

Carrier Seeds

A Cultural Analysis of Care and Conflict
in Four Seed Banking Practices

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Abstract

Carrier Seeds:

A Cultural Analysis of Care and Conflict in Four Seed Banking Practices

Seed banking has become a hopeful technology of *ex situ* conservation in the face of devastating biodiversity loss. Through storing seeds in liminal, often frozen, states, seed banks create valuable living archives. This thesis analyses four such seed banking practices ranging from iconic global seed vaults in the Norwegian Arctic (the Svalbard Global Seed Vault) and the UK (the Millennium Seed Bank) to the Kostrzyca Forest Gene Bank in Poland and the food sovereignty seed bank of the Union of Agricultural Work Committees in Palestine. It asks: what are these practices saving (for)? But also: what escapes them?

What is threatened in the current era of the Anthropocene is not just the genetic diversity preserved in seed banks but the cultural, epistemic, and relational diversities of human-vegetal ecologies. On this basis this research uses an interdisciplinary approach grounded in cultural studies and interwoven with perspectives from conservation and plant science, multispecies ethnography, and the environmental humanities more broadly. Methodologically it follows patterns of collection, containment, and cultivation through three *carrier seeds* as analytical and narrative devices: a black bean, a banana wild relative, and an endangered white cucumber.

Conversing in particular with decolonial and postcolonial theory and feminist Science and Technology studies, the thesis observes shifting, sometimes conflicting, understandings of mastery, vulnerability, and sovereignty. It argues that these concepts are produced *in practice*, in relation to national imaginaries of 'nature' and 'culture'. These seed banks do not simply preserve seeds but through their care actively shape life across the scales of genetic data to the (agro)ecologies seeds exit from and enter into. This thesis suggests that while similar technologies of conservation are shared across practices, their ecological imaginaries differ vastly in their politics, cultures, and ethics of saving.

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Abbreviations

CBD – Convention on Biodiversity

CGIAR - Consultative Group for International Agricultural Research

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

DEFRA – Department for Environment, Food and Rural Affairs, UK

ESCONET – European Seed Conservation Network

EUFORGEN –European Forests Genetic Resources Programme

FAO – United Nations Food and Agriculture Organisation

IUCN – International Union for Conservation of Nature

KFGB – Kostrzyca Forest Gene Bank

ICARDA - International Centre for Agricultural Research in the Dry Areas

MSB – Millennium Seed Bank

MSBP – Millennium Seed Bank Partnership

SDG – United Nations Sustainable Development Goals

SGSV – Svalbard Global Seed Vault

STS – Science and Technology Studies

UAWC – Union of Agricultural Work Committees

USDA – United States Department of Agriculture

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Table 1: Timetable of empirical research

Audio

Audio 1. Selection of sound recordings outside the MSB's cryochambers. Recording: the author and Tommie Introna, 2019

Introduction



Figs. 0.1–0.3. Seed extraction from serpent cucumbers in Dura, Palestine. Photographs: the author, 2019

COLLECTION

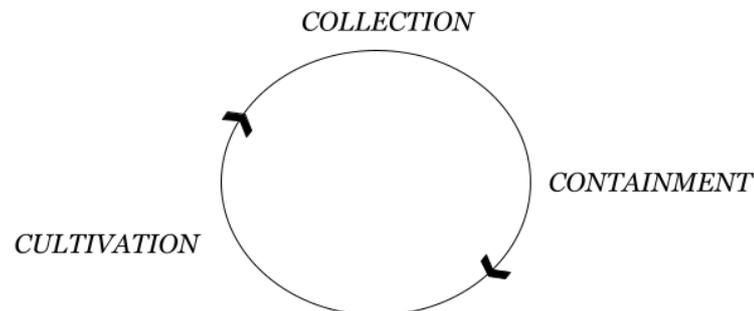
A yellow stream of seed pulp and water was slowly spreading across the backyard of a farmer's house. My eyes rested on the yellow liquid, its interplay with the shadows cast by the surrounding trees and the dry soil in the summer heat. I had joined staff of the Palestinian *Union of Agricultural Work Committees (UAWC)*'s food sovereignty seed bank for a seed extraction from serpent cucumbers (*Cucumis melo*).¹ The cucumbers had been harvested earlier that day. During the previous week, I had seen them growing in a dusty field in the village of Dura in the Palestinian West Bank. They were locally adapted, rainfed plants (*ba'al* seeds in the Arabic vernacular) whose roots reach deep into the ground to access water in a harsh landscape. They grow without irrigation and carry valuable local adaptations for environments where water is scarce. When we extracted the seeds, the flesh was still warm from the sun and a heavy melon-like scent filled the air. I was in awe at how these plants held liquids in their giant bodies, and how round and full of water the seeds themselves felt by the time they were extracted. Here were two slow discoveries of the multitudes that both seeds and the plants grown from them can carry: an abundance of water and unique environmental adaptations.

Scraping the pulp from the inside of the cucumbers and washing the seeds provided relief from a tense morning where I had joined the seed bank's team on the first visit to a women's support group in the densely populated and militarised inner city of Hebron. They had analysed small plots of urban farmland caught between multiple check points and discussed the seeds and support the seed bank was going to provide in the establishment of a thyme farm. As the yellow stream of seed pulp and water spread across the back yard later, I noticed the grounding effect of this tactile labour of care. The seeds' materiality provided a sense of dignity in an environment of conflict and threats to cultural heritage. It also offered practical resistance to the loss of land through continuous cycles of cultivation in the settler-

¹ Throughout this thesis I provide Latin scientific binomial nomenclature for plant species where I had this information available to aid identification. At the same time, I also refer to vernacular names for specific varieties to give space to the cultural histories embodied by these plants.

colonial space of the West Bank. These were other things that seeds can carry: an ecological and political connection to land and a sense of cultural identity and memory. In observing the seed bank's practice seeds appeared as time-bending beings that, if listened to, could 'take you back' and teach lessons about resilience.

I often returned to the undulating yellow stream during the work on this thesis as I tried to pinpoint how seed banking as a human-vegetal ecology goes beyond 'banking', and when exploring its entanglements with coloniality, and the multiplicity of its care and formations of sovereignty. After the extraction, the serpent cucumber seeds were dried and cleaned in the seed bank's offices in Hebron. Water was slowly removed from seeds to extend longevity. Once the moisture content had been tested, they went temporarily into storage. A seed sample was frozen for long-term storage while most seeds were distributed to farmers for the next growing season, only to then be re-collected the following year. This vignette describes a cyclical temporality of banking through collection, containment, and the cultivation of seeds.



Diag. 0.1. Simplified pattern of what I term a *seed circuit* in seed banking, and structuring device for this introduction. Illustration: the author, 2022

The introduction to this thesis follows this cyclical pattern, which I term a *seed circuit*: the movements of seeds into and out of seed banks according to flows of collection and cultivation. It is organised in three corresponding parts: *COLLECTION*, *CONTAINMENT* and *CULTIVATION*. *COLLECTION* explores the gathering of seeds before they enter a seed bank. *CONTAINMENT* describes institutional structures of seed banking, their care, and how seeds are understood once they enter a seed bank. Finally, *CULTIVATION* asks what happens if and when seeds exit a seed bank and what kinds of futures do they feed into. Across these sections I draw out specific meanings of 'seed', 'seed bank', and the significance of care in seed banking

practices. While the observation of the seed extraction process in Dura shows how ‘seed banking’ is inherently extractive – seeds are removed from the plants that produced them, processed, and then put in storage, often for indefinite periods of time – it also reveals important ties with cultural heritage and potential struggles for sovereignty.

CONTAINMENT



Fig. 0.4. Entrance to the Svalbard Global Seed Vault. Photograph: The Norwegian Ministry for Food and Agriculture, 2013

Fig. 0.5. Entrance to the Millennium Seed Bank's two seed storage chambers. Photograph: the author, 2019

Banking and Saving

When I had started this research two years before taking part in the seed extraction in Dura, I was drawn to seed banks because they appeared as inaccessible spaces of (neo)colonial control over vegetal life, and by extension over future human life on a planetary scale. Seed banks were ‘frozen arks’ (Qvenild, 2008; Laboissière, 2019), ‘doomsday vaults’ (Gan, 2016a), extinction insurances, biocapital, and genetic ‘backups’ (Breithoff and Harrison, 2020). Taken together, these readings view seed banking as a techno-fix through the lowering of temperature and a valuable, speculative device for end times. I was particularly captivated by images of the Svalbard Global Seed Vault (SGSV), the world’s largest backup facility for the conservation of crop biodiversity located in the Norwegian archipelago Svalbard in the Arctic circle. These images showed how seeds from agri-scientific institutions across the globe were being deposited and securely stored in the vault’s bunker-like architecture. They made visible the anthropocentric care for ‘vulnerable’ seeds and depicted the vault as a technical solution to biodiversity loss. As the image above (fig. 0.4), produced by the Norwegian Ministry for Food and Agriculture, one of the three administering organisations of the vault, shows there is a techno-heroic quality to this making-visible of seed conservation. Combined with a remote Arctic location, this creates an eerie image of the futures of frozen biodiversity. A similarly cold and fortified quality can be discovered in an image I took outside the entrance of the Royal Botanic Gardens Kew’s Millennium Seed Bank (MSB) in the UK. Here a sign solemnly declares that ‘You are standing in the world’s most biodiverse location’ (fig. 0.5). Returning to the multitudes seeds contain, what exactly is being held, and *lives*, in these high-security cold storage chambers?

Seed banks are technologies of *ex situ* conservation. The term implies an extraction of a life form from its habitat in order to preserve it. *Ex situ* conservation is often linked to *in situ* conservation (the onsite conservation of biodiversity in populations) and ecological restoration projects. By extracting life forms from their habitats and turning them into ‘proxies’ for entire species (van Dooren, 2009) the focus of *ex situ* conservation lies on the

conservation of genetic diversity rather than ecological complexity. In the framework of *ex situ* conservation seeds and their germplasm carry valuable genetic data.² This dilemma around ecological relationality – how to not just preserve a species but its relations? – resurfaces multiple times throughout the following chapters and the tension between the preservation of individual species against the preservation of ecological relations will be vital for this thesis.

This research traces four seed banking practices across the globe in a loose network, sometimes overlapping, sometimes inaccessible to each other. What the practices share, the fundamentals of seed banking, is a frozen and liminal realm: a *cryosphere*, where the metabolic processes of seeds have been temporarily slowed down as much as possible, to be thawed again when germination is desired or needed.³ They span multiple borders and conservation regimes. I begin outside the SGSV, as a seed storage for the ‘genetic resource community’ in the Norwegian Arctic (chapter three), then move to the MSB which saves the diversity of planetary wild flora in the UK (chapter four), to the Union of Agricultural Work Committees food sovereignty seed bank in Palestine (chapter five), and the Kostrzyca Forest Gene Bank in Poland. Through this diversity of practices, I observe political realities and *divergent ecological imaginaries*, which I understand as sites of interaction and world-making amidst biodiversity crises.

I entered this research with the assumption that seed banks are not open to the public (Hartigan, 2017) and hard to access, yet at the same time control a powerful futurity of hope and conservation through their biopolitical management of vegetal life. Science and Technology Studies (STS) scholars Emma Kowal and Joanna Radin describe as ‘cryopolitics’ this governance of life through the lowering of temperature where life ‘may be beyond the reach of political power *or* especially vulnerable to it’ (2017, p.8; italics in original). Seed banks thus stabilise and suspend life through temperature and temporal delays. However, by the time I observed the yellow stream in Dura my perception of what seed banks *can* be, and what

² ‘Germplasm’ refers to living genetic resources, such as tissues, that are maintained for breeding.

³ Agri-scientific seed conservation techniques emerged in the late nineteenth century (Lehmann, 1981) and were developed into cold storage ‘seed banks’ as a response to the loss of crop diversity in large-scale industrial agriculture in the 1960s-70s (Peres, 2016). Today its usage extends to the conservation of wild plant biodiversity and grassroots and food sovereignty movements.

interventions in the present they make, had significantly shifted from understanding them in cryopolitical terms. In multi-sited observations I had started to see the radical potential and transformative effect of some conservation practices. In trying to interlink anti-colonial methods and more-than-human scientific ethics in each of the seed banks I visited I observed processes of adaptation, resistance, and care that actively challenged the previously discussed anthropocentric image of cryopolitical control. Saving and banking seeds had become a process that to me was as concerned with flows and circulations, struggles for sovereignty, recognition, and restoration, as it was with stabilisation. While my approach shared optimism with some of the cultures of conservation I observed, almost four years after starting this research the devastation of those worlds that these practices seek to build or remain within has become even more apparent: from a deadly humanitarian refugee crisis in the forest where the Kostryca Forest Gene Bank has collected plant and animal DNA, to pressures from right-wing policy groups and the *un*-decolonisation of RBG Kew's engagement with its history, to Israeli government raids on UAWC's offices in Palestine, the ground on which these practices work has rapidly become more contested and precarious.

I approached these practices from a background in cultural studies and art practice.⁴ Analysing seed banks as loaded sites for what it means to care for and preserve vegetal life in times of ecological crises, I first had to unlearn assumptions about scientific practice as well as slowly build a better understanding of seed biology and ecology. I couldn't 'think with' seeds and seed banks (Puig de la Bellacasa, 2017) without taking them seriously as collaborators in knowledge practices.

⁴ My disciplinary and methodological approach will be explored at length in chapter two. *A tomb of things that were and a womb of things to come* (ongoing), a film made in collaboration with Charles Pryor, was developed alongside the empirical research for this thesis, and many of the images included here are stills from this film. For a discussion of the film project and its methodology see Kießling, Boschen and Pryor, 2020. At the time of finalising these notes in April 2022 film editing is still ongoing. A performative iteration of this project, produced for Manifesta13 in Marseille in collaboration with Lou-Atessa Marcellin and Sara Rodrigues is included in Appendix 1. While I do not directly refer to scholarship in visual anthropology or visual sociology, the images embedded across this thesis seek to make visible and give a tactile impression of the slow practices of care I observed.

Alongside the research for this thesis, I also co-curated the exhibition *Soil is an Inscribed Body: On Sovereignty and Agropoetics* at SAVVY Contemporary in Berlin in 2019, which further explored questions of agroecology and liberation through artistic practices (Appendix 2).

By now the term ‘seed bank’ needs some unpacking. As one of my interlocutors at the Millennium Seed Bank said, the word ‘bank’ is not ‘connected to nature at all, it’s very connected to people with money [...] And it sounds secure’ (Erica, personal communication, 14 November 2019).⁵ This links to the evocative image of ‘seed banking’ as an insurance policy for biodiversity. Scholars from multiple disciplines have been drawn to seed banks and analysed them in this way, as powerful techno-fixes for biodiversity loss and genetic archives for agri-science including from the perspective of anthropology (van Dooren, 2009), critical heritage studies (Harrison, 2017; Breithoff and Harrison, 2020), STS and environmental history (Fenzi and Bonneuil, 2016; Peres, 2017; Curry, 2017), and cultural studies (Sheikh, 2018). Here, seed banks are a conservative technology of biocapital and endangered DNA.⁶ Recently, a range of scholars have explored the relationalities, living temporalities, and cultural politics of seed banking and saving as anti-colonial practices of resistance towards sovereignty (of land, seeds, and food) and cultural heritage conservation (Nazarea, Rhoades and Andrews-Swann, 2013; Phillips, 2016), in indigenous seed saving practices in North America (Breen, 2015) or within the Zapatista movement in Mexico (Aguila-Way, 2014). Despite the pervasiveness of these approaches to theorising the banking of seeds, in this thesis I propose that what has so far been overlooked is what is *shared and contested* across practices and *through practice*. I thus build on the important, in-depth studies of seed banks as germplasm collections (Peres, 2017) and more-than-human assemblages (Lewis-Jones, 2018b), and of the politics of seed saving (Phillips, 2016). I depart from these works by bringing together embodied knowledges and more-than-human sensitivities with a political

⁵ All interviews across this thesis have been anonymised and respondents have been given pseudonyms. The research had ethics clearance within the department of Media, Communications and Cultural Studies at Goldsmiths. I used consent and participant information forms to contextualise the research and data use before I conducted interviews.

⁶ While seed banking clearly resonates with terminology of the financialisation of nature and concepts such as Natural Capital or biocapital, I will only address these to the extent that they surface in each practice and its organisational model. For a conceptualisation of Natural Capital see Barbier (2019) and a critical discussion of the financialisation of nature see Büscher, Dressler and Fletcher (2014).

reading of seed banking cultures, thereby working towards *a politicisation of the more-than-human*.⁷

While this research is not conceived to directly compare the selected practices, I observe patterns and relations between practices to describe their respective and unique world-making. Practices of seed banking have been analysed separately, rather than as cultures of conservation and persistence. Yet they mutually and simultaneously grapple with rapid loss of biodiversity and growing calls for the decolonisation of a single Western, canonical ecology into multiple ecologies (Ferdinand, 2022). Through a material and speculative engagement with vegetal life I show that as a technology of conservation seed banks can contain and (re)imagine worlds and ecologies. This research suggests that by studying how practitioners are transformed by the care for seeds and learn from their objects of conservation, the potential for more-than-human ethics and politics practiced in seed banking becomes evident. It is therefore productive to explore ‘what can a seed bank be?’ and ‘what is a seed?’ to ask how caring for these seeds might initiate a transformative, or even, resistant relationship.

This plurality of what a seed bank can be is crucial in my exploration of seed banking practices and their entanglement in human mastery over ‘nature’, extraction, and the ethics and politics of conserving life.⁸ Each practice’s understanding of diversity and relationality differs, yet all practices considered use ‘seed bank’ as a framework to describe their containment of seeds.⁹ Containment here is aligned with colonial practices of ordering and classification and I use it to refer to the withholding of seeds from their seed ecological cycles

⁷ The ‘more-than-human’, first used by David Abram (1996), is a productive concept for holding life forms that include but are not exclusive to the human without being bound to the category of ‘species’. The ‘more-than-human’ has been used as a framework for relationality by a range of scholars (including van Dooren, 2009; Tsing, 2013; Neimanis, 2015; Haraway 2016; and Puig de la Bellacasa, 2017) and has become particularly useful in reframing the object of anthropology. I use the term more-than-human throughout to actively contribute to its theorisation, in particular the political and ethical capacities of the more-than-human with regards to notions of sovereignty, care, and mastery.

⁸ Throughout this thesis I put in quotation marks understandings of ‘nature’ and ‘culture’ if they are positioned in a socially constructed dualism to each other (see Descola, 2013 for an overview of Western understandings of ‘nature’ and ‘culture’, as well as chapter one in this thesis and later discussions on *naturecultures*).

⁹ It is important to keep in mind that many seed saving organisations reject the term ‘bank’ and prefer to be seed libraries in their reference to free sharing, distribution, and circulation (see Sansour, n.d., for the Palestine Heirloom Seed Library).

of reproduction. Throughout this thesis containment also speaks to the role of nation states and private organisations in the conservation of seeds, thus creating a liminal space for past and present interventions in seed ecology. This containment evolves across the thresholds of *time* through suspension and delay, and of *temperature* through freezing to extend seed longevity and slow down metabolisms. Seed banking practices make tangible a sense of urgency in the protection of seeds, but also show that seed saving cultures are much older than the first agri-scientific seed banks. My path to selecting practices came from wanting to observe a range of different ecologies in industrial agriculture, threatened wild flora, food sovereignty and land struggles, and the relationality of old growth forests. In developing relationships with individual practices and practitioners, I was long resistant to seeing individual practices as ‘case studies’ as it seemed to reproduce the classificatory politics of banking individual species.¹⁰ It is important to note that the relations and networks they form are crucial to the ecology of practices across the case studies.

Empirical research consisted of interviews, observations, practical participation in seed conservation activities, and the attendance of events such as the SGSV Seed Depositing Ceremony in 2020. Across the four case studies I conducted 31 interviews with structured and unstructured components. Being able to observe practices often came through introductions and connections within the wider ecology of practices. While a narrower focus on, for instance, seed banking for restoration projects would have led to a different set of practices, I argue that the divergence in ecological imaginaries assembled here will reveal a tension in how seed banking is multiple – more-than-human ethics can work towards a passive stabilisation of life forms but also transformative and radical interventions and conflicts.

¹⁰ Initially, I wanted to focus more on the movements of seeds between different seed banking practices, yet the practicalities of doing research during Covid-19 and my increased understanding for the individual complexities of each practice means that I am presenting them here as separate empirical chapters.

Seeds

What is a seed? Flicking through the folders containing the learning materials of the globally renowned seed conservation course at the MSB I came across the following definition: a seed is a ‘mature and fertilised plant ovule’; it is ‘the unit of reproduction of a flowering plant, capable of developing into another plant’.¹¹ In this definition seeds hold *past and future plants*. This past plant can be the outcome of millennia of human-vegetal relations through practices of cultivation, migration, and consumption. Seeds are multiple, as discussed so far, in meaning and matter. In human-vegetal ecologies they become genetic data, future resilience, biocultural heritage, biosocial archives, powerful spiritual and philosophical metaphors, and much more.¹² It is difficult to pin down the lure to the imagination contained in seeds as well as their complexity as portable time-bending objects. An interlocutor beautifully described a seed’s speculative temporality: ‘a seed is a mystery that hasn’t happened yet’ (Lech, personal communication, 28 March 2019).

Seed ecology, how seeds interact with their environments including through processes of dispersal, dormancy in the ‘soil seed bank’ (natural seed deposits in the soil), and germination (Fenner and Thompson, 2005), involves a complex range of temporalities and relations. It thus provides an important framework in conserving seeds not just as objects but as ecological agents that communicate and respond. Listening to practitioners, *learning from plants* about processes of resilience and adaptation is crucial in not anthropomorphising vegetal life but acknowledging its unique adaptive potential. Seeds appear as future ‘forests in a box’ (chapter four) and time-bending devices to a cultural past and history of local adaptation (chapter five). Or as valuable genetic archives for future plant breeding (chapter

¹¹ See a similar definition in Locascio *et al.* (2014).

¹² I use ‘biocultural’ and ‘biosocial’ throughout this thesis to describe how the social and the cultural are always more-than-human and shaped by human interactions and dependencies on nonhuman others. The term ‘culture’ itself comes from agricultural relations (Hartigan, 2017) speaking to the role of more-than-human cultivation in how we understand the locus of culture. Thom van Dooren describes the biosocial as both reflective of the genetic parts that plants have been turned into in conservation and wider diversities that exceed this. He provides a succinct application of the biosocial to cultivation and agricultural science as ‘the way in which humans are inextricably entangled with various non-humans in both the cultivation of crops and the making of agricultural socialities, knowledges and practices’ (2009, p. 375).

three). Yet, seeds are also often resistant (technically referred to as ‘recalcitrant’) to processes of banking (chapter four). As slowly becomes clear, the question of what a seed is cannot be answered in stable ways; it is intimately connected to the practices in which the seeds are involved.

What makes most seeds ‘bankable’ is their capacity for spatial and temporal mobility. Conserved in the right conditions, ‘orthodox’ seeds can be stored for long periods of time. Orthodox seeds are seeds that are long-lived and can be dried to five percent moisture content while still able to tolerate freezing without tissue damage. In conventional seed banking ideal storage conditions are at -18°C . Here, molecular and metabolic activity is restricted and thus slows processes of ageing. One interviewee, a cryobiologist, described the conservation of seeds at extremely low temperatures as a ‘solid, glassy state [...] They are rocks, living rocks’ (Morgan, personal communication, 15 January 2019). I find these *living rocks* a useful image to think with. It carries the contradictions of suspended life and the slowness of time at low temperature. And yet it also shows how seed scientists sometimes imagine their subjects of care outside of biological conventions.



Figs. 0.6-0.8. Three carrier seeds and their fruit

Fig. 0.6. The Cherokee Trail of Tears black bean (*Phaseolus vulgaris*) deposited at the SGSV in chapter three. Photograph: the author, 2020

Fig. 0.7. A banana wild relative (*Musa velutina* from Kew’s Palm House) with its seeds. Photograph: Chris Cockel, October 2017, reproduced with permission

Fig. 0.8. A white cucumber (*Cucumis melo*) at UAWC’s seed bank in Hebron preserved in chapter five. Photograph: the author, 2019

In scholarly discussions seeds range from valuable resources of conservation in botany, forestry, and agri-science (Eastwood et al., 2015; Fenzi and Bonneuil, 2016; Curry, 2017; Hartigan, 2017; Montenegro de Wit, 2017) to speculative agents in the context of critical plant studies (Marder, 2012 and 2013; Myers, 2015; Irigaray and Marder, 2016), mobile subjects of hybrid geographies (Whatmore, 2002), carriers of ‘wild memory’ (Bristow, 2015), records of bioprospecting and colonisation (Chacko, 2019b), collaborators in struggles for sovereignty in agroecology (Nazarea, Rhoades and Andrews-Swann, 2013; Aguila-Way, 2014), and carriers of survival in multispecies extinction studies (van Dooren, 2017). This multiplicity shows how seeds are both biosocial and biocultural. Put differently, seed banks are archives of ‘naturecultures’ (Haraway, 2003), of past and future co-cultivation.

In the following chapters I propose specific meanings of seeds and their relations by observing a *carrier seed* in each practice. This is a narrative and analytical device for tracing the movements, histories, and surrounding practices of care of a specific variety as it passes through the seed bank and surrounding ecologies.¹³ Carrier seeds thus enable a unique shifting between and folding inwards of classical ecological scales from organism to population, community, ecosystem, and biosphere and their wider social and cultural resonances. In this way, my approach to representing seeds dialogues with interdisciplinary research across new materialism, feminist STS, and anthropology that argues for the importance of acknowledging more-than-human agency (Marder, 2013; Neimanis, 2015; Myers, 2015). At the same time, I also highlight challenges that emerge for representation (Kohn, 2013; Roncancio, 2017; Singh, 2017) and interspecies politics (Youatt, 2020) in exploring the ethical and political potentials of the more-than-human. Critically, the carrier seeds reveal how what is understood as sovereignty, conservation, resilience, and vulnerability is produced in practice.

In chapter three, I follow a Cherokee Trail of Tears black bean to the Arctic to ask what kind of sovereignty is stored and being absorbed here. Chapter four follows a banana wild relative as it is sent out from the MSB to collaborating research organisations to ask how drives

¹³ The methodology of the *carrier seed* is described in detail in chapter two.

for decolonisation enter global botanical institutions and bring up difficult collection histories. In chapter five the rainfed cucumbers introduced earlier allow me to observe practices of persistence in Palestinian seed saving.¹⁴ Across practices a shared interest in *wild relatives* will appear as a pattern. Wild relatives are plants that are closely related to a domesticated crop, often their ancestors. They are sought after for potential resilience to pests and harsh climate conditions that commercially bred varieties suffer from. Therefore, exploring how wild relatives are treated opens interesting challenges to constructed binaries between ‘nature’ and ‘culture’, ‘wild’ and ‘domesticated’ species, and ‘traditional’ and ‘scientific’ knowledges.

Care

What became noticeable when I participated in the seed extraction and seed cleaning in Dura as we scraped out the cucumber seeds and washed away the fruit pulp was the haptic and embodied quality of care in seed banking. Haptic care, yet of a politically different kind also occurred when representatives of more than 30 organisations handed over their seed accessions at the SGSV in the largest depositing event since the opening of the vault in 2008. It was accompanied by a presentation that promoted ‘Taking Care of the World’s Seeds’. Or, at the KFGB in Poland, where care involved ‘waking up’ oak embryos after cryo-preservation in liquid nitrogen. These embryos needed to be supplied with all nutrients and hormones that the seed package would have provided if it hadn’t been removed to enable cryo-preservation. I also learned of a destructive kind of care when I was told that all seedlings grown in germination tests at the MSB need to be incinerated according to protocol.¹⁵ Analysing seed banks as scientific practices of care thus allows for the exploration of the complicated dimensions of regimes of care in conservation, which often carry violence as van Dooren

¹⁴ Some of these carrier seeds I grew myself, not always successfully, in the methodological attempt to meet these carriers of adaptation and resilience on a different, embodied level. These growing experiments are discussed in chapters two, three, and five.

¹⁵ Morgan, a seed scientist at the MSB, described that there are practical reasons for these protocols: the MSB doesn’t have the capacity to look after all the seedlings it produces (personal communication, 2019). Additionally, there are health and safety concerns attached to species that could become invasive. The plants that tend to be cultivated and survive are those with interesting stories attached to them or those that look aesthetically appealing.

argues (2014).¹⁶ He addresses the ethical difficulties of conservation where protecting some species from extinction will be to the detriment of others, and where individuals can be sacrificed for ‘the greater good of conservation’ (2014, p. 117). These moments begin to show how care in seed banking makes evident what feminist STS scholar Maria Puig de la Bellacasa (2012) describes as the ‘affective, political, and practical’ dimensions of care. Care is ‘noninnocent’ and at times paternalistic, entangled with control, exploitation, and the depletion of resources (Puig de la Bellacasa, 2017).¹⁷ Care as an ethico-political practice is central to my research methodology responding to (feminist) STS theorists in their conceptualisations of care in scientific practices (Mol, Moser and Pols, 2010; Law, 2015a; Singleton, 2015; Schrader, 2015) and broader considerations of the ethics of care (Tronto, 1993; Held, 2006; and Puig de la Bellacasa, 2017), in particular in the relation to *conservation as care* (van Dooren, 2017; Hartigan, 2017; Parreñas, 2018).

Taking seed banking seriously as a practice of care also means ‘thinking-with’ (Puig de la Bellacasa, 2017) plant breeders, seed conservation scientists, food sovereignty activists, and foresters to acknowledge difference in their knowledge and world-making. It means observing care as it is practiced – ontologically, epistemically, and politically – by individuals, not just institutions. It also means to not reduce practices to their often-problematic histories. Thinking with care in this sense allows for a working towards a more-than-human ethics of care in seed conservation. Thus, the encounters with care are multiple throughout the following chapters: care can be extractive, violent, heroic, and global in its ambition but at times also radical, vulnerable, and grounded.

Throughout the process of researching this thesis I was often reminded of Donna Haraway declaring ‘I will critically analyse [...] only that which I love’ (1997, p. 151) when holding the affective tension of not demonising practices based on their colonial histories,

¹⁶ Violence here also implies Macarena Gómez-Barris’ use of the term as both a containment that turns life into a commodity and an epistemological violence that reduces life to systems (Gómez-Barris, 2017a, p. xix).

¹⁷ Puig de la Bellacasa addresses care critically as ‘noninnocent’ (a term taken from Donna Haraway (2008) for interspecies relations) and often shaped by ‘pastoral paternalism, the power it gives to care takers, and the unequal depletion of resources it implies in existing divisions of labor and exploitation of nonhumans and human’ (2017, p.164).

biopolitics, and noninnocent conservation practice but looking closer at processes of transformation and reconfiguration. I sought to practice care in how I related to my interlocutors, human and non-human, and was influenced by multispecies ethnographies that carefully manage to give space and visibility to more-than-human others whilst discussing the wider ethico-political implications of care (Rose, 2012; Tsing, 2015; Kirksey, 2015; Hartigan, 2017; and Parreñas, 2018). ‘Listening’, as a slow and steady form of attention, became an important methodology – of practitioners listening to and learning from plants—and of me listening to the practices I encountered. I experimented with what it would mean to listen for vulnerability. Postcolonial literary scholar Julietta Singh’s concept of ‘vulnerable reading’ (2017) runs throughout the following chapters in attempts to sense this precarious collaborative world-making (and unmaking) of seed banking. It was crucial for tracing how vulnerability can challenge previous conceptions of human mastery over ‘nature’. I work with Singh’s definition of mastery as a concept at the ‘threshold of matter and narrative’ throughout this thesis. She writes

mastery invariably and relentlessly reaches toward the indiscriminate control over something—whether human or inhuman, animate or inanimate. It aims for the full submission of an object—or something *objectified*—whether it be external or internal to oneself (Singh, 2017, p. 10; italics in the original).

In the face of mastery vulnerability was multiple in how I encountered it in human-vegetal ecologies – from constructions of ‘vulnerable’ seeds in need of human saving to ecological vulnerability and a collective vulnerability to environmental crises. As a writing exercise this thesis therefore suggests care in witnessing the ‘unmaking’ of life in the Anthropocene (Rose, 2013).¹⁸ I propose this process of writing becomes a form of conservation – of putting words to partial fragments and glimpses of that which escapes the frameworks and materialities of *ex situ* and *in situ* conservation. These fragments include stories and histories of co-cultivation, co-dependency, and the slow practices of care beyond a ‘techno-heroic’ (Le Guin, 1996) human mastery over ‘nature’.

¹⁸ Criticisms of the Anthropocene and its temporalities are explored further in chapter one in the section ‘Planting Divergence’.

Across Time and Space



Fig. 0.9. *Leucospermum conocarpodendron* plant in MSB greenhouse grown from seeds collected in 1803. Photograph: the author, 2019

Inside the MSB's greenhouse, I encountered a mysterious plant (*Leucospermum conocarpodendron* subsp. *Conocarpodendron*) that was grown from a seed collected during an expedition to South Africa approximately 220 years ago. Its soft and furry leaves gave no indication of the time span it had spent as a seed. Across the Royal Botanic Gardens Kew (RBG Kew), it is a famous example for seed longevity and one of the longest living seeds that has been documented. Jay, the horticulturalist who had grown this plant, described the gentle pressure she felt in looking after and growing its seedlings. Grown from a collection of 40 seed parcels that were discovered in the UK government's National Archives, this plant was a powerful living example of the infrastructures and histories of botanical economies and the movement of plant materials to European scientific centres. The aftermaths of colonialism and the ongoingness of coloniality (Quijano, 2000; Mignolo, 2007) and extractivism (Gómez-Barris, 2017; de la Cadena and Blaser, 2018) are present across the case studies and their

epistemological and scientific practices. How plants were an integral part of the colonial project and led to the creation of powerful botanic institutions has been discussed in analytic detail in postcolonial STS and environmental history (Brockway, 1979; Schiebinger, 2007; Endersby, 2008). This thesis contributes to these historiographies by highlighting the relevance of thinking through the lens of coloniality when analysing practices in the present and their visions for the future. This analysis of scientific practice is particularly insightful at a moment in time when many seed banking institutions are newly absorbing indigenous forms of sovereignty (chapter three) or confronting their past entanglements of colonisation and botanical scientific practice (chapter four). Because the organisations assembled here do not merely archive seeds but actively shape the ecologies these seeds exit from and enter into, I propose that this thesis shows how the meaning of what is understood as decolonisation and seed sovereignty is produced *in practice*.

RBG Kew's 2020 *State of the World's Plants and Fungi* report opens by stating 'never before has the biosphere, the thin layer of life we call home, been under such intensive and urgent threat' (2020, p.2). The report argues that currently two out of five plants are threatened with extinction. It is hard to contain – in writing or in scientific practice – the multiple crises of the present, their scales of loss, and the finality that is extinction as they threaten ecological relationality and collective survival (van Dooren, 2014; Rose 2017). In this context seeds are hopeful objects to mitigate the effects of droughts, rising temperatures, soil erosion, and food scarcity. As a gesture of stabilisation the freezing of seeds is arguably very much a product of its time based on a belief in technical fixes to ecological devastation (such as discourses of greening deserts and seeding clouds). Rather than a solution, the movement of plant materials from across the globe into centralised storage spaces might thus be more akin to a buffer or a small delay in the temporalities of ecological crises. Seed banks as cultures of conservation offer how responsibility in the present can be delayed through keeping life forms in liminal frozen states.

Seed banks put *ecological time* – patterns of growth and reproduction as well as relations with other life forms – on hold and make active interventions in the present. There

is a diversity of temporalities at play in seed banking through containments, delays, and suspensions. But they are also bound by the cyclical temporality of seed ecology, its cycles of seed reproduction and dispersal as well as limited timeframes of just how long seeds can endure cryogenic temperatures before they need to be regrown. How long seeds are viable in cryo-storage varies between species and recalcitrant seeds cannot be frozen at all. Bringing together multiple temporalities seed banks thus can be read as productive meeting points of imperialist pasts, ecological conflicts of the present, and future visions of decolonisation, eco-nationalism, and sovereignty. They can curate what I term *national nature* (chapter six), a nationalist scope for the conservation of biodiversity that links ‘nature’ to identity through exclusion of an invasive ‘other’.

The multi-sited approach across the four practices is influenced by geographical and anthropological scholars who show the spatial mobility of specific life forms which are at once caught in capitalist webs and situated practices of care (Tsing, 2015; Hartigan, 2017) alongside careful analyses of the role of seeds in global zones of governance (Whatmore, 2002; Kloppenborg, 2005; Nazarea, Rhoades and Andrews-Swann, 2013). I am aware that this is a large spatial scope to hold. Yet, I am convinced that through the tracing of spatial movements of *seed circuits* (the movements of seeds into and out of seed banks) tensions of access and exclusion will become visible. Following the movements of seeds (or lack thereof) shows which potential futures for seeds are in fact enacted, while also revealing complexities and conflicts between situated, local ecologies, nation states, global conservation frameworks, and planetary ecologies. In their ties to land, soil, agriculture, and settlement seeds are also fundamental for wider debates on the commons and struggles for sovereignty (Tsedell, 2013; Azoulay, 2019,) and could feed into discourses on tools of resistance against the spatial oppressions of settler colonialism (Weizman, 2015; Bhandar, 2018; Azoulay, 2019), extractivism (Gómez-Barris, 2017; de la Cadena and Blaser, 2018), and colonial epistemological practices (de Sousa Santos, Nunes and Meneses, 2007). Ecologies that stretch across cultural and national borders – what I term *border ecologies* in chapters five and six – are particularly productive in analysing seed banks as spatial practices. While the first two

empirical chapters focus on seed banking projects that work through the global mobility and representation of seeds, the chapter on Palestinian seed saving (chapter five) and the Białowieża forest conservation conflict in Poland (chapter six) reveal the powerful entanglements of national natures and ecological imaginaries in border ecologies.

CULTIVATION

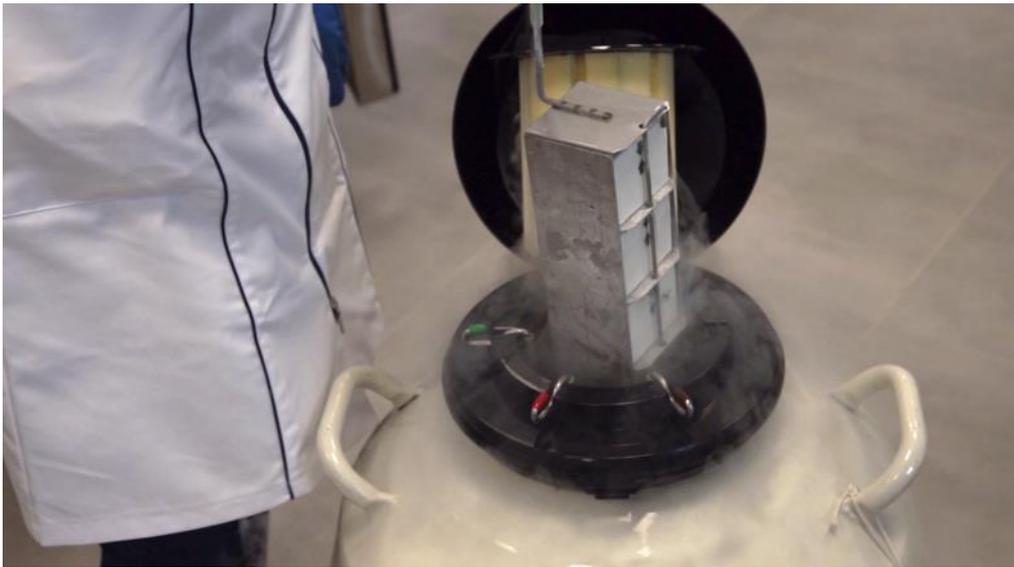


Fig. 0.10. DNA samples extracted from plants and animals from the Białowieża National Park held in cryo-conservation in liquid nitrogen. Photograph: the author, 2019

Saving seeds and the more technical banking of seeds are fundamentally hopeful; these seeds might be cultivated in the future – if not, then what would be the point in saving them? Following from *COLLECTION* and *CONTAINMENT* the question eventually becomes: at what moments in time do seeds leave their frozen states and re-enter into a ‘melting world’ (Radin and Kowal, 2017) of rising temperatures and environmental change? During my stay at the MSB one interviewee voiced her frustration with current banking protocols and the limited futures available for seeds. She wished for a more critical examination of whether and how seeds will exit the seed bank again and what kinds of restoration projects they feed into. She challenged what it would mean if ‘we’re not just banking, but we’re banking for it to be used and to be used in a certain way. What are we banking and why?’ (Billy, personal

communication, 13 November 2019). Moments like this, when practitioners explored what other possibilities their living collections hold, were crucial in developing the over-arching research question running through the empirical chapters: *what are seed banking practices saving (for)?* In its double focus on the materiality of the objects of saving and the temporality of saving ‘for’ a future moment of release the question contains the material-semiotic complexity of seed banking and its orientation towards the future. More specifically, what are the patterns of becoming in how practices shape and imagine their pasts, presents, and futures?

I describe these futures embedded – and, as I will argue, constantly reconfigured – in seed banking practices as *ecological imaginaries*. I draw this term from Astrida Neimanis, Cecilia Åsberg, and Johan Hedrén’s (2015) discussion of ‘environmental imaginaries’ as sites of interaction and worlding practices in the face of environmental crises with both speculative and material effects. My focus on the *ecological* rather than the *environmental* seeks to foreground relationality and interdependence, working with biologist Merlin Sheldrake’s definition of ecology as the ‘study of the relationships between living organisms’ (2021, p.19).¹⁹ My understanding of relationality – in an ecological but also social and cultural sense – also draws from philosophical traditions of process-relational ontologies (Whitehead, 1978), assemblages (Deleuze and Guattari, 1987), decolonial philosophy (Glissant, 1997) as well as anthropological approaches to relations in knowledge-making (Strathern, 2020).²⁰ The discussion of ecological imaginaries is grounded in scholarship on multispecies world-making (Tsing, 2015; Haraway, 2016; Gan, 2016b) and theorists who have discussed world-making critically in relation to coloniality (Venn, 2018; de la Cadena and Blaser, 2018). ‘World’ or ‘worlds’ are uneasy containers here that give space to the incommensurability of practices and

¹⁹ In Neimanis et. al’s understanding the environmental imaginary is grounded in the context of the ‘environmental humanities’ as a developing and shifting academic field.

²⁰ I further discuss relationality in chapter two in reference to Haraway’s concept of becoming-with. Martinican philosopher Édouard Glissant’s notion of Relation is important to briefly mention here in bridging decolonial philosophy and ecology. Glissant uses Relation to describe experiences of shared knowledge. He coins a ‘poetics of Relation’ as a rhizomatic mode of thought and of becoming ‘in which each and every identity is extended through a relationship with the Other’ (Glissant, 1997, p.11). Glissant also refers to the imaginary; he discusses the political potential of poetics in shaping the imaginary as the way a culture conceives its world.

local ecologies, to recognise culture and context. Throughout this research ‘ecology’ is often a better descriptor than ‘world’. Yet, world remains present for the consideration of how practices manifest embodied, situated enactments of their worlds. A focus on ecological imaginaries enables an exploration of what Neimanis et al. (2015) discuss as an investigation into the ethics and politics of the Anthropocene and the ontologies and epistemologies of environmental organisations such as seed banks.

To explore the present and futures held in each practice I describe human-vegetal ecologies as formations of ‘becoming-with’, which Haraway (2008) defines as a becoming that is shaped by being in relation. These formations are *becoming-safe* in the Norwegian Arctic, a vulnerable *preserving-with* at the MSB, *persisting-with* as a practice of resistance in Palestine, and *becoming-forest* in the conservation conflict in Poland. All these becomings are forms of stabilisation, of saving and protecting, of holding something so it doesn’t slip into disappearance. Ecological imaginaries of becoming-with are thus explorations of more-than-human ethico-politics, of what it means to save and care for a seed amidst vulnerability and conflict.

Does a seed bank mainly preserve practices of mastery and Eurocentric beliefs in linear progress that have already failed (Radin and Kowal, 2017)? Arguably, seed banking as a technology can embody a continuance of colonial imaginaries of extraction, containment, the commodification of life through scientific methods, and the making vulnerable of ‘the other’. With seed banks often tied to powerful botanical or agricultural institutions, during the time period that I worked on this thesis (September 2018-March 2022) powerful mobilisations for decolonisation (chapter four) and against settler colonialism (chapter five) and extractive capitalism (chapter six) emerged across the case studies. In particular, the public response to the murder of George Floyd in May 2020 and the subsequent intensified Black Lives Matter protests globally led to a deep questioning of the colonial heritage of botanical institutions (Antonelli, 2020) and their role in a world where the interlinking of environmental destruction and racialised capitalism is increasingly undeniable (Klein, 2016; Verges, 2017; Venn, 2018; Ferdinand, 2019). A decolonial and postcolonial approach to ecology is therefore needed in

analysing how the practices assembled here are caught up in more-than-human politics on local, national, settler-colonial, and planetary scales.²¹ This thesis contributes to these important joint readings of environmentalism and anti-racism in analysing how institutions who hold power over vegetal life are responding to these confrontations.

Multiple formations of sovereignty – national, ecological, bodily – are examined across this thesis. Some depart from an understanding of sovereignty as a Western concept of supreme authority that links state power and territory, as ‘he who decides on the state of exception’ developed by authoritarian theorist Carl Schmitt (quoted in Agamben, 2004, p.1). Put differently, it is a question of who is included in the world and under which terms. Recent formations of sovereignty depart from the state form, challenge the Eurocentric foundations of sovereignty in the Westphalian peace of 1648 and the European state system that emerged from this (Hansen and Stepputat, 2005), and are particularly significant for seed saving. They offer alternative, bodily and ecological relations to Schmitt’s theory of power, such as food sovereignty, which is the self-determination to produce and consume one’s own food. Ariella Aïsha Azoulay’s concept of ‘worldly sovereignty’ also rejects the framework of the nation-state as the foundation of sovereignty. Worldly sovereignty, what she describes as ‘persisting and repressed forms and formations of being in the world’ (2019, p. 388), runs through these chapters as a resistant relation to what she terms ‘imperial sovereignty’. In each seed banking practice, I consider how its project of conservation is also always a *self-conservation*, an extension of an archive as a system of order, values, and care into the future (Azoulay, 2019). I seek to build on Azoulay’s conceptualisation by investigating the potential of reading worldly sovereignty through the more-than-human, as a form of *co-cultivation*.

²¹ The origins of postcolonial and decolonial studies are geographically and epistemologically distinct (Bhabra, 2014), yet their shared concern for colonial legacies explains theoretical references to both debates across this thesis. Gurminder Bhabra suggests that both postcolonialism (developed in the foundational works of Spivak (1988), Bhabha (1994), and Said (1995)) and decoloniality (as conceptualised in the works of, for instance, Mignolo (2000), Quijano (2007) and Lugones (2007)) emerged with a sensitivity towards the geopolitics of knowledge production. Yet she argues that the temporalities of their subjects of knowledge differ – decoloniality starts from the European colonisation of the Americas in the fifteenth century and the socio-economic world system that emerged from this, whereas postcolonialism is grounded in nineteenth and twentieth century discussions of the cultural impact of colonialism.

Returning to the seed extraction in Dura, after the visit to the women's support group the staff from the seed bank discussed whether they should support the group. Leila, the seed bank's project manager, asked me if I thought the group would be good to work with, if they were motivated and committed. This was one of many moments where I was unsure of how my perspective as a researcher was actively influencing the practices I sought to observe. In the same way that I was curious to learn in moments like this, or when discussing the decolonisation process at RBG Kew, I felt that practitioners cared about my opinion and the perspective I could offer. Becoming-with turned into a methodological consideration: how was I affecting the practices I was observing and vice versa? This in many ways was the strongest experience of listening to, but also being listened to, of noticing how practices responded to and adapted in the present. What those practices assembled here share is a struggle for *remaining in the world*. This research shows how this remaining in the world is imagined, but most importantly, how it is practiced. Most of all, through a focus on relationality, it can draw out the tensions between hopeful imaginaries in cultures of conservation and material practices of co-cultivation, conflict, and persistence.

Thesis Outline

Chapter one **Theoretical Foundations for Banking on Seeds** frames my cultural reading of seed banking practices through interdisciplinary perspectives including plant and conservation science, the environmental humanities, feminist STS, and post- and decolonial theory. It offers a historical contextualisation of human-vegetal ecologies of mastery and sovereignty through a discussion of the interconnections of colonialism, bioprospecting, global plantation systems, and the social construction of 'nature', 'culture', and 'race'. These dynamics of mastering vegetal life continue into the present through the Green Revolution and genetic enclosures of seeds. I connect this to today's seed conservation infrastructures and the cryopolitics involved in the temporalities and materialities of freezing life. On this basis, I position this thesis within critical scholarship on the Anthropocene to argue that through a

focus on divergence differences will become evident in the ecological imaginaries brought together by different seed banking practices. In the final section I focus on the multiple readings of what a seed can be, what it can contain and carry. In this section I interweave biological, philosophical, and economic perspectives on seeds.

Chapter two **Becoming-with in an Ecology of Practices** begins by posing the question ‘how can a seed tell a story?’. In working towards possible answers, it outlines the empirical and ethical approach I take, as well as conceptual methodological reflections on representation, relationality, and practice. I introduce the approach to interviews and observations as well as the selection of practices and position them within an ‘ecology of practices’, which enables a focus on relationality and divergent knowledges. I propose ‘listening against mastery’, drawing on Singh (2017), to focus on vulnerability and care, and develop the concept of the *carrier seed*. Reflecting the writing process as a form of representation I discuss the challenges of writing about vegetal agency. This chapter draws from a foundation of methodological approaches from feminist STS which are put in relation with decolonial and postcolonial perspectives on questions of representation, mastery, and accountability.

Chapter three **Becoming-Safe: Global Care in a Seed Depositing Ceremony** observes a depositing ceremony at the SGSV in the Norwegian Arctic in February 2020. It traces an organisational response to ecological vulnerability: the flooding of the vault’s tunnel through melted permafrost water and the structural upgrade that followed. The performative depositing ceremony lays out the different temporalities and politics at play in the SGSV, its relation to the Arctic as a precarious ecology, and the global ‘plant genetic resource community’. Using the SGSV as a platform for divergent interests the chapter makes evident the role of rhetoric and storytelling in the mediatisation of global seed-saving narratives around vulnerability and securitisation in crop science and global agricultural systems. Carried by the Cherokee Trail of Tears black bean variety deposited by the Cherokee Nation it reveals the complex projection of international collaboration and mutual dependency

contained in the SGSV, and how anti-colonial narratives of sovereignty and resistance are absorbed into this.

Chapter four **Preserving with Vulnerability: Undoing ‘Forever’ from within the Millennium Seed Bank** follows a banana crop wild relative in the MSB at RBG Kew in Wakehurst in the UK. In this chapter I seek to further understand the challenges of freezing life and how recalcitrant seeds resist being frozen. I suggest that liminal, suspended states can be a useful point of critique for thinking through current seed circuits and the multiplicity of futures for seeds to move through seed banks and, importantly, out into life worlds. I analyse a selection of interviews with plant scientists, conservationists, cryotechnology specialists, and science education workers alongside visual materials and science and collection strategies to ask how organisational vulnerability can lead to the development of new relations and anti-colonial methods from within organisations that have taken on the global care for seeds. This chapter challenges the techno-heroic notion of seed banking observed in chapter three and brings to the surface personal and intimate encounters with plants and the multispecies ethics of taking care of the world’s wild flora.

Chapter five **Persisting with Radical Care: More-than-Human Worldly Sovereignty in a Palestinian Seed Saving Practice** follows the activities and activism of UAWC across the West Bank through observations and interviews with farmers, agronomists, and ecologists. While scientific protocols mirror the practices in the previous chapters, this chapter argues for the importance of witnessing and making visible more-than-human dynamics of conservation as resistance in a precarious border ecology. I explore how settler-colonial spatial and temporal pressures on agro-ecologies in the West Bank affect ecological imaginaries. Learning from how indigenous rainfed seeds have adapted to a hostile climate, the chapter follows an almost extinct white cucumber in revealing the situated knowledges of farmers and multiple meanings of seeds as carriers of biocultural memory, national identity, and persistence. I observe a culture of *radical care* shaped by cultivation, ingestion, and the preservation of living heritage amidst environmental contamination and erasure to discuss the possibility of more-than-human ‘worldly sovereignty’ (Azoulay, 2019). Ultimately, I ask if

there can be a practice of seed banking without mastery that is instead shaped by grounded and embodied struggles for sovereignty.

Chapter six **Towards Restoration? Disturbance and Intervention in the Białowieża Forest Border Ecology** traces the making and unmaking of forests as complex, biosocial ecologies and how extractive, nationalist imaginaries shape forest ecologies. Building on the previous chapters' findings that relationality escapes seed banking in its focus on *species* and *genetic data* as the objects of stabilisation, this chapter observes a forest conflict and its relation to seed conservation. The conservation conflict revolves around the logging of the primeval old growth Białowieża forest in Poland and the KFGB's project to bank its genetic diversity in a new high-tech cryo-storage laboratory. The conflict raises questions about the governance and financialisation of forest worlds and how they feed into imaginations of national identity and various formations of sovereignty. This chapter critically analyses the blurring of financial and conservationist motivations and challenges the notion of ecological sovereignty. Human forest interventions, such as clone forests, assisted migration, and restoration support arguments for a forest life world that works with rather than against human practices in conceiving political capacities.

In the **Conclusion: Beyond a World on Hold** I discuss the potential of thinking with wild relatives and recalcitrance, and of reading seed banking as a spatiotemporal intervention. I argue that amidst rapidly eroding ecologies, conservation conflicts, and struggles for sovereignty the world-making of seed banking is not inherent its technology and can be utilised for divergent ecological imaginaries. These go beyond treating seeds as manageable genetic data and towards formations of sovereignty that are embodied and grounded in cultivation as a resistance to mastery.

Chapter One

Theoretical Foundations for Banking on Seeds



Fig. 1.1. View from inside the Millennium Seed Bank greenhouse. Photograph: Charles Pryor, 2019, reproduced with permission

Introduction

When I explored the greenhouse adjacent to the Millennium Seed Bank (MSB) at the Royal Botanic Gardens (RBG) Kew in Wakehurst in Sussex, Jay, the horticulturalist based at Wakehurst's nursery, recounted a near-encounter with extinction. It demonstrates important lines of thinking, temporalities, and imaginaries for the theoretical foundations of seed banking across this chapter. Jay germinates and grows seedlings for the MSB, often with very little available information about wild seeds that have been collected in their habitats across the planet. She closely observes them as they germinate, trying to understand their ideal environmental conditions of biotic and abiotic factors.

According to Jay, a few years earlier the nursery had received seeds of a succulent collected by botanists in South Africa, taken from the last surviving population. They had

managed to transfer these seeds to what would become the MSB while the population in the wild went extinct due to industrial agriculture. From the collected seeds the MSB was able to grow the succulent and regenerated hundreds of seeds that were sent back to South Africa. This account is a useful point of departure – it reveals the pressure of working with plants at the edge of extinction but also the importance of perceiving seed banking as more than just ‘banking’, as potentially tied to restoration projects and living ecosystems. Yet, this story stood out in that regard, seeds do not leave the seed storage at the MSB very often. The succulent is evidence for how extinction happens in the present due to anthropogenic environmental changes: monocultural agriculture – another context where many seed banks (such as the SGSV in chapter three) exist – undoes diverse relations in the fields. In returning the seeds to South Africa a crucial dependence of eroding ecologies on banked biodiversity transpired. At present these occurrences are rare; it was the closest encounter with extinction Jay could remember. RBG Kew relies on plants to tell these stories and make its conservation work tangible. Inspecting the plants that are kept in the greenhouse’s three spaces Jay explained that those plants that remained here do so because they have a good ‘story’ to tell. She told me some of these stories– of old seeds discovered from past expeditions, of difficult seeds, and economically valuable seeds. They brought together colonial histories, the financialisation of ‘nature’ in the present, and the agency of seeds themselves. In this chapter I attempt to do something similar, yet on a theoretical level. I build foundations for a cultural analysis of seed banking by interweaving plant and conservation science, the environmental humanities, STS, and cultural studies to trace historical developments and emergent ecological imaginaries.

