern part, bears even stronger ideological connotations. In the last quarter of the eighteenth century, the French naturalist Charles Sonnini (1801, 95–97) on the occasion of his travel to Cyprus and Crete formulated the argument about a Greek "degraded natural environment", initiating thus one of the most powerful loci of the travel and environmental literature for Greece. From the European travelers of the late eighteenth century and the forerunner of the modern western environmentalist movement George Perkins Marsh (Barca 2010, 2–4), to contemporary scholars and environmental historians (Thirgood 1981; Diamond 1997, 416–417; Hughes 2005), the idea that the contemporary Greek and overall Mediterranean landscape is the outcome of a gradual environmental degradation beginning in Antiquity occupies a salient position within the European ecological imagination.

A number of the usual suspects crop up as causes for the decline from a wooded Mediterranean Eden: people's ignorance, misgovernment -especially under Ottoman domination- and above all goats, declared the number one enemy of the Mediterranean forest, leaving behind in their destructive effects even the modern bulldozers. Debates over the causes of environmental degradation in the Mediterranean often reproduce stereotypes – for example the traditional hostility against nomads and contempt of stock grazing as an inferior occupation compared to the nobler agriculture – or even reflect claims for the control over natural resources. A similar rhetoric is often recognizable in those instances and places where the exclusion of traditional users from the management of resources was underway in favor of the state or industrialized forestry, as was the case in eighteenth century Germany or in colonial India. The difference is that in the case of the Mediterranean, environmental degradation has no conjectural or time limited character. It pervades and transcends almost the entire past of the region, it becomes ultimately a constitutive part of the Mediterranean continuity.

Both continuity and catastrophe paradigms seem to conform with the modernization scheme that has still influence on the Greek and overall Mediterranean historiography and public discourse – and here we come to the third problem that the environmental approach is confronted with. In the light of this scheme, the environment, as is the case with the Greek economy, society, culture and politics, is described as *what it is not* in relation to an ideal Western model. Thereby, environmental history is reduced to a search for aberrations from a prototype, namely to a history of *absences and negativities* (Liakos 2004, 360, 363).

Obviously, the formulation of a distinct Greek environmental history paradigm is not a trivial enterprise. It requests historians to step beyond the established categories and to elaborate new concepts and tools for approaching environmental continuity and change. This presupposes a more theoretical reflection and mainly a more critical stance towards sources.

In the following, I shall attempt an alternative reading of the environmental past of the region, using as case study the Greek forests during the early modern period, an era that coincides with the Ottoman dominion over the Greek peninsula (fifteenth to early nineteenth century).

12.3 Greek Forests During the Early Modern Period

As mentioned earlier, Greek forest history of the early modern period suffers from the scarcity and dispersion of written documents. The European travel accounts of the eighteenth and nineteenth century and the reports of the Bavarian foresters who staffed the first forest agencies of the nascent Greek state (1833) constitute an exception. They form compact bodies of documents and serve as main sources of information. The view of the Greek forests these sources offer is that of a general deforestation, neglect and under-exploitation, a situation that is evaluated as compatible to the "despotic and ignorant" Ottoman administration.

Did Greek forests really suffer from such a massive decline during the Ottoman era and were they so neglected and unexploited as the sources suggest? We cannot approach the first part of this question based solely on historical evidence and without adopting a long-term perspective. Even so, a conclusive answer that would pertain to the entire Greek territories is not attainable. Consequently, we have to be content with rough estimates.

The widespread idea of a wooded Greek peninsula that underwent a massive deforestation at the outset of historical times resulting in wide ranging soil erosion has been questioned by scholars coming from the field of archaeology and palaeobotany. While the instances of extended anthropogenic erosions in the era of the first agricultural expansions and those of a lesser scale in the classical period are not to be overlooked, the impression resulting from the study of the alluvial and palaeobotanical records is that the great erosions in the region had already occurred in the Bronze Age and that the landscape has been generally stable over the last 5.000 years (van Andel et al. 1986; Rackham and Moody 1996). Certainly, this view is not without controversy (Bintliff 2002; Hughes 2011). Nevertheless, for the matter under consideration the findings of the palaeobotanical and palynological research are more important, according to which the vegetation of Southern Greece, in those cases where it had not undergone grazing and other anthropogenic disturbances, would not have been a pure forest but a mosaic consisting of woodland, steppe and garigue (Bottema 1980; Rackham 1982, 193–194). Habituated to the high hygrophilous forests of Northern and Central Europe, the travelers may had evaluated as "degenerate" a structurally typical Mediterranean landscape.

Moreover, the idea of a progressive deforestation in Greece seem to be disputed by the data from the medieval and early modern period that record fluctuations in the extent of forest cover as well as local variations. The palynological and historical evidence, especially from the region of Macedonia, converge on the hypothesis that the retreat of forest cover due to the expansion of agriculture and colonization was followed by a regeneration phase that lasted from Late Antiquity to 850–1110 AC. The economic and demographic upturn of the following centuries was accompanied by increasing pressures over the forests. This trend was reversed after the mid-fourteenth century, when the economic and demographic crisis in connection with the climatic cooling phase (Little Ice Age) that became more noticeable between the sixteenth and the eighteenth centuries contributed to the advance of woodland, whereas radical changes of the forest landscape are to be noticed after the mid of the nineteenth and during the twentieth century (Athanasiadis 1975; Id. and Gerasimidis 1995; Lefort et al. 1986, 99–104; for an overview of the palynological research concerning the Byzantine period, Dunn 1992, 242–249).

Nevertheless, the effects of the Little Ice Age on the woodlands were not homogeneous. The cooling of the climate may had created favorable conditions for the conservation or the regeneration of the forests, however it was followed by population movements towards higher altitudes and consequent pressures over forests that had not undergone intensive anthropogenic intervention until then. Due to the amphibian conditions existing in the Mediterranean lowlands between the sixteenth and the eighteenth centuries, the mountain slopes became main sites of settlement and economic activity (Tabak 2008). The increase in volume of semi-nomadic animal husbandry and the introduction of mixed cropping in higher altitudes resulted in the expansion of summer pastures and cultivated lands over forests. Although the estimation that between 1700 and 1850 woodlands in the Eastern Mediterranean shrank by over 10 % when the world average was 4 % is not sufficiently documented,[1] it is true that some regions felt intensely the consequences of the demographic and economic pressure over their forest vegetation. Such is the case of the Northern Pindus region in Northwest Greece (McNeill 1992, 162–276). However, even if the massive logging operations and the forest arsons during the government of the local tyrant Ali Pasha (1788–1821) are taken into account, phenomena of deforestation and erosion in Pindus are attested only after the middle of the nineteenth century (McNeill 2010, 112). It is also noteworthy that in the wider context of the Ottoman Empire there is no evidence of a general wood scarcity alert between the sixteenth and the eighteenth centuries, while at the same time timber shortage constituted one of the main concerns for the naval powers of the time, Venice (Lane 1992[2]), Britain (Albion 1926; Knight 1985) and France (Bamford 1956).

Consequently, during the period of Ottoman domination and especially during the eighteenth century we can speak of an intensity of local pressure but not of a general retreat of forests. The latter were not fewer in comparison to the period prior to the Ottoman conquest nor to the period after the nineteenth century. Given the low population density, the lack of major consuming centers, the limited transport capability and the widespread use of olives as firewood in southern Greece, we can

[1] The estimation, which is cited also by Tabak (2008, 288), comes from Thirgood (1981, 52–53, 114) who is based mainly on the example of Cyprus. As proponent of the British colonial forestry on the island Thirgood tends to overemphasize the degradation of forests during the previous period (Harris 2012).

argue with certainty that the centuries of the Ottoman dominion were not associated with a negative "watershed" in the history of Greek forests.

The second question, namely if forests under the Ottomans were so neglected and empty of productive activities, is more complicated than it initially appears. If we consider as criterion for evaluating a forest as "neglected" or not the degree of state supervision over it, then Greek forests do not seem to constitute a major matter of concern for the Ottoman authorities. Until the second half of the nineteenth century and the promulgation of the Ottoman forest regulation of 1870 the state's interest and control over woodlands was limited in the state forests (*miri koru*) that provided timber for the Arsenal and the major cities of the Empire (Dursun 2007; Michail 2011, 144–149; White 2011, 28–31; Özden and Birben 2012).

Greek lands were not among the major timber suppliers of the Empire. Wooded islands in the northern Aegean, such as Thassos (Vakalopoulos 1953, 37) and Samos (Grispos 1973, 67) offered timber for the construction of Ottoman fleets, while the forests of the Holomondas mountain in Halkidiki supplied exclusively the state-owned silver mines at Sidirokausia (Lefort et al. 1986, 75). Nevertheless, the majority of Greek forests belonged to the category of communal forests (*baltalik*) and of forests available for public use (*cibal-i mübaha*), where state control was minimal (Nikolaidis 1869, 430, 436, 451–452, 454; Eleftheriadis 1939, 59–64; Nakos 1986, 28, 31; Grispos 1973, 125).[2]

The absence of state control did not mean the lack of supervision over the forests. The typical forest in the Greek lands during the Ottoman era was the so-called *baltalik*, namely the communal forest. In a way that reproduced their internal social hierarchies, communities ensured their members' access and usage rights that covered the local needs in wood; they appointed forest supervisors and set regulations for wood-cutting operations, fire protection and the prevention of trespassing. The communities' scope was not limited to the assignment of usage rights and to forest supervision. It also included forest management practices targeting the long-term availability of resource stocks. Contemporary forest research has documented evidence of the conscious use of sustainability principles in the communal forests in the past (Grispos 1973, 129–130; Dafis 1989, 23–26) and there is plenty of ethnographic material about the existence of "protected forests", dedicated to local saints (Stathis 1971, 179–180; Tsiodoulos 1998–1999, 304).

In the context of local economies the *baltalik* forests constituted multifunctional spaces with multiple and parallel uses. First of all they were used for livestock grazing; they were also available for apiculture, the extraction of resin, the production of charcoal, tar and spunk, as well as for a variety of local specializations. For example, the Albanian-speaking communities of Attica (*Arvanites*) were specialized in charcoal burning and resin production (Leake 1835, 380, 420–421;

[2] On the contrary, in the Greek territories under Venetian rules forests as resources of naval timber were subjected to the direct control of the state authorities (Papadia-Lala 2000; Panopoulou 2009; for an overview of the Venetian forest policy Appuhn 2000).

Oikonomou 2007, 49–98),[3] while the island of Ikaria was famous for its charcoal (Zei 2004; Kapetanios 2010, 240–242).

Forest products were offered within the limits of local and regional markets. In the second half of the eighteenth century timber and charcoal trade in the Aegean increased rapidly and expanded beyond the local and regional limits triggering internal wood shortage and price rises. Some insular communities attempted to respond by imposing restrictions on wood-cutting and price control, yet without being able to intercept the widespread timber smuggling (Zei 2004, 189; Kapetanios 2010, 242). In the same period the oak forests of Western Greece (Epirus and Acarnania) that had passed to the property of local Ottoman officers and since the last quarter of the eighteenth century to that of Ali Pasha experienced an intensive exploitation by French and Greek companies that supplied the shipyard of Toulon and other ship building sites in the Mediterranean with timber (Giannakopoulou 1982; Papakonstantinou 2006, 210). The intense logging business promoted economic activities that had emerged in the area during the previous period. Apart from the blossoming of shipbuilding in the towns of Preveza and Messolonghi, there was an increase in the trade of construction timber and the export of charcoal (Giannakopoulou 1982, 179–181; Papakonstantinou 2013), while the trade of acorns was oriented towards Italian markets (Giannakopoulou 2002, 5–6; Katsiardi-Hering 1986, 531, 610–613).

We need to adopt a critical position against the repeated complaints of the European travelers about the gloomy condition of the Greek forests. More than the local reality, the eighteenth and nineteenth century sources reflect the state and scientific discourse on forest management that developed in Central and Western Europe and the experience of a forest management system, from which communities had already been excluded. Warning voices about deforestation were certainly not a novelty of the eighteenth and the nineteenth century. Given the central role of wood in the organic economy and the awareness of local societies about the finite nature of this resource, forest conservation became since the High Middle Ages a policy matter, around which both lordship and communal institutions had been developed (Radkau 2012, 57–70). By the end of the eighteenth century the increasing demand of commercial timber implied a more active intervention of the state in the forest in favor of industrial forestry that endowed the treasury with higher yields. The transformation of the multifunctional forest into a timber-producing one required the clarification and simplification of property rights that entailed the abolition of the common rights and the alienation of the forest from its traditional users (Ernst 2000; Grewe 2004; Warde 2006; Hölzl 2010; Radkau 2012). Besides, the short-term boom of commercial logging in Western Greece by the end of the eighteenth and the beginning of the nineteenth century proved that without the protection of the state clear cutting for profit could not operate effectively, since it came

[3] According to British officer and topographer William Martin Leake who traveled in Greece in the first decade of the nineteenth century, the charcoal production in mount Parnitha in Attica continued the tradition of the charcoal burners of ancient *Acharnae* that appear in Aristophanes' comedy *Acharneis*.

up against the dispositions of the various proprietors of the forests (Giannakopoulou 1982, 90–91, 111–112).

State supervision over forests was initiated in the newly established Greek kingdom in 1833 by the Bavarian governors. The forests of the Greek territory, with the exception of the woodlands of Attica and Euboea that were held by private owners, were declared as national property and set under state control. Within a short span of time a forest legislation was issued and forest authorities supervised by educated Bavarian foresters had been established throughout the kingdom. Five years later, the Bavarians were in the sad position of abandoning their sophisticated reform plans for the Greek forests. In 1838 king Otto abolished many forest offices and kept only the forest guard stations (Kontos 1929, 205–216). Arguing for the reduction of forest offices in Greece, the forest inspector d'Herigoyen stated in 1838: "*The wood consumption in this region* (Central Greece) *is insignificant. A necessary condition for the increase of the value of wood is the population growth and the increase in forest fires that would lead to the increase of demand and*, *subsequently*, *to the shift to the commercial timber economy*" (Greek State Archives, Archive of Secretariat – Ministry of Finance (1833–1863), Sub-archive of Secretariat, Forests, Statistic (1834–1839), Fasz. 99, f. 30). If *Holznot*, the wood shortage, was in Central Europe the raison d'être of the state-sponsored, scientific forestry, wood surplus seems to constitute here a structural disadvantage.

What lessons can be drawn for Greek environmental history from the example of the Greek forests? Firstly, that the adoption of the long-term perspective is necessary for understanding the human-environment interaction in the area. It helps historians to shift their attention from the question of continuity or disaster to the study of the various adaptations to the environmental challenges in the region. Secondly, the above example questions the interpretation of the Greek environmental history in terms of modernization narratives. It delineates the Greek environmental past not as a "shadow" or negative but as a paradigm that enriches or challenges the assumptions of European environmental history, as this has been institutionalized in Northern and Central Europe. Finally, it demonstrates that the study of the environment could serve as a means to redefine the broader contexts of Greek history, like the Mediterranean, the Ottoman Empire or the Balkans.

Obviously, Greek environmental history has a long way to go; and it has also a lot to offer.

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Part IV
Blurring All: New Interpretations, Old Themes, Different Outcomes

Chapter 13
Science, Society, and Knowledge of the Columbian Exchange: The Case of *Cannabis*

Chris S. Duvall

Abstract This chapter argues that botanical scientific knowledge of *Cannabis* has shaped its environmental historiography. This chapter engages the epistemological concerns of science and technology studies (STS) by examining how botanists have conceived biological speciation; it contributes to environmental history by showing that concepts of speciation—at least for domesticated taxa—bear narratives of human history that shape and constrain imperatives for historical research. Dominant concepts of *Cannabis* taxonomy have enabled biological hypotheses to substitute for historical evidence, thereby reducing imperatives to research the plant's transatlantic dispersal history. Historiographical neglect has enabled a Eurocentric narrative of *Cannabis* that is not supported by the documentary record. The chapter proposes a historiography for *Cannabis* that is more attentive to past social, cultural, and environmental contexts.

13.1 Introduction

The plant genus *Cannabis* is well known, or at least widely recognized. The word 'cannabis' is spoken worldwide, nowadays mostly because it can name the illicit drugs marijuana and hashish, both derived from the plant. Yet 'cannabis' has been spoken in European languages for centuries, long before the plant's drug use gained global popularity. The word can also refer to hemp, a highly valued plant fiber resource during the European Age of Sail. In Europe, *Cannabis* has a voluminous written record extending to Herodotus (fourth century BCE).

Given past and present interest, it is remarkable how thin the environmental historical literature is on *Cannabis*. The plant's past is truly global in scope. During the Holocene it has dispersed from its center of evolutionary origin in Central Asia to all inhabited landmasses to about 60° latitude. There are several book-length, global

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histories of the plant that ostensibly trace its biological and cultural diffusion over the millennia of human–*Cannabis* interaction (inter alia: Abel 1980; Booth 2005; Clarke 2010a; Clarke and Merlin 2013; Herer 1998; Lee 2012). These histories are informative in varying degrees, but they are implicitly or explicitly advocate histories, written to advance political agendas for or against marijuana and/or hemp in the present. These advocate histories are poorly attentive to past social and environmental contexts (Mills 2003: 12). There are some professional histories of *Cannabis*, mostly published since 2000 (key earlier works: Crosby 1965; du Toit 1980; Hopkins 1951). Recent histories focus on marijuana since 1800, in specific countries or regions (Borougerdi 2014; Campos 2012; Mills 2000, 2003, 2012; Paterson 2009), but these are primarily social histories, and less concerned with biological, cultural, and political ecologies of *Cannabis*.

In this chapter, I argue that botanical scientific knowledge of *Cannabis* has shaped its environmental historiography. Dominant concepts of *Cannabis* taxonomy have enabled biological hypotheses to substitute for historical evidence, thereby reducing imperatives to research the plant's transatlantic dispersal history. Historiographical neglect has enabled a Eurocentric narrative of *Cannabis* that is not supported by the documentary record.

In making this argument, I build upon theory in science and technology studies (STS). Many scholars have considered roles science can have in environmental historiography. In the Atlantic World, postcolonial scholars have explored how the imperatives of European economic expansion and colonial governance shaped the assumptions and purview of scientific thought (Carney 2001; Carney and Rosomoff 2009; Davis 2007; Schiebinger 2005; Sluyter 2012). More broadly, recognition of cultural and social bias within scientific literature lies at the roots of environmental history as an academic field, particularly because environmental historiography attempts to balance the historian's ethical concerns and engagement with 'objective' environmental sciences. In my case, I seek to challenge stereotypes of drug use in current societies by excavating the origins and assumptions of *Cannabis* science, while attempting to trace the historic dispersal of the plant and its uses. Conscious engagement with both science and history has led environmental historians to contribute to and benefit from theory in STS (Jørgensen et al. 2013). In this chapter, I engage the epistemological concerns of STS by examining how botanists have conceived biological speciation; I contribute to environmental history by showing that concepts of speciation—at least for domesticated taxa—bear narratives of human history that shape and constrain imperatives for historical research.

The remainder of this chapter comprises three sections. First, I analyze the scientific taxonomy of *Cannabis*, and show that the dominant species concept for the genus implies human–plant interactions that are not tenable in terms of botanical science. Second, I argue that a more plausible history of *Cannabis* emerges with analyses that are more cognizant of bias within the primary and secondary source literature. Finally, I propose a historiography for *Cannabis* that is more attentive to past social, cultural, and environmental contexts.

13.2 Producing Species

Environmental histories of plants (and other living beings) are predicated upon taxonomic concepts. All knowledge cultures classify plants (and other objects) according to culturally and historically subjective ideas about what makes different plants different. These concepts thus determine the number and types of species that are perceived to exist (Berlin 1992; Ellen 1993). Consequently, taxonomic concepts provide ontological basics in environmental historiography; only with existence can plants have distinct, traceable histories (Schiebinger 2005). Natural scientists seek to understand the biological past through the lens of biogeography, a primarily historical, rather than experimental, science that seeks to explain current biodiversity patterns through hypotheses about past processes. In biogeography, species are both historical objects—entities with histories—and analytical tools—events that provide evidence of environmental change. Thus, the concept of speciation crucially links material patterns with theories of change (Andersson 1996; Cracraft 1982, 1989).

In recent decades, molecular genetics has produced an epistemological shift in systematic taxonomy. Historically, taxonomists have privileged the visible characters of plant morphology as the basis for distinguishing species. However, genetic analyses have led botanists to perceive previously unrecognized, cryptic species, and to develop histories for these genetically distinct but physically indistinguishable species (Arbogast and Kenagy 2001). Biogeographers with a background in the natural sciences accept a dual epistemology, using both morphological and molecular data as bases for recognizing plant histories (Ebach and Humphries 2003: 960). Also, historical geographers have based histories for agricultural species on documentary records, material cultures, and plant names (Carney 2001; Carney and Rosomoff 2009; Parsons 1972; Voeks 1997). Environmental scholars are adjusting to new ways of distinguishing species within ecosystems, and of writing histories that integrate multiple biogeographic epistemologies.

Taxonomists have debated *Cannabis* species concepts since the late 1700s. The bibliography of this debate has been summarized elsewhere (Clarke and Merlin 2013: 314–317; McPartland and Hillig 2008). In short, taxonomists have contended one-species versus two-species (and multi-species) concepts of the genus. These concepts have always been based primarily upon visible plant characters. However, since 1783, taxonomic debate has also included *Cannabis* psychoactivity as a potentially diagnostic character (Lamarck 1783: 695). Not all *Cannabis* plants are psychoactive. In current taxonomy, psychoactivity is salient in distinguishing *Cannabis* types, whether these are labeled separate species or sub-species (Emboden 1974; Hillig 2005; Small and Cronquist 1976). The current, formal taxonomy is a one-species concept that considers all individuals to represent *Cannabis sativa* L., with the psychoactive and non-psychoactive types labeled sub-species (Small and Cronquist 1976).

Cannabis has been a difficult taxonomic subject because it is highly variable in physical form, and people have not found physical characters that reliably and consistently correlate with the psychoactive versus non-psychoactive distinction. The appearance of individual plants depends upon environmental conditions, especially soil fertility, and the plant's capacity for long-distance pollination and seed dispersal facilitates genetic exchange between distant populations. For centuries botanists have acknowledged the lack of reliable, visible characters to distinguish types (Acosta 1578: 360–361; Dukerley 1866; Emboden 1974), despite proposals of minute, imprecise, and/or variable characters, such as relative width or color of leaves. The current, formal taxonomy deals with the morphological challenge by describing *Cannabis* as "a single, highly variable species" distorted through millennia of artificial selection (Small and Cronquist 1976: 405). Morphological data are poor for identifying *Cannabis* lineages.

Phytochemical and molecular data provide better evidence. All *Cannabis* plants produce a class of phytochemicals called cannabinoids. Since the 1970s, botanists have found that the two *Cannabis* types produce consistently different combinations of cannabinoids. The most important for taxonomy are cannabidiol (CBD) and Δ9-tetrahydrocannabinol (THC), the psychoactive phytochemical. Simplistically, non-psychoactive plants produce mostly CBD, while psychoactive ones produce mostly THC (Hillig and Mahlberg 2004; Small et al. 1975). Artificial selection can alter the total quantity of cannabinoids produced within a type, but not THC:CBD ratios (Clarke and Merlin 2013: 317–320). Molecular data similarly suggest two major lineages, corresponding to the phytochemical types. In particular, Hillig's analysis of allozymes—genetically determined, variant forms of one enzyme, whose occurrence is not affected by artificial selection—shows that two types preexisted the plant's domestication (Hillig and Mahlberg 2004: 973). Other studies have identified other consistent genetic differences between the psychoactive and non-psychoactive populations (Datwyler and Weiblen 2006; de Meijer et al. 2003; Gilmore et al. 2007; van Bakel et al. 2011). In this chapter, I follow Hillig (2005) in labeling the two types psychoactive *Cannabis indica* and non-psychoactive *C. sativa*. Confounding the cryptic biogeographic pattern are the realities that the two types are cross-fertile (like many plant congeners) and have mixed in many locations over the last two centuries, and much earlier across southern central Eurasia. Nonetheless, distinct, cryptic species underlie outcomes of artificial selection (de Meijer et al. 2003; Hillig 2005: 177–178). For instance, despite millennia of selection for fiber and seed characters, East Asian *Cannabis* cultivars maintain THC-dominant phytochemistry (Hillig 2005).

The two types have distinct distributions, globally characterized by latitude (Clarke and Merlin 2013; Hillig 2005; Schultes and Hofmann 1980). There is consensus that the genus originated in Central Asia. The non-psychoactive population has dispersed globally between about 30 and 60° latitude, north and south of the Equator. The psychoactive global population grows widely below about 30° latitude. Since at least the 1850s, biogeographers have sought to explain this pattern (de Candolle 1855: 833; Hehn 1870: 157).

Central to all explanations have been ideas—whether assumptions or formal hypotheses—about the process of speciation within the genus. The dominant concept of *Cannabis* speciation is that the phytochemical difference between types originated through artificial selection for psychoactivity, practiced on some plant populations but not others. I term this concept anthropogenic speciation. For instance, the current, formal taxonomy states, "Variation in the genus *Cannabis* is due in large part [...] to selection by man" (Small and Cronquist 1976: 419, 406). A recent, exhaustive ethnobotany specifies, "THC content is not of great natural adaptive significance [to the plant]. From evolutionary and ethnobotanical points of view, THC is to a large extent a human artifact" (Clarke and Merlin 2013: 51). As suggested in these quotes, anthropogenic speciation recognizes that 'nature' has had some role in producing diversity within the genus, but this role is discursively and conceptually secondary: "Natural environment and culture work hand-in-hand [... but] human intervention has been the major force in the evolution of *Cannabis*, at least during the Holocene" (Clarke and Merlin 2013: 311–312). Humans have certainly practiced artificial selection on *Cannabis*, but genetic evidence does not support the anthropogenic speciation hypothesis (Hillig and Mahlberg 2004: 972–973).

Biogeographic explanation is uniformitarian. No process has been observed in the present through which non-psychoactive *Cannabis* can be made psychoactive. Plant historians note that artificial selection can affect cannabinoid content, which is true but provides entry into circular reasoning: artificial selection is taken as the cause of *Cannabis* chemical diversity because the conditions necessary for artificial selection—natural variability in, and human use of, the plant—have existed for millennia (Campos 2012: 63; Clarke and Merlin 2013: 52). The circular logic causes historians to insert humans into *Cannabis* prehistory despite a lack of evidence: "[*Cannabis*] may have been introduced to [Scandinavia...] during Mesolithic times. *Cannabis* would have been a very useful plant and [...] may have been one of the first plants to be consciously managed" (Clarke and Merlin 2013: 111). Further, the circular reasoning is co-produced (Jasanoff 2004) with taxonomic description. The current, formal taxonomy includes human use as the basic character for differentiating the drug and hemp types (Emboden 1981).

The logical problem is apparent in attempts to explain the historical appearance of drug *Cannabis* in locations where morphological, molecular, and historical evidence is absent or inconclusive. Published historical evidence for the dispersal of *Cannabis indica* is poor or non-existent for many locations around the Atlantic. For instance, to explain the eighteenth- to nineteenth-century appearance of drug *Cannabis* in Mexico, an historian concludes, European hemp "strains imported [from Spain] for fiber eventually became drug-producing plants" (Campos 2012: 64). The historian makes this claim even though his consulting botanist found it "unlikely" (Campos 2012: 64). Indeed, botanists have no straightforward explanation of how the cryptic species might be transformed genetically into the other. Again, the chemical–molecular types are cross-fertile and there is environment-driven variability in physical and chemical traits. But both natural and artificial selection act upon genes, and there is no evidence that a non-psychoactive population can become psychoactive without the separate introduction of psychoactive genetics (de Meijer et al. 2003, 2009; Hillig and Mahlberg 2004; Small et al. 1975).

Other than such hybridization, the only hypothesized process through which non-psychoactive *Cannabis* can become psychoactive is a combination of founder effects (when a small range of genetic diversity occurs in an initial population), genetic drift (change in genetic diversity due to random events), and atavism (the reappearance of primitive characters through chance genetic recombination) (Clarke and Merlin 2013: 39, 51, 317, 322, 352, et al.). In other words, *Cannabis* populations can, without human intervention, revert to the hypothesized, aboriginal state of having the potential to become psychoactive or non-psychoactive—though this transformation becomes evident only through human decisions about plant use. Thus, even a hypothesis about non-anthropogenic change within plants frames psychoactivity as a consequence of human behavior.

Framing phytochemistry as a human choice enables cultural generalization to substitute for biogeographic data. For instance, to explain the (undocumented) origins of marijuana in the U.S., one *Cannabis* history concludes, "Hemp had been grown in the USA for a long time but this had not led to an awareness of its psychoactive potential, at least in the white population. Black slaves, however, knew of it from their experience of *dagga* back in Africa" (Booth 2005: 156). This statement bears layers of errors that expose recourse to race as an explanation for drug use in recent U.S. society: there is no evidence of *Cannabis indica* in the U.S. until 1895 (in California: Anonymous 1895); U.S. slavery ended in 1865; and essentially no slaves in the U.S. came from South Africa, suggested by the misused term *dagga*.

Past founder effects and genetic drift are unknowable, but atavism in relation to cannabinoid production has not been observed in horticultural studies (de Meijer et al. 2009; Hillig and Mahlberg 2004; Pacifico et al. 2006). Atavism has been a fraught idea in biology for centuries, and current evidence (from animal biology) suggests that it is rare, and should be hypothesized only if it is the most parsimonious and plausible explanation for observed phenomena (Zanni and Opitz 2013). I argue that better explanations are available for ancient speciation and historic appearances of drug *Cannabis* in the Atlantic.

A two-species concept for *Cannabis* is not new, but the epistemological shift of molecular genetics enables a re-framing of diversity within the genus. The epistemological shift strengthens a plant-centered ontology that has been secondary to the human-centered ontology of anthropogenic speciation. The anthropogenic concept builds primarily upon the visibly obvious human uses of *Cannabis* that exist, rather than the visibly less obvious types of plant that exist. Both sets of ontological basics—human uses and cryptic species—are relevant for understanding *Cannabis* history. If these sets are given equal consideration, *Cannabis* histories can provide a more balanced understanding of social–ecological interactions in the plant's past.

13.3 Re-centering *Cannabis* History

The anthropogenic speciation concept is human-centered, and, I argue, enables a Europe-centered narrative of *Cannabis* history. The biogeographic problem of *Cannabis* speciation and the historiographic problem of drug *Cannabis* diffusion in the post-Columbian Atlantic can be explained more parsimoniously by re-centering the scholarly debate in two ways.

First, plant-centered analysis is a basis of human–plant studies, an emerging, multidisciplinary field (Hall 2011; Head and Atchison 2009; Ryan 2012). A plant-centered consideration of ancient *Cannabis* speciation suggests a process from which humans are absent, even if the phytochemical results have human significance. Geological processes offer better explanation for *Cannabis* speciation than artificial selection.

Cannabis is highly sensitive to light, and the two types are adapted to different conditions of sunlight intensity and seasonality. The two types succeed best under daylength seasonality characteristic of different latitudinal zones (Clarke 1981: 124). The non-psychoactive population thrives in the long days of mid-latitude growing seasons, while the psychoactive population prefers the more equable daily conditions of lower latitudes. Light sensitivity can also account for the difference in cannabinoid production between the types. THC absorbs ultraviolet-B (UV-B) radiation and thereby protects plant tissues from damage (Pate 1983, 1994). Drug *Cannabis* plants produce greater amounts of THC with increased exposure to UV-B light, but Eurasian hemp does not (Lydon et al. 1987), because it lacks THC-dominant molecular chemistry (Hillig and Mahlberg 2004). The psychoactive plant population probably originated around the Hindu Kush mountains in the southwestern Himalaya (Hillig 2005; Schultes and Hofmann 1980). The Hindu Kush has experienced rapid geological uplift since the late Pliocene, about 2,700 m over the last 3 million years (Dambricourt-Malassé 2011; Zeitler et al. 1982). Increased altitude reduces the UV-filtering effect of the atmosphere, and strengthens natural selection for UV-B tolerance. Additionally, the area's lower latitude causes increased insolation relative to mid-latitude Central Asia, where *Cannabis sativa* grew at lower elevations with much lower UV-B exposure. UV-B exposure in the Hindu Kush is unequaled worldwide except in the high-elevation, low-latitude Andes (Beckmann et al. 2014). Other plants in the Hindu Kush are adapted to high ambient radiation (Agkhanyantz and Lopatin 1978). Natural selection produced two *Cannabis* types, and geologically very recent human selection has amplified the difference.

Second, centering historical analyses of the Columbian Exchange on subsistence economies and non-European peoples exposes past ecologies lost in historiography that focuses on commercial economies of European colonial expansion (Carney and Rosomoff 2009; Carney and Voeks 2003). Anthropogenic speciation abets a Eurocentric narrative of *Cannabis* history that is obvious in maps (Fig. 13.1), and parallel to traditional themes in the broader Columbian Exchange literature. The narrative is that *Cannabis* in the Americas came almost exclusively from Europe, where non-psychoactive *sativa* hemp was valued long before 1492. Initial instances of *Cannabis* drug use in the historical record are attributed either to anthropogenic speciation, or to hypothesized hybridization events that depend upon human migrations that are undocumented and unsupported by contextual evidence (such as language geography).

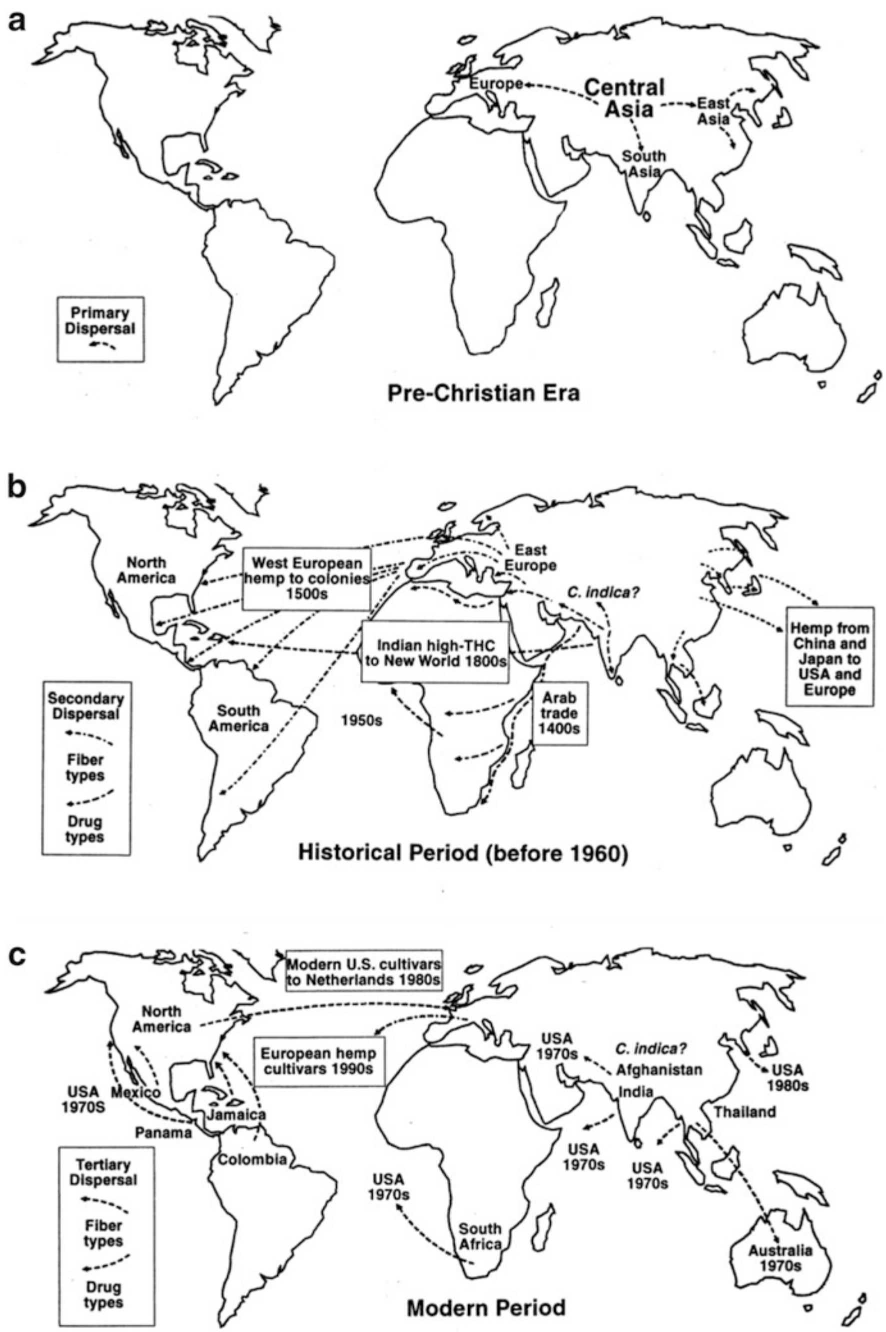

Fig. 13.1 *Cannabis* global dispersal (Reproduced from Clarke 1999). These maps represent the historic dispersal of all types within the genus. Clarke (2010a: 12–14) and Clarke and Merlin (2013: 123–131) have re-drawn these maps with minor changes, but larger, shaded formats of the newer versions reproduce poorly at the page size used in this chapter. (**a**) Map 1 of 3. (**b**) Map 2 of 3. (**c**) Map 3 of 3

Eurocentric maps reflect bias within the historical record, as well as bias in how historians have analyzed the record. European maritime expansion required great quantities of hemp fiber, and there is a thick record of European efforts to introduce non-psychoactive hemp worldwide. The record shows that these introductions failed at low latitudes, where daylength seasonality does not suit *Cannabis sativa*. In contrast, relatively few primary sources document other known dispersal vectors. The one other vector shown on most *Cannabis* maps represents indentured South Asian laborers, who were shipped from British India during 1834–1920 to replace slaves in some British Caribbean colonies (primarily Jamaica, Trinidad, and Guyana). Caribbean authorities knew of drug use amongst these laborers based on information from colonial India, and adopted Hindi terms, particularly *ganja*, in late nineteenth-century drug-control laws. The legal vocabulary established *ganja* as the primary common name for drug *Cannabis* in the region (Bilby 1985), and ultimately caused the South Asian dispersal vector to be salient to *Cannabis* historians. Finally, many maps show a *Cannabis indica* dispersal vector proceeding from western Africa toward South America at an uncertain date, but histories cite no sources indicating how Africans might have aided this dispersal. An African heritage seems obvious at least in Brazil, where common names for drug *Cannabis* include *maconha* and *diamba*, both borrowed from Angola's Kimbundu language (Schneider 1991: 172, 187).