What strongly came across in Jay’s account is the reliance on human care – and its associated power dynamic – in plant conservation. This chapter is organised in two parts: *BANKING ON LIFE* and *SEED AS MULTIPLE* that give a theoretical overview of human-plant relations in seed banking. In part one I first explore the historical role of mastery through two significant moments – firstly colonial bioprospecting practices and their systems of classification and secondly the twentieth-century Green Revolution of industrial agriculture alongside movements for land and seed sovereignty. Following this, I define and critique the

concept of the Anthropocene and the plantation logic inherited in many seed banking practices to argue for the possibility of divergence from the monocultural logic. This allows me to take a closer look at the biopolitics and temporalities of conservation, particularly in practices of freezing, before considering relationality in seed banks through living archives and ecological imaginaries. To approach this living dimension of seed banking an important task in conducting this research was to develop an understanding of seed biology and seed ecology. The final section, *SEED AS MULTIPLE*, lays the groundwork for this while drawing connections between agential, technological, and relational approaches to seeds.

BANKING ON LIFE

Saviours, Gods, and More-than-Human Sovereignty

‘We are gods to these crops – we determine what they are, or not, in the future’ states Cary Fowler in the documentary *Seeds of Time* (McLeod, 2015, 05:14). Fowler is the ex-director of the Crop Trust, the organisation that manages the Svalbard Global Seed Vault (SGSV) in the Norwegian Arctic. He is referring to the seed deposits inside the SGSV, their histories of domestication, and dependence on human care in the present. Fowler evokes a heroic relation of human saviours to vulnerable crop seeds. It is necessary to explore the conditions which led to the emergence of this kind of seed banking, the enclosure of seeds and Eurocentric practices of mastering the vegetal world more broadly. I will thus establish links between botanical collections, colonial epistemologies, industrial agriculture, and seed banking. From Fowler’s difficult statement I critically explore the human-vegetal ecologies portrayed here and ask how ‘saving’ seeds is entangled with anthropocentric heroism. The saving of seeds coincides with the birth of agriculture. Arguably the domestication of plants was crucial for human settlement. Plant domestication and cultivation started from 9000 BC as hunter-gatherers transitioned towards settlement (Gunn, 1972) in a range of habitats, particularly Northern

China, India, and Ethiopia (Sauer, 1969).²² Yet two moments have particularly shaped anthropocentric human-vegetal ecologies globally: the seventeenth- and eighteenth-century bioprospecting dynamics of imperial expansions and their connection to the establishment of plantation economies (Grove, 1996; Brockway 2002; Schiebinger, 2007; Carney, 2011); and the biotechnological commodification of seeds during the Green Revolution from the 1930s-1960s (Kloppenburg, 2005; Fenzi and Bonneuil, 2016; Peres, 2016), as well as its slow aftermath of genetic engineering and ecosystem services (Harris, 2014; Fenzi and Bonneuil, 2016).



Fig. 1.2. Instagram page of Kew Gardens, March 2021. A recent acknowledging of colonial legacies and the intersection of exploitation of plants and people. Photograph: screen capture by the author, 2021

²² Archaeologist Marijke van der Veen connects the fact that cereal grain seeds and pulses could be stored and saved to the emergence of settlements and farming practices, initiating exchanges and a 'permanent material culture, wealth accumulation and the rise of social inequality' (2014, p. 806) once the ownership of land became the dominant model. James Scott (2017), and David Wengrow and David Graeber (2021) offer insightful critiques of the connection between early agriculture and centralised state formation.



Fig. 1.3. Whips made from lace bark (*Lagetta lintearia*) held in Kew's Economic Botany Collection. Photograph: courtesy of the Board of Trustees of the Royal Botanic Gardens, Kew, 2021, reproduced with permission

Feminist historian of science Londa Schiebinger's account in *Plants and Empire* (2007) locates plants as the objects of politics and fundamental to the separation of 'nature' and 'culture' through practices of classification. She suggests that throughout the European colonial expansions and explorations of the seventeenth and eighteenth centuries, botany as a new science was entangled in the emergence of capitalist structures of extraction and dispossession. Botanists were 'agents of empire' (2007, p.11) driving the commodification of 'nature'. Bioprospecting was an imperial tool and formed the foundation of early and powerful botanical collections in Europe and future plantation systems.²³ It was necessary for making 'wild' plants economically useful. RBG Kew is a dominant example here described by Tom Bristow as 'a fortress of knowledge, at the center of Imperial exploitation' (2016, p.86). Its plant collection was driven by efforts to collect material samples and information on *all plant parts and products globally* to build successful economies around these (see for instance the recent acknowledgement of this colonial history in fig. 1.2 and objects that were linked to plantation economies in fig. 1.3). Parallel to the establishment of botanical collections and

²³ Bioprospecting refers to the search for medicinally and agriculturally useful species.

sciences in Europe, plantation economies were developed in the Caribbean and South Asia that cultivated profitable crops such as coffee, rubber, or cotton.

Yet, beyond geographies of imperial cultivation resistant human-vegetal ecologies flourished. For instance, geographers Judith Anne Carney and Richard Rosomoff (2011) analyse slave gardens in the Americas, particularly in Jamaica and Brazil, in the seventeenth and eighteenth century. These gardens were established for enforced self-reliance in plantation systems, as sites that kept alive the cultivation knowledges associated with specific plants (such as sorghum, millet, yam, banana, and okra) which had crossed the Atlantic alongside their enslaved custodians. This diaspora of plants allowed slave gardens to become spaces for adaptation and experimentation, for spiritual and cultural healing practices where ‘Africans realised an alternative botanical vision to the plantation export commodities that were vested with the dehumanising practices of the plantocracy’ (Carney and Rosomoff, 2011, p.270). This shows how practices of cultivation are also practices of conservation, of biocultural memory, that can fork relations between local and remote ecologies through the mobility of seeds.²⁴ Moreover, I suggest it points to how they can be sites of resistance against the erasure of more-than-human struggles for self-determination.

I want to briefly explore the epistemic significance of taxonomic classification here and its linking with racialised thinking. Michel Foucault (2005) traces the emergence of the system of botanical classification developed by Carl Linnaeus within wider systematisations of knowledge at the end of the eighteenth century, burgeoning discourses of ‘science’, and the writing of ‘natural’ history. Classification here is located in a space ‘between a theory of the *mark* and a theory of the *organism*’ (Foucault, 2005, p. 158; italics in the original), where the act of naming and language as such become expressions of mastery and inscription. Foucault suggests that these new institutional practices actively contributed to making invisible the inner lives of life forms; ‘they conceal the organism’ (ibid, p.150) amidst a normative hierarchy of units and subunits of classification. These systems of botanical classification were directly

²⁴ Édouard Glissant’s discussions of the ‘creole garden’ are also insightful here as a counter-plantation practice that encouraged ecological flourishing on small, allocated spaces (Murray-Román, 2022).

linked to the construction of race, racial taxonomies, and scientific racism (Gray and Sheikh, 2018). Historian of science Helen Anne Curry (2021) echoes this in her discussion of maize *taxonomy as a technology* in the context of race as a socially constructed phenomenon starting from Linnaeus' human and non-human racist taxonomy. She links this to current scientific practices in maize breeding that downplay indigenous contributions to cultivation knowledges, in particular the creation of locally adapted varieties or *razas*, and that reject the link between creativity in cultivation and genetic biocultural diversity in seeds (also Hartigan, 2017 on the intersections of race science and maize breeding). On this basis of how classification became a justification for control of living organisms, discussions on biopiracy provide an important development of the intersection of knowledge, property, and custodianship.²⁵

The colonial monocultural drive of global plantation systems that eradicated a diversity of relational knowledges was the precursor of industrial agriculture and the plant-biotechnology-driven Green Revolution in the mid-twentieth century. The Green Revolution, a period of agricultural modernisation and 'improvement', was driven by philanthropic organisations involved in agri-scientific research, such as the Ford and Rockefeller foundations in the United States. It enabled the financialisation of crops in the production of high-yield, monocultural varieties to increase nutrition and productivity. Jack Kloppenburg (2005) suggests that the Green Revolution and its paternalistic 'miracle seeds', which sought to solve hunger crises in the 'developing world', in fact produced dependencies, the loss of local varieties and the depletion of natural resources such as water and soil. Geopolitically, the Green Revolution was embedded in the power dynamics of the Cold War and US attempts to make communism unappealing for agrarian societies. On a biotechnological level the Green Revolution also set in motion the emerging global bioeconomy of free trade in germplasm and the commodification of plant life. This 'institutional management of genetic erosion', a 'genetic

²⁵ Biopiracy is the commercial exploitation, especially through patenting, of genetic materials found in 'nature'. My account somewhat skips how life forms have entered the realm of intellectual property, which has been covered by Hayden (2005), Shiva (2007), and dos Santos (2007).

modernist project' (Fenzi and Bonneuil, 2016, p.75) represented a techno-ecological imaginary where crop biodiversity in the field got in the way of agronomic efficiency.

What followed from these high-yield but resource consuming varieties was another revolution in the 1980s – on the level of the gene – with the onset of genetic engineering of hybrid seeds. Crops grown from hybrid seeds are sterile; the cyclical pattern from plant to seed is broken. As a consequence, farmers were forced to purchase sterile seeds for each growing cycle – an act of 'writing ownership into the genome' (van Dooren, 2007, p.71). From this complicated claim of material and intellectual ownership arose the patenting of life forms, as well as debates on the ethics and implications of genetic engineering practices in the development of new varieties in the 'techno-capitalist framing of vegetal life' (Bristow, 2015, p.85). Across these historical developments I am interested in the interactions of scientific and economic forces, what STS scholar Sarah Peres calls the 'creation of economic value from technoscience' (2017, p.61). These 'seed enclosures' (Montenegro de Wit, 2017) are fundamental to many seed banking practices today. Questions of access and property are deepened in chapter three in the SGSV's entanglement with agro-industrial plant breeding, in chapter four when partners refuse to bank their seeds at the MSB, and in chapter five where seed sovereignty activists resist the monocultural logic and defend local heritage varieties.

Beyond the described practices of mastery there is a plethora of human-vegetal ecologies that relate differently to cultivated plants, including indigenous conservation and seed sovereignty movements – not as control on the level of the gene and seed enclosures but as kinship, co-nurturing, and shared self-determination. Kloppenburg (2010) for instance discusses seed sovereignty within wider eco-Marxist critiques of 'accumulation by dispossession' (Harvey, 2005) to suggest the development of a protected commons, 'populated by those who agree to share' (Kloppenburger, 2010, p.375). This would enable seed sovereignty by taking inspiration from the open-source movement. Indigenous conservation offers another, resistant form of sovereignty in a context where conservation often goes hand in hand with enclosures, commodification, and dispossession of indigenous lands (Rubis and Theriault, 2020). Neshnabé Potawatomi scholar-activist Kyle Powys Whyte (2017) describes

the relational focus in indigenous conservation as a linking of cultivation, spiritual practice and the restoration and conservation of native species through stories, knowledges, and memories. Conservation in this sense is always a learning from the other, a collaborative adaptation process in the face of devastating settler-colonial climatic destabilisation. Whyte's sense of conservation is deeply linked to indigenous sovereignty which is understood by Eileen Moreton-Robinson (2015) as an opposition to patriarchal white sovereignty, a regime of power shaped by illegal possession. Indigenous sovereignty instead is carried by the body rather than a 'social contract, universal authority, territorial integrity and individual rights' (Moreton-Robinson, 2007, p.2). The distinction between these different formations of sovereignty matters here – sovereignty is multiple and enacted in fundamentally different ways in the saving of seeds. Cultural theorist Ariella Aïsha Azoulay (2019), whose discussions of sovereignty I return to throughout this thesis asks how sovereignty can exist in non-imperial, non-violent terms. For her, sovereignty is performative and can include persisting and repressed forms of being in the world.²⁶ While Azoulay doesn't explicitly frame what she names 'worldly sovereignty' in ecological terms, I argue that worldly sovereignty as consisting of 'care for the common world in which one's place among others is part of the world's texture' (2019, p.388) is deeply ecological in its emphasis on relationality. Sovereignty is thus important for human-vegetal ecologies as it ties together seed, land, and cultivators. Sovereignty as a framework for legitimate care in the conservation of seeds rather than within seed enclosures of property, securitisation, and possession surfaces throughout this thesis, specifically in chapter three regarding international sovereignty zones and indigenous sovereignty, and in chapters five and six in relation to nationalism and Azoulay's 'worldly sovereignty'.

²⁶ My understanding of performativity here, and throughout this thesis, is through Sarah Ahmed's usage of the term for generating an object through repeating its past associations (2004, p.194). Ahmed bases her understanding of performativity on Judith Butler and foregrounds the futural quality of the performative, as that 'which is not yet' while at the same time being grounded in a repetition of the past to bring something into being. Butler (1997) draws from the work of J.L. Austin on 'performative utterance' to describe how certain speech acts create the relations in the world that they describe.

This discussion of histories of human-vegetal ecologies has framed seed banking as a political practice, and often a practice of mastery and human domination while hinting at the importance of movements of resistance and alternative formations of sovereignty.

Planting Divergence

At present, certain human socialities have become the strongest threat to the continuance of planetary life.²⁷ The multiple anthropogenic crises of the present – from climate change to biodiversity loss, soil erosion, and pollution – cannot be contained in efforts of saving as a ‘putting aside for the future’. The diversity of life, and of life worlds in complex ecologies, is unravelling in the ‘sixth extinction wave’ (Ceballos and Ehrlich, 2002). When I spoke to Anne, a restoration ecology specialist at the MSB, she emphasised that often climate change measures such as reforestation and carbon capture end up damaging biodiversity and accelerating extinction (Personal communication, 13 February 2020). Restoration is hard to do on a large scale, it is not enough to ‘plant trees’ but it matters where and how. In this section, after I review Anthropocene criticisms, the Plantationocene will deepen previous histories of human-vegetal ecologies to explore constructs of ‘nature’ and ‘race’. I then ask if the Anthropocene can be an opportunity for divergent political ontologies and ecological imaginaries. The following interdisciplinary grappling with the Anthropocene matters for this thesis since the methods of seed banking are both a response to the fallout of the Anthropocene *and* representative of techno-fixes to ecological devastation in the Anthropocene.

Dating the period of the Anthropocene has long been contested, even more fundamentally contested is the idea of ‘the human’ force at its centre. Geographers Simon Lewis and Mark Maslin consider multiple dates for the onset of the Anthropocene, a term popularised by atmospheric chemist Paul Crutzen in 2000. Eventually, Maslin and Lewis

²⁷ It is helpful to briefly touch on the terminology of the ‘planetary’ in relation to the ‘global’. In my analysis the ‘planetary’ is foremost ecological and implies the entire planet as an ecosystem of more-than-human dependencies whereas ‘global’ is rooted in the socio-political. While I cannot discuss the implications of the planetary in depth here, Gayatri Spivak’s (1999) conceptualisation of *planetaryity* provides a useful starting point for considering the uncontainable beyond the global on a basis of collective responsibility and re-imagining.

choose 1610 based on the ‘orbis hypothesis’, a noticeable drop in global carbon levels (Lewis and Maslin, 2015). They suggest this resulted from the reforestation of farming land, which led to carbon sequestration and a reduction of fire after the ‘disappearance’ of 90 percent of inhabitants of the Americas caused by the violent onset of colonialism in 1492. To be more precise, in what is the US today the number of indigenous people dropped from an estimate of 61 million people to 6 million by 1650. Black studies scholar Katherine McKittrick (2013) also highlights 1492 as a crucial moment for the emergence of a globalised, racialised logic. The year 1492 also marks the onset of bioprospecting and later botanical explorations, the taxonomical making of nature-as-resource. I suggest that this intersection of the beginnings of ‘nature’ (to be extracted from and made economically useful) and ‘race’ (to be extracted from and made economically useful) as constructs in global transfers of labour and material is no coincidence.²⁸ Fundamentally, the scale of this violence fuelled by enslavement, diseases, war, and famines was of such magnitude that it registered in the material constellation of the atmosphere and geological strata globally. Lewis and Maslin suggest this dating of the Anthropocene allows for an analysis of the destructive impacts of the meeting of the ‘Old’ and the ‘New World’, and the consequences of colonialism and trade on the global distribution of life forms. Importantly, it also puts into perspective current Anthropocene rhetoric of the future loss of life in climate crises to come by showing that for many peoples their world has ended many times already (Danowski and Viveiros de Castro, 2017). Situating the onset of the Anthropocene in the domination of both ‘nature’ and of racialised people in the Americas also allows for a rethinking of the duality of ‘nature’ (as static, passive, waiting to be used) and ‘culture’ (as dynamic and driven by progress, only reserved for certain human socialities). And yet, it also points to the fact that ‘anthropos’ – ‘the human’ force of the Anthropocene – has never been ecologically singular. There has always been a multitude of worlds. This is important to keep in mind when observing practices in the empirical chapters: human agency is not homogenous.

²⁸ See also Yusoff (2018) for a geological perspective on the entanglement of the making of anti-Blackness, settler colonialism, and the extractive economies of the Anthropocene.

As a concept the Anthropocene has, in my opinion, been most useful in the fierce criticism it has received and the plethora of rearticulations and renamings it gave rise to.²⁹ These renamings highlight the importance of thinking colonial, environmental, racial, and neoliberal violence together, across methodological tools of post- and decolonial theory, STS, anthropology, the environmental humanities, geology, and geography, amongst others. While I cannot go into depth about these proposals here, at their core these criticisms argue for accountability and relationality and against a unified anthropocentrism. This has included Jason Moore's *Capitalocene* (2017), and developing this, Françoise Vergès' *Racial Capitalocene* (2017), as well as Nicholas Mirzoeff's *White-Supremacy-Scene* (2018), Haraway's *Chtulucene* (2016) and TJ Demos' *Misanthropocene* (2017).³⁰ What these concepts share is a frustration with how the Anthropocene thesis mystifies accountability and evokes responses to the ecological crisis focused on technocratic fixes, such as geo-engineering, greening of deserts and largescale infrastructures which follow the same solutionist patterns that have produced the crisis in the first place.³¹ Arguably, seed banking is often imagined in a similar way – a technical solution shaped by a rhetoric of 'vulnerable' and 'resilient' seeds that can be activated for climate change adaptation. It is this rhetoric and instrumentalisation of vegetal resilience, adaptation and vulnerability that needs to be critically examined. This research thus contributes to critical discourses of the Anthropocene by highlighting how differential concepts of human ecological agency are enacted in practice.

²⁹ Historian Dipesh Chakrabarty (Chakrabarty, 2009) highlighted early on in discussions on the Anthropocene that in thinking together natural and human history, the implications of capitalism must be considered in seeing humanity as a species with geological force.

³⁰ The 'Capitalocene' describes the need to see 'capitalist man' rather than 'humanity as a species' as the driving force of anthropogenic destruction. The 'Racial Capitalocene', drawing on Cedric Robinson's notion of racialised capitalism' (Robinson, 2000) suggests the importance of the connection of racialising processes across colonialism, environmental crisis management, and capitalism. The 'Chtulucene' emphasises the significance of entanglements and situated differentiated agencies beyond the human, while the 'Misanthropocene' reflects the differential impact of inequality, injustice, and violence.

³¹ Anne, for instance, discussed topsoil restoration projects in the Jarrah Forest in Australia, where 'they pretty much roll the forest and the topsoil back like a carpet take the bauxite out and then push it back where it was before' (Personal communication, 13 February 2020) which combine an extractive approach to natural resources with high-tech restoration technologies. According to this approach, extraction can continue if restoration is built into the process.

The slowly unfolding violence of the Anthropocene heightens questions of visibility, enactment, and representation. In *Against the Anthropocene* (2017) art historian and cultural theorist TJ Demos argues that imagery produced around the Anthropocene tends to reproduce disaster management aesthetics in a globalised, objectifying ‘techno-utopian position that “we” have indeed mastered nature, just as we have mastered its imaging, and in fact the two, the dual colonization of nature and representation, appear inextricably intertwined’ (Demos, 2017, p.28). This aestheticisation of mastery gets in the way of any real mitigation or adaptation and stops the potential for mobilisation and making visible the ‘slow violence’ of the Anthropocene, a delayed and dispersed ‘violence that occurs gradually and out of sight’ (Nixon, 2011, p.2). I argue that in order to understand how this mastery is constructed in seed banking practices, it is necessary to analyse the *performative* nature of ‘saving’ in speech acts and visual materials produced by practices.

Anna Tsing and Donna Haraway’s concept of the Plantationocene (developed further in Wolford, 2021) is particularly useful for thinking through the afterlives of plantation economies in present day seed banking and bio-economies. Haraway (2015) defines the Plantationocene as shaped by the devastation of ecologies through plantation economies that rely on exploitative and displaced labour practices in order to globally move plants and people and reconfigure life forms and their components. A visit to a silver fir plantation (*Abies alba*) in Poland in chapter six makes this emphasis on genetic reconfiguring of local ecologies more tangible. The Plantationocene enables me to connect the complicated temporalities of colonial extraction, banked genetic diversity, and monoculture in the fields with the financialisation of ‘nature’ and violence in human-vegetal ecologies. It links human and nonhuman exploitation and continues today in ever greater complexity in globalised monocultures, for instance in the proliferation of palm oil plantations in Indonesia and Malaysia and soybean plantations, in particular in the US, Brazil, and Argentina. The plantation and its labour regimes have also been sites of analysis for critical race and Black studies; in ‘Plantation Futures’ (2013) McKittrick argues that the migratory logic of the plantation has dispersed a certain idea of modernism and anti-Blackness globally along racialised geographies:

Thus, in agriculture, banking, and mining, in trade and tourism, and across other colonial and postcolonial spaces – the prison, the city, the resort – a plantation logic characteristic of (but not identical to) slavery emerges in the present both ideologically and materially. (McKittrick, 2013, p.3)

In this sense the plantation, as a logic of organising living materials and labour, has seeped into today's organisation and materiality of human-vegetal ecologies globally, in particular agricultural production. This continuance occurs for instance through racialised violence, biocultural memory, and the organisation of labour models. The plantation here is both a 'theoretical schema' (McKittrick, 2013) and a scalable modernising formula (Tsing, 2015) of the following pattern: 'exterminate local people and plants; prepare now-empty, unclaimed land; and bring in exotic and isolated labour and crops for production' (Tsing, 2015, p.39). McKittrick refers to Sylvia Wynter's 1971 essay 'Novel and History, Plot and Plantation' and its discussion of the simultaneous emergence of two systems of socio-economic 'world making' (2013, p.10): the novel and the plantation. This world-making ingrained in the plantation logic describes a brutal ecological imaginary of domination and extraction that still seeps into practices of cultivation and conservation today. Reading McKittrick alongside Tsing here points to the productive interactions of Black studies and the environmental humanities to analyse past and present ecological imaginaries as they are produced in practice whilst considering their genealogies.

Building on this world-making in plantations discussed by Wynter and McKittrick I want to consider, thinking with anthropologists Marisol de la Cadena and Mario Blaser, whether seed banking practices can become 'nature-culture entities' of responsible world-making instead. In *A World of Many Worlds* (2018) they ask whether the Anthropocene could offer 'the opportunity for a condition to emerge that, instead of destruction, thrives on the encounter of heterogeneous worldings, taking place alongside each other with their divergent here(s) and now(s), and therefore makes of their taking place a negotiation of their going on together in divergence?' (de la Cadena and Blaser, 2018, p.18). It is this heterogeneity, negotiation, and divergence that I explore in asking 'what are seed banking practices saving (for)?'. De la Cadena and Blaser suggest that the Anthropocene brings to the surface the falsity

of the 'nature'/'culture' dualism of a one-world perspective, where the 'end of the world' is that of one world 'hegemonically conceived and practiced' (ibid., p.18). The crises of the present provide a chance for a different political ontology, where heterogenous divergent views can coexist in the face of erosion and destruction of diversity – of life forms, ways of living and relating.

Conservation and Diversity

Amidst these crises of the present, seed banking is an attractive form of conservation. Considering 'conservation' and 'diversity' as discursive constructs, I now focus on seed conservation in order to develop the notion of *biocultural diversity* in bridging agricultural and wild seed conservation practices to move beyond the 'nature'/'culture' dualism.

Initially it is crucial to consider conservation as a field: what is being preserved and why when we speak of conservation? The wealth of biodiversity as a limited and threatened entity as well as the positive value of diversity are often the main arguments for the conservation of biodiversity. Geographers William Adams and Martin Mulligan suggest that most conservation projects rest on a logic of 'nature' as a resource worthy of protection, *and manageable through protection*. This is rooted in European values and a settler-colonial mindset that 'constructed nature as nothing more than a resource for human use and wildness as a challenge for the rational mind to conquer' (2003, p.5) echoing earlier sentiments of bioprospecting. Mulligan and Adams observe a breadth of arguments for conservation justified by 'the continuing assault of global consumption on non-human nature' (ibid., p.9) from a range of perspectives from anthropocentric approaches such as sustainable development and ecosystem services to deep ecology, radical ecology, and indigenous cosmologies. At the root of many conservation practices (albeit not all practices, which will be discussed) is a passive, practical perspective on 'nature' as static; it can be made vulnerable, contained, and policed.

Within the field of plant conservation, crop biodiversity is often framed as the key to food security and therefore in need of protection (Bewley et al., 2012). The larger the number

of cultivated varieties the more resilient these will collectively be to pests and diseases. Monocultural specialisation makes individual crops more vulnerable. Seed scientists Bewley et al. argue for the necessity of long-term conservation of plant genetic resources: ‘the fate of billions of lives hangs on the precarious balance of the genetic systems of these three crops [wheat, rice and maize]’ (2012, p. 358). There are two spatial logics of plant conservation: *in situ* and *ex situ*. Cold storage seed banks are a form of *ex situ* conservation that removes seeds from the soil and growing cycles to extract them from their environments and store them. *In situ* conservation takes place within the habitat of the species to be protected and is for instance practiced in agro-ecological farming or nature reserves. In mainstream scientific conservation of plant genetic resources there are two strands of conservation: firstly, the protection of ‘wild’ flora for the sake of the integrity of biodiversity and functioning ecosystems; and secondly, the protection of agricultural varieties and their associated gene pools and adapted varieties for future use. Seed conservation infrastructures thus make a clear, enacted distinction between naturally and culturally useful seeds which I need to be sensitive to, despite wanting to go beyond the ‘nature’/‘culture’ binary. However, the conservation of ‘natural’ and ‘cultural’ biodiversity overlaps in the conservation of wild relatives.³² Wild relatives can be found in seed banks focused on wild biodiversity (the MSB) and agricultural biodiversity (the SGSV and UAWC) – they thus make a convincing point that what should be the object of saving instead is *biocultural diversity*, the holistic diversity of ‘natural’ and ‘cultural’ life and life forms.³³

In the above discussion ‘biodiversity’, a shorthand for ‘biological diversity’ that emerged in discussions in the 1980s on the effect of climate change on biodiversity loss (Sarkar, 2021), is arguably not a neutral term. Anthropologist Arturo Escobar argues for the need to view ‘biodiversity as a discursive invention of recent origin’ (1998, p.54), creating a

³²‘Crop wild relatives’ are the wild ancestors of a domesticated plant; considered an increasingly important resource in sustainable agricultural systems because of genetic erosion.

³³ I want to emphasise here that the ‘cultural’ is not reserved to human activities. Biologists Monica Gagliano and Mavra Grimonprez consider as culture in plants the sets of behaviour and ways of living shaped by interactions and relationships with members of the same species and other life forms (2015, p. 149).

historically produced 'interface between nature and culture' (ibid., p.75). He proposes that the networked nature of biodiversity as a scientific discourse, co-produced by technoscientific and social forces, brings together divergent perspectives including NGOs, scientists, prospectors, local communities, and social movements. In this network lies an opportunity for marginalised spaces to become 'centres of innovation and alternative worlds' (ibid., p.54) in the negotiation and contestation of biocultural ecologies. Both Mulligan and Adams and Escobar discuss conservation as based on a 'nature' construct that led to the concepts of conservation and biodiversity. It is on this foundation of biodiversity as a tool for the management of 'nature'/'culture' binaries that I now specifically look at the loss of diversity as it concerns seed conservation.

The rapid loss of agricultural biodiversity is discussed as 'genetic erosion' (Kloppenburg, 2005; van Dooren, 2009; Fenzi and Bonneuil, 2016; and Harrison, 2017). Heritage theorist Rodney Harrison points out in his analysis of the future-making practices of *ex situ* cold storage conservation, working with Fenzi and Bonneuil's socio-historical analysis of the terms 'plant genetic resources' and 'genetic erosion', that the latter was coined by the UN Food and Agriculture Organisation (FAO) in 1967. It 'gained strength from its resonance with [...] the concept of soil erosion' (Harrison, 2017, p.85). Thinking together geological and biological, genetic, and planetary processes, this connection between the erosion of biodiversity and the geological and ecological erosion of soils is an instrumental indicator for the extractive and eroding processes of the nature-as-resource approach. Harrison points to differences among seed conservation practices in their biopolitical management of temporality and the way 'their collecting and ordering practices not only reflect but actively intervene within and shape the worlds they order' (ibid., p.80). Arguably, the public perception of the intervention seed banks make is often associated with hope; their ecological imaginaries offer hope for the continuance of threatened species and varieties. Harrison is critical of the creation and distribution of hope as well as the disposition of technoscientific seed banks towards the future. He suggests they instrumentalise hope 'as a form of biopolitical power' connected to 'particular formations of biocapital' (ibid., p.81). This criticality towards

hope as an emotional tool for risk mitigation will be useful for considering what seed banking practices are saving their seeds for.

I focus on a specific biopolitical dynamic of *ex situ* conservation here, of what has been evocatively discussed as the ‘cryopolitics’ of practices of freezing life by STS scholars Joanna Radin and Emma Kowal in the editors’ introduction to *Cryopolitics: Frozen Life in a Melting World* (2017).³⁴ Here, politics refers to ‘tactics and practices that organise and animate science and technology’ (ibid., p.6). Reconfiguring the axis of Foucault’s biopolitics as the power that *makes live and lets die* (Foucault, 1979), cryopolitics is the management of liminal life, the suspension of life from death, ‘where beings are made to live and *not allowed to die*’ (2017, p.6; italics in original). The volume proposes that practices of cooling and freezing are symptomatic of a ‘cryogenic culture’, of modernity’s dependence on technologies of cooling and freezing (Friedrich, same volume, p.59) and ingrained in imperial and colonial economies of claiming ownership through artificial cold. Radin and Kowal argue that an absence of governmental frameworks for cryopolitical life makes it an ambiguous zone where organisms are particularly vulnerable to political power in their suspension between life and death. Cold storage produces a particular ‘kind of insurance that turns life itself into a protection against death’ (2017, p.9). Echoing Harrison’s remarks on hope, cryopolitics works with a similar affective horizon of heroism and salvation in its management of time: ‘the abdication of responsibility in the present made possible by recourse to the promise of an ever-receding, and techno-scientifically enabled, horizon of future salvation’ (Radin and Kowal, 2017, p. 9). Radin and Kowal see this denial of responsibility in the present as the foundation of what they term ‘cold optimism’ marked by a ‘belief that death – or the acceptance of its finality [and for biodiversity conservation the second finality of extinction] – can be postponed indefinitely

³⁴ Radin and Kowal borrow the term cryopolitics from Michael Bravo and Gareth Rees (2006) to now include not just Arctic landscapes but artificial coldscapes. While in bio-scientific gene banking ‘cryo conservation’ only refers to temperatures below -100°C (Morgan, personal communication, 2019) the notion of cryopolitics to refer to the biopolitics of *all* cooling practices is still productive. It points to the slight mistranslations and shifts in signification that can happen between life sciences and cultural theory when scientific concepts are mobilised in cultural theory or philosophy.

through practices of preservation' (ibid., p.9; comment in brackets mine).³⁵ This heroic 'messianic thinking' (Rose, 2017, same volume, expanded on in chapter three) of cryopower is at the heart of the

deeply rooted and systemic resistance to death and decay that manifests as refusal to mourn the demise of the political economic regime of carbon-based capitalism and the philosophical regime that rests on the human as an autonomous agent. The denial that these fundamental western projects may already be dead is often managed through practices of freezing. (Radin and Kowal, 2017, pp. 10-11)

Conservation through practices of freezing contributes to technoscientific 'thermal regimes' (ibid, p.5) which 'unscale' temporalities of living organisms from their natural temporal patterns and scales to slow down their metabolic rates in line with hopeful temporalities of mitigation, resilience, and insurance. Cryopolitics is thus a crucial concept for addressing a Eurocentric heroic conservatism in cold storage seed conservation. I build on this argument throughout this thesis through investigating the nexus of temporality and temperature.

A range of theoretical dilemmas arise from discussions of *ex situ* seed conservation. Anthropologists Virginia Nazarea and Robert E. Rhoades (2013) emphasise the halting of adaptive and evolutionary potential through removing seeds from the ecological processes of adaptation. Additionally, as described above *ex situ* sites can create complicated zones of property designation and access regulation to both plant genetic materials and associated knowledges. Instead, Nazarea and Rhodes argue for the importance of *in vivo* conservation, of understanding 'everyday conservation in place' (2013, p.6) as more 'important against global monocultures than archives and gene banks' (2013, p.5). Often practiced at the margins of state and economic control, these forms of living conservation need to be considered as part of global transnational flows of seeds through natural seed dispersal and the informal sharing of seeds, and through how these relate to practices of cultivation and memorisation in the displacement and relocation of peoples. Patterns of cultivation and migration point to the historical linking of crop biodiversity, 'landscapes of loss' and 'landscapes of memory' through domestication, care, and reconciliation. Nazarea and Rhoades call for a paradigm shift from a

³⁵ Cold optimism responds to Lauren Berlant's concept 'cruel optimism' (2011), the pervasiveness of belief systems centred around unfulfillable hopes.

‘paradigm based on expropriation and control’, often encapsulated by developmentalist *seeds of hope*, to one ‘based on cultural integrity and revitalisation’ (2013, p.6) which can create space for anti-colonial *seeds of resistance* in conservation practices. In *Cultural Memory and Biodiversity* (2006) Nazarea suggests the concept of ‘memory banking’ to go hand in hand with gene banking, seeking to conserve what has been neglected so far: ‘indigenous knowledge and technologies, including uses, preferences and evaluation criteria associated with traditional varieties’ (ibid., p.5). Archiving these knowledges alongside genetic information would give agency to seeds as carriers of biocultural memory, against what she terms ‘cultural erosion’ as opposed to a genetic understanding of biodiversity loss. She points to forms of memory that seed banking in a genetic sense cannot contain – more-than-human memories of cultivation, preparation, and adaptation. In an analysis of community seed banks, genetic resources specialist Ronnie Vernooij (2012) argues that localised community seed banks are largely unexplored in comparison to institutional seed banks; there are few studies that take into consideration the diversity of their practices, temporalities, and relations to land, and, as I propose, the worlds held within them. The focus on UAWC as a grassroots food sovereignty practice partially addresses this gap.

This review of seed banking as a conservation practice has shown the complex links between biological and cultural diversity, or rather biocultural diversity, within and beyond spaces of cryopolitical mastery.

Ecological Imaginaries and Living Archives

Building on Nazarea and Rhodes’ critique of *ex situ* seed conservation this section considers the physical spaces of seed banking as living archival infrastructures. I ask if it is possible to read collections as ecological imaginaries and as more-than-human *living archives*, but also what might be obscured in this focus on relationality.

Seed scientists Bewley et al. outline the infrastructures of long-term gene banking as a process of collecting, processing, and regenerating ‘accessions’.³⁶ They argue that diversity only becomes useful if seeds have been ‘evaluated and characterised for their phenotypic traits’ (2012). A phenotype describes the observable characteristics caused by interactions between a genotype and environmental conditions. Usually, seed banks lack the resources to sufficiently phenotype stored seeds and therefore sit on enormous unused wealth of genetic data. Echoing discussions of genetic erosion in the previous section, this wealth erodes over time. Van Dooren (2009) describes the global wealth of banked biodiversity as 6.1 million agricultural plant accessions held across 1,300 facilities, which, as the FAO analysed, are often in desperate need of regeneration to keep collections viable. Curry (2017) refers to seed banks as ‘conservation technologies’ that became institutions in industrial agriculture in the USA in the mid-twentieth century for monocultural practices that favoured homogenisation. She argues that in industrial agriculture seed banking was used as the only way to ‘responsibly’ advocate for uniformity, by making sure that diversity that was not in use was securely backed up. This is important: agro-scientific seed banks did not materialise for the conservation of biodiversity as such but because of the loss of agricultural diversity in breeding practices of industrial farming. It was easier to bank diversity as a resource to draw from when needed than to cultivate. Peres (2016) also describes how seed banks as conservation strategies developed as a response to changing plant breeding practices from earlier ‘working collections’ for plant breeders, such as Nikolai Vavilov’s work in the 1920s and 1930s on a biogeographic systematic repository of variation within crop species. Peres echoes Curry’s approach of conservation-as-technology in her analysis of the political economy of germplasm to suggest that agricultural gene banks are a ‘form of technoscientific intervention’ (2017, p.42), a genetic archive of evolutionary history that can be ‘recalled’ for future use (2016). In their practices gene banks both reflect and shape the societies they are embedded within. I reflect on this in

³⁶ ‘Accessions’ are seed deposits. ‘Regeneration’ is the planting, cultivation, and recollection of seeds.

each empirical chapter, tracing the connection between the collection, its world, and its ecological imaginary.

Through their accumulated genetic archives seed banks are sites of value creation in the conservation and facilitation of access; they make information and material visible and manage its temporality in frozen states. Methodologically, Peres highlights the importance of analysing practices as sites of both value creation and care; or, as I want to put it, value creation *through* care. Frameworks for translating and measuring this value increasingly include ecosystem services and Natural Capital. As interlocutors at the MSB argued, this financialisation of life is often the only way to convince funders of the value of the work they are supporting. Erica suggested that funders ‘are very anthropocentric. [...] we need to translate it in that way, even if behind this we have a higher meaning or a higher goal’ (Personal communication, 14 November 2019). This notion of value creation as ‘translation’ is important for distinguishing the approaches of individual practitioners to conservation from organisational rhetoric as to where value is located.

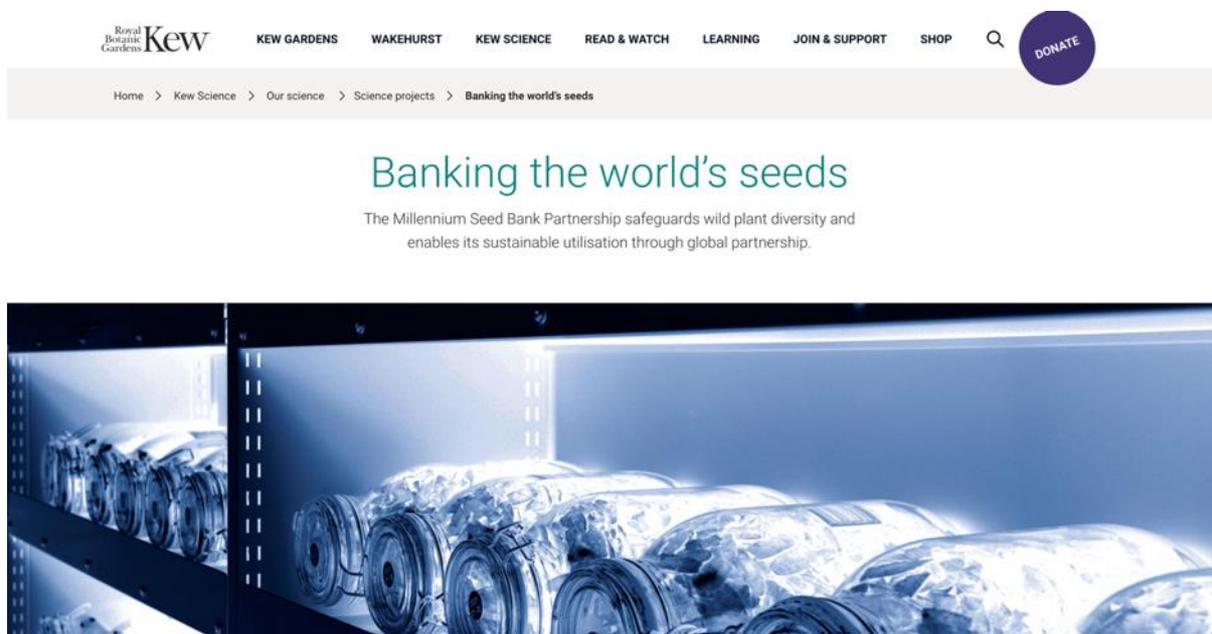


Fig. 1.4. ‘Banking the world’s seeds’—Royal Botanic Gardens Kew website. Image: screen capture by the author, 2021

‘Banking the world’s seeds’ is the tagline RBG Kew uses for the MSB on its website (RBG Kew, n.d.; fig.1.4). In conversations I observed that it is an uncomfortable phrase: Anne,

for instance, described how ‘we had to start calling the seed banking – “banking the world’s seeds”, which was a Kew target, to bank 25 percent of the world’s plants’ (Personal communication, 13 February 2020). The numerical targets speak of a kind of seed banking that puts the amount of collected genetic diversity first. What practitioners emphasised was instead a focus on including more restoration projects and different ways for the seeds to be used (see chapter four). Rethinking human-vegetal ecologies inside the seed bank, van Dooren proposes that we reimagine ‘banking’ in a way that is no longer about ‘storing, but would rather be about enhancing flows’ (2009, p.390). Moving beyond diversity as genetic units he suggests reimagining diversity ‘as a complex field of ongoing co-evolutionary interactions’ (ibid., p.390). He concludes that banking ‘well’ requires new legal, economic, and social frameworks – here banking is reimaged as an ethical commitment to sharing. This relational understanding of diversity was echoed in Anne’s description of the MSB’s purpose: to build and strengthen seed conservation programmes in partner countries and offer a seed duplication application. The focus on local conservation clearly describes a different ecological imaginary than ‘banking the world’s seeds’.

In response to van Dooren’s relational shift of banking and Anne’s hesitation with ‘banking the world’s seeds’ the theoretical concept of the ecological imaginary can help to reveal what seed banking practices are saving their seeds for. I build my understanding of ecological imaginaries on Astrida Neimanis, Cecilia Åsberg and Johan Hedrén’s (2015) discussion of the ‘environmental imaginary’. The framing of ‘ecological’ rather than ‘environmental’ in my research puts specific emphasis on the dilemma of relationality in seed banking. Neimanis et al. discuss the environmental imaginary in the context of imagining future directions for the environmental humanities, grounded in cultural studies and feminist theories and their understanding of the ‘social imaginary’ as explorative of the material world and the formation of identities.³⁷ Building on this, environmental imaginaries are sites of

³⁷ Chiara Bottici’s (2014) reading of Cornelius Castoriadis’ theory of the imaginary (Castoriadis, 1987, 1991) in *Imaginal Politics* (2014) is insightful here in emphasising the ontologically and politically radical potential of the imagination. According to Castoriadis there is no reality without the imagination and individuals are shaped by the social imaginaries they are embedded in through practices and institutions.

negotiation of attitudes towards the environment, the Anthropocene being an imaginary itself. Neimanis et al. directly connect the environmental imaginary to ‘worlding’ practices in Haraway’s sense in how they can counteract alienation, depoliticisation, and compartmentalisation of the environment. This resonates with my consideration in the introduction of working with the theoretical scope of both the ‘world’ and ecology in relation to each other. Neimanis et al. suggest that environmental imaginaries are important for future explorations of ‘what imaginaries sustain what kinds of goals, values, politics and actions in the so-called Anthropocene? To the benefit of which environmental bodies, where, how and why?’ (2015, p.83). I draw from this that environmental – or ecological – imaginaries can be crucial for understanding the relation of more-than-human ethics and politics in seed banking through ontologically and epistemologically grounded research on practices. The empirical chapters explore how, while practices share similar techniques and technologies, their genealogies and enactment of ecological imaginaries might reveal tensions regarding human agency, mastery, and the ethics of care.

Resonating with the discussion of ecological imaginaries as a disposition towards the future, I want to briefly reflect on the seed collection within the temporal discourse of the archive. Philosopher Jacques Derrida argues in *Archive Fever* (1996) in an exploration of the archive in relation to human memory and technologies of remembering that

the question of the archive is not [...] a question of the past [...]. It is a question of the future, *the question of the future itself*, the question of a response, *of a promise* and of *a responsibility for tomorrow*. (Derrida, 1996, p.36, emphasis mine)

Seed banking practices can be read as living archives through Derrida’s connecting of promise, responsibility, and futurity to unpack the control of hopeful vegetal temporalities and the ethical responsibility that emerge from this containment. Seed banking practices-as-archives can hold multiple relationalities. Artist Jumana Manna’s film *Wild Relatives* (2018) follows the transfers of seeds between the SGSV and ICARDA, an agricultural research centre in Lebanon which was forced to relocate because of the Syrian Civil War. This marked the first withdrawal of seeds from the SGSV. Cultural theorist Shela Sheikh suggests in her reflections on the film that

here ‘the archive’ takes multiple forms: at best, an ecology of ‘living’ cultural heritage that testifies to human–nonhuman alliances and co-nurturing; at worst, the preservation, management and enhancement of genetic material as yet another form of (now neoliberal) biocapital or biopower. (Sheikh, 2018, p.219)

Harrison (2017) also addresses this duality of archived diversity and accumulated ‘latent’ biocapital for future use, not as an either-or of different ecological imaginaries, but as embedded within the same practices of genetic resource conservation of past diversity and future value in complex temporalities of securitisation. Similar to the seed collection as a ‘living’ ecology as Sheikh suggests, Tania Aguila-Way in her analysis of the Mother Seeds in Resistance, a Zapatista community seed bank in Chiapas, Mexico thinks of the seed collection as a ‘living, self-organised archive’ (2014, p.67). These readings make tangible that the ecological imaginary of the seed bank depends on how it organises the relationality of its living archive, how it is situated within wider politics of temporal and spatial access, distribution, and value creation.

In this section I have shown that whether as genetic archives of biocapital or as living archives of entangled continuance, seed banks are complex and liminal biosocial and biocultural spaces. They reveal historical patterns, represent, and ‘save’ the politics of their worlds. In my conception this also includes a political reimagining of who can be the agent of banking, and of thinking beyond human capacities of saving, risk taking and resilience as I explore in the following and final section on the multiplicity of seed.

SEED AS MULTIPLE

As suggested in the introduction to this thesis a seed is impossible to contain in its temporal, transformative, regenerative potential, and evocative powers for the imagination. Yet, what does it mean to *think with seeds* in the context of this research to allow these multiple meanings to feed into each other?



Fig. 1.5. *Orthocarpus luteus* (Yellow owl's clover) through an electron microscope. Image: Wolfgang Stuppy and Rob Kessler; Board of Trustees RBG Kew, reproduced with permission

Seed as 'Tiny Plant in a Package'

On a biological level seeds are organisms. Following biologists Bewley et al. seeds contain plant embryos, 'the next generation of a plant' (2012, p.1) prior to germination, as well as storage reserves containing protein, starch, and oil. I asked many of my interlocutors what a seed is. Jesse at the MSB described a seed concisely as 'a tiny plant in a package' (Personal communication, 18 August 2020) which contains everything the embryo will need to develop and break through the seed coat (see fig. 1.5 for a detailed image of a seed coat). Seeds also form the basis of agricultural cultivation. Around three quarters of human food consumption stems from seeds (Bewley et al., 2012). The cultivation of seeds and plant domestication are dependent on germination, which often requires symbiotic associations with soil fungi, bacteria, insects, worms, other microorganisms, and other factors including soil density, water availability, light conditions – everything is connected in seed ecology.

Seeds form one stage in a plant's reproductive cycle, where the process of dormancy, an intentional 'temporary failure to complete germination' (Bewley et al., 2012, p.247) allows for spatial and temporal dispersal. Bewley et al. suggest that 'dormancy provides a strategy for

seeds to spread germination in time, in order to reduce the risk of premature death in an unfavourable environment' (ibid., p.248). Seeds are strategic in this way – they await germination until conditions are as ideal as possible. Yet, dormancy is a complicated process in knowledge practices. Practices relate to it differently; this was an important distinction in noticing varying epistemologies. At the MSB, Robin described how agricultural seed banks see dormancy as an obstacle to be broken whereas at the MSB, with its focus on wild flora, it was more of a mysterious challenge. They instead wanted to understand the organism and its strategies, the ecology of the species and its resilience:

For them [agricultural seed banks] it's a question of they want the seeds to germinate, first because we want to cultivate them, we want to be us in charge. If we sow the seed this day, we want the seed to germinate the day after. We have to be the one who controls everything. And it makes sense. We don't want to do that here [at the MSB], we don't want to germinate the seeds because they have to germinate, we want to germinate the seeds because we want to understand which are the ecological drivers that shape the dormancy in time of the seedling. (Personal communication, 7 November 2019)

What comes across here is an important divergent understanding of and epistemic approach to the same ecological process dependent on the usefulness of the seed.

Seed dispersal, a slow process of plant migration, provides the seed which is (mostly) incapable of motoric movement with an opportunity to travel. Seed dispersal occurs, for instance, through wind (*anemochory*), water (*hydrochory*) and living organisms (*zoochory*). After dispersal, seeds ideally end up in the soil, where they form the soil seed bank sensing environmental cues such as moisture, temperature, light, chemicals, and other triggers (Bewley et al., 2012, pp.300-3). In this way anthropogenic seed banks mirror and adapt the conditions of soil seed banks and crucial features of seed ecology (Lewis Jones, 2018). Seed viability and longevity in storage is dependent on 'desiccation tolerance' to the removal of water content, keeping in mind that a lot of species are recalcitrant, which makes conservation in cold storage seed banks challenging. Recalcitrant species are interesting for a couple of reasons. First, in zones that are framed as biodiversity-rich, such as tropical forest ecosystems, many tree seeds are recalcitrant, which poses a challenge to banking because of the complex symbiotic relationships of forest ecologies. These complex relationships also make forest

ecologies very sensitive to disruptions. Second, the treatment of recalcitrant seeds might point to how scientific knowledge practices work along Eurocentric geographies, assessments of human usefulness and technological mastery.³⁸

Seed as Genetic Archive, Seed as Technology

The genetic information held within the vastly unexplored vegetal world holds an archive of untapped biocapital and knowledge (van Dooren, 2009; Breithoff and Harrison, 2020). This places the genetic information of seeds in broader debates on the genetic and the molecular as new frontiers of colonial expansion and extraction and the colonisation of ‘life itself’ introduced earlier in this chapter.³⁹ Kloppenburg (2005) argues that seeds in efforts of ‘plant improvement’ need to be contextualised within the political economy of plant (com)modification and the division of seed related labour. It is important to consider the *seed as means of production* here (Kloppenburg, 2010) in that it is both a food supply and reproduces itself. Its cyclical patterns of growth are an obstacle to commodification. In a crucial biotechnological intervention in seed genetics, ‘terminator transgenes’ have turned seeds into a technology of death where regenerative capacities have been artificially halted to create a commodity (van Dooren, 2007).

Seed as Proxy, Seed as World

Haraway (1997), whose thinking on positionality and more-than-human relations of becoming-with I return to in depth in the following chapter, aptly summarises the fascinating complexity of the seed, as ‘simultaneously literal and figurative’, stating

a seed contains inside its coat *the history of practices* such as collecting, breeding, marketing, taxonomizing, patenting, biochemically analyzing, advertising, eating, cultivating, harvesting, celebrating, and starving. (1997, p.129, italics mine)

³⁸ These limitations of seed banking storage are discussed in-depth in chapter four.

³⁹ Environmental activist Vandana Shiva, for instance, refers to this colonisation of life: ‘the new colonies are the interior spaces of the bodies of women, plants and animals’ (2007, p.274).

It is the relation to practice ingrained into a seed – the inscription of biocultural processes of adaptation, intervention, co-cultivation, and ingestion – that exemplifies what Haraway speaks of as the ‘material-semiotic’, where matter and meaning constitute each other. Haraway groups seeds together with a ‘set of objects *into which lives and worlds are built—* chip, gene, seed, fetus, database, bomb, race, brain, ecosystem’ (ibid, p. 11, italics mine). Each of these objects contains knowledges, practices, and relations. This image of the seed-as-world is important for thinking through the links between seeds and their life worlds, their surrounding ecologies. A seed that is ingrained with a history of practices provides a useful example for what Haraway terms *naturecultures*: rather than based on the separation and dualism of ‘nature’ and ‘culture’, the term *naturecultures* prioritises ontological relationality, and argues for the inseparability of fields of meaning making.⁴⁰ *Naturecultures* are an important point of reference for the inseparability of human and nonhuman agencies in the Anthropocene.

The representational relationship of the individual seed-as-archive in relation to its species or variety shifts when a seed enters a seed bank. In this context van Dooren (2009) speaks of the seed as a *proxy*, a stand-in for agricultural plant varieties that are being lost in their habitats. Where genetic erosion is threatening crop varieties, selected groups of seeds become ‘good enough’ representations of entire species. Through ‘technologies of stasis’, such as seed banking, they are ‘simultaneously inside and out of the world [...] this is their explicit purpose, to set aside, preserve, and safeguard’ (2017, p.164). Yet, what remains unaccounted for is the question of good enough for whom, for what future purposes, and to what extent can seeds really be ‘set aside’ considering the above discussion of *naturecultural* inseparability?

It is important to mention the hopeful, spiritual and figurative worlds contained in seeds, their metaphorical and rhetorical potential as carriers of imaginary and literal growth. There is a certain evocative, promising quality to seeds and our hopeful dependence on them that I cannot fully unpack here, but that is shown, for example, across the multiple references

⁴⁰ Haraway’s (2003) *naturecultures* are embedded in anti-racist feminist approaches to STS where non-human biological life is inextricably linked with human history.

to seeds in the bible or other spiritual and metaphysical texts.⁴¹ I return to this ‘messianic’ quality in chapter three surrounding the depositing ceremony at the SGSV.

Seed as Archive of Relationality

As has been pointed out, seeds are not fixed or static. Within limits, they have capacities to adapt, respond, and resist. Van der Veen suggests, ‘they change in the context of their relation with people – and this process is mutual; people are changed too – and the properties of plants thus form archives of past human and plant behaviour’ (2014, p.804).⁴² Harrison sees the seed as ‘a biosocial archive in its own right’ (2017, p.85): the genetic material of crop seeds holds records of cultural selection and crop experimentation and describes agricultural histories. Bristow also addresses this dimension of power in the seed as biosocial archive, where he argues that plants contain histories of extraction and migration. He uses ‘wild memory’ to refer to the agency of seeds within seed dispersal and cultural knowledge circulation, in ‘how we produce and circulate knowledge of our environment’ (Bristow, 2015, p. 81), particularly in relation to institutions that affect the public imagination – what I discuss as ecological imaginaries. ‘Memory’ here reflects material, bodily forms of memory through a ‘deep pattern of practice’ (ibid, p.81) and ‘wild’ is positioned in relation to socially constructed ideas of sustainability and biodiversity in how they are deployed in capitalism. These examples make tangible the relationality of the seed as biosocial archive due to bodily memory that goes beyond genetic data. While seeds are archives of cultivation histories, the suggestion of ‘wild memory’ points to the fact that the seed also retains its being before the history of domestication. Connecting to this biosociality, van Dooren describes seeds as archives of ‘intergenerational, interspecies, human/plant kinship relations’ (2007, p.83). As archives of relationality across species boundaries seeds therefore carry future relations in ways that are other than human but also other than ‘just’ plant. They contain miniature worlds of relations.

⁴¹ For instance, in The Parable of the Sower, Luke 8: 5-8; Genesis 9: 2 and Genesis 47: 23.

⁴² This mutual becoming is explored in-depth in the following chapter on methodology.