Together, the limitations of the primary record alongside inherited ideas about *Cannabis* produce clear problems of historical explanation. For instance, a map entitled "Dispersal of *Cannabis* to the New World" suggests that drug *Cannabis* arrived in Colombia, Cuba, Panama, and Mexico with South Asian laborers, and the accompanying text further names Guatemala and Brazil (Clarke and Merlin 2013: 123, 129), although no workers arrived in these countries (Northrup 1995). Additionally, European attempts to farm hemp in these countries failed (de Souza Moraes 1994; Pérez-Arbaláez 1956: 513–514; Schafer 1958: 290, 322–323, 329; Serrera Contreras 1974), a historical situation that provides weak footing for hypothesizing a European source for the subsequently observed drug *Cannabis* populations—unless through recourse to anthropogenic speciation. Instead, a more parsimonious and plausible explanation is that historians have overlooked important vectors of *Cannabis* dispersal in the Atlantic.

13.4 Reconsidering *Cannabis* in the Atlantic

Recognizing inherent biases in the primary record and analytical biases in secondary sources enables a re-centered assessment of *Cannabis* in the Columbian Exchange, which considers possible plant use in both commercial and subsistence economies, and in European and non-European populations. A more complete and balanced survey of source literature suggests an historiography that is more attentive to historically contingent, social, cultural, and environmental contexts. Four themes should be underscored in this historiography.

First, primary and secondary sources often neglect the agronomic realities of hemp production, and thereby overestimate the rate of plant dispersal associated with European colonial expansion. *Cannabis* histories portray hemp dispersal as an outcome of its importance to European colonists. Hemp was certainly important to kings and empires, but its historical diffusion generally arose either from the imposition of political and economic authority within highly stratified societies, or from the droppings of seed-eating birds.

The desires of imperial authorities often determined where and when *sativa* was transported worldwide. Nonetheless, farmers and processors directly decided whether or not to produce hemp. European farmers were often willing to produce enough *sativa* to meet household needs. However, as European authorities became increasingly reliant on hemp, farmers found *Cannabis* unprofitable at the levels of production necessary to supply maritime empires. *Cannabis* is a demanding crop, if meant to produce high-quality fiber. Historic hemp processing comprised a series of tedious, heavy tasks (Clarke 2010b; von Schmidt 1843). Few tasks were mechanized until the late 1800s, although manual processing remained common into the 1940s. Harvesting was back breaking, often unpleasant, and potentially dangerous work. The plant's smell could be nauseating (Masclef 1891: 244). Water used in processing the fibers was considered poisonous (Marcandier 1758: 38). Dust raised when cleaning fibers caused lung disease (McPartland 2003). Hemp labor represented suffering from Italy to China (Mueggler 1998; Schaefer 1945).

Around the Atlantic, hemp succeeded commercially through exploitative labor systems. For instance, slave labor was crucial in the US. Production centered on Kentucky, whose antebellum economy depended upon sales of sackcloth and twine to cotton plantations in the Deep South. A professional historian concluded: "Without hemp, slavery might not have flourished in Kentucky" (Hopkins 1951: 4). Free laborers refused the work. In the U.S. and elsewhere, convicts, paupers, sharecroppers, and wage slaves did the work when chattel slaves were not available.

Beyond its labor demands, *Cannabis* was difficult to place within agricultural systems, because it competed with staple grains. Hempseeds were not food in western Europe. Authorities in Europe and the Americas regularly encouraged, coerced, or required hemp production, but farmers widely avoided the crop. For instance, when British authorities in Ontario made hempseed freely available in 1790, farmers claimed 29 of 2,000 bushels; at the time, Canadian settlers grew *Cannabis* only for birdseed (Lambert 1810: 465; Macdonald 1936: 387). *Cannabis sativa* did not spread rapidly from its points of introduction in North America (Haney and Bazzazz 1970), and failed at low latitudes. European *Cannabis* did not sweep across American landscapes to await non-European drug users.

Second, primary and secondary sources on *Cannabis* are rife with racial ideologies. European scholars gained knowledge of *Cannabis indica* only in non-European locations. Knowledge of psychoactive *Cannabis* developed within 'the tropics' and 'the Orient' as imagined geographic regions. In this context, drug use has represented cultural difference, rather than biological dispersal of *Cannabis indica*. Historically, *Cannabis* drug use was framed as an "Oriental" behavior (Borougerdi 2014), while in more recent decades drug use has been portrayed as racially determined. For instance, in 1965, an international expert on crime told, "different races of people vary in their susceptibility to marihuana". His list of marijuana-induced crimes carried just one racial identifier, "Negro" (Munch 1965: 22). Biogeographic and historiographic narratives of *Cannabis* speciation conceptually underpin such racial discourse.

The language of race has been explicit in *Cannabis* science, paralleling and substantiating the idea that race is environmentally determined. A paper on UV-B radiation in *Cannabis* ecology began with "the casual observation that the sun-drenched areas growing the most potent Cannabis [are] populated by native peoples of the darkest complexions" (Pate 1983: 397). This observation is inaccurate. The potency of drug *Cannabis* has always depended upon the cultivar, and the use of inputs such as fertilizer and irrigation. The current, formal *Cannabis* taxonomy specifies that "the northern races" of the plant are distinct from its "southern, intoxicant races" (Small and Cronquist 1976: 416).

Third, *Cannabis indica* crossed the Atlantic primarily as a subsistence plant resource of underclasses in exploitative labor regimes. Racial stereotypes of drug use have obscured the mostly class-based, social diffusion of drug use, while historiographic emphasis on commercial economies has obscured subsistence-oriented plant dispersals. European, African, and Asian laborers carried drug *Cannabis* across the Atlantic (Table 13.1). European sailors used the plant medicinally and recreationally in the Indian Ocean (Bowrey 1905 [1701]; Knox 1681), but in the Atlantic only linguistic echoes of their use persist. South Asian laborers brought *ganja* into the Atlantic during the 1800s, when hard laborers in India used the drug interchangeably with opium in coping with their conditions of life (Chandra and

Table 13.1 Transatlantic dispersal vectors of psychoactive *Cannabis indica* prior to c. 1940; earlier evidence of plant presence exists in some cases, without clear dispersal vectors

Dispersal vector, main date range	Origin	Key destinations and representative, non-comprehensive evidence
European sailors, 1500s?–1700s	India	Angola: linguistic evidence (cognates of *banga*) (Sanders and Fay 1885: 17)
		Brazil: linguistic evidence (cognates of *banga*) (von Spix and von Martius 1824: 39)
		Britain: account of seed transport, 1689 (Derham 1726: 210)
		Spain: linguistic evidence (cognate of *banga*) and account of plant observation, 1754 (Monteagudo 2002: 377, 384)
African slaves, 1600s?–1850s	Angola	Brazil: linguistic evidence (cognates of *liamba*), first published 1839 (Taunay 1839: 250)
		Colombia: linguistic evidence (cognates of *liamba*), in maroon community dating from 1600s (Castillo Mathieu 1984: 143)
	Gabon	Brazil/Cuba: account of seed saving, 1840s–1850s (Du Chaillu 1861: 420)

(continued)

Table 13.1 (continued)

Dispersal vector, main date range	Origin	Key destinations and representative, non-comprehensive evidence
African post-slave laborers, 1808–1940	Angola	São Tome: linguistic evidence (cognates of *liamba*) and account of plant observation, 1886 (Moller 1886: 41)
	Brazil	Nigeria: account of use associated with Afro-Brazilian immigrants, 1863 (Anonymous [Richard F. Burton] 1863: 222)
	Lower Congo region	Jamaica: account of horticulture and use, 1862 XXXXX
		Liberia: account of seed transport, likely 1830s–1840s (Büttikofer 1890: 276)
		Sierra Leone: account of seed transport, likely 1830s–1840s (Clarke 1851)
	Sierra Leone	Guinea: linguistic evidence (cognates of *liamba*), first published 1906 (Pobéguin 1906)
		New York, United States: secondary source (Akyeampong 2005)
		Senegambia: linguistic evidence (cognates of *liamba*), first published 1859 (Poisson 1859: 46)
Indian post-slave laborers, 1834–1920	India	Jamaica: account of horticulture and use, 1862 XXXXX
		Trinidad: secondary source, 1885 (Anonymous 1885)
		New York, United States: secondary source, 1940 (Akyeampong 2005)
Commercial networks, 1860s?–1910?	Angola	Brazil: importer's advertisement, 1883 (de Almeida 1883)
		Britain: trade records, 1891 (Administração Geral das Alfândegas 1896: 221)
		Gabon: account of trade, 1870 (Lartigue 1870: 175)
		Germany: trade records, 1890 (Administração Geral das Alfândegas 1896: 60, 227)
		Guyana: commercial regulations, 1885 (Editors 1885)
		Portugal: trade records, 1880 (Ministerio da Marinha e Ultramar 1887: 69)
		São Tome: trade records, 1884 (Ministerio da Marinha e Ultramar 1887: 113)
	India	Guyana: commercial regulations, 1856 (Ball 1856: 18)
		St. Helena: account of sale from South Asian lascars to liberated slaves, 1845 (M'Henry 1845: 437)
Levantine immigrants	Asia Minor	California, United States: account of horticulture and use, 1895 (Anonymous 1895)

Swoboda 2008). African laborers from Angola and the Lower Congo, both enslaved and nominally free, carried the plant widely. Subsistence drug use of *Cannabis* was, emphatically, not a generalized 'African' practice amongst the people who entered the Middle Passage. In Angola, slavers made the drug an item of commerce because it "was highly esteemed [for] supporting the strength and condition of the slaves when on the long and toilsome marches towards the place of their embarkation" (Daniell 1850: 363). After slavery was outlawed, Portuguese Angola began exporting drug *Cannabis* to post-slave laborers in São Tome, Gabon, and Brazil; British India similarly supplied *ganja* to South Asian laborers in the Caribbean. The belief that drug *Cannabis* is simply a use of European hemp has obscured these multicultural, commercial and subsistence dispersal vectors.

13.5 Conclusion: *Cannabis* Past and Present

Cannabis has helped produce social and cultural divisions for centuries. Recognizing these divisions helps to correct dominant understandings of the plant's post-Columbian history. *Cannabis sativa* is an example of European-led plant dispersal across the Atlantic after 1492. A Eurocentric narrative is valid for this specific tale in *Cannabis* history. However, this transfer relied upon the exercise of power within highly stratified societies, and the spatial extension and development of exploitative labor relationships. In contrast, the transatlantic crossing of *Cannabis indica* was not Europe-centered, but originated in Asia and Africa, carried by people who have been often overlooked in historiography on the Columbian Exchange. The drug plant succeeded in destination societies because people of all cultural backgrounds came to value it in coping with hard labor, poor health, and social marginality.

The dominant historiography that frames *Cannabis*' post-Columbian past as almost entirely Eurocentric has obscured the fact that social context, not cultural heritage, has determined drug use for centuries. The anthropogenic speciation concept of *Cannabis* taxonomy supports this Eurocentric history, while also enabling social and cultural stereotypes. By allowing the plant's psychoactive potential to represent human difference rather than plant diversity, the 'objective' science of anthropogenic speciation has helped produce and sustain subjective ideas about drugs and drug use in human societies. In particular, the notion that drug use is a racially determined behavior underlies many policies and practices of drug control in current societies. In the U.S., for instance, Blacks face four times the rate of marijuana arrest as Whites (Edwards et al. 2013), despite identical rates of use between the two racial groups (Substance Abuse and Mental Health Services Administration (SAMHSA) 2014). The anthropogenic speciation hypothesis of *Cannabis* history supports racial stereotypes that can underpin biased drug-law enforcement. Environmental history is relevant to challenging stereotypes of drug use in current societies.

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Chapter 14
History of the Colonization of Minas Gerais: An Environmental Approach

Alexia Helena de Araujo Shellard

Abstract A wild world, full of unknown dangers, barbarian people and hungry dragons: this is how the Portuguese settlers used to figure out the interior of Brazil in the early centuries of occupation of Brazil. Only brave or desperate men would dare to leave the 'civilized' environments of the coast to scroll through the vast hinterland of the colony in search of slaves and richness. Nevertheless, in the last decade of the seventeenth century, the discovery of gold mines in Minas Gerais caused the migration of thousands of people to the unknown terrains, on the first gold rush of the Modern Era. In less than one century, old forests were devastated to open space to cities, pastures, fields and mines, while the indigenous population was almost entirely replaced by Africans and Europeans.

This paper address to a common thematic in Brazilian History: Minas Gerais' gold rush along the eighteenth century. Its approach, however, incorporates an element whose importance is often underestimated: nature.

14.1 Introduction

This paper is an analysis of the social and environmental changes that occurred between late seventeenth century and mid-eighteenth century in Minas Gerais due to the discovery of countless rich gold deposits in the region. Actually before these findings in the 1690s, the area hadn't even an official name: it was a vast and wild land inhabited by indigenous people and occasionally visited by *paulistas* in their hunting for slaves. Nevertheless, along the first half of the eighteenth century, the possibilities of quick enrichment attracted thousands of people from all the corners of the colony and also from different regions of the metropolis, besides having caused the abduction of millions of people in Africa, who were compulsorily brought to exploit the mines of Brazil. Thus, the period studied represents a profound transformation of a territory that completely lost its 'wild' character in less

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than a century, becoming a crucial extension not only to the Portuguese colony but to the whole Portuguese Kingdom.

Occurrences observed in the eighteenth-century reflect homogenizing trends that are still ongoing today: on one hand, exotic species has been introduced in monoculture systems, contributing to reduce the natural diversity; on the other, indigenous cultural diversity has been constraint by European colonial power. Moreover, great part of the land in these new Portuguese territories were turned into lands owned by noblemen who would win their dominium from the crown, according to the number of slaves possessed. As determined by the Mineral Statement from 1702, the access to mineral and gold mines would be given only to wealthy men who could provide labour force to exploit the mines; miners without possessions were, evidently, excluded from these sharings (Reis 2007, p. 66).

Therefore, Portuguese colonization in Minas Gerais had a high cost in terms of social and environmental impacts. Through enslavement, massacre and acculturation of native peoples, the colonial frontier expanded, causing deep cultural and environmental constraints in this hinterland. The forests were destroyed and turned into mines, pastures, crop fields and villages. Communities, whose survival depended on certain environmental settings, were disrupted.

Untying motivations for the use of natural resources from local scale, Portuguese Crown articulated the events in Minas Gerais to European socio-economic conjuncture, establishing new relationships between use and preservation of nature (Santos 2008). The limits of natural resources use were no longer associated to local issues, which caused the expansion of predatory attitude towards nature. The effects of gold exploitation were spread to places as far as Gold Coast in Africa – where much of the slave workers were captured – and Uruguayan Pampas – where farms developed to attend mines' demands for cattle. The collection of the Fifth – a Royal tribute of 20 % imposed upon all the gold found in Brazil – nourished not only the ostentation of the King João V's court, but also the invigoration of the British economy, which culminated in the Industrial Revolution. Furthermore, the trade flow that joined African slave market to South Atlantic Iberian colonies was substantially increased to fill the voluminous Minas Gerais' demands for slaves.

In Brazilian captaincies, the impact was even more immediate: the supply of the mining system required the colonization of new areas of the hinterland, and implied the introduction of new plant and animal species to support the great surge of migrations. Even the 'civilized' coasts altered their economic activities to supply the material needs of Minas Gerais' miners (Fig. 14.1).

Exploring the dialectic between culture and nature, this paper addresses to the transformation of the unknown hinterland into one of the most important captaincies of the Portuguese colony throughout the eighteenth century. In this territory, at that time, the clash between distinct temporalities and spatialities caused gigantic changes in historical and geographical dynamics. We could even set the eighteenth century as the entrance of Minas Gerais into the modern world, meaning that from that point ahead, Minas was no longer an aside territory, being connected to the incipient Occidental world economy.

Fig. 14.1 *Terra Brasilis* in *Atlas Miller* (c.1515–1519). In: Knauss et al. (2010)

14.2 Paths, Routes and Maps

> Em menos de trinta dias, marchando de Sol a Sol, podem chegar os que partem da Cidade do Rio de Janeiro ás Minas Geraes […] da Cidade do Rio de Janeiro foraõ a Paratijs. De Paratijs a Taubatê. De Taubatê a Pindamonhangâba. De Pindamonhangâba a Guaratingaetâ. De Guaratingaetâ ás Roças de Garcia Rodrigues. Deftas Roças ao Ribeiraõ. E do Ribeiraõ com oitos dias mais de Sol a Sol chegaraõ ao Rio das Velhas.[1] (Antonil 1711: 163)

One of the first gold routes in Brazil, the so called Old Path included not only the land portion described above by Antonil, but also a sea route, connecting Paraty to Sepetiba. From Sepetiba, the chargers would unload the ships, carrying by land, to

[1] In less than 30 days, walking from dawn to dusk, the ones who left Rio de Janeiro to Minas Gerais, may arrive […] from Rio de Janeiro they went to Parati. From Parati to Taubate. From Taubate to Pindamonhangaba. From Pindamonhangaba to Guaratingueta. From Guaratingueta to Garcia Rodrigues' lands. From these lands to Ribeirao. And from Ribeirao in 8 days, from dawn to dusk, they will get to Rio das Velhas (free translation).

the city of Rio de Janeiro the goods brought from Minas Gerais. While the sea section was haunted by pirate threats, the terrestrial part beginning in Paraty and ending at the wilderness where the mines were located was ominous because of its dense forests and steep mountains. The passage, linking Atlantic Coast and Serra da Mantiqueira, was just a prognostic of the arduous obstacles that would have to be overcome along hundreds of miles and dozens of travel days in order to reach the gold deposits.

The Old Path had incorporated ancient indigenous trails to connect the 'civilized' coast to the 'wild' outback, representing one of the first axis of interiorization of the Portuguese America. Crossing Serra do Mar, it reached Vale do Paraíba, where it joined the so called General Path to the hinterlands – coming from São Paulo. Then it passed through Serra da Mantiqueira – at one of its lowest points, named Garganta do Embaú – and penetrated the wild hinterlands.

Soon, Portuguese authorities decided to prevent these disadvantages of the Old Path and establish a new route to Minas Gerais. They ordered the opening of a new path, which remained known as the New Path. It connected Rio de Janeiro straightly to Minas Gerais, extinguishing sea routes outside Guanabara Bay, and decreasing substantially the number of days for the trips. Although the tourism industry affirms nowadays the exact location of both New and Old Paths, we may never know the accuracy of this kind of information. The map shown below, produced and released by Estrada Real Institute, is very known in Brazil and it helps to stimulate the economy of the featured towns, but it is actually an estimation of the real position of the paths and it has no solid corroboration.

The reports that were written at that time about territories beyond Serra da Mantiqueira are vague and contradictory: Antonil (1711) cites the fields of Garcia Rodrigues at both New and Old Path. We can not asseverate categorically whether it is a matter of homonymy or if the fields of Rodrigues had such a vast extension. Garcia Rodrigues' father, Fernão Dias, was one of the first pioneers to explore the Cataguases hinterlands, so the favors granted by the Portuguese Crown for his important role on gold mining development in Minas Gerais may have been extended to his heirs in the form of gigantic lands (Fig. 14.2).

Although Portuguese crown had first stimulated the migration to the mining zone in order to increase the collection of taxes and duties, in the early years of the eighteenth century, this policy was inverted. Noticing that it was impossible to control the territory of the mines, not only because of its extension, but mostly because of its geography – meaning steeping mountains, dense forests, native people – Portuguese authorities decided to establish official roads to Minas. Traveling by non-official routes would be then considered a crime and therefore it would be subjected to penalties and even death.

Nevertheless, the isolation policy caused little effect: smuggling continued occurring concomitantly with the official trade of the metal. The taxes charged by the Crown encouraged the frauds: besides the fifth levied on gold production, all kinds of goods were taxed if traded in the territory; even the domestic market of agricultural products did not escape from duties: sometimes, a single commodity

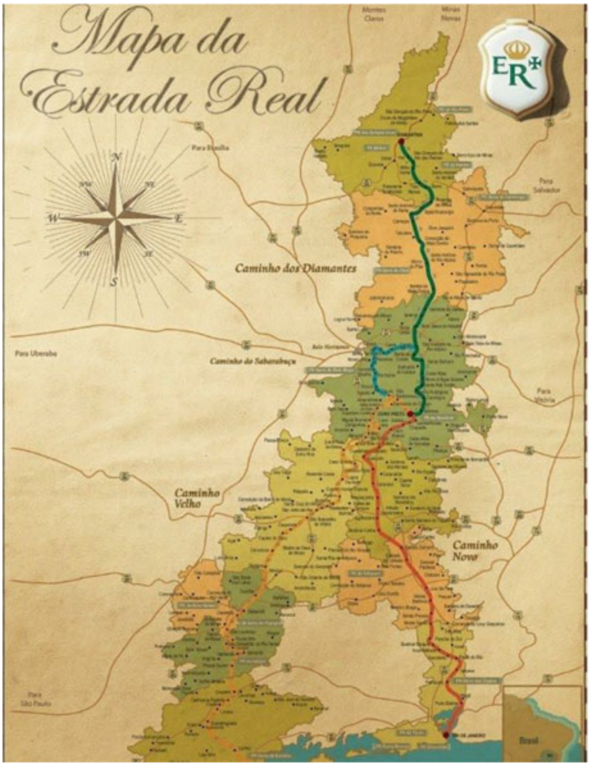

Fig. 14.2 Map of Old Path in *orange* and New Path in *red*. In: http://www.institutoestradareal.com.br

would have a great inflation in its price due to taxes charged over taxes (Furtado 2005).

Conservative estimates state that 35 % of the gold extracted from Minas Gerais in the eighteenth century was smuggled. But the bootleggers were not the only ones to disturb the authorities; the escape of African slaves was a big issue at that time: the rebels used to gather and form *quilombos* around the mines. The Iberian legal powers had great difficulty fighting the outlaws during the earlier decades of the century, especially because of the lack of spatial information. In order to plan, to manage and to control, knowing the territory was an indispensable necessity: without a consistent system of mapping, it would be impossible to make the Portuguese colonization a successful and permanent enterprise (Fig. 14.3).

In this manner, the precarious mapping of the interior of Brazil started to improve. Parallel to the emergence and growth of fields and villages, many of the landforms in the vicinities of mines and paths were identified and named, favoring the effective recognition of the places mentioned. Hence, the cartographic production of Brazil's interiors presented a dramatic change of perspective throughout the eighteenth century: while the images of previous centuries used to show homogeneous masses of land representing the wilderness of Portuguese America; the hinterland maps were now full of details and toponymy, especially those depicting Minas Gerais.

Fig. 14.3 Map of the captaincies by Joan Blaeu (1689). In: Knauss et al. (2010)

On the previous map, designed in 1689, the coast is divided into various captaincies which are no longer limited by straight lines – as it used to be along the sixteenth century – but by flexible shapes based on natural features; the map also shows that the Portuguese had named a lot of places along the coastline. On the other hand, the interior of the colony looks more like a vacuum: there are few signs showing indigenous nations, rivers and mountain ranges: the scale used for the coast region and the one used for the hinterlands clearly differs. There is a clear opposition between the indigenous outback – unknown and wild – and the colonial European coast – 'civilized' and scrutinized (Knauss et al. 2010).

The map shown bellow is example of another period of Brazilian history, after the gold rush, when knowledge about Minas Gerais had been intensified. The scale of the map is now larger, allowing the detailing of mountains and rivers, which are then named, showing an intimate relationship with the place. There are, now, numerous paths, villages and settlements, which reflect the intense flow of people within the captaincy.

Initially, paulistas pioneers developed the first maps of the region, based on indigenous information, but instead of using this information to overcome the adversities of the environment, the settlers employed it as tools for killing and trapping indigenous people people and for exploiting other "resources" in the region, such as gold and water. Over the following centuries, the indigenous cartography[2] supported historical cartography, besides being the basis for the implantation of highways and railroads (Vangelista 2005) (Fig. 14.4).

At first, the auriferous territory is embeded "em meio ao sertão vasto e desconhecido [...] nas margens do mundo conhecido, ao qual se opunha, rejeitando os

[2]Although Vangelista (2005) and Holanda (1994) use the term cartography in their texts, there is no evidence that there was an organized system of indigenous maps. Probably they referred to mental and symbolic knowledge of living spaces.

Fig. 14.4 Map of Minas Gerais (1778). In: Knauss et al. (2010)

valores da vida civilizada[3]" (Costa 2005, p. 209). The Portuguese, then, must join the indigenous culture, lowering, at their point of view, their civilization standards, in order to keep going inland. Gradually, as the wilderness was demystified, the Portuguese resumed their inheritance, selecting from their traditional repertoire, technical and cultural elements to apply to this new territory.

In colonial frontiers, paths are initially the main factor for historical changes. Movement is the mark of this frontier environment, in which mobility predominates over stability; there is no such thing as "um espaço organizado, mas itinerários de penetração, rasgos permanentes nos mapas, devidos à sobreposição geológica dos caminhos modernos sobre os ancestrais[4]" (Vangelista 2005, p. 138). To transitority, it is added multiplicity, contingency and reversibility, profoundly shaping this moment of the frontier: paradoxically, the continuity is found in flows instead of in fixed elements (Duarte 2005). Therefore, nature had conditions to regenerate after its intense use, since paulistas was constantly moving to unexploited mines.

Governance, hence, required cartographic information for delimitation of powers, limits districts, as well as for the establishment of mechanisms to order and

[3] Amid the vast and unknown outback […] at the margins of the known world, to which it opposed itself by rejecting the values of civilized life (free translation).

[4] An organized space, but axis of penetration, permanent rips on the maps, due to the geological overlay of contemporary and former paths (free translation).

control the flow of goods and people. Evidently, fixed cities and populations would be crucial to this project of dominance. As the economic importance of Minas Gerais growed, the expeditions to the region acquired a scientific character and the Crown started to send technicists and scientists in reconnaissance and mapping missions; however, much information on the maps were deleted or changed purposely to hinder access to the mines (Costa 2004).

Having geographical charts and maps, the authorities could identify proper locations for record houses and foundry houses. Nevertheless, the borderlines of Minas Gerais were not totally determined until the subsequent centuries. The eastern boundaries with Espírito Santo and the western boundaries, with the captaincies of Goiás and Mato Grosso, remained unclear throughout the eighteenth century, amidst wildernesses, forests and wild indigenous populations (Costa 2004).

In the first quarter of the eighteenth century, colonization changed its character: now not only adventurous and nomadic people were the ones looking for gold but many rich and distinguished men, specially from the northeast region, who were also coming to the interior in search for greater richness. Moreover, superficial gold was becoming rare, requiring the use of more sophisticated techniques in order to find gold in deeper soil layers. Besides digging, miners built dams and changed the course or even dried streams to examine riverbeds (Boxer 2000).

This meant the necessity of money to buy or build machines and also to buy slaves – who became the main labor force in the mines; so that, from this moment on, colonization acquired a more sedentary way: it would be hard to be constantly moving slaves and machines (Zemella 1990). The Crown acted to strengthen this standard giving mines concession according to the number of slaves lords possessed. Actually, those ones who owned 12 or more slaves would get bigger areas to exploit and would also gain the right to exploit water streams (Carles 2013)

Many constructions were built in order to apply the hydraulic power for gold exploitation: extended aqueducts transported water from distant places – there was one reaching 40 km – and big dams contained it; both of which required tones of wood material and hundreds of working arms to be built (Dean 1997). Recently, between Ouro Preto – formerly Vila Rica – and Ouro Branco – where the route known as Caminho Novo was probably located – archaeologists found three sites where there are ruins of structures used to drain and transport waters (Guimarães 2007). As we argued before, gold business was being taken by richer entrepreneurs who could afford these expenses.

One of the most used hydraulic techniques was to throw water against rivers banks and mix it to as much sediment as it was possible. After turned into mud, it was carried to decantation tanks where the gold particles would precipitate; the remainder mud was then leaked through a channel covered with leather and sent back to its original course in an altered composition: more acidic and dirtier (Guimarães 2005). The entire ecosystem dependent on certain water qualities as a determined PH and crystallinity level should then readapt to survive.

Hydraulic power mismanagement also intensified erosion processes since water was used to provoke avalanches – specially on the east face of Serra do Espinhaço, where water sources were perennial (Luna 1980). Water became even more crucial to the gold economy and Portuguese authorities tried to reach its fiscal interests – tax collections – throughout water control. Municipal chamber of Vila Rica, for instance, acquired almost a monopoly over urban water supply along the eighteenth century, providing piped water to much of its important buildings as the Governor's palace which started to receive water in 1716. The establishment of urban water programs happened concomitantly to the creation of the foundries houses in 1725 (Carles 2013).

Gold economy was thus extremely dependent upon water: if there was no water there wouldn't be mining. Initially, population settled next to water streams due to basic life necessities; from 1710s on, the dependence on water was no longer a physiologic question only but it also concerned to the expansion of gold exploitation. Water management became a complex issue and tensions referring to water disputes spreaded, being responsible for the delaying of many water buildings. Portuguese Crown tended to benefit those miners possessing slaves and capital to apply to the hydraulic machines (Carles 2013).

14.3 Frontier

The American historian Alfred Crosby defends in his book, *Ecological Imperialism* (2004), the idea that Europeans, when conquering America, had brought with them numerous species of living beings who contributed to the viability of the Portuguese colonial project for Brazilian territories. He refers not only to cattle and crops, but to a whole range of microorganisms that caused the death of millions of indigenous individuals, even before they actually met European navigators. The diseases spread by these microorganisms killed Indians not only because of their own evolution, but also because of the subsequent cultural disruption caused by fear and food shortages due to the lack of labour force.

Another American historian, Warren Dean, in his analysis of the Brazilian Atlantic forest – *With Broadax and Firebrand* – corroborates Crosby's thesis affirming that when the settlers arrived in Minas Gerais at the turn to the eighteenth century, those hinterlands – which once were inhabitated by thousands of people – had been empty due to paulistas hunting for slaves and to the mortality caused by diseases brought to America by European conquerors.

The Portuguese invasion throughout the eighteenth century was unrelenting, imposing not only their human presence, but also the presence of a set of exotic animals, plants and microorganisms, which significantly altered the local ecosystems. Disoriented in their own environment, Amerindians had no time to reacquaint after so drastic and sudden changes in their lives.

Nevertheless, in the early century colonization progressed like waves in a sense that the original mining settlements would expand to juxtapose the next mining settlements in a non-linear process. The frontier would be first virtually determined, and then, as the settlements expanded and filled the space between them, it would earn a real content. The history of the colonization of Minas Gerais is characterized thus by a condition of peripheral fluidity that runs throughout the eighteenth century: as the distance from the colonial core areas increases, the power structures of colonial administration lose their strength.

Thought the frontier was reversible. In Luso-Brazilian occupation areas, colonization wasn't necessarily going to be completed in terms of political and economic mechanisms: in many cases, little towns, which had been precarious formed, vanished after the depletion of the mines (Santos 2010). Then, the space would keep environmental brands caused by this exploitation, remaining an area of ecological frontier in which species from different geographical origins lived along. The ecological transition from a native biome to a new biome, predominantly modulated by anthropogenic forces, rarely occurred in an abrupt way (Ellis and Ramankutty 2008). The colonial frontier would advance destroying the Atlantic Forest or any native biome to extend its pastures, crops and settlements, but in one little period of carelessness, the forest would regain these altered and abandoned areas.

The idea we should keep in mind is of a system of territorial appropriation that is, even in its nuclei, marked by discontinuity (Santos 2010). The analysis of this territory should be analyzed through motion, through routes: even the official roads would cross vast wilderness areas, reflecting this discontinuous character of the internalization of the colony in which 'civilized' territories would be interspersed with hinterlands, i.e. 'natural' indigenous areas. Nevertheless, the hinterlands would not only represent the spaces of nature and idyllic Amerindians (identified more with 'natural' than with 'social'), but it was also the territory of outlaws, where colonial rule could be avoided:

> Escravos fugidos, grupos indígenas hostis e criminosos comuns atuavam nas franjas do território colonial, aproveitando-se da debilidade do controle militar nessas regiões. Com efeito, essa parece ser uma característica comum às zonas de fronteira, pela qual o incremento da população fomenta, paradoxalmente, o surgimento de focos de extraterritorialidade, que podem manter sob pressão os núcleos pioneiros por anos ou décadas. A instabilidade e a ameaça de reversão da ocupação parecem ser condições inelutáveis da fronteira.[5] (Santos 2010, p. 285)

The threat posed by these outbreaks of extraterritoriality to Minas Gerais is one of the elements that attributed the status of frontier to this area, even after the captaincy was institutionalized. The clashes were so widespread that the military presence is constant, even in the most precarious settlement, represented by paulistas mercenaries and indigenous allies. To combat these considered outlaws, the Portuguese colonial power would burn vast extensions of forests in order to eliminate the protection offered by the vegetation density to the ones who would not follow colonial rules.

[5] Runaway slaves, hostile indigenous groups and common criminals used to act on the fringes of colonial territory, taking advantage of the weakness of military control in these areas. Indeed, this seems to be a common feature to frontier areas, in which the increase in population promotes, paradoxically, the emerging of extraterritoriality focus, which may keep under pressure pioneers centers for years or decades. The instability and the threat of reversal of occupation seem ineluctable conditions of the frontier (free translation).

Fig. 14.5 Routes and horses (according to Von Martius). In: Costa (2004)

14.4 Devastation

Fire was also used as an agricultural and cattle ranching technique. Portuguese settlers adapted an indigenous method in which a forest area would be burned to provide areas for crops. But, in opposition to indigenous practices which ended up in the abandonment of the agricultural field to be retaken by the forest, the Portuguese method would intensify the use of fire through time. Because of the sedentary way of life of Luso-Brazilian settlers, as the population increased requiring the expansion of agricultural fields, the available areas to crops would decrease: this would cause the progressive expansion of the distance between urban areas and crop fields and also the increase of the frequency and extension of the fires: annually, this would cost hundreds of square miles of forests and native ecosystems.

Livestock farmers would also generate fires to facilitate the expansion of pastures. The technique would work in the short-term, but after a few generations of grazing, the compacted and leached soils would be covered by aggressive plants which were poor in nutrients. In a ceaseless cycle, the degradation of pastures then drove the advancement of livestock fringes to forest areas; in these new fields, the nutritious grasses were, in just a few years, replaced by weeds, causing a new breakthrough.

Many native species would lose the competition with exotic grasses, which impetuously invaded abandoned fields, fringing forest and native grasslands. The dispersal mechanisms of opportunistic species facilitated the spread of seeds, traveling on cattle's fur. Moreover, other species would rapidly multiply in Brazilian jungle and savanna, such as pigs, becoming wild in few generations. Evidently, their proliferation caused significant impact not only in the vegetation, but also in animal populations, which had to face either new predators or new competitors (Fig. 14.5).

Another major impact of gold mining economy was on the water systems. Diverting waterways for hydropower use and for examination of riverbeds, as well as eroding riverbanks, the miners ended up modifying the properties of water flows. The turbidity and siltation of rivers damaged the riparian zone, which often contained the only evergreen tree species around. Mismanagement of hydro energy also intensified erosion processes in the soil, causing the lost of nutrients and frequent landslides.

The water was also affected by the spread of many tons of mercury in its toxic version throughout soils and waterways, since the metal was used to separate fine gold amalgams of sediments. Recently, in thesis defended at Unicamp, the geologist Ricardo Perobelli Borba (2002) also claimed the detection of arsenic – a chemical element that can cause damage to human health, for example, cancer – in sites in Rio das Velhas, Rio Conceição e Rio do Carmo. According to the author, much of Ouro Preto waters could contain high concentrations of arsenic due to the mining that has taken place in city's hills for over the last 300 years.

The exploitation of gold therefore caused deep alterations on the quality of water and soil, extending its impacts throughout whole ecosystems due to chain effects.

Soil physic quality – such as infiltration and capillarity capacities, nutrients availability, soil stability and micro fauna diversity – depended upon the Atlantic forest: vegetation cover protected the soil from the erosive impacts of rain and wind, soil nutrients were constantly fed by organic matter decomposition, and the trees provided good drainage and stability to the soil.

Deforestation and soil compaction facilitated superficial drainage impoverishing soil, besides taking big sediments and particles to riverbeds, provoking siltation and turvation. This resulted in a feedback process – deforestation would leave the soil more vulnerable to nutrients lost, reducing nature capacity of regeneration – noticed in basin as Rio das Velhas and Sabará (Dean 1997). Bumpy landscapes, full of ravines and gullies were abundant at that time (Romeiro 2005).

The French naturalist, Auguste de Saint-Hilaire (1938), who traveled through the interior of Minas Gerais in the late 1810s, noticed the state of abandonment of vast tracts of deforested land in the vicinity of the road linking the city of Mariana and Vila do Príncipe (current Serro). Assuming that they had been burned to implement crops, he commented, in his writings, that invasive grasses were now covering areas once covered by dense forests. Such altered environment, eroded and devastated by mining activities, paradoxically, conferred value to the interior of Portuguese America. Miners, with their rudimentary techniques, adopted a predatory attitude towards nature, depleting streams sequentially and leaving paths of devastation, but these paths reflected the progress of colonization.

Based on the classification of biomes of Ellis and Ramankutty (2008), the most consolidated territories of Portuguese America would present higher population densities, more humanized landscapes, reduced biodiversity, a significant number of domestic and exotic species, and permanent architectural landmarks. Meanwhile, the virtual frontiers would present most endemic ecosystems, higher biodiversity and less evidence of human presence.

14.5 What Happens Next?

From the 1690s ahead, the auriferous economy gradually started to move economic forces towards Minas Gerais, expanding the 'civility' cores through the discontinuous and fragmented frontier space. The region around the mine ceased to be a mere reservoir of precious goods, generating its own economy, which attracted people and goods from all over the globe. However, the introduction of a new logic in ancient wildernesses – the logic of accumulation – has been tragic, and three centuries later, devastation reached more than 60 % of the native vegetation. If we focus on the situation of the Atlantic Forest, the data is even more alarming: only 6.2 % of its original area survives in Minas Gerais nowadays.

Nevertheless, there is evidence that dependence on hydropower has softened predatory practices in certain places. Associating water flow sustainability with the protective effect exercised by riparian forests, miners avoided to devastate springs margins (Dean 1997). At that time, authorities noticed the malefic effects mining was provoking on the waters and in 1736, articles were included on Mineral Statement to avoid damaging waters, such as the obligation of protecting riparian forests – "E que os roceiros não possam roçar de novo nas cabeceiras dos córregos de pouca água de que se usa para serviços minerais, e devam conservar o mato em distância de quinhentos palmos, para evitar o dano da falta de água (…)[6]" and the interdiction of water degradation: "e que se não entulhem ou danifiquem os regos de água limpa (…)[7]" (Fonseca 2004).

In his trips to Minas Gerais at the beginning of nineteenth century, Saint-Hilaire noticed that the higher regions were often forested, which may be related to miners' precautions (Nogueira 2005). But not all researchers would agree on that: Lamego (1950), Rodrigues (2003), and Santos (2010) would identify the preservation of the higher mountains to the own restraints imposed by the environment; topography would then have prevented colonization of steep and rocky mountains. Unquestionable is that mining activity promoted, directly and indirectly, predatory uses of nature.

According to Dean (1997), mining enterprise along the eighteenth century required much more from Atlantic forest than the sugar and wheat plantations of the two previous centuries: the constantly removal and degeneration of the soils happened in a scale which prevented natural processes of ecological succession. My point, however, is not that mining activities in the eighteenth century caused all the destruction observed today. My argument here is that the connection between Minas Gerais and a developing world economy opened gaps referring to use and conservation of the space; by ending local populations' dependence on local environment. From this moment on, resources could be overused since people could move on or import goods from distant places.