Seed as Agent

The breadth of scholarship in recent years that has sought to destabilise, decentre, and challenge the category of ‘the human’ – and who is included in this humanity – has included embraces of the posthuman (Braidotti, 2013), critical race studies and postcolonial thought (Wynter, 2003; Mbembe, 2017; Yusoff, 2018), and a ‘nonhuman turn’ (Grusin (ed.), 2015) that swept through anthropology and philosophy with enquiries such as new materialism and more-than-human anthropology in scholarly approaches that ‘can no longer take the human subject as their dominant object of analysis’ (Livingston and Puar, 2011, p.4). If agency in these ontologies can be found outside the human, this affects the understanding of the agentic capacities of the vegetal, and of seeds specifically. Approaches to plants, their relationality, cognition, and intentionality cross anthropology, philosophy, geography, and biology such as in anthropology Eduardo Kohn’s *How Forests Think* (2013), Natasha Myers’ ‘Conversations on Plant Sensing’ (2015) with plant scientists, and Monica Gagliano’s (2013, 2015) work on plant behaviour, bio-acoustics, and intelligence that locates agency, memory, and cognition in the vegetal world. I often asked interlocutors what it means for them to ‘think with’ plants, what they have learned from plants and how this has shifted their practice. Many found patience and resilience in observing their subjects of care (see chapters four and five).

In *Plant-Thinking: A Philosophy of Vegetal Life* (2013), philosopher Michael Marder uses a phenomenological framework to describe what he terms ‘plant-thinking’, a ‘non-conscious intentionality’ (2013, p.12) and ‘post-metaphysical ontology of vegetal life’ (ibid., p.18) marked by material significations such as growth without conscious representation.⁴³ In his conception thought is ‘fluid, receptive, dispersed, non-oppositional, non-representational, immanent, and material- practical’ (ibid., p.152), coinciding with the phenomenality of vegetal life. Marder argues for the distinct otherness of plants. When plants and humans meet,

⁴³ Arthur Schopenhauer’s work on plants in *On the Will in Nature* (2010) provides an interesting counterpoint here for exploring will and intelligence in plants. Schopenhauer observes different kinds of forces and capacities for movement in plants to describe their physical agency and response to stimuli.

‘worlds’ and temporalities intersect (ibid., p.8). I suggest it is precisely these worlds that are held and contained by seed banking practices. Reflecting on the specific status of seeds within vegetal ontologies Marder considers the falsity of ‘the mystical aura of the seed taken to be an originary principle’ (ibid., p.82). Rather than a moment of genesis, the seed is only one stage in a cycle of growth. It follows that there is a ‘vegetal memory’ ingrained in the seed, as ‘the site of material inscription on the body of the plant’ (ibid., p.155). This material trace, a bodily memory, is an element of the distinct ontologies and epistemologies of vegetal life – what Marder terms *epistemophytology* and *ontophytology*. Building on this conception of plant-thinking I want to emphasise the particular speculative potential of *seed-thinking* as an extension of plant-thinking. Marder suggests ‘the speculative sense of “vegetation” is paradoxical and double’ (2013, pp.52-53). Plant-thinking in my interpretation remains speculative in its acknowledgement of and reliance on the otherness of plants and their *symbolic* complexity for human thought. In *Radical Botany: Plants and Speculative Fiction* (2019) Natania Meeker and Antónia Szabari explore the multiple liveness of plants to ask ‘do plants speculate?’ (2019, p. 2) in imagining new worlds, where their passivity is a force and plant bodies reassemble us. They are attempting to not anthropomorphise the vegetal world but to investigate the gap between the two. Across this thesis speculation not only supports a thinking with plants but also an envisioning of the worlds and ecologies contained in each practice, their speculative ethics. Puig de la Bellacasa’s use of ‘speculative ethics’ (2017, p.227) is helpful in conceiving the potential of critical feminist speculation for holding the multiplicities of possible relations in practices of care. Where I sense space for development of Marder’s concept is in closer attention and sensitivity towards the biological, biosocial, and biochemical processes of vegetal life. Seed-thinking in this sense has to be more connected to the outlined biological processes of dormancy, dispersal, and germination as states where seeds are sensing and responding to their environments carefully. It is an adaptive way of thought where intentionality is both loaded with risk and responsive to circumstance.

In the introduction to *A Thousand Plateaus*, Gilles Deleuze and Félix Guattari ask the reader to ‘follow the plants’ (1987, p.11). They conceptualise the rhizome as a distributed, living

network that resists the vertical hierarchies of root structures in favour of decentralised distribution. Amongst vegetal agents I believe seeds have a very specific quality, one that makes seed-thinking distinct from Marder's plant-thinking: their unique capacity for deterritorialisation and reterritorialisation through patterns of dispersal, movement, and temporal delay. Across this thesis plants appear in ecological disturbance (chapter four), and they can be invasive and pioneering (chapter six). A thinking with agency also affects vegetal representation in legal spaces. Iván Roncancio (2017) brings together Latin American legal theory, perspectives on plant sensing and intelligence, and Amerindian principles of intentionality and relationality found in concepts such as multi-perspectivism (Viveiros de Castro, 1998) and animism (Descola, 2013) to conceive an interdisciplinary non-anthropocentric politics.⁴⁴ Roncancio's approach to the legal implications of vegetal ontologies is important for the political implications of the carrier seed outlined in the methodology chapter. It is also insightful for the legal questions posed by the Cherokee Trail of Tears black bean in chapter three as well as the white cucumber in chapter five in their relations to land and sovereignty.

This section has sought to give shape to the multitude of relations, representational challenges, and agential forces contained in seeds, with sensitivity to the shift and translations that occur when a seed enters a seed bank.

Conclusion

This chapter opened with Jay's description of saving and regenerating a species at the edge of extinction. Seed conservation in this sense appears as fundamentally good and ethical. Yet I have shown throughout this chapter that many of the connotations of saving, diversity, and conservation are entangled in complex social constructs of care and histories of mastery and classification. In exploring the relationships between seed banks, seeds, living archives,

⁴⁴ Biological, neurological, and phenomenological explorations of plant intelligence can, for instance, be found in Mancuso and Viola (2015), Trewavas (2014), Struik et al. (2008), and Marder (2012).

ecological imaginaries, and biocultural diversity I have started to explore what cannot be contained and stabilised in practices of banking.

Despite the attempts to reflect the multitudes held in seeds in the final section I want acknowledge that throughout this thesis seeds will remain fugitive. Across theoretical disciplines and ecologies, they escape static definitions and cannot be captured wholly by theoretical perspectives. This is the theoretical allure of what I've sketched out as seed-thinking. The following chapter on methodologies, through the concept of the carrier seed, will thus outline how empirical observations allow me to work with this multiplicity and fugitivity.

Chapter Two

Becoming-with in an Ecology of Practices

Introduction

How can a seed tell a story? This is not only a question I've asked myself when I started this research and many times in the years that followed when observing seeds as they entered and exited seed banks. It is also at the heart of how the practices analysed here attempt to share their care and its importance. It is a matter of how to relate to vegetal life and what ethical and political concerns arise from this. Jasmine, who works in RBG Kew's communications team, went through a range of questions with me that she asks herself in choosing plants for media stories. Is it pretty? Is it interesting? How has the plant adapted? How does it interact with its environment? Is it useful? What's its collection story? She described her thought process as such: 'you instinctively, as a storyteller, know what's a good story because it makes you go, what happened next?' (Jasmine, personal communication, 30 January 2020). What comes across in Jasmine's questions is a tuning into and harnessing of the cultural significance of the plants RBG Kew cares for, and their potential to mobilise audiences around wider issues.

Jasmine's sense of what a story is, in her professional capacity to develop audiences for a large public organisation, differs of course in many ways from the critical inquiry into human-plant relations that I seek to narrate in this thesis. What I asked myself, in deliberating how seeds, in the multitude of meanings explored in the previous chapter, could affect the methodology of this research was also *who is it up to, to share the stories of a seed?* In the following I conceptualise the more-than-human ethics and representational politics in working with seeds and their custodians, as well as the resulting methodological approach to empirical research. While the previous chapter mapped the histories and infrastructures of banking seeds, this chapter focuses on relational ethics across my research practice and in

encountering the practices I observed. This is thus not a chapter on methodology in a narrow sense, but includes a philosophical and political positioning and reflection on the ethical deliberations at the heart of a critical reading of human ecological agency. I encounter each of the four practices observed across this thesis (the SGSV, MSB, UAWC, and KFGB) in a process of what Donna Haraway describes as ‘becoming-with’ to give shape to the relational becoming in each practice, and situate this research in an ‘ecology of practices’ – a constellation of seed banking practices sensitive to their making of divergent ontologies and epistemologies. Throughout this chapter I grapple with how to approach scientific practices from the cultural field and thus draw from feminist STS and the concerns shared with decolonial and postcolonial studies around representation and agency.

Empirical Approach

How I approached empirical research is informed by a range of STS, anthropological, and sociological methods in conducting interviews and observations during research periods at the selected practices. Here the tools of ‘multispecies ethnography’ as an approach to relationality (Kirksey and Helmreich, 2010; Livingston and Puar, 2011; and van Dooren and Rose, 2016) were productive in developing the carrier seed method outlined in the following section. This makes possible a thinking together of ecologies and a politics of representation. Multispecies ethnography in particular supports analyses of biodiversity conservation, processes of domestication, ‘improvements’ of plants, and histories of cultivation. This enables me to ask important questions of representation of the more-than-human in how I write about seeds. Here, ethnobotanical writing (Nazarea, 2006; Hayden, 2005) has also been influential in thinking through the interactions of anthropology and botany. Working in a partial, dispersed framework, I draw from George Marcus’ (1995) concept of ‘multi-sited ethnography’ to support the relationships between ecologies and the ‘tracing’ of stories through strategies such as following conflicts (see chapters five and six) as well as with Haraway’s ‘situated knowledges’ (1988) to address my positionality in these partial perspectives. While drawing from sensory, bodily ethnographies (Fox Keller, 1983; Despret, 2004; and Roosth, 2010) and

ethnographies of global connection (Tsing, 2005 and 2015) I am not framing this thesis as an ethnography. It does not claim the depth of immersion in the field expected of ethnographic research and the effects of the Covid-19 pandemic on being able to access practices made long-term in-person observations impossible.



Figs. 2.1–2.4 Storage spaces of the four seed banking practices observed

Fig. 2.1 Seed chamber of the SGSV, 2020. Photograph: The Crop Trust, creative commons license CC BY-NC-SA 2.0

Fig. 2.2 Interior of one of the MSB's two seed chambers. Photograph: Charles Pryor and the author, 2019



Fig. 2.3. Seed storage in UAWC's offices in Hebron. Photograph: the author, 2019

Fig. 2.4. DNA bank at the KFGB including germplasm samples. Photograph: Charles Pryor and the author, 2019

Case Studies

I observe four seed banking practices and each of the empirical chapters focuses on one of them. I briefly summarise them here:

The **Svalbard Global Seed Vault** (SGSV; fig. 2.1) was established in 2008 and is permanently unstaffed. It is located on the Norwegian archipelago of Svalbard and only opened three times a year to deposit duplicate accessions from *agri-scientific* seed collections globally. It focuses on crop biodiversity in *cultivated* varieties and wild relatives. It also

functions as a centre node for the ‘genetic resource community’ and describes itself as the *ultimate* backup for humanity’s food supply and the global agricultural system (chapter three).

The RBG Kew’s **Millennium Seed Bank** (MSB; fig. 2.2), built in 2000 in Wakehurst, UK, holds the largest collection of *wild* plant biodiversity globally and, as with the SGSV, stores duplicates of collections, in this case from botanical partners across the globe. Kew’s imperial history connects the establishment of seed collections to the cartographies of colonial expansions, the economic usefulness of wild plants, and the performance of present-day *scientific authority* in the development of seed banking protocols (chapter four).

The **Union of Agricultural Work Committees** (UAWC; fig. 2.3) seed bank in Hebron, Palestine was started by volunteer agronomists and works on food sovereignty, community support, and land reclamation. It supplies farmers with seeds and knowledges for the cultivation of local rainfed varieties. For these varieties of crops farmers do not need to irrigate seeds artificially in a settler-colonial political context where water is extremely scarce but cultivation necessary to protect access to land. UAWC’s practice highlights the saving and distribution of seeds as infrastructures of resistance and more-than-human sovereignty, connecting vegetal resistance in harsh climates to human resistance (chapter five).

The organisational foundations of the **Kostrzyca Forest Gene Bank**, Poland (KFGB; fig. 2.4), lie in the mitigation of anthropogenic climate change. With a specific focus on forest species the KFGB’s project to preserve the biodiversity of the threatened primeval old growth Białowieża forest and the highly politicised logging campaign by the State Forest Department are of particular interest for asking if the relationality of a threatened ecosystem can enter a bank. The KFGB’s combined approach of *in situ* and *ex situ* conservation enables a thinking through of the entanglements of state interests in the preservation of forest diversity (chapter six).

Research Schedule

Date	Empirical research activity
February 2019	Initial visits to the Millennium Seed Bank, UK
March 2019	Stay at Kostrzyca Forest Gene Bank near Jelenia Góra in Poland
July 2019	Stay at the Union of Agricultural Work Committee seed bank in Hebron, Palestine and visit to other seed saving initiatives in Palestine
November 2019	Stay at the MSB to conduct interviews
February 2020	Attendance of seed depositing event at Svalbard Global Seed Vault
February – November 2020	Follow up interviews via Skype

Table 1: Timetable of empirical research

I conducted research stays at each of these practices (see table above for timeline). First, I visited the MSB for a film project in February 2019.⁴⁵ Following this I stayed at the KFGB in Poland where I interviewed foresters, observed *in situ* conservation projects, visited tree plantations, forest nurseries, and followed the seed extraction and depositing process within the seed bank. I then visited the seed bank of UAWC in Hebron, Palestine where I stayed above the seed bank while visiting multiple sites across the West Bank where farmers were cultivating traditional *ba'al* varieties, extracting and sharing seeds, reclaiming, and protecting land from surrounding settlements. I spoke to farmers, agronomists, volunteers, and members of local community support groups. Both the KFGB and UAWC had previously been in conversation with the MSB and the KFGB was an active depositor there. After this, I visited the MSB at Kew, where, staying in researcher accommodation within the seed bank's building, I followed the movements of plants through the building and spoke to plant scientists (including cryobiology specialists and restoration ecologists), partnership coordinators, building managers, greenhouse horticulturalists, and education and communication teams. I observed processes of freezing, cleaning, sorting, germination tests and the day-to-day coordination of the MSB's global partnerships. The worlds of wild flora conservation and

⁴⁵ See footnote on page 20 for further information on this film.

global agricultural systems intersected publicly for the first time when I observed the Seed Depositing Ceremony at the SGSV in February 2020, where Kew was a first-time depositor. Meeting some of my interview partners from the MSB in the High Arctic made tangible the interconnections of global networks of seed banking, the so-called 'cold chain'. Leading up to the ceremony I had interviewed members of the Crop Trust and NordGen, the Scandinavian seed bank that manages the vault. In total, I conducted 31 conversations across the practices; not all of these were formal interviews, often they were conversations during a drive, lunch, or while waiting for a bus. This includes follow-up conversations during the Covid-19 pandemic which I conducted via Skype.

Access and Participation

Access to these practices was not always easy. I tried to explain to practitioners why someone from the field of cultural studies wanted to explore their work and the plants they care for, what I was trying to research through ecological imaginaries. Participant information sheets and consent forms were crucial in explaining how this data would be used. Sometimes interviews were not possible at all, for example with the Cherokee Nation, whose seed deposit I observed in Svalbard. I reflect on this silence in the following chapter. However, practices such as UAWC who are politically isolated from the global networks of the SGSV and the MSB met the research visit with enthusiasm, putting great care into making visible and narrating the need for seed banking in the West Bank, which raised important questions on my responsibility as a researcher addressed in the last section of this chapter. Here, I also want to mention my positionality as a white, cis-female German researcher from a UK university in accessing practices. I assume that these attributes made access easier for the elements of this research that took place in Europe. On the other hand, these attributes might have made some of my respondents more guarded of potentially extractive research practices, in particular when engaging with indigenous communities and struggles for sovereignty.

Observations and Interviews

Observational techniques included field notes, sound recordings, notes on sensory impressions, diagrams, and film material. The analysis of these materials depends on the relationship developed with each practice over time and revolves around tracing enactments of vulnerability, sovereignty, and mastery throughout the collected materials as well as observing connections and divergences between practices. ‘Multimodal ethnography’ (Dicks et al., 2006) as a method for combining ethnographic materials from a range of different media was a helpful reference in exploring the different meanings that media ‘afford’, and the meanings produced in relation between these media. This was particularly significant for considering sound and film recording in my analysis; the photographic images embedded across the following chapters are often film stills (see image credits) from the collaborative film project *A womb of things to come, a tomb of things that were* with Charles Pryor that I developed alongside this thesis and that documented some of the seed banking practices involved. The film explores questions of nonhuman representation through artistic means, drawing from Lorimer’s (2010) analysis of the potential of moving image practices in engaging with nonhuman difference. An important dimension of what I sought to observe was the performative, enacted aspect of making care in seed banking *visible*. Throughout the empirical chapters I therefore also integrate visual materials produced by the practices, such as films and images, promotional materials, and media collaborations. This performance of care is analysed to understand the making of vulnerability as a justification for care, relating back to earlier discussions of visibility in the Anthropocene in chapter one.

Interviews, combined with observations, make the practices tangible as practices of care and living knowledges, made up of individual perspectives, rather than through scientific outputs such as research papers, which I also consider. Some of these interviews have elements of expert interviews and seek clarification on plant science. All interviews had a semi-structured element of inquiry about the tactile and embodied knowledges enacted in seed banking, as well as the role of affect and personal positions towards the larger politics of the practices interviewees contribute to. I asked most interviewees a set of questions on human-

vegetal ecologies and their imaginaries for their practices. In conducting these interviews, I aimed to create a conversational environment where I would also share stories from my research. These conversations have been an important process in challenging my assumptions, reframing my initial research questions, and shaping the selection of practices and encounters. They were also crucial for separating individual experiences from organisational rhetoric. In processing these interviews I was aware of the responsibilities to represent interviewees and attempted to not just to ‘mine for’ and extract materials but see conversations as co-constructed knowledge exchanges between interviewer and interviewee (Gubrium and Holstein, 2001; Roulston, 2014). The settings of these interviews, often in seed bank buildings, but sometimes in farmers’ fields, on Skype, or in a hotel lobby surrounded by people, always influenced my narration of them. I seek to position my presence in these interviews; they were not words spoken into a vacuum but part of larger conversations, whose embedding in my analytical narrative needs to be acknowledged. Often, these conversations also involved an element of translation for research in Palestine and Poland.⁴⁶ Conversations and observations are analysed alongside documents and image materials to ask how practices frame the need for and imaginaries of seed banking.

Carrier Seeds

In the following I describe how *seed-thinking* – the attempt to think with the vegetal agency of seeds explored in the previous chapter – shapes the methodology of this thesis. Following a *carrier seed* – a chosen variety that can help to bring relations, tensions, and questions to the surface – the empirical chapters think with seeds to explore seed banking as a narrative practice and ecological imaginary. I propose carrier seeds in this conception, and building on the previous chapter, as an interdisciplinary methodological concept drawing from perspectives in anthropology and philosophy, ethnobotany, conservation studies, decolonial

⁴⁶ While most practitioners I met spoke English and were comfortable conducting interviews in English, some conversations with farmers and seed bank beneficiaries were translated by seed bank practitioners who were with me for these conversations.

and postcolonial theory, the environmental humanities, political ecology, seed science, and STS. STS has long been interested in actors other than human, their agency, and networked beings.⁴⁷ Convincing arguments have been made for the need for critical engagement across these disciplines, between STS and postcolonial thought (Harding, 2009 and 2011), STS, anthropology, and/or critical indigenous studies (de la Cadena et al., 2015; Todd, 2016; Jensen et al, 2017) or between the vital, somatic, and ontological concerns of new materialism and political ecology (Bennett, 2009). The empirical chapters trace the movements of a carrier seed into and out of the respective bank, the ecology it was removed from and potentially returns to. I describe these movements as *seed circuits* and follow the connections between *in situ* and *ex situ* conservation, the processes of duplication and backing up, as well as the circumstances under which seeds would leave the banks. In following these seed circuits I was sometimes struck by an inability of seed banks to meaningfully usher seeds out of the bank and an absence of imaginaries to make seeds available for shared futures and alternative forms of sovereignty. The methodological contribution to cultural theory I aim to make through carrier seeds is to make tangible and visible the precarious patterns of ecological imaginaries, mastery, and sovereignty.

My narrative device of the ‘carrier’ departs from feminist science fiction writer Ursula K. Le Guin’s carrier bag theory of fiction (1996) to consider how power influences what kinds of stories are told, who acts as their ‘hero’, what futures they make imaginable and how this can decentre ‘the human’ or reveal who is included in this humanity. Following Le Guin, a carrier is a holder and recipient, a conceptual container that, in my case, travels through the research process. It holds memories of entangled histories. In ‘The Carrier Bag Theory of Fiction’ she suggests a thinking with quieter, unheroic registers of storytelling focused on the slow stories of surviving with what could be described as more-than-human collectivities, of being able to learn from other life and its alienness:

It is hard to tell a really gripping tale of how I wrested a wild-oat seed from its husk, and then another, and then another, and then another, and then another [...] Before

⁴⁷ Bruno Latour, Michel Callon, and John Law’s conceptualisations of Actor Network Theory in the 1980s are early examples from the perspective of STS for approaching networked social material-semiotic relations with nonhuman actors (Callon, 1984; Law, 1997; Latour, 2005).

you know it, the men and women in the wild-oat patch and their kids and the skills of the makers and the thoughts of the thoughtful and the songs of the singers are all part of it, have all been pressed into service in the tale of the Hero. But it isn't their story. It's his. (Le Guin, 1996, p.149; italics mine)

Through the slow caring labour of seed saving Le Guin urges to rethink the carriers we have for telling stories beyond the apocalyptic mode of the 'techno-heroic', the triumph over and domination of 'nature', and the masculinist human agent of progress. In my understanding a seed body is – as is science fiction as a literary genre according to Le Guin – a 'womb of things to be and a tomb of things that were' (ibid., p.154), a living carrier that holds both future and past life worlds. Storytelling, and arguably academic practice, becomes an ethical practice that narrates these worlds, but also makes them imaginable otherwise. Across the empirical chapters I take the seed as narrative 'carrier' to trace flows of organisms, and their classification and translation into genetic data and resources, germplasm, species, and varieties, into and out of banks. Through this the carrier seeds enable me to investigate the ethico-political visions of practices – their ecological imaginaries.

Le Guin explores the distinct qualities of vegetal life and its pull on the imagination. In the short story *Vaster than Empires and More Slow* she describes the visit of a human envoy to an alien planet, a 'pure phytosphere' (Le Guin, 2015, p.175), marked by the absence of sentient beings:

Nobody here ate anybody else, all life forms were photosynthesising or saprophagous, living of light or death, not off life. Plants – infinite plants, not one species known to the visitors from the house of Man. Infinite shades and intensities of green, violet, purple, brown, red. Infinite silences. Only the wind moved, swaying leaves and fronds, a warm southing wind laden with spores and pollens, blowing the sweet pale-green dust over prairies of grasses, heaths that bore no heather. Flowerless forests where no foot had ever walked. No eye had ever looked. (ibid., p.176)

This forest planet is shaped by a collective intelligence distributed silently and without noticeable movement. While Le Guin conjures a fantasy world, it also describes a past evolutionary state before the evolution of sentient beings on Earth. Pausing on the stillness and silence of the 'phytosphere' I suggest that Le Guin makes tangible an encounter with vegetal life that remains alien and other. Yet it sustains us and is receptive of human care. I observed how seed banking practices struggle to narrate affective experiences that make 'alien'

plants present as living, responsive, and adaptive beings against what Jasmine, whose storytelling practice at Kew opened this chapter, called ‘plant blindness’. Without faces, without eyes, plants are not prone to be ‘charismatic species’; nonhuman charisma is a relational property in interspecies encounters (Lorimer, 2007). Carrier seeds are a testing of how these affective, embodied experiences of saving can translate into a research method.

The speculative foundation of carrier seeds draws from the growing field of critical plant studies which crosses literature, art, philosophy, and plant science (for instance Laist et al., 2013, Gagliano, Ryan and Vieira, 2017, Gibson, 2018), to address the agency of plants beyond immobile passivity. How can I research through vegetal epistemologies and ontologies, or the fact that the vegetal doesn’t distinguish between the two? In theoretical and practical attempts to work out what *seed-thinking* means as a process in extension of Marder’s ‘plant-thinking’, I approach the capacity of seeds to communicate, make decisions, respond, and adapt as an important factor for how practices work with their objects of care. As outlined in the previous chapter, a major challenge in dealing with human-vegetal ecologies is to resist anthropomorphising the vegetal when considering intentionality and agency. From interviews across seed banking practices, it became evident that this issue is particularly sensitive for plant scientists who often fear anthropomorphic projections being cast onto seeds (Alex and Jasmine, personal communication, 2019 and 2020). I was, for example, quickly corrected various times for slips of the tongue when referring to what the seeds ‘want’ when visiting the KFGB and the MSB.⁴⁸ And yet, I do not want to discard but challenge the seed’s hopeful, symbolic, and metaphorical promise since this evocativeness is also why seed banking has such a captivating hold on imaginations. Here I echo Meeker and Szabari (2019) who suggest that plants have a twofold hold on human desire both through their alienness but also through the power they have on our imaginations.

Anthropologist and multispecies scholar Natasha Myers asks through an ethnography with plant scientists how we can learn with plants what we mean by the ‘phenomena of sense,

⁴⁸ Philosophical positions on plant intentionality that are insightful to mention here are Schopenhauer’s discussions of ‘will’ (2010) and Aristotle’s ‘entelechy’ or ‘actuality’, as discussed in Meeker and Szabari (2012).

sensation, and sentience' (Myers, 2015, p.6). She argues for an enchantment of the vegetal, tuning into the molecular sophistication of its operations and mechanisms, while allowing the researcher to be 'vegetalised' rather than seeing anthropomorphism as a one-way flow of projection and inscription. Through the methods employed I give space to this potential 'vegetalisation' (ibid., p.20) while tracing the anthropocentric gestures of containment. I try to navigate the lure of projecting thought onto the vegetal, and the trap of thereby anthropomorphising what it means to care, nurture, be dormant, or as Myers suggests 'to anticipate.' This anticipation can be directed at growth, environmental sensing or the futures held in seeds more broadly. Through an interdisciplinary approach to positionality, I follow Myers in viewing seeds as different, 'metabolically superior' (2015, p.17) organisms, whose adaptive and resilient capacities often inspire those who work with them (Leila, Erica, and Liz, personal communications, 2019). A focus on vegetal agency in carrier seeds encourages a thinking with seeds and their unique sensory and memory capacities rather than viewing seeds as lacking – of consciousness, mobility, and sentience.

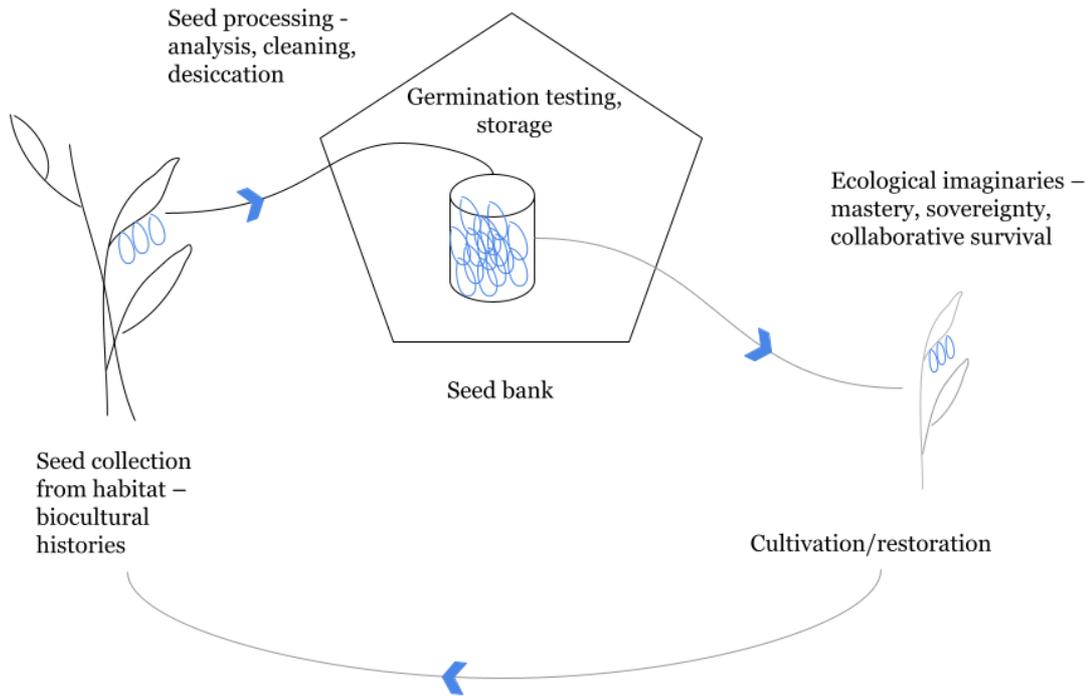
I selected the carrier seeds as follows:

Chapter three follows the Cherokee Nation's Trail of Tears black bean as it arrives at the SGSV. The variety was cultivated and cared for by Cherokee Nation citizens starting before their forced displacement and resettlement in Oklahoma in 1838 and has a loaded biocultural history.

Chapter four follows a threatened banana wild relative from seed collection to the MSB and consequent adoption after germination tests by a range of botanical gardens across Europe.

Chapter five describes the search for an almost extinct white cucumber in the valley of Wadi Fukin in the Palestinian West Bank and its connections to food sovereignty, cultural memory, and resistance to occupation.

Chapter six explores the conservation conflict around how to deal with a Norway spruce infestation by a bark beetle in the Białowieża forest in Poland. This chapter doesn't follow a carrier seed as such but deepens relational considerations.



Diag. 2.1. Schema of a seed circuit, that describes how a seed *can* move into and out of a seed bank. Diagram by the author, 2021

In focusing on wild and domesticated plants the carrier seeds reveal how patterns of human cultivation have changed the cyclicity of plants and their seed producing capacities (see diag. 2.1 for a schema of a seed circuit), for instance explored in chapter four, which focuses on seed bearing banana wild relatives needed for vulnerable commercial bananas, which do not produce seeds.

Carrier seeds make it possible to ask if concepts such as ‘more-than-human’, ‘interspecies’, and ‘multispecies’ are productive in describing relationships and where their limitations lie. While this research seeks to contribute to the growing scholarship on the more-than-human, I am also critical of how this framing still centres the human as the centre of these relations. Searching for an analytical approach for carrier seeds with the human-vegetal ecology as the interface of enquiry, I therefore build on Jasbir Puar and Julie Livingston’s intersectional approach to ‘interspecies’ (2011), as a relation shaped by the (bio)political effects of biosocial life. Rather than an investigation into the co-existence of a multitude of species, a method built on interspecies relationality accounts for social and (bio-) political

dimensions constituting the messy interventions of one species into the integrity and survival of others. Arguably, in terminological terms ‘interspecies’ or ‘multispecies’ are still problematic, as both rest on a fixed category of species while arguing against the political project of species classification and taxonomy – similar to how the more-than-human still relies on the human. As a device carrier seeds hold but also fold into each other the scales of individual organisms, populations, species and ecosystem, and therefore allow for a thinking beyond the species-oriented ordering systems used in seed banking.⁴⁹ Puar and Livingston advocate for the importance of intersectionality in interspecies thinking, suggesting that animal studies and posthumanism have so far been driven by Eurocentric conception of ‘the human’ and need to be challenged by acknowledging the work of critical race and postcolonial studies.⁵⁰ The carrier seeds point to how discussions of ‘species’ and ‘race’ are interrelated and I will discuss how both have manifested as cultural constructs historically as it concerns the case studies.

Listening Against Mastery

In approaching and analysing interviews, observations, and movements of the carrier seeds, I work with an adaptation of what postcolonial literary theorist Julietta Singh describes as ‘reading against mastery’ (2017, p.1). I suggest that reading seed banking practices against mastery can reveal tensions in conservation solutions– who has rights to access future

⁴⁹ Gabrielle Hecht’s concept of the ‘interscalar vehicle’ resonates here with carrier seeds and is helpful in highlighting the performative quality of scale. She describes interscalar vehicles as ‘a means of connecting stories and scales usually kept apart’ (Hecht, 2018, p. 115), that has political, ethical, affective, and epistemological dimensions.

⁵⁰ This discussion of human ecological agency adds to earlier discussions of the silencing of racialised and neo-colonial patterns of thought in some Anthropocene scholarship in who is included in the category of ‘the human’. Posthumanist drives to decentre the human and to acknowledge the role of technology in the production of bodies and socialities have been criticised for the uncredited appropriation of indigenous thought (Todd, 2016). Queer and critical race studies theorist Shannon Winnubst (2018) argues that in decolonial and postcolonial critique the figure of ‘the human’ is produced by the violent history of racialisation. According to Winnubst, this constitutes an ontological divide between posthumanist scholarship and decolonial critique since they operate along different historical coordinates: posthumanism grounds ‘the human’ in 17th century Enlightenment humanism centred on rationalism and universalism. It complicates this through ontological considerations on technology and nonhuman sentience. Decolonial and postcolonial theory on the other hand moves with the historical coordinates of 15th century onset of European colonialism that led to 18th and 19th century slavery. Winnubst argues that both enquiries are thus grounded in divergent social ontologies.

diversity and at what cost? How will seeds get out of the bank? It also shows how power relations between practices are enacted. Singh develops an interdisciplinary reading of mastery through productive intersections of postcolonial theory, new materialism, and queer theory and their respective treatment of agency and rights. This forms a theoretical grounding that is echoed throughout this thesis in my attempts to develop a critical problematisation of ‘the human’ as an ecological force. In opening postcolonial studies to the nonhuman, and vice versa, Singh argues that dehumanisation is based on the subjugation of both environments and peoples and a worldview that the nonhuman world does not contain ‘meaningful, dynamic life’ (ibid., p.18). She situates mastery at a meeting point of matter and narrative, enabling – in my reading of it – a bringing together of material and storytelling multitudes held in seed banking practices. It is impossible to contain mastery, as Singh suggests, merely defining it ‘would be a gesture towards mastering it’ (ibid., p.12). Instead, she explores qualities of mastery that go beyond ‘sovereignty’, ‘as a state problematic’ (ibid, p.12), and ‘domination’, as an ecological relation. When a seed is placed in artificial dormancy through processes of freezing, I suggest that it is in Singh’s sense ‘a rupturing of the object being mastered’ (ibid, p.10). In cold storage seeds are at the liminal threshold of life, with all metabolic activity slowed down as much as possible. It is a practice of ‘a splitting of the object that is mastered from itself’ (ibid, p.10); the seed on its own accord could never become-plant from this state. However, mastery also denies the ‘master’s own dependency on other bodies’ (ibid, p.10); this acknowledgement of dependency in masterful relations is crucial in the following *vulnerable listening* to seed banking practitioners through moments when mastery breaks down or is rejected from within the practices, as explored in the following two chapters. Listening against mastery thus can enable a methodological approach to collective vulnerability, particularly in ecological terms.

For my research practice this meant a slow unravelling of layers of mastery, of being open to hearing hesitation in conversations and alternative imaginaries from within practices of mastery, but also being sensitive to the potential masterful thinking in my own practice – I

listened *for* and *against* mastery.⁵¹ It is a relational approach to listening that is sensitive to place and the more-than-human rhythms of seed banking. In this approach to listening, I'm influenced by AM Kanngieser's thoughts on 'listening as method' (2020) that frame listening as a sensitivity to embodied, collective histories and positioning the self in a place, in a relation that is 'never benign, and nor is it arbitrary' (n.p.). For me, beyond conversations, this also included ambient sound recordings of the environments surrounding seed banks and of the sounds of their technical infrastructures and the soundscapes of cultivation amidst settlements in chapter five.⁵²

My approach to observing vulnerability and mastery in practice asks how practices can both reveal the imperial power formation and epistemological binaries many of them emerged from, but also show strategies of what Ariella Aïsha Azoulay calls 'worldly sovereignty' (2019) – of repressed and persistent forms of being in and knowing the world. In her discussion of imperial temporalities and resistance to them Azoulay unearths violent practices that created archives as 'neutral technologies' (2019, p.42) for self-preservation across space, time, and body politic. Methodologically, she proposes *unlearning* as a way of understanding how these practices destroy shared worlds and care for a shared world. From this a 'potential history' can emerge that 'does not mend worlds after violence but rewinds to the moment before violence occurred and sets off from there' (ibid., p.10). I suggest unlearning imperialism can reveal other formations of sovereignty, mastery, and care in seed banking practices as living archives and ecological imaginaries. Reading archives as technologies of self-preservation can open a thinking about conservation that does not just affect the objects of saving – the seeds – but a self-conservation of the ideologies and agricultural systems of their custodians. This makes seed banking practices capable of making and unmaking liveable ecologies.

⁵¹ Tiffany Page's (2017a, 2017b) writing on vulnerable feminist research methods asks important questions here about becoming vulnerable in return as a researcher and the violence, omission, and erasure that can be carried in the name of vulnerability. I want to acknowledge my own hesitations around accountability here in who it is up to, to tell these stories and how I might be reproducing relationships of mastery in academic practice.

⁵² See chapter four and conclusion for discussions of the MSB's sonic environment.

Reading against according to Singh and *unlearning* according to Azoulay offer two methodological tools for me to go beyond seed banking as a practice of mastery of vegetal life to explore how human-plant relationality can be practiced otherwise, as a desire for resistant world-making.⁵³ Importantly, this resistance is not a rejection of science, as shown in UAWC's agronomist expertise in chapter five or debates around history and inclusion at RBG Kew in chapter four. Instead, these readings and unlearnings can reveal practices as divergent but responsive to each other in enacting a multiplicity of the meanings of sovereignty, care, and vulnerability in their ecological imaginaries.

An Ecology of Practices

'Practice' is an ambiguous term, and it deserves some attention here because of its centrality to my argument. As a form of every-day engagement, enactment, or performance it is not in opposition to 'theory'. Rather, philosopher Michel de Certeau argues in *The Practice of Everyday Life* (1984), when 'practice' initially emerged as a concept in cultural theory, that practice is a 'way of operating' (1984, p.xi). It allows for a sensing of the 'clandestine forms taken by the dispersed, tactical and makeshift creativity of groups' (1984, p.xiv). Henri Lefebvre argues that 'practice' opens a space to analyse continuity, cohesion, competence, and performance in the social production of things – practice is 'lived directly before it is conceptualized' (Lefebvre, 1991, p.34). It is necessary to define my approach to 'practice' broadly and 'seed banking practice' specifically, which proposes human-vegetal ecologies as ontological and epistemological at once. I first frame the notion of 'practice' as such – and the ubiquitous space it holds for wanting to talk about 'doing things' according to sets of principles, professional standards, or ethics – the order of and control over the things practices create, and the material-semiotic claims they make. Fundamentally, the notion of 'practice' is

⁵³ Desire here points to the temporal diversity at play in ecological imaginaries in what individual practices are saving seeds for. The reference to desire is informed by Eve Tuck's (2009) approach to desire-based research rather than damaged-based research to consider how a focus on desire, rather than loss, lack, or oppression can show different relations to futurity and community.

productive for me in generating critical thinking through a sensitivity to haptic, embodied, and temporal processes.

Catherine Phillips, who uses the framework of ‘seed saving practice’, argues that these practices are ‘sustained through time and space’ in that ‘the doings, knowings and possibilities of gene banking, for instance, differ from those of seed saving, through both may be (in part) aimed at conserving diversity’ (2016, p.6). Holding multiple temporalities, Phillips defines the term seed saving practice as follows: ‘a shorthand term for a complex set of practices including the planting, tending, harvesting, storing, eating and planting of seeds’ (2016, p.3). While containment is one component, the cultural implication of ‘saving’ is much broader and as I propose, also hints at messianic, heroic implications. Phillips suggests that there is a gap in scholarship on ‘sustained attention to the practices of seed saving, with its implications for savers, seeds, and their shared worlds’ (2016, p.5). Throughout this research I mainly use ‘seed banking’ as it is the term used by all the practices I observed that carries its own ambiguity in relation to ‘saving’; banking appears more technical and passive.⁵⁴ Seed banking practices allow me to explore the ethico-politics of engaging with practitioners, seeds, and the infrastructures that hold them through their ongoing, uneventful labour of care.

Building on this discussion of ‘practice’ I outline how the ‘ecology of practices’ is conceived of here as shaped by divergence. Connecting to the discussions of vulnerable listening and unlearning I argue for the importance of a diversity of knowledges since it is crucial to observe how knowledges are embedded and developed within epistemic communities (of science, conservation, plant breeding, and so on) and in historical specificity. The term ‘ecology of practices’ is used by philosopher of science Isabelle Stengers (2005) in her discussion of the science wars for imagining a speculative political ecology of practices. Yet my use of the term is closer to what sociologists Boaventura de Sousa Santos, João Arriscado Nunes and Maria Paula Meneses call an ‘ecology of knowledges’ (2007). Instead of a

⁵⁴ The term ‘seed saving’ is also used by Sheryl Breen (2015) in her analysis of native American seed saving practices and common in discussions of community seed saving and food sovereignty. ‘Seed banking’ is used more broadly, often referring to discussions around genetic resources and food security.

‘monoculture of scientific knowledge’ they propose acknowledging diversity within global knowledge practices, and the importance of rooting scientific knowledges within this ecology. In the introduction to *Another Knowledge is Possible: Beyond Northern Epistemologies* (2007) they argue for a different global framework of cognitive justice and recognition of epistemic diversity. They especially address the hegemony of ‘universal’ Western science as an ‘offshoot of Western cosmology’ (ibid., p.xxi) and highlight feminist and decolonial critiques of this dominance embedded in the coloniality of power and knowledge. But crucially they see ‘science’ as a space of disunities where an internal and external plurality of science surfaces. They argue that ‘what is at stake is not the validity of science but the exclusive validity’ (ibid., p.xlix). This transition from ‘knowledge-as-regulation to knowledge-as-emancipation’, which sees all knowledges as socially constructed and situated, allows me to place scientific knowledge within a diversity of knowledges, and thereby to search for an anti-colonial approach to science. In the *ecology of knowledges* translations can emerge between different knowledges on account of their respective ‘situatedness, partiality and constructedness, while rejecting relativism’ (xxx). Lastly, the ecology of knowledges allows for a framing of epistemic diversity embodied by seed banking that can analyse how some practices work with and produce scientific knowledges while others challenge these without creating a binary epistemic opposition between ‘scientific’/‘unscientific’ and ‘traditional’/ ‘modern’. The ecology of knowledges works with a social understanding of ecology. Yet I want to suggest that the relationality of ecology is not unpacked by Santos et al. as to its forms of co-production and dependency. ‘Ecology’ is assumed as a positivist, somehow balanced constellation of relations. I would like to argue this could also be a simplification of ecology that is inattentive to subjugation and power dynamics and the possibility that ecologies can be hierarchical and not just horizontal. As a tool the ecology of practices offers multiple, partial epistemologies.

A useful concept for looking at relationality in the ecology of practices is the onto-epistemology of the *pluriverse*, a world of many worlds.⁵⁵ It speaks to the ecology of practices as a habitat, where epistemological and ontological diversity can both politically co-exist *and* be in conflict in how practices relate to each other. Working with Zapatista cosmologies, de la Cadena and Blaser define what they call the pluriverse as ‘heterogeneous worldings coming together as a political ecology of practices, negotiating their difficult being together in heterogeneity’ (2018, p.4). This constitutes ‘an analytic tool useful for producing ethnographic compositions capable of conceiving ecologies of practices across heterogeneous(ly) entangled worlds’ (2018, p.4). Rather than aiming for a comparative framework across the practices, the pluriverse enables me to think with heterogeneity, sovereignty, and alterity without epistemological hierarchies, while still being able to consider questions of biopolitics. Locating the ecology of practices within the pluriverse unveils the commons as a realm accessible to and cared for by all members of a community. The commons is often evoked in questions of seed and food sovereignty in reference to movements of enclosure and commodification of life.⁵⁶ De la Cadena and Blaser propose the ‘uncommons’ as a realm for relationality between ‘worlding practices’, which I argue seed banking practices can be read as in their containment and remaking of life worlds.

This section has described how I conceive the coming together of an ecology of practices that is inclusive of divergence in multiple enactments of partial concepts. This ecological and philosophical relationality is crucial for positioning myself in empirical research across practices.

⁵⁵ This builds on the discussion on de la Cadena and Blaser’s conceptualisations of the Anthropocene as an opportunity for heterogenous political ontologies in the previous chapter. Explorations of the pluriverse as a concept of many interrelated worlds from different political perspectives are, for instance, found in Escobar (2018) and Ferguson (2007).

⁵⁶ The commons and practices of commoning have been discussed extensively including Klein (2001), Harvey (2011), Federici (2014), and Berlant (2016).

Ethics of Care

Reading seed banking practices as practices of care, this section traces how ethics and responsibility emerge in practices of care and how this translates to research as a careful practice. I see care here as infrastructural and slow. Feminist STS scholar Maria Puig de la Bellacasa's (2017) ethics of care in more-than-human worlds offers an important framework for my reading of care. She suggests that care is 'the fostering of the endurance of objects through time' (2017, p.171); it is 'a vital affective state, an ethical obligation and a practical labour' (Puig de la Bellacasa, 2012, p.197). On this basis care brings into being a practical, embodied ethics. A sensitivity to the institutionalisation of ethics in and across practices is therefore crucial. Care is an ethico-political relation, an active intervention, and practices of care can be held accountable to the heroism and rescuism enacted in saving and caring. Care is 'an everyday labour of maintenance that conveys ethical obligation: we must take care of things in order to remain responsible for their becomings' (Puig de la Bellacasa, 2017, p.43); I explore these becomings in the following section. The obligation to care present in seed banking amidst ecological crises offers a way to think about the 'modes of maintenance, repair and continuation of life through ecological practices that unsettle traditional binaries' (ibid., p.155). I draw out two significant formations of care across this thesis that can challenge these binaries. First, the performance of *global care* by those organisations who have taken on the protection of diversity on a global scale and work within international partnerships (the SGSV and MSB in chapters three and four). Second, the practice of *radical care*, as a scientific place-based, grounded practice of co-cultivation as explored in chapter five.

Reflecting on my role as a researcher, care also extends to academic research as a practice of care, 'as something we *do* as thinkers and knowledge creators, fostering also more awareness about what we care for and about how it contributes to mattering in the world' (Puig de la Bellacasa, 2017, p.41; italics in original). The practices analysed in the following chapters are vulnerable and 'have a right to care' (Puig de la Bellacasa, 2011), are becoming, shifting, and adapting over time and caught in complicated sets of power and demands. They seek to

preserve and repair, to rehabilitate and protect, and often need protection themselves. According to Puig de la Bellacasa, care resists the notion of eventfulness; it is a slow practice, yet it is also transformative, disruptive, and noninnocent (Puig de la Bellacasa, 2017, p.71). I respond to this in attempting to observe practices for multiple years to see their ecological imaginaries evolve while following the biological life cycles of their objects of care. In many ways this was made difficult by the ongoing Covid-19 pandemic and how it impacted access to practices, particularly the haptic, embodied aspects of care.

Regarding academic research as an ethical practice of care, I briefly outline ethical questions I have encountered and have been working through. A range of concerns regarding ethics emerged around empirical research and relations with the selected practices. Consent for interviews and conversations of any kind that were recorded was sought before each interview and documented in a Participant Information Sheet. To protect relations involved here (such those of employment or organisational hierarchies) all participants had the option to have their statements anonymised for privacy and I have used pseudonyms for all interviewees. Standards of data protection are also outlined in the Participant Information Sheet.

An ethical question emerges from research on UAWC's practice in Palestine around accidental exposure of sensitive data, even or especially if from a position of solidarity. This concerns developments in Palestine after I conducted my research. On 19 October 2021 the Israeli Ministry of Defence declared six Palestinian civil society organisations as 'terrorist organisations', a decision that was widely condemned by human rights organisations including Amnesty International and Human Rights Watch and understood as a move to restrict the work of the affected NGOs (Amnesty International, 2021). The decision was also criticised as an 'unjustified attack' by Michelle Bachelet, the UN Commissioner of Human Rights (OHCHR, 2021). This included Aldameer for Human Rights, the International Movement for Defense of Children, Al-Haq, UAWC, the Union of Arab Women's Committees, and Bisan Center for Research and Development. The Ministry of Defence did not provide any evidence for these allegations and classification, yet funding can be withdrawn, offices can be

closed down, and employees of these organisations can face prison sentences. To address with care these ethical risks of exposing individuals I focus on highlighting the nature of human-vegetal ecologies rather than accounts that make individuals identifiable in practices of resistance. UAWC's practitioners also explicitly expressed that international research visibility is valuable in legitimising their work scientifically, rather than as a form of activism (Leila, personal communication, 23 July 2019). I have sought to contribute to this making visible through means such as sharing my perspective as a researcher at a food sovereignty event UAWC participated in.⁵⁷

Research on/as Becoming-with

As has been established, the ecology of practices is more-than-human. Here, I address how research methods could respond to Donna Haraway's relational-ontological concept of 'becoming-with' (2008) to address human-vegetal relationality as it emerges over time and space, and the usefulness of this concept in following carrier seeds.

Although in their often-frozen states it might not appear as such, I read seed banks as spaces of becoming. Or rather, of potential becoming, where becoming is vital, valuable, and speculative – a promise directed to the future. Practices can be an interface between humans and plants based on Haraway's exploration of becoming-with in *When Species Meet* (2008). She argues 'becoming is always becoming *with* – in a contact zone, where the outcome, where who is in the world, is at stake' (2008, p.244; italics in the original). This being in and falling out of the world, the loss of whole ecologies, is precisely where seed banking is ontologically located between past and future life. It is not an infinite becoming-with but a becoming-with of those subjects that have been deemed worthy of saving, of being 'in the world'. Haraway's conception of becoming-with through an analysis of human-dog relations describes a noninnocence between life forms in naturecultures to ask 'how is becoming with a practice of

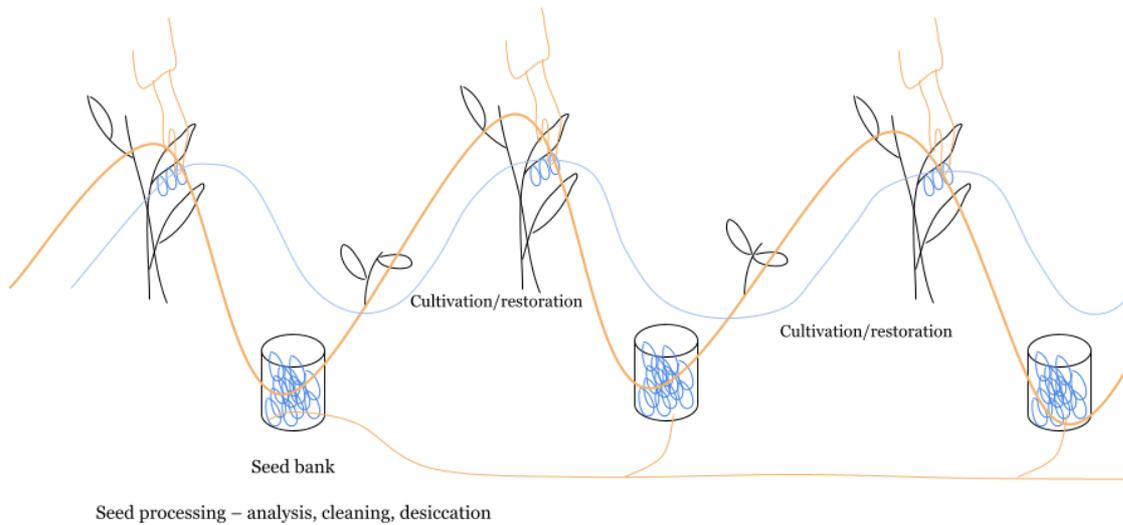
⁵⁷ On 20th May 2021 UAWC participated in 'Seeding Sovereignty', a solidarity event organised by the American agroecology and food systems organisation A Growing Culture (2021), with support of the Agroecology Fund, where I shared observations from my research.

becoming worldly?’ (2008, p.35). This worldliness, or unworldliness, is present in seed banking practices, as a control over the making and unmaking of ecologies. Becoming-with as a worldly practice includes noninnocent improvements and use of nonhuman others. But Haraway’s discussion remains centred on human-animal relations. I believe she neglects vegetal life and its histories of domestication and co-dependency in her considerations on companion species.

My readings of seed banking practices explore to what extent practitioners perceive processes of becoming, of transformation and adaptation, as an essential dynamic of the ontology of seed banking. I ask if becoming-with can unfold in the denial of co-dependency and how it impacts on ethics.⁵⁸ While Haraway mostly considers becoming-with as a relation between individual humans and individual animals I explore to what extent this can be applied to practices and the multitudes of seeds in their custodianship; a becoming-with of ecologies separated into species and varieties. In the following chapters describing these becoming-withs through following carrier seeds is a method to understand the ecologies and relations that are being preserved and denied in the selected practices; their ‘ecological epistemologies’ (Wright, 2014, unpaginated) and the epistemic loss they are banking against. It is an analysis of the different temporalities that come together in human-vegetal ecologies (see diag. 2.2 below for an illustration of temporalities of becoming-with), of what Deborah Bird Rose names ‘multispecies time’ (2012).

⁵⁸ Postcolonial theorist Couze Venn’s description of ‘being with’ beautifully captures this potential ontology and epistemology:

an ontology grounded in the idea of being as being-with and being alongside extended to all life, an ethics of co-responsibility for the other consistent with such an ontology, an epistemology that departs from assumptions of mastery over others and over nature, and that rejects anthropocentrism. (Venn, 2018, p.140)



Diag. 2.2. Schema of seed conservation as becoming-with depicting interwoven temporalities of ecological cycles (light blue line) and seed banking interventions (orange line).⁵⁹ Illustration: the author, 2022

I describe the distinct qualities of becoming-with as *becoming-safe* in the SGSV's anthropocentric mastery of crop seeds. *Preserving-with* expresses the MSB's collective global wild seed conservation efforts in the face of disappearing habitats. *Persisting-with* describes seed saving practices in Palestine and their rooting in millennia of cultivation, struggles for sovereignty, and against land dispossession. And lastly, *becoming-forest* contains the preservation of a primeval forest in Poland. Carrier seeds describe the histories and potential futures of these liminal becoming-withs in often violent processes of dislocation and transplantation, but also cyclical regeneration, resistance, and nourishment.

⁵⁹ Elaine Gan (2021) offers a methodological exploration of oscillating multispecies temporalities through diagrams which has informed this schema.



Figs. 2.5–2.6. Cherokee Trail of Tears Black Beans, shortly after germination (2.5.) and after they have been planted outside two months later (2.6). Photographs: the author, 2020

I wanted to learn from each chapter's carrier seeds as participants in and embodiments of these becoming-withs – the Cherokee Trail of Tears black bean, the white cucumber, the banana wild relative, and the Norway spruce-bark beetle relationship. I therefore decided to cultivate cucumber and black bean seeds in an amateur gardening project. It was a haptic and embodied attempt to understand the care necessary to support their growth, the pace of germination, water absorption, and seed production. But also, to simply to get a sense of the organisms I was writing about.⁶⁰ During the Covid-19 pandemic's global slowing down in April 2020 I observed their growth in response to an alien environment in the unusually dry and hot soil in the South of Germany. I wanted to see if the seeds of a bean from Oklahoma and a cucumber from Wadi Fukin could grow here and if I was able to keep them alive, while waiting

⁶⁰ A sensory approach to more-than-human relationality is discussed insightfully by Evelyn Fox Keller (1983) who describes what plant geneticist and Nobel Prize Laureate Barbara McClintock refers to as a 'feeling for the organism' in her work on maize breeding. Further helpful framings are STS scholar Sophia Roosth's use of 'sensory ethnography' (2010) as a tool in the critical observation of science practices that goes beyond an objectivist, visual approach to ethnography to include other tactile and bodily experiences as deserving of attention, and Mark Peterson's exploration of 'haptic geographies' (2009).

for other aspects of this research to be able to continue. Tuning into their temporalities of growth I tried to take pressure off writing fast and mechanically, observing them amongst the plants that my grandmother planted in my mother's garden more than twenty years ago. Those plants were also carriers of care that a keen amateur botanist left here. It was maybe the first time that I began to understand on a personal, bodily register what vegetal becoming-withs could narrate about life cycles and continuity. They became carriers of memory and loss, but also resistance to disappearance and forgetting.