[6] And that the planters can no longer graze along small spring margins from which water is used for mining services, and that they should conserve the vegetation cover for five hundred feet, to avoid damage from lack of water (free translation).

[7] And that clean water streams should not be obstructed or damaged (free translation).

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Chapter 15
Locusts in Southern Settler Societies: Argentine and Australian Experience and Responses, 1880–1940

Edward Deveson and Alejandro Martinez

Abstract Locust invasions were a problem common to many colonial settler societies, for whom agricultural development was crucial to success. Their impact on crops and pastures caused repeated losses and hardships for the nascent farming enterprises. In the southern lands of Argentina and Australia the initial hopes that bringing more land under cultivation, restoring the 'balance of nature', using disease organisms for biological control, or collective labour would solve the problem faded as swarms kept appearing. An increase in the frequency and intensity of plagues during the late nineteenth century created a fear that farming might become impossible and an urgency to find scientific solutions. The migrations of swarms across provincial boundaries and areas of cultivation propagated the risk of damage over wide geographic regions and into subsequent seasons. This led to government involvement in organising and funding collective responses and directing scientific research into locust ecology.

In both countries government departments were established to promote 'progressive agriculture' based upon scientific practice. Although the institutional frameworks involved in the modernisation of agriculture differed, the trajectory toward the appointment of entomologists as public scientists with a particular focus on locusts converged on a similar set of concerns. All grappled with the problematic taxonomy, distribution patterns and ecology of the locusts. The ways of addressing issues of collective participation in locust control also differed, but the ecological questions and attempted technical solutions drew on worldwide scientific expertise and experience of control methods. In spite of their different colonial, political and cultural histories, close parallels existed in the scientific responses to plagues in

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Australia and Argentina. These were shaped by similarities in the geography and agricultural history of their grassland ecosystems, as were the population irruptions of the locusts native to each country. The commitment to finding scientific means of dealing with this shared environmental challenge led to explorations of the same potential biological and ecological solutions, but a divergence and dependence on different control technologies. We examine the historical record of locusts written by the scientists, farmers and other workers who experienced them in the agricultural landscape.

15.1 Introduction

Locusts have plagued agricultural societies throughout history. In settler societies the imperative to establish and expand agricultural production often brought vulnerable and poorly supported new farmers into collision with locusts. Locust and grasshopper swarms became a recurring problem for European settlers in the temperate grasslands of the USA, South Africa, Canada, Argentina and Australia during the late nineteenth century. This paper explores parallels in the environmental history of these insects in the latter two European southern 'newlands' during the 1880–1940 period: a time when their agricultural and economic fortunes also followed parallel paths.[1] It is a history of interactions, perceptions of locusts and of their intersection with scientific history. We trace the scientific, technological and ecological 'wars' and public actions aimed at stopping the agriculturally destructive but historically creative force of the locusts.

Argentina and Australia span the same southern latitudes on opposite sides of the Pacific Ocean. Their shared environmental history as members of Alfred Crosby's temperate 'Neo Europes' included the usurping of indigenous lands, the imposition of millions of European ungulates on extensive inland grasslands and economies dependent on agricultural production.[2] But their colonial histories have very different chronologies and cultural roots. Argentina was settled by Spain in the sixteenth century and achieved independence from its loose viceroyalty in 1816, when the fledgling colony of New South Wales had only just found a way over the mountains surrounding Sydney. Australia continued as six British colonies, with largely autonomous governments, that only federated to become a single dominion in 1901. By that time Argentina had experienced both civil and territorial wars but had maintained relatively stable national government since 1880.

[1] We adopt the term 'newlands' used by James Belich to characterise settlement booms in the inland of both colonial and ex-colonial countries. See Belich, J. (2009) *Replenishing the Earth. The Settler Revolution and the Rise of the Anglo World*, *1783–1939*. Oxford University Press, Oxford, UK. p. 85; Settler societies are distinguished from other colonial settings by their commitment to permanent residence, immigration and autonomous government.

[2] Crosby, A.W. (1986) *Ecological Imperialism*, *the Biological Expansion of Europe 900–1900*, Cambridge University Press, Cambridge, UK.

In both places there was rapid pastoral expansion into the vast western grasslands. While cattle were the source of their early exports, from the 1840s sheep numbers 'exploded' in both countries, reaching 100 million in 1890.[3] Cereal cropping followed in better watered areas from the 1850s, but both grazing and farming operated under different land tenures in each place.[4] By the 1880s they were in competition for the same European markets for their meat, fibres and grain, and for immigrant settlers. Cattle regained their predominance on the Pampas in the early twentieth century, but Australia's pastoral earnings continued to come from the 'sheep's back'.[5]

An increase in the frequency and intensity of locust plagues took place in Argentina and Australia in the late nineteenth and early twentieth centuries. This coincided with the professionalisation of science and a time when 'the applications of science to agriculture were illimitable'.[6] It also coincided with attempts to bring a scientific understanding of the threat locusts posed for agriculture, through the establishment of institutions for dealing with them. Our focus is the history of scientific and physical engagement with the locusts, because most textual sources come from this arena, and because states invested resources over a long period in the belief that science would save them from the plagues.

Many different acridid species have earned the ancient title of locusts, appearing in swarms and living off the fruits of others' efforts.[7] The technical distinction between grasshoppers and locusts hinges on the scale of changes and migrations associated with high population densities, but species from both groups that become agricultural pests have the capacity to respond rapidly to changed environmental conditions by producing large, gregarious populations. Their population fluxes are driven by climate but they are also sensitive to land use changes. Farming and pastoral practices altered or created habitats in ways that affected the incidence of

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[3] Knibbs, GH (1908) Commonwealth Bureau of Census and Statistics, Melbourne. *Official Yearbook of the Commonwealth of Australia*, *&c. No. 1. 190*8. Minister of Home Affairs, Melbourne; Hanson, SG (1938) *Argentine Meat and the British Market*: *Chapters in the history of the Argentine Meat Industry*, Stanford University Press, California. Table p. 6. Sheep numbers were estimated at 95 million in the eastern mainland Australian colonies and over 103 million in Argentina. Cattle numbers in that year were around ten million in Australia, with a large proportion in Queensland, while Argentina recorded 20 million 'owned' cattle. From the 1840s, sheep numbers increased so rapidly that Argentina had the world's largest flock from the 1880s to 1910, mostly in the provinces of Buenos Aires and Santa Fé.

[4] Argentina's pastoralists purchased large areas of land outright, while in Australia it was first rented and then held under lease. The 1860s 'Selection Acts' gave farmers the chance for freehold access to cropping land in Australia, while in Argentina most small farmers were tenants of the pastoralist landowners.

[5] Hanson, SG (1938) *Argentine Meat and the British Market*: *Chapters in the History of the Argentine Meat Industry*, Stanford University Press, California.

[6] *Rockhampton Morning Bulletin*, Queensland. 14 April 1903. p. 6. The quote was taken from the *American Agriculturalist* about the death knell of the grasshoppers and the progress of science.

[7] The derivation of the English word 'locust' is often drawn from Pliny (AD 77), who already used 'locustae' to refer to these insects. However, by the 1620s the word had become a trope for all kinds of middlemen who drew wealth from others.

swarming populations of different species in several parts of the globe.[8] However, disentangling such causes from the increase in reporting as farming populations expanded into new territories in the nineteenth century is problematic for Argentina and Australia.

'Model' locust species of the Old World that switch from apparently harmless solitary grasshoppers to a visibly different gregarious form in response to crowding, with serious demographic consequences for agriculturalists, became the subject of taxonomic controversy and then of intense scientific enquiry after the 1920s, when Boris Uvarov and Jacobus Faure showed they were in fact different forms of the same species.[9] The impressive transformation of the desert locust (*Schistocerca gregaria* Forskål) remains the signal case of phase polyphenism and one of the most intensively studied facets of insect biology.[10] The locust of the Pampas is a species of *Schistocerca* and its different forms presented a taxonomic puzzle to Argentine entomologists. In Australia an inverse confusion prevailed; two species swarmed over its southern agricultural lands and their similar appearance led to frequent misidentifications.

15.2 Environmental Background to the Argentine and Australian Newlands

Historians and natural scientists have made much of the effect that millions of grazing animals had on the soils and vegetation of the Australian grasslands, previously untouched by ungulate hooves.[11] When European settlers moved onto the plains,

[8] Examples of agriculture resulting in increased swarming: Latchininsky, AV (1998) 'Moroccan Locust *Dociostaurus maroccanus* (Thunberg, 1815): a faunistic rarity or an important economic pest?' *Journal of Insect Conservation*, 2, 167–178; Cease, AJ, Elser, JF, Ford, CF, Hao, S, Kang, L and Harrison, JF (2012) 'Heavy livestock grazing promotes locust outbreaks by lowering plant Nitrogen content' *Science*, 335, 467–469.; Uvarov, BP (1957) 'The aridity factor in the ecology of locust and grasshoppers of the Old World' *Arid Zone Research*: *Human and Animal Ecology*. UNESCO, Paris, pp. 164–198; Barrientos, LL (1995) 'The present state of the locust and grasshopper problem in Brazil' *Journal of Orthoptera Research*, 4, 61–64.

[9] Uvarov's ideas came from earlier field studies in Russia, while Faure worked in South Africa; Uvarov, BP (1921) 'A revision of the genus Locusta (L.) (= Pachytylus Fieb.), with a new theory as to the periodicity and migrations of locusts.' *Bulletin of Entomological Research* 12, 135–63.; Faure, JC (1923) 'The life history of the Brown Locust (*Locustana pardalina* (Walker))' *Bulletin Faculty of Agriculture Transvaal University Collection. No 4*. 30 pp.; For a discussion of 'model' locusts, see: Song, H (2011) 'Density-dependent phase polyphenism in non-model locusts' *Psyche*, Volume 2011, article 741769, 16 pp.

[10] Pener, MP and Simpson, SJ (2009) 'Locust phase polyphenism: an update' *Advances in Insect Physiology*, 36, 272 pp. (Elsevier Ltd, Amsterdam).

[11] See for example: Bonyhady, T (2000) *The Colonial Earth*. Melbourne University Press, Melbourne. 432 pp.; p. 284; Bolton, G (1992) *Spoils and Spoilers*: *a history of Australians Shaping their Environment* (2nd Ed.) Allen & Unwin, Sydney; Dale, L (2007) 'Empire's proxy: sheep and the colonial environment' pp. 1–14 in, Tiffin, H (ed) *Five Emus and the King of Siam*: *Environment*

dense perennial grasses grew up to their horses' flanks on soft soils that they sunk into up the fetlocks. Bill Gammage makes a compelling argument that the curtailing of intricate Aboriginal burning regimes and the explosion in livestock numbers fundamentally altered the nature of the vegetation and soils.[12] In just 50 years from 1840 in southern Australia, the squatters' sheep had eaten the 'haystack' and compacted the soil, while the rabbits ringbarked anything still trying to grow.[13] The result was a dramatic loss of productivity, a crash in sheep numbers and then repeated periods of drought-induced land degradation that commenced in the 1890s.[14]

The history of European influence on Argentina's grasslands began with the introduction of cattle and horses that by the seventeenth century had already increased to form huge feral herds. Crosby cites descriptions of horse 'herds covering the face of the earth' and later estimates of immense numbers of wild cattle, using the Pampas as a dramatic example of ungulate irruptions.[15] Their effect on the Pampas has been interpreted as favouring livestock production by increasing soil nitrogen and the proportion of 'soft' grasses, a point earlier conjectured by Charles Darwin.[16] There was a later 'bio-recolonisation' by British breeds of cattle to cater to European markets and a new system of cropping followed by alfalfa boosted production. With more fertile soils and higher rainfall than Australia, the grasses of the central Pampas withstood early pressures of enclosure and intensification of grazing.[17] But environments of the 'peripheral' Pampas were degraded by livestock

and Empire. Cross/Cultures 92, Rodopi B.V., Amsterdam, The Netherlands.; Lunney, D (2001) 'Causes of the extinction of native mammals of the Western Division of New South Wales: An ecological interpretation of the nineteenth century historical record' *Rangeland Journal*, 23 (1), 44–70.

[12] Gammage, B (2012) *The Biggest Estate on Earth*: *How Aborigines Made Australia*, Allen & Unwin, Sydney. Gammage cites over 45 separate comparisons by explorers, settlers or travellers of the initial landscape with 'English parks', with widely spaced trees and dense grassy understoreys. There are numerous references to dense tall perennial grasses, principally kangaroo grass, pp. 188, 192, 205, 266, 269.

[13] Bolton (1992), p. 85, cites a report of a stock inspector to the NSW Royal Commission into the condition of the Western Division in 1901, who commented that graziers did not realize they were 'eating the haystack'.

[14] McKeon, G, Hall, W, Henry, B, Stone G and Watson, I (2004) *Pasture Degradation and Recovery in Australia*'*s Rangelands*: *Learning form History*. Natural Resource Sciences, Queensland Dept Mines & Energy, Indooropilly, Qld, Australia.; Ratcliffe FN (1936) 'Soil drift in the arid pastoral areas of South Australia', *Pamphlet No. 64. C.S.I.R.*, Canberra. 84 pp.

[15] Crosby (1985), p. 178, cites Felix de Azara, who travelled through Paraguay and the Rio de La Plata during 1781–1801, as estimating wild cattle numbers at 48 million.

[16] Brailovsky, AE and Foguelman, D (2009) *Memoria verde. Historia ecológica de la Argentina*. Debolsillo, Buenos Aires; Darwin, C (1845) *The Voyage of the Beagle* (*2nd Ed.*), pp. 118–119. [available from 'Darwin online: Charles Darwin University' at: http://www.cdu.edu.au/beagle-kiosk/#section-5 – December 2014]

[17] Australia's native perennial grasses were widely spaced tussocks with summer C4 genera dominant (*Themeda*, *Astrebla*), while an alternation of sward-forming summer (*Paspalum*, *Bothriochloa*) and winter (C3 *Stipa*, *Bromus*) genera characterised the Pampas. Suttie JM, Reynolds, SG and Batlello, C (eds.) (2005) *Grasslands of the World. Plant Production series No. 34*. FAO, Rome, pp. 430–435.

and dust storms became frequent during droughts.[18] In 1894 'drift and dead stock' blocked the rail line from Buenos Aires to Rosario for days.[19]

The regions in which the nineteenth century pastoral booms took place were vast and ready for animal production. In Australia it was centred on the Murray-Darling basin and in Argentina on the southern La Plata basin.[20] By 1870 large areas of Australia's western plains had been taken up by the 'squatters' in a frantic, uncontrolled land grab, 'clearing' the land of its Aboriginal inhabitants 'beyond the limits of location'. The Pampas were not fully opened for the ranchers' estancias until after the so-called 'Conquest of the Desert' in 1879–1880 that decimated Araucarian Indian populations.[21]

Cultivation followed livestock in changing the face of the southern landscapes. Wheat showed such early promise that from the 1850s arable lands were rapidly taken up throughout south-east Australia and the Pampas. After satisfying their domestic markets, wheat became a major export commodity and by 1891 there were 1.3 million ha sown to wheat in both countries.[22] In 1913 2.9 million ha were sown in Australia, while Argentina, which also had large areas under corn and linseed, had expanded its wheat production to 4.1 million ha.[23]

Locusts were also herbivores of these grassy ecosystems and their primary habitats were sparse short-grass plains of the semi-arid western areas. It is hard to establish their pre-European distributions, but the coevolution of high density populations and migratory lifestyles is a response to variable environments, so swarms were likely to have intermittently spread across the plains of both continents. Locusts and grasshoppers have a straightforward lifecycle, made complex by 'syndromes' of linked life history, genetic and behavioural traits such as dormancy and migration.[24] Females lay eggs in clusters, or 'pods', in the soil; hatched juveniles, 'nymphs' or 'saltonas', are miniature wingless replicas of adults and go through several moults between growth stages before fledging to adulthood. The locusts of the Pampas and south-east Australia come from different taxonomic subfamilies within the

[18] Zarilli, AG (2001) 'Capitalism, ecology, and agrarian expansion in the Pampean region, 1890–1950' *Environmental History*, 6, 561–583: p. 562, 565; Zarrilli, AG (2010) *Ecología*, *capitalismo y desarrollo agrario en la región pampeana* (*1890–1950*). *Un enfoque histórico-ecológico de la cuestión agraria*. Thesis Dissertation, accessed on: www.eumed.net/tesis/2010/agz/

[19] Bateman, W (1894) 'Sheep-breeding in Argentina' *The Australasian*, NSW. 21 July 1894, p. 9.

[20] There were 50 million ha of grassland on the Pampas and the western plains of southeast Australia. The Murray-Darling basin covers 100 million ha, but about half was either too arid, or covered by dense shrub vegetation, to be taken up for the sheep.

[21] Belich (2009), p. 526.

[22] McLean, IW (2005) *Recovery from Depression*: *Australia in an Argentine Mirror 1895–1913*. University of Adelaide School of Economics Working Paper 2009–19. 31 pp.: p. 21.

[23] Barsky, O and Gelman, J (2005) *Historia del agro argentino. Desde la Conquista hasta fines del siglo XX*. Mondadori, Buenos Aires.: p. 139. The rapid rates of growth in Argentine and Australian agricultural exports during 1870–1913 were strikingly similar (a 45 times increase) and were exceeded only by Canada.

[24] H. Dingle. 'The Evolution of insect Life Cycle Syndromes' pp. 11–26 in F. Taylor and R Karban (eds) *The Evolution of Insect Life Cycles*, New York: Springer, 1986.

Acrididae and they differ in their life histories and ecologies, but they both display density-dependent phenotypic plasticity at nymph and adult stages – they form dense, gregarious bands and migrating swarms.[25]

The South American locust, *Schistocerca cancellata* (Serville) is the only species of this widely distributed genus to have commonly exhibited phase polyphenism in the Southern Cone. Gregarious adults often turn a red colour and nymphs are a distinct yellow and black. Its swarms have been recorded in Paraguay, Uruguay, Bolivia, Brazil and Chile as well as Argentina.[26] In Australia, two related phase-polyphenic species swarmed regularly on the southern agricultural lands of Victoria, South Australia, New South Wales (NSW) and Queensland. The most widespread is the Australian plague locust, *Chortoicetes terminifera* (Walker), but no distinct chromatic or morphological change accompanies the gregarious phenotype. However, swarming males of the 'grasshopper' pest, *Austroicetes cruciata* (Saussure), can turn bright yellow. The monotypic *Chortoicetes* and the grasshopper genus *Austroicetes* have been assigned to a distinct taxonomic clade with no close relatives in other continents.[27]

These locusts were not the only species to cause agricultural losses in Argentina or Australia but they have been historically the most damaging. Because the initial swarms during plague cycles often appeared suddenly and from places further inland, the details of their life cycles and proposed permanent breeding grounds were important questions first addressed by scientists. When agricultural areas were invaded, the causes, duration and periodicity of plagues presented further ecological puzzles, but the subyacent issue was how to kill them.

15.3 Economic and Agricultural Growth

The remarkable parallels in the agricultural, economic and demographic histories of Argentina and Australia from 1870 to 1930 have drawn the attention of historians in both places.[28] Their parallel agricultural potentials were also well known at the

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[25] This phenomenon has evolved independently in different species from several groups, suggestive of a phylogenetically conserved trait. see Gotham, S and Song, H (2013) 'Non-swarming grasshoppers exhibit density-dependent phenotypic plasticity reminiscent of swarming locusts' *Journal of Insect Physiology*, 59, 1151–1159.

[26] Centre for Overseas Pest Research (1982) *The Locust and Grasshopper Agricultural Manual*, London. pp. 294–302.; Song (2011), p. 3, mentions *S. interrita* (Scudder) forming swarms in Peru in 2003–2004.

[27] Fries, M. Chapco, W. and D. Contreras, D. (1997) 'A molecular phylogenetic analysis of the the Oedipodinae and their intercontinental relationships' *Journal of Orthoptera Research*, 16, 115–125.

[28] Gallo, E. (1979) 'El método comparativo en Historia: Argentina y Australia (1850–1930)' in E. Gallo; J. Fogarty and H. Dieguez (eds.) *Argentina y Australia*. Buenos Aires, Editorial del Instituto Torcuato Di Tella; Duncan T and Fogarty J (1984) *Argentina and Australia*: *on parallel paths*. Melbourne University Press, Carlton, Victoria; Diéguez, HL (1968) *Argentina y Australia*:

time.[29] Agricultural and economic booms were at times offset and linked to population and capital inflows. Both shared the great boom of the 1880s and financial bust of the 1890s. Economic recoveries were in the main led by increased production and export of staples, but they increasingly diverged after the 1890. These divergences, some having environmental contingencies, have also occupied economic historians.[30]

The rapid agricultural development after the 1850s was achieved in both places using largely European labour and infrastructure built on British capital.[31] A rich, landowning elite of pastoralists emerged to dominate economic and political life, in many cases educated and living in the capitals. Both had less than two million European inhabitants in 1870 and both encouraged a European immigration boom from the 1880s, although of different ethnic compositions. In 1900 Australia's population had risen to 3.77 million and Argentina's to 4.6 million. By 1930 Argentina's concerted immigration program lifted its population to 11 million, neary twice Australia's 6.5 million.[32] Rural development also followed similar patterns, along rivers and expanding as rail linked the inland to the capitals. Although over a third of their workforces were still employed in agricultural industries in 1900, both populations became highly urbanised with more than half living in the capital cities in 1915. Myths of heroic pioneers fed the urban populations' search for national identity. These were populated more by romanticised images of the itinerant male stock handlers on limitless plains than the stoic, struggling 'cocky' or 'colono' farming families scanning the sky for rain clouds or clouds of locusts.

Both countries shared a vision of modernisation, looking often to the USA and Europe as models of progress. It came from the nineteenth century Western fascination with scientific developments, but had different local flavours. This view developed in parallel with the professionalization of science in its alliance with government and was driven by the political currents of liberalism and positivism. In Argentina, the influential Pampa landowners implemented their own vision of science in economic development through their corporate association, the Sociedad Rural Argentina (SRA), established in 1866 to support agriculture and cattle production. The overt ideology of progress was typified by Argentines of 'Generación

algunos aspectos de su desarrollo económico comparado. Instituto Torcuato di Tella, Centro de Investigaciones Económicas Buenos Aires.

[29] Duncan and Fogarty (1984), pp. 2–10. The Buenos Aires government sent Ricardo Nelson on a technical mission to Australia and the USA in 1883 to report on agricultural developments. He recognised Argentina's advantages of better rainfall and soils and, though he complained about the flies, did not compare their locust problems.

[30] Esposto, A and Tohmé, F (2009) *Drifting apart*: *the divergent development paths of Argentina and Australia*. VDM Verlag, Saarbrücken, Germany; McLean (2005) pp. 18–20, identified the Federation drought and the relative lack of new cropping land as reasons for Australia's poor performance from 1890 to 1913; see Belich (2009) for staple export-led economic recoveries.

[31] North American investment in the Argentine beef industry at the end of the century contributed to agricultural growth.

[32] Duncan and Fogarty (1985), p. 17.

del 37', who saw science as integral to political organization and social development through education, immigration and technology.[33]

15.4 The Rise of the Locusts

Locust plagues were already a feature of inland Argentine settler life in the early nineteenth century. Swarms were frequent visitors in many provinces and it was struggling farmers that suffered most:

> I could tell that the locusts of Santa Fé like the locusts of Egypt and other countries, eat up everything that is green, and leave fields and orchards, gardens and orange groves, bare, and brown and fruitless… The poor people, as they see some such army approaching, sally out with drums, brass pans, rattles, and every other conceivable thing with which they can make a noise… But what is thus spared to-day, is devoured to-morrow; and the grim aspect of Desolation alone, which they themselves have created, can effectually drive the locusts from the scene of their devastating work….[34]

William McCann recorded plagues in Córdoba and Santa Fé Provinces during 1833–1840 and 1844–1849, and Darwin observed swarms in Mendoza in 1835. The descriptions and timing all implicate *S. cancellata*.[35]

Infestations were reported in Australia soon after the settlement of Europeans and their livestock, commencing in 1843 in South Australia and also spreading with the pastoral frontier in NSW and Victoria. With the return of the 'old enemies' in 1859 in South Australia:

> The North seems to have attracted all the grass hoppers from the four winds of the heavens; indeed, they are in such clouds that one has a great difficulty to induce a horse to face them, and they are making sad havoc amongst the sheep runs.[36]

And in the Riverina of NSW:

> It is difficult to convey a notion of the quantity of these grasshoppers: it is scarcely credible, but the very atmosphere on some of the runs is thick with them… and as they have now made their appearance for three or four successive seasons, those who have hitherto indulged in a little cultivation … are beginning to lose heart…[37]

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[33] Graciano, OF (2004) 'Los caminos de la ciencia. El desarrollo inicial de las Ciencias Agronómicas y Veterinarias en Argentina, 1860–1910', *Signos Históricos*, *núm. 12*, julio-diciembre, pp. 9–36, Universidad Autónoma Metropolitana Unidad Iztapalapa, México; Duncan and Fogarty (1984), p. 13.

[34] Robertson, JP and WP (1838) *Letters on Paraguay comprising an account of a fours years' residence in that Republic under the government of the Dictador Francia*, *Vol. II*, London: John Murray, 1838, pp. 196–197.

[35] McCann, WA (1853) *A two thousand miles' ride through the Argentine provinces of South America*, London: reprint 1854, New York, AMS Press, p. 67.; Darwin (1845), p. 349.

[36] *South Australian Register*, South Australia. 5 November 1859, p. 3.

[37] *Maitland Mercury and General Advertiser*, NSW. 22 November 1862, p. 6.

In the absence of any institutional authority on these insects in South Australia, the detailed descriptions of the 'locusts' around Adelaide in 1844–1845 by a young naturalist, Charles Algernon Wilson, are crucial to identifying the species involved in the early inland plagues as *A. cruciata*.[38] But things changed dramatically in 1870 when, for the first time, swarms appeared and bred in autumn. This was the start of the first recorded plague of *C. terminifera* that lasted until 1875. Migrating swarms spread right across the altered grasslands of the south-eastern colonies, producing several generations of dense nymphs or 'hoppers' each year, in bands so thick they 'blackened' the ground.

By the 1890s plagues were a well-known Argentine and Australian problem. Australian newspapers often reported how bad locusts were in other lands as a reassurance and as a deterrent to potential emigrants. The southern settler lands, including South Africa, were often compared for their agricultural potential and limitations. All were self-consciously anxious that their international image was tainted by their long list of rural troubles, headed by droughts and locusts.

Collective locust control efforts have a long history in Europe and so does institutional involvement in ensuring participation.[39] But small farmers in Argentina and Australia were largely on their own in dealing with the locusts before the 1890s, despite many solemn church services. Although the ranchers and squatters suffered some stock losses, their anguish was buffered by the capital accumulated in livestock, which could be moved or sold. Farmers and villagers tried various manual means of repelling locusts; driving them into trenches, burning and beating, or accommodating them by cutting crops before the swarms arrived.

Records indicate that locust plagues were of longer duration in Argentina than in Australia, but the frequency and alternation of *C. terminifera* and *A. cruciata* plagues produced a similar view of increase and a fear they were becoming permanent.[40] The making of graphical 'inscriptions' of the historical extents of infested areas is part of the scientific documentary historiography in both places, allowing some comparisons.[41] As a period when numerous regional jurisdictions are affected by swarms, the severity of a 'plague' has a temporal as well as a spatial component.

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[38] Deveson, ED (2012) '*Naturae amator* and the grasshopper infestations of South Australia's early years' *Transactions of the Royal Society of South Australia*, 136, 1–15.

[39] Sprenger, J (2014) 'Animal Pests in Agriculture and Forestry – Perception, Damage and Control in Prussian Brandenburg (1700–1850)', pp. 159–162 in Herrmann & Mauch (Hg.): *From Exploitation to Sustainability? Global Perspectives on the History and Future of Resource Depletion. Nova Acta Leopoldina NF*, 114, No. 390.

[40] Gastón, J (1952) 'Conocimientos prácticos sobre la langosta y tucuras'. *Publicación Miscelánea No. 368. Ministerio de Agricultura y Ganadería.* graph of infestations 1898–1943, p. 12; Hunter, DM and Cosenzo, EL (1990) 'The origins of plagues and recent outbreaks of the South American locust, *Schistocerca cancellata* (Orthoptera:Acrididae) in Argentina' *Bulletin of Entomological Research*, 80, 295–300.; Wright, DE (1987) 'Analysis of the development of the major plagues of the Australian plague locust, *Chortoicetes terminifera* (Walker) using a simulation model' *Australian Journal of Ecology*, 12, 423–37.

[41] Latour, B and Woolgar, S (1979) *Laboratory Life. The Construction of Scientific Facts*. Princeton University Press, New Jersey, p. 52, the authors use the term 'inscriptions' to describe the graphical and textual outputs which create scientific knowledge.

Consecutive years of high levels on the reconstruction graphs suggest 4–10 years was typical for *S. cancellata* and 1–4 for *C. terminifera*. Populations of locusts are irruptive and their increase is influenced by habitat productivity following rainfall sequences.[42] The association of periods of high rainfall with opposite phases of the El Niño Southern Oscillation (ENSO) in Argentina and Australia might suggest that their plagues could have commenced alternately. However, their regional rainfall is also influenced by other ocean-atmosphere circulation patterns and, significantly, both places experienced a 'wetting phase' (or the end of a dry phase) during the second half of the twentieth century.[43]

What is clear is that there was a historically high reported incidence of plagues in both places during 1890–1940 and, although varying in their regional impacts, this fact was not lost on the landowners, administrations or the scientists, who saw it as an alarming increase. In fact there were few years when swarms were absent in either Argentina or Australia.[44] Faced with the real and perceived threats to agriculture, governments fostered scientific investigations into these insects in the hope of solving the problem. In both countries pulses of intense government-directed research followed major plagues.[45] Knowledge and experience of locust ecology and control was being hard won and widely shared in the newland settler societies, while the metropolitan contribution was largely limited to taxonomic knowledge, produced and held in European museums.

[42] Farrow, RA (1979) 'Population dynamics of the Australian plague locust, *Chortoicetes terminifera* (Walker) in central-western New South Wales I. Reproductions and migration in relation to weather' *Australian Journal of Zoology*, 27, 717–745.; Waloff, Z and Pedgely DE (1985) 'Comparative biogeography and biology of the South American Locust, *Schistocerca cancellata* (Serville), and the South African desert locust (*S. gregaria flaviventris* (Burmeister): a review' *Bulletin of Entomological Research*, 76, 1–20.

[43] Gonzalez, PM, Polvani, LM, Seager, B and Correa GJP (2013) 'Stratospheric ozone depletion: a key driver of recent precipitation trends in South Eastern South America' *Climate Dynamics*, 42, 1775–1792; Leibman, B, Vera CS, Carvalho, LMV et al. (2004) 'An observed trend in Central South American Precipitation' *Journal of Climate*, 17, 4357–4367; Murgida, AM, Gonzalez, MH and Tiessen, H (2014) 'Rainfall trends, land use change and adaptation in the Chaco Salteno region of Argentina' *Regional Environmental Change*, 14 (4) published online 10 January 2014. DOI 10.1007/s10113-013-0581-9; Holper, PN (2011) *Climate Change Science Information Paper. Australian Rainfall – Past*, *Present and Future*. CSIRO, Australian Government Department of Climate Change and Energy Efficiency, Canberra.

[44] Gastón, J (1952), p. 12; Key KHL (1938) The regional and seasonal Incidence of grasshopper plagues in Australia, CSIR bulletin no. 117. H.J. Green, Melbourne, pp. 14–42; Deveson (unpubl. data).

[45] Zarilli (2010); Deveson ED (2011) 'The search for a solution to Australian locust outbreaks: how developments in ecology and government responses influenced scientific research' *Historical Records of Australian Science*, 22, 1–31.

15.5 Governments Take Responsibility

After its separation from NSW in 1851, the new Australian colony of Victoria was the first to establish a government Department of Agriculture in 1872, with an explicit view of science as a practical aid to agriculture.[46] The department formed during the first locust plague and entries in its annual report show just how new and little known these locusts were. It did however include the first clear illustrations of *C. terminifera*. Its Secretary, Alexander Wallis, relied on available historical references from overseas and called in a prominent Ballarat farmer to report local knowledge from affected areas.[47] Victoria grappled with a persistent plague during the 1880s and pressure from within its Legislative Council forced the Agriculture Minister to appoint the first Government Entomologist, Melbourne naturalist Charles French, in 1888. Much ecological knowledge was accumulated during that decade: most came from close field observations by non-professional naturalists, many farmers themselves, and the first physiological experiments in Australia were carried out on locust egg development in 1888.[48]

Argentina established the National Department of Agriculture in 1872, although this was poorly resourced and shuffled between portfolios until 1898 when it became a Ministry. The National Government sponsored an investigation of the locusts in 1875 by the Dutch zoologist Hendrik Weyembergh, working at the Universidad Nacional de Cordoba. Attempts to breed *S. cancellata* were conducted in the laboratory of the SRA in 1891 under the supervision of English biologist Arthur Stuart Pennington. These early scientific studies faced the same vacuum of professional knowledge about the species as those in Australia.

The severity of the 1890s plagues in both countries initiated a flurry of organised activity aimed at 'checking' them. Reports of the U.S. Entomological Commission on control research during the 1870s Rocky Mountains locust plagues and the well-advertised colonial success stories of using organised manual labour in Cyprus and Algeria were read closely by entomologists and agricultural authorities in Australia and Argentina.[49] There was a hybridisation of the mechanised U.S. methods using

[46] Wright, R (1982) "*Dispensed with*" *A.R. Wallis. first Secretary for Agriculture in Victoria 1872–1882*. Department of Agriculture, Government of Victoria. Research Project Series No. 150, December 1982; The establishment of the Victorian and Argentinian departments largely followed the examples of individual states of the USA and the federal USDA created in the 1860s.

[47] Department of Lands and Agriculture, Victoria (1873) *Report of the Secretary for Agriculture 1873*. Melbourne. pp. 1–18. The principal reference at the time was W. Kirby and W. Spence, *Introduction to Entomology* 1815–25.

[48] *The Argus*, Victoria. 12 January 1888, p. 11, farmers and agricultural extension staff made many observations and discoveries of locust parasites in 1888. AN Pearson, Victorian Government Plant Pathologist, conducted temperature controlled experiments on egg development rates and also explained host-parasite lagged density-dependent interactions.

[49] *The Argus*, Victoria. 1 December 1884, p. 4. The report by the British colonial engineer of Cyprus, S. Brown, claimed the virtual elimination of locusts on the island after annual organised mass action campaigns under his direction. Of Brown's highly numerical report of mobilising 1882 Cypriot labourers (exclusive of superintendents) and using egg collections, traps and screens

rollers, ploughs and 'hopper dozers', with the organised mass action of the British and French colonial model in the southern lands in the 1890s, despite a shortage of labour relative to the vast areas infested.

The 1890 locust plague in Australia saw the first government attempt to deal with the locusts and again it was the Victorian department that led the way. When locusts started hatching in spring, Charles French used newspapers to convince people the problem was increasing and to mobilise all sections of the rural male populace in a simultaneous 'battute' of harrowing, rolling, dragging, livestock trampling and burning.[50] French and Joseph Knight made an extensive train tour of northern Victorian towns, alerting agricultural groups and newspapers of the imminent danger and the need for action. The 'locust days' came and went as did the locusts so the success of the campaign was moot, but the Minister for Agriculture was pleased with the result of the 'exterminations'.[51] Such a rapidly organised event was made possible by the expansion of the Victorian rail network, local agricultural associations and rural newspapers during the 1880s economic boom.

There was an equivalent program during the 1890s locust plague in Argentina, which affected some provinces every year during the decade.[52] In an effort to provide any information, in 1890 the monthly *Boletín del Departamento Nacional de Agricultura* reprinted a general article from 1878 that harked back to mass public actions in Spain.[53] The governments of the worst affected provinces had tried committees and regulations to ensure collective participation in fighting off the locusts for many years, but by 1893 their farmers were desperate after a sequence of major crop losses from drought, storms and locusts.[54] Local efforts in districts of Entre Rios, Cordoba and Santa Fé in 1897 involved ploughing, trampling by livestock and the collection of eggs and nymphs. After one Santa Fé edict, 700 tons of saltona

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to kill 56 million locusts. A Victorian newspaper editorial in 1884 asked 'is there not a lesson here for the people of this colony, where the pest is more ignoble than the Victorian rabbit'.

[50] *Horsham Times*, Victoria. 28 October1890, p. 3, The 'locust days' even had a role for schoolboys, whose 'destructive instincts' were harnessed by the giving them a day off school to bash the locusts with branches.

[51] *The Mercury*, Tasmania. 14 November 1890, p. 3.

[52] Pineda, Y (2013) *Dry farming and Immigrant colonists in the settlement of the southern arid Pampas*. Preliminary draft for the International Water History Conference, Montpellier, France, June 2013, p. 14; *Albury Banner & Wodonga Express*, NSW, 19 June 1898, p. 9, A report from Entre Rios of swarms laying eggs in March 1898 stated that was the eighth year in a row.

[53] 'Historia Natural de la langosta de España y modo de destruirla' *Boletin del Departamento Nacional de Agricultura*, 1872, 80–85. The article was typical of the fragmentary knowledge of the time, and the author was likely a member of the SRA. It was largely taken from a much earlier Spanish booklet written by an Irish scientist William Bowles. It described trenching among other methods used in Spain; McCann (1854), p. 69. reported attempts by the Paraguayan government to enforce collections of locust eggs by families in the 1840s.

[54] Gastón, J (1952), p. 101, in December 1850 the province of Entre Rios used its Police Department to ask all citizens of Parana to obey and collaborate with the authorities; Pineda (2013), p. 4, cites reference to the adverse environmental conditions and growing political consciousness in Santa Fé leading to farmers' revolts and military suppression in 1893.

locusts and 100 tons of eggs were reportedly destroyed.[55] The response to appeals for national government aid was grants for the supply of seed to stricken farmers, but in subsequent years these became loans.[56]

15.6 Practical Entomology Takes on the Locusts

The faith in science translated into the ideology of 'progressive agriculture' to which the relevant bureaucracies subscribed as a guiding principle. This accorded scientists expert authority and general community respect, although often tinged with a dose of earthy scepticism. A new discipline of 'practical' or 'economic' entomology emerged as an important component of the agricultural sciences.[57] Its role was to advise agriculturalists on insect pests through scientific identification and study of their lifecycles and to demonstrate new technologies for control. Governments directed agricultural resources toward locust research and in Argentina private institutions also played a prominent early role. Of primary interest were the natural population interactions of locusts with parasites, diseases and predators. The entomologists and interested naturalists embarked on a catalogue of all the parasites and there were many genera common to both places.[58] The roles of predators as regulators of locust populations, and of birds in particular, were frequently discussed. The ecological premise for their rise and fall, and the apparent increase of infestations, was couched in the metaphor of the 'balance of nature'.[59] This included ideas of population regulation by climatic and biological processes and human disturbance of those natural biological interactions.

The first step in dealing scientifically with the locusts was a clear taxonomic identification. This challenged the local entomologists, not simply because type specimens were held in the collections of numerous European museums, but because species were at first thought to be the same as those on other continents.

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[55] *Buenos Aires Standard*, Argentina. 21 Dec 1896: cited in *Riverine Herald*, NSW. 9 April 1897, p. 3.

[56] Scobie, JR (1964) *Revolution on the Pampas*: *A Social History of Argentine Wheat*, *1860–1910*. Institute of Latin American Studies, University of Texas Press, Austin. p. 145.

[57] The term economic entomology was adopted in Australia from the USA, where the first meetings of the new disciplinary association were held in 1889. Froggatt WW (1898) 'Economic Entomology in Australia' *Agricultural Gazette of NSW*., 9, 131–138.

[58] Species of tachinid, sarcophid and bombyliid flies, nematodes, trombid mites, and scelionid egg parasites were identified in both Argentina and Australia. See: Berg, C (1898) 'Sobre los enemigos pequeños de la langosta peregrina Schistocerca paranensis (Burm.)' *Commun. Museum. Nat. Buenos Aires*, 1, 25–30; French, C (1900) *The Destructive Insects of Victoria &c. Part 3*, Victorian Department of Agriculture, Melbourne.

[59] French, C (1891) *The Destructive Insects of Victoria &c. Part 1*, Victorian Department of Agriculture, Melbourne; Froggatt, WW (1910) 'Friendly Insects' *Department of Agriculture* NSW. Farmers' *Bulletin No. 34*. 8 pp; Lahille, F (1907) 'Las langostas y sus moscas parasitarias' *Anales del Ministerio de Agricultura*, 3 (4), 1–136.

Typical of the circuitous and arcane track of entomological authority and revision of the times, the locust from Argentina was first named *Acridium cancellatum* in France, *A. paranensis* in Germany and the current genus name was established in 1873.[60] The multiple names and the remarkable variation between solitary and gregarious individuals seen in the field left doubts as to how many species there were. Similarly, in Australia the locust had been named *Epacromia terminifera* in London in 1870, was labelled as *Edipoda musica* by Professor McCoy in Melbourne during the 1873 plague and the current genus name established in 1893. The Australian grasshopper was named *Cortolaga australis* in Vienna in 1888 and the genus *Austroicetes* was established by Uvarov in 1925. Their general physical similarity led to ongoing uncertainty over their separate identities. Expressing confusion over whether there had been one or two species in the 1870s plague, South Australian entomologist Otto Tepper complained of an apparent synonym for the locust in 1888 by Saussure, who had identified *A. cruciata*.[61] During the plague in 1899, NSW entomologist Walter Froggatt presented specimens of *A. cruciata* as a 'new' species (*Pachytylus australis*) that he knew was different from the locust of the 1890 plague, but the confusion continued in different places well into the next century.[62]

Both countries sought overseas expertise on locusts and saw the USA as a source of modern scientific methods. With its colonial links, Australia looked first to the British Empire, but it chose to rely on local entomologists to acquire knowledge through journals and networks of correspondence. Argentina, more cosmopolitan, threw its net much wider by drawing both from within its universities and from worldwide expertise. It built a strong science capacity by importing entomologists from the USA, France, Russia and Britain. And it chose entomologists with acknowledged locust experience.

The threat that locusts posed to the Pampas economy prompted a group of grain merchants in Buenos Aires in 1897 to hire entomologist Lawrence Bruner from Nebraska, a field agent of the US Department of Agriculture, to head a commission of scientific investigation about them.[63] Bruner's reports were a collation of local knowledge from all over Argentina and set a template for future research. They covered locust behavior, distribution, migration patterns and winter refuges, color changes, natural enemies and various means of control, and included maps of areas

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[60] The South American locust was given the name *A. cancellata* by French entomologist Jean Audinet-Serville in 1838, *A. emortuale* by Saussure in Vienna and then assigned to *A. paranensis* in a revision by Hermann Burmeister in Germany in 1861. The current genus was established by Swedish entomologist Gustav Stal in 1873. The Australian grasshopper was named *Cortolaga australis*, by Saussure in Vienna in 1888, then synonymously as *C. jungii* by Brancik in 1898. Uvarov established the genus *Austroicetes* and species *A. cruciata*, in a 1925 revision of specimen collections.

[61] Deveson (2012), p. 10.

[62] Froggatt, WW (1900) 'Plague Locusts' *Agricultural Gazette NSW.*, 11 (3) 175–183.

[63] Bruner had worked as assistant to the US Entomological Commission investigations under Charles Riley and was suitably experienced to carry out the investigations. Bruner worked with a locally composed Locust Investigation Commission. Its members obtained information from over 300 corresponding observers.

infested like the earlier U.S. Entomological Commission reports. Bruner's team conducted some laboratory and field studies, for which they travelled free on the rail network.[64] At the end of the first report Bruner suggested further work on native fungus diseases and the appointment of a 'competent Government Entomologist ... like in Australia or New Zealand'.[65]

In the same year the National Congress sanctioned the Ley de Exterminación de la Langosta. Under this anti-locust legislation, an Entomological Section was created within the Agriculture Ministry to study the locust and spread practical knowledge concerning its prevention and destruction. In 1898, French entomologist Jules Kunckel d'Herculais was hired to run the section for two years. He had previous experience in Algeria, organizing collective actions using local labourers paid to collect eggs and kill locusts. Before coming to Argentina, he held a conference at the French Association for the Advancement of Science where he proposed creating permanent scientific services to draw together the experience gained by other countries.[66] Herculais recommended that Argentina employ barriers to channel the saltonas' movement for destruction, like the cloth screens used in Algeria and Cyprus.[67]

At the start of the twentieth century the Australian states each had an agriculture department with a government entomologist attached to it. Most were native-born, self-taught naturalists, or Britons co-opted from the museums. They were also keen ornithologists and this complemented a duality in their roles, given the importance ascribed to insect-eating birds in controlling locust populations. The entomologists were outspoken advocates of legislation and education to protect birds, but the adoption of chemical pesticides for locusts put them in a paradoxical situation. They maintained professional allegiance to state arsenic control programs in the face of public outcry and grass-roots agro-ecological resistance because of bird poisonings. Bruner had also supported the legal protection of native birds in Argentina and even suggested that the destruction of rheas and other species had produced the increase of locusts in the previous decade.[68] The decline of insectivorous birds symbolized the human causes of locust plagues in both countries.

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[64] *South Australian Register*, South Australia. 14 January 1899, p. 6. The Anglophone colonial press reported that the Argentine populace were vying to assist Bruner in any way possible. The free train passes were organised by the Chamber of Commerce, which was dominated by English traders and English companies also owned the railways. Bruner's field collaborators were a group of North American settlers established in Carcarañá (Santa Fé) and they were the nexus between him and the Argentinian population.

[65] Bruner, L (1898) *The first report of the Merchants' Locust Investigation Commission of Buenos Aires*. South American Bank Note Co., Buenos Aires. 99 pp.; p. 85–86.

[66] He referred specifically to the scientific results obtained by the US Entomological Commission headed by Charles V. Riley and the advances made by Russian scientists Elie Metchnikoff in 1879 and Isaac Krassilstchik in 1888 using *Metarhizium anisopliae*.

[67] Birabent, F (1900) *El génesis y la obra de un naturalista de nuestros días*: *ensayo biográfico*, *histórico y de vulgarización científica*: *noticia biográfica sobre M. Jules Künckel D'Herculais*, *entomólogo del Muséum d'Histoire Naturelle de Paris*, *ampliada*. Imprenta y Casa Editora de Coni, Buenos Aires.

[68] Bruner (1898), p. 54.

15.7 Technological Wars

A central tenet of economic entomology was that unified collective action was an essential part of controlling pest insects and this was stridently expressed in relation to locusts. It was rationalised as a public good because of the spatial externalities of risk due to migrations and, with their potential for logistic population growth, was increasingly justified as preventive. In Argentina the problem of ensuring public participation was addressed through legislation and government funding for equipment. In Australia, state governments' response to calls for assistance was to 'send an expert' to assess the situation and demonstrate the current control technology. Only after 1917 did they take up the overseas model of organising local 'farmer committees' to carry out control. In both countries participation was encouraged through agricultural journals, newspapers, pamphlets, and later through radio broadcasts. Although it was vigorously debated by agricultural organisations from 1907 and favoured by some entomologists, legislative regulations for compulsory control were only introduced in NSW, South Australia and Queensland during the 1930s locust plagues.[69] The graziers' associations had opposed such moves, seeing it as an impost because of their large landholdings and shortage of labour. State governments already had problems enforcing the 'rabbit acts' and the idea of more inspectors was unpopular in the bush.

There was a divergence in the technologies adopted to deal with the locusts, but both placed responsibility on the people affected. Argentina utilised the labour of its rural populace and opt for largely manual methods. The suggestion of barriers was taken to heart by the authorities, but in a local innovation they used galvanized zinc sheeting to protect crops and drive locusts into trenches, which became a mainstay of collective control efforts. Australia adopted the chemical insecticides used in South Africa and came to rely on the sure 'kill-all' of arsenic compounds.

The extent of infested areas and the economic importance placed on the locusts was reflected in the scale of the mass actions and the emergency funding they attracted. With the return of locusts in 1903, the Argentine Government added Act 7 to the Locust Law, requiring all inhabitants of the Republic, aged 17–50, to provide their help, property and animals for the destruction of the locusts.[70] The Agriculture Ministry's committee for 'Defensa Agrícola', as its name implied, was largely responsible for organizing and administering the provinces' public collective control efforts. It survived forced resignations, changes of government and ministerial responsibility, despite criticisms of mismanagement and political patronage.[71] Its paid officers or 'langosteros' supervised the public actions with the power to impose fines for non-compliance. The efforts involved not just farm labourers, but also the

[69] *Proceedings of the First Australian Locust Conference, Melbourne 19–22 July 1938.* C.S.I.R., Melbourne; The Western Australian Government did have regulations under the Plant Diseases Act (1913–1925) for charging landowners the cost of control on their land.

[70] Cámara de Diputado s de la Nación. Diario de Sesiones. *Decretos reglamentarios de 1903.*; *The Farmer and the Settler*, NSW. 28 April 1911, p. 4.

[71] Scobie (1965), p. 147; Zarrilli (2010), pp. 360–365.

small holders, their families and children. The compulsory laws were contested by some congressmen who saw them as an attack on individual's rights, but a plethora of regulations were enacted including, in 1911, one requiring 'proprietors' to pay for the costs of workmen: the number determined by a formula for the area of either cultivated or grazing land they controlled.[72] The methods that endured were the 'State charity', as one Ministry officer called it, of paying for eggs by weight and the intensive use of barriers of galvanized iron sheeting.[73] An idea of the rural landscape during plague years can be gauged from the impressive quantities of eggs purchased and zinc sheets the Department prepared: in 1906, 700 tons of eggs and enough zinc to extend over 10,000 km of country.[74] In 1909 payments for eggs and locusts were abandoned because of the expense, but the production and rental of galvanized sheets continued to expand.[75] In 1936, 25,000 km of zinc sheets were used in Santa Fé, Cordoba, Entre Rios and Buenos Aires.[76] Other novel control methods were tried, but ideas of using the locusts for soap, fertilizer or lubricants never came to fruition.

It had been argued since the 1870s in Australia that mass organized labour actions of the Algerian type were not feasible because of its small population and vast locust breeding areas. The difficulty in getting complete cooperation was put down to the fact that locusts were an irregular pest, which Walter Froggatt thought accounted for the 'apathy on the part of landholders'.[77] Locusts invaded eastern NSW regularly from the 1900s, where 'in a few days the whole of the farmer's year's labour is gone. Wheat crops, potatoes, oats, barley, lucerne–everything green has gone.'[78] Entomologists initially recommended soap and kerosene sprays, but followed South Africa in adopting arsenic baits and sprays from 1911, despite concerns over the poisoning of stock. They converged on standard recipes using arsenite of soda, which remained the basis of locust control until after World War Two.[79] Pressure sprayers mounted on rural fire trucks and locally-built bait mixing machines enabled larger scale actions. Only when the states were supplying bait materials to ensure cooperation in the 1930s were total quantities estimated. In 1937–1938, NSW spent £42,000 organising and distributing 7000 tons of bran bait and 1000 gallons of

[72] *The Sydney Morning Herald*, NSW. 3 August 1910, p. 7. Act 7 of Locust Law; *The Land*, NSW. 5 May 1911, p. 8, landwas categorised as either cultivated, pastoral or unoccupied and landowners were required to pay for at least one workman/50 ha of tilled land, one workman/500 ha for grazing land. Railway companies were to pay for three workmen per km of line.

[73] Zarrilli (2010), p. 365.

[74] *Barrier Miner*, NSW. 5 October 1907, p. 7.

[75] Zarrilli (2010), p. 397.

[76] República Argentina, Ministerio de Agricultura de la Nación (1937) *Memoria correspondiente al ejercicio de 1936*. Buenos Aires, p. 447.

[77] Froggatt, WW (1910) 'Locusts in Australia and other Countries' *Department of Agriculture NSW, Farmers' Bulletin No. 29*, Sydney. 40 pp.

[78] *Molong Argus*, NSW. 1 December 1911, p. 4.

[79] Gurney, WB (1938) 'Grasshopper swarms, a review of methods of control.' *Agricultural Gazette of NSW*., 49, 431–434.

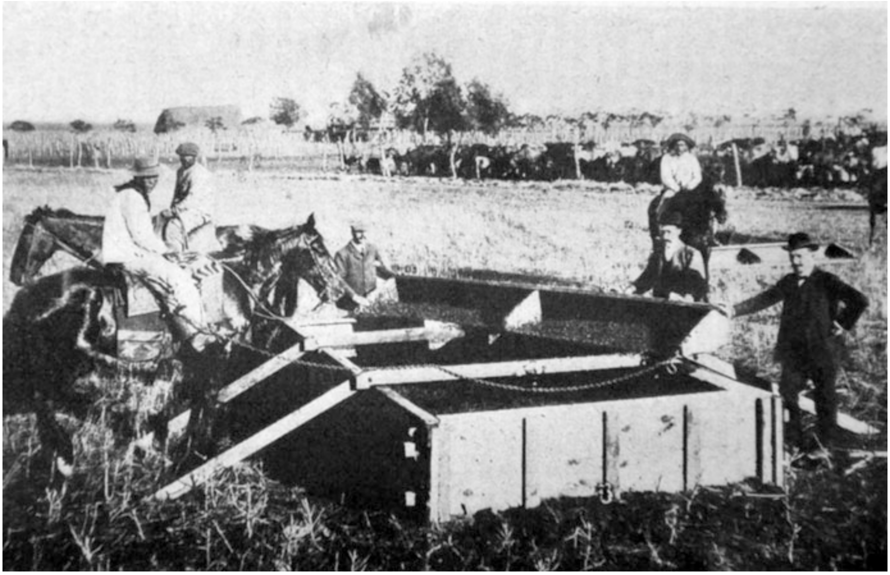

Fig. 15.1 Locusts collected with the 'Caracaraña' device and poured out in burial crates, 1906. *Almanaque del Ministerio de Agricultura de la Nación*, Vol. 24, p. 374. República Argentina, 1949

spray from hundreds of mixing stations throughout the state.[80] Argentina also tested arsenic baits and the spray 'Fluido Defensa Agricola' in the 1930s, but the technology was abandoned because of poisoning risks to stock and people (Fig. 15.1).[81]

15.8 Scientific Wars

The preoccupation with locust parasites was partly fuelled by the expectation of using them for control. James McWillams has called our period of interest the 'heyday of biological control', when farmers, naturalists and states joined forces in transnational exchanges of potential beneficial organisms.[82] There could be no clearer demonstration of the value of scientific developments than the germ theory

[80] Council for Scientic and Industrial Research, (1938) 'Report on locust control in NSW' W. B. Gurney, p. 6. CSIR 1938.

[81] Johnston, WC and Gross, FCG (1935) 'Some field observations on the grasshopper pest, with details of trapping experiments conducted at Snowtown. *South Australian Journal of Agriculture*, 1935 (April), 1072–1081. Conducted a trial with galvanized iron sheets on locusts in 1934, but it was considered less effective and more labour-intensive than poisoning.

[82] McWilliams, JE (2013) 'Biological control, transnational exchange and the construction of environmental thought in the United States' pp. 163–180, in Bsumek EM, Kinkela A and Lawrence MA (eds) *Nation-states and the global environment*: *new approaches to international Environmental History*. Oxford University Press, Oxford.

of disease and of using a ‘plague to fight a plague’.[83] Agriculture departments encouraged introductions and experimentation in biological control using microbes and fungi as well as arthropod parasites.

The discovery and successful trial of an entomopathic fungus of locusts in South Africa in the late 1890s led to its culture and distribution to many countries, including Australia and Argentina. In 1899 Charles French imported the ‘Cape Fungus’ to Victoria, directing a program of mass culture and broadscale use of the fungus against locusts and grasshoppers. Farmers were to conduct the experiments and report on the results. Entomologists and agricultural groups in other Australian states also tried the fungus obtained from French, but with mixed or negative results. Despite doubts by his colleagues and mounting evidence from overseas of the failure of the fungus, French continued to distribute and advertise its successes.[84] The realization in 1910 that a benign mould had mistakenly been originally sent to Australia brought an end to the placebo effect in Victoria. Bruner also tested the South African fungus in Argentina in 1898. He reported some success in enclosures, but saw more potential in a native species, confirmed as ‘Sporotrichum’ by an expert back in Nebraska.[85] Bruner later ran experiments with this ‘Carcarañá’ fungus on Nebraskan grasshoppers in 1901, but with no obvious result.[86] Argentine entomologists continued research on native pathogenic fungi in the 1930s and pioneered spraying of suspended spores, but research stalled in Australia, perhaps because of the early mistake.[87]

In 1911, French-Canadian microbiologist Felix d’Herelle was hired by the Argentine Government to culture and deploy the disease organism, *Coccobacillus acridiorum*, which he had isolated from infected locusts in Mexico and promoted as a biological control.[88] It was widely used in several provinces in 1912, but with little

[83] *Border Watch*, NSW. 2 March 1904, p. 4. The phrase was used in describing US tests on fungus diseases.

[84] *The Broadford Courier and Reedy Creek Times*, Victoria. 31 January 1908, p. 2.

[85] Bruner (1898), p. 77.

[86] Bruner, L (1901) cited in: Hostetter, DL and Dysart, RJ (2000) ‘The biological control potential of parasites, predators and fungal pathogens’ Section I.12. *Biological Control: An Introduction. Grasshopper Integrated Management User Handbook* (1–5). USDA Animal and Plant Health Inspection Service Technical Bulletin No. 1809, Washington.

[87] Fresa, R (1936) ‘Enfermedades de la Langosta, *Sporotricmun paranense* March., *Coccobacillus acridiorum* d’Hér’, *Mem. Com. centr. Invest. Langosta 1934*, Min. Agric. Nac. Buenos Aires, 97–102. The green fungal parasite cultured and reported succes with spraying – turned pink; Marchinatta and Valega (1934) cited in McMartin, A (1935) ‘The natural enemies of locusts. South African Sugar Technologists’ Association, Conference Proceedings 1935, 178–181. Fresa’s experiments were with the ‘green fungus’ and dead locusts did not climb on vegetation to die and later turned pink. These suggest he was working with *Metharizium*, rather than *Sporotrichum*, which is now known as *Beauvaria*, a common biological control agent in locust research.

[88] d’Herelle was known outside the Pasteur Institute in Paris as being from there, but apparently only worked as a volunteer on several occasions. He is seen as a pioneer bacteriophage researcher. see: Summers, WC (2011) ‘In the beginning…’ *Bacteriophage*, 1 (1) 50–51; Ackermann, HW, Martin, M, Vieu, JF and Nicolle, P (1982) ‘Felix d’Herelle: His Life and Work and the Foundation of a Bacteriophage Reference Center’ *American Society for Microbiology News*, 48, 346–348.

Fig. 15.2 Government Entomologist, Mr Walter Froggatt, conducting locust exterminating experiments at 'Goodwill', Condobolin, NSW in 1902. *The Australasian* (Melbourne), 17 November 1902, p. 33

success. Good scientific news and bad agricultural news travelled widely. Felix d'Herelles' epizootic was reported as a success in Australian newspapers, as was the severity of Argentine plagues in 1913 and 1917. The Queensland Department of Agriculture requested a sample and instructions from the Argentine Instituto Bacteriológico in 1912, and entomologist Alexandre Girault conducted several trials on *Locusta migratoria* (Linn.) in the northern cane fields. These also proved unsuccessful and the remaining tubes were 'liberated'.[89] In 1915, the Bureau of Sugar Experiment Stations tried again, this time obtaining a 'virus' from the Pasteur Institute in Paris which was passed on to the Queensland virologist, but no trials eventuated (Fig. 15.2).

[89] *Brisbane Courier*, Queensland, 17 July 1913, p. 3; *Cairns Post*, Queensland, 13 May 1915, p. 2.

15.9 Ecological Wars

There had long been settlements in Argentina's north-west and the seasonal migration patterns and 'winter refuges' of *S. cancellata* were known before Bruner codified them. In Australia, early observations of the southward direction of swarm movements indicated the locusts came from the 'uninhabited steppes' like in other continents, but reports from the arid inland were sporadic. In both countries there was a view that bringing more land under the plough would see the problem disappear, but this hope faded as the limits of dryland cropping were reached.[90]

Detailed research into the distribution, 'source areas' and seasonal migration cycles became part of the nationalisation of the locust problem, as ecological research came to be seen as fundamental to a scientific solution. Argentina called on its local scientists in this quest, while this time Australia reached overseas. Argentine zoologist Enrique Lynch Arribálzaga led a ministry expedition to northern Argentina, Bolivia and Paraguay to identify the winter refuges in 1908 and a decade later Carlos Lizer y Trelles was sent to review Lynch's results.[91]

The publication of Uvarov's phase theory in 1921, based on his previous close observations of *L. migratoria* in the Caucasus, stimulated intensive research on locust morphology, distributions and migration patterns for two reasons. First it offered a resolution of the long-standing taxonomic questions over the apparent duality of the locust species in many countries. Secondly, the associated concept of 'outbreak areas', permanently occupied habitats within which phase change occurred and from which swarms then migrated to infest other areas, provided a rationale for preventive control strategies. If locusts could be killed at the sites where phase change occurred, the subsequent spread of plagues could be stopped. This became a focus for ecological research in Argentina and Australia and during the 1930s their entomologists travelled the landscape making detailed observations of the locusts and the microhabitat variations exploited by them.

The Comisión Central de Investigaciones sobre la Langosta (CCIL) was created by Argentine presidential decree in 1933 to achieve a better understanding of the biology of the locust and to identify locations for the 'winter battle', thus to 'proceed to its extinction' or 'partial destruction to prevent the severity of next outbreaks'.[92] Its Director, Fernand Lahille, who had come to the Ministry of Agriculture from the La Plata Museum in 1906, saw its creation as his vision of a dedicated scientific service for locust research. It first had to prove the existence of the 'winter

[90] Lieberman (1939); *Leader*, Victoria, 6 July 1918, p. 53.

[91] Lizer y Trelles, C (1919) 'Informe sobre la expedición al Chaco Boliviano' *Talleres Gráficos del Ministerio de Agricultura de la Nación*.

[92] Lahille, F (1934) 'Introducción', pp. 5–24 in *Informes de la Comisiones exploradoras. Mayo a agosto de 1933*, Ministerio de Agricultura de la Nación, Buenos Aires; Liebermann, J (1939) 'Los Acridios de Mendoza, con observaciones acerca de su ecología y distribución' pp. 259–289 in *Memoria de la Comisión Central de Investigaciones sobre la langosta correspondiente al año 1936*, Ministerio de Agricultura de la Nación, Buenos Aires.

shelters', for which purpose nine field teams were despatched in 1933 and 1934 to northwest Argentina and Paraguay. They included several entomologists who continued locust research in the following decades, including P. Kohler, J.B. Daguerre and R. Maldonado Bruzzone. The objective was to mark swarm locations and observe their movement, collect detailed information on vegetation and soils and suggest precise locations and methods for control, either 'mechanical, physical, biological or chemical'.[93] Although observing some 'hibernating' swarms, no special 'winter refuges' or 'outbreak areas' could be identified.

The formation of a national science bureau had been in Australian federal-state planning since 1908 and in 1926 the federal government established the Council for Scientific and Industrial Research (CSIR).[94] From 1935 its agricultural research priorities were set by the Australian Agricultural Council, composed of state and federal ministers and bureaucrats to identify issues of national significance. The locust problem was one of the first such issues and, aware of Uvarov's work, it directed that the Division of Economic Entomology investigate the 'habits and ecology of grasshoppers' to find their major breeding areas.[95]

CSIR hired South African entomologist Kenneth H.L. Key, then working under Uvarov in Britain, to conduct the research in 1935. Key identified numerous 'outbreak areas' that covered huge areas of inland NSW and Queensland. He focussed his research for many years in one area of central-west NSW, where swarms had occurred every year during 1936–1941, and detailed the soil and vegetation landscape mosaics that favoured the locusts.[96] The first locust conference in 1938, attended by state and CSIR entomologists resolved that the Waite Institute in South Australia should concentrate on *A. cruciata* and CSIR on *C. terminifera*. This imposition of disciplinary space was not appreciated by the South Australian researchers, James Davidson and Herbert Andrewartha, who continued to investigate locust habitats. Travelling through the arid north, they identified the importance of landscape features such as watercourses and depressions in providing ephemeral, locally suitable conditions for locust breeding.[97] They more easily delineated the climatic and landscape limits of *A. cruciata*, finding its distribution and migrations were

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[93] Lahille, (1934).

[94] Borrowing the name and the framework for national funding of science from Britain, the CSIR was one of several dominion government organisations established in the 1920s.

[95] Deveson (2011), p. 5.

[96] Key, KHL (1938) 'The regional and seasonal Incidence of grasshopper plagues in Australia' *CSIR Bulletin No. 117*. Melbourne; The first CSIR expedition to the 'Cooper Creek' outbreak area of arid inland southwest Queensland, was only possible in 1949, when vehicles and scientists became available.

[97] Andrewartha, HG, Davidson, J and Swan, DC (1938) 'Vegetation types associated with plague 'grasshoppers' in South Australia' *Department of Agriculture of South Australia*, *Bulletin No*, *333*. 47 pp; Andrewartha, HG (1940) 'The environment of the Australian plague locust (*Chortoicetes terminifera* Walk.) in South Australia' *Transactions of the Royal Society of South Australia*, 64, 76–94, Fig. 4, p. 85.

regionally limited within a Mediterranean climate 'grasshopper belt' stretching across several states.[98]

José Liebermann, one of the Argentine entomologists of the CCIL who continued his work in the Instituto de Investigaciones sobre la Langosta, was commissioned as field researcher to the province of Mendoza in 1938. In his report he related locust plagues to the expansion of the agricultural frontier and cattle raising, defying the idea that plagues would diminish as cultivation increased. At the same time entomologists in Australia were realizing that overgrazing, soil erosion and tree clearing had increased habitats for both *C. terminifera* and *A. cruciata*, thus exacerbating the problem.[99] They saw that erosion scalds and compacted ground were favoured egg laying sites, and that *A. cruciata* swarming increased on abandoned farmland.

The taxonomic and ecological implications of Uvarov's work were also felt by the field entomologists. It finally lifted the curtain of confusion in Argentina, allowing comparison with species in other countries. Initial resistance to the idea that the phase theory applied to *S. cancellata* was quelled by local experiments at the CCIL's replacement, the Instituto de Investigaciones sobre la Langosta, headed by the Russian entomologist Alejandro Ogloblin.[100] In Australia the issue was different. Key had clarified the taxonomic problem but was critical of the research emphasis being placed upon phase state as somehow the answer to the locust problem. He went further, suggesting that phase change was a secondary concomitant of population increase and that behavioural change was its only relevant manifestation. This made Key unpopular among some adherents of the theory at the time and a 'straw man' for later researchers.[101]

Uvarov left another lasting legacy, when his recommendations for dedicated agencies to control the pests across jurisdictions and in their source areas were implemented in both countries. The Direccion de Acridologia and the Australian Plague Locust Commission began operation in later decades with the Uvarovian strategy of preventive aerial spraying in the same arid outbreak areas that had eluded earlier researchers.

[98] Andrewartha, HG (1944) 'The distribution of plagues of *Austroicetes cruciata*, Sauss. (Acrididae) in Australia in relation to climate, vegetation and soil' *Transactions of the Royal Society of South Australia*, 68, 315–326.

[99] Clark, LR (1947) 'An ecological study of the Australian plague locust (*Chortoicetes terminifera* Walk.) in the Bogan-Macquarie outbreak area, New South Wales. *CSIR Bulletin No. 226*. Melbourne; Andrewartha, HG (1943) 'The significance of grasshoppers and some aspects of soil conservation in South Australia and Western Australia' *Journal of the Department of Agriculture South Australia*, 46, 314–322.

[100] Gastón (1952).

[101] Deveson (2011), p. 9.

15.10 Locusts and Environmental History

Reflecting on the environmental historiography of formal empire in 1997, John MacKenzie noted the variety of colonial experience and duration rather than a monumental presence and consequences. Mackenzie identified four broad subject threads; narratives of 'apocalyptic' ecological loss, of some positive environmental and scientific outcomes for settler and indigenous populations, of 'longer views' exploring the depth of temporal changes and linkages with natural science, and finally an integration of cultural, political, ideological and emotional histories with the environment, which was opening the way for environmental humanities.[102] Reviewing the broader discipline in 2003, John McNeill stressed its diversity and interdisciplinary nature, and these frameworks serve to place the comparative locust histories in the context of the growth of environmental history.[103]

There is a declenionist narrative for the first nations and their environments in our regions as a result of colonial agricultural expansion, but by the early twentieth century their European populations enjoyed relatively high standards of living and low prices of red meat. Argentina was a republic, but in a linguistic twist its immigration incentive policies provided large areas of land for internal, ethnic or financial, agricultural 'colonies'.[104] The entomologists' roles in 'national science' enterprises were largely subsumed by their very practical goals. Locusts were native species and they transgressed all human boundaries as often as they were altered; boundaries that were only relevant in terms differences of locust policy and response capability.

Our examples show the near universal experience of the environmental challenge locusts were to settler societies and the social forces that directed a similar sequence of scientific and technical responses. They demonstrate exchanges of scientific knowledge and people in attempting to understand and deal with this common agricultural problem, where the 'global south' participated in its transmission and production.[105] The language difference may have limited the establishment of direct networks between Australian and Argentine entomologists, but they were aware of each other's as well as worldwide developments.[106] The government and scientific

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[102] MacKenzie, J (1997) 'Empire and the colonial apocalypse: The historiography of the imperial environment', pp. 215–228, in Griffiths, T and Robin, L (eds) *Ecology and Empire: Environmental History of Settler Societies*, Melbourne University Press, Carlton, Victoria.

[103] McNeill, J (2003) 'Observations on the nature and culture of environmental history' *History and Theory*, 42, 5–43.

[104] Land was allotted, complete with planned townships, under agreements to produce crops for given periods and these communities did operate with a level of internal autonomy. *The Buenos Aires Standard*, cited in the *Riverine Herald*, NSW, 9 April 1897, p. 3.

[105] McCook, S (2013) 'Global Currents in National Histories of Science: Introduction', *ISIS*, 104, 773–776.

[106] Many Argentine entomologists read English and the Department subscribed to the *Agricultural Gazette of NSW*, but the equivalent Argentine *Boletin* appears not to have been collected by any Australian department.

responses to locusts in South Africa followed similar paths, although they were faced with several species. The socio-environmental history of locusts for the 1920–1950 period in Orange Free State by Lize-Marié van der Watt complements the great southern grasslands locust narrative.[107]

Locusts were such a visible and damaging pest to crops that they provided a raison d'être and bureaucratic imperative for agriculture departments to act. The first organised mass actions were sceptically compared to baling out both Rio de la Plata and the Murray River with a cup, but they drew on long accumulated historical knowledge of manual control, entailed minimal environmental hazards and unified farming communities in the face of emergency.[108] The farmers' and pastoralists' willingness to participate was, as for individuals, relative to what they had to lose, so the 'dilemma of collective action' as a public good was played out by different institutional means in different jurisdictions.[109] The divergence in choice of control technologies after 1900 had cultural, demographic and environmental dimensions. Argentina was able to mobilize its sizeable workforce of landless farm labourers and poorly resourced immigrant farming families, living within a relatively confined cultivation area. It also had deeper connections to European traditions of fighting locusts than Anglo-Australia. Australia's farmers were generally better equipped, had larger individual holdings and were widely dispersed over suitable cropping land. The promotion of arsenic controls was a scientific choice that followed the technological lead of the USA and South Africa in locust control. The US-style hopper-dozers only appeared in 'back-yard' prototype in Australia, despite a thriving local farm machinery industry, possibly because of the irregular appearance and unpredictable location of plagues.

In both countries many wheat farmers lived out a precarious 'one in three' year existence, expecting to lose two crops either to drought, storms, rust or locusts. Just how bad the plagues were depended on locations, perceptions and memory of the events. The regional passage of capricious swarms and the localised production of their offspring meant that certain districts suffered disproportionately. There is no shortage of reports of serious crop damage and often total losses, but sometimes that the damage was less than expected.[110] The insights of cognitive psychology into how people cope with natural disasters by Karin and Niki Pfeifer could be extended

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[107] van der Watt, SME (2009) "*It is Drought*, *Locusts and Depression … and the Lord knows what else*": *A socio-environmental history of white agriculture in the Union of South Africa*, *with reference to the Orange Free State c. 1920–1950*. MA thesis (History), Stellenbosch University, South Africa.

[108] *The Argus*, Victoria, 14 November 1890, p. 6; *Review of the River Plate*, cited in Scobie (1964), p. 76.

[109] The study of 'collective actions' and 'public goods' are an integral part of 'group theory' of economic behaviour, first articulated by Mancur Olsen (1965) *The Logic of Collective Action*: *Public Goods and the theory of Groups*. Harvard University Press, Cambridge Massachusetts.

[110] *Horsham Times*, Victoria, 5 December 1890, p. 3. Mr Crichton, Victorian agricultural lecturer, claimed that the danger was exaggerated.

to unpredictable locust plagues.[111] Their sheer numbers and visible presence feature in descriptions and memories of the events, therefore perhaps coloring the historical record. Fear played a part in the perception of the threat and could also be manipulated. Risk assessments and the preparedness of individuals and states to act were relative to the event having occurred in the recent past. Institutions and entomologists could overstate or underplay the risk depending on their political motives.

We attempt both a 'longer' and 'broader' view by comparing these separated environments and event sequences, placing institutional and scientific responses in their cultural, economic and political contexts. The relevance of the environmental to other branches of social science and public policy may be seen in our examples of the 'feedback' relationship between scientific knowledge and state institutions in making decisions that had environmental antecedents and consequences'.[112] Their spokesmen could claim success when plagues declined, but were less outspoken when the actions made little difference. The geographical extent and frequency of plagues changed in historic times and, while the pattern of *C. terminifera* plagues continued throughout the twentieth century, the other species declined in prominence. The continued 'recession' of *S. cancellata* and *A. cruciata* since the 1950s might be attributed to the success of control programs, but it may be well to also look to changes of land use and climate in their primary habitats.[113] Uvarov's final reminder to entomologists in 1968 was that some species had declined for natural reasons or risen because of land use change, that direct controls were 'mere palliatives' and that solutions might be found through ecological regulation of populations.[114]

Insects have been a frequent subject in environmental histories since Edmund Russell's 2001 *War and Nature*, often to do with pesticides and related institutional decision-making because the relationship was unavoidable in the arena of modern humans' most fundamental environmental activity – agriculture.[115] It is pertinent here that the consequence of that 'war' against insects was the trigger for Rachel Carson's *Silent Spring*. Insects' transnational colonisations, interactions with environmental changes, politics and consequences for the geography of public health

[111] Pfeifer, N and Pfeifer, K (eds) (2013) *Forces of Nature and Cultural Responses*: *An Introduction*. Springer, Netherlands; Karin and Niki both presented research at the WCEH 2014 conference [abstracts available from: http://www.ecum.uminho.pt/uploads/eventos/EV_9098/20140707454722830000.pdf – accessed online December 2014].

[112] Sorlin, S and Warde, P (2007) 'The problem of the problem of environmental history: a re-reading of the field' *Environmental History*, 12, 107–30.

[113] Although peripheral to the identified core habitat of *S. cancellata*, the scale of climate and landscape changes in northwest Argentina can be seen in Murgida, AM, Gonzalez, MH and Tiessen, H (2014) 'Rainfall trends, land use change and adaptation in the Chaco Salteno region of Argentina' *Regional Environmental Change*, 14 (4), 1387–1394.

[114] Uvarov, BP (1968), cited in *In Memorium*: *Sir Boris Uvarov 1888–1970*. Anti-Locust Research Centre, London, p. 18.

[115] Russell, EM (2001) *War and Nature*: *Fighting Humans and Insects with Chemicals from World War I to* '*Silent Spring*'. Cambridge University Press, Cambridge UK; Tutsui, WM (2007) 'Looking straight at "Them!" Understanding the big bug movies of the 1950s' *Environmental History*, 12, 237–253.

have featured in recent environmental histories.[116] They have also been a vehicle for exploring the spatial, intellectual and sociological networks between scientists, and with their institutional patrons.[117] At the WCEH 2014 conference there were five abstracted presentations about locusts from different times and places.[118] Our locust histories show this conflicted and competitive relationship with people was a pervasive part of material agricultural life and the insects themselves were familiar, powerful historical agents. Environmental events directly influenced the course of public science as the major plagues each produced pulses of government-directed research. In the more complex nexus between the history of science and environmental change, during 1880–1940 the particular and changed ecologies of the locusts were revealed to those closely observing them in the landscape rather than in the laboratory.

[116] The linkage between malaria mosquitoes and major engineering projects in Egypt are treated in Mitchell, T (2002) *Rule of Experts*: *Egypt*, *Techno-Politics*, *Modernity*. University of California Press, Berkeley, pp. 19–54; see also: Suttor, P (2004) 'Nature's agents or agents of empire – mosquitoes and the Panama Canal' *ISIS*, 98 (4), 724–754.

[117] Castonguay, S (2004) 'Naturalising federalism: Insect outbreaks and centralisation of entomological research in Canada, 1884–1914' *Canadian Historical Review*, 85, 1–34.

[118] Abstracts from Guimaraes conference [available from: http://www.ecum.uminho.pt/uploads/eventos/EV_9098/20140707454722830000.pdf - accessed online December 2014].