Observing these becoming-withs I was keen for them to translate into writing strategies. Ethnographer Deborah Bird Rose – who wrote extensively on the intersections of extinction, multispecies loss, Aboriginal peoples, and social and ecological justice – proposes 'slow writing' as a response, strategy, and form of witnessing to our participation in ecological collapse. Against a modernity that has created the breakdown of connection she calls for ethical imaginations, situated in encounters, bodies, time, and place. 'Writing into the great unmaking is a form of testimony' (Rose, 2013, p.8), contributing to the world's becoming. For Rose writing is a service to the multispecies life that sustains us to 'take ethical stands from within life processes that both radically precede and exceed us' (ibid, p.12). She describes the coming into being of 'multispecies time' (2012) between flying foxes and myrtaceous trees who depend on each other for pollination, seed dispersal, and food. The trees and mammals co-evolved; olfactory signalling times of the trees match the patterns of when flying foxes are most active. Her reflections on multispecies temporality suggest a consideration of ethics as an 'interface' and reveal a different kind of diversity, a *temporal diversity*. This temporal diversity, in observing the life cycles and processes of nonhuman others, needs to be acknowledged to understand how becoming is a process over time, *bound to time*. Rose argues writing is a form of preventing a 'multispecies double death' (2012, p.139), a second death caused by disappearing in silence. Responding to this, I suggest that in exploring the multiple meanings of conservation that this thesis encompasses, writing can emerge as a narrative medium of conservation. Building on the previous chapter, I am aware of the problems this relational approach might carry in potentially overshadowing the power relations and politics

in conservation networks that I have also set out to address. Yet, I argue that this approach can aid in making these power relations explicit in novel ways through specific human-plant relations. This would be impossible for traditional readings of power relations due to their anthropocentric perspective. Additionally, this position enables me to observe practices and their objects of care as changing over time. Rather than presupposing power structures this approach to writing can give space to seed banking practices as collectivities while being sensitive to how these collectivities are often historically produced and maintained by colonial, racist, and patriarchal systems.

My observations of becoming-with evolved around material transitions – from states of freezing to unfreezing, the impossibility of fully pausing life and the ageing of seeds, and of disappearances such as local extinctions. They also evolved around movements – in and out of storage, in between collections and legal frameworks, out of habitats and invading new ones, affective movements felt by practitioners from hope to frustration and loss. And I observed the pace of bureaucracies of archiving, depositing accessions, and building up databases. But most importantly, I encountered the life cycles of seeds in an exploration of multispecies time. In asking what the practices are saving *for*, tracing the different processes of becoming-with is a methodological stance to reveal the ecological imaginaries at play in each practice.

‘Channelled by Human Tongues’: Representation of the More-than-Human

This understanding of becoming-with and the carrier seeds leads me to questions of representation when dealing with ecologies and how this affects accountability as a researcher. I try to treat empirical research not as extracted data, but as knowledge that has been co-cultivated. Anthropologist Michael Taussig highlights this representational tension in ethnographic work as ‘the fact that ethnography cannot exit outside writing, outside of representation’ (1987, p.492). In this sense all ethnographic writing takes on a representative role, one that needs to be carefully acknowledged vis-à-vis the represented others. I suggest this goes beyond what is framed as ‘ethnography’ in the strict sense to include the representation of all observations and analyses of conversations.

Representation of the more-than-human is specifically complex. Cultural theorist Astrida Neimanis (2015) proposes that we can rethink representation and agency of the nonhuman without falling into the traps of anthropomorphism and representationalism, which describes an ontological distinction between human practice of representation, such as writing, and what is being represented, for instance seeds. Reflecting on Gayatri Spivak's argument for the necessity and yet impossibility of representation in 'Can the Subaltern Speak?' (1988), Neimanis argues that post- and anti-colonial positions can support the question of representation of the nonhuman, while also remaining sensitive to the fact that (referencing Haraway) 'facile analogies between colonised peoples and non-human natures are always problematic' (2015, p.143). Yet, it is important to acknowledge that violences affecting both these groups have often stemmed from the same dynamic of Eurocentric extraction from living 'resources'. When I speak of carrier seeds across this thesis, I am aware of the problematic this operationalising of seeds entails but believe that reflecting this is more productive than shying away from the critical narrative that thinking with seeds can enable. What would happen if we extended conceptions of agency and creativity to the nonhuman, as Neimanis suggests, incorporating the concerns for and of 'feminist, anticolonial and ecological others' (2015, p.137)? Responding to this I argue that it is important to consider who gets to protect and defend the diversity of ecologies, who gets to 'speak for' seeds through preserving them, and how this process of representation is instated legally, politically, and culturally.

It is productive here to consider how questions of representation are approached within practices. Many of the conversations I had at RBG Kew focused on the potential of different plants to tell stories for making the wider mission of the organisation and conservation at large more emotionally urgent and relatable while at the same time avoiding anthropomorphising vegetal life, as Jasmine touched on at the beginning of this chapter. Alex works on 'interpretation' (the telling of stories of what is 'significant' for visitors) for Wakehurst's garden where the MSB is located; she translates scientific research. Across RBG Kew there is a hesitation to speak *for plants*, it is understood as unscientific. The approach

instead seeks to give scientists a voice, but Alex suggested it is impossible not to ‘think like a plant’:

And if you take giving plants a voice in its most literal term, as an organisation, we do not do that. We don’t anthropomorphise. We don’t; however, it’s what we all do naturally. It’s so much easier to think like a plant. They do, but officially we’re not supposed to, but we do all do it. (Personal communication, 13 November 2019)

I hear a relational urge to think with and for other life forms in this ‘but we all do it’, despite a scientific organisational position to attempt to do otherwise. Building on Alex’s comment on how to tell these stories as an organisation while attempting to not anthropomorphise plants, Jasmine described her position in relation to Kew’s communications strategy as follows:

I’m not personally against anthropomorphising the plants, *I think that might be an interesting way to get people to care about a living thing by making it living in the way that they understand*. But it’s probably not right for Kew. And scientists already have platforms. [...]. So, it’s really about finding another channel and another way for that voice to be heard.

We want the plants, I mean, we want plants to have a voice, we want them to speak for themselves. We’re just the channel.

I ask her if this means giving more visibility to plants.

Well, I prefer to think of this more as a channel and a conduit rather than something more. They’re not as passive, it may feel that they’re passive. Any subject of any story is not passive. We are not giving them a voice. This is the same with people. It’s not my team’s job to give them a voice. It’s my team’s job to protect the platform for their voice. (Personal communication, 30 January 2020; italics mine)

Jasmine’s reflections on channelling instead of ‘giving voice’ to tell what she calls ‘plant-based stories’ resonate deeply with Neimanis’ concerns over representation of the nonhuman. It is crucial here that Jasmine argues against plants as passive subjects of conservation, but rather as living entities that are expressive and can be made relatable through scientific care. Building on earlier discussion of listening against mastery, plants are not a subject to be controlled here but rather to be *listened to and channelled*. In fact, Neimanis also thinks through the conduit of the channel and complicates this notion: ‘Yet if non-human natures as agential express themselves in myriad ways – that is, if *nature speaks for itself* – what mistranslations or *further colonisations* are taking place as these voices are channelled by human tongues?’ (2015, p.139; italics in original). I aim to reflect this likelihood of mistranslation and colonisation in the empirical observations, and it is important to keep them present

throughout. This question of translation and mistranslation, of both human and nonhuman others, and who these translations are accountable to is crucial in moving between multiple sites and lived experiences.⁶¹

In this section I have explored a methodological positioning in questions of representation, this is explored further in the following section on accountability in research.

A Politics of Positioning

The selection of practices represented in this thesis – in the understanding of representation that the previous section outlined – is limited by factors of language and accessibility, but also hesitations regarding potentially essentialising indigenous knowledges and non-Western ontologies in how I am including practices beyond techno-scientific, Eurocentric seed banking.

Haraway's concept of 'situated knowledges' has been instrumental in conceiving my research positionality in the ecology of practices.⁶² Locating research in relation to the wider truth and objectivity claims of 'science', Haraway develops an intersectional, feminist approach for doing STS through a 'politics of positioning' (1988, p.586) with a critical sensitivity to science's implications in militarism, capitalism, white supremacy, and colonialism. To undermine the objectivist 'god trick of science', a 'seeing everything from nowhere' (ibid., p.581), she argues that 'vision is always a question of the power to see – and perhaps of the violence implicit in our visualising practices' (ibid., p.585). This sense of vision, and by extension I argue of research methods based on observation, as always already embodied and corporeal, is crucial for tracing the links between seed banking practices as visualising practices and their claims on custodianship. Observing seed banking practices is therefore always a witnessing of becoming-visible. There is a tension between attempting to

⁶¹ Jasmine also offers an interesting description of this process of representing scientific research as 'translation' in collaborative writing with scientists to make it accessible: 'It is impossible for all subjects. And that's okay. You just need to make sure that you are trying to *translate*.' (Personal communication, 30 January 2020; emphasis mine).

⁶² It is important here to acknowledge the simultaneous work by other feminist scholars in developing epistemological and political sites for accountability on which Haraway's situated knowledges are grounded, including Hartsock (1983) and Harding (1986).

work through situated knowledges whilst being dispersed across multi-sited, epistemologically and politically divergent practices, and the achievability of this within the temporal limitations of a PhD thesis. I seek to reflect on this tension and have taken measures to respond to it as fully as possible:

First, I have built relationships with seed banking practices from the beginning of the research period to observe practices, individuals involved in them and the plants under their custodianship for as long as possible. The practice where this slow observation was the most possible was the MSB, although Covid-19 restrictions made long-term observations impossible from March 2020 onwards. As far as possible I scheduled visits around the life cycles of plants, organisational events, moments within agricultural cycles, and moments of networking amongst organisations, such as seed collections and extractions at UAWC in Hebron and the Seed Depositing Ceremony at the SGSV.

Second, with the focus on relationality the networked links and exchanges between practices are as important as the practices themselves and can only be observed across the ecology. Holding together a focus on situated practices while also scrutinising the global dynamics of movements and exchanges I am aware of the difficulties of this partial, fragmented reading of the 'global' through the 'situated'.

In 'Resisting Piratic Method: On Doing Research Otherwise' (2017), sociologist Lisa Tilley proposes an ethics for research methodology through a decolonial framework with a sensitivity towards the wider extractive knowledge economies of academic research. Research needs to respond to the academic environment and the power structures that it is always already embedded in. She specifically calls for a decolonisation of European epistemologies in favour of a scientific pluralism and an intellectual commons that do not separate knowledges as 'scientific'/'unscientific'. She references indigenous studies scholar Linda Tuhiwai Smith (2012) who argues that 'research' has often been used to embed the 'underlying code' of colonialism across social life. This would entail, as Tilley suggests, an 'unravelling of European epistemic frames of time and space' (2017, p.31). Tilley uses debates on the extractive methods of biopiracy as a dispossession of knowledge to describe how epistemic 'piratic' extraction, as

a process of appropriation of knowledges in academia, works along similar geographical lines and patterns of knowledge dispersal through representing knowledges in a certain academic canon in the Global North. I want to be careful here about situating research practices as ‘situated’ observation, referencing what Haraway warns of in ‘Situated Knowledges’ that acknowledging vision as an embodied politics of positioning does not neutralise its power dynamic. Complicating the dynamic of vision as a positionality further, research as an eventful ‘making visible’ and becoming-visible needs to be navigated carefully. As Puig de la Bellacasa suggests making visible is never a neutral affair, it is necessary to ‘treat this passing into visibility as an event in its own right’ (Puig de la Bellacasa, 2014, p.27). I was actively involved in this becoming visible – the film project that I developed with Charles Pryor alongside this thesis sometimes meant that a camera accompanied and documented the practices of care I observed. I want to acknowledge here that this presence of a camera, as well as my own presence, affected practitioners. There is an ethico-political concern to acknowledge here; Tilley suggests that ‘projects motivated by solidarity, resistance, the need to expose corrupt corporate practices and so on, often fall into the snare of exposing this human terrain data, which can ultimately be used against communities’ (Tilley, 2017, p.37). Making-visible as exposure therefore needs to reflect on the potential impacts of visibility for those who the gaze is directed at. Strategies – for instance of seed conservation, habitat protection, resilience, funding, and exchange – might be absorbed by other practices, echoing what Tilley warns of as decolonial methods being taken up by (also, and especially *unwillingly*) neo-colonial endeavours. This is an important consideration to reflect upon when organisations like RBG Kew are publicly taking on a decolonising approach and thereby in some ways reorienting the attention on practices in the Global North (chapter four). Or when indigenous seed saving practices are absorbed into projects of ‘global care’ under the banners of collaboration and protection during the depositing ceremony at the SGSV (chapter three).

To work within this complicated terrain of extraction, exposure, and representation Tilley suggests a ‘relational, co-creational and grounded’ (2017, p.38) approach led by enquiries formulated by research participants through attention to ‘emplacement’, sustained

relationships with practitioners and an ethico-political grounding responsive to practitioners (this echoes Haraway's situated knowledges). This rooting in enquiries led by practices leads back to my overarching research question: *What are seed banking practices saving (for)?* For example, for the MSB one way of tracing these becoming-withs in relation to past projects of imperialism and Eurocentric conceptions of science and knowledge is through RBG Kew's 'Science Collections Strategy' (2018), which outlines future plans for development, the relationships to partners and a grounding in RBG Kew's histories. While references to the British Empire's methods of collection and extraction of plant materials are absent and collaborations are framed by a position of 'scientific authority', interviews with members across the MSB showed that a direct acknowledgement of RBG Kew's colonial past would be helpful, and that scientific authority is often actively rejected in working with partners and their situated knowledges (Erica, Billy and Liz, personal communication, November 2019).

Tensions and risks surrounding representation and ethics when bringing together indigenous, decolonial, and more-than-human politics, practices, and forms of storytelling surface throughout this thesis (in particular in chapters three and five) and are at the core of attempting to develop a method that can be sensitive to power dynamics and expressions of resistance. I seek to reflect attempts to decentre a very specific kind of human as the embodiment of science, knowledge, and ecological agency *through practice* while remaining sensitive to how some of the sites I work with are places of colonial trauma and, as geographer Angela Last argues, the 'processes that render 'nonhumans' nonhuman are the same that render the majority of humans 'nonhuman'' (2018, p.88). In this thesis I risk advocating for epistemic diversity and partial perspectives while merely embedding this in a wider Eurocentric canon without sensing its local specificity and historicity. I attempt to navigate this through long-term relationships with selected practices to sense the histories of their collections, through careful contextualising of concepts in the ontological and epistemological frameworks they have emerged from, and through testing what these perspectives can reveal about the limitations of 'the human' as an ecological agent in 'technoscientific' practices. I have

begun to outline the complexity of the ethics and politics of representation and extraction and discussed how a methodology reflective of these tensions can emerge in response.

Conclusion



Fig 2.7. Cherokee Trail of Tears black beans after four months of cultivation. Photograph: Barbara Boschen (author's mother), July 2020, reproduced with permission

My experiment of growing the Cherokee Trail of Tears black beans has progressed much more visibly than I have in the weeks of writing this chapter. They grow incredibly fast, faster than anything else I planted. They are starting to strangle each other and are being attacked by flies, maybe because they are not native to the surrounding insect species. All seeds germinated. They are forgiving and undemanding, and happy with the climate here, where it hasn't rained in five weeks. This has been one of the slow lessons of Covid-19 isolation and its impact on research: to observe vegetal growth more, learn to recognise it as an indicator of time and as communicative with the surrounding ecology. I am struck by the movements of plants from one day to the next, how growth seems to emerge as a reading of the environment.

This chapter has framed and explored questions of practice, representation, ethics, and positionality through specific tools drawing from multispecies ethnography, decolonial and postcolonial studies, and STS. I have raised questions that were critical throughout the research process, particularly of situatedness in a dispersed ecology of practices and the ethical, representational, and political implications of working with a diversity of epistemic practices and life forms. I explore this inextricability of epistemology and ontology in the following four empirical chapters. These encounters are narrated through following a carrier seed in each of these chapters, tracing the temporalities and seed circuits of each practice. In working through perspectival, multi-sited observations, this approach enables me to analyse the multiplicity of enacted meanings of sovereignty, conservation, and vulnerability – what it means to preserve, to extract, to stabilise, to adapt, and to save. I have proposed that these meanings are produced and enacted *in practice*. They are practices of vulnerability, practices of conservation, and practices of sovereignty. This chapter, in connection with the previous chapter, has therefore created a basis for an exploration into the world-making and unmaking of seed banking practices and their ecological imaginaries, for how they describe processes of becoming-with the plants in their care.

Chapter Three

Becoming-Safe: Global Care in a Seed Depositing Ceremony

Introduction

When I arrived in Svalbard, a Norwegian archipelago in the Arctic Ocean, at the end of February 2020 a green hue filled the sky. This otherworldly glow in pastel shades was the only green element I encountered during my days here. The island, just emerging from darkness after a three-month Arctic night, was covered in ice and snow and even during summer months cultivation is near impossible. Under the Northern lights Svalbard's ecology remained unfamiliar and distant. But its fragility and rapidly changing environmental conditions started to feel increasingly urgent throughout my stay. This is not a place for most forms of vegetal life. And yet it is home to an expansive collection of frozen seeds that carry more-than-human cultivation histories – the Svalbard Global Seed Vault (SGSV), the planet's largest backup seed facility for agrobiodiversity. In January 2022, it contains more than 1.125 million seed samples deposited from 89 gene banks in 66 countries (Svalbard Global Seed Vault, 2022). These gene banks send duplicates of their collections to the SGSV which functions as an insurance should the original collections be compromised.⁶³

The SGSV is unstaffed and only opens its doors three times a year for seed deposits. I had travelled to Svalbard to attend the Seed Vault Deposit on 25 February 2020, the largest deposit since the vault's opening in 2008 with 36 depositing organisations. The event programme included a Seed Summit on *Genetic diversity for more resilient food systems*

⁶³ The most prominent withdrawal from the SGSV took place in October 2015, when the International Centre for Agricultural Research in the Dry Areas (ICARDA) was forced to withdraw its seed deposits because of the Syrian war and subsequent relocation of ICARDA's gene bank from Aleppo to Lebanon (CNN, 2015; Westengen et al., 2020).

which consisted of presentations from representatives of depositing organisations, SGSV partners, and invited speakers. It was followed by the Seed Depositing Ceremony when seeds were carefully handed over by the depositing organisations and carried into the vault in a highly mediated event. This chapter follows my account of this Seed Vault Deposit, its rhetoric, and the narratives that emerged to explore the ecological imaginary of the SGSV as a carefully orchestrated performance of care. I do so by considering the implications of a specific deposit of seeds which was part of this event, the Cherokee Nation's first ever deposit to the vault, in the context of which I follow the Cherokee Trail of Tears black bean (a variety of *Phaseolus vulgaris*) as a carrier seed.

Attending the Seed Deposit was not easy. For the previous two years the organisations in charge had been cautious to allow visitors; in the end it was possible through my research relationship with MSB in the UK, making evident the importance of trust in what was described as the international 'genetic resource community' during the events. The Seed Vault Deposit coincided with the presentation of an extensive upgrade to the vault's architecture. In May 2017 the vault's tunnel, not the seed chambers, had flooded with melted permafrost water (Carrington, 2017). Since then, no visits to the inside had been possible at all. How were the vault's partner organisations going to respond to this moment of vulnerability? Presenting the new features of the upgrade the vault was framed as an 'even safer facility' (Dempewolf, 2020). Throughout this chapter I explore what happens when living biocultural heritage, such as that of the Cherokee Nation, is absorbed into the genetic resource community and its process of securitisation, what I will describe as an ongoing *becoming-safe*. I follow a movement of translation and spatial and temporal detachment when seeds that are carriers of sovereignty are curated into genetic resource collections and their regimes of care and mastery. This detachment occurs through the lowering of temperature and Arctic remoteness, but mostly through translations of seeds as living organisms into valuable genetic resources in an international community of agri-scientific organisations. Observing Svalbard's precarious ecology, specifically the water intrusion into the vault, I frame this chapter under the overall

question of what challenges arise to discourses of stabilisation and securitisation when there is no outside to ecological vulnerability, even in the supposedly safest place on the planet.

The Cherokee Nation and the Trail of Tears Black Bean



Fig. 3.1. The Cherokee Trail of Tears black bean. Photograph: the author, 2020



Fig. 3.2. The Cherokee Trail of Tears black bean after four months of cultivation. Photograph: Barbara Boschen, 2020, reproduced with permission

The documented journey of the Cherokee Trail of Tears black bean (see figs. 3.1–3.2) started in Georgia in the what is today called the US almost 200 years ago. In what follows my

account of the Cherokee agroecological practice and the history of the Cherokee Trail of Tears black bean will remain on the surface. Multiple approaches for conversations with Cherokee Nation citizens working on the nation's seed banking project remained unanswered. Resonating with the 'listening against mastery' proposed in the previous chapter I intend to give space as a white European researcher to this silence in the following account of the Cherokee Trail of Tears black bean deposit. I considered whether it at all made sense to write this chapter, but, as I will argue, it is important to explore the tensions in the SGSV's ecological imaginary as a practice of mastery in how it absorbs indigenous formations of more-than-human sovereignty. I follow AM Kanngieser's reflections on silence in 'Listening as taking-leave' where they suggest 'knowledge of environments, knowledge of places are not always mine to ask for or to hear' (2021, n.p.). They argue that resonances of colonial trauma cannot be ignored in extractive white Anglo-European interest in indigenous knowledges and ecological practices, in particular in attempts to de-centre the human. Instead, according to Kanngieser, it is crucial for Anglo-European researchers and artists to take refusal seriously, and to practice how they listen to and mediate the environments they engage with.

In the previous chapter I posed the question of 'who is it up to, to speak for a seed?' The Cherokee Trail of Tears black beans are freely shared and easily accessible. The seeds can be purchased from multiple seed platforms and, for instance, are available for free on the London Freedom Seed Bank seed database (London Freedom Seed Bank, 2022).⁶⁴ I understood this generous sharing as an openness to approaching this chapter through the Cherokee Trail of Tears black beans themselves, rather than expecting tribal citizens to speak for and represent their seeds, or share their knowledges. As discussed in the previous chapter, I started a Cherokee Trail of Tears black bean cultivation project during the change to field work and research patterns in the Covid-19 pandemic. Observing the rapid growth of the bean plants, their spiralling climbing upwards, and reliable harvest became part of an embodied

⁶⁴ The London Freedom Seed Bank is a network of food growers that shares and preserves open-pollinated seeds for free, provides training for urban food growers, and since 2020 operates a data base that records how seeds are passed and shared between growers.

inquiry into what seed-thinking could mean here as explored in chapter one, and what aspects of vegetal life escape the stabilisation of cold storage seed banks.

In February 2020, the Cherokee Nation was a first-time depositor at the SGSV and, after the Peruvian Potato Park in 2015, the second indigenous organisation to store its seeds in Svalbard's insurance system for global agrobiodiversity. Until then mistrust had dominated within Native American seed saving communities towards institutionalised *ex situ* conservation, fearing loss of ownership and seed sovereignty (Breen, 2015). Sheryl Breen in 'Saving Seeds: The Svalbard Global Seed Vault, Native American Seed Savers, and problems of property' (2015) analyses interviews with multiple Native American seed saving practices. She observes scepticism in seed saving practices towards 'black box' governmental *ex situ* conservation programmes, even if seeds can supposedly *only* be withdrawn by the depositors, as is the case with the SGSV. Regarding the Cherokee Nation Breen describes a particular gift economy that sets it apart from other Native American seed saving initiatives in that seeds that are grown in its seed production and educational garden near Tahlequah, Oklahoma, are distributed freely every autumn to Cherokee Nation citizens. The seeds are a widely accessible biocultural heritage, but could, in this way, also become accessible to commercial seed companies: 'the Cherokee gift economy is coming into tension with the tribe's contrasting need to maintain sovereignty over its heritage seeds' (Breen, 2015, p.45).⁶⁵

The Cherokee Trail of Tears black bean's mournful name speaks of the Cherokee Nation's eviction, alongside Chickasaw, Choctaw, Creek and Seminole peoples, from its lands in Georgia by military forces in 1838 following the discovery of gold and triggered by the Indian Removal Act of 1830. The Cherokee Nation had lived as an autonomous nation and had cultivated the seeds carried by those who were forced to leave. The 800-mile journey, known in the Cherokee language as 'Nunna daul Isunyi' ('the trail where they cried') (Stewart, 2007), took an estimate of 4,000 lives through diseases such as measles and dysentery that quickly spread in temporary camps, lack of provisions, and extremely harsh winter conditions

⁶⁵ This tension mirrors discussions on biopiracy (Mgbeoji, 2014) where groups also often have to claim ownership of plants and other life forms in order to protect them from commercial interests despite being opposed to these forms of ownership.

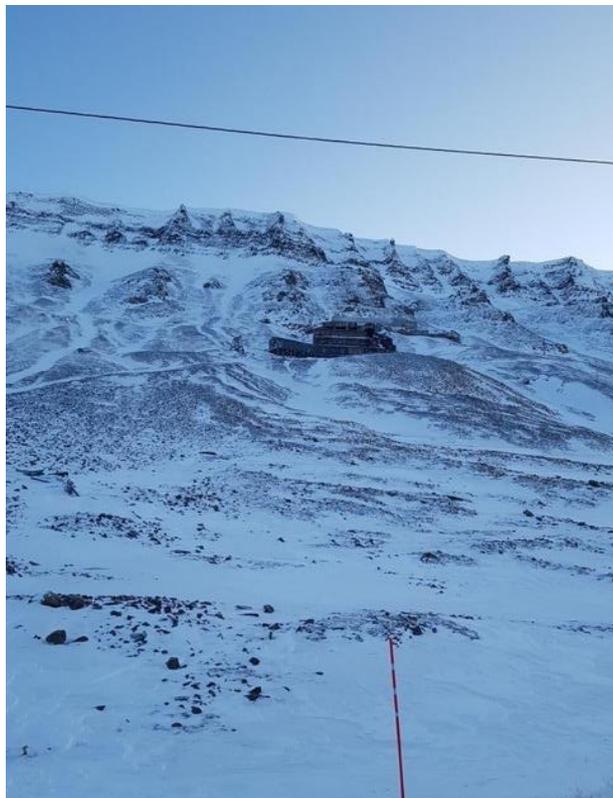
during the track and after arrival in Oklahoma (Stewart, 2007; McLoughlin, 2014). Prior to and following the Trail of Tears the Cherokee Nation had defended its sovereignty, learned to use the tactics of state politics, and protected its grounds through expert legal knowledge (McLoughlin, 2014). Cherokee nationalism and sovereignty – which meant ‘self-government under their own laws and chiefs with communal ownership of land guaranteed by the federal government’ (McLoughlin, 2014, p.6) – was a response to the European concept of nationhood employed to protect the ownership of land.⁶⁶ In comparison to other Native American communities Cherokee had been clear to model the sovereignty of their nation on the US constitution (Young, 1981; McLoughlin, 2014); they were also more open to trade and transitioned to farming. The seeds that made the Trail of Tears journey, their saving and continued cultivation in the Cherokee Nation’s territory in Oklahoma carry this settler-colonial trauma of loss and displacement. But they also ground the knowledges held within them and embody a celebration of survival and ongoing struggle for sovereignty.

In 2006 the Cherokee Nation established a seed bank with the aim to be a ‘plant and cultural preservation programme’ (Cherokee Nation, 2022) amidst harsh weather patterns in Oklahoma including floods, droughts, and tornadoes that make crops vulnerable. It was also a defence against the slow loss of cultivation knowledges. Networks and seed exchanges exist amidst multiple Native American seed saving practices (Breen, 2015). Cherokee agricultural history places an important focus on the ‘three sisters’ – maize, squash and beans – which can be grown in agroecological companion planting; they remain staple crops today and the seed bank preserves genetic varieties and cultivation practices that predate European settlement and colonisation. Its deposit to the SGSV comprised of nine accessions and included the sacred ‘Cherokee White Eagle Corn’, the nation’s oldest heirloom variety, ‘Yellow Flour Corn’, a shiny shell bean named ‘Cherokee Long Greasy Bean’, the ‘Cherokee Trail of Tears black bean’, which is commonly used in soups, as well as ‘Cherokee Candy Roaster Squash’, an old variety

⁶⁶ Formations of sovereignty that differ from the nation-state model are discussed in chapter five in relation to Azoulay’s ‘worldly’ and ‘imperial sovereignty’. Cherokee sovereignty references national sovereignty as inscribed in the US constitution and in this way also becomes a form of subversion of this.

which supposedly remains fresh without refrigeration for more than a year. What are the implications when these seeds that carry the biocultural heritage, and trauma, contained in the Cherokee Nation seed deposit enter the SGSV as a space for international collaboration and trust? To approach this question, we first need to better understand the foundations of the SGSV and its genetic resource community.

Becoming-Safe



Figs. 3.3–3.4. Reminders of coal mining infrastructure in Svalbard. Photographs: the author, February 2020

Svalbard's history is written through the exploration and exploitation of natural resources. Observing the orchestrated nature of the Seed Vault Deposit, I suggest that establishing the SGSV as a global conservation symbol of peace and collaboration would not have been as easy had there been an indigenous population on Svalbard. Imaginaries of settler colonialism would have been more dominant.⁶⁷ While there was no human population to colonise on the barren archipelago, histories of extractions from Svalbard's ecology can be described as a process of colonising the more-than-human in settler expeditions. In public imaginations the Arctic is often 'othered', a remote and apolitical zone (Huggan and Norum, 2015). The archipelago was possibly discovered in 1596 by the Dutch explorer Willem Barentsz – but theories of earlier discoveries and ancient settlement also exist (Brown, 1919; Arlov, 2005) – and long functioned as a base for whaling expeditions. Since its discovery, Svalbard had been a no-man's land, whose natural resources could be accessed by anyone (Symmons, 1997; Rossi, 2016).⁶⁸ I argue that Svalbard was therefore as much an object of shared colonial imaginations of moving frontiers and the scavenging of resources as the biodiversity rich countries in the Global South whose valuable plants formed the foundations for Europe's botanical gardens. In the nineteenth century Svalbard became a point of interest for European prospecting expeditions searching for natural resources, leading to a coal rush in the early twentieth century when Dutch, British, Norwegian, and Russian companies occupied coal fields. In 1914 Svalbard was classified as *terra nullius* (Brown, 1919) at a conference between states who had claimed sovereignty and resource usage at various times.⁶⁹ In 1925 the 'Svalbard Treaty' was ratified, granting Norway sovereignty over the archipelago (Symmons,

⁶⁷ The question of the state treatment of and care for indigenous peoples is present on mainland Norway, where the Sámi are recognised constitutionally as an indigenous group living across parts of Norway, Sweden, Finland, and Russia (Carstens, 2016). There were brutal cultural assimilation campaigns in the nineteenth century including the removal of Sámi children who were sent to boarding schools.

⁶⁸ Since then, the zones of extraction have expanded beyond land masses. The sea surrounding Svalbard and the opening up of the Northern passage as sites of speculation for future extraction rights make it part of a long history of the planet's oceans as complicated zones beyond individual sovereignty rights. These zones are explored in Bentley et al. (2007).

⁶⁹ *Terra nullius*, 'a term that escapes a single, precise, and agreed upon meaning' (Rossi, 2016, p.111), was often used by colonial projects as a legal instrument to describe *seemingly* deserted and uncultivated land to justify settling on and extracting from this land.

1997; Rossi, 2016). The island's economic prosperity was shaped by the harvesting of coal, formed of ancient forests. A compressed ecology of pre-human times is memorialised inside those mountains, slowly excavated it still fuels life on the island today. These energy cycles that bridge millions of years make evident how much Svalbard's economy is spatially and temporally dependent on time-bending vegetal energy sources. All power in Longyearbyen, the largest settlement on Svalbard, is generated through coal. One mine is still operational, the last working pit in Norway. The shells of a further six mines are dotted across the hills and clearly visible from the town, marking what Sara Pritchard calls a 'landscape of energy' (Pritchard, 2019; figs. 3.3–3.4). Svalbard's history and present are tied to deposited plant materials and carbon cycles in an overlapping of the geological, economic, and political utilisation of the island's matter. The supply pipes and cable car poles that connected the mines to the town still appear like veins across the landscape. As I walked a stretch of polar-bear-unprotected path to the cultural centre where the Seed Summit events were held, I tried to decipher the grid of power supply lines and past mining shafts that carves through Longyearbyen further down the hill. They reveal the past and present paths of infrastructures of extraction and circulation of once living vegetal materials. And today, since the construction of the SGSV vegetal life forms are re-entering Longyearbyen's Platåberg mountain in the form of seed deposits.

To contextualise the SGSV within the wider ecology of practices it is important to note that the vault itself is not an active seed bank but a backup facility, unstaffed and only opened for depositing events. Human involvement was conceived to be as minimal as possible.⁷⁰ Throughout this chapter the SGSV functions as a symbolic and material platform for a range of international actors and histories of extraction, conservation, and collaboration. Therefore, it makes possible to consider what it means to 'save' a seed according to the SGSV's ecological

⁷⁰ After the water intrusion in May 2017 Hege Aschim, a spokesperson of the Norwegian government, said of the role of human oversight in the management of the vault: 'It [the vault] was supposed to [operate] without the help of humans, but now we are watching the seed vault 24 hours a day' (Carrington, 2017, n.p.).

imaginary across the thresholds of time, temperature, zones of sovereignty, and material states.

According to the vault's official website in January 2022 it contains more than 1.125 million seed deposits of 5,481 species from duplicate collections that have been deposited since its opening in 2008 (SGSV, 2022). These seeds include globally important crop varieties and their wild relatives – all genetic diversity that may be useful in future agri-scientific plant breeding. The vault is managed in a tripartite partnership by the Crop Trust, the Norwegian Ministry of Agriculture and Food, and NordGen, the gene bank for the Nordic countries.⁷¹ Its mission is to 'safeguard crop diversity, forever' (Crop Trust, n.d.). The Norwegian ministry is the legal and administrative body and was responsible for funding and constructing the vault's architecture as well as maintaining security today. NordGen organises the seed deposits, operates the public database, and is the contact point for new depositors. The Crop Trust structures the global crop conservation infrastructure that the SGSV is embedded in, funds the vault's operational costs, and develops awareness campaigns.

It is important to better understand the Crop Trust, the organisation at the heart of the SGSV's public image, rhetoric, and fundraising campaign. It was established in 2004 by the UN's Food and Agriculture Organisation (FAO) and Bioversity International, a global agricultural biodiversity research organisation, on behalf of the Consultative Group for International Agricultural Research (CGIAR), which is an international partnership on food security with fifteen centres globally. These fifteen centres are also depositors at the SGSV. The CGIAR was established in 1971 after the Rockefeller Foundation had recommended an international network of food security research centres to address rural poverty and increase nutrition (Kloppenborg, 2005) which was crucial to sustain the developments of the Green Revolution. The Crop Trust financially supports these international gene banks and

⁷¹ Funding for the vault is provided partially from the Norwegian government, which funded construction in 2008 and the upgrade in 2019. The Crop Trust funds the operational costs and has received funding from governments including Egypt, Germany, Switzerland, UK, US, amongst many others, international philanthropic foundations such as the Rockefeller Foundation and the Bill & Melinda Gates Foundation, and private seed companies including KWS SAAT AG, Syngenta AG, and DuPont/Pioneer Hi-Bred. For a full list see Crop Trust, Donor's Council Meeting (2022).

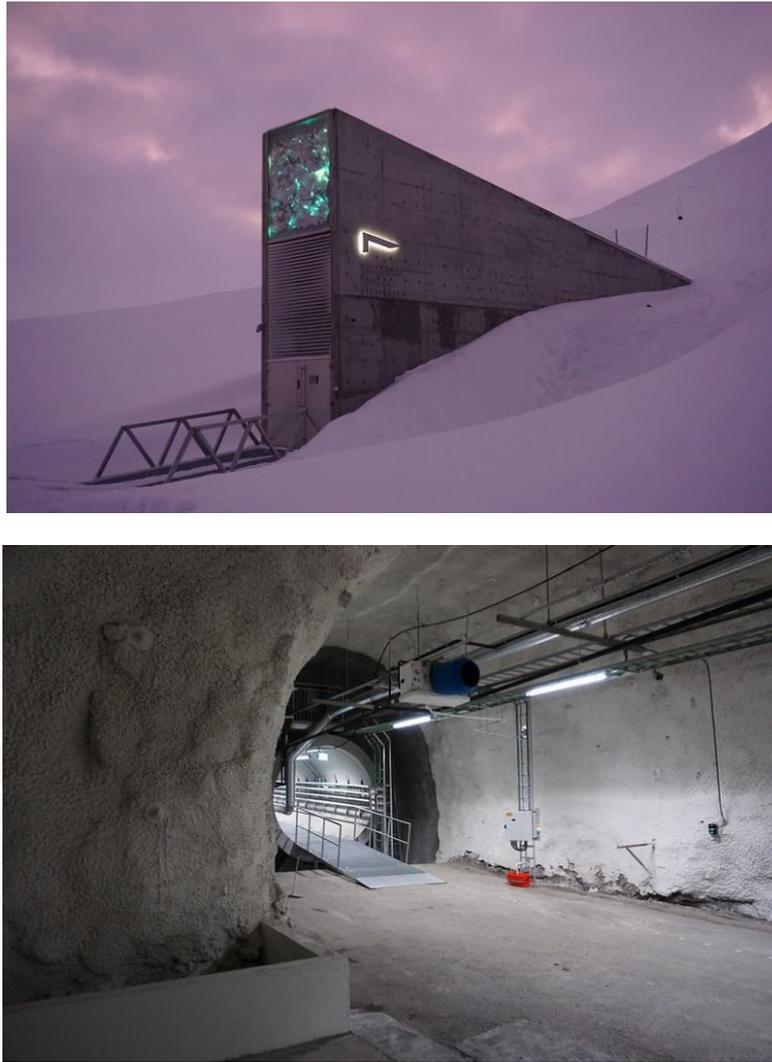
coordinates between organisations. The SGSV's iconic image forms the 'tip of the iceberg' in the global narrative of *ex situ* agrobiodiversity conservation as Nick, who worked on Crop Trust communication campaigns, explained to me (Personal communication, 21 March 2018).⁷² Because of its iconic image and remote Arctic location, the vault offers an attractive vision for funders. Crucially, the trust seeks to protect genetic resources *in perpetuity* according to multiple interviews with Crop Trust staff (Nick and Lukas, Personal communication, 2018 and 2020); 'everything the Crop Trust does is in a forever perspective' as Lukas, a senior scientist at the Crop Trust put it (Personal communication, 22 January 2020). Storytelling, image production, and public awareness of the dependence on genetic resources are integral to this project. To achieve this, the trust is working towards securing an endowment fund of 850 million USD, which is expected to bring returns of around 35 million USD annually if invested in capital markets. The trust forms the central node in the international genetic resource community's financial infrastructure. According to Lukas this endowment would be sufficient to run the SGSV and the 'globally important seed banks', which 'hold these collections on behalf of the global community' *forever* (Personal communication, 22 January 2020). This imaginary of 'forever' employed by the Crop Trust is crucial throughout this chapter in thinking through securitisation and vulnerability. It is a forever that is arguably grounded in a financialised sense of time.

⁷² As in all empirical chapters, interview respondents have been given pseudonyms, while speakers at the Seed Summit are referred to by their given names.



Fig. 3.5. The interior of the Svalbard Global Seed Vault's seed chamber. Photograph: The Crop Trust, 2022, Creative Commons license CC BY-NC-SA 2.0

Arriving in Longyearbyen I wondered how the managing organisations' tripartite partnership would publicly respond to the fact that what was referred to as the 'ultimate backup' and 'insurance policy' in the press materials distributed for the Seed Vault Deposit, had recently proven very vulnerable in the face of unpredictable climate change. In 2019, the vault space underwent extensive reconstructions and reinforcements at a cost of 20 million USD. It is now 'an even safer facility', as announced by Hannes Dempewolf, senior scientist and head of global initiatives at the Crop Trust, in his presentation during the Seed Summit, which took place in Longyearbyen's cultural centre. At no point throughout the Seed Summit was the water that had entered the tunnel mentioned. The construction work was framed as a technical 'upgrade', in the same way that any technology in use needs to be upgraded to adjust to environmental changes and technological progress. I argue this rhetoric of the 'upgrade' therefore reveals the SGSV as a *conservation technology*, rather than a storage architecture. Instead of merely functioning spatially, as a storage structure, the 'upgradable' cooling system which controls the seeds' metabolic state turns the building into a temporal technology of conservation.



Figs. 3.6–3.7. The Svalbard Global Seed Vault after the upgrade in 2020. Photographs: The Crop Trust, 2022, Creative Commons license CC BY-NC-SA 2.0

Taking a step back, it is important to consider the pre-upgrade architecture of the seed vault. The outside resembles an iceberg jutting out of the snow. A crystalline artwork entitled *Perpetual Repercussion* by Dyvke Sanne installed at the vault entrance evokes a ‘portal’-like quality (Nick, personal communication, 21 March 2018), casting its light across the sparse vastness of Svalbard (fig. 3.6). The texture of the installation acts as a reminder of the material state change that seeds are about to go through. Beyond the entrance gate lies a 120-metre tunnel, which was reinforced during the upgrade, leading to three seed chambers. Here, the walls are permanently covered in ice, sparkling in what has been described by Marie Haga, former director of the Crop Trust, as a ‘cathedral’ like space in a Crop Trust promotional video (The Crop Trust, 2016, 0:50 min).

Svalbard was chosen because of its geopolitical stability. As Norwegian territory it is located in a ‘peaceful part of the world’ (Dempewolf, 2020), which is geologically stable with no danger of earthquakes or tsunamis; at the time of its construction, it was deemed *the safest place on Earth* (Nick, personal communication, 2018). Additionally, Svalbard’s permafrost was meant to function as a natural protective layer for the vault, keeping its energy consumption to a minimum in ensuring the best temperature for long-term seed storage at minus 18°C. This forever-frost, a permanently frozen layer that can reach deep below the surface (the etymology of *permanent* signals ‘enduring’, ‘lasting’ (Oxford English Dictionary)), was suddenly disrupted in 2017 when an unusually warm Arctic summer melted its surface layer.⁷³ The techno-fix of the *upgrade* resonates with the logic of the computational *backup* at the heart of the SGSV’s ecological imaginary, which states that the vault only holds secondary deposits of organisations that have already established a duplicate with another gene bank elsewhere. Elaine Gan suggests that the permafrost provides an additional backup layer for temperature control (2016a) – when this natural backup starts to fail, the technology of the vault needs to be adjusted to an even less reliable world.

In the face of the disappearance of its protective layer and the active intrusion of meltwater, the recent upgrade has not only established physical barriers but also made the interior de facto inaccessible for anyone apart from NordGen depositing staff. Previously, a range of artists, journalists, and depositors had been allowed to see the interior spaces when the vault was still establishing its public profile. Sara Landqvist, communications manager at NordGen, gave the following simple reason for the increased fortification of the vault in her presentation during the Seed Summit, explaining why none of the depositing ceremony attendees would be allowed to enter the vault: the seeds are ‘invaluable’. This reveals the value attachments to genetic resources; it is too dangerous to let anyone approach the immense biocapital – the ‘surplus values generated by the commodification and circulation of forms of

⁷³ Permafrost is a part of the cryosphere that is usually invisible, it is the ‘frozen ground that ranges from a few meters to hundreds of meters deep’ (Marshall, 2011, p.4), often millions of years old. Its slow disappearance also releases organic carbon into the global carbon cycle that has so far been stored away.

biological life' (Breithoff and Harrison, 2020, p.48) – held in the seed chambers. What remained unclear, and no explanation was given, was why human presence *as such* would endanger this value. Interestingly, the technical upgrade that has turned the vault into an 'even safer facility' for seeds has made it less safe for the humans that deposit these seeds because of a new carbon dioxide system.

While seed banks globally were framed as vulnerable to disasters, mismanagement, and 'civil strife' during the Seed Summit, the language of vulnerability was not applied to the SGSV following the water intrusion. The vulnerability of other organisations is collective, but in a climate where risks and threats are not calculable the SGSV is an insurance policy that can be upgraded to keep '*rescuing* the seeds in endangered national crop collections' (Crop Trust, financial statement, 2019, p.14; emphasis mine). This technological adaptation – which also includes a new bomb safe door – suggests that the SGSV, and the living archive it is home to, is forever in a relationship of what I call 'becoming-safe'. The unique dynamic of becoming-safe is that it is a more-than-human relationship of securitisation, fortification, and paternalism. It is a becoming against threat and into resilience. It is also a denial of vulnerability.

It is necessary to theoretically explore here the biopolitics of managing 'vulnerable' bodies and populations. The management of vulnerability, which I define as a state of exposure to impact, stress, or pressure, emerges from security and resilience discourses. Considering the governance of vulnerability and its imperial spatiality, environmental historian Gregory Bankoff asks in 'Rendering the World Unsafe: Vulnerability as a Western Discourse' (2001) for a reframing of debates on vulnerability and adaptation as continuations of Western, imperial projects. Tracing the fear of vulnerability and potential failure to colonialist fears of loss of control, he argues that states of vulnerability are often projected onto the Global South, calling for intervention in the management of vulnerability. Bankoff suggests that the disaster studies discourses of vulnerability, resilience, and adaptation have to be seen as ideological products of a specific historical moment; 'vulnerability' was adopted from Cold War discourses and 'resilience' was taken on from ecosystems theory in the

blossoming of neoliberalism in the 1980s. This makes both terms conceptual tools in the management of crises, unpredictability, and an othering of the Global South in the context of the SGSV. I suggest it is crucial in this analysis of the SGSV's ecological imaginary to observe the concrete conditions of who and what is *made* and *framed* as vulnerable, how this vulnerability is made visible in care and control, and how specific vulnerabilities and their representation are used to legitimate the saving and banking of seeds. And on the other hand, to observe when vulnerability is not evoked, such as during the water intrusion. To sum up, I propose to see the SGSV as a conservation *technology of vulnerability*. I argue that rather than conceiving seeds as vulnerable bodies that can be banked this necessitates an investigation into the shared vulnerability of ecosystems, humans, and organisational infrastructures.

There is no outside of ecological vulnerability in the Anthropocene. When the supposedly fault-proof SGSV flooded, it was especially shared by those who promise to be an insurance against vulnerability through extraction and fortification. And yet, this relational sense of shared vulnerability can risk obscuring the specific and localised risks different practices are working with and the scales and gradients of power.⁷⁴ It is important to give nuance to the difference between vulnerability and precarity, when vulnerability is strategically deployed. While it seems that one is always vulnerable *to* something, waiting for it to impact on the body, precarity is a state internalised. Anna Tsing explores precarity, 'life without the promise of stability' (2015, p.2), as a shared condition of learning to live within and as a part of life worlds deeply impacted by environmental degradation. What seed banking promises is stability, this is what makes it so alluring amidst ecological vulnerability – the stabilisation of life against loss and of genetic information against erosion. This planetary sense of shared vulnerability and precarity also surfaces in Rosi Braidotti's *The Posthuman* (2013), where she observes a 'negative sort of cosmopolitan interconnection through a pan-human bond of vulnerability' (2013, p.63); in her view the global economy becomes post-anthropocentric in how it unifies all species under its extractive operations that have created

⁷⁴ For example, the very real risk of vulnerability actualised into death and disappearance across the West Bank in Palestine in chapter five.

a threat to the continuance of all life. I believe it is important to return to localise these vulnerabilities and look at the specific struggles they are stemming from. Otherwise, vulnerability frameworks can aid the making invisible of structural violences.

Arguably, for the SGSV and its performance of becoming-safe, safety is never fully achieved and remains always improvable. ‘Even safer now’ (Dempewolf, 2020) can be projected into the future, and upgraded again and again, should there be further destabilisations. This reading of becoming-safe builds on the earlier discussion of cryopolitics in chapter one where I drew from Radin and Kowal (2017) on the interconnections of a failing carbon-based capitalism with a Western philosophical regime that relies on the human as a heroic ‘autonomous agent’. What the flooding shows is that this sense of autonomy through stabilising life in temperature-controlled spaces is increasingly challenged in vastly interdependent and vulnerable ecologies.

This discussion of becoming-safe in the face of ecological vulnerability has taken us far away from the deposit of the Cherokee Trail of Tears black bean. Yet it is crucial to understand the discourses of ‘making vulnerable’ and becoming-safe that the Cherokee Trail of Tears black beans enter when they are deposited in the vault. It is a translation from carriers of sovereignty and biocultural memory into an ecological imaginary of fortification. To analyse this ecological imaginary further it is now necessary to explore Svalbard’s precarious ecology.

The Melting of the Cryosphere



Fig. 3.8. Longyearbyen's fjord in February 2020 which used to be completely covered in ice during winter months until 2018. Photograph: the author, 2020

The Cherokee Trail of Tears black bean, after the violent loss of the Cherokee Nation's homelands and their continued fight for biocultural sovereignty, has entered a different yet also threatened life world with its arrival in Svalbard. The archipelago is located in the most extreme zone of global warming: Arctic marine and terrestrial ecologies are already immensely affected by rising planetary temperatures (Holmén, 2020). I will argue that both these vanishing worlds have been made to disappear by a mindset driven by frontier expansion and resource extraction, settler violence against Native Americans on the one hand, and the delayed and dispersed 'slow violence' (Nixon, 2011) of anthropogenic climate change on the other. Longyearbyen's fjord, which the SGSV overlooks from its location on the Platåberg mountain, was covered with ice every winter up until two years before my visit. During my time in Svalbard in February 2020 it remained uncovered (fig. 3.8), and the surrounding hills were only coated in a thin layer of snow. Temperatures were much higher than average, and shards of ice floated across the water. I was witness to how the archipelago's glaciers were slowly retreating, and the ground was becoming unstable. Ice found in Svalbard now tends to be young ice, while the older ice depositories are steadily melting. On the night before the Seed Summit, most of the introductory talks by members of the Norwegian Polar Institute and

NordGen focused on the precarious nature of Svalbard's ecology, and I focus on them here to analyse how the SGSV's ecological imaginary of securitisation relates to its surrounding ecosystem.

The Arctic shows a forewarning for what is to come for the rest of the planet, suggested Kim Holmén, international director of the Norwegian Polar Institute, in his talk *Climate Change Scenarios in the Arctic*. Reworking this chapter in August 2021 it feels like the climate across the planet has become significantly wilder and hotter since I initially drafted this chapter in March 2020; forests are on fire across Europe and elsewhere (Sullivan, 2021). The Arctic plays an important role in the development of future climate because it forms the planet's 'natural' cryosphere, the frozen realm including 'glaciers and ice sheets, sea ice, lake and river ice, permafrost, seasonal snow, and ice crystals in the atmosphere' (Marshall, 2011, pp.1–2). This precarious Arctic ecology, whose fast disappearance we were witness to, in a way gives image to a sense of future unpredictability and loss. While doomsday metaphors, often associated with the SGSV (Gan, 2016a), were vehemently rejected throughout the Seed Depositing Ceremony, I suggest this ecological fast-forwarding into the future reveals that a certain kind of doomsday has already been reached.⁷⁵ Svalbard has seen temperature increases at a fivefold rate to the global average, 4°C since 1971, and is likely to reach 10°C of warming by 2100 (Hanssen-Bauer et al., 2019). The present rate of warming will possibly not be seen in other parts of the globe until the twenty-second century (Watts, 2019). This is not the anthropocentric food security apocalypse for which the SGSV is an iconic image. It is a present-day end time for sensitive niche ecologies in the polar regions and elsewhere.

I turn to the *cryosphere* here as a concept that allows me to bring together perspectives from political ecology, STS, postcolonial theory, and environmental history through the production and maintenance of cold. Spatially the 'natural' cryosphere designates a zone 'composed of solid water' (Friedrich, 2017, p.61), its size fluctuates cyclically with the seasons. According to Alexander Friedrich the 'artificial cryosphere' of cold storage spaces and

⁷⁵ This echoes and is put into perspective by Deborah Danowski and Eduardo Viveiros de Castro (2017) who suggest that imminently-ending worlds discourses obscure that for some peoples the world has ended many times already at the hands of colonial projects.

distribution chains suspends this cyclical temporality. It induces artificial dormancy and reduces the aging processes of organic materials through detaching them from their life cycles. It is a ‘thermodynamic infrastructure’ (ibid.), a global network of artificial cold. This networked cold is attached to cryogenic cultures, which both ‘produce and are produced by cold’ (ibid., p.60). Friedrich suggests that cryogenic cultures are biocentric, and entangled in a ‘global topology of producing, distributing, consuming, and disposing of life as a resource’ (ibid.). For my argument, this connects cryogenic cultures directly with the material flows of the Plantationocene, but with temperature and transition into frozen states as the threshold where biopower is applied. While Haraway et al. discuss the ‘spatially transported labor’ (2015, p.162) and more-than-human extractive material flows, I suggest that cryogenic cultures produce a temporal transplantation through the lowering of temperature, postponing the life functions and genetic information around which the Plantationocene is centred, thereby making them more valuable. The SGSV provides a naturecultural meeting point of the ‘natural’ and ‘artificial’ cryospheres, or rather proof that the distinction between ‘natural’/‘artificial’ is void in a vault sheltered in permafrost and ‘backed up’ by a CO₂ cooling system.

The polar regions are another ‘frontier to be mastered’ (Bravo, 2017, p. 51) through technologies and infrastructures. But I argue that, crucially, their vanishing also reveals the limits of techno-scientific mastery, when ecological changes cannot be contained or tamed. Holmén emphasised in his presentation the importance of the protection of diversity amidst these accelerating changes. Diversity becomes an important *resource* for dealing with the new unpredictability of ecological transformation in a ‘warmer, wetter and wilder’ Arctic (Holmén, 2020). He stressed the significance of an understanding of diversity that goes beyond *biodiversity* to include human, cultural, and scientific diversity. This is crucial and reveals some of the limitations of the SGSV’s ecological imaginary – it is solely built on genetic diversity. Some species are more adaptable than others and can survive in warmer and wetter conditions; not all will fall victim to what ecologist Åshild Pedersen called a ‘cryosphere regime shift’ (Pedersen, 2020) in her presentation *Terrestrial Ecosystems in the Arctic* on processes of greening and browning of the Arctic. Certain species, such as wolves, can handle thawing

and melting; other species, such as narwhales, are less adaptable to extreme temperature shifts and can only survive in narrow temperature brackets. What I observed in the precarious nature of Svalbard's ecology was its specific temporality: the coexistence of slow and fast, the liminality between ice and water when frozen states are not stable. While within the 'artificial' cryosphere, the global network of cold storage facilities, the stabilisation of time is manageable, Arctic ecologies reveal the extent to which anthropogenic temperature control only works on the scale of what can be spatially contained in protected spaces. The conservation of vanishing Arctic ecologies as relational life worlds seems impossible without extracting individual components in order to protect them. Species can be preserved through representatives that act as proxies as in the conservation technology of a seed bank. However, the relationality of collective life escapes *ex situ* conservation. And importantly, the energy consumption of the 'artificial' cryosphere and its emissions are directly fuelling the disappearance of the 'natural' cryosphere (Bravo, 2017, p.31): the SGSV is powered through Svalbard's public power plant which until 2023 will produce power from coal (Icepeople, 2021), mined from Svalbard's mountains.

Throughout this thesis I grapple with concepts that try to contain and stabilise the disappearance of life and diversity that 'banking' is a response to, from 'erosion', to 'extinction' and 'loss'.⁷⁶ Erosion and its etymological root in 'gnawing away' and 'slow consumption' (Oxford English Dictionary) is particularly relevant for the processes of extraction that have shaped Svalbard's landscape and layers of inscription that the SGSV is embedded in. There is a multiplicity of erosions unfolding and being contained here: the *genetic erosion* and vulnerability caused by the homogenisation of crops, the *erosion* of biocultural diversity, and the very *physical erosion* of the seed vault's surrounding matter. Collections of agrobiodiversity held in the SGSV are strongly tied to co-adaptations through millennia of care

⁷⁶ Some of these disappearances have been discussed in the section on conservation in chapter one including 'genetic erosion' (Fenzi and Bonneuil 2016; Harrison 2017, in response to soil erosion) but also the erosion of life worlds on a larger scale, the affective experience of loss (Nazarea and Rhoades, 2013 'landscapes of loss', considering how memory can be held), and the final ecological, genetic, and affective loss that is extinction. Van Dooren argues that projects of freezing often do not pause extinction but the '*recognition of extinction*' (2017, p.274; emphasis in original).

and domestication, yet most of the species banked in the vault are not grown in fields (Ellen, personal communication, 18 March 2020). They are representatives of different moments in agricultural time and their environmental conditions.

Svalbard's climate does not support the production of food under the island's harsh conditions; all of Svalbard's soil is barren in an agricultural sense, with permafrost keeping the ground frozen and uncultivable year-round (Holmén, 2020). Little is understood yet, as Holmén pointed out in his presentation, about how the eventual disappearance of the 'natural' cryosphere will affect global climates and future ecologies. But the anthropogenic driving forces of these changes were barely addressed throughout the days I spent in Svalbard. Climate change remained an abstract force, violent but seemingly, for some, without perpetrator, in attempts to pause life and control temperature in a melting world. With an estimate of one hundred people attending the Seed Depositing Ceremony from across the globe I asked myself if there was going to be a symbolic acknowledgement of the environmental cost of us attending, or the carbon that is constantly being released to move materials and visitors to Svalbard (all foods consumed, or seeds deposited).⁷⁷ But this was not addressed throughout the events. Overall, I was left with the impression of having visited not an Arctic fortress, but a very vulnerable place caught in processes of vast and rapid transformations that negate initially referring to these processes as 'slow violence'. If this vulnerability was acknowledged more in the SGSV's ecological imaginary, could this be productive? I return to this question towards the end of this chapter after exploring the translations seeds go through when they enter the vault.

A 'Symbol of the Genetic Resource Community'

This section traces the making of 'genetic resources' from seeds through reading the Seed Summit and the Seed Depositing Ceremony as a performance of the genetic resource community. By focusing on what narratives were mobilised – and which were not – I observe

⁷⁷ It is an acknowledgement that I also need to make for this thesis and the international air travel it relied on in being able to access practices in Svalbard, Poland, and Palestine.

the process of becoming-safe as an epistemological project across multiple organisations. I thus explore the SGSV as a symbol for the ‘international genetic resource community’ (Dempewolf, 2020), its legal framework, its approach to questions of property and sovereignty, and the actors in the international network of gene banks and germplasm conservation. This connects to the history of the Green Revolution, which gave birth to many of the organisations discussed here, the role of plant biotechnology, and the global flow of germplasm.⁷⁸

The legal framework for this genetic resource community of research centres, private sector companies, farmers, conservationists, and UN bodies emerged out of the 1993 *Convention on Biological Diversity* (CBD), a multilateral UN treaty, which brought plant genetic resources under the sovereignty of individual states. Additionally, it established a special status for agricultural resources to be governed differently due to their critical importance for global food security. In 2004, this led to the coming into force of what is referred to as the Seed Treaty, the *International Treaty on Plant Genetic Resources for Food and Agriculture*, a multilateral treaty that currently has 147 signatory countries and was negotiated by the FAO. The Seed Treaty has its own governing body and has created a multilateral framework for benefit sharing, farmers' rights, and the protection of traditional knowledges – the responsibility to ensure farmers' rights here rests with individual states which also causes some problems if states do not enforce the protection.⁷⁹

There are tensions between the CBD and the Seed Treaty, in what Lukas, a senior scientist at the Crop Trust, described as struggles around access and benefit sharing agreements across the two treaties since the CBD is an environmental treaty and the Seed Treaty is agricultural (Lukas, personal communication, 22 January 2020). While the two treaties are meant to complement and support each other in practice there is frustration within the genetic resource community about individual countries not sharing those varieties and agricultural resources that are not explicitly listed in the Seed Treaty. Lukas explained that

⁷⁸ See ‘Saviours, Gods, and More-than-Human Sovereignty’ in chapter one.

⁷⁹ Of specific importance for plant conservation and the framework of the international genetic resource community are the treaty’s articles 5 and 15 (Food and Agriculture Organisation, 2004).

within the CBD bilateral access conditions have to be negotiated while the Seed Treaty works on a multilateral basis and a common set of rules in mutual transfer agreements, which creates a conflict between the different access and benefit sharing models of the two treaties. This is important: the two treaties operate on different understandings of sovereignty and property.

The CGIAR research network exists at the intersection of these two treaties, self-proclaimed on its website as ‘a global research partnership for a food secure future’ providing ‘science for humanity’s greatest challenges’ (CGIAR, 2020, n.p).⁸⁰ The impact of the CGIAR’s fifteen centres on food security has been well documented and can be traced through following the genetic makeup of seeds used by farmers globally (Wopereis, 2020). However, what remains hard to assess is how seed companies in the Global North have benefitted from access to CGIAR genetic resources and how these have been redistributed. The Seed Treaty governs the CGIAR centres; the centres’ materials fall outside of individual states sovereignty. They cannot be protected through individual national sovereignty claims. ‘For us it’s really important that the material continues to be available for the long term’ Lukas emphasised (Personal communication, 22 January 2020). Kloppenburg, building on his analysis on the political economy of seed banking explored in chapter one, suggests that the

CGIAR system is [...] the modern successor to the eighteenth and nineteenth-century botanical gardens that served as conduits for the transmission of plant genetic information from the colonies to the imperial powers. (2005, p.161)

Kloppenburg makes an important connection between genetic erosion creating vulnerability on the basis of homogenised breeding in industrial agriculture (ibid., p.162) and the flow of genetic resources into international research centres where they will be accessible to private companies in the name of scientific research. I propose that this adds an interesting layer to earlier discussions on vulnerability, when seed banks who deposit seeds at the SGSV are often framed as vulnerable to loss and collapse, especially through disruptions of their ‘cold chains’ – the connections between a series of cold storage spaces. Yet on the other hand, the

⁸⁰ CGIAR centres received substantial (13.6 million USD) funding from the World Bank in 2003 to overhaul and update gene banking infrastructures, followed shortly by the establishment of the SGSV in 2008 as a backup facility for all CG centres, since individually they were said to be vulnerable to political and environmental disasters (Roosth, 2016).

dependency on their resources for international industrial agriculture due to genetic erosion is usually not framed as a vulnerability.

During the Seed Summit a panel titled *Genetic Diversity: Why it Matters* saw, amongst others, presentations from three directors of CGIAR centres, ‘less visible yet powerful postcolonial institutions’ (Gan, 2016a, p.121): CIMMYT, the International Maize and Wheat Improvement Centre in Mexico, (founded with support from the Rockefeller Foundation in 1960), the World Vegetable Centre in Taiwan, and CIAT, the International Centre for Tropical Agriculture in Colombia. Marco Wopereis, the director of the World Vegetable Centre is Dutch; Martin Kropff, the director of CIMMYT in Mexico is German; despite the global scope of the CGIAR organisations their directorate appeared Eurocentric. I was surprised by how much focus their presentations put on collaborations with the private sector in the engineering of tolerance and resilience to ‘realise the economic and nutritional potential’ of genetic resources (Wopereis, 2020). They shared an approach that was looking at plant genetic resources ‘not as a museum but as a supermarket’ (Kropff, 2020), framing farmers as dependent on the development of new technologies.

Praising the Green Revolution as a ‘public sector effort’, Wopereis called for a ‘revolution of vegetables’, which importantly would need to be a ‘private sector accomplishment’. He revealed that currently fourteen percent of the hybrid seeds used in India and South Asia have direct links to the World Vegetable Centre; the centre’s newly introduced breeds are frequently picked up by seed companies. He was in the process of organising the ‘Power on your Plate’ summit in Tanzania, that looks to strengthen private sector involvement in Africa in questions of food security. This clearly links the SGSV and the network of international agriscience research in CGIAR centres as depositing organisations to the commodification of seeds, while discourses of food security, access, and solutions to hunger can often distract from this financial dimension. How would this anthropocentric human-plant relationship shift if food security was framed as a more-than-human co-constitutive dependency? For one, the framework would probably be food sovereignty, rather than food

security as a relationship of control.⁸¹ Harrison describes the archival dimension of the SGSV in relation to the Green Revolution as a record of relations and systems of ordering and classification, which have direct impacts on the organisms they order and their relations:

As such, the SGSV as meta-archive also constitutes its own biosocial record of specific, historically embedded, neoliberal practices of multispecies relationships, that is, the attempts to mediate modernized agriculture through *ex situ* conservation that emerged in the latter part of the twentieth century. (Harrison, 2017, p.86)

Interestingly, languages of empowerment and resistance ('Green Revolution', 'Power on Your Plate') are taken up by agro-capitalism. I argue that this is indicative of how the organisations around the SGSV, the 'genetic resource community', create an often-opaque epistemological mixture of private sector interests, international diplomacy, and humanitarian work on the 'challenges humanity faces' without addressing the link between farmers' direct access to seeds and the international network that holds these genetic resources. Media representatives mostly just attended the Depositing Ceremony outside the vault. With most attendees in the room during the Seed Summit presentations being members of a gene bank or an agricultural research organisation (as well as a handful of external researchers) rather than media representatives I was left wondering who the performance of securitisation in the upgrade presentations and international collaboration was actually for, and whether the main purpose was simply reassurance after the water intrusion, a demonstration of *becoming-safe*.⁸² This brings to the surface a particular more-than-human quality of becoming-safe: it is not the seeds as such that are in a process of stabilisation but their status as genetic resources.

There was a sense of exclusivity surrounding the Seed Summit and the Seed Depositing Ceremony in the accreditation process and security briefing surrounding the ceremony. Here, participation revealed power and influence in the genetic resource community and international humanitarian politics. Since being granted access to the events had been a long and careful process, I felt almost no guardedness when speaking to attendees during the

⁸¹ Food sovereignty as a social movement is achieved when food production and distribution is controlled by those who also produce, share, and consume those food elements (Schanbacher, 2010). It is a stance that centres dignity rather than security.

⁸² I am grateful for the insightful conversations on the experience of the Seed Summit I shared with sociologist Franziska von Verschuer who I met during the Seed Vault Deposit and whose feedback on this chapter has been invaluable and generous.

Svalbard events.⁸³ There was no contradiction in entering a conversation between a farmers' rights specialist and a representative of a private seed company and I learned in multiple conversations that private sector collaborations on crop research and development were standard practice in many research institutes.

Reflecting on the Cherokee Trail of Tears black bean in Svalbard, it is hard to align the interests and fight of the Cherokee Nation for sovereignty and access to land for cultivation through referring to the legal concept of European nationhood with this genetic resource community that operates outside of the spaces of national sovereignty. What are the implications when the SGSV curates the narratives of indigenous self-determination into its collection while also housing collections of organisations that have encouraged the dispossession of farmers through collaborations with the private sector? Many of the Crop Trust's funders are private seed companies. CGIAR funders include the Ford Foundation and the Syngenta Foundation.⁸⁴ While holding backup deposits for the CGIAR centres, the SGSV is also home to a range of national gene banks and university research collections, and occasionally solicits direct invitations to organisations like the Cherokee Nation and the Peruvian Potato Park. I argue that this is indicative of how the SGSV, since it is not a seed banking practice itself, becomes a projection of international peacebuilding projects that can have multiple and often contradictory ecological imaginaries for how the access to and development of seeds should be controlled and how sovereignty is understood.

This section has shown how the SGSV is embedded in, and emerged from, a complex network of international organisations and frameworks. While it is symbolic for a genetic

⁸³ I had initially contacted the SGSV coordinator in July 2018 and had been told the access policy was currently under review and no visits possible in the immediate future, that requests for visits were high and often couldn't be granted. Between then and the depositing ceremony I kept inquiring through the Crop Trust and NordGen.

⁸⁴ See CGIAR (2022) for a breakdown of current Trust Fund Contributors and Kloppenburg's in-depth analysis of the historical development:

Since the late 1990s, the CG centers have concluded a wide variety of exchanges, contracts, joint ventures, and licensing arrangements with companies such as Pioneer, Monsanto, and Novartis (Manicad 1999). In October 2002, the CGIAR took the unprecedented step of adding the Syngenta Foundation for Sustainable Agriculture as a member. (Kloppenborg, 2005, p.334)

He argues that there is an imbalance in private and public sector investments in agri-science research, leading to an unequal power distribution for accessing agricultural resources outside these private-public collaborations.

resource community, it at the same time actively absorbs other narratives of sovereignty and human-plant relations that exist outside of this ‘resource’ framework.

Vegetal Storytelling

During his Seed Summit presentation Dempewolf highlighted that Ban Ki Moon, in his role as UN General Secretary, once referred to the SGSV as a ‘gift to humanity and symbol for peace’ (Dempewolf, 2020). This section explores the symbolic nature of the SGSV to consider its importance for seed storytelling and how this influences the rhetoric of the partners in their discussion of food security, to further explore the implications of absorbing narratives of sovereignty and resistance developed in the previous section.

The living archive of agrobiodiversity held in the SGSV is portrayed as a ‘global common good’ (Lukas, personal communication, 22 January 2020). While this does not directly reference ‘the commons’, humanity as a wider benefactor is evoked when the Crop Trust explains who it is banking seeds for. What remains obtuse in this narrative is the direct relation between, on the one side, global common goods and individual farmers, and on the other side, the role of the depositing organisations in how the common good is financialised and turned into property in the process. Returning to the Cherokee Trail of Tears black bean and its history of displacement and loss of land, by absorbing collections that put an emphasis on seeds as carriers of biocultural memory, heritage, and identity, the SGSV also becomes a container for storytelling around food sovereignty. It is important to consider how the SGSV as a living archive is curated to be specifically inclusive of these kinds of narratives. What translations happen in *ex situ* storage when carriers of sovereignty and symbols for resistance become part of archives of ‘genetic resources’? I suggest that ‘seeds of resistance’ (rather than ‘seeds of hope’ (Nazarea and Rhoades, 2013)) are carriers for a narrative of survival that agri-science organisations can somehow utilise *rhetorically* beyond genetic information.

Considering the value of storytelling to individual depositors, what became clear during various Seed Summit presentations was how hard it is to demonstrate the impact of *ex situ* conservation to funders – this is a struggle for multiple practices in this thesis. Therefore,

I argue that the SGSV needs to be seen as an evocative fundraising project. Throughout the summit the need for intermediaries, who can narrate and make visible the importance of seed banking practices, became a crucial issue. This was also a challenge that this thesis itself evolved as a response to when asking ‘how to tell the story of a seed?’ in the previous chapter.

For the Seed Depositing Ceremony, the Crop Trust and the presenters chose to narrate the importance of their work through highlighting the practices of individual organisations, and heroic individuals (Sethi, 2020). What I observed that remained unexplored throughout the Seed Summit was the potential of narrating these stories through individual species and varieties, through the seeds themselves in how they can demonstrate mutual dependency, sovereignty, and resilience. The plants and their histories of breeding and adaptation remained abstract across the presentations while the need to relate to them more was raised multiple times. They were framed as passive objects for breeding, rather than capable of responding to their environments. Kent Nnadozie, Secretary to the Seed Treaty, highlighted the importance of making the ‘transition from fridge to fridge’ (Nnadozie, 2020), of creating an emotional impact between the frozen collections of gene banks and the personal fridges of consumers who indirectly depend on these banks. It could be argued that he advocated for an affective understanding of the artificial cryosphere, of sensing and making tangible our implications in the infrastructures of cold chains. Reflecting on this presentation during my experiment of cultivating the Cherokee Trail of Tears black beans in Germany I was left wondering why this affective link needed to go through cold storage spaces, as in Nnadozie’s suggestion. What I experienced during the small-scale cultivation of the Cherokee Trail of Tears black beans was the importance of growing timescales and the support structures needed. I borrowed metal poles for the beans to climb on from my grandfather, who was excited that someone was interested in his old gardening tools. Growing the beans as a collective project involving my grandfather, mother and me, and cooking a meal from them in the following year made me question if the affective shift the Seed Summit was advocating doesn’t lie in creating a ‘fridge-to-fridge’ connection, but instead in connecting ‘genetic resources’ with tangible experiences of cultivation and the sharing of food – of not conceiving

human-vegetal relations as those of ‘consumers’ but of co-cultivators. What would this look like on a planetary scale?

Throughout the Seed Summit and Depositing Ceremony, I noticed that hope was not mobilised as a concept; heroic visions of the future often evoked in media collaborations (GoPro Cause, 2017) were put aside to instead highlight scientific practices working on breeding resilience and tolerance to changing climatic conditions and to reassure media representatives and genetic resource community members that the upgrade had successfully secured the vault. While cultural analyses of the SGSV often focus on this hopeful dimension (Harrison, 2017), the focus here was on reassurance and securitisation for funders, media, and stakeholders where the value of the SGSV has already been demonstrated. This focus on reassurance makes becoming-safe in the SGSV an ecological imaginary that is, in many ways, *anti-ecological*. Rather than keeping seeds safe through lived relations of cultivation and sharing, it suggests that they can only be protected through extraction into the upgraded SGSV architecture.

The analysis of the narratives that were used during the Seed Summit showed a pattern of referring to seeds as ‘multiple’ (Sehti, 2020) in how, as objects, and for the purpose of my analysis as more-than-human carriers, they are simultaneously ‘fuel, fibre, medicine, and food’ (Sethi, 2020), echoing the multiplicity I explored in chapter one. Seeds were praised as ‘building blocks’ (Dempewolf, 2020; Sethi, 2020) which can be assembled, activated, preserved, and reproduced. This multiplicity of uses and replicability saw seeds always for the purpose of ‘the human’; they were conceived as multiplication technologies for food security. Here emerges a first practice-based sense of ‘what a seed is’, both ontologically and epistemologically for the SGSV: *a multiplication technology and genetic resource* to be extracted from and reassembled, and ultimately – to be kept safe. This anthropocentric reading of human exceptionalism in reconfiguring and reproducing seeds will be challenged through ecological imaginaries and alliances in the following chapters on the MSB and UAWC.

To summarise, while the value of seed-based storytelling was evident to the organisers and participants at the Seed Summit, the SGSV does not actively evoke the wealth of attached

stories, biocultural memories, and living knowledges already held in its collection. Considering that most of these seeds are not actively cultivated anymore, as Ellen who works for NordGen in communications pointed out to me (Personal communication, 18 March, 2020), this is undoubtedly the largest collection of living vegetal memory of eroding cultivation ecologies globally. In the following sections I will explore whether the Cherokee Trail of Tears black bean can subvert the narratives of collaboration and securitisation that have dominated the Seed Summit with its arrival at the vault, starting to ask if moments of decolonisation can happen within practices of mastery. Rather than viewing the living heritage of the Cherokee Nation as something in need of rescue, how can its presence within the genetic resource community challenge the rhetoric of reassurance?

Curating Global Care

This section describes the arrival of the Cherokee Trail of Tears beans in the SGSV vault during the Depositing Ceremony on 25 February 2020. The seeds entered the vault amidst a highly orchestrated, solemn performance of international collaboration.

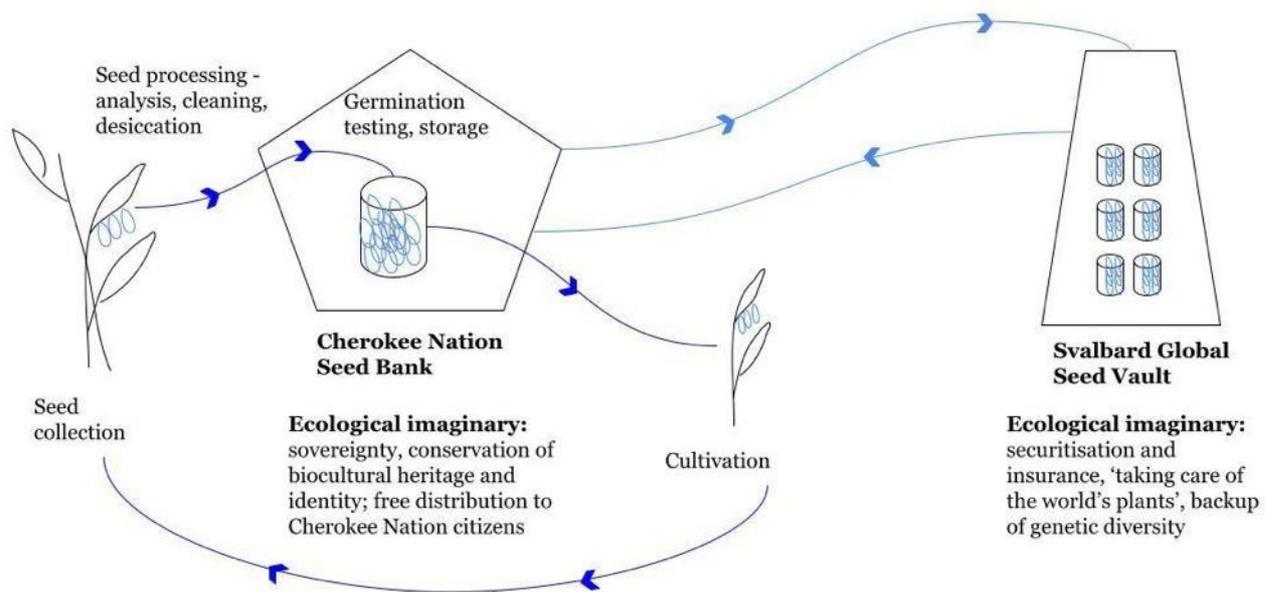




Figs. 3.9–3.11. Depositing ceremony at the SGSV, depicting the deposit of seeds into the vault by NordGen staff (3.9), the walk to the vault flanked by a choir of Norwegian sailors (3.10), and the delegation of international politicians overseeing the ceremony, surrounded by candles in ice sculptures (3.11). Photographs: the author, 25 February 2020

As darkness set over Longyearbyen, after a day of presentations at the Seed Summit, we ventured to the vault. Having analysed images of the SGSV for two years prior to this, to me approaching a site that was so remote and iconic felt pre-mediated by the visual archive the SGSV has produced to date. The road had been blocked off and only the official government busses could make their way out of town on the 10-minute drive from Longyearbyen. Since many attendees did not have warm enough clothing for temperatures of minus 30°C, they wore what appeared to be a seed vault uniform as they walked towards the ceremony. With the vault illuminated in bright blue and white lighting for camera teams and photographers, as well as blocks of ice filled with candles outside the entrance, it was impossible to avoid references to religious ceremonies, echoing the earlier cathedral reference for the vault's interior by Crop Trust directors. Observing the ceremony while my face and fingers slowly became numb, the building with Sanne's *Perpetual Repercussions* crystalline light art installation above the door became a secular yet sacred space, a portal into a different temporality, a sci-fi church where plants will deliver salvation to a global community. Erna Solberg, the Norwegian prime minister, alongside advocates for the UN Sustainable

Development Goals (SDG) including the president of Ghana, stood next to the entrance of the vault. The advocates had been meeting in parallel to the Seed Summit events to raise global awareness on SDG 2 ‘No Hunger’ in an ‘Arctic Call to Action on Food Security and Climate Change’. A male choir walked towards the vault and positioned itself next to the entrance, humming and singing solemnly while each depositing organisation, or someone on their behalf, carefully handed over their seeds.



Diag. 3.1. Seed circuit of the Cherokee Trail of Tears black bean. Illustration: the author, 2021

No representatives of the Cherokee Nation attended the Depositing Ceremony; the seeds entered the vault without the guardians that had grown them. I never found out why they chose not to take part in the Seed Depositing Ceremony. It is a question that remains at the heart of the different, and often conflicting notions of sovereignty across this chapter. For the time being, this marks the end of the journey of the Cherokee Trail of Tears black beans, until they need to be regenerated or withdrawn for other reasons (diag. 3.1).

The Cherokee Nation delivered the first Native American deposit to the SGSV, and into the genetic resource community. The beans will be held in total darkness apart from three depositing openings annually. The Cherokee Nation had not approached the SGSV and applied to become a depositor, a route that is open to any organisation, but was explicitly invited. This is an interesting dynamic to consider for what kinds of narratives around food security and

seed sovereignty are welcomed into the vault, how it is *curated* as a genetic collection. ‘Curation’ is both a form of selection and of care, considering its etymological roots in Latin *cura*, that is used across seed collections to refer to the process of prioritising which seeds are worthy of inclusion in the collection. This speaks to considerations on care as a protective and restrictive double bind imbued with power formations in chapter two.⁸⁵ While the following chapters trace the circuits of seeds through different banks and their relations to the individual life worlds, the SGSV implies a finality – a forever – in the deposit. Seeds will only be withdrawn if the original collection, as well as its first duplicate, are compromised.

In a solemn sonic landscape the choir sang eerily as the seeds were deposited into the vault while, with a handshake from the Norwegian prime minister, one by one the depositing organisations handed over their seeds to NordGen staff who carried them into the vault. Nnadozie, Secretary to the Plant Treaty, had stressed earlier in the day that the SGSV ‘wasn’t just science fiction’ (Nnadozie, 2020) while a representative of the Norwegian government had opened her remarks referring to ‘the frozen garden of Eden underneath our feet’.⁸⁶ These remarks revealed, again, how the SGSV is used for different projections of security and salvation – of becoming-safe – which was echoed in a depositing ritual that was a lot more spectacular and dramatised than I had expected. As Jesse, a representative from the MSB at RBG Kew pointed out, ‘it was one of those things where I’m going to wonder if it really happened’ (Personal communication, 18 August 2020). Jesse was, leading to the following chapter, also handing over a box that marked the MSB’s first deposit at Svalbard.

Reflecting on the remote location and aura of inaccessibility the Seed Depositing Ceremony felt other-worldly. The seeds entered a space of slow time and heroic purpose, and are now inaccessible. The handing over of care, as the boxes passed from the hands of depositors to NordGen staff, was also a carrying-into-the-future of their genetic information and reproductive capacity. The individual seeds became representatives – proxies – for whole

⁸⁵ See ‘Ethics of Care’ in chapter two.

⁸⁶ This resonates with references to the Arctic as an ‘Edenic’ space, untouched and frozen in time, waiting to be utilised (Bravo, 2015).

varieties and species.⁸⁷ In this sense the SGSV is very much an ‘ark’ in its reliance on proxy representation, another biblical reference that is often evoked. Nnadozie described the overall project of saving agrobiodiversity as ‘*taking care* of the plants that feed the world’ (Nnadozie, 2020; emphasis mine).⁸⁸ I want to suggest that what emerges in the Seed Depositing Ceremony is a particular formation of care, what I will refer to as *global care* of those organisations that have taken on the protection and maintenance of global biodiversity. Puig de la Bellacasa also discusses ‘global care’ in the context of soil erosion: ‘at the turn of the twentyfirst century, Earth soils regained consideration in public perception and culture due to global antiecolological disturbances. Soils are now up on the list of environmental matters calling for global care’ (2017, p.169). She considers the role of international organisations like the FAO in conceiving care on a global scale for living materials and their webs of relations. Building on Puig de la Bellacasa’s concept of care, my understanding of ‘global care’ brings together the actions of international organisations, legal frameworks, and their relationships to situated knowledges in the configuration of custodianship for seeds on a global scale. And crucially it includes an attentiveness to how performative acts like the Seed Depositing Ceremony create legitimacy and visibility for global care.

What I observed in the Seed Depositing Ceremony was a performance of global care where all participants contributed to and witnessed the salvific project of carrying these seeds into the vault. Yet, the performance was completely apolitical – there were *technical* problems to address such as resilience, genetic erosion, and climate change. At no point were specific powers and actions discussed as the cause in creating these conditions for the seeds’ vulnerability and loss of diversity, in the same way that the war that destroyed ICARDA’s collection in Syria was discussed as a technical challenge rather than a political one. ‘When you’re in the vault politics don’t matter, what matters is keeping the seeds safe’ (Al Jazeera, 15 May, 2016) states an interviewee inside the vault in a short video about the purpose of the

⁸⁷ This connects to the discussion on seeds as proxies in chapter one; also van Dooren (2009) and Peres (2017) on seeds as genetic archives that can be ‘recalled’.

⁸⁸ The current motto of the Plant Treaty is ‘15 years of saving, sharing and caring’ (Food and Agriculture Organisation, 2020).

SGSV. This is emblematic for how the managing organisations frame the vault as an apolitical, inclusive project.

The ‘Forever’ Perspective: What is the SGSV saving (for)?

Considering the overarching research question of what the seed banking practices across this thesis are banking (for), in terms of the material deposits, their temporalities, and ecological imaginaries, I now return to the wider project of saving around the SGSV through the materials discussed so far as well as a selection of media statements. How does the SGSV enact global care for more-than-human futures, and who are these futures directed at or inaccessible to?

Observing the temporality of banking, it was emphasised throughout the Seed Summit that the SGSV is not a facility for a far future post-apocalyptic relaunch of the global agricultural system. Paradoxically, at the same time it is also presented as if it is this ‘forever’-solution. Actively shifting the image often picked up in media representations, the message was ‘this is not a doomsday vault’, as stated by Norway’s prime minister in her speech.⁸⁹ Instead, it is a backup facility whose value lies in the present, exemplified, for instance, by ICARDA’s seed withdrawal from Svalbard when its collection in Syria was destroyed. I want to argue, though, that these two visions are not in conflict but two sides of the same catastrophic/messianic thinking of becoming-safe. If we understand the present as already in a ‘doomsday’ state, this necessitates acknowledging the extent of the planetary ecological crisis right now as well as present and historical violences that led to this. Suggesting that the SGSV is a facility that responds to crisis in the present would considerably shift the level of urgency, but also raise the stakes when this backup facility ends up being ecologically vulnerable to changing climates, as evidenced by the water intrusion. What could a response to this *shared ecological vulnerability* be that also includes patronising projects claiming to not be affected by this state of vulnerability? Here, the *ex situ* conservation logic of the backup fails because

⁸⁹ Interestingly, the doomsday reference was still picked up in almost all media coverage following the event, despite clear messaging to move away from this.

the backup is also vulnerable, and I consider alternative ways of protecting relationality in the following chapters. These alternatives, such as *in situ* conservation or UAWC's approach to seed distribution, respond to urgency in the present and do not operate on a spatial and temporal delay of the loss of diversity.

The SGSV brings to the surface a vision of mastery and human exceptionalism, beyond scientific expertise: the mastery of time in its promise that together 'we can secure our agriculture, our food, forever' (Crop Trust, 2020).⁹⁰ This 'forever' also appears in the Crop Trust's official slogan of 'conserving crop diversity, forever' (Gan, 2016a; Crop Trust, 2020), and interviews confirmed that the trust's activities are imagined from a 'forever perspective' (Lukas, personal communication, 22 January 2020). According to the statement celebrating 15 years of operation, the need for 'forever' emerged from the vulnerability of agricultural gene banks globally due to funding cuts, environmental and political disasters, or technical faults:

The Plant Treaty [...] brought attention to the question of exactly what 'forever' means in crop conservation. A crop collection requires daily work, constant vigilance, and steady, reliable, predictable funding. There had been too many close calls at genebanks over the years. Something new was needed to *fulfil the promise of conserving forever*. Something like the Crop Trust. (The Crop Trust, 2019; emphasis mine)

In one way, the Crop Trust and the SGSV operate as a masterful insurance for other gene banks, generally those in the Global South, but also as mastery over the seeds themselves. There is a plethora of references to the vault as a 'service to humanity'⁹¹ and as the aforementioned 'ark' for the world's seeds (Qvenild, 2008; Wollan, 2017) creating a sense of masterful custodianship. This 'salvific ark paradigm' (Laboissière, 2019) through which seed banks are often read resonates with Deborah Bird Rose's notion of 'messianic thinking' (Rose, 2017). Here, organisms are moved into a 'zone of suspended life – enlarging the zone of the incomplete – in order to be able to kick-start time and life again when the moment arrives' (Rose, 2017, p.152). Through the 'zone of the incomplete' Rose describes a space marked by promises of redemption in waiting for the coming catastrophe of the Anthropocene. Echoing Radin and Kowal's notion of cold optimism (2017) she argues that technologies of suspension,

⁹⁰ This connects to earlier discussions in 'Listening against Mastery' in the methodology chapter on Singh's approach to vulnerable reading (2018).

⁹¹ Marie Haga for the Crop Trust (2016, 0:50 min).

driven by ‘techno-apocalyptic vision’ (Rose, 2017, p.153), create a hopeful and optimistic ‘time-space zone’ where time can be put on hold and the promises of restoration and utopia are kept intact. I suggest that the Crop Trust actively evokes the twofold implications of the word ‘saving’ as both storage and messianic salvation when listing on its website its various projects on ‘Saving Coffee’, ‘Saving Apples’ (Crop Trust, n.d.). While it distances itself from doomsday narratives (Lukas and Nick, personal communication, 2018 and 2020) and the invocation of end times, the rhetoric used to describe the SGSV clearly evokes perpetuity:

The Vault is the *ultimate* insurance policy for the world’s food supply, offering options for future generations to overcome the challenges of climate change and population growth. It will *secure, for centuries*, millions of seeds representing *every* important crop variety available in the world today. *It is the final back up.* (The Crop Trust, n. d., emphases mine)

References to finality and the universalism of the ‘ultimate insurance’ create a sense of temporal mastery, where the organisms held at the SGSV can be protected and carried into the future forever, without actually becoming-plant. Climate change and environmental loss are not threats but technical challenges that can be overcome. The vault embodies a technologically grounded ecological imaginary, a promise of *rational salvation*, where the logic of the computational backup is transferred to the realm of the organism, a genetic backup that can endure over time. These statements reveal how the affective burden of biodiversity loss is turned into an opportunity to master this crisis and stabilise biological objects before their disappearance. Of course, the statements analysed above must be understood in context, as fundraising messages, appeals to donors and supporters, and in public awareness raising campaigns where the convincing mobilisation of becoming-safe is fundamental to the continuity of the SGSV’s project. What this section highlights is the interweaving of the SGSV as a technocratic conservation technology based on insurance thinking, and a masterful storytelling project for the heroic rescuing of diversity.

What became clear throughout the Seed Summit was that the object of vulnerability, and of stabilisation, is genetic diversity. Diversity is not understood as a ‘relational concept’ (van Dooren, 2009) but ‘the raw material out of which responses to future pest and pathogen challenges must be fashioned and with which the broadening of the crop genetic base can be

accomplished' (Kloppenburger, 2005, p.163). While humanity as a guardian for diversity has come up with a somewhat resilient model of protecting genetic diversity from eroding through gene banking, other kinds of diversity, such as relational, cultural, and scientific diversity, remain vulnerable to loss. The SGSV and CGIAR centres, as the most prominent depositors, do not offer a vision for how these other diversities can be carried into the future or recognised. What eludes rescue is a wealth of biocultural diversity in cultivation practices attached to situated knowledges, place, history, identity, and memory, often framed as 'tradition'. The Cherokee Nation seed bank focuses on how plants represent Cherokee (agri)cultural history and pass on traditions of ancestors and elders to younger generations. This embodied biocultural and spiritual diversity and living, evolving heritage escapes the SGSV and cannot be turned into a static object.

Amidst a shared call for acknowledging mutual dependence in seed banking, as stated in Simran Sethi's presentation during the Seed Summit ending in 'we need each other, we feed each other' (Sethi, 2020), I want to consider the envisioned ethics of containment and carrying-into-the-future for the SGSV. The global care for and safe-keeping of seeds is portrayed as an act of stewardship, an ethics of responsibility. While the SGSV is continuously becoming-safe, the relation to the objects of rescue is one of paternalistic control. Nnadozie highlighted in his presentation 'without active human management most crops would cease to exist' (Nnadozie, 2020). Agrobiodiversity, with its history of millennia of human cultivation, is framed as a human creation that now requires continued support; it is a denial of becoming-with, of acknowledging humanity's deep dependence on these relationships of cultivation and their continuity.⁹²

When carriers of sovereignty and resistance get incorporated into what can be considered as a mastery of the loss of genetic diversity, I suggest throughout the following

⁹² It is interesting to compare this understanding of biodiversity's value to the CBD's definition of biological diversity, which focuses on ecological relationships and diversity within ecosystems:

'Biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the *ecological complexes of which they are part*; this includes diversity within species, *between species and of ecosystems*. (Convention on Biological Diversity, Article 2 Use of Terms, 1992, emphasis mine).

chapters that seeds can also challenge neo-colonial structures of containment from within as carriers of colonial trauma, such as the Cherokee Trail of Tears black beans. It remains important to not demonise the SGSV and its backup system: the black box agreement in place (only depositors can withdraw and access seeds) has alleviated some of the suspicions community seed banks had towards *ex situ* conservation. These included the loss of sovereignty and ownership in centralised collections and past deception by governments (Breen, 2015, p.44), and whether the seeds would become accessible to international seed companies. As Breen suggests in her analysis of Native American seed saving practices in relation to the SGSV, the vault shows an ‘avenue toward *ex situ* deposits that can enforce and protect indigenous seed sovereignty’ (2015, p.48).

But considering the more-than-human relationality at play in seed saving it is crucial to reflect on what escapes stabilisation in the SGSV, and arguably *ex situ* conservation at large. In her interviews with indigenous seed sovereignty activists Breen shows how they observe ethical problems in detaching the seeds from their life worlds. Breen paraphrases Louie Hena, a tribal elder of Tesuque Pueblo and activist who describes how

seeds are living beings that exist within a web of relationships, they are connected to the human who plants the seed, the microbes that live in the soil alongside the seed, the soil itself, the harvester, and those who use and/or consume the plant. These relationships are reciprocal and constitutive, which means that both seeds and humans are entities formed by and simultaneously forming life’s actions around themselves. (2015, p.46)

This diagram of relations of co-constitutive care, ingestion, growth, and nurture is at the heart of the formations of becoming-with that I seek to analyse. According to Breen, what is being denied in *ex situ* conservation is this relational and cyclical essence of ‘seedness’ (Breen, 2015); isolation and detachment in gene banks removes seeds from their entanglements, webs of connection, and cycles of growth. Focusing on different carrier seeds in the following chapters I observe how this ‘seedness’, building on earlier considerations on seed-thinking, is affected in various projects of saving and banking, and how it reflects on care and ecological imaginaries beyond fortification: those of sharing, distribution and localised formations of sovereignty.

Conclusion

What I hope to have shown throughout this chapter is the precarious nature of *becoming-safe* through global care. It is undermined by ecological vulnerability. This chapter has formed the first part in exploring how divergence exists amongst seed banking practices, how liminal spaces are organised and temporality imagined in ecological imaginaries. The SGSV in its efforts of becoming-safe has been read as an ecologically vulnerable space that holds different more-than-human worlds, which are governed by complex relations of (cryo)power, connected to the global cold chain and industrial agriculture. Situated in an extremely precarious life world, the Arctic ecosystems and their histories of colonisation have shown that mastery struggles to preserve life outside controlled *ex situ* environments.

The Cherokee Trail of Tears black bean as a carrier seed has hinted at the interlinkages of the global and the localised across past, present, and future. It has shown the importance of situated knowledges, and the banking of histories of sovereignty, but also made present the echoes of colonial violence. While this analysis has to some extent stayed on the surface – of understandings of indigenous sovereignty but also of access to a somewhat guarded international community of agri-science institutions – it has revealed the processes of incorporating different formations of sovereignty into the SGSV. I suggest the Cherokee Trail of Tears black bean as a carrier seed has opened up multiple, ambivalent meanings of *resistance*, which will become clearer in the following chapters, as both an engineerable and extractable genetic resistance to stress and disease, drawing from the SGSV as a living archive of climate adaptation, and of resistance to loss of land, biocultural sovereignty, and to agro-capitalism.

The question of who will have access to seeds in the future remained vague throughout the events I observed; the benefactors of the ‘common good’ were opaque beyond ‘humanity as a species’ (Nnadozie, 2020). The following chapters will continue the investigation into the more-than human politicisation of sovereignty and conservation from a more-than-human and anti-colonial perspective, taking into account power relations within the category of

'humanity'. The SGSV remains an ecological imaginary of mastery that is financially secure and able to adapt to changing climates through technical fixes. It is a conservation technology for a climate change 'zone of the incomplete' that will continue to be able to upgrade its facilities with large financial investments.

I close this chapter by asking what it means if this management of time and of vulnerability fails. What if knowledges needed to cultivate seeds held in the vault are lost? What if climatic conditions for their cultivation don't exist anymore? What would change if instead we look at vulnerability as an 'ethical orientation to the other' (Vardy and Smith, 2017, p.177) as planetary degradation escalates over the coming decades. In this context the logic of securitisation can obscure rather than support struggles for 'liveable life'. A focus on shared vulnerability can advocate for conservation beyond top-down models of genetic resources. The following chapter on the MSB will go further in exploring the problems of stabilising scientific objects of knowledge and the ethics of containment and release, while nonetheless accepting vulnerability. The SGSV does by no means work for all species; a lot of important crops like coffee, banana, avocado, cocoa, and mango are recalcitrant and cannot be preserved in *ex situ* conservation. Its global care therefore needs to be seen within wider projects of conservation including *in situ* conservation and restoration, but also in the context of the interests of the communities involved. For many of the depositors at the SGSV this includes collaborations with commercial seed companies. What the SGSV's Seed Vault Deposit in the Arctic has revealed is an ecological imaginary of fortification and trust in seeds as replicating technologies whose genetic diversity can be preserved forever.

Chapter Four

Preserving with Vulnerability:
Undoing 'Forever' from within the Millennium Seed Bank

Introduction

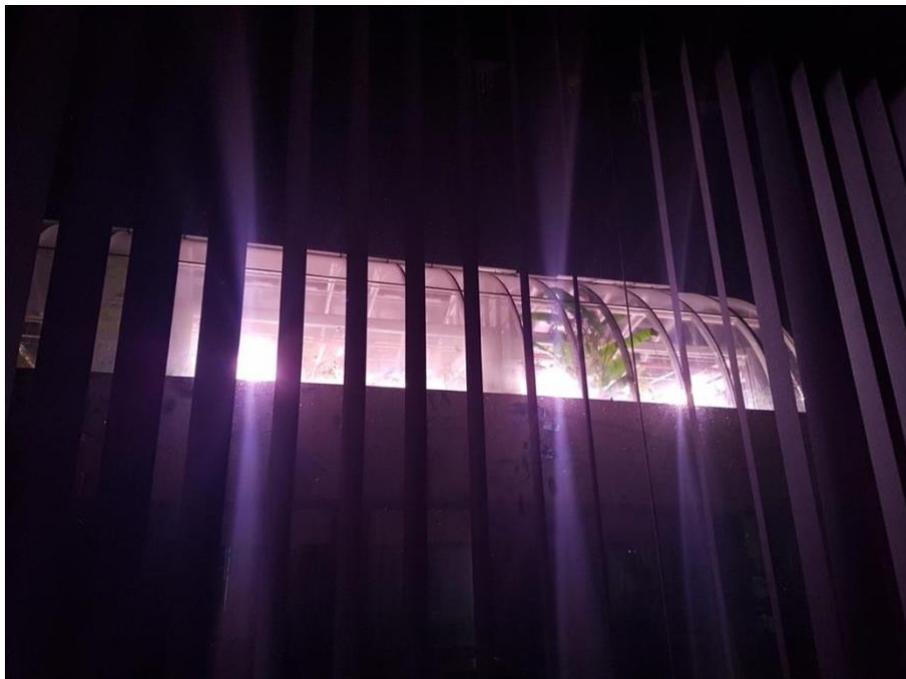


Fig. 4.1. View of the MSB greenhouse from the researcher accommodation. Photograph: the author, November 2019

Looking out at the Millennium Seed Bank's (MSB) greenhouse at night, the most prominent plants were two illuminated banana wild relatives. Their large leaves curled against the glass that was eerily lit in a pale pink hue. These *Ensete livingstonianum* plants, often referred to as the Ethiopian 'false banana', had almost outgrown the greenhouse space, gently pushing towards the rounded glass ceiling. As I observed the quiet nocturnal greenhouse from the researcher accommodation on the ground floor in the long nights of November 2019, I was

reminded of the ways plants – and their relations – escape containment across the practices I was observing, in this case quite literally.⁹³

These plants had grown in the greenhouse since 2013 and were blossoming for the very first time, coincidentally during my stay. It was also the last time – the *ensete* life cycle ends after flowering initiates the plant's death. Later on, I found out that these hard-to-germinate plants could not be pollinated in the horticulturalists' attempts at artificial pollination. After years of care nurturing the largest plants in the MSB their seeds were sterile. Usually, the MSB is a space where conservation protocols state that all seedlings need to be incinerated after routine germination testing; I never found out how the *ensete* escaped this fate. Throughout my stay they provided a useful reminder of the link between seed and plant, and the futures imagined for seeds. They hinted at the millions of potential plants held in the cold storage seed chambers separated by a few walls and further underground from the greenhouse. The MSB's architecture, discreetly nestled into the shallow hills of the Sussex countryside, was conceived around how seeds move through the stages of care in banking – drying, cleaning, counting, x-raying, and storage – before they arrive in the seed chambers for an indefinite period of time; 'forever' in the seed banking imaginary of the previous chapter. Throughout my stay, the Royal Botanic Gardens, Kew (RBG Kew), the parent organisation behind this iconic building for the global care of wild plants, revealed itself as increasingly vulnerable and shifting. It was caught in slow processes of reframing and reconsidering scientific authority, knowledge practices, the ethics of partnerships, and its colonial past. How seeds are researched, conceptualised, and cared for at the MSB offers important insights into analysing this historical practice of mastery as vulnerable and self-critical – unlike the Arctic performance of resilient heroism during the SGSV Seed Vault Deposit observed in the previous chapter.

Across the MSB, bananas and their wild relatives are treated as important storytelling tools, tangible and relatable, and, as I will argue, useful carriers for narrating histories of adaptation and extraction, and the temporalities of care in the Plantationocene. As Françoise

⁹³ I visited the MSB for two weeks in November 2019 to conduct interviews, explore the site, and observe seed banking processes. I had previously visited the MSB twice in January and February 2019 for film and sound recordings as part of a collaborative art project.

Vergès (2016) points out, beyond colonial histories the cultural signification and stereotyping of bananas also relay racism and sexism. The ecologies contained in the frozen collections at the MSB are vast, from drylands to alpine highlands, and tropical forests. It is the largest *ex situ* wild plant conservation project in the world holding the genetic afterlife of rapidly eroding worlds. Banana wild relatives, the pre-domestication ancestors of commercial bananas, whose interiors hold sought after adaptations, have become time-bending naturecultural assets harnessed on the level of the gene, such as *Ensete perrieri*, an example for banana wild relatives that are threatened with extinction in their forest habitats in Madagascar due to deforestation pressures. As scientific objects they encapsulate RBG Kew's historical collection priorities for curating its powerful living collections of 'endangered, endemic or economically useful' species (Fry et al., 2011, p.44). And crucially, I will argue they reveal the limitations of cryopolitical conservation regimes that I started to explore in the previous chapter in seed banking and its conceptualisation of temporality and vulnerability.

Reflecting on banana wild relatives amidst the soundscape of the nocturnal humming of the MSB's cold storage chambers, after days of conversations with seed scientists, horticulturalists, cryobiologists, partnership coordinators, and members of the communications and learning teams, I traced multiple constellations of what a seed bank could be, and in particular where efforts to stabilise seeds as objects of knowledge seemed to fail. During my visit I realised that what I anticipated to find here was a neo-colonial technofix for 'wild' biodiversity, and often felt out of my depth in technical conversations with scientists about seed biology and storage behaviour. But what permeated my experience and this reading of the MSB's practice is a sense of uncontainable *collective vulnerability* and rejection of the 'forever' perspective. I propose this relationality as a *preserving with* vulnerability, understood as dependency and shared exposure to stresses. The previous chapter investigated the performance of securitisation and fortifications in genetic conservation. Now this chapter considers the impacts of multiple forms of vulnerability – ecological, organisational, temporal – on more-than-human futures. I will then move towards analysing sovereignty and relationality rooted in cultivation in the following two chapters.

Vulnerable Listening

This chapter continues the methodology I mapped out in chapter two to trace and analyse formations of 'becoming-with' (Haraway, 2008). Working with Julietta Singh's method of 'reading against mastery' (2017) towards a 'dehumanist' ethico-politics as introduced in chapter two, throughout this chapter I conduct an exercise in *listening against mastery*.⁹⁴ This adaptation of Singh's decolonial approach for literary texts to conversations with plant scientists reveals moments of vulnerability as awareness of shared dependency within a perceived practice of mastery. In analysing interviews and observations at the MSB for traces of colonial power and knowledge but also ecological and organisational vulnerability, I am aware of my own implication in attempting to observe mastery, potentially mirroring processes of mastery in the treatment of my research subjects. Therefore, throughout this chapter I give extensive space to direct quotations from conversations in an attempt to mitigate this somewhat through staying close to these direct accounts.

Building on the discussion of Gregory Bankoff and Anna Tsing's analyses of vulnerability and precarity in the previous chapter, in what follows I develop what Singh describes as a 'vulnerable reading', or rather listening, as an 'open, continuous practice [...] by remaining unremittingly susceptible to new world configurations' (2017, p. 22) and resisting disciplinary enclosure. I do so by focusing on subjectivities within the organisation that express awareness of dependency and limits of control. Reframing Judith Butler's universalist discussions on vulnerability Singh emphasises that vulnerability can be understood as inclusive of nonhuman collectivities when human mastery is increasingly fragile in the wake of ecological collapse.⁹⁵ On this basis, Singh suggests reading as a practice of 'unmasterful vulnerability' (ibid., p.23) to move towards being able to imagine relationality otherwise. Vulnerability is multiple across

⁹⁴ Singh proposes dehumanism as a 'practice of recuperation' that undoes violence at the heart of (neo)colonial mastery that denies humanity to some (2017, p.4).

⁹⁵ In *Vulnerability in Resistance* (2016) Judith Butler departs from an understanding of vulnerability as solely instrumentalised and invoked in neoliberal governmentality to think of vulnerability as a mode of relationality: 'we cannot understand bodily vulnerability outside of this conception of its constitutive relations to other humans, living processes, and inorganic conditions and vehicles for living' (2016, p.16).

this chapter – it is both *strategically deployed* (what Butler would refer to as precarity) in making seeds vulnerable subjects in need of protection and in framing RBG Kew’s global partners as lacking expertise to adequately care for their seeds. But vulnerability is also internalised and inescapable, *organisational and ecological*, threatening the very formations of the MSB. To introduce this ‘listening against mastery’, or affirmation of vulnerability, in practice, a conversation with Morgan, a seed scientist, makes tangible the multiple vulnerabilities the MSB is facing on an organisational and temporal scale:

It’s a tricky concept, when you think in big places like Kew and the MSB you think it’s not very vulnerable and it’s resilient. But that’s not the case, Kew is losing money from DEFRA [the UK Department for Environment, Food and Rural Affairs] every year. This building was a department in the past, before the restructuring, it was a department with a lot of power and a lot of funding, and after the restructure this building lost a lot of power and funding, so that means that people will lose their jobs in March, six people. Who’s gonna cover that, who’s gonna do the work? They’re putting projects for collecting new species and banking them, but we are losing the people who are doing that. That shows that the space is quite vulnerable. Any institution like the MSB or the USDA [United States Department of Agriculture], they need constant input of funding, not only to be created but also to continue over the years. (Personal communication, 14 November 2019)

I asked Morgan if the scope of the MSB’s global care makes it hard to scale down. Seeds are not regenerated but need to be recollected from the wild for each deposit. At present many are slowly ageing inside the seed chambers.

Yeah definitely, these banks for example they don’t... the seeds that are ageing, they are not germinated, reproduced, and banked, like crops. (ibid.)

This conversation introduces the unique stresses the MSB faces as an organisation dealing with *wild* plant species rather than easy-to-bank agricultural varieties as explored in the previous chapter.⁹⁶ Morgan touched on molecular cell processes that make recalcitrant seeds hard to bank and age quickly, a physiological behaviour not considered in the ‘forever’ perspective of seed banking. He also referred to the fact that some funders seem to believe the MSB’s banking project is successfully completed, unaware of the continuous, slow care and investment needed to keep the living collections alive, and to eventually usher the seeds out of

⁹⁶ Robin, also a seed scientist, explained with a gesture that grasped the whole MSB building when we sat in the ground floor meeting space that ‘everything we do here is translated from the agricultural world, that’s where the seed bank was born’ (Personal communication, 7 November 2019). Adapting agricultural seed banking processes to wild flora is an ongoing research process at the MSB.

the bank. In these ways the MSB enables a listening for constellations of power in the geopolitics of global care and the protocols it produces. But this is also challenged internally by practitioners who intimately care for plants and are affected by this care.

The Millennium Seed Bank Partnership: A Postcolonial Reframing of Kew's Living Collections?

'The Science Collections at the Royal Botanic Gardens, Kew represent *an asset that has been growing more or less continuously for the past 170 years*. [...] the decision as to what to collect and from where has been largely driven *by serendipity and political trends*' (RBG Kew, 2018, p.1; emphasis mine).

The MSB, the physical seed storage for the Millennium Seed Bank Partnership (MSBP), was established in 2000 by RBG Kew, a public body with charitable status (Eastwood et al., 2015). The MSBP is a global *ex situ* conservation network whose partners deposit duplicate collections at the MSB; the primary collections are kept in the 190 countries and territories where seeds have been collected from their habitats. The banking protocol of the MSB is thus similar to the SGSV; both are global spaces for duplicate deposits. A millennial project in ambition, the MSB building was funded by the Wellcome Trust as well as the Millennium Commission, which was the major funder of the first stage of the project until 2010 (Eastwood et al., 2015). DEFRA (UK Department for Environment, Food and Rural Affairs) has remained the main funder since the end of 'Phase I' but reduced core funding substantially in 2014. This created the organisational vulnerability the MSB has faced since and resulted in a large restructuring and down-scaling of the MSB's activities after RBG Kew had 'just avoided bankruptcy' in 2014 (Felix, personal communication, 4 August 2020). Following the loss of core funding the MSB model had to diversify to include foundations and private individuals.⁹⁷ Katja Grötzner Neves (2019) gives a detailed account of Kew's financial crisis around a £5.5

⁹⁷ During my stay at the MSB I came across a public signage stating the building was supported by the following funders (I could not find this information elsewhere): Anglo American Plc, British Airways plc, the Esme Fairbairn Foundation, GlaxoSmithKline plc, The Maurice Laing Foundation, the Phileology Foundation, the Rufford Foundation, Tate & Lyle plc, AXA plc, English Nature, The Kirby Laing Foundation, Marks and Spencer plc, Shell International Limited. Particularly striking here are the presence of petro-capital and pharmaceutical companies.

million budget hole (around 10 percent of the annual budget) that led to a restructuring of the organisation which according to Neves revamped it as a ‘centre of calculation within the Anthropocene’ (2019, p.85) and aligned it with DEFRA’s Natural Capital Committee. To date, funding remains precarious and multiple interviewees were directly affected by this precarity having to reapply for their jobs frequently.

The MSB has created protocols for wild seed conservation, which go beyond banking and include ‘acquisition, drying, cleaning, storage, viability monitoring, regeneration, propagation, duplication, distribution, documentation’ (Liu et al., 2020, p. 2924). To do so it adapted agricultural seed banking methods. During ‘Phase I’, until reaching the initial 10 percent target of banked global wild flora diversity in October 2009, the collection priority was placed on dryland species. The assumption was that plants with adaptations to dry and hot climates would be more prone to produce orthodox seeds with long term storage viability (Li and Pritchard, 2009). Additionally, it was argued that drylands were particularly affected by extinction threats (Smith et al., 1998).