Part V
Resetting Data – Information Upon Classic Subjects (Crossing Methodologies and Proposing New Interpretations)

Chapter 16
Locust Invasions, Climatic Factors and Human Affairs in Modern Age Mediterranean

Elina Gugliuzzo and Giuseppe Restifo

Abstract Today people consider the threat of swarms of locusts as a thing belonging to the past. That is actually not the case: till now, the invasions of locusts are a terrible deal for different areas of the world. Of course, the question has a history behind it. The co-evolution nature-society is somehow a fight in the dark. Living beings more visible than microbes, such as locusts, led effects that should draw the attention of researchers of economic and social history, not excluding the history of mentality. If we assume that migrations of locusts are connected with climatic factors, then a historical reconstruction of their invasions can be useful in advancing research in Mediterranean environmental history. It seems evident the interest in investigating the possible relationship of the phenomenon with the Little Ice Age.

16.1 A Swarm of Questions

Today people consider the threat of swarms of locusts as a thing belonging to the past. That is actually not the case: till now, the invasions of locusts are a terrible deal for different areas of the world. The lack of funding, the reluctance to use insecticides, the state of war in too many parts of the world and the instability that prevent the monitoring of the breeding areas of locusts, could lead to a widening of the problematic situations. Of course, the question has a history behind it.

And it should be of great interest to historians and common people too: "invisible" biological organisms were enemies of humanity in the pre-industrial era Europe and Mediterranean. The co-evolution nature-society is somehow a fight in the dark and it is necessary to mobilize all human ingenuity to win, however, knowing anyhow that the victory is always temporary.

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But also living beings more visible than microbes, such as locusts and rodents, led effects that should draw the attention of researchers, for example in the field of economic history or in that of social history, not excluding that of mentality.

Moreover, if we assume that migrations of locusts are closely connected with some climatic factors, then a historical reconstruction of their invasions can be useful in advancing research in the field of the environmental history, and on the return, in that one of the social history. It seems evident the lively interest in investigating the possible relationship of the phenomenon with the Little Ice Age, with respect not only to the temperature, but also to other factors (for example, airstreams and winds). Spreads of locusts should have been more frequent in the middle of the fourteenth century, during the Spörer Minimum (1460–1500), with a higher peak in the early sixteenth century, and at the beginning of Maunder Minimum (c. 1645).

When the biological and natural "affair" of the locusts' invasions becomes an "Italian history", in the half a millennium between 1300 and 1800, the studies will shrink essentially to a not very recent essay by Dario Camuffo and Silvia Enzi, covering the northern area of Italy. Their methodical investigation is still valid, based on recordings of medieval chroniclers and other sources, until the nineteenth century, but limited to a part of northern Italy (Camuffo and Enzi 1991, pp. 43–73).

The catalogs of invasions of locusts, published in the past and about Europe, are based on narrative sources and chronicles, but sometimes assumed uncritically and without selected criteria. Where they have been explored also archival collections, such as has been done for the modern age Spain, we can find massive and repeated attacks over several years of the periods 1270–1360, 1530–1590 and 1650–1750. "No modern researchers have examined such key areas as Sicily and southern peninsular Italy or medieval Spain" (Hoffmann 2010, p. 144).

The descriptions of locusts' invasions sometimes include comments on the weather conditions, which may be associated with the arrival of swarms of those insects. But not enough it is known yet about the connection between the migrations of locusts, and their intrusion in local environments, on the one hand, and on the other, climate events. The aim should therefore be to try to correlate the environmental factors and the invasions of locusts.

In the existing studies on an international level the hypothesis made for Sicily and the western coast of Italian peninsula still appear inconsistent: the invasions of locusts seem mainly related to the winds blowing from the South (especially the Sirocco). These would carry the swarms of locusts from North Africa; however Lüterbacher et al. simply quote only the period 1566–1572 (Lüterbacher et al. 2006, p. 50). Locusts, or grasshoppers, directly provoke famine and starvation. Giovan Battista Segni adds: "Even some African winds ordinarily, from those marshes, lift up very big clouds of Locusts, or Grasshoppers… to expel them in the air in this region and in the other one" (Segni 1605, p. 8).

First of all it is necessary to find the descriptions of locusts which came in succession in the areas of the Tyrrhenian, Ionian and Adriatic Italy, but also in the wider Mediterranean area, defining a chronological frame from 1355 to 1832.

These two dates have been chosen to pivot, for the history of the locusts' invasions, on Sicily, the Island placed in the real centre of the "Inner Sea".

16.2 Locusts: A History in the Wind

The Migratory Locust (*Locusta migratoria*) history is exemplary in putting into play several environmental factors, in which man is totally excluded, but which fully suffers for their devastating effects.

"At the beginning of a cycle, we observe an innocent green locust, calm and not voracious… When in June the temperature reaches a certain limit (20°) and when the humidity reaches the 70 %, this insect begins to proliferate and join the others in the area, often limited, where all these climatic conditions are present…. the shy grasshopper, under the influence of the pheromones released by millions of congeners and too tight in the same space, is transformed into a fearsome locust, an insect left, harnessed and armoured, equipped with functional wings and suffering from bulimia. The army furthermore march off, then flies gathered in monstrous swarms grouping up to billions of specimens dragged by winds for hundreds or thousands of miles" (Delort and Walter 2002, pp. 179–180). The locusts do not fly from their original habitat to another place because they think it can be rich of food, but simply to keep airborne fly and leave to the wind the task of transport.

In fact, the history of these insects in the course of 500 years can also communicate information on the incidence of the winds in the Mediterranean (Lamb 2012, p. 234).

The mutant schemes of the winds circulation are important research points, being in connection with the variations in the presence of insects, pollen and diseases carried by the air. According to Rosenberg and Burt, the insects are not an "aeroplankton" passively transported, but direct their flight actively upward, keeping it beating their wings and gliding and ending their migration simply by ceasing to flap their wings. In short, it realizes a synergy between the wind speed, the inherent ability of the insects to fly and temperatures (Rosenberg and Burt 1999, pp. 167–168). Here what interests is to detect the southern Mediterranean quadrants, within which lie the main winds: Grecale, from NE and prevalent in the Ionian Sea, with a maximum speed of 92 km/h; Libeccio, from SW and present more frequently in the Tyrrhenian Sea, with Summer persistence and a speed that can also rise up to reach or exceed 100 km/h; the Scirocco, coming from SE and present on the north-African, Italian, Greek coasts, with variable speed but which can reach 100 km/h. The Scirocco, wind blowing more frequently in spring and autumn, reaches a maximum of dynamism in March and became also one of the climatic symbols of Sicily, Calabria, Salento and the Land of di Bari.

16.3 A Concise Chronology

In this research were examined sources and original texts, commonly with a broader scope to the specific area of the natural sciences, in order to try to have a more overall of the object of this study. It is, at first, to trace a chronology of plagues of locusts in the Mediterranean, even if the information is scattered in different sources.

Moreover, even if the risk to the historian is to return to a purely anthropocentric history, the adventure of this research can be exciting, because, along with the purely scientific aspects, the texts used can provide a picture of social history. The question relates to when and how the inhabitants of towns and villages faced repeated environmental challenges, represented in the case by the "intrusive" grasshoppers.

The answers should be provided by the sources for various reasons considered. Historical evidence can take a variety of forms: for example, it may be descended from testimonies and phenomenological notes, which document the arrival of the swallows and the invasion of locusts, the dates of planting and harvest, histories of cold winters and springs and wells and sources which dry up (Barrow 2014, p. 61).

In the case of the early modern chronicles and annals often their writers actually lived at the time of the phenomenon reported or had been able securely to access the documentation produced by their immediate predecessors.

Consequently we have to take into consideration not only the reports of eyewitnesses, but also those arising from subsequent authors, who based their texts on sources known to them. Even if they are tiny creatures, insects, grasshoppers and locusts, the researcher still is not exempted by evaluating sources and evidence of the past with the critical and virtuous accuracy of its own job.

16.4 1300

Dealing with the issue of locust invasions in the first 150 years of the general period considered (1355–1832), it is required to escape the deformed perspective of a negative medieval age. There were invasions, bur not very frequent, even if passed on by chroniclers with a sense of fear, in remembrance of the texts of the Bible (Albini 2005, p.15).

In the period before the mid-fourteenth century, with regard to the Mediterranean area it was observed a phase of climate variability. In particular, Asia Minor was scourged, between 1300 and 1333, by droughts and locust invasions (Tabak 2008, pp. 208–209).

1355: Sicily, 15 May, an extraordinary amount of locusts came from Africa (Fazello 1817, p. 394).

Let we are not impressed of the chronicler observation that the swarms were so numerous and dense as to obscure the sunlight: this will be a *topos* all the time considered. Rather we can get two interesting elements about the relationship with the time of the year: "in May 15" is the time of the locusts coming in Sicily; and with the geographic element: "a disaster, which Sicily often suffers from for the proximity with Africa". The specification is useful to mark the spatial element in the migrations of locusts: Mazara and the territories of southwestern Sicily are the most near crossing the Strait of Sicily, starting from the northern Tunisia.

1363: events in Apulia, in Sicily the plague of locusts (Corradi 1865, p. 223). In L'Aquila epidemics and grasshoppers are advancing together (Signorini 1868, p. 30). On the coasts of Ancona, Pesaro and Fano on July 1, a "tempered" wind, blowing from Dalmatia and lasting for 10 h, brings the insects.

1364: in Romagna, from Imola toward Marche region (Corradi 1973, p. 62). 1st July, in Ancona and toward Senigallia, Fano and Pesaro (Leoni 1832, p. 170; Amiani 1751, p. 288). In summer, in Ascoli countryside.

1365: in summer in the country of Faenza, Forlì, Cesena and Rimini; in Ascoli area, between May and June (Camuffo and Enzi 1991, p. 59); in Porto Maurizio.

1367: events in Abruzzi.

16.5 1400

Chronicles and annals report for the fifteenth century several invasions of locusts in Italy, which are recorded, however, mainly in its northern part. Considering Southern Italy, there is an information about the locusts invasion in the countryside of Vasto, in 1450 (Marchesani 1838, p. 162).

1458: Gallipoli, town on western coast of Salento peninsula; famine provoked by grasshoppers; "bruchi" in spring (Corradi 1865, p. 300).

25 May 1485: the "grilli" in Naples; they remain in the kingdom "throughout the month of August", moving towards the province of Terra di Lavoro.

1490: an invasion of locusts in Sicily (Adria, ms. XVI c.). In Naples nearby 27 May.

16.6 1500

1508: Naples, Wednesday 27 September, "per la via del ponente, et andavano verso levante" (with west wind, and going eastward), for 2 days long (Notar Giacomo 1845, pp. 155 and 311).

1525: in rural areas of southern Italy, on the Adriatic coast; in May and June from Apulia to Aquila area.

1526: in spring, in the Marca di Ancona.

1527: along the coast of Ascoli. In Fermo on 7 April.

1541: in Leghorn a "flood" of locusts, "coming from the Levant" (Grifoni 1844, pp. 18 and 27).

1542: invasion from Lombardy, to Veneto, to Tuscany and to Rome; in the territory of Taggia; near the end of September in the plain of Massa; flying towards the Garfagnana and Pietrasanta, in Versilia; not crossing the Apennines; in the country of Rome.

1543: in the countryside of Lucca (Targioni Tozzetti 1767, pp. 75–76).

1548: May, single episode in the Marche (Marini 1863, pp. 56–57).

1553: the army of insects comes after 5 years of drought, as noted by Aldrovandi (1602, p. 419).
1559: in Bari region.
1562: in Apulia.
1566–1572: in the Roman countryside (Camuffo and Enzi 1991, p. 63).
1573: August brings in Italy all the heat that had not been warned in July.
1574: Maremma of Siena (Dei 1872, without page).
1575–1576: territory of Tuscania, in Viterbo area; in Tuscia region (Gallo 1721, p. 239). 1576: Document of the Municipality of Tuscania, "Libro de' consigli" in 1577.
1577: 27 May, the community of Farnese builds the Church of St. Anne; grasshoppers in Roman countryside, then in Maremma of Siena (Metaxà and Rolle 1825, p. 13); in Apulia region, in Vieste, on the eastern tip of the Gargano promontory. Camillo Porzio, in reference to the Terra di Otranto between 1577 and 1579, recalls how "is sometimes haunted this Province by the 'bruchi'."
1592: territory of Talamone.
1595: in Cosenza, on 7 August; famine in 1596–1597 too (Palmieri 1999, p. 28; Andreotti 1869, p. 321).

16.7 1600

Even in the seventeenth century, it is possible to follow a succession of plagues of locusts, through chronicles, diaries and annals. If attention is focused on the region of Sicily, gazing upon the dates of the invasions, large gaps are immediately perceived. It must be admitted that the Sicilian chroniclers of the sixteenth century neglected to record the phenomenon; therefore research of other documentary materials about the issue has to be increased.

1601–1602: Sardinia; "a cloud of locusts" carried by the African wind; Sulcis fields (Aleo 1998, p. 63; Casalis 1842, p. 662).
1611, 1638, 1652, 1653, 1654: Tuscany, in coastal regions and in the territory of Massa "of Maremma". Noticed swarms are often transported "by vehement Siroccos" from hot countries and in particular from the areas of the Maghreb.
1612, 1644, 1652–1656: Lazio (*Relazione* 1721, p. 413). 1612: Apulia (Giuliani 1768, p. 127).
1616, 1637, and 1666: feud of Mazzarelli, south eastern Sicily.
1619: county of Modica (Sipione 2001, p. XVIII).
1629: Sardinia, nimbus carried by the wind from the African soil (Casalis 1842, p. 671).
1630: in Borgagne, in Lecce area, a painting dedicated to Our Lady of the Rosary was commissioned by the inhabitants.
1637: in Sicily (Di Marzo-Ferro 1863, p. 73). 1637, 1655, 1659, 1687, 1699: rural area of Palermo, Sicily, province of Caltanissetta, province of Syracuse, Calatafimi (De Stefani Perez 1914, p. 162).
1638: Palermo countryside, in summer.

1644: Apulia.
1647: in the country of Volterra and in Maremma of Pisa and Siena; Sardinia, in the territory of St. Teresa di Gallura, the scourge raging up to 1652 (Puggioni 1967, p. 33).
1648: Sardinia, "when the rays of the spring sun were warming the air" (Manconi 1994, p. 134).
1652: in Maremma and there they stayed for 2 years more (Dei 1872, w. p.); on the Italian Tyrrhenian coasts; "Southern winds."
1653: from Tuscan Maremma to Roman countryside (Corradi 1973, p. 181); in the month of June; "Lybico" wind; Brindisi (Jonston 1757, p. 83).
1654: in Lazio and Tuscany Maremma, in Pontifical countryside.
1655: Tuscany and Lazio regions, "dry year, with Earthquakes, and Locusts" (Toaldo 1802, p. 42; Gastaldi 1684, p. 757). 1655–1656: Apulia countries (Giuliani 1768, p. 127). 1655–1658: Sicilian countries. 1655 e 1657: in Palermo area.
1656: in Lecce countryside, frost in spring; Rome, invasion and disappearance (Scufonio 1718, pp. 197–198 and 214). 1656: whole Sicilian region. Sardinia: two previous invasions of locusts (Manconi 1998, pp. 23–24).
1657: very dry summer preceded by a very rainy spring. Candela, in Foggia territory. Sicily, June, Palermo district, summer, "southern winds".
1658: in Palermo, 16 April. 1658–1659: Monte San Giuliano (Erice).
1659: Mezzojuso; in Caltanissetta countryside.
1660: Terra d'Otranto; "In the Province of Apulia".
1661: Southern Calabria, "in the countryside of Ulterior Calabria"; Foggia countryside; Bisceglie countryside. 1661–1662: in Candela territory.
1662: Sansevero, Gravina and Molfetta (Palumbo and Rossiello 2003, pp. 124–125); in the month of April, Calabria districts of Mammola, Grotteria, Martoni, San Giovanni, Gioiosa and Siderno.
1664: Tavoliere of Apulia (Di Stefano 1731, p. 9).
1665: Tavoliere of Apulia. 1665: Sardinia, three consecutive years, "scourge that is coming ordinarily from Africa" (de Gregory 1847, pp. 17–18).
1671: in April, Bovalino, on the Ionian coast of Calabria.
1677: in May, in the plain of Palermo.
1678: Monte San Giuliano (Erice); Catanzaro area of Calabria.
1679–1680: Milazzo countryside, in Sicily.
1682: Vasto
1687: Sicily fields, countryside and town of Erice.
1687–1688: in Apulia. 1687–1689: Sicily (Villabianca, ms. XVIII century, f. 418).
1688: Erice; in the country of Rome (*Gli Statuti* 1718, p. 193), in May (Scufonio 1718, pp. 197–198).
1689: Palermo countryside.
1689–1690: Caltanissetta (ASPa, AM, b. 256; D'Angelo 2009-2012, pp.65 and 424).
1692: Sinagra, in the province of Messina (Orifici 2014).
1696: Messina: 4 June, 9 August; Sicily.
1699: Syracuse.

16.8 1700

1703: province of Caltanissetta, 12 April; in the feud Soffiana.
1704: province of Caltanissetta, 17 April.
1705: Sicily, "lasting for 3 years" (Giovanni dei Cappuccini 2009, p. 75).
1707: Erice countryside, in Trapani area.
1708: in province of Caltanissetta, 5 April; in May, a multitude of locusts from Africa and the Levant (Gallo 1881–1882, p. 45); Sicily; Scicli, in south-eastern Sicily.
1708–1712: Sicily (Zanghì 1835, p. 37), always in the month of May (Crisafulli et al. 2000, p. 196). 1709: in province of Caltanissetta, 8 April (De Stefani Perez 1914, pp. 162 and 167; Baldacchino et al. 2011 p. 202).
1709: Caltagirone and its surroundings.
1710: Mazzarino, Butera, Barrafranca, Niscemi, Terranova, Riesi, 7 April; Palermo, 6 July: "rushing a vehement sirocco". After 10 days the wind shall blow the locusts away, bringing them into the sea.
1711: province of Caltanissetta, 13 April (Zanghì 1835, p. 15); Palermo, 28 April, May; Monreale. In the plain of Piombino, 23 June, "vehement siroccos from the coasts of Barbary and Sicily" (Targioni Tozzetti,1767, pp. 117–118).
1712: Tuscany, around the middle of April. Sicily.
1713: around the middle of April, in Piombino area.
1714: the middle of April, in Piombino "State", then toward Poggio di Vignale and Riotorto.
1715: the middle of April, in Piombino "State" and in the plain of Campiglia area, up to the hills of Sassetta, towards the Pisa Maremma.
1716: Piombino and Maremma, April; Rome countryside.
1717: Lazio, spring.
1726: territory of "Massa di Maremma", currently Massa Marittima.
1727: countryside of Apulia Daunia.
1727-1728: Apulia (Di Stefano 1731, p. 38).
1729: Albano.
1736: Viterbo.
1741: province of Bari and territory of Andria.
1742: early June, Enna territory; territory of "Massa di Maremma", currently Massa Marittima.
1758: Sansevero countryside.
1759: Apulia countries (De Lucretiis 1811, p. 263).
1767–1784: Tuscia and Patrimonio di S. Pietro.
1783: near l'Impruneta, 15 km from Florence.
1784: Maremma of Siena and Tuscan territory, up to Buonconvento, Sovicille, Montalcino e Piancastagnaio.
1785–1786: Florentine territory, included Galluzzo and Greve (Dei 1872, w. p.).
1786: Maremma of Siena and Tuscan territory.
1790: Molfetta, town of Apulia, 21, 24 and 30 July, dry and hot summer (Giovene 1791, p. 10).

1797: Sicily, floods in winter and strong south wind in the spring; feuds of Piazza Armerina and Castrogiovanni, currently Enna, lands in the territory of Pietraperzia and Caltanissetta.

1798: Sicily, severe drought; territories of Piazza, Castrogiovanni, Barrafranca (Valenti 1982, p. 6; Salamone 1997, p. 12).

16.9 1800

1806: territory of Pienza, in Siena area, in summer; Maremma of Siena, Volterra and Pisa; Val d'Orcia, in the months of June, July and August; Papal provinces.

1807, 1812, 1813: Sicily in some Valli (districts).

1807: Roman countryside (Angelini 1830, p. 16). 1807–1815: Roman countryside and surrounding territories; 1812, 1815, force and "long continuance of winter".

1809: Apulia and Terra d'Otranto; Bitonto, 20 February, summer (Giovene 1813, p. 190).

1810: Acquaviva delle Fonti, in spring. Viterbo, 5 February, 27 February, 5 March, 18 April (Michelis 2009, pp. 166–167).

1811: in June, Altamura district; in August, Bitonto.

1812: Acquaviva delle Fonti, Bitonto, in June, in consecutive July locusts appeared from the sea and from the Matine hills. Cosenza (Rubino 1968, p. 49).

1821: the middle of May, after dry and serene winter, Roman countryside, along the road of Fiumicino, to the plains of Ponte-Galera, Bracciano, Tor di Quinto; September, district of Lagonegro.

1822: Roman countryside, late spring.

1823: long, cold winter; in the territories of Monticelli, Fiano, Leprignano, Nazzano, S. Oreste.

1824: in Southern Italy, in several parts of the kingdom of Naples and in the territory of Benevento.

1825: Abruzzi countryside, territory of Vasto. Sardinia, Island territory.

1832: in la Selva zone bordering with Terlizzi countryside (Palumbo and Rossiello 2003, pp. 131–132 and 139).

1832: Sicily (Di Blasi 1842, p. 818).

1850: eastern part of Malta island.

16.10 In Western Mediterranean

It is not easy to identify the species of locusts that invaded in medieval times the region of Murcia or have reliable information on some penetrations of swarms: this is the case of the narrative of an eighteenth-century chronicler on the infestations of these insects in the area of Orihuela, on the edge with the area of Valencia, which would take place in 1358, in 1359 and 1407. Even the Catalan region is attacked by a cloud of locusts in 1358.

1438, 1440, 1463, 1464: in Murcia, in February and March, in April, in autumn and in summer.
1488: territory of Murcia.
1492: Murcia.
1495: Zaragoza.
1507–1508: Andalusia.
1542: Spain, southern Europe, Turkey, “Esclavonia, Croacia, Austria, è Italia”.
1548–1549: Toledo surroundings (Hoffmann 2010, p. 146).
1553: Arles countryside.
1574: ‘comarca’ of the Sagra, in Valencia territory.
1579: Spain, in July, hot weather (Schiavina 1861, p. 593).
1581, 1585, 1588, 1607, 1645, 1659, 1680–1688, 1698, 1703, 1726, 1756, 1770, 1769, 1780–1784 (then following again 1810–1812 e 1845): Canaries.

More generally, it should be noted that the invasions of pilgrim locusts (*Schistocerca gregaria*, or *desert locust*), born in the southern Sahara and taken to the north of Africa by the winds, have followed with irregular intervals, but with appreciable effects on local and social contexts. The eggs of locusts sometimes gave rise to new swarms that have crossed the Mediterranean, reaching Spain (as in 1590), southern Italy and Sicily, the islands and the Greek mainland or Cyprus (Delort and Walter 2002, p. 179).

1613: Arles zone, Marseilles.
1619 spring–1620 May: Antequera, in Andalusia region.
1665: Tunis region, carried by winds (Pagni 1829, pp. 73–75).
1685: Languedoc, spring, Aramont, near Avignon (Birch 1757, p. 489).
1688: Catalonia.
1753–1756: Villarobledo, in Castilla-La Mancha region.

In Spain things are even worse than the rest of the Mediterranean: we are informed by the naturalist William Bowles, who said that the locusts desolated various provinces of the Iberian Peninsula between 1754 and 1757. In 1754 was born such an amount of females that the following year locusts flooded the Mancha and Portugal.

1770: in Toro province, part of the ancient Kingdom of Leon and part of Castilla la Vieja, Montes de Hiniestas e Bardales.
1778: Morocco, in summer, from South; it will be followed by 3 years of poor harvests due to drought.
1779: Morocco, in spring. Andalusia.
1780: famine, North-Western African area, empire of Morocco (Villa and Villa 1856, p. 128).
1787: Estadilla: 4 years before the area was invaded by locusts.
1790–1791: Morocco (Lemprière 1801, p. 79).

1812: May, Nixar (today Nijar, in the province of Almeria, Andalusia).
1824: Trigueros in Andalusia.
1844: spring, Algeria and Mediterranean coast of Africa.
1845: Algeria (Villa and Villa 1856, p. 128).

16.11 In Eastern Mediterranean

In the Little Ice Age also Egypt, Cyprus, Rhodes and Turkey live the risk of invasions of locusts. The first mention of an invasion of locusts in Cyprus dates back to 1351 and comes from the chronicler Leontios Makhairas (1932, p. 61; Jennings 1988, p. 279).

1354: North Africa; island of Cyprus.
1355: island of Cyprus.
1358: Cyprus, previous 6 years "moltitudo locustorum" (Arbel 1989, p. 1060).

In the eastern Mediterranean is Cyprus to attract attention: in the large Mediterranean island grasshoppers are a recurring and endemic phenomenon since the end of the Middle Ages, and especially in the first half of 1500. To crowd the island of locusts contributes the Tramontane wind, according to the testimony of John Husbands. That wind gets up from parts of Caramania, province of Asia Minor, the island suffers from the expiration of that "inconvenient" wind. Moreover, grasshoppers, scourge of those campaigns, "are raised mostly on that occasion" (Mariti 1772, pp.18–19).

1509: Cyprus lands.
1512: Cyprus (Arbel 1989, p. 1061).
1521: Famagosta, in September (Basola 2003, p. 45).

According to an anonymous report, the "crickets", or grasshoppers, could destroy an average of 2260 tons of wheat on an annual harvest of 33,900 tons. The percentage of approximately 6.6 % may seem modest, but it must be taken into account which was calculated on "normal" crops, that knew no disasters.

1550: Cyprus (Braudel 1996, p. 244).
1571: Rhodes and Iznik, in north-western Anatolia, "possibly driven north of their usual range by the dry weather" (White 2011, p. 81).
1572–1576: famine, Cyprus (de Lusignan 1589, f. 211).
1682: Izmir. Crete and Greece: exceptionally cold winters.
1710–1711: Epirus, between autumn and winter warm and dry weather. Ioannina and Arta (Xoplaki et al. 2001, p. 597).
1728: Antioch, Aleppo and surrounding countryside.
1760–1768: Cyprus (Mariti 1769, p. 168).
1778: Izmir.
1785: Cairo toward Nile river Delta.

1799: Egypt, 20 May.
1802: Egypt.
1812: Izmir.
1827: June, Troy, Izmir.

16.12 Two Examples of Archival Sources

In the private Archive of Amato De Spuches family it is possible to follow the complete sequence of the struggle against the locusts engaged in 1689 in Caccamo, province of Palermo. The peasantry noticed the “simenza”, the ovules of grasshoppers in their early stage. The Municipality, aware of the problem existing in the country, immediately informed the ‘Tribunale del Real Patrimonio’, the Royal Financial Authority, in order to get orders and provisions (ASPa, ADS, 1689).

An eighteenth century manuscript, author the Marquis Villabianca, contains many informations about the locust invasion in 1784. The insects occupy nearly the entire Island of Sicily, particularly the area of Palermo. On March 1st the vice-royal Authority issues the first measure, promptly following the news coming from Val di Mazzara, the south-western part of Sicily. The locusts infests especially the territories of Carini, Cinisi, Favarotta, Partinico, Valguarnera Monreale. The amount of eggs of grasshoppers in the countryside of Western Sicily is above expectations as well as their resistance to weather factors. It is necessary to hurry, because spring is not far and the heat of the fervent sun is getting close. Anyway, problems exist not only in regard to “animals”, but to men too (Villabianca, XVIII c. ms., Qq D 104).

16.13 *Mentalités* and Locusts

Thanks to the locust invasions we can “Re-cross our story highlighting how the disappearance of animals from our reference systems, or as subjects, and their appearance as objects of consumption, is tied hand in glove with each other issue that we considered to be only human. It is, finally, to strike for the last time the specter of anthropocentrism” (Caffo 2014, p. 8).

Divine punishment or ill omen insect cricket/grasshopper was fought throughout the traditional Christian society through prayer and the invocation of saints. Some icons were considered particularly effective against locusts after their appearance. In the middle of the fourteenth century, Ignatius, Patriarch of Antioch, had ordered the Cypriots to bring in procession the images of the saints Christopher, Tarasius and Tryphon (Arbel 1989, p. 1061).

Besides, the invasion of locusts can be said to have an emotional overload, playing, for this, a considerable role in the religious traditions. The farmers of the

Mediterranean have always feared the “surprises” that come from the sky, which can destroy all the fruit of their efforts, they are capricious winds, drought or excess of water or frost, and they are still the fast pestilential clouds of locusts (Braudel 2012).

It should be noted that for the mentality of the sixteenth and seventeenth centuries, the control measures of religious nature and those technical practices were not in contradiction with each other. The city council of Innsbruck, for example, ordered to all the inhabitants they must take part in the procession and observe silence during the mass.

The pragmatic attitude towards the phenomenon/plague of the of locusts emerged in Cyprus since the beginning of their appearance, at the same time of the use of religious or magical remedies. It was probably the king Hugh IV in 1355 that would have ordered his subjects to amass eggs and crickets and bury them in the pits and ditches. In a letter dated April 18th, 1504 addressed to the Council of Ten, where governors reported the reappearance of locusts, they specified of having ordered the destruction of insects throughout the territory as it had been done in the past in similar occasions.

There are actually many places of the Mediterranean Europe to be involved and shocked by the invasions of different animals. The reactions were often similar. We can still mention basically three types of reactions to the phenomenon of locusts. Very often magical-religious attitude and pragmatic attitude coexisted within a same society in which every social group and every institution favored their own. There was a dominant attitude? And what or who imposed it?

In the case of the Venetian Cyprus reported us by Benjamin Arbel, the Venetian governor Lion believed that the man had the duty to meet the challenges of nature. But it is also undeniable that the processions have never ceased to exist nor the belief in the special virtues of the water of Persia.

The activism of the Venetian judges was able to transform the insect predator from an instrument of the divine anger in a vulgar beast. Here you definitely feel a change “a shift” in mentality.

The attack of locusts, caterpillars, mice, of wild animals was normally considered an intentional work of the devil that is embodied in them: and therefore the Church created a whole network of ritual defenses against them, represented by anathemas and incantations, or even by legal processes and threads. Those processes, even though they may appear “superstitious”, however, were the culmination of a long history of judgments and punishments of animals that had covered the Western civilization (Aberth 2013, p. 218). The same Roman Pontiff, when is warned of the damage that the locusts are causing, does not hesitate to make the “solemn curse, prescribed in the Roman Ritual”. The operation was fully “orthodox” as among the Ritual of Gregory XIII (1576) and that of Paul V (1614) had tried to put a little ’order in the forest of the most various blessings and exorcisms (De Rosa 1998, pp. 68–69).

16.14 Conclusions

Climatic factors appear clearly closely associated with plagues of locusts and, thereby, they have to be considered of primary importance in the study of the phenomenon. Climatic factors allow the natural conditions, ideal and necessary, for hatching eggs, for the individual and collective survival of insects and for the transfer of their swarms, which are inclined to submit passively to the effects of the winds.

The invasions of locusts do not constitute evidence of how the weather was, they are not good indicators of climate cycles, since they are resigned to get where the winds want to bring them, even in climatic regions that are not identical to those of origin.

Temperatures, humidity levels, atmospheric pressures of the places of arrival of their flights are not sought by them, but by the direction and intensity of the wind vectors; on the contrary, it can happen to them they are obliged to make efforts to adapt to the new climate in which are found than the home debut on the big scene of Nature. And this could be fatal for them.

There are several species of grasshoppers, each with its specific geographical distribution and its peculiar sensitivity to various climatic factors, some even more ready to invade more frequently certain well-defined areas.

We cannot exclude that frequent appearances in Italy are due to the species "Calliptamus italicus", particularly during periods when the land was abandoned, when consequently nothing prevented the uncontrolled development of this species. The direct African origin of locusts appeared clearly in Pliny, which probably refers only to the invasions that occurred in southern Italy. Here comes in particularly the species Dociostaurus maroccanus". The southern origin of locusts is confirmed by a lot of early modern history sources in Italy, as testified by different authors. The periods, when the frequency of the invasions was greatest in central and southern Italy, were: 1363–1365, 1525–1527, 1541–1543, 1572–1577, 1629–1630, 1637–1638, 1647–1648, 1652–1662, 1664–1665, 1677–1679, 1687–1689, 1703–1705, 1707–1717, 1726–1727, 1741–1742, 1758–1759, 1783–1786, 1797–1798, 1806–1807, 1809–1812, 1821–1825.

A probable role played by meteorology on the development and maintenance of past infestations has been theorized in the literature, but the general mechanisms of action on a synoptic scale have not yet been explained (Vallebona et al. 2007, p. 777).

The life of locusts depends on various competitor causes: the seasonal humidity, intensity and wind direction, atmospheric pressure, the availability of food.

Especially the latter factor appears to be decisive: after having devastated a land, locusts move in search of new foods; indeed even within human populations, in the modern age and during famines, we have movements from the countryside to the cities where presumably the poor can be fed (Dethier 2012, p. 201). Locusts contribute to increase the difficulties of the companies of Mediterranean Europe. It could be that epidemic diseases have developed following the debilitation of the population, caused by famines, in turn generated by the action of locusts. Human actions, through the centuries, have reduced the damage and frequency of invasions of locusts. Thanks to the transmitted experience, the companies of the Middle Ages and the early modern age were able to develop strategies to minimize the risk of this type of disaster, sudden but repetitive. Once again back to light the important role of agriculture, as a land abandoned potentially constitutes an ideal habitat for the mass reproduction of insects and for their survival.

As regards southern Italy, it should be noted that parts of a semi-arid land were left uncultivated and used only as pasture for sheep, this would mean that “naturally” they were infested by locusts. The gravity of that plague would be determined not only by the climatic factors, but also by the effectiveness of the methods used to deal with the locusts. Even in the case of southern Italy, only a high-intensity cultivation would prove to be the most effective way to put an end to this scourge in the early part of the nineteenth century.

This is valid not only for the modern age, but also for the contemporary period and especially for developing countries. In the current complexity of the phenomenon a significant role is played also by the characteristic climatic phase of global warming. Locusts could then reappear in lashing multitudes. Some areas of the Apennine, as well as Sicily, Apulia and Sardinia, are exposed to this risk, although the restricted populations of Italian Locust in Western Europe are “critically endangered” and about dying out (Sergeev et al. 2000, p. 78).

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Chapter 17
Wood for Burning: The Continuity of Woodland Management in Medieval and Early Modern France

Richard Keyser

Abstract This essay argues that over the last five or six centuries of the preindustrial era northern French patterns of woodland management, which prioritized the production of fuelwood, were more stable than is usually thought. Regulations were gradually tightened, most famously in the Forest Ordinance of 1669, but such administrative reforms aimed primarily to reassert the state's authority and improve its finances. Silvicultural techniques themselves changed only incrementally, and more often as the result of market forces than of central planning. Early modern norms of woodland management had much deeper and broader sources than the tendency to trace them to royal initiative suggests. The French state appropriated and standardized practices that were in many cases already common by the thirteenth century. This essay focuses on the pervasiveness of coppicing, the enduring norms governing tree density and species, and the persistence of use rights.

At least until the late twentieth century forest historians tended to accept at face value the abundant testimony of contemporary observers that later medieval and early modern Western Europe suffered from serious shortages of both timber and fuelwood. Yet as many recent scholars have noted, such testimony must be critically evaluated. Particularly problematic are complaints about shortages of timber, which usually reflect relatively narrow, elite demand for specific sizes and qualities of lumber for shipbuilding and large-scale construction projects. The supply of such timber corresponds only weakly with the extent or sustainability of preindustrial woodlands. This is because in the Middle Ages and well into the Early Modern period most West European woodlands in deciduous forest zones, that is, virtually everywhere outside of the coniferous woodlands found in mountains and the boreal

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forests of Scandinavia, seem to have been managed not primarily for tall timber, but rather for small wood, mostly for fuel.[1]

Perceived shortages of fuelwood have, therefore, greater potential ecological relevance. And there is widespread evidence of rising prices for wood across the early modern period. Indeed, the relative economy achieved in Britain by gradually replacing wood with coal as a source of heat from the sixteenth century onwards played a key role in enabling that country to launch the first Industrial Revolution by the late eighteenth century. But even at that late date and in Britain, which had long had much less woodland than most parts of the continent, we must distinguish between high prices and the more catastrophic scenes of ruined or vanished woodlands that many contemporary sources evoke. However plausible scenarios of acute wood scarcity may be by the later eighteenth or early nineteenth centuries, after three or more centuries of intermittent but cumulatively robust growth in population, urbanization, and industry, similar complaints from earlier periods must necessarily be considered with due skepticism.[2]

Focusing on evidence from northern France, this essay aims to contribute to the more positive appraisal of preindustrial woodland management that has been emerging since the 1980s. It emphasizes the fact that the overall patterns of woodland management, centered on the production of fuelwood, remained remarkably stable for at least the last five or six centuries of the preindustrial era. It is true that as population grew and industries expanded over the early modern period, regulations were gradually tightened, most famously in the Forest Ordinance of 1669, whose chief architect was Louis XIV's financial minister, Jean-Baptiste Colbert. This legislation mandated standardized rotations of both timber and small wood for all significant French woodlands. In a sense Colbert's project of forest reform was an early model of the rationalization and "state simplification" that was taken much further with the development of modern scientific forestry in late-eighteenth-century Germany.[3] Yet as historians have long recognized, the 1669 ordinance innovated more in its centralizing vision and will to enforce than in its substantive administrative and especially its silvicultural provisions, most of which closely resemble those of royal

[1] Oliver Rackham, *Ancient Woodland*: *Its History*, *Vegetation*, *and Uses in England* [1980], 2nd ed. (Colvend: Castlepoint Press, 2003), 3–7, 137–72; Paul Warde, "Fear of Wood Shortage and the Reality of Woodland in Europe, c. 1450–1850," *History Workshop Journal* 62 (2006), 28–57, who claims (p. 36) that "in northwestern and central Europe, the great bulk of wood grown in the lowlands, between 70 % and 90 %, was cut for use as firewood, in fencing, and in agriculture;" Joachim Radkau, *Wood*: *A History*, transl. Patrick Camiller (Cambridge: Polity Press, 2012), 92–103; Richard C. Hoffmann, *An Environmental History of Medieval Europe* (Cambridge University Press, 2014), 181–88, 199–202.

[2] This remains true even if we allow for the cyclical character of much preindustrial growth. See: Warde, "Fear of Wood Shortage," 39; Astrid Kander, Paolo Malanima, and Paul Warde, *Power to the People*: *Energy in Europe over the Last Five Centuries* (Princeton University Press, 2013), 37–118, 144–58.