Attending the depositing ceremony at the SGSV described in the previous chapter provided a unique overlapping of the two organisations of global care in seed banking – practices that have taken on the conservation of global biodiversity in its totality: the SGSV for agricultural biodiversity and the MSB for wild plant biodiversity. I had met Jesse, senior research leader at the MSB, in Svalbard where she was handing over RBG Kew’s seeds for storage at the SGSV marking the first material overlap of these two collections.⁹⁸ Reflecting on the remote Arctic experience in August 2020, after the Covid-19 pandemic caused activities at the MSB to grind to a halt for months, Jesse compared the two ambitious seed banking projects and their shifting global centrality for seed custodianship:

I think symbolically the MSB will always be significant, it’s a bit like Svalbard, we haven’t got the same global presence in some ways in people’s mentalities. That’s maybe easier for people to grasp onto. But I think for people working in conservation it will always have that same signification.

⁹⁸ The RBG Kew deposit included 27 wild plant species collected from the residence of Prince Charles (an avid supporter of the MSB), including wild carrot, perennial ryegrass, clover and five orchid species. The deposit was considered important as a public demonstration of collaboration rather than a necessary duplication from a conservation perspective.

She went on to describe the positive affective experience of visiting the vault and being a node in its hopeful, collaborative network:

It was moving, just the event, and all the other countries who were represented and seeing that people can come together for global good, and that is really about securing people's future through agriculture. (Personal communication, 18 August 2020)

As with the SGSV, for the MSB the promise of global care for 2.4 billion seeds of around 39,000 species (RBG Kew, 2021) comes with an ethical responsibility to maintain this custodianship; a responsibility that many of the practitioners I spoke to felt that RBG Kew might struggle to maintain the human capacity to keep up in future.⁹⁹ In the summer of 2020, there was a backlog of processing seeds that had arrived, further delayed by Covid-19; and once seeds are banked they might age before there is capacity to make a new collection.

During conversations at the MSB I realised I was observing an organisation at a time when it was dealing with multiple internal and external reconfigurations and their aftermaths. In November 2019 staff had just found out that the MSB was facing new redundancies after a large restructuring in 2015 when the building that houses the MSB 'lost a lot of power' (Morgan, personal communication, 14 November 2019) and the future of the millennial project was becoming increasingly precarious. In November 2019 it was also clear that the conservation teams were not achieving the 25 percent of total global flora target, approximating 75,000 species, set for 2020.

Observing this vulnerability and current reconfiguration of the MBS's global role it is necessary to ground my analysis of the MSB's practice in RBG Kew's history of plant collecting to understand this present shift. Scientific study of seed collections has been conducted at Kew since the 1890s (Brown and Escombe, 1898); a small seed bank was set up in the 1960s to support exchanges with other botanic gardens in the Physiology Unit, later renamed as the Seed Conservation Department (Eastwood et al., 2015) from where the vision for the MSB was developed. In *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens*

⁹⁹ Morgan describes this process of slow organisational overload as follows:

The seed bank has always been a place where everybody is sending the seeds, so the seeds are cleaned and processed and banked. But now we are realising, we can't continue doing that, we need seeds that are already clean [...]. We don't have the staff to do that. And indeed what is happening is that we are losing staff. (Personal communication, 14 November 2019)

(1979) post-colonial STS scholar Lucile Brockway observes the work of RBG Kew botanists in laying the foundations for imperial plantation economies. She describes an emerging network of relations by tying together scientific knowledge production, or arguably *extraction*, and power. She traces the movements of three economically useful plants – cinchona, rubber, and sisal – from their habitats in Latin America to commercialisation in Asia under the care of RBG Kew. These eighteenth and nineteenth century transplantsations offer insight into the collection priorities at RBG Kew at the time and its involvement in global transfers of plants. They were echoed, at least in sentiment, in the first ever *Science Strategy* (2015-2020) which defines RBG Kew’s scientific vision as ‘to document and understand global plant and fungal diversity and its uses, *bringing authoritative expertise* to bear on the critical challenges facing humanity today’ (2015, p.6; emphasis mine).¹⁰⁰ Across the Science Strategy there is a strong focus on demonstrating utilisation, and commercialisation of plants through projects focusing on Natural Capital, ecosystem services, and agricultural adaptations.¹⁰¹ Wild plants are translated into natural resources. However, as I discovered at the MSB, the maintenance of ‘authoritative expertise’ in its colonial legacy is increasingly challenged.

In recent years the MSB has been the focus of a range of careful and detailed scholarship rooted in the social sciences, focusing on care in seed banking (Chacko, 2019a), ethics in the assemblage of seed collections and their stewardship (Lewis-Jones, 2018b), the relation between plant-being, seed banking, and seed ecology (Lewis-Jones, 2019), and *ex situ* conservation as a world-making device (Laboissière, 2019). What my reading of, or listening to, seed banking practice at the MSB seeks to add is that a focus on shared vulnerability

¹⁰⁰ Authority here is both linked to histories of botany but also present-day international legal agreements: RBG Kew is, for instance, the designated UK ‘Scientific Authority’ for CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). In this role it provides ‘independent and impartial scientific advice’ to DEFRA and government policy (RBG Kew, n.d.).

¹⁰¹ Brockway (1979) describes the historical linking of botanical science and economic value through the role botanists played. Echoing Brockway’s critique of the financialisation of nature in the name of science Natasha Myers (2017) proposes a decolonial feminist mode of inquiry of scientific knowledge. She critiques the databases of colonial science to instead propose an ‘ungridable ecology’ that asks for new forms of embodiment and attention. She suggests that ‘affirmations of more-than-human sentience are blasphemous to a colonial ecology whose data forms and modes of inquiry tacitly and explicitly assume that bodies and lands must be managed as property, resource and commodity’ (2017, p.7). These masterful translations of seeds into genetic data, and their ‘afterlife as data’ (Hartigan, 2017) and financial assets runs throughout this and the previous chapter.

(ecological and organisational) can shift the foundation of claims to scientific authority and following from this, resist reading care as a form of organisational mastery. The initiative for decolonisation emerging from RBG Kew and conversations within the MSB on its future reveal divergent visions for self-critical custodianship rather than a homogenous conservation practice with imperialist roots as suggested by Chacko (2019b) and Laboissière (2019). In her analysis of the connections between Kew's paternalistic history and the current 'rebranding' of partnerships within the framework of the MSB, Chacko argues that the percentage targets of known biodiversity still used for conservation goals (10 percent global biodiversity in 2010 and 25 percent for 2020) reveal an 'imperialist fervor of extraction' that opens critical questions as to which seeds are banked and why, and crucially, who will eventually have access (Chacko, 2019b). While I agree with these criticisms of numerical targets, I propose what came across in interviews with practitioners is that these targets are often the only ways funders can be convinced to support biodiversity conservation and translating conservation efforts into the languages of Natural Capital is currently the only way to fund conservation. Practitioners at the MSB were uniformly against these numerical targets and often frustrated when this was brought up in conversation; the second *Science Strategy (2021-2025)* does not include them anymore. Another pitfall of numerical banking is that currently those species are selected that are easy to store and collect in the wild – recalcitrant seeds are left out for the time being. Standard cold storage protocols of preserving seeds at five percent moisture content and minus 18°C temperature do not work for recalcitrant species. In the MSB's poster projects it is often not biodiversity as a 'global good', but specific plants that are banked because they hold a future 'value'. This includes frameworks such as crop wild relatives, Natural Capital, medicinal plants, plants for climate change mitigation, or in livelihood support projects.

Building on this organisational vulnerability I explore the potential of wild relatives, bananas in particular, as carrier seeds because they can demonstrate how the tensions emerging from standardised seed banking protocols are acted out on the level of species bodies and species care, and how value is harnessed from 'wild' genetic information.

Wild Relatives: The Scramble for Resilience and Storytelling Tools



Figs. 4.2–4.3. Banana wild relatives (*Musa velutina* from Kew’s Palm House and *Ensete livingstonianum* from the MSB) with their seeds. Photographs: Chris Cockel, October 2017 (**fig.4.2**) and October 2018 (**fig.4.3**), reproduced with permission



Fig. 4.4 Banana seedlings appearing as a pioneer species in recent landslide location in central Taiwan. Photograph: Chris Cockel, 2017, reproduced with permission.

It is a confusing sight to see a banana filled with large black and shiny seeds (figs. 4.2 and 4.3), the flesh almost completely pushed aside. Cavendish bananas, the most dominant cultivar for commercial banana breeding, are sterile and completely seedless. Rowan, who works on wild relatives, told me that he has observed an interesting intersection of international banana transfers with his daily commute from Portsmouth to the MSB at Wakehurst when we discussed the potential for bananas to make tangible global flows of plants for consumption. Almost 90 percent of the UK banana imports pass through Portsmouth:

If you go out at the right time you can see the banana boat coming in. It comes in from the Caribbean but comes via Rotterdam once a week, sometimes you can see its Geest line logo. They have these big containers, you can see them stacked up in the port when I drive. (Personal communication, 14 November 2020)

Rowan and I shared a banana curiosity and interest in their wild relatives because they sit between both ‘wild’ and ‘domesticated’ and orthodox and recalcitrant seed physiology classifications. They are neither orthodox nor quite recalcitrant and their storage behaviour brings to the surface particular *ex situ* conservation challenges and knowledge gaps (Kallow et al, 2020). What fascinated me in conversations about *Musa acuminata*, *Musa balbisiana*, *Ensete perrieri*, and *Ensete livingstonianum*, some of the wild relatives of commercially cultivated bananas, is that these plants, whose seeds were collected for the MSB in Vietnam, Malaysia, and Nepal, thrive in *disturbed ecologies* where human interference has altered local

ecosystems through landslides, deforestation, and industrial agriculture (fig. 4.4). Tsing (2015) makes an important point about disturbance, it is ‘ordinary’, more-than-human, and from an ecological perspective does not equal damage.¹⁰² A carrier seed attracted to disturbance is productive for exploring the framing of ecological vulnerability, concepts of invasiveness, nativeness, and pioneer species, and the co-adaptations and dependencies of plants and humans outside of cultivation.

Bananas, a classic plantation crop which was transplanted to the Caribbean through colonial trade routes and domesticated as early as 5000 BC (Piatti-Farnell, 2016), are seedless and therefore sterile, cultivated clonally via cuttings.¹⁰³ The resulting genetic uniformity makes plantations vulnerable to a range of fungal diseases in the absence of natural resistance. A particular kind of which, the ‘Panama disease’ caused by the fungus *Fusarium oxysporum*, wiped out almost all commercial banana production of the Gros Michel variety, then the dominant cultivar, in the 1950s in Central and South America and Africa (Parnell-Fiaffi, 2016). The fungus is now starting to attack Cavendish bananas, currently the main cultivar for commercial banana production in a trade that is worth 13.5 billion USD annually (FAO, 2019). This threat, combined with local extinction threats for banana wild relatives through habitat destruction, has made the collection of banana wild relatives increasingly urgent for both conservationists and plant breeders. Rowan was keen to promote research on bananas and their wild relatives at the MSB and suggested that ‘in terms of PR they’ve been our best crop’. Banana wild relatives are liminal natureculture subjects that sit within and between multiple seed banking discourses – of the genetic resource community and its ties to agri-business discussed in the previous chapter and of conservationists and restoration ecology. And as discussed, in their seed physiology they are also liminal, somewhere between recalcitrant and orthodox. Usually, cultivars on the one hand and wild plants on the other are conceived as separate epistemic objects of conservation. The former are kept in agri-scientific gene banks and the latter within the frameworks of nature conservation. I argue that the varieties of

¹⁰² This notion of disturbance is explored in-depth in chapter six.

¹⁰³ Cavendish bananas are triploid (they have three sets of chromosomes), an intentional breeding anomaly that makes them seedless, and therefore sterile. Banana wild relatives are diploid.

banana wild relatives held at the MSB, their histories and framing as assets make evident the blurring of constructed binaries between ‘nature’ and ‘culture’ and ‘wild’ and ‘domesticated’. What makes wild relatives *assets* is exactly their ability to inhabit both sides of these binaries. Following the threads of collective vulnerability running throughout this chapter, they also make evident how the ‘wild’ is increasingly harnessed as a resource for *genetic diversity* due to homogenisation arising from capital-intensive approaches to agriculture. Bananas kept appearing in stories across different epistemic projects during my research at the MSB, such as when discussing IUCN (International Union for Conservation of Nature) red listing for threatened species, wild relative prebreeding, plant and seedling care in the greenhouse, and digital image production and campaigns. They are genetic and digital assets, threatened objects of care, carriers of conservation data, and relatable actors for mediatization because of their complicated histories and present ubiquity. As Rowan made clear, they ‘generate good stories’.

Banana wild relatives are ‘valuable’ at the MSB because of the potential resistance they carry in their genes. The banana wild relative collections are part of the Crop Wild Relatives (CWR) project.¹⁰⁴ The project was initiated by the Crop Trust in 2010 in a dual race against time to both collect the genetic diversity of wild relatives before extinction in the ‘wild’ and to breed desirable traits into agricultural varieties to improve them for rapidly changing climates. This double temporality of urgency situates the project as both responding to ecological vulnerability in the ‘wild’ and genetic vulnerability of cultivars (Castañeda-Alvarez et al., 2016). The overall mission of the CWR project, which came to conclusion in summer 2020, was, as stated in a concept note, to assemble a ‘*portfolio of plants* [...] collected, protected and provided to plant breeders.’ It prioritises the utilisation of genetic adaptations found in wild relatives to heat or drought, salinity, and disease resistance. Mining wild seeds for these traits will take place in the CGIAR (Consultative Group for International Agricultural Research)

¹⁰⁴ The CWR project focuses on wild relatives of prominent food crops including banana, barley, bean, cassava, chickpea, finger millet, grass pea, lentil, oats, potato, rice, sorghum, soya bean, sweet potato, and wheat. According to Kallow et al.’s assessment of banana conservation globally currently around 1000 edible banana cultivars exist, and wild relatives are not sufficiently represented in gene banks, both concerning intraspecies and interspecies diversity (Kallow et al., 2020).

centres' prebreeding programmes after the MSB has overseen the wild seed collection and conservation.¹⁰⁵ A crucial component of the CWR project was 'preparing' wild relatives for agri-scientific research. The MSB was approached due to its expertise in wild species taxonomy, conservation biology, and seed physiology. The CWR project clearly connects to the genetic resource community sketched out in the previous chapter and earlier discussions on genetic erosion and vulnerability. It was envisioned that duplicates of the collections held at the MSB and CGIAR centres would eventually also be deposited in Svalbard, connecting the cryogenic cultures and cold chains in the ecology of practices across this thesis.

In a scientific environment where germinated seeds are destined to be incinerated Rowan was particularly excited to be able to rehome a group of banana wild relative seedlings. These had been grown from seeds collected as part of the CWR project for a PhD research project on banana 'bunchy top disease'. Only between 20-30 percent of banana wild relative seeds can be successfully germinated and germination rates reduce significantly during storage (Kallow et al., 2020). The care that had gone into these seedlings also needed to be protected. He arranged for the seedlings to be sent to botanical gardens in Bochum, Edinburgh, Kent, and the Eden project, creating a self-initiated small network of banana wild relatives, not driven by institutional partnerships but personal curiosity and investment in the plants.

¹⁰⁵ In *Care of the Species* John Hartigan defines prebreeding as 'surveying phenotypic variation in relation to different environments, then screening for possible genetic links and associations' (2017, p.103).



Fig. 4.5. Banana wild relative seedlings at the MSB nursery, before relocation. Photograph: Chris Cockel, 2018, reproduced with permission.

Within the CWR project RBG Kew as a ‘scientific authority’ on wild plant conservation was responsible for developing collection protocols for a range of identified wild relatives. Their seeds will be held at the MSB and distributed to the responsible CGIAR research centres. As the wild relative genes are analysed at the respective research centres for traits that will help commercial varieties adapt, I argue this points to how wild relatives embody a fundamental power dynamic of the Plantationocene. What Haraway et al. discuss as the ‘relocation of generative units: plants, animals, microbes, people’ (Haraway et al., 2015) can now be seen in a time-bending practice that harnesses vegetal pasts in wild relative *prebreeding*. It shows the extraction of a temporal moment of adaptation from before the process of domestication and increasing genetic homogenisation to solve the problems of future agricultural genetic vulnerability. Yet, it cannot undo the colonial trauma that many of these crops are enmeshed in, and the more recent violence caused by banana plantation economies. Vergès (2016) and Ferdinand (2022) describe the devastation caused by the carcinogenic pesticide chlordecone in Martinique and Guadeloupe in the 1970s and 1980s which led to the poisoning of soils and workers on banana plantations. Crucially, bananas were a central fuel in the development of extractive plantation economies in very material terms:

they were a staple food and cheap nourishment for enslaved people, before they became a travelling luxury commodity in the eighteenth century (Piatti-Farnell, 2016).¹⁰⁶ While the Cherokee Trail of Tears black bean in the previous chapter made tangible the increasing agri-scientific valuing of *pre-colonial and pre-industrial* varieties and their biocultural adaptations, the banana wild relative demonstrates the harnessing of *pre-cultivated* vegetal capacities before human intervention. This ‘rewinding of time’, as Rowan described it, offers breeders an optimistic outlook when dealing with volatile future climates. Time travel becomes easier than controlling ecological disturbance. In *Care of the Species*, an ethnography on maize races, John Hartigan Jr. describes this temporal layering in maize breeding programmes as ‘compound temporal vision – [...] one designed to tell them something about evolutionary deep time and adaptations the species made in the highlands; then forward in time, to the next rounds of crosses, as well as the pools of data that will emerge from molecular analysis’ (2017, p.114). I suggest that while the habitats of banana wild relatives are aggressively destroyed, they are harnessed for their liminal *genetic afterlife*, echoing what Hartigan calls the ‘afterlife as data’ of plant genetic research. They survive in gene banks as uncultured and uncultivated potential that might undo vulnerabilities human cultivation has introduced into their monocultural, domesticated cousins. The bananas Rowan saw arriving in Portsmouth are transported for Geest, a competitor of Chiquita Brands International Inc., the direct successor of the United Fruit Company. This controversial plantation corporation and its different iterations have been subject of criticism for neo-colonial exploitation and a massacre of workers (Piatti-Farnell, 2016).¹⁰⁷ Marianne North’s painting held in Kew’s

¹⁰⁶ Lorna Piatti-Farnell in *Banana: A Global History* summarises the crucial role bananas played in fuelling plantations. She describes how bananas are intimately entangled in the histories of plantation economies, as a food source for enslaved workers and as a companion plant that provided shade for more precious plantation crops (2016, pp.38-39).

¹⁰⁷ The United Fruit Comp is also the agricultural company that Gabriel Garcia Marquez’s ‘American Fruit Company’ is modelled on in *One Hundred Years of Solitude* (1967) in his narration of the massacre on striking banana plantation workers. The actual massacre that Marquez’s account is based on took place in 1928 when workers of the United Fruit Company went on strike against exploitative working conditions in the liberal opening up of Colombia’s postcolonial economy. The fictional rendition of the massacre shows the histories of extractive and violent experiences fuelled by plantation economies and their corporate hegemonies. It also shows how bananas and their global germplasm flows connect future and past cultivation movements.

collections of a banana plantation in Brazil provides an additional early example of the global proliferations of bananas as a commercial crop from their centres of origin in Southeast Asia to plantations in the Caribbean and Central America; the painting also reveals RBG Kew's interest in these economically useful crops.¹⁰⁸



Fig. 4.6 Cocoera Palms and Bananas, Morro Velho, Brazil. Oil painting by Marianne North, 1872-73. Photograph: © Board of Trustees of the Royal Botanic Gardens, Kew, reproduced with permission.

¹⁰⁸ Art historian Khadija von Zinnenburg Carroll discusses the collection of more than 800 paintings by artist Marianne North's on display at RBG Kew's *North Gallery*. North went on a range of botanical expeditions across the world and challenged Victorian artistic and gender conventions. Carroll suggests North 'provides an early critique of the colonial botanist and artist as mere hunter' (2018, p.196) through an artistic practice that decentres the human as an expert in human-plant-relations, as well as challenging the practice of botanical representations and epistemic dominance. 'The artist's representation of botany instead provides a counter to the colonial economic enterprise that she witnesses first-hand' (2018, p.296).

Colombia, with a dominant presence of US American banana agri-corporations, is of particular interest in multiple research projects across RBG Kew in another temporal layering of past and future valuable biodiversity.¹⁰⁹ Erica, who works on seed conservation projects with MSB partners in Latin America, described how since the 2016 ceasefire deal between the Colombian government and FARC rebels the utilisation of natural resources has opened up. I quote a longer extract from our conversation here to give space to Erica's description of the role of conflict as a protective sphere for biodiversity and its impact on indigenous practices.

MB – You mentioned you also work in Colombia, does the post-conflict situation there impact on conservation at all? Does politics come into it?

E – Yes, that is basically why, because until now there was no possibility to get into the land, it was impossible to do fieldwork, scientists could not go anywhere. Now everything is starting, it's flourishing really, everybody is doing stuff from very different points of view. There are lots of botanists that are exploring what actually is in the land. So they find out about new species, or species that are not there anymore, we now can do maps. [...] *But during the, how do you say in English, rebellion, during the war, during the political conflict, actually many lands were protected by that fact that botanists could not go, but neither could other industries.*

MB – No extraction for resources?

E – Many lands were abandoned, which means forest could regrow everywhere, there are so many forests, you can cross them and they say, oh yeah, that's just from the last twenty years, because we couldn't go there and nature took the space back. So actually, all this time nature was protected. And now there are so many lands that are being destroyed right now. And even the coca fields for the cocaine, apparently they could get much more money out of those fields, rather than agriculture, so now they are deforesting much more, because they can't use coca anymore. Which anyway is a very native plant and really sustainable, and sacred actually, local people were just growing their own plants, it's normal. [...]

M – So the end of the conflict has also created a danger...

E – Yeah, a destructive yeah... *because 'the man' is in power again.*

(Personal communication, 14 November 2019; emphasis mine).¹¹⁰

This renewed interest in Colombia as a biodiversity hotspot reveals how research and collection strategies at RBG Kew can reconfigure a historical interest in bioprospecting once

¹⁰⁹ One such project is the 'Colombia Bio Programme' which aims at 'transforming the Colombian economy into one based on green growth by assisting the country to make sustainable use of its Natural Capital and rich biodiversity' (RBG Kew, n.d.).

¹¹⁰ Hannah Meszaros Martin (2018) offers an insightful analysis of coca plant criminalisation and violence against non-humans in Colombia through reading the War on Drugs as an 'ecocidal force'.

new areas become accessible. I am particularly interested in how the conflict has created a protective sphere in the sense of conservation, spatially and temporally. Having considered the temporal layers of vulnerability and resistance in banana wild relative conservation, I further analyse this complicated dynamic in how seed scientists at the MSB conceptualise their care in the following.

‘Kew is an organisation that cares’: Tensions of Care, Loss, and Hope

This section analyses how care is enacted and conceptualised at the MSB by focusing on the perspectives of practitioners, both as caring for the more-than-human and in relationships to partner organisations globally considering the colonial legacies discussed earlier in this chapter. It brings together identified overlapping vulnerabilities in how they affect the haptic labour of handling seeds as well as the affective and ethical dimensions of seed banking.



Fig. 4.7 The MSB dry room where seeds are kept on arrival. Photograph: the author, 2019

Upon arrival at the MSB, the banana wild relative seeds rest in the drying room until an ideal moisture content of below 5 percent is achieved (fig. 4.7). This process is called desiccation and some species do not tolerate it well. Water held within seeds damages and ruptures living tissues in the freezing process. Seeds are then manually sorted, cleaned, x-rayed, and counted before being deposited in the seed chamber in glass jars. The MSB's architecture was conceived to make these stages of care visible to visitors at Wakehurst. Approaching the building, to the left the atrium has large windows revealing the drying, cleaning, and x-raying laboratories as well as, to the right, scientists' workspaces who work on germination testing. Alongside the long-term infrastructure for seed storage underneath the atrium, bringing the public into close contact with the scientific work taking place at the MSB was a priority in the purpose-built construction. This arguably performative visibility of scientific work was difficult to adjust to for many scientists (Alex, personal communication, 13 November 2019).

A tenth of each collection is set aside for research purposes and routine germination testing and stored in small aluminium envelopes, before all deposits are transferred into the two subterranean seed chambers. Here, the seeds will be stored indefinitely (the chambers have been built with a 500-year lifespan (Eastwood et al., 2015)), until they are replaced when viability rates are too low, necessitating a new collection from the wild. Framed as a backup for primary collections held by partner organisations, the protocols for seed deposits at the MSB stipulate that they are held until they show signs of changing viability. The partner then sends new seeds, and the previous deposit is disposed of. For most wild seeds this viability time span is unknown since long-term storage for wild species is a new practice; for the banana wild relatives it is still being researched. Rowan told me that the banana wild relatives will probably prove to be *intermediate* seeds, somewhere between recalcitrant and orthodox in their long-term storage behaviour. Current deposits show that germination rates reduce after short storage periods, in line with a recent paper on banana wild relative storage behaviour (Bohra et al., 2020).

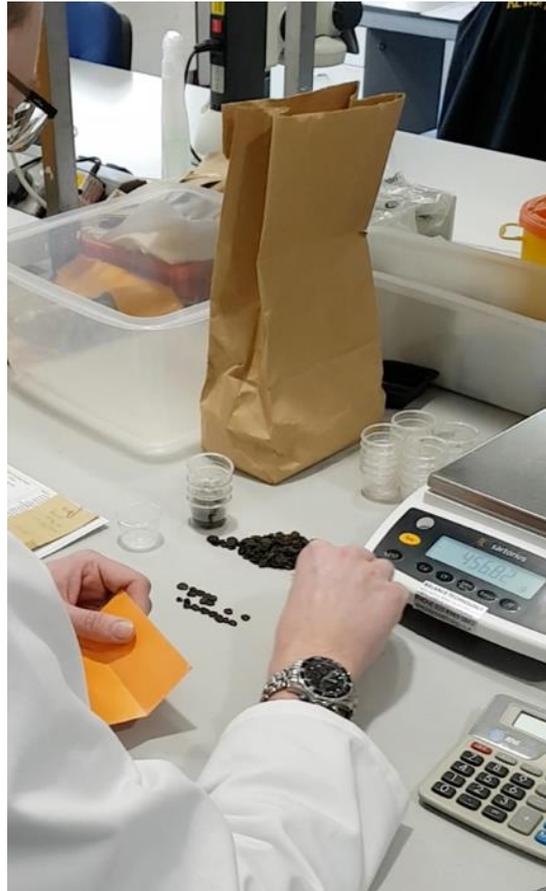


Fig. 4.8 Seed counting, weighing, and processing at the MSB. Photograph: the author, 2019

Passing through multiple human hands these stages reveal the haptic labour of care and body of knowledge that goes into seed banking after collection (fig. 4.8). This tactile dimension of seed banking in different stages of handling and processing was largely invisible in the previous chapter and will thus be observed more closely in the following in how seed scientists approach their subjects of care. Analysing how ‘bankable’ each species is (Morgan, personal communication, 14 November 2019) requires scientists to develop a more-than-human sensory sensitivity, echoing what Evelyn Fox Keller calls a ‘feeling for the organism’ (1983) in her discussion of cytogeneticist Barbara McClintock’s work on maize breeding. Keller describes how McClintock cultivated a slow, creative sensitivity for the plants she worked with in intimate observations and interactions and recognises the many forms of agency that emerge beyond seeing plants as passive subjects. According to Jay, a horticulturalist working with the banana wild relatives in the green house, through slow processes of care she has amassed a huge ‘body of knowledge’. This allows her to predict what

the needs of a certain plant might be regarding the ideal germination substrate, soil composition, and water and light conditions (Personal communication, 13 November 2019). Yet, she always expects surprising behaviours. As she walked me through the three greenhouses she described the different stories and research projects attached to the plants here, some of which have been abandoned after projects officially ended. The greenhouse is an exceptional space within the seedling incineration protocols at the MSB. The plant Jay was most attached to grew from a collection discovered in the National Archives in 2006, collected in South Africa approximately 220 years ago. Out of 32 species in this collection the seed bank managed to germinate three. One of them, a member of the *Proteaceae* family, has developed into a beautiful plant with furry leaves. Of this species, horticulturalists were only able to germinate one of the seeds from the parcel. Daws et al. (2007) suggest that these seeds were able to survive due to an oxygen-impermeable barrier in the seeds. Jay received ‘these rather precarious, no pressure, seedlings and potted them up without very much background information, [...] they were very old and possibly a bit damaged’ (Personal interview, 13 November, 2019). Jay’s understanding of the seeds as *precarious* and in the need of horticultural care makes tangible the pressures to be able to germinate the seeds stored in the MSB, and what is rarely considered at present, being able to keep seedlings alive after germination. Considering the divergent processes of becoming-with in each practice, this reveals how becoming-plant is currently not envisioned in the MSB’s care and seed circuits as plants rarely pass the seedling stage. Future plants are kept in their liminal seed state which they will only depart from if germinated and then incinerated, or if the partner organisation’s collection and the plants at the collection site in the wild have both been compromised. *Without this double loss of worlds seeds at the MSB will never become-plant.* This is a strange dependency for backup collections that function as insurances where the activation of one life rests on the disappearance of multiple others. I was struck following the banana wild relatives that at present there are no meaningful visions for the seeds to leave the chamber again, beyond being a record of genetic diversity for prebreeding programmes elsewhere.

Throughout the stay at the MSB I was often confronted with the affective toll of handling these seeds on practitioners working in seed conservation during an accelerating biodiversity crisis. While the public imagination of seed banking is hopeful and optimistic, I asked practitioners to what extent this hope animated them amidst both ecological and organisational vulnerability. The seed scientists I spoke to agreed that generally the ethical purpose of the MSB's work was undeniable for them; they seemed 'invested in a politics of 'the good'' (Singh, 2017, p.174). In the following I give space to some of their accounts of grappling with the purpose of their work at the MSB at length, because I suggest that these accounts are crucial for challenging the notion of 'banking' as a practice of mastery. Morgan summarised the ethical purpose of his work as follows:

When I think about the ethics of what we are doing I think it's very ethical. We're trying to preserve the plants of the world, I think, we are aiming to do something for the world, not just for us. It's not like a private company that's just preserving for its interest. We want to protect everything, from the tropics in the jungle, that I may not be interested in personally, to the oaks of my forest. I think that's highly ethical from that point of view. We want to help other people preserve all the plants because we think they have value. (Personal communication, 14 November 2019)

While agreeing with the importance of this ethical, hopeful purpose, Billy, who works as a partnership coordinator, emphasised the distinction between public storytelling and the negative toll of conservation in preserving life amidst habitat loss:

[At Kew] we're really good at highlighting the positives of the work that we do and the work that scientists are doing. I think as an organisation we do a quite good job of doing that. But as conservationists, I think, we do tend to focus on the negatives quite a bit.

I asked her if by that she means when the focus is not on public storytelling and fundraising but on a personal, emotional level.

Yeah, on our own. There is a lot to worry about, there is a lot. But I think we need to as an individual as a community, as a conservationist community we need to stop and smell the flowers. (Personal communication, 11 November 2019)

Erica also reflected on the loss of hope, and the necessity of feeding off hope in seed banking:

Hope is vital, it is everything. And I think most of the people here would feel that all the time we are doing something very useful. [...] Sometimes I definitely lose my hope, and that is creating a lot of problems in my work, because then I feel like whatever I do is going to be a tiny bit of... I will never catch up with everything basically. (Personal communication, 14 November 2019)

Building on earlier discussions of Puig de la Bellacasa's conceptualisation of care as transformative, noninnocent, and disruptive in chapter two what is evident in these accounts is that care in seed conservation is emotionally transformative for those directly involved. It ethico-politically constantly confronts with ecological vulnerability and loss. Becoming-with at the MSB is in this sense an *observing into disappearance*, not of genetic diversity but of ecologies. While many of the scientists I spoke to were aware of the already discussed limits of *ex situ* conservation (such as the loss of ecological relations and lack of capacity for regeneration) they had arrived at the pessimistic conclusion that at current levels of biodiversity and habitat loss *ex situ* conservation was the only practicable option. Jesse explained cyclical conversations on the problems with *ex situ* conservation, of storing wild biodiversity away and removing it from its habitat until it is needed or can be utilised to reanimate ecosystems:

Every so often you do come across, it goes in waves, 'why are we doing *ex situ*?' we need to just obviously conserve things *in situ*, 'isn't this just deflecting and deferring attention from what we need to achieve on the ground?'. But I think increasingly we are seeing in this biodiversity crisis, we can't just, I mean before we couldn't conserve everything on the ground and now we definitely... now that's just not happening. We need these insurance policies. (Personal communication, 18 August 2020)

What transpired in these personal, affective accounts is not the 'salvific ark paradigm' (Laboissière, 2019), the public performance of seed banking, but a self-questioning set of perspectives, aware of the limits of care. Care here is both a 'concrete work of maintenance' (Puig de la Bellacasa, 2017) and an ethico-political concern. It is a becoming-with into collective vulnerability, where *ex situ* conservation is not the perfect modernist technofix but a small delay amidst probable loss. There is a clear divergence between RBG Kew's public messaging of hope in biodiversity conservation and these individual accounts, which, as I will argue in the following sections, tell of a slow process of unlearning mastery from within. Tracing the overall research question of what each practice is saving their seeds for throughout these conversations, it becomes evident that practitioners were aware at the time that meaningful futures for seeds were absent in the bank. It is not a banking towards resilience but a genetic backup amidst the loss of worlds into genetic data. Erica described her fear of

the absence of meaningful futures for seeds as follows in a statement that both encapsulates challenges to anthropocentric urges to save seeds for the sake of continuity and against epistemic loss, and the lack of power to control the actual loss of habitats and ecosystems:

I think that seed banks are a second option because unfortunately the first option is not always available. But it won't make any sense if it's then not linked to *in situ* conservation again. We don't take seeds out just because we want to make crazy collections of saying 'I have, I have, I have...' and that will always be my fear, *I don't want to be in that role to just possess for my sense of science and my sake of knowing and knowledge and being human*. And again it comes back to humans – are the plants for the human or do the humans help the plants in return? If we take seeds out but not for us, it needs to be for them. And eventually for us as well, because if nature survives then we can survive, it's a basic condition. (Personal communication, 14 November 2019; emphasis mine)

This was a very important moment for my research project, and I could feel her frustration, realising that the banking protocols and futures for seeds break down for those involved in assembling the bank. Loss is understood as a shared, more-than-human vulnerability that humanity is relationally implicated in rather than something that 'we' can control and contain. I asked Erica, reflecting on the breadth of projects at the MSB that go beyond the bank as a space and the banking protocols as such, if the seed bank was too successful an image as a static solution, distracting from ongoing habitat loss.

Totally yes, if you think about it, even the word 'bank' is already something that is not very connected to nature at all, and it's very connected to people with money. It maybe helps to get this funding that comes from people with money who don't know anything about nature, so bank is kind of a nice word for them. And it sounds secure. (ibid.)

This gave me pause; it was the first moment when a conservationist reflected how strangely the word seed *banking* sits with the conservation of ecosystems, but how successful it is at connecting to models of financialising 'nature'. There lies a danger in this framing, and an exhaustion that comes with the responsibility for banking amidst dwindling resources. Throughout the conversations I had at the MSB practitioners often returned to this security as false, as wishful thinking, and Erica went on to reflect that the promised insurance (of the seeds as objects that can be activated with a spatio-temporal delay) is rhetorical:

But the reality is not like that, it's not going to be forever. These seeds eventually die anyway you know, we can just prolong that time, but not forever. That's a propaganda thing, but that's impossible. (ibid.)

Compared with the promise of the secure ‘forever perspective’ analysed in the previous chapter, the critical care I encountered at the MSB such as in Erica’s statement was self-reflective of its own limits and fragility. It was also aware of how translations of life forms into assets that can be stored and banked away are always incomplete. The following section builds on this by asking how the seed futures and ecological imaginaries contained in the MSB’s seed chambers can only meaningfully develop if RBG Kew reckons with its world making project and colonial ecological imaginary of the past.

Decolonising Kew: ‘Influence rather than power’?

Across the fourteen interviews I conducted at the MSB and RBG Kew more broadly there were moments when certain practices were termed as ‘colonial’ – those that were too controlling or revolved around a pure exporting of expertise, rather than an exchange of knowledges and a listening to the needs of partners. And there were moments of discomfort when I asked about how the ‘scientific authority’ laid out in the Science Strategy is practiced in partnerships. ‘Colonial’ is a word that was carefully used at the MSB, and when I brought up decolonisation in interviews respondents replied tentatively. I felt that, while the practitioners I spoke to at the MSB were clearly aware of Kew’s colonial legacy, there had not been a clear framework or platform for this history to be addressed, and to critically reflect on its possible continuance in current knowledge practices.

What could and could not be discussed openly suddenly changed when in June 2020 Alex Antonelli, RBG Kew’s Director of Science, released a statement in *The Conversation* which aligned Kew as sympathetic with the Black Lives Matter movement and protests taking place globally (Antonelli, 2020). In a way this statement could be read as a response to what Chacko critically asks in her reading of RBG Kew’s colonial legacy: ‘how would a deeply colonial institution such as Kew gain legitimacy and maintain functionality in a decolonizing world that was growing critical of extractive practices?’ (Chacko, 2019b, p.2). Kew’s silence on its historical roots had made some practitioners uncomfortable by implication in this silence. In *The Conversation* Antonelli stated:

For hundreds of years, rich countries in the north have exploited natural resources and human knowledge in the south. Colonial botanists would embark on dangerous expeditions in the name of science but were ultimately tasked with finding economically profitable plants. Much of Kew's work in the 19th century focused on the movement of such plants around the British Empire, which means we too have a legacy that is deeply rooted in colonialism. (Antonelli, 2020; n.p.)

What was astounding here was how Antonelli linked the extraction of natural resources to the maintenance of global inequalities in a reading of botany as an imperial science that mirrors eco-Marxist, postcolonial STS, and environmental histories of scientific mastery (Brockway, 1979; Grove, 1996; Schiebinger, 2007; Endersby, 2008; Moore, 2015), but from the perspective of the very organisation that has practiced this extraction. He went on to criticise taxonomical classification and nomenclature framed as the 'discovery' of species and the appropriation of indigenous knowledges. I began to wonder about the scale of the restructuring this statement would need to initiate across RBG Kew. It evoked a future-oriented sense of debt and a planned undoing of injustice to reconcile this past extraction. While I cannot go into the details of how this process might unfold at RBG Kew – in April 2022 the report with official recommendations has not been released yet – I highlight crucial moments of how this conversation has developed over the last two years and its wider cultural implications. Antonelli's statement was followed by the establishment of a *Decolonising Kew* working group in July 2020, which was in the process of defining how to approach this task holistically across the organisation, its collections, and practices when I spoke to Felix and Sophia, members of the working group. At the same time, I answered their questions about potential approaches to decolonisation and improvement of the seed bank.¹¹¹ The working group was well aware of and in conversation with the decolonisation debates that had emerged in recent years across a range of ethnographic museums and natural history archives, in particular the Pitt Rivers Museum in Oxford and the British Museum, the academic discourse

¹¹¹ RBG Kew is increasingly encouraging humanities scholars to engage with its work. A productive outcome of this engagement that reflects upon and challenges Kew's practice has, for instance, been Kay E. Lewis-Jones's 'Report and recommendations from an anthropology PhD on ecological perceptions and ethics in seed conservation' (2018a) which resulted from her research at the MSB and included recommendations for Kew's upcoming Science Strategy.

surrounding this (such as Bodenstein and Pagani, 2014; McCarthy, 2015 and more recently Hicks, 2021), and restitution debates occurring in France (Sarr and Savoy, 2018; Saxby, 2019).

When speaking to Felix and Sophia in August 2020, I asked how Kew's undoubtedly colonial history would be addressed publicly – currently it discussed carefully in relation to particular objects (Cornish, 2020) but it is hard to get a sense of the overall organisational position towards its colonial past – but Felix emphasised that while Kew's history was 'catnip' in the upcoming process and its mediatisation, it was much more about reconsidering organisational practice on all levels, past, present, and future. This focus on present and future organisational practice was important since to decolonise can never just mean to revisit the past. I suggest this would need to echo Subhandra Das and Miranda Lowe's suggestion for decolonising natural history collections in a first step 'to acknowledge the colonial past of natural history collections and to present the stories about the history of these collections' (2018, p.11). Felix elaborated that 'in all of this naturally the history of Kew underlies everything that we do today and obviously part of the decolonising logic is in order to do better now you need to understand where you're coming from. And what unconscious biases and practices that brings with it' (Personal communication, 4 August 2020). Felix emphasised that it was not about rewriting RBG Kew's history and changing databases and collections (some deal with historical materials from the nineteenth century, such as the Economic Botany collection, and by the nature of their historical context are often racist or otherwise offensive), but to add additional layers to these databases that contextualise and frame their contents as a 'service to source communities' (Personal communication, 4 August 2020).

The power of language is crucial across the decolonisation process.¹¹² A reframing of labour and knowledge dynamics – such as from 'capacity building' to 'skill sharing' – will be important in how 'scientific authority' and global custodianship are reconfigured in a botanical

¹¹² Max Liboiron's (2021a; 2021b) important work on methodologies for anti-colonial science practice is an insightful reference here. They point to the need to acknowledge land relations more clearly – such as the scientific reliance on accessing indigenous lands – and develop new approaches to describing and clarifying the terminology of colonial relations of dominance in scientific practice through reading colonialism as an *ongoing* set of relations, that is kept in place through frameworks such as 'equity' and 'inclusion'.

world imagined as collaborative and consensus-based. In line with this reframing of authority, ‘power’ was a term that my interviewees felt does not describe RBG Kew. Felix explained that, when he responded to a workshop participant who stated ‘Kew is a powerful organisation’ in a workshop just after the organisation escaped bankruptcy in 2014, he felt that RBG Kew is actually ‘a very fragile organisation’, and the focus needed to be on influence rather than power. Reflecting on this later, I wondered if ‘influence’ is not a more technical, softer framing of mastery, maybe not in material and financial terms, but for knowledge production and recognition. Yet, maybe influence is something to be earned, rather than to be taken, as Felix emphasised in a follow up exchange. Connecting to the wider discussions on vulnerability throughout this chapter I learned from this insightful conversation that RBG Kew was willing to acknowledge these vulnerabilities; a next step would be to address the structural power dynamics rooted in this influence still at the heart of its global network.¹¹³ This resonates with Azoulay’s argument in *Potential History* introduced in chapter two that to unlearn imperialism there needs to be an understanding of the ‘conflation of epistemological with ontological violence. The regime of the archive shapes a world, not just distorts the way it is perceived’ (2019, p.171). This needs to be understood alongside the formative violence of invasion, land-seizure, plantation labour and slavery, and imposition of industrial agriculture that seed banking is connected with more broadly here. It is in this sense that I want to suggest that RBG Kew’s imperial legacy still resurfaces in the present and co-constitutes its world –

¹¹³ This was also reflected in my conversation about colonial legacies and power in the present with two members working in communication departments:

Obviously, [Kew] comes from a history that is steeped in Empire and colonisation, and there’s no getting away from it. And we don’t deny that. But that is definitely the Kew from the past. It does not resemble what Kew is today. Kew is very collaborative. It is equal in pretty much all its partnerships. [...] We would absolutely promote the partners. They’re the experts that the expertise comes through. I mean, Kew is a global leader and I don’t think you can get around it [...]. I don’t think that comes with dominance as such. (Jasmine, personal communication, 30 January 2020)

It’s more that actually we are a collaborative organisation. Whatever your thoughts of how we got here, how we got our plants and how we got our artefacts in the economic botany collection. Aside from that, right now, I’m hoping that people actually are more open to seeing that if we don’t all collaborate and work together, no matter what your government background is, or what your political subject is, or who’s running your country, that if we don’t have these links. If something goes wrong, there’s no support. (Alex, personal communication, 13 November 2020)

its databases, living collections, taxonomical systems, and scientific priorities. Unlearning this is an important element of decolonising work. It requires, as Azoulay argues, a political ontology that engages with those who have been ignored in imperial taxonomies, a retrieving of ‘other modalities of sharing the world’ (2019, p. 26). This undoing of silencing is echoed in Das and Lowe’s discussion of the decolonisation of natural history collections. They emphasise that ‘the natural history knowledge from indigenous people from around the world, captured through colonial encounters needs to be more widely acknowledged for their impact on society’ (2018, p.12). This offers one modality of unlearning.

Throughout the conversation my interviewees brought up questions of control – an alternative term for mastery – twice, once regarding systems of classification and databases that Kew cannot control, and the second time when considering who ultimately has control in co-curation and displays that integrate the so far silenced voices of collaborators.¹¹⁴ I had the impression that this loosening of control was hard to grapple with in practical terms. This is a tension that also appeared in conversations at the MSB. Felix described one of the upcoming challenges as ‘how can we scale that up, if you’re doing decolonisation work that isn’t performative you have to ask quite hard practical questions about how to do things’ (Personal communication, 4 August 2020). He discussed the difficulties of taking the organisation along on this process, of listening to collaborators and staff members, rather than accentuating moments, of how to integrate a decolonising approach at the beginning of decision-making processes. I observed a sincerity in embracing the holistic approach to practice that was envisioned across the four strands of the decolonisation working group (History & Heritage, Collections & Data, Practice of Science and Public Engagement). The fundamental question that emerged from this initial conversation was ‘what does decolonisation mean for RBG Kew?’ Why now, and in reference to what? These questions reflect both what it means to take on the task of ‘decolonising’ in the UK in 2020 after the term has become ubiquitous across

¹¹⁴ Felix discussed how for instance it escapes RBG Kew’s control that there is not one universal global database for plant names – currently there are multiple databases with different views and histories.

universities and cultural institutions, and what it means specifically for RBG Kew in the face of the organisational vulnerability and fundamental shifts observed across this chapter.¹¹⁵

Exploring the meaning of decolonisation from a UK institutional perspective in *Decolonising the University* (2018), Bhabra et al. observe the contested nature of what ‘decolonising’ means, reflective of the many sites and experiences of colonisation and decolonisation over the last 500 years. Yet, ‘decolonising’ has become a shorthand for ‘fighting Eurocentric domination and lack of diversity’ (2018, p.1) in a move that somewhat distances it from the material return of dispossessed indigenous lands that would be the consequence of decolonisation if it wasn’t practiced metaphorically (Tuck and Yang, 2012) or (non)performatively, that is in a tokenistic sense.¹¹⁶ What Bhabra et al. observe as shared across decolonising practices is an insistence on plurality and positionality, and of taking difference seriously. The implications of this plural understanding will be important to note across RBG Kew’s botanical practice rooted in universal approaches to science. In its ‘Manifesto for Change’ released in March 2021, RBG Kew gave a first public indication of what decolonisation would mean for the organisation. The manifesto pledged that by 2030 Kew will:

Ensure the diverse countries and cultures that partner with RBG Kew and contribute to our collections are accurately and equitably represented. We will move quickly to ‘de-colonise’ our collections, re-examining them to acknowledge and address any exploitative or racist legacies, and develop new narratives around them. (RBG Kew, 2021a, p. 27)

Decolonisation for Kew is thus as much about representation in the present as it is about acknowledgement of colonial legacies through its *living* collections (and here lies a unique opportunity in Kew’s decolonising work); it is an interlinking of ideological and material practice that can challenge coloniality. The economic implications of this representational shift will be crucial to observe. The manifesto was met by right-wing accusations of Kew becoming ‘woke’ and unpatriotic (Parveen, 2021), reflective of the broader UK cultural climate

¹¹⁵ Mia Liyanage’s (2020) report on decolonisation debates within universities is insightful here in giving a sense of the UK’s decolonisation landscape at the same time.

¹¹⁶ Sarah Ahmed’s notion of non-performativity in relation to university speech acts on anti-racism makes an interesting distinction here – ‘non-performative’ speech acts “work” precisely by not bringing about the effects they name’ (2006, p.105).

of culture wars when public institutions declare that they will critically explore their histories. Revising this chapter in March 2022 I note that the Decolonisation Working Group has been renamed as History, Equity and Inclusion. Following governmental pressure on decolonisation debates at UK public institutions, in the above quote from the manifesto the reference to decolonisation in the online version of the statement has been removed:

We will move quickly to re-examine our collections to acknowledge and address any exploitative or racist legacies, and develop new narratives around them. (RBG Kew, 2021a, p.27)

This coincided with a report by the influential conservative think tank Policy Exchange in late 2021 that had challenged RBG Kew's legal standing in taking a position on decolonisation. The report claimed that 'politics has nothing to do with the science of plants and Kew has no business providing a platform for political views' (2021, p.12). Of course, much of this thesis has pointed to how the plant sciences and politics are historically and presently entangled, and how public institutions such as RBG Kew have been involved in the political movements of plants. Due to the ongoingness of the conversation on decolonisation at RBG Kew, and more recently this *un*-decolonisation, it is impossible to draw conclusions here, yet these developments show tensions in publicly taking on the intent to decolonise and grappling with charged political and institutional realities of doing so.

A critical challenge that also emerges here is how official intents to decolonise might re-centre powerful European institutions in reconfiguring geopolitics of knowledge. It is important to return to the MSB and its particular human-vegetal politics and ecological imaginary as somewhat distinct from RBG Kew at large to explore this problematic. Many of the ideals the decolonisation working group wanted to embed across RBG Kew were implemented at the MSB. One such example is the decentralisation of collections and a multi-sited approach. While the MSB building represents the centre node of the MSBP network, many partners, particularly in Latin America, choose not to store duplicate collections at the MSB but in country instead (Erica, personal communication, 13 November 2019). In its approach to partnerships the MSB has taken a diplomatic tone in terms of flexibility as to where duplicate collections are held, siding with partners if there are differences in

taxonomical opinions, and in general taking the partners seriously as the owners of botanical expertise when it comes to their local flora, trying to learn to take a supportive rather than authoritative role. Billy described the approach of working in partnership in the following way, which I suggest illuminates many of the tensions around purpose and authority the decolonisation working group addresses:

I tend to be the diplomat. The neutral party that everybody tries to go through. But if, you know, if one day they turn around and be like ‘we’re quite happy working with each other and we’re going to bank all our seeds to Georgia and vice versa.’ That would be a win. I mean I might not have a job anymore, but you know that would be the dream. I think it’s a dream for most conservationists, really, to not have a job and not be needed any more. [...] I think it’s just, we need to steer away from that sort of, pardon my French, but colonial thinking. We’re here when they need it, and we can suggest things that might work better but it’s up to them in the end. (Personal communication, 11 November 2019)

The power relations within the partnership were also addressed by Jesse when I asked her about scientific authority and the development of partnerships in the future towards a decentralisation of knowledge:

I think that actually the MSBP is a good showcase of actually working in partnership. I find sometimes Kew as an overall organisation has slightly mixed messages which are also like ‘you need to achieve this, then you should be telling the partners that this is what we’re doing’ and on the other side we can’t tell people what to do because we’re working in partnership. And I’d say that across the partnership we have always adopted the latter approach of being ‘oh okay we can’t tell them that because we’re working in partnership’, it’s a quid pro quo. We might be able to say ‘this is our interest, what’s your interest?’ and we might be able to come to an arrangement that will benefit both of us. That’s quite longwinded way of saying that I think actually the partnership model is a really *valuable demonstration of listening to others and providing what they need in order to resource what we’re trying to achieve*. (Personal communication, 18 August 2020; emphasis mine)

Jesse’s focus on listening resonated with the overall attempt to listen against mastery in a diversity of perspectives from practitioners throughout this chapter. I suggest what transpires in the accounts in this and the previous section is an understanding of collective vulnerability, both organisationally and ecologically, that only comes into collaborative preserving-with when previous notions of mastery and authority are challenged. This awareness of vulnerability came across in one-to-one conversations. It wasn’t something the organisation had officially made part of its practice. The MSB partnerships, through their practices of listening and collaboration principles, were in some ways already ahead of the decolonisation

debate across RBG Kew at large, and the shift that would need to take place to translate this into unmasterful language and organisational practice. In the following I explore how this individual unlearning of mastery in partnerships reckons with the uncontainability of vulnerability. A fundamental question here is, how can anti-colonial methodologies inform more-than-human scientific ethics and care, and vice versa?

The Limits of Containing Vulnerability: Undoing ‘Forever’

Listening against mastery from within the MSB undoes the ‘forever’ perspective associated with seed banking in the previous chapter through microbiological and ecological arguments, as I explore here. Connecting this to the decolonisation process I suggest that collective vulnerability shapes care at the MSB through a self-critical sensibility for how care for seeds implicates the becoming of their ecologies, or the impossibility of becoming in frozen states.



Fig. 4.9 *Musa itinerans*, the pink banana variety that was also deposited at the MSB in 2009. Photograph: Chris Cockel, 2017, reproduced with permission.

There is a particular deposit of banana wild relatives that has been the subject of cultural analyses both for its symbolic significance to the conservation community and to the MSB as an iconic project, as well as for its potential to tell stories across ‘nature/culture’ binaries and the harvesting of wild biodiversity as a resource for future cultivated resilience (Lewis-Jones, 2018b; Chacko, 2019b). *Musa itinerans*, the pink banana from Yunan in China

(fig. 4.9), was collected in 2007 and deposited at the MSB in 2009 in a ceremony that marked the 10 percent target of banked global plant biodiversity.¹¹⁷ These seeds are both a robust ‘investment in the future of banana breeding’ (Chacko, 2019b, p.1) and, as Lewis-Jones writes, ‘entwined with the fate of the global flora and have entered into a tale of human stewardship and hope’ (2018b, p.12).

But interestingly for the argument I seek to make, Rowan told me that this collection was not repeated and the partnership with the Kunming Institute of Botany, the Chinese organisation who collected the seeds, has since gone cold. I never found out why. While China is a source of diversity for bananas it has become increasingly difficult to receive materials. Rowan explained that this was the MSB’s first deposit of banana wild relative seeds, and a new collection of this specific species should have occurred by now. Especially given how hard banana seeds are to germinate. I was fascinated by this loose end: a species that was collected and celebrated in a public performance of reaching conservation targets now sits and slowly ages, because the partnership on which its future depends has dissolved. There is no meaningful way for the seeds to leave the bank now; the only reason they would be returned to China is if the original collection of the partners was damaged. This example of following the banana wild relatives into the bank – and getting stuck there – brings to the surface relationships and modes of care that cannot be contained and frozen. The ecological imaginaries of the liminal collections at the MSB are as much entangled in international conservation politics as they are carriers for hopeful biocultural stories of resilience and adaptation. It also shows how numerical conservation targets, such as the 10 percent benchmark, embody a more-than-human mastery where humans can grasp the totality of biodiversity numerically. The targets track a linear progress, rather than something that can potentially also be lost in the future. All this creates a flawed sense of security. Without the continuation of conservation partnerships banked seeds are still as vulnerable as before. Or

¹¹⁷ This is an interesting reminder of the significance of performative events for global seed-banking imaginaries of ‘the common good’. It evokes images of the Seed Depositing Ceremony at the SGSV discussed in the previous chapter. These moments make clear the felt need to translate conservation practice into numerical targets and performative milestones. Biodiversity as an ecological relation is translated into assets that can be counted, separated, and contained.

even more so: if *ex situ* conservation was prioritised, rather than practiced alongside conservation in the wild, these seeds are now disconnected from their ecology. Beyond ecological and organisational vulnerability, the banana wild relatives reveal an ‘un-collaborative’ vulnerability of broken-down partnerships.

This vignette makes visible the limits of seed banking that came across during conversations at the MSB; these are limits practitioners are acutely aware of and concerned by. What I heard was not a belief in seed banking as a forever solution but often deep frustrations with the mastery of vulnerability which the forever-imaginary promises, and concern for the recalcitrant and difficult species that fall through its gaps. In the following section I unpack four tensions from within the MSB that challenge its current conservation protocols, relationalities, and ecological imaginaries: (1) undoing of ‘forever’, (2) absence of seed futures, (3) loss of relations, and (4) centralisation of the collection.

First, in undoing ‘forever’ it became clear that wild biodiversity temporality cannot be controlled in as easy a manner as set out by the institutions of agri-science, which I explored in the previous chapter. At the MSB each species has its own viability rate. This redefines wild seed saving as a process that requires ‘constant ongoing collecting and refreshing [...] just because we’ve banked seeds once doesn’t mean they’re secure for the future’ (Billy, personal communication, 11 November 2019). Knowledge gaps about the wild seed storage behaviour and impacts on their viability are slowly filled as the collections are routinely tested; most species haven’t been suspended in long-term cryostorage before. The task for scientists has become to undermine the successful image of banking, to dissuade funders that the project is complete and the perfect insurance it seemed to be. It was an important realisation for my research project when Morgan described that microbiologically seeds never stop ageing in cold storage chambers. Minimal metabolic activity continues to take place and life cannot be paused:

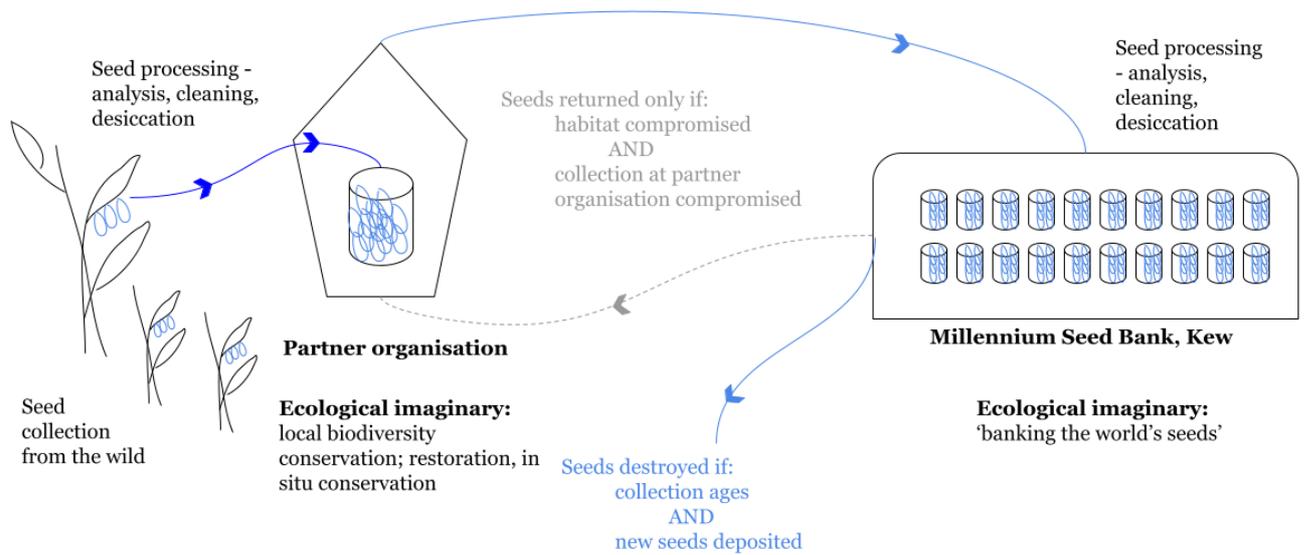
Yes, it’s already done, we have the species in the bank. But they age, they die, it’s not forever. I think people who manage the money, they think that when this was done, it was solved. But you need to invest on an ongoing basis. [...] I think what surprised me most over the years is that plant propagules, even if conserved in the ideal conditions, continue ageing over time. This idea of nothing is forever. [...] *We can’t stop time, we*

can't stop ageing, we can delay it. (Personal communication, 14 November 2019; emphasis mine)

Describing what exactly happens on the microbiological scale when seeds are frozen Morgan argued that even in cryogenic storage at minus 180°C in liquid nitrogen there is still cell activity within the seed, and some plants are more vulnerable to that:

Atoms, and chemical bonds between atoms still vibrate, rotate, and move, even at liquid nitrogen temperatures. Those molecular movements are enough to slowly make chemical reactions that lead to ageing. That's something we've discovered over the last ten years. For most species that you put into cryo it's so slow you can't detect it. But for some very short-lived species at room temperature, they also tend to be very short-lived in liquid nitrogen. [...]. They have chlorophyll, for some reason they last very short if you dry them in liquid nitrogen. We have detected complete ageing in less than ten years, that's a very short time. (ibid.)

Ten years does not amount to 'forever'. We sat thirty metres from the seed chambers when Morgan told me this, separated from the 'world's most biodiverse location' by a few walls. There was a slow realisation across the MSB that many of the seeds stored would not be viable by the time they are taken out. Currently around 16 percent of 78 collections analysed for longevity show a decline in germinability (Liu et al., 2020). As a genetic biodiversity insurance, the seeds are not used for restoration and end use is not designed into the banking protocols. I argue that while ecological vulnerability is kept at bay through temporal delay this vulnerability thaws and reappears along with the seeds should they ever leave the seed chambers. This describes a speculative 'one-size fits all' seed banking temporality (Jesse, personal interview, 18 August 2020) that according to multiple practitioners I spoke to urgently needs to be diversified. The cryopolitical paradigm – that life can be put on hold and reactivated when desired – challenged throughout my readings of seed saving practices, unravels here in the care for wild seeds from within the interiors of the seed bodies-



Diag. 4.1. Seed circuit at the MSB revealing the absence of futures for seeds: they are returned and cultivated only if their habitat and the partner collection are compromised. Illustration: the author, 2021

Second, building on how metabolic processes escape the banking temporality, what was criticised in conversations was how the seed banking protocols prioritise orthodox seeds, especially those that can easily be collected towards the numerical targets, rather than conservation systems for recalcitrant seeds. This is particularly true for many tropical tree species which do not have periods of seed dormancy (Morgan, personal communication, 14 November 2019). While I do not want to go as far as arguing that this tension implies a cryopolitical Eurocentric bias in how conservation technologies have been designed I suggest that it reveals a strategic, bureaucratic prioritisation of preserving certain life forms. Robin, a seed biologist working on Natural Capital approaches to diversity and livelihoods, imagined that rather than thinking of a seed bank as consisting of one banking protocol applied to all species instead the flows in and out of the seed chamber need to respond to end uses:

I think we have to be very careful about the message we give, because it should always be clear that seed banking *per se* doesn't work. It should always be to support integration with *in situ* conservation. [...] It should be more open to the kinds of collaboration that are not just for conservation, but for the final use of that collection [...] as I was saying before not just one seed bank, but multiple seed banks in one building. [...] In the seed bank there should also be a lot of research, we can't just store, the seed bank should also include instructions for the use of materials that we are storing. (Personal communication, 7 November 2019)

At the heart of the MSB's imaginary there seems to be a lack of vision for reconnecting seeds with their worlds. This describes a structural and bureaucratic liminality, rather than organic and metabolic. Wild seed conservation protocols specify collection, drying and storage techniques, but not the pathways for seeds to be ushered out of the bank (diag. 4.1). Across the conversations there was a sense of urgency in addressing the use of seeds while the vision as to what the seed bank is actually banking *for*, its ecological imaginary, remains vague.

The need to consider how seeds re-enter their worlds from liminal states, and how exit protocols need to be built into conservation designs raises a third tension. The difference between the conservation of species and the conservation of ecological relations necessary for that species' survival makes tangible how vulnerability escapes seed banking infrastructures. While the MSB's primary goal is clearly the conservation of genetic diversity, the diversity of relations on an eco-systemic level cannot be contained in current protocols. Robin suggested that current seed treatments imply that certain microorganisms are frozen alongside the seeds. However, what could be more productive is storing seeds in community constellations, especially for restoration projects.¹¹⁸ Erica also emphasised the loss of ecosystems once seeds might exit the banks:

What we really have to focus on is to use these seeds much, much quicker, before it's too late. That cataclysm that eventually will happen and then we have all these seeds, then those seeds won't be useful at all, because they won't have the conditions to grow. [...] the plant on its own is not able to survive. It needs biotic and abiotic factors. (Personal communication, 13 November 2019)

In Erica's statement I heard that practitioners were ultimately aware of how relationality escapes the seed bank, how it is disruptive to ecological continuance, and how without preserving relations these seeds will struggle in the post-apocalyptic imaginary associated with saving seeds 'forever', or until they are needed. Echoing earlier considerations on the continuance of masterful practice, the absence of relationality in the banking protocols points to blind spots in the ecological imaginaries that echo an extractive, colonial taxonomical logic focused on individual species, their classification and distinct genetic makeup, rather than

¹¹⁸ Robin described the approach a previous partner organisation took. They stored seeds not according to individual species but in 'community lots' that consisted of a range of species found in a certain habitat.

relational and communicative complexity. Jesse complicated this further by highlighting that the current approach to 'species conservation' does not focus enough on intraspecies genetic diversity. If a species has already been deposited from one country, it cannot be deposited by a different country, assumably to prioritise percentage targets of species in total, even though multiple collections from the same species are recommended from a conservation perspective. Maximal diversity across species is currently to the detriment of diversity within species. When seeds become proxies, as discussed in the previous chapter, part of their species complexity will always be lost.

Lastly, there is a spatio-temporal divergence at the centre of the MSB's conservation promise. Multiple interviewees described visions for futures of the MSBP that were less focused on the building as a centre node of the network (Robin, Erica and Morgan, personal communication, 2019). Rather, a more dispersed approach with regional conservation hubs could respond better to a world of dwindling financial resources at the MSB and with partners who feel concerned about sharing materials internationally. This supports calls throughout this chapter to focus more on flows and dispersal in the seed bank's practice rather than paternalistic containment.

Cryosphere: Beyond a Liminal More-than-Human Politics

In this last section I consider the vulnerable world-making project at the heart of the seed bank on the basis of potential futures – material and epistemic – imagined from within. Having found the MSB a self-critical practice of mastery faced with multiple slow re-configurations, I discovered ecological imaginaries that move beyond the limits of seed banking. Concluding the attempted listening against mastery, I reflect on the more-than-human politics and ethics emerging at the MSB and suggest how these findings provide new insights to theoretical reflections on vulnerability.

On one of my last days at the MSB Rowan was packaging up banana wild relative seeds to be sent to the International Musa Transit Centre in Leuven, Belgium. The centre received a small package of 100 seeds and is expected to plant them out to create a larger number of

seeds. The MSB will keep a duplicate collection in its seed chambers for the foreseeable future as with the *Musa itinerans* deposit in 2009. Having lent its expertise in the collection and preservation of wild species to the Crop Wild Relatives project the next stage in harvesting this wild data of agricultural resilience is up to prebreeding programmes in agro-scientific processes while the banana wild relative habitats continue to disappear.

This leads me back to my overall research question across the ecology of practices analysed in this thesis: what is the MSB saving (for)? Looking to the futures for seeds that it holds beyond the material collection, and in relation to the homogenous vision performed by the SGSV in the previous chapter, I was struck by the practitioners' wishes to refocus current banking protocols and urges towards a more holistic and pluralistic approach to seed saving. I want to describe this as an emergent *unmasterful more-than-human conservation ethics*. This includes paying closer attention to the gaps (such as recalcitrant species, seeds not exiting the banks, capacity for processing future collections) and contextualising *ex situ* conservation within larger conservation projects and restoration ecologies. In different accounts I noticed a sensitivity towards moving away from framing seeds as 'genetic resources' and assets to an interest in systemic, relational conservation.

There was a stasis to the ecological imaginary the MSB currently assembles. I want to highlight a proposal for an MSB ecological imaginary, the *Cryosphere*, that challenges the 'one-size-fits-all' liminality in the seed chambers. The *Cryosphere* project is an extreme example of slowing down life, that envisions a preservation and capacity-building project with a cross-departmental approach moving beyond seeds to include fern spores, fungi, and plant propagules, but also inclusive to recalcitrant seeds, soil microbiota, and mycorrhizal fungi. Preservation would focus on cryogenic storage, working with liquid nitrogen at temperatures of minus 180°C. It proposes a mode of highly technical continuance where freezing can take into consideration relationality and atypical desiccation behaviour.

Most recalcitrant seeds that will require cryogenic freezing in liquid nitrogen are tropical, and as Morgan told me, 'the best way of doing banking of these species is *in situ*, rather than huge buildings and hundreds of technicians' (Personal communication, 14

November 2019), allowing local organisations in biodiversity-rich countries to do their own cryogenic storage. In this way the *Cryosphere* as a living collection could locally compliment *in situ* conservation rather than relying on the remote banking infrastructures of the MSB, or the SGSV. It is a vision for small and distributed frozen ecologies that remain close to the ecosystems they were detached from, a ‘technoecology’ (Lorenz-Meyer et. al., 2017). Here, the criticisms often applied to *ex situ* could be softened a little in conceiving *in situ* and *ex situ* worlds as part of the same ‘sphere’. It wouldn’t be what Deborah Rose Bird describes in *Zone of the Incomplete* as a device to ‘kick-start time and life again’ (2017, p.152) as explored in the previous chapter but the continuous attachment of a frozen ‘sphere’ to threatened ecosystems. This would shift focus on small interventions, in line with organisational and structural capacities for care. As has become apparent throughout this chapter, currently seeds are not just slowly ageing in artificial dormancy, but organisational infrastructures increasingly struggle to cope with centralised banking on the scale of global care. In relation to the cryosphere as the naturally frozen ecology of Arctic life explored in the previous chapter, RBG Kew’s *Cryosphere* would create a frozen conservation zone in close contact, spatially and temporally, with its life worlds. Considering alternative ecological imaginaries for collections at the MSB a recent review suggested that while wild-species seed banks are not suitable for large-scale restoration projects unless collections are made with this purpose from the outset (a frequent criticism), seed banks such as the MSB must ‘close the gap between seed ecology and seed banking for wild-origin collections, especially in relation to seed storage behavior and suitable measures to conserve short-lived and recalcitrant seeds’ (Liu et al., 2020, p.2926).

Reading the MSB as a vulnerable world-making practice I consider its epistemological futures here, connecting to the decolonisation process and reconfiguration of scientific authority discussed earlier in this chapter, and discussions on vulnerability throughout this thesis. I reiterate Azoulay’s criticisms of ‘neutral technologies’ of archiving carrying imperial power formations that conflate epistemological and ontological control. Unlearning or decolonising in this context therefore also means reframing the epistemic authority and soft

power embedded in RBG Kew's *curating*, its care, and its species prioritisation. Reading the MSB in this way has also revealed the emergence of a reverse dependency rather than scientific authority: a dependency on its partners in trusting the MSB to look after their plant materials. It is in this sense a collaboration born out of collective vulnerability, that reconfigures RBG Kew not as a scientific authority but a co-dependent actor in a global network of care that is responding to rapid biodiversity loss.

I suggest that this vulnerable reading of the MSB adds to the framing of vulnerability in the previous chapter: an understanding of vulnerability that is *ecological and relational*, an ethics of *preserving-with*. It reflects Tsing's biosocial understanding of precarity as 'the condition of being vulnerable to others' in an indeterminate world that is constantly shifting, a 'world without teleology' (Tsing, 2015, p.20). Here, relational vulnerability speaks to an 'ethical stance' (Puig de la Bellacasa, 2017) in practitioners reflecting on organisational vulnerability, relations of knowledge production, and affective impacts of working against loss. I was struck that multiple practitioners felt that RBG Kew should be using its advocacy ability more in environmental politics, rather than scientific political neutrality. There was a shared sentiment in considering the MSB's world-making practice that suggested conservation ethics should respond to collective vulnerability rather than anthropocentric framings. Morgan emphasised how this co-implication should also extend across borders and frameworks of national sovereignty to put the species at the centre of care in conservation. This puts human and scientific knowledge in the service of species in their struggles for collaborative survival, rather than positioning 'the human' as a heroic actor or saviour for the 'common good' that can claim ownership of knowledges and plant materials. Practitioners perceived the holding and withholding of seeds as being in limbo together, at the service of nonhuman life, rather than as mastery.

Conclusion

This chapter has shifted from the epistemic community of genetic resources to ‘wild’ biodiversity conservation. Perspectives from practitioners at the MSB have revealed that *there is no outside of vulnerability* here; rather than something to be mastered it affects knowledge practices, partners, and more-than-human subjects of care – not necessarily equally but holistically. From this realisation I sought proposals for *preserving-with* otherwise – through abandoning numerical targets and the ‘forever perspective’, and being more inclusive towards difficult species and the futures envisioned for seeds. This listening to perspectives from within the MSB, and wider decolonisation processes across RBG Kew, has challenged the spatio-temporal organisation of standard seed banking protocols, revealed the affective impact of internalised loss and erosion of life worlds on practitioners, and shown how through following the banana wild relatives as a carrier seed the absence of meaningful futures for seeds beyond their genetic afterlife becomes evident. What is striking here is the relative absence of an ecological imaginary, but also an urgency from the perspective of practitioners to address this.

The practitioners across this chapter demonstrated that divergent perspectives exist within and against cryopolitical care and that mastery of life is challenged ethically and epistemologically. This is not a story of techno-heroic progress, but of ‘collaborative survival’ (Tsing, 2015) and resistance to banking for the sake of genetic backups. It is told by those responsible for the scientific care – its tactile, embodied, and relational aspects – for seeds and their becomings where anti-colonial methods and more-than-human scientific ethics start to inform each other. While the previous chapter has shown that the SGSV is in a constant paradoxical process of *becoming-safe*, of mastering fortification and manifesting control over its collections, the vulnerable close listening to practitioners here has allowed me to discuss how *preserving-with* as an epistemic and ecological becoming challenges masterful world-making from within. Preserving-with at the MSB may open seed saving relationalities “beyond” mastery, not in the sense of exceeding it but in the sense of *surviving* it’ (Singh,

2017, p.24; italics in the original). It hints at the possibility of a decolonial ‘new geopolitics of knowledge’ (Bhambra, 2014) in conservation practices.

As is the case in processes of unlearning and decolonising, reckoning with the ontological and epistemic violence at the historical foundation of some practices necessitates their acknowledgement. Returning to the nocturnal image of the MSB greenhouse and the banana wild relative plants pushing against the glass ceiling, I wondered what human-plant-relations are unable to access the spaces, partnerships, and conservation futures of the MSB. The following chapter on seed saving practices in Palestine responds to this question and shifts this debate from global care to more-than-human sovereignty and resilience. Resilience here is a collaborative resistance to being made vulnerable, rather than a harvesting of ‘wild resilience’ as encountered in the Crop Wild Relatives project. My analysis has moved from the cryo-security vision at the SGSV to vulnerable and embodied scientific care at the MSB to now observe agro-political cultivation and ingestion practices and biocultural histories ‘on the ground’, amidst conflict, in the third empirical chapter.

Chapter Five

Persisting with Radical Care: More-than-Human Worldly Sovereignty in a Palestinian Seed Saving Practice

Introduction

When I arrived at the seed bank of the Union of Agricultural Work Committees (UAWC) on the outskirts of Hebron in the Palestinian West Bank in July 2019 the large storage containers in the seed bank were almost empty.¹¹⁹ This marked a stark contrast to the seed banking practices I had observed so far in their accumulation of genetic data and resources. With the end of the summer season the containers of *ba'al* seeds – the Arabic vernacular for indigenous ‘rainfed’ seeds – would fill up once seeds were collected from the farmers responsible for reproducing them.¹²⁰ They were then distributed to beneficiaries of the seed bank planning to cultivate them. I learned over the coming weeks – in conversations with agronomists, farmers, and ecologists – that seed conservation here, in the context of anti-colonial struggles for food sovereignty, is less about cryopolitical genetic backups and insurances. It is about more-than-

¹¹⁹ I visited agroecological initiatives in the West Bank for three weeks in July 2019 including a one week at stay at UAWC’s seed bank. I conducted conversations with UAWC’s seed bank staff in English. Sami, Nadia, and Dina kindly translated conversations with farmers and seed bank beneficiaries. As in other chapters all participants have been given pseudonyms. To reflect different perspectives on the human-vegetal ecologies across Israel-Palestine I also reached out to the Israel Plant Gene Bank but did not receive a response.

¹²⁰ Agroecologist Omar Tesdell describes the specific qualities of ‘rainfed’ *ba'al* seeds in his doctoral thesis on questions of territory and sovereignty in Palestinian cultivation as follows:

Rainfed production is a suite of planting, tillage, and plant protection strategies that exploits soil moisture for growing crops without irrigation. It also uses water catchment strategies like cisterns to collect water during the rainy season for watering crops in dry months. Rainfed production has been the basis of agriculture in Palestine for generations owing to the dearth of freshwater, and as such developed through highly sophisticated and localized practices of cultivation. (2013, pp. 114-115)

He gives an interesting etymological definition of *ba'al*:

Palestinians use the term *bali* or *baal* as an adjective to describe fields, crops, or fruits that rely only on rain and dew for water. It is believed to be a reference to the Canaanite title for master god Baal, who was associated with Hadad, the Canaanite god of rain and agriculture. The word remains in common usage today. (2013, p.126)

human persistence in a settler-colonial sphere where lines of occupation can shift overnight.¹²¹ Despite the pressures of the occupation and harsh climates in the West Bank rainfed seeds *persist*. I will explore this vegetal persistence through the biological concept of phenotypic plasticity, which describes changes in an organism's behaviour in response to its environment.

The MSB and the SGSV, the previously discussed spaces of global care, remain inaccessible for UAWC's seed bank in the absence of governmental support, Palestinian statehood, and specific markers of 'scientific practice'. Strikingly, the university of Haifa in Israel was a first-time depositor at the SGSV when I attended the ceremony in Svalbard in February 2020 described in chapter three. It deposited seeds from across Israel-Palestine.¹²² Confronted with these deposits by Israeli institutions, the Palestinian agronomists and seed conservationists I spoke to felt the necessity to work towards a deposit of Palestinian seeds in order to not have their more-than-human histories erased in global collections of biodiversity. In this chapter I challenge the considerations of ecological and organisational vulnerability in the politically neutral projects of *global care* at the MSB and SGSV, to situate seeds in relation to land, and move from vulnerability to persistence.

¹²¹ Israeli settlements across the West Bank are illegal according to international law (Lein, 2002), which is why I refer to the 'occupation' in the following. In summer 2020, then Israeli prime minister Benjamin Netanyahu stated that 'there is no change to my plan to extend sovereignty, our sovereignty in Judea and Samaria' (Al Jazeera, 13 August 2020) referring to annexation plans for large parts of the West Bank, in particular the Jordan valley, that were revealed in 2019.

¹²² For the Wild Cereal Genebank (ICGB) at the university of Haifa the deposit included wild emmer wheat which was discovered by Aaron Aaronson in 1906. The collection by Aaronson is also subject of Omar Tesdell's article 'Wild wheat to productive drylands: Global scientific practice and the agroecological remaking of Palestine' (2017) where he argues that agro-scientific research into wheat and its wild relatives was crucial for framing Palestine as in need of colonisation and scientific improvement.



Fig. 5.1. A rainfed terrace outside of Hebron overlooking the open sewage wastewater channel from the settlement on the opposite hill, what I will refer to as a ‘border ecology’. Photograph: the author, July 2019

Developing the interaction of anti-colonial methods and more-than-human scientific ethics that the previous chapter arrived at, I specifically observe the role of conflict in the protection of and threat to biocultural diversity. The instrumentalisation and vegetal agency of seeds in political and environmental conflicts surrounding *border ecologies* – ecological entanglements that cross the borders of nation states (fig. 5.1) – are at the centre of this chapter and the following chapter on forest conservation in Poland.¹²³ I continue to draw on the work of Julietta Singh, her reading against mastery and critique of ‘masterful’ submissions of the subjects of care explored in chapters two and four, and Ariella Aïsha Azoulay, in particular her concept of ‘worldly sovereignty’ as a practice of remaining in the world through localised and embodied forms of sovereignty where national sovereignty is denied. Palestinian agroecologist Omar Tesdell’s (2013, 2015, 2017, and with Othman and Alkhoury, 2019) detailed and relational analyses of territoriality and persistence in rainfed agriculture are

¹²³ ‘Borders’ here are multiple. For one, they refer to the contested zones of sovereignty across Israel-Palestine. Wendy Brown’s (2010) discussion of the spatially overlapping claims to sovereignty in Israel-Palestine through strategies of domination, separation, and enclosure is insightful here. The ecological complexities of border spaces have been discussed with a political ecology framework by Núñez-Mchiri (2009) for the US-Mexican border and Rossiter (2011). Yet borders also refer to the blurry lines of epistemic objects of conservation between ‘wild’ and ‘cultivated’ as well as ‘invasive’ and ‘native’ across this chapter.

important throughout this chapter for considering seed saving in relation to land as place-based, adaptive, and political.



Figs. 5.2.–5.3. The threatened white cucumber and its seeds. Photographs: the author, 2019

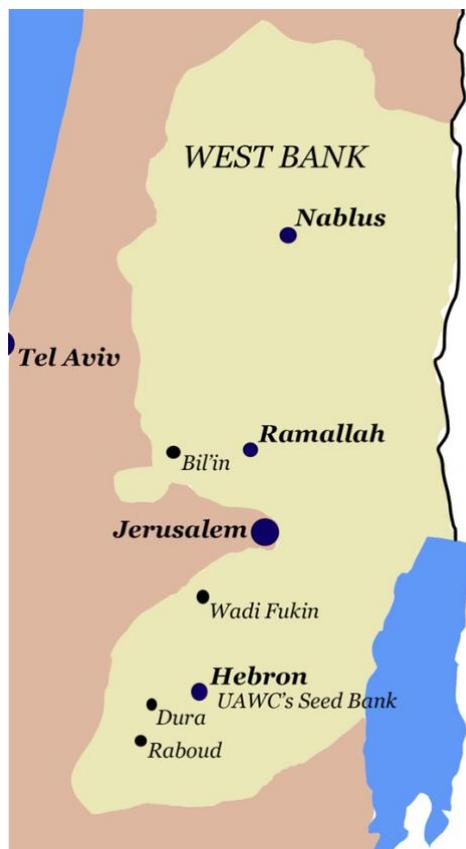


Fig. 5.4. Map of the Palestinian West Bank with locations marked that I refer to throughout this chapter. Map: the author, 2022.

As the carrier seed, I follow a threatened white cucumber, *Cucumis sativus L*, a rainfed variety, to work towards describing UAWC's seed banking as a relation of *persisting-with*. My approach to UAWC's seed banking practice sought to follow the plants, to see how the distribution of seeds responds to the territorial conflict and how farmers take solace from seeds. The plants I encountered endured in challenging landscapes, from gigantic serpent cucumbers – on a reproduction field for the purpose of generating seeds that had not seen rain or artificial irrigation in months – to fig trees in Wadi Fukin which function as sun shelter and collective meeting spaces (fig. 5.4 gives a map of locations referred to in this chapter). Plants were carriers of dignity, witnesses to displacement and loss, and collaborators for re-rooting belonging. This *persisting-with* is a collaborative becoming amidst the pressures of a militarised, contaminated environment at the fringes of settlements, artificial water scarcity, harassment against plants and humans, and aggressive agro-capitalism. What emerges is an unmasterful ecological imaginary of *more-than-human worldly sovereignty* where plants are turned to and ingested as carriers of persistence, heritage, and futurity in a hostile environment. Through the labour of care and the plants' deep-reaching roots I will propose this practice of persistence as an act of *radical care*, that is grounded and embodied.

Methodological Adaptations

In the vulnerable listening practiced in the previous chapter I was attentive to moments that defy mastery, as a rupturing of the object in Singh's understanding, in the MSB's seed saving practice. However, the power relations and slow violence (Nixon, 2011) surrounding the occupation of the West Bank call for a different empirical position, as an observer/witness who can *make visible* and amplify. I have sought a perspective where my access to and mediation of UAWC's seed banking could offer visibility to struggles for sovereignty, recognition, and more-than-human survival. There was a palpable excitement from the practitioners I met in being able to share the challenges they faced and UAWC staff were keen to have their work recognised as a case study in an international research project.

Reflecting on moments when farmers shared the perpetual pressures, critical colonial studies scholar Ann Laura Stoler's argument in *Duress: Imperial Durabilities in our Times* (2016) was helpful in situating this chapter. She suggests postcolonial studies has often shied away from Palestine's exceptional present. It was long a difficult subject, a political conflict rather than scholarly territory as such, and Stoler makes a convincing case for the importance of such scholarship in the present. Seed banking becomes explicitly political in this chapter with its focus on land relations where practices in the previous chapters had sought to create a focus on the ethical 'common good' of preserving the totality of global seeds for humankind. For me, witnessing moments of harassment, destruction, and contamination – as well as the precarious cultivation on the fringes of settlements – fuelled a cyclical negotiating process between personal empathy and supposed academic distance. There was also the specific power dynamic of moving through Palestine's militarised spaces relatively easily as a white European researcher, passing as a tourist. I visited the West Bank in the summer of 2019. The ongoing Covid-19 pandemic made a second visit unimaginable, and I have since conducted follow up interviews virtually. In writing this chapter I am left with a feeling that I can only hint at some of the complexities at stake in Israel-Palestine. Negotiating these complexities I was aided by seminal Palestinian writers such as cultural theorist Edward Said (1978 and 1992) and poet Mahmoud Darwish, as well as anti-colonial figures such as Frantz Fanon who is often invoked in the Palestinian context, and a range of recent scholarship critical of Israel's legal, racial, and territorial politics (for instance Gregory, 2005; Shoshan, 2010; Weizman, 2015; Stoler, 2016; Bhandar, 2018, and Azoulay, 2019). These scholars employ methods ranging from archival analysis, agroecological science, forensic visual analysis, and critical colonial studies. While they analyse the legal and territorial apparatus and mechanics of the Israeli government's land politics and legal instruments in great depth, I will contribute more specifically to discussions of Palestinian strategies of resistance (Azoulay, 2019), and in particular through human-vegetal persistence (Teddell, 2013 and 2017).

In the previous two chapters I have sought to trace the relations between seed collections and the eroding life worlds around them, what is stabilised and what escapes

stabilisation. The ecological imaginary of a stable and containable ‘world’ was crucial to my critique of these projects of saving in revealing what they failed to contain. It has become evident across these chapters in how diversity is valued and shared (or not) that these worlds are for and foremost genetic rather than relational. Amidst the multiple crises and threats that seed saving in this chapter responds to, the concept of the ‘world’, grounded in the use of ‘world-making’ in feminist science studies (such as the notions of ‘world’ in Haraway, 2008, and Puig de la Bellacasa, 2012 and 2017) and anthropology (Tsing, 2015; de la Cadena and Blaser 2018) is in many ways too comfortable and containable. It is centred around a whole that is both temporal and spatial, as well as epistemic and experiential. I will argue that for the Palestinian context this temporal and spatial whole has long been contested and threatened with erasure since the Nakba, the expulsion of Palestinians following the creation of the state of Israel in 1948. Yet, I do not want to get rid of the ‘world’ entirely but ask: what kind of resistant worlding occurs in the contested spaces of Palestine? In particular the state of being ‘worldly’ in Haraway’s understanding resonates here – a sensing, listening, and responding, rather than mastering (Haraway, 2008); a form of alliance with nonhuman others. Haraway asks ‘how is “becoming with” a practice of becoming *worldly*?’ (2008, p.3, italics mine), of more-than-human alliances, communication, and expression that engage with the noninnocent complexity and messiness of the world. It is only through reliance on and *learning from* plants and soils that seed and food sovereignty can manifest across generations in a way that is mindful not only to the protection of shared knowledges but also to the land.

Building on Azoulay’s proposal for *unlearning* as a political ontology that centres those who have been silenced by imperial practices (as outlined in the chapters two), I focus here on Azoulay’s argument around worldly sovereignty and imperial sovereignty. Her understanding of sovereignty goes beyond the territorial borders of a sovereign state – it is shaped by the inhabitants of a shared world in a rejection of statehood as a premise for sovereignty. This detaching of sovereignty from the nation state is crucial for the Palestinian context. She argues *imperial sovereignty* is a technology of mastery, extractive and exploitative, which dismisses

other formations of sovereignty. In opposition to this Azoulay defines *worldly sovereignty* as the

persisting and repressed forms and formations of being in the world, shaped by and through intimate knowledge of the world and its secrets, of multiple natural, spiritual, political and cosmological taxonomies transmitted over generations and shared among those entitled and invested to protect them. (Azoulay, 2019, p.388)

She goes on to suggest that ‘worldly sovereignty’ is grounded in

recognition and respect of the land’s needs, of the knowledge of the land, assiduously transmitted across generations, and of the limitations that this knowledge imposes on one of the major weapons of imperial sovereignty – the commanding power of growth for growth’s sake’ (p.389; italics mine).

While Azoulay does not explicitly consider the more-than-human in these formations of being in the world and knowing the land, this is central to my exploration of *more-than-human* worldly sovereignty. The following reading of UAWC’s seed banking practices shows how Azoulay’s concept can be productively expanded to reflect relations with the more-than-human as active participants and fundamental collaborators in worldly sovereignty.

UAWC’s Seed Bank





Figs. 5.5.–5.7. Storage containers in UAWC's seed bank (5.5.); the plant reproduction unit (5.6.), and UAWC seed analysis unit (5.7.). Photographs: the author, 2019

This section outlines the activities of UAWC's seed bank, its scientific research and project of preserving biocultural heritage. I contextualise the significant ways the Israel-Palestine conflict affects seed saving at UAWC's seed bank, and is, in many ways, the reason the seed bank exists. UAWC, a seed, food, and land sovereignty NGO, is highly dependent on international supporters and governmental aid organisations. The goal of the seed bank is, as Leila, the seed bank project manager, explained shortly after I arrived, to 'document, preserve and protect local seeds' (Personal communication, 21 July 2019). She described UAWC, the seed bank's umbrella organisation, which was established in 1986 by volunteer agronomists, as an 'agricultural NGO that works with water, land, and seeds' (ibid.). This threefold relation between seed, water, and land remained at the heart of my stay which involved exploring the seed bank's facilities, its reproduction and research fields, as well as speaking to its beneficiaries and collaborators. The seed bank at UAWC's office in Hebron was established in 2010 and only collects the aforementioned *ba'al* seeds, indigenous rainfed seeds that can survive without artificial irrigation. At the time of my visit the seed bank team consisted of seven members, most of whom I accompanied on visits to farmers, reproduction units, community organised cooperatives, seed extractions, and land reclamation sites. The core seed bank team were Leila, Nadia, Sami, Hassan, and Dina (all names have been changed for anonymity) whose roles ranged from seed bank project manager to land reclamation coordinator and student assistants.

At the time of writing in November 2020, the seed bank held forty crops from eleven plant families including onion, okra, cucumber, carrot, radish, and turnip. It was starting to collect the seeds of indigenous medicinal plants and crop wild relatives. There is no commercial seed company for indigenous Palestinian seeds, therefore access can be difficult and relies on informal exchanges between farmers.¹²⁴ UAWC's seed bank curation is sensitive to vegetable seeds that have the most direct impact on food sovereignty and local variations

¹²⁴ A project that encourages this kind of exchange is the Palestine Heirloom Seed Library by artist and anthropologist Vivien Sansour based in the village of Battir. It seeks to preserve traditional farming practices, knowledges, and the stories carried by seeds (Sansour, n.d.).

within varieties between different regions of the West Bank. This emphasises the importance of unique local adaptations in intra-species varieties.¹²⁵

Ba'al seeds are fundamental to UAWC's mission to work towards food sovereignty since artificial irrigation is often not possible with limited freshwater resources, legal restrictions on the collection of rainwater, and groundwater appropriation by the Israeli government (Assaf, 2010).

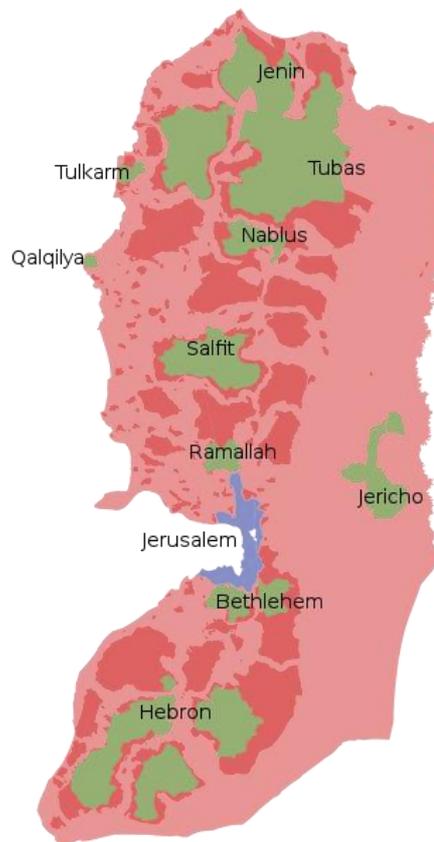


Fig. 5.8. Administrative division of the West Bank according to the Oslo II Accord; in green is Area A, dark red is Area B and pastel red is Area C. Image: Wikimedia, Creative Commons license CC BY-SA 4.0

During my stay I followed the activities of the land reclamation unit that supports farmers in the development of fields and in the response to demolition orders. The administrative classification of land in the West Bank into Area A, B, and C that was established after the Oslo II Accord between the Israeli government and the Palestinian Authority in 1995 inevitably shapes agricultural practice (fig. 5.8). Area A is administered by

¹²⁵ It is this intra-species diversity with different adaptations that organisations of global care are not addressing in their collections with the focus on banking genetic diversity across species.

the Palestinian Authority, Area B is jointly governed, and Area C is controlled by the Israeli government. However, 80 percent of Palestinian agricultural land is in Area C making it extremely vulnerable and difficult to cultivate. In addition, the collection of rainwater is illegal on Area C land. Across the agricultural practices I observed, water is intricately linked with questions of sovereignty. Sami, a UAWC staff member, pointed out that the issue of water in the West Bank is not about availability but about *access*.

The seed bank is where the different strands of UAWC's activities come together. The collection, testing, reproduction, and storage units are part of a broader project to move beyond just 'collecting seeds and genes' to instead care for 'the human, the farmer, and education' (Leila, personal communication 21 July 2019). In 2019, the seed bank distributed seeds to 512 farmers based on applications received every season in which farmers apply for specific seeds they would like to cultivate.



Fig. 5.9. Entrance to the seed bank. Image credit: the author, 2019

The seed bank is located on the second floor of a residential building. An array of plants and educational posters framed the interior corridors (fig. 5.9). Architecturally the seed bank consists of a seed extraction room, a drying room, a seed testing room, and the seed storage space. Most of the storage was at room temperature with smaller containers for genetic records

(fig. 5.5) and larger containers for seed distribution to farmers. There was a small fridge that contains a genetic record of all varieties in small frozen samples at minus 18°C. While technically the processes of extraction and drying were almost identical with the protocols I observed across the practices in this thesis, the ecological imaginary that the seeds here were part of is wildly different, as will become evident throughout this chapter.

Changing climates across the West Bank, with increasingly hotter temperatures and less precipitation (Mimi et al., 2009), affect the seed bank's research on *ba'al* seeds and resilience. Leila described how shifting climates have altered the flowering stages of plants and made it crucial for farmers to adapt their growing cycles to new temporal patterns. Using *ba'al* seeds ensures that they are already somewhat adapted to arid, hot, and dry climates in the region. Additional agroecological innovations that the seed bank advocates include the creation of microclimates, water harvesting (although this is made illegal by Israeli policies if rainwater would otherwise go into a natural stream in a baffling protection of 'nature'), and different watering techniques closer to the root (Leila, personal communication, 24 July 2019). These strategies offer more relational approaches to coping with changing climates than the pre-breeding and genetic harvesting of adaptive potential from wild relatives explored in the previous chapters. UAWC has projects that target Bedouin communities specifically seeking to make them 'more resilient' (Leila, personal communication, 21 July 2019). As analysed by Daoud and Jabareen (2014), Weizman and Sheikh (2015), Bhandar (2018), and Jabareen and Switat (2019), it is Bedouin communities in particular that are made vulnerable by the territorial politics of the Israeli government.

Building connections with international conservation and food sovereignty networks is an important step in overcoming what UAWC practitioners perceived to be an isolation from international participation without Palestinian statehood. In multiple interviews practitioners voiced concern for the absence of Palestinian seeds in international projects like the MSB and SGSV. Outside of conservation frameworks UAWC's seed bank was beginning to connect with agrarian activist organisations focused on food sovereignty. UAWC was the first Arab member of the international peasant movement La Via Campesina and, alongside organisations in

Tunisia and Morocco, was in the process of establishing the Arab office for La Via Campesina. In October 2019 UAWC organised a seed exchange summit in Ramallah, inviting members of La Via Campesina's international network.

In the wider context of this thesis UAWC's seed bank shows a unique space for scientific research on seed conservation in alignment with a politics of resistance, against both the occupation and a resource-heavy technoscientific capitalist agriculture. Leila described the overall project of the seed bank as such: 'We do not want to collect and preserve the seed, we also want the knowledge that's related to it, the relation between the people and the land, it's very important for us, and also between the generations' (Personal communication, 24 July 2019). Here, the saving and cultivation of seeds seeks to prevent the loss of what Mastnak et al. (2014) have described as a 'place based' relation between plants and people in the preservation of not only situated knowledges but also situated (as in rooted) plants.

Searching for an Almost-Extinct White Cucumber





Figs. 5.10.–5.12. Produce shared during meetings. Photographs: the author, 2019

It was remarkable how conversations with farmers across the West Bank were usually accompanied by the gift of fresh produce and strong coffee. Every evening my collection of fruit and vegetables grew (figs. 5.10–5.12). I was especially amazed by the array of cucumbers consisting of a range of varieties of different sizes, colours, and shapes. It is crucial to acknowledge these acts of ingestion and digestion that happened while farmers discussed their struggles, and the tangible link to personal food sovereignty that those who grow seeds from the seed bank experience.

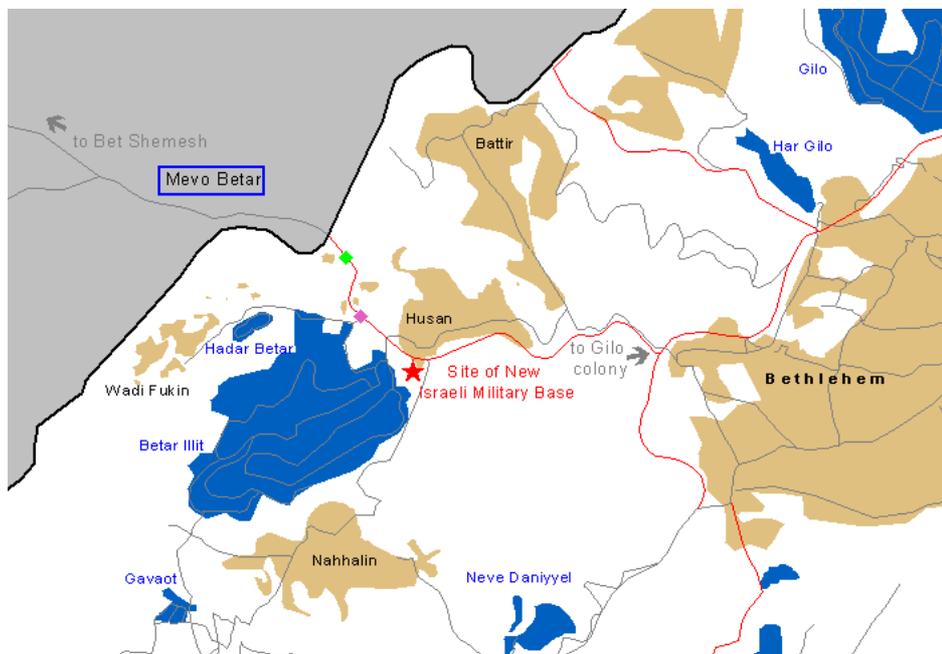


Fig.5.13. Wadi Fukin’s location in relation to settlements and the Armistice Line (black line). Areas in blue show Israeli settlements surrounding Wadi Fukin. Brown areas are Palestinian villages and towns. Graphic: Applied Research Institute Jerusalem, 2001, reproduced with permission

One variety that was described by Nadia as an almost extinct white cucumber, *Cucumis sativus L.*, can help to make tangible the pressures of settler colonialism on Palestinian cultivation, the intersections with the pressures of global agro-capitalism, and the spatio-temporal specificity of this conflict. The only place in the West Bank where this indigenous white cucumber is still cultivated is the village of Wadi Fukin, situated in a precarious border ecology surrounded by the Betar Illit settlement founded in 1985 to one side and the 1949 Armistice Agreement Line to the other side (fig. 5.13). While there was no official assessment of how threatened this cucumber was, multiple farmers and seed bank staff spoke of it as rare and endangered. Across the West Bank, Wadi Fukin is known for its heritage in growing *ba'al* varieties. Local farmers described how the agricultural fields in the valley used to consist of 9200 dunams, 8000 of which have been confiscated to date for the construction of settlements.¹²⁶ The village's agricultural land is in Area C while the village itself is in Area B and has been marked by a history of displacement, demolition, and subsequent reconstruction during the last century. Like the nearby UNESCO world heritage site of Battir, Wadi Fukin's proximity to the Armistice Line directly interferes with its soil and water ecology and the more-than-human dependencies of cultivation.¹²⁷ However, Wadi Fukin's border ecology doesn't have protected UNESCO status.

¹²⁶ A 'dunam' is the commonly used unit of measurement for land; a leftover from the Ottoman Empire that in Palestine corresponds to around 900 m². Many of the farmers in Wadi Fukin also work in the settlements, symptomatic of a shift away from agricultural work into construction and service industries. The tension of being employed by the occupiers of their land is particularly painful for the farmers I spoke to.

¹²⁷ The nearby village of Battir offers an interesting example of strategies for the protection of more-than-human cultural heritage. Its 4000-year-old open channel irrigation method was threatened by the construction of the separation wall as described in an interview with lawyer Michael Sfar in *Forensis* (2014). The village's agroecology and terracing system was granted UNESCO world heritage status in 2014. Sfar's approach for the protection of Battir's landscape was successful through appealing to environmental rights, rather than human rights. Interestingly, UNESCO was also the first UN body to recognise Palestine as a member state. The living cultural heritage held in Battir's landscape is in many ways intangible and contains cultural memories of cultivation and adaptation, such as a purple aubergine that is famous across the West Bank. Yet, many villages across the West Bank do not have ancient irrigation infrastructures that can protect their cultivation practices from erasure. This raises problems in how heritage status like the UNESCO World Heritage is defined.



Figs. 5.14–5.16. A fig tree which functions as a social space; view of the surrounding settlements from underneath the tree. Photographs: the author, July 2019

I visited Wadi Fukin with Hassan and Nadia from the seed bank. Gathered under a giant fig tree which functions as a collective meeting space, as shelter from the scorching sun, and as a shield from the gaze of the surrounding settlement, farmers described the struggles they face (figs. 5.14-5.16). The conversation was framed by the pervasive sound of construction from the surrounding hills, an ambient soundscape that permeates the West Bank's sonic ecology. One of the farmers in Wadi Fukin mentioned the psychological stress resulting from the permanent sonic reminders of enclosure.

In 2020 the seed bank included the white cucumber as one of its banked varieties for the first time; Wadi Fukin was the only village where it was still cultivated. In addition to the white cucumber, the UAWC seed bank contains a selection of different varieties of serpent cucumber, such as *Cucumis melo var. flexuosus (L.) Naudin*, another rainfed variety. In total, three different varieties of this cucumber with local adaptations to microclimates across the West Bank are collected. I was astonished by their unique capacity to extract water from the ground. In his analysis of rainfed agroecologies in Palestine Tesdell (2013) argues that the serpent cucumber, locally known as *faqqus*, has adapted to dryland agriculture to the extent that it will not grow fruit under irrigation. He describes the robust qualities of rainfed agriculture as a dynamic, adaptable system rather than a static, 'primitive', historical heritage that can thrive independently from costly resources (ibid.). I asked Leila about this apparent rejection of water in a miraculously resilient plant, but she described a pilot project the seed bank was undertaking with the Palestinian Ministry of Agriculture which has demonstrated the opposite. If irrigated at the right time, but crucially not during the flowering period, the serpent cucumber grows much faster in green house environments under irrigation. To me, this was a useful example to not be drawn too easily towards instrumentalising rainfed varieties and projecting resilience onto plants. Rather than an essentialist understanding of plants this demonstrates that relationality goes both ways in human-vegetal ecologies and cannot be answered in simple oppositions of 'resilient' and 'vulnerable'. The rainfed cucumbers do not reject water but only respond positively to irrigation at specific stages during

their growth. Their resilience is not a political choice but a coping strategy under extreme conditions.

Importantly, the reasons the white cucumber has almost become extinct have more to do with the development of agro-capitalism in Palestine than the expansion of settlements and settler-colonial politics. Consumer demands have been shifting to year-round greenhouse grown cucumbers, rather than seasonal, slow-growing *ba'al* varieties. Tesdell, Othman and Alkhoury describe how hybrid greenhouse cucumbers introduced into the West Bank were developed by Israeli plant breeders and are known as *Beit-Alpha*. They met a growing local demand for cucumbers, but require more water intensive farming, and since they are parthenocarpic (seedless) clones they create dependencies in farmers to continuously purchase seeds (Tesdell et al., 2019). Extinction and the loss of varieties, here initiated by shifts in consumer expectations, entangle the survival of some varieties in the technological development and spatial distribution of others. One of the agroecologists I spoke to who ran a farm just outside of Bi'lin, also a village close to the separation wall, believed that this shift is strategic: it creates an intentional rupture of food sovereignty that aims to turn 'Palestinian society from producing to consuming' while slowly confining citizens to the cities in Area A and B and detaching them from agricultural land.

Leila explained that from 2010 onwards the seed bank had observed the appearance of hybrid, genetically modified seeds in Palestine, which do not enable farmers to reproduce their seeds.¹²⁸ Hybrid seeds break the seed cycle and therefore make seed sovereignty impossible. This dependence on improved seeds reminds us of the effects of the Green Revolution on farmers in the Global South that I discussed in chapter one. This has created an artificial vulnerability since farmers are now reliant on high-tech inputs such as synthetic fertilisers, machinery, equipment, pesticides, herbicides, and irrigation. It has 'left Palestinians increasingly vulnerable to the Israeli government' (Tesdell, 2013 referring to Tamari, 1981). As in other places in this thesis, vulnerability is strategic and instrumentalised here, rather

¹²⁸ Journalistic references on the entry of GMOs into Palestine include Dhenin (2020) and Remy (2013).

than the universal ecological threat as which it is framed. Dina, a student researcher at the seed bank, shared a particular challenge – the impossibility of sharing UAWC’s seeds internationally – while she described how the seed bank tried to convince farmers to return to rainfed *ba’al* seeds: ‘it’s not allowed for us to export these kinds of seeds. There’s a lot of interest [internationally] but they can’t have them’ (Personal communication, 22 July 2019). The rainfed varieties are of increasing interest to international agri-scientific research in a move that would turn them into genetic resources and assets, extracting them from their relationality, yet Palestinian organisations are also not allowed to share their seeds internationally. The resilience found in these seeds makes them powerful symbols and carriers of stories, grounded in a belief in their unique adaptations to sustain themselves amidst harsh climates. Leila, who trained as an agronomist, remembered her first encounter with *ba’al* seeds:

The local seed is really unique in its ability to survive in very harsh conditions. When I was studying agronomy at my university, we were taught how to plant the commercial varieties. No one teaches you how to plant the local seeds. So, when I started working with UAWC and they said we need to produce serpent cucumber seeds without a drop of water I said ‘I’m sure it will not survive’. You’ve also visited the Dura fields, without a drop of water they survive, even in very harsh conditions and high temperatures. *It’s really a lesson we have to learn from plants.* (Personal communication, 24 July 2019; emphasis mine)

This more-than-human persistence, this lesson to be learned from the plants, is in my argument the foundation for worldly sovereignty without mastery. It is an adaptative, slow learning based on trust.



Figs.5.17–5.18. Three small white cucumbers in Wadi Fukin. Photographs: the author, July 2019

Returning to the meeting under the fig tree in Wadi Fukin, it proved difficult to find the white cucumber. Its growing season is extremely brief and only a few farmers cultivate it. One of the farmers who supplies the seed bank with rocket, cabbage, and cucumber seeds assured us that so far they hadn't witnessed the disappearance of any varieties. Everything he saw being cultivated as a child is still grown today, but often in smaller quantities. Passing on this knowledge to his family members is a crucial part of his practice. Nadia added that preserving this knowledge is important for the seed bank; they were working on a manual that archives farmers' knowledges. What the farmers struggle with most in Wadi Fukin is a degradation of the soil. At the time of writing salinity was extremely high, and residents were awaiting results of further testing. The settlement construction has depleted some of the local springs and aquifers, and waste waters from the settlements have seeped into the soil in the valley. Additionally, the introduction of input-heavy GMO seeds by farmers in Wadi Fukin has

affected the soil microbiology.¹²⁹ Here I extend Rob Nixon's concept of 'slow violence' (2011), a gradual, delayed, and invisible violence, to explicitly consider the more-than-human ecologies exposed to this violence through toxins, erosion, and the drying up of springs and aquifers, alongside smaller acts of aggression and sabotage. One of the farmers described attacks by settlers on his greenhouse four weeks prior to our visit when his tomato seedlings were uprooted during prayer time on a Friday. This echoed previous incidents in Wadi Fukin when irrigation channels and greenhouse infrastructures had been attacked, and local ponds contaminated. It is this *violence against plants* that was present in many of the conflicts in Palestine and its politics of cultivation. Sami described this practice of uprooting – of violently severing the connection with the land – as follows as we drove through a land reclamation project:

If you put up a fence it's a construction, a tree isn't. In this case sometimes farmers used to grow just seedlings on their land in Area C, sometimes the lands look like that mountain that you can see there [a rugged hill] and they dug small holes and planted the seedlings. And the settlers, not the military, came and removed all the seedlings from the land. (Personal communication, 24 July 2019)

This vegetal violence has been discussed by other scholars, including Eyal Weizman in the context of his analysis of Bedouin land struggles in the Negev desert where crops were destroyed by the Israeli Green Patrol in the repeated destruction of villages: 'the crops were simply crushed under the wheels of the Green Patrol's road vehicles, or uprooted by the blades of their bulldozers' (2015, p.36). A similar aggression, but remotely and chemically, was observed in the Forensic Architecture investigation into herbicidal warfare in Gaza.¹³⁰ Stoler also discusses the toxic warfare of the occupation that has put 'material and social micro-

¹²⁹ How exactly different GMOs affect their surrounding soil microbiologies is still largely unexplored (Mandal et al., 2020). Yet for the context of Palestine, it can be assumed that the introduction of new input-heavy varieties has significant effects on soil composition. The ingestion of the foods grown from *ba'al* seeds is also a question of health amidst toxic landscapes, as multiple members of a women's self-help group in Dura emphasised. Through growing indigenous seeds, they feel they do not need to worry about pesticides or other contamination. This control over what is ingested speaks of a *bodily sovereignty*, on the smallest possible scale, a direct consequence of the food sovereignty UAWC works towards.

¹³⁰ The Forensic Architecture investigation *Herbicidal Warfare in Gaza* (2019) revealed aerial spraying at Gaza's Eastern border with herbicides that destroyed the crops of Palestinian farmers. Wind was utilised to carry dangerous concentrations of herbicides into Gaza; there was no compensation for farmers. It is assumed that this agricultural scorched earth strategy is intended to control the vegetation along the border strip and damage crops in Gaza.

ecologies' under strain (2016, p.353). These analyses show that the violence against plants in Wadi Fukin was not an isolated incident but embedded in a climate of aggression on human-vegetal ecologies where a weakening of the tie between plants, cultivators, and land works towards making land available.



Fig.5.19. Cucumber seedlings in my growing experiment. Photograph: the author, 2020

Ironically, it is the appreciation of Wadi Fukin's ecological diversity and natural beauty that cut our visit short in the end. When a group of Israeli hikers accompanied by military protection vehicles arrived to explore the valley Nadia and Hasan decided it was best to stop the interviews and head back to Hebron.¹³¹ Only by chance did Hassan stop another farmer passing through the village who had a small harvest of three white cucumbers. He gave them to me as a gift (figs. 5.17–5.18). From the following year onwards the seed bank supplied white cucumber seeds to those farmers who are curious to cultivate them. Throughout my research in Palestine cucumbers were always present, as refreshing snacks during meetings, as gifts, and in salads to share in festive meals. The moments described in this section support this biocultural belonging. Yet, I also encountered cucumbers as often instrumentalised slippery

¹³¹ Tesdell describes this securitised enjoyment of 'nature' and the role of the Green Patrol in attempts to claim springs and spaces of natural beauty in the West Bank as recreation areas for settlers through providing armed escorts (2013, p.170).

subjects in naturecultural politics. Some of the seeds that I took away from Palestine were for the previously mentioned serpent cucumber. Throughout the following year I tried to cultivate them numerous times, wanting to make this carrier seed and its storytelling potential more tangible, especially during the shift in attention to vegetal life in the Covid-19 pandemic. I managed to grow small seedlings, but soon they became etiolated and died; I never manage to grow any fruit from them (fig. 5.19). This, in a way, shows an important lesson: resilience is complicated and not ingrained in the seeds as such but held in place-based ecological relations.