[3] For a succinct, critical account see James C. Scott, *Seeing Like a State*: *How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998), 11–22.

legislation going back to the sixteenth and even the fourteenth centuries.[4] Moreover, as Andrée Corvol and a generation of French forest historians have shown, in other ways too Colbert's reform was not the shining beacon of conservation that nineteenth-century forest historians claimed.[5] This reform, like many others before and after it, was occasioned less by any enduring shortages of forest products than by a perceived need, after a period of devastating warfare and economic distress, to reassert the state's authority and improve its finances. Despite more than a century of efforts after 1669 to fine-tune and better enforce its provisions, the Forest Ordinance's application beyond the royal forests was limited, and even where it was more fully applied its silvicultural impacts were ambivalent.[6] Nor did the Revolution spell an end to the force of tradition in forest policy: in many respects the French Forest Code of 1827 remains true to the already well-worn practices codified by Colbert.[7]

Even where changes in woodland management can be demonstrated, they were typically gradual and incremental, and more often the result of market forces than of top-down central planning. This essay proposes that the basic norms of northern French woodland management as they appear in the early modern sources go back further and were more widespread than the still-influential tendency to trace them to royal initiative might suggest. It is true that after 1669 the royal forestry service, *Les Eaux et Forêts*, often imposed these norms intransigently and sometimes did so in regions where they did not work, such as the mountains of eastern and southern France.[8] Yet when seen from a medieval perspective, it becomes apparent that the French state merely appropriated and sought to standardize practices that were already common in many northern French regions by the thirteenth century.[9] Within its ecological homeland of the Paris Basin and nearby lowland regions of northern, central, and eastern France, medieval patterns of woodland management proved sustainable over the long run, at least until the beginning of the industrial revolution in the nineteenth century.

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[4] Michel Devèze, *La Grande Réformation des Forêts sous Colbert* (*1661–1683*) (Publications de l'Université de Paris, 1954), 213–36; Paul Bamford, "French Forest Legislation and Administration, 1660–1789," *Agricultural History* 29 (1955): 97–107.

[5] For a contrasting view, see [Raymond Lefebvre et al.], *Les Eaux et Forêts du 12e au 20e siècle* (Paris: Centre National de la Recherche Scientifique, 1987), 131–65.

[6] Andrée Corvol, *L'homme et l'arbre sous l'Ancien Régime* (Paris: Economica, 1984), 187–264; Jérôme Buridant, *Espaces forestiers et industrie verrière*, *XVIIe – XIXe siècle* (Paris: L'Harmattan, 2005), 291–364; Martine Chalvet, *Une histoire de la forêt* (Paris: Éditions du Seuil, 2011), 162–3.

[7] *Les Eaux et Forêts*, 162, 477–82.

[8] Christian Fruhauf, *Forêt et société*: *de la forêt paysanne à la forêt capitaliste en pays de Sault sous l'ancien régime* (*vers 1670–1791*) (Paris: CNRS, 1980); Tamara Whited, *Forests and Peasant Politics in Modern France* (Yale University Press, 2000), 21–51; Emmanuel Garnier, *Terre de conquêtes*: *La forêt vosgienne sous l'Ancien Régime* (Paris: Fayard, 2004), 525–39; Chalvet, *Histoire de la forêt*, 179–207.

[9] Here my argument reinforces and extends that of Jérôme Buridant, "Du 'modèle' à la pratique: la gestion des peuplements caducifoliés dans la France moderne, XVIe-XVIIIe siècle," *Flaran* 24 (2002): 203–20.

In the remainder of this essay I will briefly describe the substantial continuity of northern French woodland management geared towards small wood production. I will consider in particular two key aspects of this system: the prevalence of small wood production through coppicing; and regulations governing the density and ages of tree. I will also mention two other topics that need fuller attention: norms regarding which species were harvested and by whom; and the enduring character of local use rights, despite tenacious efforts to curtail them.

17.1 The Prevalence of Coppicing

Besides timber, woodlands can also be managed to prioritize either grazing, resulting in what is usually called "wood-pasture," or the production of firewood and other "small wood." The production of small wood is most effectively achieved by "coppicing," the frequent cutting of the poles and branches that resprout from recently cut stumps or trunks of most species of deciduous, broad-leaved trees. While all three management approaches—timber, wood pasture, and coppice—can be found throughout the preindustrial era and can even coexist in the same woods, one or another of these management strategies tends to predominate in a given region and historical period. The evidence suggests that in Western Europe between ca. 1200 and 1800 CE coppicing prevailed over both wood pasture, which had predominated until then, and timber, which in turn become the main, indeed almost exclusive focus of modern forestry in the later nineteenth century—precisely when coal began to lessen the need for woodfuel.

Modern scientific forestry's ideological hegemony goes a long way towards explaining why historians overlooked for so long the range of choices preindustrial people actively made in managing their woodlands. But this recent scientific prestige is in a sense only the tip of the iceberg: it expresses and validates an enduring elite preference for tall timber. Such a preference is already apparent in the first explosion of medieval documentation in the twelfth century. Perhaps the earliest clear example is recorded in the famous tale told by Abbot Suger of Saint-Denis, just outside Paris, about how in the 1130s it was only with divine intervention that he was able to find in the abbey's woodlands of Yvelines, about 50 km west of Saint-Denis, 12 trees of sufficient size to rebuild his church's roof. The scornful comments Suger makes about the carpenters, peasants, and local lords he mentions in relation to his woodland expedition implies that he attributed the scarcity of good timber to poor management, local warfare, and outright theft. While his account is not detailed enough to determine the exact nature of the woodlands he saw, he does not even consider the possibility that they were managed for other purposes than timber.[10] Even such twentieth-century scholars as Marc Bloch and Georges Duby, who are known for their sympathy for traditional rural life and their realism about

[10] *Scriptum Consecrationis Ecclesiae Sancti Dionysii*, ed. and transl. Françoise Gasparri, *Suger*: *Oeuvres*, 2 vols. (Paris: Belles Lettres, 1996), 1: 18–21.

lordly exploitation of peasants, seemingly adopted Suger's perspective uncritically. Thus in commenting on Suger's story, they suggest that the Yvelines woodlands had suffered from "unregulated exploitation," or that were "badly maintained and damaged by unplanned utilization."[11] Nor were Bloch and Duby at all exceptional in this regard. Similar statements about poorly maintained medieval woodlands, usually noting a dearth of high-quality timber, run through most twentieth-century works of preindustrial rural and regional history. Of course, such negative assessments about timber stocks are often qualified by recognition of the fact that preindustrial people needed to use woodlands for other purposes, such as pasturing livestock, hunting game and gathering other wild products, and, perhaps most of all, as a reserve of land for clearance when population grew.[12] In fact the prominence of woods-clearance as a topic among most medieval rural historians until very recently largely justifies Georges Bertrand's quip that "historians have been really interested in the forest only when it was cleared."[13]

More research is certainly needed on the first of the two major shifts postulated here, which saw a move away from wood pasture and the extensive, subsistence-oriented, silvopastoral approaches with which it was associated. These modes of woodland management are difficult to study both because of the limited or imprecise documentation available for the early Middle Ages and, in many regions, even for the eleventh and twelfth centuries, and because of the slow progress of archeological and paleo-scientific research concerning woodlands.[14] But evidence continues to accumulate from across Western Europe that after about 1200, at least on densely populated plains and near towns, coppice and more intensive, commercial-

[11] Bloch, *French Rural History*: *An Essay on its Basic Characteristics*, transl. Janet Sondheimer (Berkeley: University of California Press, 1966), 7; Georges Duby, *Rural Economy and Country Life in the Medieval West* (Columbia, SC: University of South Carolina Press, 1968), 143. For these quotations and comment, see: Ellen Arnold, *Negotiating the Landscape*: *Environment and Monastic Identity in the Medieval Ardennes* (Philadelphia: University of Pennsylvania Press, 2013), 64; and Richard Keyser, "The Transformation of Traditional Woodland Management: Commercial Sylviculture in Medieval Champagne," *French Historical Studies* 32 (2009): 353–84.

[12] For some examples concerning France, see: Guy Fourquin, *Les campagnes de la région parisienne à la fin du Moyen Age* (*du milieu du XIIIe siècle au début du XVIe siècle*) (Paris, 1964), 150; Robert Fossier, *La terre et les hommes en Picardie jusqu'à la fin du XIIIe siècle* (Paris, 1968), 309, 418–19, 430–31; André Chédeville, *Chartres et ses campagnes* (*XIe–XIIIe s.*) (Paris, 1973), 202–7; and Dominique Barthélemy, *Les deux âges de la seigneurie banale*: *Coucy* (*XIe–XIIIe siècle*) (Paris, 1984), 389.

[13] George Bertrand, "Pour une histoire écologique de la France rurale," in *Histoire de la France rurale*, ed. Georges Duby and Armand Wallon, vol. 1 (Paris: Seuil, 1975), 86.

[14] For a recent survey of archeology focusing on early medieval France, see: Isabelle Catteddu, *Archéologie médiévale en France*: *Le premier Moyen Age* (*Ve-XIe siècle*) (Paris: Editions La Découverte, 2009). For discussions of the sources and methods of research on medieval woodlands, see: Peter Szabó, "Sources for the historian of medieval woodland," in *People and Nature in Historical Perspective*, ed. József Laszlovszky and Peter Szabó (Budapest, 2003), 265–88; and Peter Szabó and Richard Keyser, "Woodlands," forthcoming in *Handbook of Medieval Environmental History*, *vol. 2*, *1000–1350* (Leiden: Brill), ed. Timothy Newfield and Philip Slavin.

ized, wood-harvesting approaches to woodlands became prevalent.[15] Even then, the early history of these modes of woodland management is typically revealed to us only indirectly and partially, especially through the disputes and the writing and rewriting of regulations at the level of the village or lordship. The local, customary character of much of this documentation has made it difficult to perceive the overall pattern of change suggested here. Yet for the relatively well documented regions of northern, central, and eastern France, it seems likely that after ca. 1200, and for some six centuries thereafter, most woodlands in areas of even modest urban demand were managed as variations of coppice-under-standards (French: *tailli sous futaie*), in which scattered taller trees, or standards, provided partial shade for woods made up mostly of coppice that was harvested every 5–25 years.[16]

One of the clearest indications of a pervasive high-medieval shift in the priorities of woodland management from pasture to wood production is the increasing frequency in thirteenth-century charters of a customary limit on grazing during the first 3–6 years after wood harvesting. This restriction is indicative of coppicing, because a recently harvested coppice requires several years before the new growth can withstand grazing. In 1271 the high court of Champagne recognized that such a custom was the norm in the county's woodlands. By this time similar rules were operative across northern France, and they remained prominent in the sixteenth-century codifications of French regional customs.[17] French royal legislation adopted a 6-year period as the norm for protecting a newly cut coppice, a rule that still appears in the Forest Ordinance of 1669.[18] These widespread limits on grazing "after the fifth or sixth leaf," as the early texts put it, show that pasturage and other uses had now become subordinated to the coppicing cycle. These were still multi-use woodlands, but now the priorities had been re-juggled to privilege wood production.

More concrete evidence for cutting wood on short rotations comes from such fiscal sources as inventories and account books. Though for the thirteenth century these are available only for some regions, they show that by the middle of this century in Normandy, the French royal domain, and Champagne (which was an independent principality until 1285), frequent commercial wood harvesting accounted

[15] Odile Redon, "Une forêt urbaine: la 'Selva del Lago'," in *Villes, bonnes villes, cités et capitales. Études d'histoire urbaine* (*XIIe-XVIIIe siècle*) *offertes à Bernard Chevalier* (Publications de l'Université de Tours, 1989), 247–57; Monique Somme, "Règlements, délits et organisation des ventes dans la forêt de Nieppe (début XIVe – début XVIe siècle)," *Revue du Nord* 287 (1990): 511–28; Bettina Borgemeister, *Die Stadt und ihr Wald. Eine Untersuchung zur Waldgeschichte des Städte Göttingen und Hannover vom 13. bis zum 18. Jahrhundert* (Hannover: Hahnsche Buchhandlung, 2005).

[16] Buridant, "Du 'modèle' à la pratique;" Corinne Beck, *Les eaux et forêts en Bourgogne ducale* (*vers 1350 – vers 1480*): *société et biodiversité* (Paris: L'Harmattan, 2008), 129–74; Keyser, "Transformation of Traditional Woodland Management."

[17] Alexandre Teulet, et al., eds., *Layettes du Trésor des Chartes*, 5 vols. (Paris: Plon, 1863–1909) [hereafter = *LTC*], 2, no. 2813, 5 years as the "custom of Champagne;" Paula Portejoie, ed., *L'ancien coutumier de Champagne* (*XIIIe siècle*) (Poitiers, 1956), 174, art. 21 (1271). See also Duby, *Rural Economy*, 144; Michel Devèze, *La vie de la forêt française au XVI siècle*, 2 vols. (Paris, 1961), 1: 100.

[18] Baudrillart, Jacques-Joseph, *Recueil chronologique des réglemens forestiers* (Paris, 1821), 1: 41–92, at 75 (Title 25, art. 13).

for the bulk, usually more than 80 %, of woodland revenue, which all told often made up as much as 15 % of a ruler's revenue.[19] A Champagne survey of 1276 focuses on parcel size and average annual values from wood harvesting, making it absolutely clear that virtually all woods owned by the count or subject to his rights of forest overlordship (called *gruerie*) were frequently cut. Some of the cutting intervals applied to extensive tracts. In Séant-en-Othe, in the Othe Forest between Sens and Troyes, four lots adding up to 2475 arpents (an arpent being roughly an acre) could be cut every 20 years, and were worth two and a half pounds per arpent when cut, or two and half sous per arpent on an annual basis. Most plots, however, were considerably smaller, ranging from a few arpents to 50 or 60, each cut on a different cycle. At Pont-sur-Seine the count had five woodlots ranging in size from 16 to 60 arpents, which were cut every 10–16 years.[20] The predominance of cutting cycles of 20 years or less reveals that the priority was on coppicing to produce an abundant supply of underwood, within an intensive silviculture that required micro-management: each woodlot had its own regime.

A more detailed type of evidence consists of contracts for the sale of cutting rights made to woodmongers, which have survived, albeit sporadically, from the early thirteenth century onwards. One early example is a sale made in 1219 by the Benedictines of Molesmes to two men of 1000 arpents of their woods of Rumilly, about 20 km south of Troyes, allowing the men 10 years to remove wood, on condition "that they cut any one part of these woods only once." This represented a 10-year lease that required the men to cut about 100 arpents per year, moving from one section to another each year.[21] Such contracts had become routinized by the end of the century, as we can see in the *Book of Sales of the Woods of Champagne* (*Livre des Ventes des Bois de Champagne*), the earliest account book in France of which I am aware devoted to wood-cutting sales. This remarkable account book was written under the authority of Pierre de Chaource, a Champagne forest manager (*gruyer*) kept on by King Philip IV (1285–1314) after he acquired this province through his marriage to the Champagne heiress in 1284. It records more than 200 wood-cutting sales made between about 1280 and 1300, mostly in the castellany of Villemaur in the Othe Forest. For each sale, scribes recorded the name of the seller, either an official like Pierre de Chaource for woods in the royal domain or a local landowner for woods held under *gruerie*, the area, averaging about 40 arpents, and the price, usually about 6 lb per arpent. Owners other than the count-king paid a *gruerie* tax

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[19] André Lefèvre, "Les finances de la Champagne aux XIIIe et XIVe siècles," *Bibliothèque de l'École des Chartes* 19 (1858): 409–47, at 435–7; Joseph Strayer, *The Administration of Normandy under Saint Louis* (Cambridge: Medieval Academy of America, 1932), 43–4; Heinrich Rubner, *Untersuchungen zur Forstverfassung des mittelalterlichen Frankreichs* (Wiesbaden: Steiner, 1965), 72–80, 94–116, 130–1; and John Baldwin, *The Government of Philip Augustus*: *Foundations of French Royal Power in the Middle Ages* (Berkeley: University of California Press, 1986), 156–8, 242, 252–6. For a more detailed analysis of the material presented in this and the following paragraph, see Keyser, "Transformation of Traditional Woodland Management," 371–80.

[20] Auguste Longnon, *Documents relatifs au Comté de Champagne et de Brie*, *1172–1361*, 3 vols. (Paris: Imprimerie Nationale, 1901–1914) [hereafter = *DCB*], 2: 22, 24.

[21] Jacques Laurent, ed., *Cartulaires de l'abbaye de Molesme*, 2 vols. (Paris, 1907–1911), 2: 324, no. 176.

that typically amounted to half the sale price. Altogether profits from wood cutting in the castellany of Villemaur brought in about 1300 lb per year, about the same as the annual tax paid by the city of Troyes, and at a time when the entire bailliage of Troyes produced only between 15,000 and 20,000 lb. Moreover, the entries for woods held in gruerie show that the count-king's vassals normally exploited their woods in the same way.[22]

Records of court cases from this period occasionally provide echoes of evocative discussions concerning different woodland management practices. In 1258 in the French Parlement an abbey sought damages because an unspecified part of the Forest of Crot, near Dreux, about 75 km west of Paris, "had been sold" (*foresta vendita fuit*). The monks complained that because of the "smallness and newness of the woods" (*propter parvitatem et novitatem boscorum*) they could no longer find as much firewood and wood for charcoal-making as they were accustomed to, nor as much pannage for their pigs, nor as much pasture. But ultimately the judges sided with the royal bailiff, apparently persuaded by his argument that in fact one could find more firewood and pasture in 100 arpents of woods of between 15 and 20 years of age than in 1000 arpents of "high forest" (*magna foresta*).[23] Indeed the royal bailiff may have been right about the greater profitability of woods managed primarily for small wood rather than for timber. Perhaps the monks complained because frequent wood sales had only recently become prevalent in this particular forest and, as holders of mere usage rights here, they shared very little in the profits from these sales.

By the early modern period, the prevalence of small wood production across northern France leaves little room for doubt. Both urban and industrial demand focused on small, albeit somewhat different, sizes of wood. While short coppice rotations of about 10–15 years sufficed for rural domestic usage, for making charcoal, and for most industrial purposes, longer rotations were needed to satisfy urban demand. Sixteenth-century regulations for Paris stipulate that *bois de corde*, the highest-quality firewood, should consist of pieces 3.5 ft long and at least 6 in. thick, which required rotations of 15–25 years. For certain industries requiring especially intense heat, such as glassmaking, rotations of 25–30 years were preferred.[24] By the mid-sixteenth century growing pressures on woodlands led to a new concern with shortages of fuelwood. The best documented conflict pitted urban demand for fuel against that of industry, especially the iron industry. Whereas a first generation of French iron smelting based on blast-furnace technology was located within 100 km or so of Paris and other major cities, such as Rouen or Troyes, by the mid-sixteenth

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[22] BN ms français 4660, partially edited by Longnon, *DCB*, 3: 102–18. Comital income: Henri d'Arbois de Jubainville, *Histoire des ducs et des comtes de Champagne*, 6 vols. (Paris: Durand, 1859–1866) [hereafter = *HDCC*], 4: 803–24.

[23] *Les Olim, ou registres des arrêts rendus par le cour du roi…*, tome 1 (1254–1273) (Paris, 1839), pp. 70–71; André Chedeville, *Chartres et ses campagnes* (*XIe-XIIIe s.*) (Paris: Garnier, 1973), 205–6.

[24] Jean Boissière, "La consommation parisienne de bois et les sidérurgies périphériques," in *Forges et Forêts*: *Recherches sue la consommation proto-industrielle de bois*, ed. Denis Woronoff (Paris, 1990), 29–56, at 29; Buridant, *Espaces forestiers*, 294–95.

century the iron industry had largely retreated to less urbanized regions beyond the Paris basin where the price of wood was lower, such as the Ardennes, Lorraine, northern Burgundy, and western France. By the eighteenth century, even these "peripheral" industrial zones seemed to many Parisian authorities to pose a threat to urban fuel supplies, provoking a series of largely ineffectual royal efforts to regulate how iron mills and other industries met their needs for firewood and charcoal.[25]

17.2 Regulation of Tree Density and Age

A second key element of French woodland management was the reservation of scattered taller trees, or standards (French: *baliveaux*), which were retained for their timber, their mast (acorns and beechnuts), and in order to re-seed the woods. Once again we find evidence of substantial continuity. Early sales contracts, such as those recorded in the Champagne *Book of Sales* discussed above, frequently note the requirement to leave some *bailivaux*, usually specifying 16–25 per arpent, densities similar to those recommended by early modern foresters. These proportions point to the priority placed on small wood, which requires abundant sunlight for the regeneration of shoots after cutting, since coppice-under-standards fares poorly if the canopy shades more than about 25 % of the ground.[26] The emphasis on small wood helps to explain the fact that early contracts that include timber are very rare. The few mentions of specific numbers of trees in the *Book of Sales* appear as afterthoughts of coppicing, usually as a result of windfalls, such as a sale of "fourteen downed oak and beech trees."[27] The coppicing cycle was clearly the primary regulator of thirteenth-century woodland management, with timber as a secondary, albeit valuable by-product.

Systems of coppice under standards were also the norm on the French royal domain, at least by the mid-fourteenth-century, when legislation for the French forestry service, the bureau of *Waters and Forests* (*Eaux et Forêts*), first becomes somewhat detailed. The first royal regulation to mention the retention of baliveaux is an Ordinance of 1376, which requires that foresters retain at least 8–10 *baliveaux* per arpent.[28] It is testimony to the astonishingly repetitive character of royal forest legislation that the article containing the rule about baliveaux is repeated virtually verbatim, including the figure of 8–10 per arpent, almost 150 years later in 1516, in a key ordinance that inaugurated a new period of forest reform.[29] Traditionally

[25] Boissière, op. cit., with map at p. 56.

[26] Longnon, *DCB* 3: 105; 106; Buridant, "Du modèle à la pratique;" Warde, "Fear of Wood Shortage," 36.

[27] Longnon, *DCB* 3: 103; 106.

[28] Isambert et al., *Recueil general des anciennes lois françaises* (Paris, 1822–1833), tome 4, no. 575, pp. 456–71, at p. 462 (article 21).

[29] *Ordonnances des rois de France. Règne de François Ier*, tome 1, 1515–1516 (Paris, 1902), no. 80, pp. 348–81, at p. 360 (article 37).

this kind of repetition was viewed as evidence of scribal conservatism or administrative weakness, or both.[30] I would suggest, however, that it reflects much more the fact of a great, and to administrators often frustrating, stability in practices. The early modern period also saw incremental change: the Forest Ordinance of 1669 stipulates the retention of 16 baliveaux per arpent in coppices-under-standards when the coppice is cut.[31]

Perhaps the most important early modern administrative change, and the one that has long captivated historians' attention, was the claim advanced by the royal government from the mid-sixteenth century onwards that its regulations applied throughout the kingdom. Whereas in the Middle Ages royal forest legislation had applied only to land within the royal domain, from now on it became applicable, albeit at first mostly only in theory, to woodlands owned by religious institutions, village communities, nobles, and other private owners.[32] In terms of silvicultural practice, however, royal legislation remained conservative. Its overriding goals remained focused on the preservation of resources, the flow of revenues to the royal administration, and the maintenance of the king's and others' rights. There was apparently little or no attempt to innovate.[33] A passage from an ordinance of 1346 already summed up this attitude perfectly: "The…Masters of the Forest…should make inquiry and visit all the forests and woods where there are or will be sales, ensuring that the said forests and woods can be perpetually sustained in good condition."[34]

Thus early modern changes consisted of minor adjustments rather than any effort at more fundamental change. By the late sixteenth century the persistent demand for more and better quality timber led to a new requirement that one-third of the surface area of any substantial woodland should be set aside as a *reserve* for timber of at least 40 years of age, where any cutting not authorized by royal foresters was prohibited.[35] This rule was scarcely enforceable, however, and it was only over the seventeenth and eighteenth centuries that such royally-sanctioned timber reserves began to become more common, though with a somewhat more realistic goal of one-fourth of the surface area, as stipulated by Colbert's ordinance of 1669.[36]

Early modern administrators also pushed for longer harvesting cycles on the majority of woodlands that remained coppice-under-standards. Colbert's Ordinance was the first to impose a minimum age for coppice, of 10 years. Gradually over the eighteenth century coppice cycles of 20–25 years became more common, though

[30] Thus a 1987 history of the bureau of *Eaux et Forêts* attributed the remarkable legislative continuity of the entire period from 1315 to 1827, when the first scientifically-based *Code forestière* was issued, to a fundamental lack of both administrative and technical progress: *Les Eaux et Forêts*, 73. See also Devèze, *La vie de la forêt*, 2: 64.

[31] Baudrillart, *Recueil*, 1: 74–75.

[32] Devèze, *Forêt française*, 1: 65–7; 2: 64, 82–93.

[33] Devèze, *La vie de la forêt*, 1: 69.

[34] Isambert, *Recueil*, 4: 523, no. 133, article 4.

[35] Corvol, *L'homme et l'arbre*, 163–84.

[36] Baudrillart, 1: 73–75 (titles 24–25).

this was more likely the result of changing demand than of royal fiat.[37] Both this increase in the duration of the coppice cycle and that of the density of taller trees left standing (noted above) gradually reshaped woodlands towards denser stands of taller trees. This goal was, however, only beginning to be attained in the late eighteenth century. Even then, the basic system of coppice-under-standards persisted without radical change until the later nineteenth century.

17.3 Species Harvested

While seigneurial and royal administrators sought to protect their superior's revenues, this goal remained in tension with the rights they also recognized for local residents to gather wood for their own needs. Most high medieval normative texts on woodlands recognize both usage rights and limits on them. By ca. 1300 these limits included, besides the 5-year or so exclusion from coppices noted above, various limits on what kinds of wood could be gathered. Most texts of this period say little about exploited species, typically limiting firewood collection to "dead wood," but explicitly protecting only oak and beech. What about the living wood of other trees? Scattered charters expand the list of protected species to include not only oak and beech but also wild apple, pear, and other "fruit trees." This seems to reflect a deeply engrained idea of "fruit-bearing trees" that appears throughout the medieval period and became an explicit part of French forest law in the sixteenth century. All these species have edible fruit, whether eaten primarily by people or pigs – though acorns and beechnuts long remained a famine food for people too.[38] Some high-medieval regulations also identified certain less valuable species as being fully accessible for local usage – these were confusingly called *mort-bois*. Although lists of these unprotected species varied, a royal act of 1315 concerning the forests of Normandy defined them as including such small trees and shrubs as willow, alder, juniper, and bramble.[39] These two categories left plenty of room for contestation

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[37] Baudrillart, 1: 73–75 (titles 24–25), though this norm too can be found earlier at a local level: see ibid, 1: 18 (1582, concerning Pressigny in the Bailliage of Chaumont); Corvol, *L'homme et l'arbre*, pp. 131–54.

[38] Theodore Evergates, ed., *Littere Baronum*: *The Earliest Cartulary of the Counts of Champagne* (Toronto, 2003), 73 (1165); 80 (1165); Baldwin, *Registres*, 1: 86 (1212); Jean Rauzier, *Finances et gestion d'une principauté au XIVe siècle. Le duché de Bourgogne de Philippe le Hardi* (*1364–1384*) (Paris, 1996), 259; Rubner, *Forstverfassung*, 44–5; Chédeville, *Chartres*, 204; Devèze, *Forêt française*, 83–4. On wild apple (*Malus sylvestris*) and pear (*Pyrus* spp.), see Rameau, *Flore forestière*, 502–3, 550–3. On human consumption, see: Marie-Pierre Ruas, "Éléments pour une histoire de la fructiculture en France: Données archéobotaniques de l'Antiquité au XVIIe siècle," in *L'homme et la nature au Moyen Âge*, 92–105.

[39] Jourdan, Decrusy, and Isambert, eds., *Recueil général des anciennes lois françaises depuis l'an 420 jusqu'à la révolution de 1789*, 29 vols. (Paris, 1821–1833; reprint Ridgewood, NJ, 1964–1966), 3: 108–9 (1315), paragraph 9. On these species, see Rameau, *Flore forestière*: 618–41: saulx, marsaulx = willow (*Salix spp*.); aulne = alder (*Alnus glutinosa*); 606–15: genévrier = juniper (*Juniperus communis*); 606–16: ronce = blackberry and raspberry bramble (*Rubus spp*.). For earlier lists, see: Chédeville, *Chartres*, 204; Bur, "Forêt du Mans," 104.

over species of intermediate value, including poplar, birch, ash, and maple, which later customs sometimes call "white wood" (*blanc-bois*).[40] Usage rights thus became subject to a graduated series of restrictions, ranging from full access to dead wood and certain, especially shrubby species, varying controls over intermediate species, and strict limits on oak, beech, and other "fruit" trees. Early modern sources reveal continued conflict over what exactly constituted mort-bois and other categories of wood that was accessible, or inaccessible for local usage.

17.4 Persistence of Use Rights

Royal ordinances of 1376, 1516, and many later years reiterated strict-sounding rules that local residents had to furnish written proof of their usage rights. But many texts also mention that evidence that rights had been held for at least 40 years would grant these rights protection. Even after the attempt to devise a more coherent and more timber-oriented policy with the Forest Ordinance of 1669, concrete changes in management practices were minimal. This effort at standardization and control, notwithstanding its centralizing ambition, was based squarely on traditional practices.[41] Thus its Title 20 on "Chauffages et autres usages de bois," begins with the seemingly draconian revocation of all rights to firewood in the royal forests. But then it goes on to exempt those who held such rights before 1560 as well as those who hold such rights in return for the (standard) customary payments. Conflict about such rights persisted right into the nineteenth century and the rise of scientific management, and it was only then, even as the need for wood began to diminish, that state control finally triumphed.

17.5 Conclusion and Perspectives for Research

This essay has presented a modest amount of evidence of medieval woodland management, and it has pointed towards the enduring character of medieval practices largely by reference to the indirect testimony of norms and regulations. Certainly more research is needed to support the arguments for continuity made here. Perhaps the highest priority for any exploration of this question is to conduct more research, using both documentary and archeological sources, into the history of specific, well-localized woodlands over the long term, of the kind that Oliver Rackham and

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[40] An ordonnance of 1376 excluded these species from *mort-bois*: Jourdan, *Recueil général des anciennes lois*, 4: 467–9, paragraphs 40, 47. See: Devèze, *La vie de la forêt*, 84; Rameau, *Flore forestière*, 358–71: erable = maple (*Acer spp.*); 392–5: bouleau = birch (*Betula spp.*); 460–1: frêne = ash (*Fraxinus excelsior*); 511–34: tremble = poplar (*Populus tremula*).

[41] Whited, *Forests and Peasant Politics*, 21–6.

Peter Szabo have been able to do for, respectively, England and Hungary.[42] But for now, this essay has adduced enough evidence to suggest that the basic patterns of woodland management found already in the thirteenth century were both productive and highly sustainable, even in a part of the world that made increasing demands on wood—primarily for fuel but also for other purposes—across more than half a millennium.

This impressive level of sustainability merits wider recognition by scholars and the public. A long line of European historians going back at least to Marc Bloch helped to raise awareness of the remarkable longevity of traditional agrarian practices, especially where communal management or common rights were involved.[43] More recently many agricultural historians have revised earlier assessments that equated tradition with low output and immobility, finding instead that preindustrial agriculture was often both productive and adaptable.[44] The evidence presented in this essay lends support to the emerging view that preindustrial woodland management should be seen in a similarly positive way.

One obstacle to a wider appreciation of this emergent view is, not surprisingly, the fact that traditional woodland management, together with most other communal agrarian practices, slowly withered across a "long" nineteenth century through a combination of state fiat, technological change, capitalist development, and new intellectual fashions that cast them as outmoded and backward peasant customs. Remnants of these earlier practices nevertheless survived in some places, especially in ecologically challenging contexts like alpine valleys. Social scientists such as Elinor Ostrom have recently re-discovered the impressive sustainability of what she terms the "common property regimes" by which such communities managed many of their resources.[45] Surprisingly, however, she makes no reference to Bloch or to the many other European historians who have studied pre-industrial commons or common rights systems of less marginal areas.[46] Nonetheless, Ostrom's well-received elaboration of a globally-applicable social-scientific model that explains not only the internal coherence of communal agrarian practices, but also their adaptability, bodes well for a broader reappraisal of traditional French and European woodland management.

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[42] Rackham, *Ancient Woodland*; Peter Szabo, *Woodland and Forests in Medieval Hungary* (British Archeological Reports, International Series, vol. 1348) (Oxford: Archaeopress, 2005).

[43] Bloch, *French Rural History*.

[44] See for example: Janet Neeson, *Commoners*: *Common Right*, *Enclosure and Social Change in England*, *1700–1820* (New York: Cambridge University Press, 1993); Philip Hoffman, *Growth in a Traditional Society*: *The French Countryside*, *1450–1815* (Princeton: Princeton University Press, 1996); and Bruce Campbell, *English Seigniorial Agriculture*, *1250–1450* (New York: Cambridge University Press, 2000).

[45] Elinor Ostrom, *Governing the Commons*: *the Evolution of Institutions for Collective Action* (New York: Cambridge University Press, 1990).

[46] A point that was impressed on me by Emmanuel Huertas, professor of medieval history at the Université de Toulouse, on the occasion of the *École d'été d'histoire rurale à l'abbaye de Flaran*, June, 2012.

It should be noted, however, that the traditional management practices that I have discussed in this essay were not implemented in relatively isolated or autonomous rural communities of the kind that Ostrom discusses in the most detail.[47] In the lowlands of Northern France, as elsewhere across the plains and low hills of northern and continental Europe, local communities were anything but isolated. Instead, they were shaped by several levels of lordship, frequent warfare, emergent regional and national states, growing local and international markets, and incipient industrialization. Perhaps most importantly, the traditional woodland management I have described was by no means an exclusively peasant affair. It is true that without any significant learned discourse pertaining to woodland management before the late sixteenth century, the silvicultural know-how that these practices required must have been in the hands of non-elite rural people. But the elaboration of the rules that governed these practices, not to mention their enforcement, owed as much or more to lords and rulers as to peasants. Most northern French woodlands were "common property" only in part; they were also subject to multiple, often conflicting claims to rights of property and of lordly or "public" oversight. It may have been precisely the multiplicity of claims on woodlands that kept the demands of each party—whether individual user, peasant community, lord, or entrepreneur—in check. Mediating these claims were customary legal systems whose capacity to preserve resources merits renewed attention, even if their role in perpetuating high levels of inequality must also be recognized.[48] Among the promising avenues for future research that these comments might suggest is investigation into how regional contrasts, not only in economy and population, but also in law, lordship, and governance, affected the long-term persistence of woodlands.

[47] Though her recognition that many local common property regimes are "nested" within regional and larger-scale ones certainly would allow her model to accommodate preindustrial European commons.

[48] See for example: Peter Ørebech et al., eds., *The Role of Customary Law in Sustainable Development* (New York: Cambridge University Press, 2005); and, with a focus on European woodlands, Joachim Radkau, "Germany as a Focus of European 'Particularities' in Environmental History," in *Germany's Nature: Cultural Landscapes and Environmental History*, ed. Thomas Lekan and Thomas Zeller (New Brunswick: Rutgers University Press, 2005), 17–32.

Chapter 18
Firewood and Charcoal Consumption in Madrid during Eighteenth Century and Its Effects on Forest Landscapes

Javier Hernando Ortego and Gonzalo Madrazo García de Lomana

Abstract The fuelling system of Early Modern Madrid was dominated by the charcoal, since neither coal nor peat were available for urban consumption. According to our estimations, the total fuel-wood consumed in the city increased from c. 170.000 t to 200.000 t between 1750 to 1800, so it was necessary a forest surface of about 117.000 - 138.000 ha in order to produce such amount of firewood.

To understand the effects of Madrid's fuel consumption on surrounding forests, we make a distintion between the different charcoal supply areas, taking into account on the one hand the different natural characteristics, and on the other hand the features related with social and economic structures in rural areas.

To conclude, we highlight how this way of exploitation is visible in today`s forest landscapes, taking into account that charcoaling has been a continuous activity until mid-twenty century. Nonetheless, the production of the fuel consumed in Madrid was, in general terms, a sustainable activity. The strongest evidence for this affirmation is that for centuries charcoal came from the same areas and, as Madrid's population increased, charcoal began to be produced in areas further away in an extensive process.

18.1 Introduction

The aim of this work is to analyse the urban energy consumption in a solar regime and its impact in land use. The exclusive use of materials such as firewood and charcoal to provide fuel for urban inhabitants allows us to analyze the impact on the evolution of forest landscapes. Our case study is the city of Madrid in Early Modern

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period, when the provision of energy was made in the context of an organic economy.

This paper, therefore, is framed within the History of Energy, one of the fields of Environmental History that is experiencing rapid growth in both its theoretical and methodological contributions and its application in the study of specific cases. Recent researches in this area have developed new perspectives and approaches to energy regimes or energy transitions through History of mankind (Kander et al. 2013).

The theoretical and methodological framework of this work is Social Metabolism, in which is central the analysis of the relationship between different social metabolisms in History and its land use. In this sense, the study of material and energy flows is fundamental to understanding the dynamics of exchange between society and environment (González de Molina and Toledo 2014). Urban metabolism in particular allows us to undertake innovative studies on interactions between rural and urban areas (Hoffmann 2006). Of the different methodological approaches, we focused on the urban environmental imprint, recently proposed in order to analyse the relationship between a city and the hinterland from which it obtains materials and energy in exchange for certain services (Billen et al. 2012). The study of energy imprint, on the other hand, is centred around the supply of energy and its imprint on the land (Kim and Barles 2012).

In this work we have adopted an interdisciplinary approach between the methods and objectives of two disciplines such as Economic History and Geography to obtain a more comprehensive approach to understand of interactions of urban supply of energy and the impact in the evolution of forest landscapes. In this sense we have carried out a complete review of the historical sources about the supply of fuel to Madrid, which has allowed us to obtain quantitative data mapping in detail the processes analyzed. Reconstructing the detailed composition of the forms of energy used has enabled to specify the volume and net caloric values in standard terms for international comparisons.[1] Another contribution is the integration of social and environmental perspectives. From a social approach, we analyze the values of fuel consumption in Madrid as a mean to study living standards in the city, as well as the impact in rural population living in the supply area and the ways this process affected their property rights and management of common resources or the new opportunities of economic activities such as production or transportation of charcoal (Bernardos et al. 2011; Nieto 2010). From an ecological perspective, the analysis of energy imprint lets discuss some important issues, as the changes in forest landscapes or the role of fuel production in the process of deforestation in organic metabolism. Finally, the long-term perspective and comparison with existing forest landscapes can assess the sustainability of forestry exploitation.

We have structured this article in four parts. Firstly, we will characterise the energy system in force in the eighteenth century, analysing the composition and consumption of energy, supply management and the importance and limitations of

[1] Energy Statistics. 1987. *Definitions, units of measure and conversion factors*. New York: United Nations. http://unstats.un.org/unsd/publication/SeriesF/SeriesF_44E.pdf. Accessed 06 June 2014.

the transportation system. Secondly, we will study the forestry policy developed since Madrid was establish as capital in 1561 and the influence of government in the modification of resources from communal forest. We will focus then on the energy imprint of this system, with calculations of the land area necessary to provide fuel to urban supply. Finally, we study the effects on forest landscapes, with a detailed presentation of the predominant species and forest formations and the features of the different areas that supplied charcoal and firewood to Madrid.

18.2 Consumption Levels and Patterns

The energy system of Early Modern Madrid was overwhelmingly solar. Fuel came exclusively from biomass in the form of charcoal and firewood, since neither coal nor peat were available for urban consumption. Attempts to locate fossil fuels in the vicinity of the city found out the evidence of the remoteness of the coalmines (at a distance always greater than 350 km), implying unaffordable transport costs in an inland city. The beginning of the transition to a fossil regimen had to wait until the mid-nineteenth century, with the appearance of a railway transport system and the integration of the national market.

The consumption patterns for the city are determined by the climatological circumstances since the inland areas of the Iberian Peninsula suffer from cold and long-lasting winters. In second place, a key determinant of consumption in Early Modern Madrid was the absolute predominance of domestic uses for cooking and heating (above 90 % of total demand), while the manufacture sector had a very secondary importance. Finally, we should also take note of the extreme social inequality that existed in terms of energy consumption, with distribution systems and prices that were more favourable to the privileged classes (Bernardos et al. 2011).

The fuel consumed in Madrid was predominantly made up of firewood and, in particular, charcoal, which provided more than 80–85 % of heat energy. Wood was complemented with a wide range of organic materials that could generate heat, such as straw (more than 20,000 t a year were consumed in the city) and dry dung (sometimes mixed with straw), as well as olive stones and animal waste. Although difficult to quantify, they had a relative importance for some economic and social sectors, which increased in times of scarcity of charcoal. Dung, for instance, was regularly used in several manufacture processes, while straw and dung were essential for the survival of large sections of the population that had little or no access to more valuable fuels.

Focusing on charcoal and firewood, we have traced the evolution of its consumption in the second half of the eighteenth century in Table 18.1, selecting the values of 3 years for which we have comparable information (1761, 1780 and 1800). Charcoal was the key component in Madrid's energy system: the amount consumed grew from 30,000 to 37,000 t, almost in parallel evolution with the population in this period. The firewood needed for its production (we have consider a proportion of 5 to 1) increased from 160,000 t to almost 190,000 t, a volume which was 12

Table 18.1 Charcoal and firewood consumption in Madrid, 1761–1800: volume

Year	Inhabitants	Charcoal (tonnes)		Firewood (tonnes)	Total firewood	
		Tonnes	Firewood equiv.		Tonnes	Kg/cap/day
1761	150.000	31.718	158.588	13.000	171.589	3.1
1780	160.000	32.365	161.826	13.800	175.626	3
1800	185.000	37.535	187.677	16.000	203.677	3

Table 18.2 Fuel consumption in Madrid, 1761–1800: net calorific value

Year	Charcoal (GJ)	Firewood (GJ)	Total (GJ)	GJ/cap/year	KCal/cap/day
1761	976.914	208.000	1.184.914	7.9	5.167
1780	996.842	220.800	1.217.642	7.6	4.980
1800	1.156.078	256.000	1.412.078	7.6	4.994

times higher than the firewood consumed directly. This firewood (around 15,000 t a year) came from the immediate surroundings of the city, within a 20 km radius; half of them were obtained from shrubs and bushes which generally speaking had little energy value. Although the total weight of firewood used was half that of charcoal, its energy contribution did not even reach 15 % (Bernardos et al. 2011).

The per capita consumption represents relatively high figures of almost 3 kg of firewood/person/year, or 1 tonne per person per year, a value that we have to consider as a minimum since it would be enhanced taking into account other fuels as straw or dry dung that were consumed permanently in the city. These figures stand out when compared with the fuel consumption in pre-industrial Europe, since they are close to the levels of Paris (Boissère 1990; Kim and Barles 2012) or the south of Germany and are triple the estimates for the Mediterranean (Warde 2006). They are, however, similar to the figures obtained for Piedmont, which has a relatively similar climate (Malanima 1996).

If we focus on the Net Calorific Value we find a somewhat different scene (Table 18.2). The elevated levels of consumption in terms of firewood volumes are mainly due to the great relative weight of charcoal, whose production entails a considerable loss of thermic efficiency of around 54 % compared to the direct use of firewood. Considering that charcoal provided for about 82 % of the total fuel from wood, we find that the actual availability of heat energy was lower than volume figures suggest. In Madrid, net energy from charcoal was 4–5 times higher than that of firewood (while required 12 times more volume). The net calorific value per inhabitant was therefore reduced to 8 Gigajoules per year, or about 5.200 kcal per capita per day, an amount which was 75 % above the minimum established for pre-industrial Europe (Malanima 2006; Kander et al. 2013).

The importance of charcoal to Madrid's energy consumption thus required a more extensive surface to obtain the same heat value than in energy systems focused mainly in firewood, which implied a higher impact on the territory (energy imprint). The main reason for this overwhelming role of charcoal was then economic, the reduction of transport costs, which was parallel to its reduction in volume. But we must consider other factors, since charcoal had also advantages from its easy adaptation to urban living conditions. It could be used to distribute heat without smoke through the rooms. In addition to this, we can add the growing number of the population living in homes without chimneys, where they would cook and heat their dwellings with portable ovens and braziers. Finally, the fact that firewood burned in fireplaces means a noticeable loss of heat due to dispersion and this is not the case for charcoal. This higher energy efficiency when used indoors would force us to refine estimates of the availability of the Net Caloric Value and the living conditions of the population.

The volume of charcoal needed for urban supply and the long distances travelled required a complex transport system. Madrid depended solely on the transportation of fuel (and the rest of commodities) via land due to the lack of navigable routes, an exception between the great preindustrial cities of Europe. This structural limitation was overcome with the intervention of authorities, which organised a transport system based on professional transport providers with carts driven by oxen (between 30,000 and 35,000 carts arrive in the city each year), and peasants with mules from areas of production. The availability of transport was then guaranteed, but with elevated costs, impacting on the real prices of fuel in Madrid. In the case of charcoal, transport costs made up half the final price, and in years of agrarian crisis this rose to 60 %, while for firewood, on the other hand, they accounted for around 16 % of the selling price. The sale price was a political one that was fixed and subsidised by the government. As a result, at times it failed to cover actual transport costs. Moreover, this mode of transport had an important economic impact, including the drawn-out process of pulling together the peninsula's internal market and encouraging the diversification of activities in rural communities.[2]

The management of the supply of fuel to the city was controlled directly by the State. As a basic necessity, its scarcity could create public order problems in the vicinity of the Court. State intervention sought, firstly, to control the offer conditions of fuel through a forestry policy to guarantee charcoal production in forest and woodland areas, and besides the development of a supply system to ensure that fuel reached the urban consumer by means the concession of legal privileges and price regulation. Private management was the solution adopted from 1561 onwards. The supply of charcoal was regulated by a contract between a company of private businessmen ("*obligados*" or fuel suppliers) and local government. The fuel suppliers were committed to guaranteeing the supply of charcoal according to the quantities, prices and deadlines established by the authorities. In exchange for this, they would enjoy important privileges that would allow them access to wood, fuel and transportation with favourable conditions (Bravo 1993; Bernardos 2004).

The fuel-supplier system was replaced by direct government administration from 1753 onwards as part of a policy that was increasingly interventionist in the supply

[2] Detailed references on historical documentation appear in Bernardos et al. 2011.

of consumer staples to Madrid. On the other hand, private management came across increased difficulties due to a rise in demand linked to the city's demographic growth during the decade of 1740. The state management of the charcoal supply to Madrid lasted until 1806. The public officers were responsible during this period for overseeing the entire process of production and distribution of fuel as well as to set consumer prices.

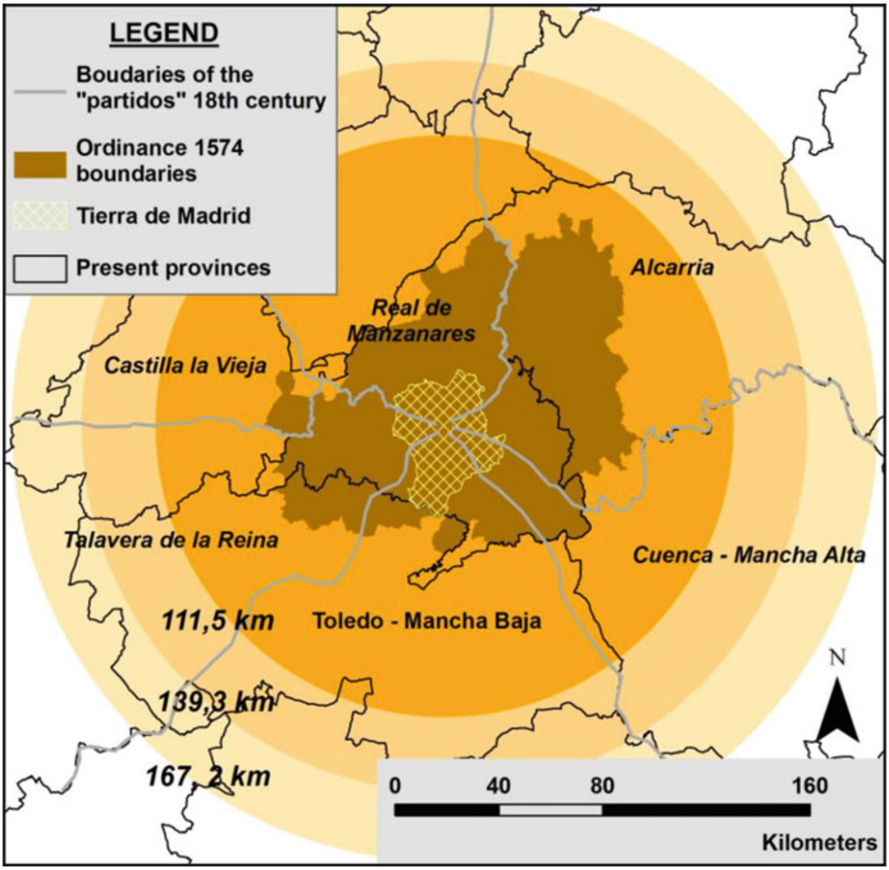
18.3 Forestry Policy and the Commodification of the Forest

Before it was established as the capital in 1561, Madrid was a modest urban centre of around 15,000 inhabitants which obtained its fuel from a hinterland that was relatively nearby: firewood came from the "dehesas" and groves on the banks of the Jarama and Manzanares rivers, while the mountainous area (Sierra de Guadarrama) provided firewood and charcoal.

In the second half of the sixteenth century, the sudden increase in the city's population disrupted the traditional supply mechanisms in place. State intervention aimed to bring in a forestry policy to guarantee the supply of firewood and charcoal to Madrid. Its first component was the regulation of the methods and techniques of exploitation of woodlands in order to protect the existing forest and promote the planting of new ones. This policy also established the demarcation of territory allocated for urban consumption requirements that was under the jurisdictional control of the state officers (Hernando 2010).

The *Instrucción de 1574* (or "Order of 1574") was the first step towards defining this forestry policy. The new duties of Guarda Mayor ("Main Keeper") and Juez Conservador ("Conservation Judge") of the forest and woodland areas surrounding Madrid were created, covering an area of over 15,000 km^2 in size. From this moment, the land that provided fuel became regulated and controlled by the State instead of by the municipality. Another key aspect of this rule was the technical regulation of forest exploitation, which was applied to the two forest structures that were responsible for the supply of charcoal to Madrid: "*monte alto*" (*dehesas*, savannahs) of holm oaks and "*monte bajo*" (coppice forests). This was the first legal measure of general scope that included the term "*monte bajo*". In the case of coppice forest it stated that oaks would be cut down every 12 years and holm oaks, every 17 years. This measure was clearly designed to promote silvicultural practices that resulted in the charcoal specialization of the forest, linked to urban supply throughout Europe.

Despite the limited application of the *Instrucción de 1574*, the institutional mechanisms that it had established for the supply of fuel to Madrid remained. In 1620, however, the area set aside for Madrid's charcoal supply was extended to a radius of 111.5 km in size, more than doubling the area allocated in 1574 (39,057 km^2). This significant increase in land allocation responded to the sudden increase in the population of Madrid at the time (140,000 inhabitants at the beginning of the seventeenth century) (Map 18.1).



Map 18.1 Administrative evolution of the charcoal supply area of Madrid

New legal measures which had the objective to protect the forest were approved, such as the *Ordenanza forestal de 1670* (or the "1670 Forestry Ordinance") and the better-known *Ordenanza de Montes y Plantíos de 1748* (or "1748 Woodland and Plantation Ordinance"). Of the content of these ordinances, of particular interest to us are the logging periods of coppice forests, which were set aside for the manufacture of charcoal. In 1670, time felling was reduced: in the case of oaks it was establish in 10 years and for holm oaks in 15, whilst in 1748, it was decided that the latter would be cut down every 10 years. The aim to increase the productivity of forest areas stood in direct contrast with other protection measures set in these ordinances. Although the sustainability of forest areas may have been placed in risk, the continuity of the traditional logging periods limited its possible negative impact.

The implementation of the 1748 Ordinance coincided with the state management of the charcoal supply from 1753 onwards. Both measures responded to the growing difficulties that were arising in the fuel supply. The initial area to which the 1748 Ordinance was applied was initially 111 km, but again the growth of the urban population and the demand for fuel led the authorities to continue extending the area, widening the woodland allocated for supplying fuel firstly to 140 km and then to 167 km (Hernando 2013). These boundaries, as we shall see, were overcome again several times at the end of the eighteenth century.

Another major objective of state intervention was to promote the commercialisation of forest and woodland areas. The increasing urban demand for firewood and charcoal required a parallel increase in offer (Allen 2003; Warde 2005). Market incentives affected both private forest owners also rural communities. In the case of private proprietors (mainly members of nobility and ecclesiastics) prices paid for fuelwood were an adequate reason, because they could integrate them with the livestock exploitation in their "*dehesas*". But the majority of the charcoal consumed in Madrid came from common forests. Local councils, the entities responsible for the management of commons in Castile, could obtain significant incomes for local needs. If this were not enough, the central administration had a way to overcome such resistance and to achieve its goal of imposing the commercialization of charcoal, the fiscal burden. The increasing demand for new taxes from the government in Early Modern Spain drove many councils to commercialize resources from commons, like firewood or charcoal in order to obtain the funds that allowed to moderate the impact of tax burdens in the members of local community.

Sale of forest resources from commons provoked two mayor problems to villages in the peninsular centre. The first difficulty was the possibility of causing restrictions in the availability of fuel for self-provision of the local commoners. The main restriction of charcoal production was that it could affect the productive resources obtained, since the practice of livestock exploitation in the forest was a fundamental way of obtaining resources for peasants communities (Warde 2006).

The creation of coppice forests was one of the solutions of this dilemma. The result was an intensification of the production of firewood but at the cost of limiting livestock activities. Felling times, fixed between 10 and 20 years, required to ban the access of cattle, with differences according livestock species.

Coppice forests developed in the centre of Spain during Early Modern Age as a result of supply of fuel to Madrid. In the second half of eighteen century, charcoal obtained from coppice was predominant (about 55 % of total consumption) relative to that obtained in savannah or other types of woodlands. Even more significant is the spatial distribution, as the coppice forest prevailed in certain areas where charcoal was obtained mainly from common lands, as the *Alcarria* and the Sierra de Guadarrama. These rural communities thus adopted the strategy of increasing the production of energy. In order to reconcile the "charcoal specialization" of the forest with the availability of other resources necessary for their survival, such as fuel or pasture, communities could choose between two possible strategies. The first consisted in the differentiation of woodlands, in villages that marked a forest area as coppice, and so closed to the access of cattle, and other zone was a savannah, in which livestock uses were predominant. The requirement for this was to dispose of a wide woodland surface within the municipal term that could reconcile the different interests of the community. This was the case of the mountainous area of the Sierra de Guadarrama. A second option was the exclusive orientation of common forests to the production of charcoal through coppice, while neighbours resorted to other common lands to obtain alternative pastures and harvesting firewood from shrubs or small tree formations scattered throughout the municipal term. This was the most frequent situation in *Alcarria*, where e low population density allowed a relative abundance of uncultivated land.

18.4 Energy Imprint of Madrid

Now that we have established how fuel supply was organised and the quantities and kinds of fuel that were consumed in Madrid in the eighteenth century, in what follows we will focus on the city's energy imprint.[3] How many hectares of woodland and forests were needed to meet the city's energy requirements? How far was it necessary to go to obtain charcoal? Definitely, How was the Madrid's energy imprint on the surroundings?

We cannot forget, however, that a small percentage of the fuel used in Madrid came from non-forest areas, but in our analysis of energy imprint we will focus on the forest areas that were the main surfaces providers of energy.

Due to Madrid's rising population, journeys to fetch charcoal got longer as the eighteenth century went on. The average distances and the maximum trips from the woodlands and forests to bring charcoal to Madrid demonstrated this progressive change. For a few years, particularly at the end of this century, the average distance was over 100 km, with the furthest woodlands over 200 km away (Table 18.3).

Table 18.3 Distances of the forest for charcoal supply of Madrid. 1725–1803

	1725	1762–1764	1767	1794–1795	1803–1804
Average distance (km)	93.3	103		88.6	107.6
More distant forest (km)	200	225	183	210	210
Weighted average distance (km)	109.5	104.4		122.5	101.6
Ten more distant forests – average (km)	160	182.3	173	174	181.2
Ten more distant forests – prod (kg)	3.244.714	5.543.964	3.289.572	6.209.528	946.399
10 more distant forests – prod./tot. supply	*16.2%*	*9.3%*	*16.3%*	*27.6%*	*10.0%*

[3] To reach this goal the available documentation has allowed us to locate a total of 710 woodlands and forests from which charcoal was brought to Madrid. This information corresponds to a series of years from 1725 to 1804.

If we consider the distance of the forest and woodland areas from Madrid in terms of the charcoal produced, we discover that this clearly exceeds the average distance every year, and some years this gap is especially notorious (more than 30 km in 1794–1795). In addition, this average distance does indeed increase throughout the century: from 109 km in 1725 to 122 km in 1794.

Another important piece of supplementary data is that the average distance of the ten woodland areas furthest away from the court grows as the century progresses, going from 160 km in 1725 to 181 km in 1803. And these ten areas also provide the city with a significant amount of charcoal (27.6 % of the fuel consumed in 1794, for example).

This demonstrates that the boundaries of the land allocated for charcoal supply to Madrid seemed to have been well-known and stable throughout the eighteenth century, although years later forests and woodland areas that were particularly far away were included. It seems clear that these areas became essential in order to ensure fuel supply.

By making the necessary calculations, we have estimated the surface area of woodland required by Madrid every year. This figure is calculated by simplifying the variety of forestry resources providing Madrid with charcoal, and taking into account the different productivity of *dehesas* and coppices. Identifying figures on the productivity of forest and woodland areas is difficult because of the great variations in growth depending on the type of woodland in question, its location and its management.[4] Our results shows that the energy imprint required to supply Madrid increased from 119,625 ha in the mid eighteenth century to 137,750 ha by the end of the century (Fig. 18.1). These figures means a consumption of 0,77 ha per person per year.

18.5 Effects on Forest Landscapes

18.5.1 Species and Forest Formations

Now if we ask ourselves about the forest areas that were affected by this imprint, we should firstly take into account what species of trees and what kind of forest formation were used to make charcoal. The first evidence is that, without a doubt, the

[4] We have used information from the eighteenth and nineteenth centuries alongside present-day calculations on the production of firewood in the woodlands and forests of the central peninsula. In this way, a distinction should be made between the productivity of the coppice forests, whose firewood productivity has been estimated at around 2000 kg/ha/year (González de la Peña 1874), as opposed to that of *dehesas*, which is only 1000 kg/ha/year (Serrada and San Miguel-Ayanz 2008). Obviously, this forest productivity is significantly lower than the estimations of 4 m^3/ha/year in Germany or England, or 2.8–3.8 m^3 in France or 2–4 m^3 in the south of Germany (Warde 2006).

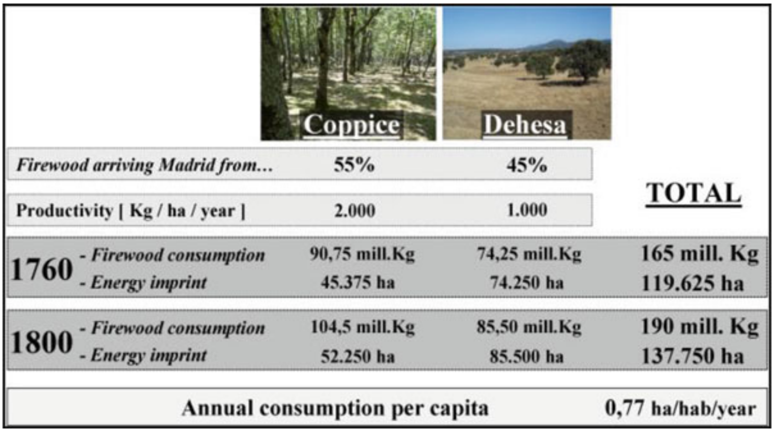


Fig. 18.1 Madrid energy imprint. Eighteenth century

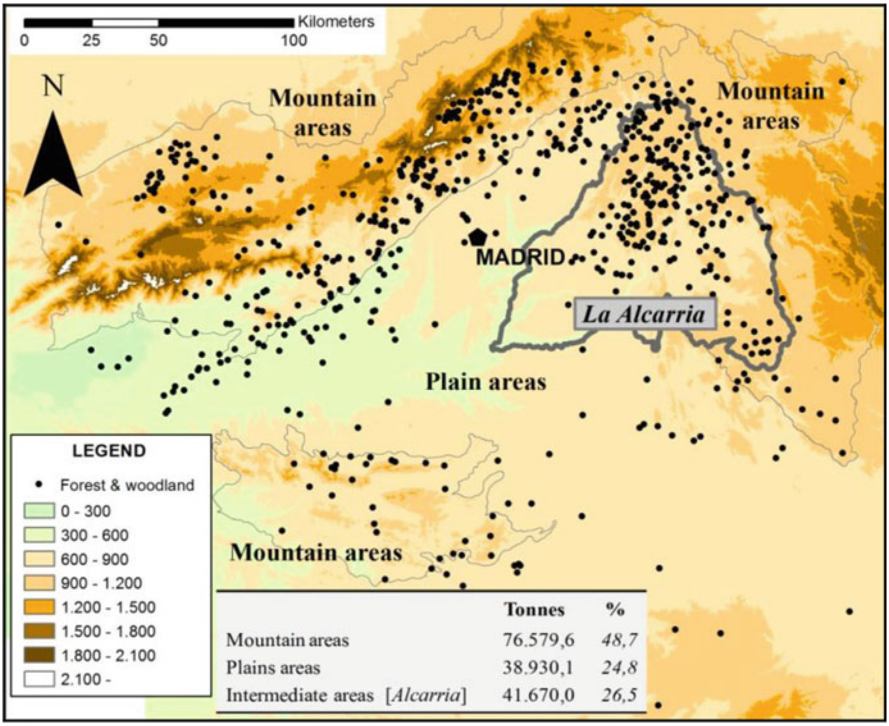
supply of charcoal to Madrid had a significant impact on various types of forest landscape. We should bear in mind, on the one hand, the various climatic conditions at large in the centre of the peninsular that condition the distribution of tree species and their productivity. One the other hand, we should also take into account the different kinds of land and its exploitation, which has led to the shaping of very different forest landscapes. Each area of woodland was developed in a different way depending on the kind of production that was given priority (firewood, wood, pastures, etc.), shaping the forest accordingly (López Estébanez et al. 2013). The supply of fuel to Madrid meant that the production of firewood took precedence at the cost of other uses of the forest.

If we focus on the forest species, there is a clear preference for holm oak (*Q. ilex*) over other forest species when making charcoal, representing almost 70 % carried to Madrid. This is followed by oak (*Q. pyrenaica*) and a mixture of the two. Portuguese-oak (*Q. faginea*) or Ash (*F. angustifolia*) only represents a paltry 1,5 % of the charcoal produced, whilst other species such as wild olive or pine are anecdotal. Of course, this preference for *Quercus* species, which is around 99 %, is because they are very hard, and shrink less during the charcoal conversion process. And it is also easy to manage these species as coppice stands, specialised in the production of firewood (Table 18.4).

The origins of the charcoal that came to Madrid shapes a ring around the city on the map which begins at around 30 km and extends to 150 km away. This distribution recalls von Thünen's location model, which sketches this second ring for the woodlands that produced energy, beyond intensive agriculture. Looking at the data, the highland areas amass around 50 % of woodlands and also 50 % of the total volume of charcoal sent to Madrid. However, it is surprising that around one quarter of

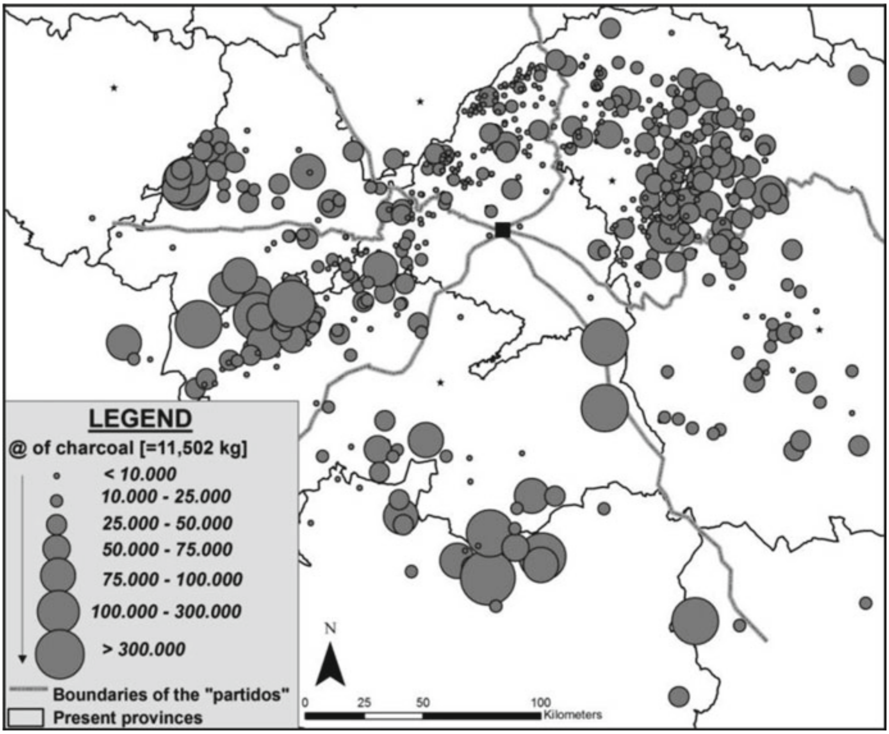
Table 18.4 Species and forest structure of the charcoal arrived to Madrid

Holm oak (*Quercus ilex*)	69.2 %	Coppice forest	51.9 %
Holm oak and Oak (*Q. ilex* and *Q. pyrenaica*)	16.3 %	*Dehesa*	41.7 %
Oak (*Quercus pyrenaica*)	13.0 %	High forest	2.1 %
Ash (*Fraxinus angustifolia*) mixed with *Quercus*	1.4 %	Mixed Coppice and Dehesa	3.3 %
Portuguese oak (*Quercus faginea*)	0.1 %	Fences and meadoes	1.0 %
Other mixed formations: *Olea europaeans*. *Pinus* sp.	0.02 %		



Map 18.2 Charcoal origins for the supply of Madrid, eighteenth century

the charcoal came from plains. It is also worth mentioning the important contributions from *La Alcarria*, an area to the east of the city, which can be consider like an intermediate area (Map 18.2). In addition, as we said before, another territorial pattern of the effects of the fuel supply of Madrid is the relationship between the more distant places where the charcoal is brought and the increasing volume participation of these areas (Map 18.3).



Map 18.3 Charcoal from each place for the supply of Madrid, eighteenth century

18.5.2 Landscapes Effects in the Peninsula Centre of Charcoal Making to Supply Madrid

Beyond this initial differentiation, to understand how supplying fuel to Madrid affected the forestry resources in the Peninsula centre, we have divided the Madrid surroundings into uniform forestry landscape areas,[5] which allow us to understand better the concrete landscape effects of the charcoal making for Madrid (Table 18.5 and Map 18.4).

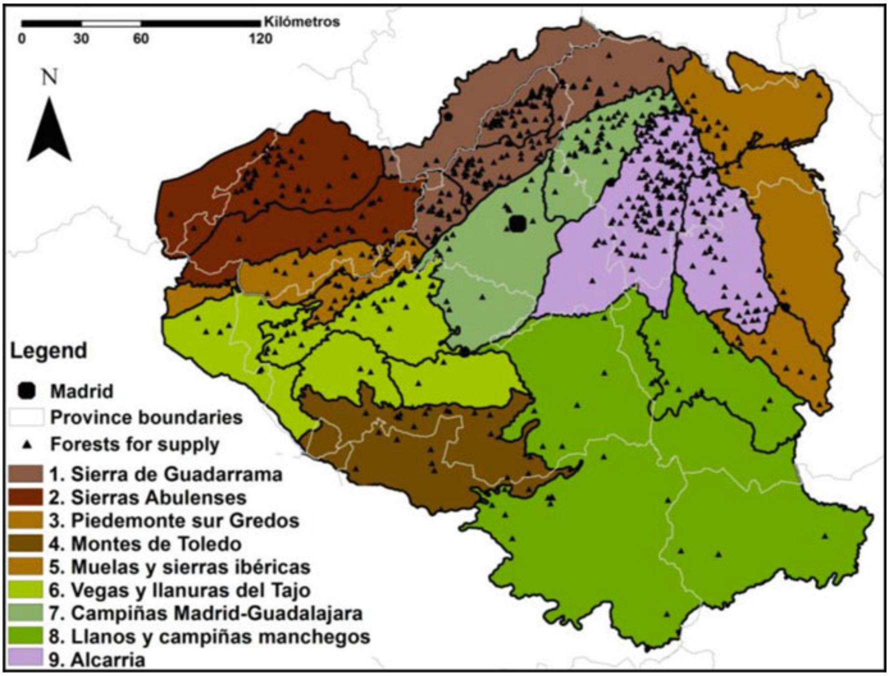
Starting with these forest areas that surround Madrid, the charcoal from the Guadarrama range reflects a unique forestry situation. Firstly, because the villages on the southern slopes of the Guadarrama Range make a significant contribution to the Court's energy supply, in addition to being the oldest area supplying Madrid. A quarter of the woodlands, that we located, belong to this area, although the total amount of charcoal taken to Madrid did not top 12 % of the city's total consumption, which indicates that they were small pieces of forest.

[5] To form these landscape units we have used previous works, fundamentally Mata and Sanz (2004).

Table 18.5 Characteristics of the forests that supply Madrid. Eighteenth century

			Owner-ship		Forest species					Forest formation				
	Charcoal Kg. %	N° of forests %	Private %	Public %	Holm oak	Oak	Quercus mixed	Ash	Others	Fences and meadoes	High forest	Coppice forest	Coppice and Dehesa	*Dehesas*
1. *Guadarrama* Range	12.3	25.8	24.3	75.7	45	47	5	4	–	25	–	75	–	–
2. *Ávila* Ranges	11.8	8.7	58.4	41.6	94	6	–	–	–	–	–	3	–	96
3. South Gredos Range	10.4	6.2	21.1	78.9	78	22	–	–	–	–	13	–	–	87
4. *Montes de Toledo*	7.7	3.8	90.4	9.6	54	31	15	–	–	–	–	–	40	60
5. Iberian ranges	6.5	5.6	–	100	68	32	–	–	–	–	–	84	–	16
Mountain areas	*48.7*	*50.1*	–	–	–	–	–	–	–	–	–	–	–	–
6. Plains in W. Tagus Basin	7.4	6.5	84.6	15.4	89	6	–	–	5[b]	–	–	10	3	87
7. *Madrid-Guadalajara* Fields	5.9	8.7	40.3	59.7	59	33	–	1.9	6[c]	–	25	59	–	16
8. Plains in *La Mancha*	11.4	4.6	19.4	80.6	97	3	–	–	–	–	8	72	–	20
Plain areas	*24.8*	*19.9*	–	–	–	–	–	–	–	–	–	–	–	–
9. *Alcarria*	26.5	30.0	18.2	81.8	65	35[a]	–	–	–	–	–	71	4	25

[a]Portuguese oak (*Quercus faginea*)
[b]Holm oak and Olive tree (*Olea europaeans*)
[c]Holm oak and Pine (*Pinus* sp.)



Map 18.4 Charcoal making and forest landscapes around Madrid, 1725–1803

The majority of public woodlands on the Guadarrama range are commons (75 %) and are usually called as "mata", which means coppice. These types of woodlands were the real firewood-producing areas of oak, holm oak and ash that still look like this today. The majority these public common woodlands had clear boundaries, fenced-off from foreign livestock. In other words, these woodland commons were laid-out like true forestry reserves, in many cases fundamentally to produce firewood (Sáez 2000; Madrazo 2010).

In addition to these Guadarrama range coppices, we can add charcoal from a specific forestry structure: the trees aligned in fences and stone walls or dispersed on the meadows that represent 60 % of the number of woodlands 25 % of the volume of charcoal of this area. Once again, these formations have historical continuity up to the present day, predominated by ash and oak in the dampest areas of valleys. This reflects a particular kind of small business that was the result of several neighbouring landowners joining together, making charcoal and selling it directly in Madrid.

The area known as *Alcarria*, that provided Madrid with 26,5 % of its charcoal, is an intermediate territory between the plain and the mountains where the majority of woodlands are public (82 %), small in size, and normally used as coppices (71 %), fundamentally covered with holm oak (40 %) and portuguese-oak (*Quercus faginea*) (36 %). In *La Alcarria*, as in the Guadarrama Range, the coppice forestry landscapes were transformed from very early, on the second half of the sixteenth century, to provide Madrid with charcoal. The woodland commons became specialised in the production and sale of charcoal to Madrid, whilst satisfying their own needs for fuel and grazing, thanks to the wide availability of wastelands. In fact, the example of La Alcarria demonstrates how common areas were placed at the service of the Court for the supply of fuel and residents were particularly active transporting charcoal by mule to Court.

We must take into account that coppices have great territorial representation in Spain, even today. For example 64 % of the *Quercus pyrenaica* or 65 % of the *Quercus faginea* appear like coppices formations and this proportion is probably exceeded in the Guadarrama Range and *La Alcarria*.[6]

In the western part of the surroundings of Madrid, both in the mountainous areas (slopes and piedmont of Gredos Range and Montes de Toledo) and in the plains around the Tagus river, predominated the *dehesa* nobility property, also reached by the Madrid's forestry needs. An example are the private *dehesas* in the north of Ávila Range (n°2 in Map 18.4) −140 and 190 km away-, which began to make a strong contribution to Madrid supply from the mid-eighteenth century, as 10 % of the charcoal reaching Madrid came from this area. Similarly, on the southern slopes of Gredos Range, although public woodlands prevail, the forestry formation that provide the largest amount of charcoal (86,5 %) were the *dehesas* of holm oak (or mixed with oak).

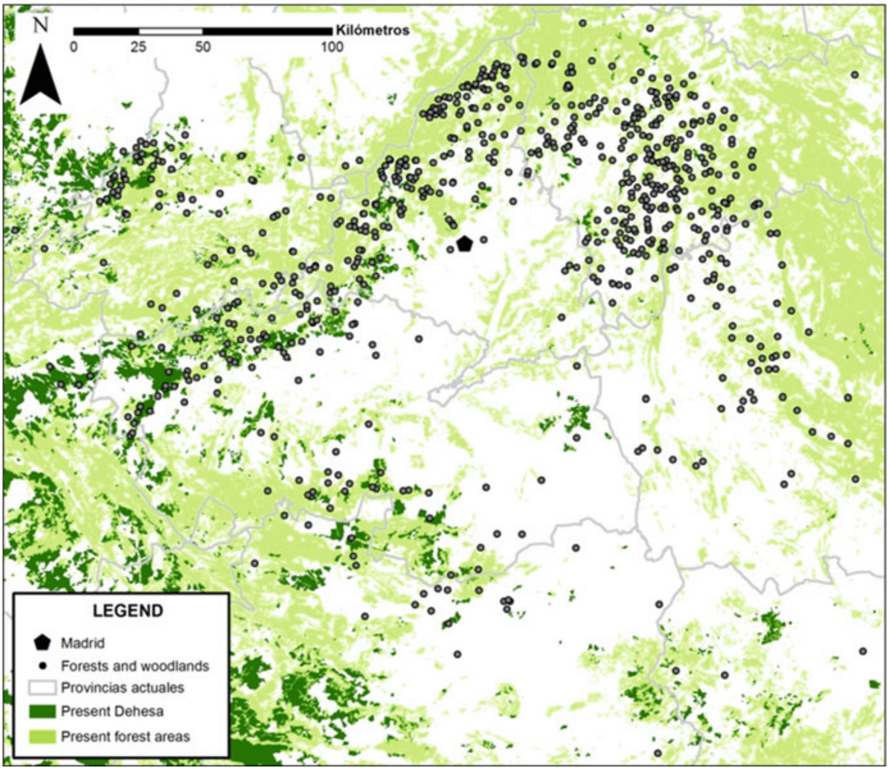
This predominance of holm oak *dehesas* spreads on the plains of the west Tajo basin, attaining 87 % of the production intended for Madrid. In this case, the furthest *dehesas*, on the border with Extremadura region, define another boundary for charcoal supply to Madrid, almost 200 km.

In short, the predominance of *dehesa*, that supplied 45 % of Madrid's energy needs, obviously coincides with the current areas of *dehesa* in the centre-west of the Iberian Peninsula (Map 18.5). Firewood production is lower, in any case, for *dehesas* than for coppices, with an estimated average productivity of 1000 kg per hectare per year. In all these cases, how charcoal is made does not differ a lot from current and it is a way of pruning that, when done properly, improves the sustainability for these forestry masses.

The contribution from villages on the plains to Madrid's fuel supply reached 25 % of the charcoal volume (Table 18.5). This region grouped together areas with varied ecological conditions: *dehesa* areas on large properties around the Tajo, small woodlands in the countryside around Madrid, and even the almost treeless land of present day: *La Mancha* in the south of Madrid. Consequently, some general issues should be mentioned.

Firstly, Madrid's immediate surroundings appear under-represented because the fact that it only needed to be carted such a short distance meant that it was not worth

[6] According to the forestry data these species along with holm oak (57.1 %) or mixed *Quercus* formations comprise 94.7 %. of the total area of coppice in Spain.



Map 18.5 Present day forestlands and *dehesas* and location of charcoal supply forest in the eighteenth century

converting it to charcoal.[7] Secondly, in some plain areas, such as the Tagus basin and La Mancha (also in *Montes de Toledo*) part of the charcoal came from uprooted firewood (10.4 % of the total amount that reached Madrid). That can mean that the firewood could be used from *dehesas* by eliminating old trees, opening-up the forestry mass. Until recently, cutting wood for charcoal from the *dehesa* still involves cutting and uprooting, because properly managed, it cleaned it up.

The relationship with the current landscape is different, depending on the area. On the one hand, in some parts of the north-eastern countryside, despite its agrarian potential, the woodland commons have been preserved as an energy reserve for the villages. And those forests constitute actually a landscape pattern in these agrarian territories. On the other, in *La Mancha*, to the south, much of the forestry mass that

[7] In the areas closest to Madrid there were indeed traditional "firewood reserves", such as the royally-owned *El Pardo* (ca. 30.000 ha), other nobility forests, the *dehesas* and woodlands of near towns and the groves and other commons which belonged to Madrid (Hernando 2003).

supplied Madrid with charcoal has disappeared today. We consider, that the loss of woodland is related to privatisation processes and the spread of agrarian crops in the nineteenth century.

18.6 Conclusions

Since the middle of sixteenth century, the rapid growth of Madrid's population supposed a long-term increase in demand for fuel (plus food and other commodities), with a growing impact on the surrounding territory. The intervention of the central government and municipal authorities was thus decisive in ensuring the supply of energy to the city through the articulation of a management system based on privilege (first private and then public) to acquire, transport and sell the fuel. It was thus possible to achieve at the end of eighteenth century an annual consumption of 37,000 t of charcoal and 16,000 t of wood in the city, increased with the contribution of other resources used as fuel, as straw and dry dung. The total volume of wood needed for urban fueling therefore added up to 200,000 t of wood per year, allowing a level of per capita consumption of at least 3 kg per person per day (or just over 1 t per person per year), much higher than those estimated for the Mediterranean and similar to those known for more Northern European areas. The prevalence of charcoal consumption in Madrid (about 85 % of the total) and the loss of efficiency in its process of production mean that in terms of net calorific values we observe a certain reduction.

The effects of these levels and consumption patterns were the need to expand the area of supply throughout Early Modern Age and the dependence on a complex system of road transportation, generating significant costs that impacted on the final price of fuel. Forestry policy developed by the monarchy tried to protect and regulate the exploitation of forest resources. Moreover, through the tax burden the government boosted the production of charcoal from common woodlands in the supply area, resulting in a process of charcoal specialization of the forest that was reflected in the importance of coppice forest (*monte bajo*).

The energy-imprint calculations for Madrid at the end of the eighteenth century, bearing in mind the firewood used and the productivity of the forests and woodlands, reached almost 140,000 ha, that is 0,77 ha per inhabitant per year, above the 0.5 ha per inhabitant per year that was set as a reference for organic European economies.

In relation to the effects on the landscape, the production and marketing of the fuel consumed in Madrid was, generally speaking, a sustainable activity. The strongest evidence for this affirmation is that for centuries charcoal came from the same areas, being remarkable the coincidence of their origins with the current forest area of the central peninsula. While Madrid's population increased, charcoal began to be produced in areas further away as an extensive solution.

In a few cases, we have discovered that in some woodland areas trees were uprooted (mainly in *dehesas*), but it seems that this was not down to the production of charcoal but rather for crop cultivation purposes. However, we believe that the deforestation occurred in nineteenth ant first half of the twentieth century, which has often been blamed on the production of charcoal to supply Madrid, is in fact the result of other key causes.

The fuel supply to Madrid encouraged woodland areas to specialize in the production of charcoal, a fact that explains the large areas of coppice forest in the surrounding area of Madrid because if its greater production of firewood. But these coppice forests have not been functional for decades and are barely even exploited for their firewood. Accordingly, in the last 50 years the forest administration has taken some initiatives to transform the coppices into other types of forest formations -reforesting with conifers or trying to transform it into oak high forest- but in general it has had little success. After all, these coppices are still an evidence of the exploitation of woodlands to guarantee the essential resource of fuel for centuries.

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Chapter 19
Bambi in Sherwood Forest and the Great Deer Escape c. 1703–1711

Sara E. Morrison

Abstract A combination of natural and human factors led to the 'great deer escape' from Sherwood Forest in the early eighteenth century. Hundreds of red deer searched for food and shelter outside the royal forest boundary during the harsh winters of the early 1700s, blissfully unaware of the imminent dangers and the long-term threats to their survival. Inside the forest bounds royal deer were protected by ancient forest laws, but outside they were fair game for hunters, especially after English game laws were changed in the later seventeenth century, which allowed gentlemen to hunt on their forest lands in the "purlieus" or grounds formerly part of the royal forest. My paper addresses the causes of this mass migration, the implications for both animals and humans, and efforts to safeguard the royal deer outside the forest. Contemporaries blamed the migration of royal deer outside Sherwood Forest on the felling activities of previous Stuart monarchs; however, the situation was more complex. An historical environmental perspective shows there were more underlying factors at play than purely human intervention. The great deer escape in the early eighteenth century resulted from decades of human activity, coinciding with a period of climatic worsening, especially the cooling years of the Maunder Minimum, and the combined needs and agency of Sherwood's wild deer population.

19.1 Introduction

In the early eighteenth century, the royal forest of Sherwood was in crisis. Red deer herds were escaping in droves and harassing local farmers and inhabitants along the forest boundary. Villages on the borders of Sherwood faced a deluge of hungry deer leaving the forest in search of shelter and food during the winter of 1707. Red deer, the largest wild animals in England, were loud and imposing, especially when roused. Many inhabitants were too terrified to sleep because deer trampled down fences every night and took refuge in cottage gardens and farmers' fields. Inhabitants bemoaned these invasions because red deer were formidable opponents as they rampaged through fields and gardens. In December 1707, Isaac Knight complained to

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Sir Andrew Thornhagh, one of the gentlemen in the county of Nottingham, and a forest verderer who was appointed to oversee royal deer in Sherwood; Knight protested that there was “no harbour nor shelter” for the deer to live. The deer were so numerous that they broke into hay barns and ate all the carrots and cabbages of poor people living next to the forest. Farmers were afraid to plant their corn (wheat); those who planted had to keep watch all night for 6 months to protect their crop. Farmers had difficulty hiring servants to live with them in these parts of the forest and on its boundary. Servants refused to keep watch for their lords at night, whilst their own crops were unprotected (HMC Savile Foljambe, 142).

In 1708 many of Nottinghamshire’s gentlemen met at Rufford inside Sherwood to formulate a public complaint. They petitioned the House of Commons directly in February 1708, outlining substantial losses to their estates: crops ruined and private woods destroyed, which some estimated caused damage of between £10 and £50 yearly. The gentlemen petitioners were supported by many other freeholders and inhabitants within the county, who were eager to seek Queen Anne’s help. Petitioners stated that until recently, the number of red deer had “never or seldom exceeded three hundred,” which they believed was a considerable number, considering the barrenness of Sherwood’s soil and the great deterioration of the woods. One of their main complaints in the winter of 1708 was that deer herds had risen to treble that number, or roughly 900 deer. Petitioners claimed that the red deer multiplied daily and had spread throughout the greater part of Nottinghamshire, “consuming the corn fields, woods and meadows many miles distant” from the forest; they complained that the increase in deer numbers became the “infinite and insupportable injury and loss of the petitioners and landholders” (JHC 1708, 118). The forest records indicate claims were genuine, yet rather exaggerated to gain the Queen’s attention.

Why did Sherwood Forest’s red deer herds leave in such numbers? What was the impact for both human and animal populations? What action was needed outside the forest to protect the royal deer and the farmers’ crops? This paper addresses the complex environmental reasons underlying Sherwood’s great deer escape, the immediate consequences for the forest inhabitants, animal and human, and the solutions Queen Anne and her Lord Warden of Sherwood sought to protect her deer as well as the livelihood of farms and villages bordering on the forest. At the time, Nottinghamshire’s angry gentlemen, farmers and tenants blamed the deer exodus on successive monarchs felling the trees within Sherwood’s oak woods. However, while spasmodic felling within the forest in the later seventeenth century contributed to some habitat loss, this was not the only factor in Sherwood Forest’s great deer escape. It was human activity, combined with animal agency and climatic worsening, that led to the mass exit of hungry red deer into the surrounding countryside. The royal deer were wild beasts that wandered freely about the forest, where they enjoyed protection from forest law. The problem arose when they roamed outside the legal forest boundary in search of food and shelter, because they were no longer protected by forest law and the royal officers employed to protect them. Also a period of intensely cold winters during the *Little Ice Age* had occurred during the first decade of the eighteenth century, which coincided with the Maunder Minimum

(1645–1715) (Eddy 1976, 1189–1202). The prolonged cold winters forced Sherwood's deer inhabitants to search further afield for food and shelter and outside the protection of the forest boundary.

19.2 A Royal Forest

Sherwood Forest in Nottinghamshire was never a very well wooded environment. It was the largest royal forest in the northern division of forests, containing about 100,000 acres lying in the heart of midland England. The forest was not well wooded according to a 1609 survey when roughly a tenth of the area was wooded; by the 1650s surveys of the Crown woods show decreased woodland, a trend that continued into the eighteenth century (Mastoris and Groves 1997, xix; E 317/Nottinghamshire 11; E 317/Nottinghamshire 23; Morrison forthcoming). The physical landscape of the forest varied from north to south; most of the young woods or coppices on fertile clay soils were located in the south around Nottingham, whereas the High Forest or mature woods in the centre and north lay on sandy, infertile soil surrounded by swathes of bracken and heath. Deer sheltered in the oak woods and coverts of the High Forest area during the day, or sometimes they lay unobserved in the bracken and heather, venturing out to feed at dawn and dusk (Cox 1706, 2, 10; NUMASC Pw 2 598).

A royal *forest* had the legal meaning of a hunting territory in forest law, rather than as a landscape feature. Royal forests were not necessarily covered with trees throughout; not all lands within its boundary belonged to the crown, but the area was subject to forest laws, which superseded common law. By the early eighteenth century, the Crown owned very little land in Sherwood after continuous centuries of royal grants and sales, particularly during the seventeenth century (*Fourteenth Report* 1793, Appendix 10, 32–33). However, the area was still subject to forest law, which protected the forest as a Crown hunting territory; within its boundary the deer (*venison*) and trees (*vert*) were protected *by forest officers* for the King's enjoyment and use. Crown hunting territories were governed by forest laws, that were enforced by royal forest officers who patrolled within the forest and sent illegal hunters and poachers to answer charges in forest courts. Originally, royal hunting territories were created by the Norman kings, but the institution survived through the medieval period into the sixteenth century and beyond. The legal historian John Manwood defined forest laws in his widely popular *The Laws of the Forest*, first published in 1598. This work was reprinted and revised throughout the seventeenth and eighteenth centuries to provide legal opinion, including a 1717 edition. Manwood's definition of a royal forest was a "Territory of woody Grounds and fruitful Pastures privileged for wild Beasts and Fowles of the Forest" for royal delight and pleasure (Manwood 1717, 143). Red deer were the most prestigious "beasts of the forest" and protected by forest laws that were enrolled in the ancient *Carta de Foresta*.

Sherwood Forest was divided into 12 *walks*. Each was patrolled by a *forester*, who regularly provided accounts of the number of deer in his walk when requested by the forest courts, including red deer surveys brought before the Mansfield attachment court at intervals in 1708, 1714/15 and 1715/16 (NUMASC, Pw 2 617; NA, DDP 27/3). The forest *verderers* were influential local gentlemen whose role was to protect both trees and deer inside the forest. They presented illegal hunting and poaching cases before local attachment courts; they either fined offenders, or sent them on to higher courts, with the most serious presented at the highest court, the Justice Seat or *forest eyre*. In Sherwood, red deer were the most important game animals found in the northern and central forest for royal hunting. The Crown prized the red deer over fallow deer, because the larger red deer were formidable opponents for hunting visits. Fallow deer were more tame, needed less space to range and lived in private parks or hunting chases (private forests). Although they are not part of this study, some royal fallow deer resided in the southern part of Sherwood, in a private hunting ground called Thorneywood Chase. Queen Elizabeth had set up the private chase, which sheltered up to 500 fallow deer and was managed by the Stanhope family (*Fourteenth Report* 1793, App 22, 54–55).

Access to the royal forest was strictly regulated at certain times of year. One very important forest law protected female deer (hinds) during *fence month*, when most hind deer *fawned* or dropped their calves. Restrictions on access to the forest at this time protected female red deer or *hinds* during the spring and early summer season. Forest officers enforced fence month between 21 June and 21 July, which was crucial for the long term survival of royal deer herds. Individuals were prohibited from wandering into areas the deer liked to hide. The laws placed restrictions on the movement of animals into and across the forest. During fence month, commoners were fined for driving cattle across the forest and they were prohibited to send swine into the forest to access traditional *pannage* or foraging rights. Forest laws excluded other animals to avoid unwanted disturbance to the females and their calves (Manwood 1717).

19.3 Exodus: Reasons to Leave

By 1708 the conditions inside Sherwood Forest had changed. Also red deer numbers had risen sharply since the mid-seventeenth century, when the herd was at an all-time low after the civil wars. In 1648 there were only 258 red deer. The herd recovered slowly, but not to levels petitioners claimed. They also ignored evidence that Sherwood had supported over 1,000 deer in previous centuries, according to early Stuart royal deer surveys made in 1616 and 1635 (NA, DD 382/3: 143; DDP 27/3; NUMASC Pw V 5: 377). In 1708 many petitioners blamed the deer escape on the dismal condition of the Crown's woods; they accused successive monarchs before Queen Anne of selling or destroying the woodland cover, especially during the late seventeenth century (*JHC* 1708 Vol. 16, 118; HMC Portland Vol. V, 375). However, historical evidence shows the underlying cause of the great deer escape was more complicated. A combination of human activities that reduced food supply and shelter, climatic worsening with the extreme winters of the early 1700s, plus animal agency urged many hungry deer to abandon Sherwood.

19.3.1 Human Activity

Human interference in the royal forest of Sherwood took various forms during the late seventeenth century. Settlement, farming and industrial activities such as timber felling and charcoal burning, likely affected deer habitat and food sources. There was also human interference through Stuart royal policy designed to help with the recovery of deer numbers after 1660. The navy used timber from Crown oak woods especially during the 1660s and 1670s, supporting naval efforts against the Dutch. From the 1650s there were also several ironmasters working within Sherwood but not in royal woods; local lords leased woods to ironmasters who coppiced the trees to produce small wood for charcoal iron production (CSPD 1663–1670; Riden 1991, 69–71). These activities disturbed the deer; they disliked the smoke and hid to avoid the workmen. However, at mid-century the loss of tree cover and bushes had negligible impact because deer numbers were so low. The full effect began in the early eighteenth century once deer numbers recovered.

Settlement of the forest in the later seventeenth century also increased the amount of forest enclosure, legal and illegal. Some enclosures that were monitored by the forest courts were only temporary, but there was also illegal enclosures or *assarts*. Enclosures had changed living conditions within the royal forest. In 1665 Charles II granted William Cavendish, duke of Newcastle, the Lord Warden of Sherwood and the Chief Justice in Eyre of the northern forests, and the largest landowner within the forest, the right to enclose his woods and lands inside Sherwood against royal deer. This was a special privilege because forest law ensured all woods and wastes in the forest were open to the royal deer; they wandered freely to feed, according to forest law (NA, DD2P 27/12; DDSK 229/1). Newcastle was permitted to fence his woods from deer and exclude them from his estates. It was a huge advantage for Newcastle to fence his private woods and fields, protecting them from the daily incursions of red deer. However, in 1707/8 Newcastle's estates were still open to the royal deer, but he was anxious to improve his estates and greatly increase their value (BL, Add. MS 33,060).

The rapid loss of tree cover begun in the seventeenth century deprived red deer of shelter, refuge, and food sources from bushes, twigs and acorns. Intensive felling in the royal woods of Birkland and Bilhagh for the navy during the 1660s was particularly detrimental to forest cover. Between 1663 and 1670, John Russell one of the Navy Purveyors, had supervised extensive felling within Sherwood for the navy; Russell organized the transportation of boat loads of timber from Sherwood to the navy shipyard at Deptford on the river Thames (CSPD 1663–1670). Local historians and visitors recorded the loss of trees and underwood used by the deer for shelter. By 1677 there was limited shade in Sherwood. Robert Thoroton noted the openness of the forest; the loss of tree cover and bilberry bushes had been important to shade royal deer, but also cattle belonging to local villages (Thoroton 1677, II, 161). Daniel Defoe passed through the forest as part of his general *Tour of England* in the 1720s, remarking that if Robin Hood had still existed "he would hardly find shelter for one week" because there was so little wood cover to hide him and his merry men

(Defoe 1724–1726, 455). Red deer had sheltered in these mature woods of the High Forest during the hottest months to avoid horseflies (Turberville 1575, 88).

The loss of shelter that resulted from rapid felling in the 1660s and 1670s coincided with restocking and recovery of the red deer population within Sherwood; with less covert and more deer, by 1700 forest officers found it difficult to keep the deer inside the remaining woods. After 1661 Charles II had restocked red deer herds in Sherwood and Windsor with imported gifts from German princes. Combined with restrictions on forest officers taking deer as fee payments these measures helped rebuild Sherwood Forest's herds (*Fourteenth Report*, 1793, App. 24, 58; *CSPD*, 1661–1662: 145,158,423; NA, DD 382/3: 143; DDP 27/3; NUMASC Pw V5: 377; Cox 1905, 79; CTB, 1660–1667, 314). One royal order in June 1662 prohibited anyone taking fee deer from Sherwood unless the monarch was present, meaning there was no reason to kill deer except when a royal hunting party visited the forest. This eliminated the temptation for forest officers to hunt or poach under the guise of taking fee deer (TNA, LRRO 5/51/3). In October 1662 Charles expanded the prohibition to fees hinds, further preserving the royal game. To encourage compliance, the Chief Justice of forests North of Trent who oversaw Sherwood offered his deputy a buck from his own deer herd (CSPD 1661–1662, 423; CSPD Add 1660–1885, 21). Local Nottinghamshire gentlemen no longer had reason to hunt in the forest for fee deer. Increasingly in the 1660s and 1670s these gentlemen petitioned the forest courts for licenses to kill foxes as a substitute (NA, DD 382/3). Stricter game policy in the royal forest coincided with late seventeenth century changes to game laws, which protected gentlemen's rights to hunt legally on their own grounds (Munsche 1981; SR Vol. V, 314. 1661; SR Vol. VI, 312-4. 1691).

Another reason for the rapid growth of deer between the 1687 and 1708 surveys was due to the efforts of Sherwood's Lord Warden, John Holles duke of Newcastle, during the 1690s and early 1700s. In 1702 Newcastle recorded scarcely five brace (ten deer) when William and Mary had appointed him as Warden. His practice of letting out a few of his own deer into the forest from his parks had increased the size of the royal herd; it proved so successful by 1702, that Holles petitioned Queen Anne to increase his annual fee deer from 10 brace (20 deer) to 15 brace (30 deer), since the forest now had so many (CTP 1702–1709, 89). The recovery of deer numbers was so successful that the royal forest could no longer support the deer with adequate shelter, covert or food. Food supply and shelter only became a problem when Sherwood's deer population started to recover. The rapid growth in red deer between 1687 and 1708 contributed to a scarcity of shelter and food by 1708, but also it demonstrated the success of later Stuart royal game policy. One deer survey in 1687 showed only 137 male deer, yet by December 1708 the total number of deer in Sherwood (including hinds) had swelled to 552 with another 100 outside the forest (BL, Add 34769, f. 89; NA DDP 27/3; NUMASC Pw 2 617). Several harsh winters in the early eighteenth century, during the *Little Ice Age* of Queen Anne's reign 1703–1714, contributed to the mass exodus of red deer from Sherwood or the "great deer escape" into the purlieus and beyond.

19.3.2 Little Ice Age and Cold Winters

Climatic worsening was especially harsh in the first decade of the eighteenth century. In 1708 the petitioners to the House of Commons and Queen Anne drew attention to the exceptionally cold winters experienced within the forest. During the early eighteenth century there were similar reports by local gentlemen and other concerned observers who described the yearly problem of feeding Sherwood Forest's deer throughout the coldest months (HMC Savile Foljambe, 142; HMC, Portland, V, 375). There were other indications of climatic worsening found in forest court records and in the estate correspondence of the Lord Warden of Sherwood, John Holles duke of Newcastle who owned lands in the forest and outside on the borders. The attachment court records for Sherwood Forest surviving between 1703 and 1726 provided evidence for large numbers of deer dying "by poverty;" forest officers recorded numerous entries especially from 1703–1715 (NA, DDP 27/3; SO.FR 6).

Deer died from starvation or froze to death during the cold winters of the Maunder Minimum. The forest court compiled numbers of deer that died in each forest walk. Usually deer were either hunted by officers for fee deer or poachers caught red-handed, others were shot and abandoned, or were diseased animals dying of murrain. Attachment records show in these decades that hinds and calves regularly died of poverty. In March 1715/1716 officers were asked to record "what deer dyed in and since the Great frost" (NA, DDP 27/3). This is direct evidence of harsher winters in Sherwood Forest and the vulnerability of hinds and calves. The estate correspondence of the Holles family also shows a link between colder winters, the food available to the deer and their escape from the forest. One report to the Lord Warden provides a reason so many deer were continuing to leave the forest; between 1709 and 1711 forest officers reported that Birkland and Bilhagh's great oak woods had failed to produce acorn mast. Forest deer relied heavily on acorns for food in autumn (NUMASC, Mol 2/6/1). Colder winters combined with a shortage of acorn mast made conditions worse, encouraging deer to leave Sherwood in search of food.

19.3.3 Animal Agency

Sherwood Forest's red deer were wild animals that needed plenty of space. Red deer (*cervus elaphas*) were much larger than the fallow deer introduced by the Normans (Cox 1905, 26). In 1658 one early modern historian of animals Edward Topsell called them "horse deer," believing they were members of the horse family (Topsell 1658, 255). See Fig. 19.1. By the early eighteenth century Sherwood's red deer had no natural predators besides hunters and poachers, because most wolves had died out in Nottinghamshire during the late fifteenth century. Only the wildest areas of the country, Peak Forest in Derbyshire and Ireland with its wolfhounds, still hunted

Fig. 19.1 Hippelaphus or Red deer. Edward Topsell described them as "hart horses" or "horse deer" shown browsing on tree foliage in Edward Topsell, *The History of Four-footed Beasts and Serpents* (1658) (University of Houston Digital Library). – See more at: http://publicdomainreview.org/collections/the-history-of-four-footed-beasts-and-serpents-1658/#sthash.MkVyuxpN.dpuf

wolves in the early modern period (Cox 1905, 25–26, 32). As Keith Thomas has shown in *Man and the Natural World* (1987) contemporaries in the early modern period strongly believed that humans had dominion over the natural world and all the animals within it, including all wild beasts. Within the royal forests the most important *beasts of the forest* were red deer stags, prized by monarchs because stag hunting provided the most exciting and challenging hunting experience. Forests lay open for wild deer to wander as they pleased. Inhabitants had to petition the forest court for special licences to make enclosures within the forest for temporary cultivation (*brecks*) or felling a coppice wood, which excluded the deer. Verderers regularly heard petitions at the Mansfield attachment court during sessions held between 1703 and 1726; these licenses to enclose woods and forest wastes were for short periods only. Verderers surveyed grounds to ensure that excluding deer was not detrimental to their sustenance and survival (NA, DDP 27/3; SO.FR 6).

The mighty red deer moved around the forest, acting as free agents in the remoter royal forests like Sherwood. They browsed and feasted as they pleased on forest vegetation: such as acorn mast and crab apples, as well foliage, small twigs and the bark of trees, with a browse-line marking the extent deer could reach. Figure 19.1 shows Edward Topsell's (1658) illustration of red deer browsing in a wood. Male deer also damaged forest trees by scraping their antlers up and down the trunks when they were "fraying" their heads, or trying to remove the skin coating from their new set of antlers (Blome 1686, 323).Deer liked to range over a large area in search of food and shelter, drawn to different parts of the forest depending on the season. Deer will eat most vegetation and have a varied diet: a variety of grasses, leaves on bushes, twigs and branches of trees up to the "browse line" as far as they could reach. Figure 19.1 shows a red deer browsing on the lower branches of a tree. During winter months forest officers often provided tree clippings (Cox 1905, 19–20). In hard winters they relied on supplementary browse provided by keepers, either hay or *lops and tops* cut from forest trees and holly bushes, or stripped bark from young trees. In autumn acorn and beech mast were staples; crab apples were a bonus and a field of young wheat or a vegetable garden was a great delicacy (NA, DDP 27/3; Thompson 1985, 30). Deer particularly liked tender shoots from new growth; for this reason forest villages frequently petitioned the forest attachment court in the early eighteenth century for licenses to enclose their woods to exclude deer for a short period after felling, which allowed shoots to regrow (NA, DDP 27/3; SO FR 6).

Interested only in food and shelter the Queen's red deer herds roamed beyond the legal forest boundary, in search of woods to hide in during the day and crops to chew at night. The boundary was meaningless to deer, but outside forest limits they lost all protection afforded by the forest law and officers (*keepers* and *verderers*), employed to look after them. The royal deer faced great uncertainty and danger by crossing the legal status boundary of the forest into the countryside beyond or into the *purlieus* (lands formerly subject to forest law but now released or *disafforested*) The purlieus existed along the forest boundary on all sides of the forest, but the problems related to deer leaving the forest were particularly bad in the north and north east of Sherwood. In Queen Anne's reign, 1703–1714, the exodus of red deer caused numerous difficulties for towns and villages lying outside Sherwood.

19.4 Bambi Outside the Forest

Forest officers entrusted to safeguard the deer within the forest were powerless outside its bounds, except for the *Purlieu Ranger,* whose job was to chase royal deer back into the forest, where they enjoyed protection from illegal hunters and poachers (Manwood 1717). By 1700 it was hard to keep the Queen's deer inside the forest. They strayed outside the forest and became obvious targets for angry tenants and poachers. Perhaps the greatest danger for the deer by the early eighteenth century were the *purlieu hunters*. Early seventeenth century historian Roger B. Manning outlined the dangers of the forest purlieus (grounds formerly part of the forest, now outside forest law or *disafforested*) for game animals in his *Hunters and Poachers* (1993, 83–108). With alterations to the game laws in 1671 and 1691, gentlemen had greater access to hunting if they owned sufficient property; stag hunting was no longer the sole prerogative of the monarch (Munsche 1981).

In the early eighteenth century gentlemen with lands in the purlieu were legally permitted to hunt and kill any royal deer on their lands if animals went outside the forest. Although these gentlemen were allowed to hunt royal deer on their own ground, they were not able to go into the forest and drive them outside to kill on their lands (NUMASC, Pw 2 619–626). During the eighteenth century legal opinion on purlieu hunting became very significant in Sherwood Forest. The Attorney General and Solicitors General made judgements on a test case in 1708, permitting a gentleman to hunt royal deer on his own lands in Sherwood's purlieus as long as he hunted by "fair chase" or riding with hounds (NUMASC, Pw 2 619–26; Thompson 1985, 30–31). This decision allowed legal hunting of any royal deer straying outside Sherwood into the purlieus. Since the Queen's wild deer knew no bounds and continued to stray outside the forest in search of covert and food, they faced new dangers from purlieu hunters. The problem for Queen Anne's red deer became much worse after these changes to the English game laws, which extended the franchise for deer hunting to gentlemen with substantial property or lands worth at least 40 shillings a year (Munsche 1981).

Gentlemen were allowed to hunt on their own estates within the purlieus, but there were restrictions. They were not allowed to hunt on Sundays, before sunrise or after sunset, nor during fence month, or more than three times a week; they were not allowed to hunt beyond their own grounds or take anyone except household servants; they were not able to let their dogs follow a deer back into the forest and must recall them, but if the dogs killed a royal deer inside the forest, purlieu hunters were not allowed to have the deer because it had to die in the purlieus (Manwood 1717; Thompson 1985, 30–31). This new group of gentlemen hunters from the later seventeenth century onwards was signalled in print by the rash of hunting manuals aimed at this market. The most famous of these were Richard Blome's *The Gentleman's Recreation* (1686), one of the first popular manuals for gentlemen hunters that were reprinted into the eighteenth century, along with Nicholas Cox's *The Gentleman's Recreation* (1706). These manuals provided useful advice about locating red deer at different seasons and methods of unharbouring stags.

In the early eighteenth century Sherwood Forest was on the verge of an environmental crisis. The great deer escape from Sherwood Forest into surrounding lands during the early eighteenth century had implications for both human and animal populations bordering the forest boundary. Angry farmers, tenants and villagers faced daily invasions by the Queen's deer and suffered losses. Within Sherwood the deer had some protection from hunters and poachers under forest law, with its courts, regulations and officers. By leaving the forest and the protective status boundary of forest law, Queen Anne's deer faced new dangers. The great deer escape challenged the Queen and her Lord Warden, John Holles duke of Newcastle, to consider creative solutions for managing and protecting royal deer outside the forest between 1703 and 1711.

19.5 Protecting Bambi Outside Sherwood

By 1708 the inhabitants of Sherwood and the purlieus desperately wanted a solution to the deer problem and their daily confrontations. Some of the freeholders of the county wanted Queen Anne to extend the purlieus, allowing more landowners to hunt legally. The Lord Warden and Purlieu Ranger, John Holles, Duke of Newcastle, was against the idea because it was not in the Queen's best interest as the deer faced decimation; he argued that it was unlikely to "ease the country in general of the Number of the Rascally Deer," or young male deer, who were in poor condition and were responsible for the most damage (NUMASC, Pw 2 302; Mi 1 6/171/167).

As an interim measure from 1703 John Holles, Sherwood's Lord Warden, began feeding and managing the royal deer outside the forest, mostly on his own grounds. This continued for several years. He provided hay to various locations, especially in Lindhurst wood within the forest and also in Hardwick wood, his own wood outside the bounds where the red deer congregated. Queen Anne paid Holles to support her deer during the worst winters, when the deer were unable to find browse from trees and bushes. Holles kept yearly accounts of the hay and the additional wages he paid to deputies and keepers to oversee the deer in the purlieus 1703–1707 (NUMASC, Pw 2 615–616, 635).

The Warden of Sherwood understood that the survival of the royal deer depended on reducing the size of the herd. He also needed to prevent confrontations between the deer and the local farmers. The Warden was opposed to a general loosening of game laws. One suggestion was to extend the Purlieus status across the entire county, which meant all gentlemen were legally entitled to hunt down the Queen's deer on their own grounds. Holles opposed this "open season" on hunting any deer outside the forest, which threatened to decimate the deer. Instead, he asked the Queen to increase his yearly *fee deer* payments from his usual 10 or 15 brace (20–30 deer) to 30 brace (60 deer) to alleviate the destruction of woods and farms outside the forest (BL Lansdowne MSS 249/39 f. 100). Royal deer surveys for the early eighteenth century show a large number of hinds and calves, which were adding to the dramatic growth of Sherwood's herd (NA DDP 27/3; NUMASC, Pw 2 617–618). Usually the Warden and other forest officers hunted mature stags for their fee deer because the entertainment and challenge of the chase was more exciting. However, Holles began culling the female or *hind* deer population, to reduce the overall numbers of deer. Essentially the Warden was hunting down Bambi and his mother for the overall survival of the herd. Holles's family accounts show he made generous gifts of hind deer to some of the townships most affected by the Queen's rampaging deer, as compensation for damaged crops and cottage gardens (NUMASC, Pw 2 633). He was able to buy some good will in the short term from these areas, but it was really only a temporary solution, especially if deer continued to leave the forest and were prey for the gentlemen of the purlieus.

The great deer escape and the environmental crisis in Sherwood called for a very novel solution from Queen Anne and John Holles. After short-term measures to cull deer numbers failed to ease the situation, Queen Anne ordered her Warden to create a new park on the northeastern edge of the forest. The new park at Clumber stood partly inside the forest and the rest was in the purlieus. The park grounds were not part of the Crown estate, but belonged to Holles. The agreement between Holles and Queen Anne passed the new royal park to at the Queen's death. The interim solution worked for the short term and the park passed to the Cavendish-Holles-Newcastle family in 1714 (Morrison 2002, 103–117).

Queen Anne's new park for her red deer at Clumber took time to establish. In 1708/1709 Queen Anne granted Newcastle a license to impark between 3000 and 4000 acres of his own forest grounds in Sherwood and within the purlieus, including two small woods that offered shelter for the royal deer. The license also allowed the duke to cut a riding through decayed wood at Birkland, which was one of the Queen's royal woods. The new park housed the Queen's deer, which Newcastle was already feeding. As recognition and payment for surrendering rights on his own forest lands, Newcastle became Ranger of Clumber Park in December and January 1709/1710. During the Queen's life he was to receive a salary, and on her death Newcastle and his heirs became the owners of Clumber Park. Relinquishing the park to the duke at her death was an ample compromise for the Queen and a very favourable grant for Holles (Morrison 2002, 103–117).

The new royal park had limited success. Even with the new park outside the forest to protect the Queen's deer, they still preferred to roam freely in search of food. Red deer were wild animals, not used to confinement within the new park at Clumber. Estate correspondence between Newcastle and his deputies include the daily duty of protecting the deer from escaping the new park. The deer were often shy and did not like to stay beside the park fence during the day, but many rebelled against captivity by beating down the fences of the new park in 1710, not long after the deer had arrived (NUMASC Pw 2 599). The Ranger outside the forest had to search the purlieu woods and return any stray red deer back into the new park at Clumber. Frequently the Ranger herded deer from the Lord Warden's woods in the north and east purlieu, where they liked to hide and feed (NUMASC Pw 2 596, 598, 618).

The park was not a total success because so many deer remained outside. By 1711 the abundance of red deer outside Sherwood became a liability for their safety. Inside forest bounds they were protected by forest law, but outside they were in grave danger from gentlemen hunting legally on their own estates. In the winter of 1713 one local gentleman reported that the forest's red deer were still in danger of decimation. The herds in the forest still lacked shelter, food, and protection from poachers and angry farmers. On 28 December, Lord Middleton wrote from Wollaton to the Earl of Oxford, the new owner of Clumber Park, advising him that if something was not done soon "there will be such a loss in the red deer as a great many years will not recover." Since the wood cover in 1713 was "almost quite destroyed in the body of the forest," the deer still rambled through the forest in winter time for sustenance, and as a result many still died or fell victims to poachers. Although forest officers provided hay in the forest night and morning especially "when the weather was severe," during the winter of 1713 the deer were again in difficulty

(HMC, Portland, V, 375; NUMASC, Pw 2 615–616, 635). John Digby, one of the forest verderers, reported to the Earl of Oxford, concerning the "very low and distressed condition" of Sherwood. In 1713 there were 700 deer in the purlieus, on the edge of the forest; these included about 80 stags that refused to stay within the bounds without the "necessary relief" (hay) that was always provided or them. In December 1713, although the winter was mild, the deer were likely to leave the forest for shelter in the purlieu woods with the first snow storm or frost. They had many enemies in the purlieu woods and Digby feared "very few will live to return to the forest in the summer season" (HMC, Portland, V, 376). Hungry, with many enemies on the edge of the forest, it was only a matter of time before the deer fled into the purview of angry farmers and poachers. Even in July 1714, the Holles family estate correspondence showed there were still watchmen on guard in the purlieus (NUMASC, Pw 2 636).

19.6 Conclusion

Writing the history of royal deer in Sherwood Forest during the early modern period poses particular challenges for an environmental historian or historian of animals. It relies on scant human records about deer from the seventeenth and eighteenth centuries, from the perspective of managing them to optimize the royal hunting experience. This paper focused on the history of red deer herds living in Sherwood as they searched for shelter and food throughout the forest within a protective status boundary. The records for the royal forest of Sherwood provide[s] a distinct advantage for the study of red deer populations. Sherwood has a continuous series of deer surveys between 1616 and 1715, which can be pieced together from a variety of sources. These survey records have survived within Crown estate records and the private family papers of Nottinghamshire gentlemen from the Newcastle-Holles-Portland family who acted as Lord Wardens of Sherwood and the Chief Justices in Eyre of Forests North of the Trent. As a result documentation is scattered widely amongst The National Archives, the British Library, the Nottinghamshire Archives and Nottingham University Manuscripts and Special Collections. By piecing together these records, it is possible to explain the fluctuations in royal deer numbers within a single royal forest and to understand the factors underlying the great deer escape from Sherwood Forest in the early eighteenth century. The evidence also shows changes of deer behavior as human cultures and practices changed.

The ancient royal forests were man-made ecosystems, created at the Norman Conquest (1066) as hunting grounds and protected by medieval laws, to guard the deer and trees, *venison* and *vert*, for royal use. Royal deer enjoyed protection from attacks within the forest, as long as these officers asserted forest law to apprehend poachers and then tried them in the forest courts. However, as deer wandered further afield from the forest in search of the best shade and feedings, they asserted their agency, but knew nothing of the dangers they faced outside the forest boundaries.

In 1708 contemporaries blamed the migration of deer outside Sherwood on the activities of previous Stuart monarchs; however, the situation was more complex. Human activity, climate change during the Little Ice Age and the hard winters of the Maunder Minimum together with animal agency were the underlying reasons for Sherwood's great red deer escape during the first decade of the eighteenth century. Increased human activity and settlement within the forest had reduced the traditional habitat available to royal deer. From 1660 successive monarchs had felled trees for the royal navy, and there were increasing demands from forest settlers in the late seventeenth century. Under the later Stuarts Sherwood's deer population gradually recovered, first by Charles II's restocking efforts in the 1660s together with stricter forest and game laws prohibiting hunting and poaching. Reduced food and shelter inside the forest coincided with population recovery in the early eighteenth century during a time of very cold winters. Deer responded by searching for food outside the forest. The lure of food and shelter outside the forest in the purlieus caused the Queen's deer to wander further afield. The red deer in Sherwood Forest were wild animals with agency, used to having free movements. Once outside the forest, life expectancy was uncertain, depending on varying efforts to protect or eat the royal deer straying beyond the forest bounds.

Royal deer in Sherwood also made use of human settlements and agriculture to prolong their survival, feasting on the young re-growing shoots of newly felled woods in the forest and in cottage gardens and farmers' fields outside. Deer behavior in Sherwood changed after 1700 in response to increased human activities and climatic conditions that affected shelter and browse. A growing deer population, climatic worsening during the *Little Ice Age*, together with diminishing habitat and browse inside Sherwood meant raucous deer left the forest in search of food and into farmers' fields. By 1707 the Queen's red deer were ranging well outside the forest bounds into the purlieus and away from the safety afforded by forest law. The escape of Sherwood's red deer herds not only put them in danger, but also challenged the ingenuity of Queen Anne's forest officers to provide solutions for protecting royal deer outside the forest and appeasing local farmers.

Like many deer today living on the borders of human settlement, the highest priorities are shelter and food. For red deer surviving on the edge of Sherwood in the early eighteenth century it was no different; they searched for sustenance within the woods of the royal forest and when this was depleted they moved into the purlieus woods and beyond. They cared little for forest boundaries nor the implications of leaving the protection of forest law. Queen Anne's red deer lived as animal agents inside the forest and outside regardless of consequences; they ignored human notions of forest law and were neither aware nor concerned as they transgressed Sherwood's protective boundary. In the early eighteenth century Sherwood Forest's red deer knew no bounds and little of the dangers awaiting them in the purlieus and beyond the royal forest.

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Pw 2 355 Note of hind deer disposed by towns affected by deer, winter 1708
Pw 2 596 Deer from Hardwick walk herded into the park, 9 Mar 1710
Pw 2 598 Driving and herding forest deer into the new park, Apr 1711
Pw 2 599 Deer dislike confinement in the new park, beating down the pale fence 2 May 1711
Pw 2 614 Survey of male deer in Sherwood, 22 Jan 1706
Pw 2 615-16 Warden's salaries to deer watchers in the purlieus, 1706–1707; 1708
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Pw 2 618 Account of red deer on Newcastle's lands in forest and purlieus, Dec 1708
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