Plasticity and More-than-Human Memory

Building on the discussion in the previous section of the white cucumber as a biocultural carrier of belonging and connection to the land, I now specifically explore the biological characteristics of plants as capable of memory as well as their adaptive and *plastic* agency that allows them to respond to their environments. Phenotypic plasticity describes an organism's ability to respond and change as a response to environmental stimuli, which can involve changes in morphology, physiology, or behaviour (West-Eberhard, 2008). It is thus a useful concept for observing how plants respond to their environments. Palestinian history is deeply connected to the domestication of grains in a landscape that is marked by 12,000 years of cultivation and remains a centre of agroecological diversity.¹³² The Fertile Crescent, a geographical area including Israel-Palestine, Jordan, Lebanon, and Syria, where the origin of many civilisations lies, has long been home to unique vegetal adaptations to arid and hot climates.

¹³² James Scott (2017) offers an in-depth study of the connection between human settlement, cultivation, and statehood.



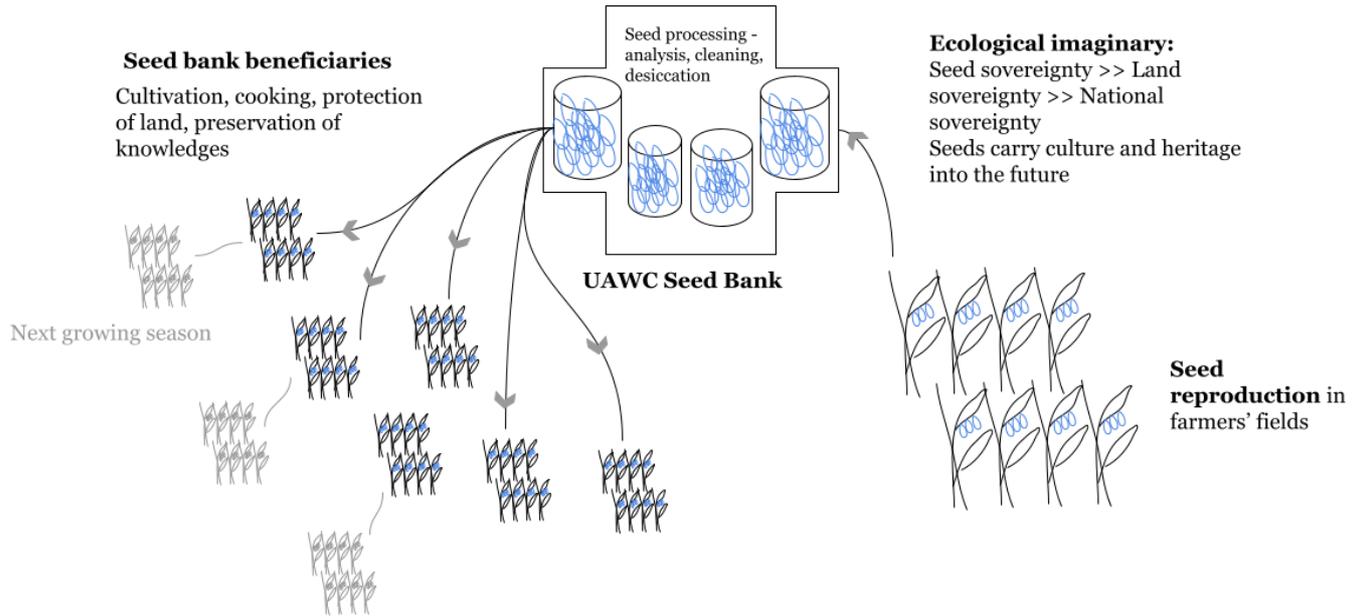
Figs. 5.20–5.21. Seed reproduction fields in Dura. Photographs: the author, July 2019

I encountered some of these adaptations when visiting one of the seed bank's seed reproduction fields in Dura, a village south of Hebron. At the end of July, the serpent cucumbers and squash grown here were long past their spring harvest time, left in the field for optimal seed development (figs. 5.20–5.21). The field gave a desolate impression, the soil extremely dried out and sparse. Scarecrows were dotted around to prevent the fruit from being decimated by birds. The plants that supported the cucumbers were small and looked vulnerable and dry, yet they managed to grow colossal fruit. UAWC pays the owner of the field to produce seed for the seed bank; one dunam will produce around 30kgs of serpent cucumber seeds per season. As we inspected the dusty field, Hassan explained, that in this region of the West Bank, which is at higher altitude than Hebron, residents do not have enough drinking water. There are no natural springs in the surrounding hills, and farmers usually only grow fruit trees. Additional irrigation was not an option. And yet, the serpent cucumbers were enormous. Their plant bodies felt warm and soft in the sun, haptically revealing the quantities of water the plants had been able to extract from the ground. I was astounded at these plastic

expressions of how the plants had directed their energy towards the fruit. Rather than the input heavy ‘making the desert bloom’ discourse perpetuated by the Israeli government, these plants showed a possibility of rainfed dryland agroecologies – a resistant ecological imaginary. ‘Making the desert bloom’ was an important reference in early Zionist remaking of the landscape in Israel, what Weizman describes as a ‘meteorological-theological imaginary’ (2015, p.14; also Naomi Klein (2016) on ‘turning the desert green’). ‘Making the desert bloom’ became synonymous with a new kind of agriculture that allowed settlers to expand into the desert through ‘new seed types, synthetic fertilizers and pesticides’ (Weizman, 2015, p.18), and importantly through access to water. Compared to rainfed agriculture this is an input heavy change of desert landscapes that requires constant technological maintenance.

The encounter with the large serpent cucumbers in Dura revealed the specific biological characteristics of *ba'al* seeds, their phenotypic plasticity, strategies of adaptation and vegetal resilience, which include seed morphology, root behaviour, and soil interaction. They are expressive of the ‘nonhuman forces’ (Tsedell, 2013) that shape cultivation in the West Bank.¹³³ Leila described that the roots of *ba'al* seeds tap deeper than commercial varieties in their capacity to draw water from the soil. Thereby, the root stabilises the soil, improves soil quality and reduces soil erosion. In 2018, UAWC introduced *ba'al* carrots into the seed bank. Local stories tell of the medicinal properties of the indigenous carrot which researchers at the seed bank are investigating. Their theory is that due to the low water availability and resulting stress the plants endure in drought, antioxidant components become more concentrated in the vegetables. And thus, *their capacity for persistence becomes ingestible* through taking in their antioxidant properties.

¹³³ Tesdell argues for the inclusion of nonhuman agency: ‘the way that the composition of biota comes to play a role in the development of political being emerges from the features of rainfed farming itself’ (2013, p.146). In agroecology the political is more-than-human.



Diag. 5.1. Seed circuit at UAWC's seed bank. Illustration: the author, 2021

An important contributing factor to the unique adaptation of these seeds lies in their continuous cultivation. Seed circuits are always in motion, dispersing and multiplying (diag. 5.1). Rather than seeds that have been removed from their agro-ecologies through the cryopolitical practices of stabilisation explored in the previous two chapters, seeds of UAWC's seed bank are in seasonal circulation. The living archive is constantly adapting and in contact with the soil seed bank. This principle of circulation – rather than stasis – creates a seed saving temporality that does not preserve a static body and moment of time in cultivation, but stays close to vegetal adaptive capacity. Tesdell analyses this attachment to land through continuous cultivation in rainfed agriculture, arguing that it works by 'exploiting the volatility and recalcitrant qualities of plants that enable a dynamic attachment to a place and a refusal to perform to the script of state power' (2013, p.119). He uses the concept of 'recalcitrance' based on Michel Foucault's use of the term in *The Subject and Power* (1982) to discuss the immense durability of rainfed agriculture.¹³⁴ In Tesdell's context recalcitrance refers to how rainfed farming practices incorporate and thrive on the 'volatility, unpredictability and radically

¹³⁴ Foucault discusses recalcitrance in his attempts to formulate a definition of power: 'without the possibility of recalcitrance, power would be equivalent to a physical determination' (1982, p.790). There needs to be a possibility for freedom, and capacity to resist, for there to be an exercise of power.

localised ideal production’ (2013, p.146). The reference to recalcitrance is particularly interesting here for its double meaning, not as recalcitrance of those seeds that cannot be stored according to normal seed banking protocols explored in chapter four at the MSB, but recalcitrance as a form of attachment to place, a refusal to let go of place, connected to micro-climates and practices of care.¹³⁵ Both understandings of recalcitrance capture vegetal processes that escape attempts of mastery. Interestingly, all the rainfed varieties in UAWC’s seed bank are not biologically recalcitrant and can be stored long-term in standard storage conditions.

Discussions of phenotypic plasticity elicit plant memory more broadly, building on the brief exploration of vegetal intelligence in chapter one. Plants’ capacity to remember has been of increasing interest in plant science: Thellier et al. (2018) discuss specific kinds of memory used by plants, Trevawas (2003) explores the similarities of states of seed dormancy and nervous memory, and Gagliano and Marder (2019) discuss how plants can learn and change behaviour according to their memories. Agronomist and geographer Nikolai Vavilov’s seminal work on ‘centres of origin’ for crops was pioneering in its exploration of plants’ attachment to place (Vavilov, 1931). This attachment is present in an expression of plasticity which I had encountered at the MSB. Namely in ‘Seeds of Future Past: climate change and the thermal memory of plant reproductive traits’ (2019), Fernández-Pascual et al. use the concept of ‘thermal memory’ to describe a plant’s phenotypic plasticity in response to the ‘thermal history’ of its parent plants. This concept is particularly interesting for analysing climate change impacts on plant behaviour in the West Bank. It suggests seeds can hold an imprint of the thermal environments they are adapted to, making seed production and dispersal a process responsive to thermal cues and thermal memory. Thermal memory in the case of Palestinian *ba’al* seeds becomes an evocative concept for thinking through the impact of a threatened, disappearing agroecology on the phenotypic plasticity of future plants. It creates a notion of vegetal temporality that is tied to cycles of cultivation – ‘*seeds of future past*’

¹³⁵ This echoes the Palestinian concept of *sumud* explored later in this chapter.

according to Fernández-Pascual et al. It is not just a human memory of cultivation and biocultural heritage held in UAWC's living archive, but vegetal memories of the ecological history of the West Bank – what Rodney Harrison terms a 'biosocial archive' (2017, p.85). Seeds here are embodiments of this history. At the same time these microclimates are constantly threatened with erasure. As UAWC's seed bank experiences increasing interest in *ba'al* seeds and wild relatives found across the West Bank, it is the previously discussed mining of genetic adaptive potential in wild relatives, their increased phenotypic plasticity (Hauvermale and Sanad, 2020), that makes them so desirable for agro-scientific research.

Thermal memory makes possible another potential role of plants in Israel-Palestine's territorial conflict, that of witnesses. Returning to the previously mentioned Forensic Architecture investigation on herbicide use in Gaza, where plants have been used as material witnesses to testify against toxic practices, plants are as caught up in processes of occupation, displacement, and erasure as the humans they share space with.¹³⁶ In Israel's settler-colonial legal apparatus, plants occupy a strange in-between space: they do not count as part of the built environment where rules stipulate that Palestinians cannot build any structures higher than 10cm on Area C land. Therefore, plants are often the subjects of violence because of the attachment to the land they form. Having grounded the exploration of more-than-human sovereignty in the plants' persistence and plasticity to respond to and hold on to their environment, the following section explores how this persistence is affected in detail by the spatio-temporal politics of the settler-colonial conflict in Palestine.

¹³⁶ 'Witness' is understood here through Forensic Architecture's concept of *forensis* that reads the testimony of material objects to address a range of political and environmental injustices (Weizman, ed., 2014).

Cultivation in the Spatiotemporal Sphere of Conflict

The spatial history of Israel-Palestine is deeply connected with cultivation and the control of land (Tamari, 1981; Said, 1992; Weizman, 2015; Cohen, 1993; Bhandar, 2018; Temper, 2009; Tesdell, 2013, 2017, and Tesdell, Othman and Alkhoury, 2019) extending from the Ottoman Empire's control of Palestine to the British Mandate (1920-1948) to the founding of the state of Israel in 1948 and current settlement and annexation plans. It is beyond the scope of my analysis to give a detailed history of this conflict, but I sketch out its crucial dynamics as they concern the cultivation and conservation of seeds and their entanglement in the Israeli government's legal apparatus. In Stoler's argument for considering Palestine within postcolonial studies she demonstrates how colonial governance is not a question of the past (Stoler, 2016). I suggest much of this spatial and temporal governance is directed at plants and their cultivators; the control of land is crucial in the present's settler colonial formation (Tesdell, 2013; Bhandar, 2018). Leila explained how the occupation specifically targets the destruction of water collection infrastructure and 'land without water is useless' (Personal communication, 21 July 2019). In addition, the uprooting of olive trees, which form an important income strand for many families, is commonplace. These trees embody a biocultural attachment to the land and heritage.

The Israeli government's interpretation of the 1858 Ottoman Land Code and its spectrum of land classification according to cultivated and uncultivated land is fundamental for current cultivation politics in the West Bank. This creates what Weizman refers to as a 'conceptual and spatial distinction between nature and culture' (2015, p.39).¹³⁷ However, the Ottoman Land Code originally sought to encourage cultivation by peasant farmers. In 1979 the Israeli government re-implemented the land law in the West Bank but reversed the burden of proof: now farmers had to show that they continuously cultivated the land; all unregistered

¹³⁷ The Ottoman Land Code created the category of *mawat* land, 'dead' land, to refer to uncultivated, barren land. This land could be taken by the sovereign which as Weizman (2015) suggests created a distinction between 'cultivated' (culture) and 'uncultivated' (nature) that is now used by the Israeli government.

and uncultivated land became state land (Teddell, 2013). Currently, if agricultural land in the West Bank has not been cultivated for three or ten years (depending on the distance to a village) it can be taken over by the Israeli state. This makes farmers in Area C vulnerable. When I accompanied Sami to visits to land reclamation sites, he explained that

Now many settler groups go to the open land in Area C and cut some plant samples and take them to laboratory to work out how long ago this plant was planted. And if it's 10 years they go to the government to confiscate the land, because it's 10 years without planting. They do carbon testing. (Personal communication, 24 July 2019)

This use of biochemical dating technologies reveals the instrumentalisation of a different kind of vegetal memory than discussed in the previous section. Here, plants become *witnesses against* the people that cultivated them by revealing whether enforced regimes of cultivation have lapsed. Sami described that the main obstacle to cultivation is land development. People have the necessary situated farming knowledge but lack the financial resources and labour force to farm land (Personal communication, 24 July 2019). This 'nature'/'culture' distinction between cultivated and uncultivated land has dominated Israeli state control of land in the West Bank (Teddell, 2013). Importantly it shows how epistemic binaries are produced and upheld in practice. In *Colonial Lives of Property*, legal scholar Brenna Bhandar argues that cultivation in the Palestinian context 'retains its force primarily as an ideological phenomenon rather than a reflection of actual economic and social realities' (2018, p.30). While I agree with this to the extent that UAWC staff told me settlers are usually not interested in cultivating the land themselves (it is taken over for the construction of towns, not for agriculture), I want to flag that for those Palestinian farmers fighting against the loss of land, cultivation is very much tied to their economic and social reality. However, as Bhandar specifies it is exactly the ideological framing of what counts and doesn't count as cultivation that makes persistence near impossible:

The Israeli courts' insistence in defining what cultivation is and what constitutes evidence of the same, according to their own cultural norms and Zionist imperatives, is a central feature of the attempt to create a relationship between Zionist nationalist identity and the land. (Bhandar, 2018, p.148)

Her discussion of the definition of cultivation is insightful here in emphasising cultivation as a construct embedded in nationalist imaginaries to establish a direct relation to the land. Once settlers have taken over land, they are not expected to cultivate it at all.

Returning to the village of Wadi Fukin and the search for the white cucumber, Nadia translated the account of one of the farmers for me:

[The villagers] have lands threatened from confiscation since 2004, but the occupation is still unable to confiscate them because the owners have necessary documentation to prove that these lands are theirs and their constant presence also helps to prevent the confiscation. There are some cases in the court since 15 years ago and they still haven't finished. All the surrounding settlements are built on land of Wadi Fukin. (Personal communication, 22 July 2019)

Often, delaying cases in court is all Palestinian farmers can do to respond to their vulnerability. Apart from carbon dating, settlers and the Israeli government employ a range of technologies to determine cultivation histories such as GIS coordinate data collection from nearby settlers and, most prominently satellite photography, turning cultivation into a highly surveilled visual activity.



Fig. 5.22. Recently destroyed cistern outside of Hebron. Photograph: the author, 2019

Farmers who were victims of the acts of violence against the plants in Wadi Fukin declared that if they went to the Israeli police nothing would happen. When the government leaves demolition notices that notify farmers of impending demolitions, this routinely happens at times when farmers will not find them for days, or they are left in places on the land that are not obvious (fig. 5.22 shows a destroyed cistern).¹³⁸ Many of the farmers I spoke to expected demolition orders eventually. I observed an interesting pattern in these exhausting conversations about legal proceedings – multiple times the conversation then shifted to farmers offering their produce, focusing on things that were tangible and digestible. It was maybe a recentring on a localised, embodied form of sovereignty.

I have sought to demonstrate that planting is as much used as a tool of erasure and dispossession in Palestine's land conflicts as it is a tool for persisting-with. All actors politicise ecology to make and defend spatial claims and plants are deeply caught up in this. These power dynamics affect temporal registers as much as spatial ones and shape the temporality of seed saving in what geographer Derek Gregory refers to as the 'colonial present' in Palestine (2005). He defines the colonial present in response to the temporality of post-colonialism to capture colonial continuity in Palestine, Iraq, and Afghanistan. Rather than anticipating a future ecological catastrophe, the temporality of UAWC's seed bank revolves around seed circulation in the present. If the seeds as vulnerable biocultural objects do not go through cycles of sharing, cultivation, and saving *now*, they will be lost. And, crucially, the land will be lost too in a linking of temporal and spatial instruments of dispossession. The post-apocalyptic insurance imaginary often associated with the SGSV and the MSB and evoked in media visualisations of frozen seeds – they are preserved for after a future catastrophe when these seeds will need to be activated – is reversed here. Instead, seed saving in UAWC's practice, I

¹³⁸ The account of a farmer who recently had his cistern destroyed (fig. 5.22):

The case of the cistern started in December 2017 and the work was finished. It was complete. They came and left the 'stop work order', the case was in the court until 10 July 2019, they gave me three days to go to the court before demolishing the cistern. But the stop work order was left under a rock when they came to the land, and no one was there. Then they left. I took two days to come to the land and find the note, and only had one day left, it was Saturday and there is no court on Saturday, so they came on Tuesday and destroyed the cistern. (Personal communication, 24 July 2019)

suggest, is *post-catastrophic*. If one considers that the Nakba translates as ‘the catastrophe’, then the human and nonhuman persistence observed in seed saving today does not anticipate catastrophe but persists-with amidst its continuous unfolding.

The liminality created in other practices in their suspension of seeds between life and death through freezing translates to a human experience here, of being held in a liminal state, where the future is unimaginable and the present increasingly vulnerable. Agroecological imaginaries of worldly sovereignty and the politics of UAWC’s seed saving hold on to the present rather than envision a future. Land is continuously threatened to slip away. Where the settler-colonial state denies the imagination and possibility of futurity, the act of seed saving as a device to hold on to the present and the past is a lived practice of persistence. None of the farmers and practitioners I spoke to dared to imagine future activities beyond one or two years; farms are set up despite the full knowledge that they may not last. When Sami and I drove across a largescale land reclamation project stretching across a hilly landscape that consist of 1300 dunams of agricultural terraces and new roads he evoked an interesting image of frozen states. I asked him if farmers can ever win in legal proceedings:

S - Mainly it’s possible to *freeze proceedings*. Sometimes they can freeze them for three years, ten years. In the end if there’s a demolishing order, they come and destroy. I think it’s in 0.1 % of the cases that the Palestinians win. Often in cases where Palestinians own the land and settlers came with trailers and homes they can move, the Palestinians win the case on paper but they’re still on the land. [...]

MB – So most of the time taking legal action is just a way of slowing something down and pausing it, rather than stopping it?

S - Yes. It’s a crazy thing. (Personal communication, 24 July 2019)

This freezing amidst slowly disappearing landscapes strangely reminds me of the futurity of banking seeds at the MSB in the previous chapter where some practitioners have accepted the inevitability of loss but continue to care for their seeds. It is also an expression of persisting-with, of sustaining the unsustainable, of resilience against the colonial governance of time. While futurity is denied, seeds contain an important link to the past in UAWC’s seed bank: the traditional flavours and the affective attachment work as time travel devices to a more stable

past. When interviewing a women's cooperative in Raboud, one of the beneficiaries receiving seeds from the seed bank explained the temporal relief found in the plants:

When you ate the serpent cucumber you could smell it. So many people don't grow the local seeds, it has faded. When we're producing and growing the local seeds, we remember our grandparents and ancestors. *We go back*. (Personal communication, 23 July 2019; emphasis mine)

This biocultural memory adds a more complex quality to the previously explored thermal memory. Seeds as biocultural objects are at the centre of UAWC's seed bank in how they create temporal links between generations. Knowledges can get lost between grandparents, their children, and grandchildren in a slow alienation from agriculture and enforced urbanisation. The *ba'al* seeds allow a reversal of this undoing, a return of different flows of time, both human and nonhuman. Artist-theorist Elaine Gan's concept of the 'time machine' (2016b) for the more-than-human socialities of rice and its spatio-temporal assemblages is insightful here for considering how *ba'al* seeds hold past and future attachments to the land as well as epistemic and biological adaptations. Gan uses the device of the time machine to decentre the human in multispecies worlds and 'to understand, not only complexity, but entanglement through emergent structures of timing' (2016, p.3). It is through cyclical temporalities of flow, rather than Eurocentric linear agri-scientific time that biocultural memories persist in UAWC's seed banking practice.

This loss of knowledges is often accelerated by pressures through the Israeli government to make the persisting-with of plants and cultivators *as impossible as legally possible*. Stoler discusses the temporal compressions and expansions of the occupation of Palestine, which can 'bring the persistence of a past to the immediacy of the present' (2016, p.33) through the sensory registers of touch and taste. She describes the unique, messy temporality of Israel-Palestine as follows:

It is not one context but many in which what is most technologically advanced (surveillance) is predicated on deeply honed colonial practices and where what are imagined as most intractably divisive—'primordial loyalties' and identity politics anchored to territorial attachments—are equally trained dispositions, part of the apparatus of modern governance, of the arts and crafts of nationalist projects and of modern invention. (2016, p.63)

This linking of new technologies of surveillance (such as the previously discussed carbon dating) with instrumentalised colonial nationalist imaginaries of territory and identity describes well the spatial and temporal complexities of the context in which seed saving occurs in UAWC's seed bank. This section has shown how the spatio-temporal dynamics of settler colonialism and their legal frameworks make and unmake cultivation and how persisting-with becomes an ecological, political strategy.

Biocultural Heritage and Vegetal Nationalism

Building on this discussion of more-than-human temporality and spatiality I now consider the national and cultural importance of seed conservation, and of cultivation more broadly. The significance of seeds as biocultural carriers of memory and past temporalities rather than agro-scientific objects has been observed in critical heritage studies (Harrison et al., 2020). Azoulay has pointed out the important connection of seed saving to sovereignty in the Palestinian context with reference to the Palestine Heirloom Seed Library (Azoulay, 2019).

For UAWC's seed bank, seeds are by no means just connected to food production – their conservation is the saving of a biocultural heritage, of histories of inscription, persistence, and ingestion. Leila described how indigenous seeds are a 'treasure for each community, not just related to the production of crops but also to history, culture, and food' (Personal communication, 24 July 2019). A year after the initial visit, I tried to understand this temporality further and spoke to Leila again. She argued that without this link, when farmers cultivate 'other' seeds, these seeds are 'without a relation to heritage, or your history, or your future' (Personal communication, 4 November 2020). This biocultural link between tradition and knowledge on the one hand, and future sovereignty on the other, makes the conservation of heritage a necessity to enable any kind of future ecological imaginary. Leila described the verification process by which seeds are incorporated into the seed bank as follows:

Each village is known for a crop. UAWC looks at different plants, and talks to the elders, asks them where the seeds were from, from grandfather to grandfather. [...]

Then we plant it in the reproduction unit and do a morphological characterisation to decide if it's local or not. (Personal communication, 24 July 2019)

Seeds need to have been cultivated in a village for more than 100 years, which is ascertained through conversations with elders. This trust in heritage, memory, and the associated generational knowledges is as much part of the seed bank's practice as scientific morphological analysis and seed development. Both these temporalities come together in UAWC's seed banking practice.

For Leila, seeds are 'deeply related to culture' (Personal communication, 24 July 2019), to memory, and identification. They are mobilised as symbols but are also material and affective guardians of this culture. She was frustrated when describing how UAWC recently had a funding application to UKAid rejected on the basis that the seed bank's work is 'agricultural' and not 'cultural' (a distinction that can also easily be challenged, of course).¹³⁹ What remains invisible and difficult to narrate are the affective experiences when dignity and relief are found in the emotional connection with indigenous seeds. Rainfed seeds are deeply relational beings. The human-vegetal ecology is entangled with wanting to reclaim a sense of history and heritage in treating seeds as *cultural*. They are external memories that can be ingested.

Nationalist nativist debates surround a range of culturally significant plants in Palestine, which occupy a blurry zone between cultivated crops, wild relatives, weeds, and wild species (Manna, 2020). One such plant is known as *akkoub* in Arabic (*Gundelia tournefortii*), a wild thistle-like plant, usually foraged as a Palestinian delicacy that tastes similar to artichoke. It has been declared 'protected' by the Israeli government, making all collection illegal and punished with heavy fines (Teddell, 2013; Manna, 2020). UAWC's seed bank included *akkoub* in its living archive in 2019 alongside other wild indigenous plants such as white micromeria (*Micromeria fruticosa*). *Akkoub* collected by agricultural research institutes in Jordan, Cyprus, and Lebanon is also held in the seed chambers at the MSB, marking a

¹³⁹ John Hartigan traces the etymology of 'culture' to agriculture and argues that "Anthropologists' notion of culture derives from an activity developed through and with plants: cultivation. The *historically recent usage of culture to identify that which is distinctively human is a metaphoric extension of this original meaning*" (2017, p. 98; italics in the original).

material overlap between these collections. UAWC's seed bank seeks to develop its collection of wild relatives. Wild relatives, as in the previous chapter's focus on their significance for connecting wild and cultivated species for the MSB's practice, again occupy an interesting space in this making and unmaking of vulnerability and persistence, here in the context of territorial conflict. Many agricultural crops were domesticated in the Fertile Crescent; their wild ancestors can still be found there. Leila talked about UAWC's attempts to access training at the MSB in their annual seed conservation course. Since most of UAWC's seed bank staff are agronomists, they do not have expertise in wild species conservation. Tesdell (2017) argues that the presence of wild relatives, their nativeness, was essential for early-Zionist expeditions to Palestine as a centre of origin for agricultural diversity at the beginning of the twentieth century. Through archival analysis he shows that 'modern Palestine was engineered as a settler-colonial space in part through material practices of plant sciences' (Tesdell, 2017, p.45). UAWC was observing increasing interest from seed companies and researchers in its *ba'al* seeds and the wild relatives native to Palestine for those very reasons. Adaptations to hostile future climates are a sought after resilient 'asset'. Rainfed agriculture will be a valuable future technology beyond the Palestinian context as desertification and droughts intensify globally.

There is a nationalist imaginary in UAWC's practice, connecting seed to the establishment of eventual statehood and sovereignty. Foreign seeds, in particular Israeli seeds, are also politicised and discussed as carriers of disease and contamination with hazardous health effects. This makes tangible a critical omission, what Mastnak et al. discuss in the context of botanical decolonisation: 'treating plants metaphorically as immigrants, but never as settlers, paradoxically divides the human from nature. It elides forms of displanting—of botanical colonization—that were part and parcel of the colonial encounter' (Mastnak et al., 2014, p.374). I repeatedly heard frustrated references to what the Palestinian Authority is doing on the level on national representation, particularly for the protection of heritage and genetic resources. When I spoke to Leila on my last day, she voiced her concern about Palestine's lack of a national seed bank:

Each government for every country should collect their own seeds, the commercial ones, the cultivated ones and also the wild ones to preserve them in some place. Each country has somewhere like this. In our country it's not, maybe it's because they do not have access to a lot of areas but maybe also because they do not work. (Personal communication, 25 July 2019)

There is an interesting expectation here in how UAWC's seed bank puts the protection of biodiversity as a responsibility of the nation state, even if denied statehood. The absence of care is read as a sign of neglect.

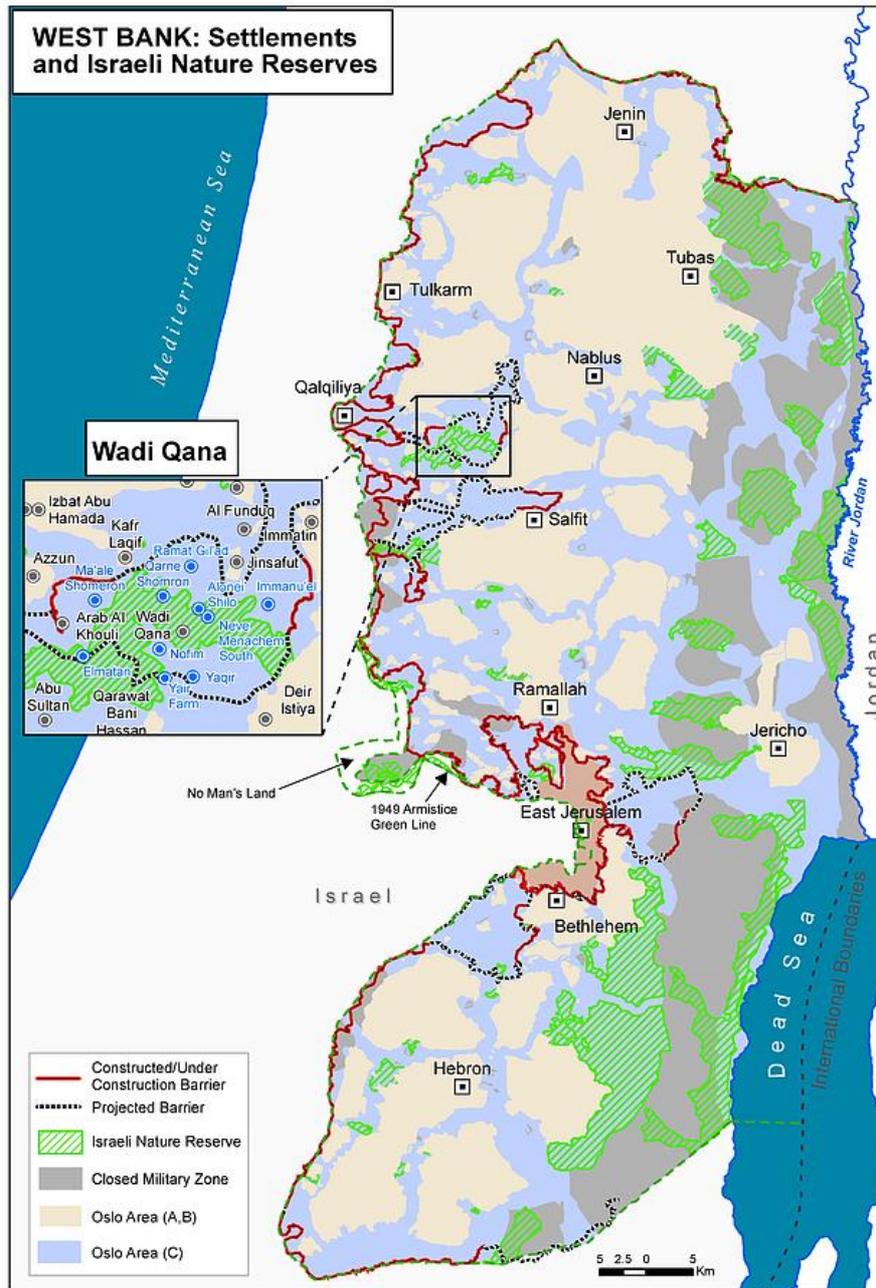


Fig. 5.23. Map of nature reserves in the West Bank. Image: UN Office for Coordination of Humanitarian Affairs, OCHA oPt, 2014, reproduced with permission

In the West Bank the artificial state of land and water scarcity for cultivation (Alatout, 2008 and 2009) is accompanied by another spatial strategy to encroach on desired areas: the establishment of nature reserves that classifies these areas as state land (fig. 5.23). The creation of these reserves, alongside the discussed protection of plants that are culturally significant for Palestinians, is often influenced by Eurocentric imaginations of ‘nature’. The politics of planting employed by Israeli organisations is most prominent in the Jewish National Fund’s (JNF) afforestation project which has planted more than 240 million trees in efforts to create forests in Israel, often covering previously existing Arab villages (Long, 2005). Many of these trees are non-native species such as pine and eucalyptus. Stoler describes this nationalist technology of planting in the campaigns of the JNF as follows:

This intensive planting campaign [...] have [*sic*] literally obliterated the very presence of Palestinian villages and farmsteads on Jerusalem’s periphery for more than sixty years. If *planting is a key technology* in Israeli politics, inciting notions of fecund futures, here ruination has a perverse, protracted, and violent colonial history. ‘Security groves’ have replaced Palestinian olive orchards with cypress and pines; recreational parks dense with eucalyptus trees smooth over Palestinian cemeteries. Remains of Arab villages have been effaced—as are the claims of their former inhabitants that these were never ‘abandoned’ fields but ones they owned, lived off, and *long cultivated*. (2016, pp.364-5; italics mine)

This extract encapsulates many of the aspects of the politics of planting developed across this chapter: it links erasure, non-native species, future imaginaries, and cultivation histories. What this chapter will add to Stoler’s exploration of planting as a process of ruination is a consideration of what is cultivated despite this erasure, and what more-than-human practices of cultivation offer as active forms of resistance against legal absorption and vanishing.

Insightful to the connection between cultivation, resistance, and national culture here are the writings of Frantz Fanon, whose anti-colonial legacy is frequently evoked in the context of Palestinian resistance (Teddell, 2013; Bhandar, 2018; Manna, 2020). Fanon’s considerations on ‘national culture’ in *The Wretched of the Earth* allow us to connect cultivation to persistence:

We must work and fight with the same rhythm as the people to construct the future and to *prepare the ground where vigorous shoots are already springing up*. [...] A national culture is the whole body of efforts made by a people in the sphere of thought to describe, justify, and praise the action through which that people has created itself and *keeps itself in existence*. (Fanon, 1963, p.233; italics mine)

I argue it is through the saving of seeds, persisting with soil microbiologies and relief found in cultivation and food sovereignty, that the culture and heritage Leila discussed earlier ‘keeps itself in existence’. Seed saving is directly preserving this culture from vanishing amidst a threatened national imaginary with, and here I am adding to Fanon’s ‘body of efforts made by a people’, a *more-than-human* body.¹⁴⁰ Fanon discusses the role of conflict and struggle not just as threats to this culture, but as constituting to the becoming of this culture and necessary for the rupture of decolonisation:

It is not alone the success of the struggle which afterward gives validity and vigor to culture; *culture is not put into cold storage during the conflict*. The struggle itself in its development and in its internal progression sends culture along different paths and traces out entirely new ones for it. (Fanon, 1963, p.245, italics mine)¹⁴¹

The sometimes-fetishised qualities of resilience and persistence of Palestinian culture are, through this lens, direct results of a national culture shaped amidst conflict.¹⁴² It allows us to consider the importance of UAWC’s seed bank to operate through flows and seed circulation rather than stasis – the seeds keep a sense of national culture in existence. The ‘seed bank is in the fields’ as Leila described it (Personal communication, 21 July 2019).

¹⁴⁰ I arrive at this ecological conversing with Fanon via Jennifer Wenzel’s ‘Reading Fanon, Reading Nature’ (2015) where she explores Fanon’s relevance for environmental movements, despite him not being an ecological thinker as such.

¹⁴¹ Glen Sean Coulthard’s reading of Fanon in *Red Skins, White Masks* (2014) on indigenous ‘resurgence’ in Canada is insightful to understand how resistance to settler colonial domination can arise through cultural practices, rather than seeking recognition.

¹⁴² The often-criticised discussion of violence in Fanon’s writing benefits from a short exploratory note here. In ‘On Violence’ in the *Wretched of the Earth*, written during the brutal Algerian war for independence, Fanon suggests that decolonisation can only ever be a violent process because there is no other choice or option in the face of colonialism as a system of continuous violence. In the revolutionary process it can be cathartic. Yet, as Lewis Gordon argues in *What Fanon Said* (2015) Fanon does not describe violence as such as revolutionary, it is not a valorisation of violence, but trust in the transformative force of the revolutionary struggle.



Fig. 5.24. View from Raboud on the wastewater channel and settlement. Photograph: the author, 2019

How does a national culture ‘keep itself in existence’ amidst an environment of erasure? This section has shown the importance of cultivation and seed saving in attempts to answer this question. During the visit to one of the beneficiaries of the seed bank I watched the open sewer wastewater channel of the Otniel settlement run through the valley from the opposite hilltop village of Raboud (fig.5.24). Here, one national ecological imaginary is actively destroying its bordering ecologies.¹⁴³ It was a moment where it felt necessary to develop new ways for talking about these disturbed border ecologies that asks for critical reflection on Anna Tsing’s previously discussed usage of ‘disturbance’ (Tsing, 2015; see chapter four) as a beneficial dynamic for some species. Disturbance in the border ecologies of the West Bank is present as toxic ‘slow violence’, perpetual acts of harassment, and more-than-human

¹⁴³ This is by no means just my observation; Weizman (2015) describes an incident when sewage was released from a settlement on surrounding Bedouin communities.

oppression. These dynamics require a critical reflection – and politicisation – of discourses of multispecies world-making, considering how plants are used as colonisers at the same time as grounds for resistance. What I hope has been shown throughout this section is the complicated status of plants as agents, which can both resist and aid colonisation and are deeply connected to imaginaries of statehood and national culture.

Sovereignty without Mastery?

Is the seed banking I observed across the West Bank still a practice of mastery? I return to the question of mastery in human-vegetal ecologies explored in the chapters on the SGSV and the MSB here, to ask if mastery, in Singh's sense of a submission of the object, lingers here in the context of anti-colonial practice.

The question of mastery evokes the deep respect implied when UAWC's seed bank practitioners refer to the farmers they work with, their knowledge about plants, and to collaboration as preservation. The settler-colonial power relations in Palestine, the relational focus of UAWC's seed banking practice in learning from the plants, as well as placing expertise and situated knowledge with farmers, all make it hard to claim the presence of mastery here. UAWC's seed banking practice avoids the danger that Singh points out through bringing together a feminist-materialist position with decolonial theory, that of 'pitting mastery against mastery' in anti-colonial counter-mastery (2017, p.2). Singh argues that some anti-colonial discourses, such as Fanon's, produced their own masterful practices, which remain bound to dialectical thinking and 'situate mastery in the theory and practice of decolonisation' (ibid., p.24). UAWC's seed banking practice can instead be read as a 'mastery of non-mastery', what Michael Taussig (2015) describes as a resistance to abstraction to instead focus on sensuous knowledge (ibid, p.145), indebted to its subjects to achieve collective future sovereignty. Rather than genetic archives of adaptation and solutions to future crop vulnerability, the object of saving in UAWC's practice is *relational*. Leila explained this relation of what I perceive as non-mastery:

Sometimes we don't say it's a local seed bank, it's a community seed bank, we want to make the farmer a part of our team at the seed bank. (...) When we start working at the seed bank our truth is that *we want to learn from the farmers and the knowledges they have accumulated* over many years and because of that we built a trusted relation with them, and until now we still learn from them. *We have the technology, but we do not have the culture and the heritage.* (Personal communication, 24 July 2019, emphasis mine)

In this sense the scientific aspect of UAWC's work, such as the germination testing and DNA analysis, is secondary to how these tests contribute to the health of the corresponding culture and community. The relationality in the farmers' work, their attachment to the land and their produce, became evident in my conversation with farmers in Wadi Fukin.¹⁴⁴ Rather than mastering the land and its outputs, they described a relationship of dependence, threatened by the absence of care in new agricultural practices through pressures of technological development and urbanisation. While we spoke overlooking his field at the edge of Wadi Fukin, close to the Armistice Line, one farmer explained:

One of the problems is that the younger generations working the land don't use the land effectively, the elders used rotations. But now they're not fulltime farmers, they have other jobs and are distracted, they don't have the time to care for it properly. *Technology and innovation have beaten the experience of the humans.* (Personal communication, 2019, emphasis mine)

UAWC's seed bank actively tries to work against this loss of situated knowledges at the expense of technological improvements and to support farmers with the emotional and legal pressures in the constant struggle to protect land. Food sovereignty can keep both the political and the ecological vulnerability experienced by farmers at bay. It is necessary here to closely refer to the understanding of sovereignty, and seed sovereignty in particular, that UAWC's seed bank uses in practice. I quote a longer conversation extract to do so. When I spoke to Leila and Nadia a year after my initial research stay, they made clear that 'agriculture is the first step in any sovereignty' (Leila, personal communication, 4 November 2020). Leila argued seed sovereignty is the precondition for food sovereignty, and only then can national sovereignty

¹⁴⁴ Experiences of non-mastery in the process of translation accompanied me throughout the conversations with farmers. There were times when it was hard for Dina, Sami, and Nadia to translate what I was trying to ask, or when translations of farmers' replies were difficult to grasp. Some nuances and meanings were lost in this process.

become achievable. I asked Leila (L) and Nadia (N) for their personal definitions of sovereignty:

L - That's a huge one [laughter]. For us the first step would be to reach food sovereignty, starting from having your genetic resources, which is the indigenous seed, and being able to reproduce it your own way, *choosing where and when you want to reproduce*.

N - My definition of sovereignty?

L - Food sovereignty, or seed sovereignty, right?

MB - Yes, but also if it extends to other sovereignty, it could be connected to national sovereignty.

N - I think *we're yet to reach that point*.

MB - And what would that point look like?

N - I think we should first *control our resources and borders*, that would maybe pave the road for seed sovereignty and other types of sovereignty as well.

L - But seed sovereignty requires that we have a certain amount of indigenous seeds available that we can reproduce *whenever we want and wherever we want*.

MB - Is seed sovereignty connected to national sovereignty for you?

L - Sure yes, starting from seed sovereignty the first step to reach is food sovereignty and after that the whole sovereignty. (Personal communication, 4 November 2020, emphasis mine)

It became clear in this conversation that seed sovereignty is not something Leila and Nadia felt has been achieved in the West Bank, but rather, it remains a future imaginary they are working towards – to eventually reach national sovereignty. In Leila's account sovereignty was twice tied to *whenever* and *wherever*; I argue this clearly responds to the previously discussed spatial and temporal constraints of the occupation. Returning to Azoulay's concept of 'worldly sovereignty' in more depth it is important so consider what is temporally and spatially included in UAWC's 'world' and what issues arise from framing sovereignty in this 'worldly' way. To include the political in human-vegetal ecologies, and in the more-than-human more broadly, within worldly sovereignty, it is crucial to acknowledge the dependencies that these alternative sovereignty constellations are often based on. Azoulay references cultivation and vegetal growth ('recognition and respect of the land's needs, of the knowledge of the land' (2019, p.389)), yet the more-than-human could be more explicitly acknowledged here and it

has a much greater significance than Azoulay acknowledges. Considering the more-than-human in worldly sovereignty in Palestine, a place where human-centred power dynamics have been analysed extensively, shows to what extent the nonhuman is overlooked in how these power dynamics are manifested, and challenged. Across multiple of the projects at UAWC's seed bank there is a shared understanding that their agroecological worlds might not last. Cycles of demolition and reconstruction, uprooting and replanting are anticipated (also Weizman (2015) on cyclical evictions and demolition); worldly sovereignty is grounded in precarious and unmasterful ways of being. In the absence of a national gene bank UAWC's seed banking practice fills this gap in an embodied and localised way that places a national culture of persistence not in a masterful genetic archive but in cyclical patterns of cultivation as non-mastery.

Persistence, not Resilience

On the day I arrived at UAWC's seed bank Leila told me that a lot of the work the seed bank does focuses on assisting farmers or other communities made vulnerable by the occupation, such as the Bedouin, to become 'more resilient'. Resilience needs some unpacking here, it emerged as a concept in ecosystem analysis in the 1970s and gained traction within the fields of risk, disaster, and sustainability management. Its present usage bridges the natural sciences, development, finance, and psychology. On the one hand resilience is a concept actively used by UAWC's seed bank. On the other hand, I suggest that there are some problems with framing seed saving in the West Bank as a practice of resilience as an external scholar.¹⁴⁵ It normalises both the political and the ecological conflict in Palestine as something than *can* be endured. Initially, Leila described that until UAWC's seed bank received core funding from the Dutch government 'for many years before then, when you don't have funding, you just want to stay alive' (Personal communication, 24 July 2019). Thus, I suggest considering

¹⁴⁵ There is a path for an ethical reading of resilience beyond mapping neoliberal economics onto nature (Vardy and Smith, 2017, p.177) in order resist turning 'biosocial communities into complex machines' (ibid, p.178).

UAWC's seed banking simply as a practice of resilience obscures legal and territorial injustice and frames this survival as positive. Rather than *surviving-with*, which would echo this impetus of resilience, what I am interested in the seed bank's practice is a more-than-human dynamic of *persisting-with*.

The Palestinian concept of *sumud* is insightful in relation to resilience in grounding this in what Tesdell terms *practices of persistence* through cultivation (Tesdell, 2013). Tesdell describes a practice of persistence as one that 'transgresses and disrupts the settler-colonial desire for territorial control' (2013, p.17) while also imagining alternative political futures around commoning through connections with the land. *Sumud* is used by UAWC's seed bank as a reference to steadfastness, an important component in the active resistance to the occupation. Tesdell argues practices of persistence extend beyond imaginaries of national sovereignty. I was reminded of this observing the forms of self-organisation and localised persistence across the West Bank such as in Wadi Fukin, where residents felt abandoned by the Palestinian Authority and self-financed and constructed a school, clinic, and mosque through community efforts rather than waiting for official authorisation. This frustration with national governance processes is also echoed by Leila's explanation for why UAWC's seed bank was set up: 'if we [UAWC] did not start more than ten years ago, we would have lost a lot of crops that we could save and protect' (Personal communication, 24 July 2019). Arguably this is another expression of worldly sovereignty, where according to seed bank practitioners, governmental authority cannot be relied on to look after its biocultural heritage. UAWC's seed banking interestingly reveals how practices of *persisting-with* incorporate scientific methods and situated knowledges to work against the occupation, rather than embracing supposed scientific neutrality. Plant science is not just used as a settler-colonial tool, as evident in many places across this chapter, but also actively integrated in persistence.

Radical Care



Fig. 5.25. Hebron inner city plot for women's self-help group pilot project. Photograph: the author, 2019

I witnessed an extreme example of this persistence amidst hostile climates on one of my last days at UAWC's seed bank. Through this moment I look at the formation and qualities of care in UAWC's practice in this final section. I accompanied the team to a meeting with a women's cooperative in the inner city of Hebron. Located between the only urban Israeli settlements in the West Bank, the zone where the group members live borders the settlement of Kiryat Arba. Residents usually must pass several checkpoints to reach their homes and are often subjected to acts of violence. More than at any other moment during this research did I feel the pressures of the occupation while being aware of my privileges in easily entering and exiting its spatial regime. Following up on the group's project a year later Leila and Nadia told me that after this initial meeting the group set up a successful thyme farm and produced a range of products grown from the two small urban fields we visited during the meeting (fig. 5.25).

Getting an understanding of the seed bank's work structures during these visits to beneficiaries, what was striking was the convivial and caring atmosphere across the team, especially the deep respect towards farmers and their knowledges. In UAWC's approach to the vulnerability of farmers a sense of solidarity and hands-on support was most important. It was evident that the core funding UAWC received from the Dutch government had greatly reduced

the stress on practitioners for the previous two years, the organisation had become less vulnerable itself. This organisational stability improved the care UAWC can give to farmers, and in extension to plants.

However, UAWC's funding situation has significantly changed since this visit in July 2019. In August 2020 the Dutch government announced a suspension of its funding to UAWC following a report by the Israeli organisation NGO Monitor (2020). Despite an investigation without findings into the claims made in the report the Dutch funding has not been reinstated. The report suggests a link between previous UAWC employees and the Popular Front for the Liberation of Palestine (PFLP), which is designated as a terrorist organisation in the European Union and United States amongst others. Following this, in July 2021 UAWC's main offices in Ramallah were sealed off by the Israeli government for six months. As discussed in the ethics section in chapter two, on 19 October 2021 Israel's Ministry of Defence declared UAWC, alongside five other humanitarian Palestinian organisations as 'terrorist organisations' without providing further evidence (Amnesty International, 2021), threatening both their present and future funding prospects and ability to operate. Ending up reflecting on the implications of this classification has been a sobering moment in considering the shifting, devastating political realities and formations of more-than-human politics I sought to trace.¹⁴⁶

¹⁴⁶ I thank Antje Scharenberg for a helpful conversation in reflecting on these concerns.



Fig. 5.26. Seed pulp after the seed extraction in Dura. Photograph: the author, 2019

Fig. 5.27. Serpent cucumbers after seed extraction in Dura. Photograph: the author, 2019

With this development in mind, it is important to return to the embodied persistence through care practiced by the seed bank. After the visit to the women's cooperative, I accompanied Leila, Hasan, Nadia, and Dina to the home of a farmer in the village of Dura. It is the same farmer whose seed reproduction field of serpent cucumbers I discussed earlier. The following moment of return to the deseeding of the rainfed cucumbers has featured as the opening vignette of the overall introduction to this thesis, a moment that was significant in how it fundamentally changed my understanding of seed banking. As we arrived in the sheltered and shady backyard of the farmer's house, a huge mountain of serpent cucumbers lay in a pile. Deseeding began by slicing the cucumbers in half and scraping the seeds and the attached soft flesh into a container. The cucumbers had been left in the fields for as long as possible, allowing the seeds to absorb more water which improves their germination behaviour. In scraping the insides of the large cucumbers, the amount of ground water they had been able to extract became tangible, slowly filling up the black plastic bucket in which we poured the seed and pulp mixture. Flies gathered on the pile of discarded cucumber bodies while a sweet

and heavy scent spread from their overripe remains. We poured the seed and pulp mixture into sieves and slowly washed away the pulp by massaging the seeds against the metal surface. I observed Leila and Nadia as they did this with great care, visibly enjoying being able to return to this haptic task of deseeding which their work at the seed bank usually does not entail. Once the seeds were cleaned from the pulp, they were left in the sun to dry before they were delivered to the seed bank. The deseeding process made tangible the bodily relief and grounding sense of dignity found in working with these rainfed seeds and the care that goes into their reproduction, distribution, and cultivation. This scraping of cucumber bodies deeply resonates with Azoulay's description of worldly sovereignty as 'care for the common world in which one's place among others is part of the world's texture' (2019, p.388), here inscribed into the texture of the cucumbers' flesh. To me, this moment gave a haptic quality to the different worldly textures of persisting-with seeds and their temporal cycles.

Reflecting on the labour of care observed here and the ability of rainfed seeds to grow deep reaching roots that can access low water deposits I want to conclude this chapter in proposing persisting-with through cultivation as an act of *radical* care. Radical here points both to the political quality of this care, and its etymological meaning from the Latin word *radicalis* as 'relating to or forming the root' (Oxford English Dictionary). 'Radical care' focuses on the connection of political practice to more-than-human soil and seed ecologies, and in particular the ways they escape visibility. Tesdell makes an interesting argument in suggesting that rather than just a laboratory for Israeli territorialisation, practices of persistence can be

fleeting laboratories for the question of sovereignty and territory. [...]. Thus, practice names the activation of a kind of botanical record in the landscape, only partly under human control, to carve out a new sense of self that does not correspond neatly to state-based political orders. It is constituted through concrete practice rather than abstract rights. (2013, p.194)

Arguably, what is being saved through radical care in UAWC's seed bank as a 'concrete practice' is a particular relationship to the world. In this sense radical care is not a performative gesture or image (as explored in the previous two chapters), but a practical necessity, an act that enables collaborative continuance. Crucially, this radical care operates outside of trust in official authorities and state bodies, as the previous section on sovereignty

has shown. Its ontology doesn't evolve towards the state form but other formations of collectivity and 'worldly sovereignty'; it is a critique of the state formation itself and cultivation of a different being-in-the-world. Worldly sovereignty has been important for my analysis because it remains open to conflicts and frictions between different models of sovereignty and their entanglements in colonial legacies and conceptions of the nation state. It is through spaces below the highly surveilled ground surface of the West Bank that radical care operates – hidden water cisterns buried in the ground, deep reaching roots of *ba'al* crops, the fig tree in Wadi Fukin that provides shelter from the gaze of surrounding settlements, and the soil seed bank of seeds awaiting germination. This resistance to visibility to the state, and the state's problematic vision of/for cultivation, at ground level has been one of the most successful strategies of persisting-with. As Leila pointed out, the duplicate of the seed bank's collection is 'in the field', often invisible, rather than as backups with larger organisations.

Ultimately, dehumanisation and the pressures of the occupation are slowly eroding the ability and willingness of farmers to care for and cultivate their lands while also materially eroding the soils. As Sami told me while we visited the land reclamation projects, a lot of farmers give up on cultivation after repeat demolition, contamination, or uprooting make the land unusable. Radical care as persistence is not an inexhaustible capacity of resilience; rather than a universal strategy it is a necessary subversive counterpart to mastery. This section has shown the importance and limits of persisting with radical care in how UAWC's seed bank considers relationality – with farmers and with the more-than-human constituents of its agro-ecologies.

Conclusion

What is UAWC saving its seeds for? What has emerged is an agroecological imaginary that is grounded in bodily sovereignty and a non-linear sense of time. Reflecting on seeds as carriers of biocultural heritage Leila's comment that 'seeds aren't just about the food they are producing; they are *deeply* related to culture' (Personal communication, 24 July 2019) stuck with me in how the evoked depth resonates with the rainfed seeds. Across this chapter it has

become evident that the culture of seed saving observed here holds on to the past while being denied a future amidst dehumanising, ecological violence. Thus, I have shown how the temporality on which UAWC's seed banking practice operates goes beyond anticipating future loss of diversity as explored in the previous two chapters on becoming-safe at the SGSV and preserving-with at the MSB. Instead, it works through a liminal post-catastrophic temporality where the repetition of growing cycles links memory and identification to land.

As a carrier seed the *ba'al* cucumbers have allowed a critical reimagining of questions of mastery and resilience by considering the role of the more-than-human in sovereignty. Azoulay's concept of 'worldly sovereignty' has been important in critiquing settler-colonial modes of domination and has allowed me to challenge the more-than-human politics encountered so far. This chapter has situated seed saving as an act of radical care amidst the ecological, affective, and territorial pressures of settler-colonial conflict. Through persisting-with this radical care seeks to avoid visibility and puts relationality and the preservation of more-than-human cultural heritage at its centre. Persisting-with in UAWC's anti-colonial seed banking practice brings together scientific expertise, cultural heritage narratives, and active resistance to challenge the apolitical framing of plant science in previous chapters.

In the following chapter on forest conservation amidst environmental conflict I will further explore seed banking in border ecologies to ask if the relationality of a forest can be preserved in seed banking. I propose that a focus on more-than-human politics can also reveal the anthropocentric nature of struggles for sovereignty in the nationalist protection of biodiversity.

Chapter Six

Towards Restoration?

Disturbance and Intervention in the Białowieża Forest Border Ecology

Introduction

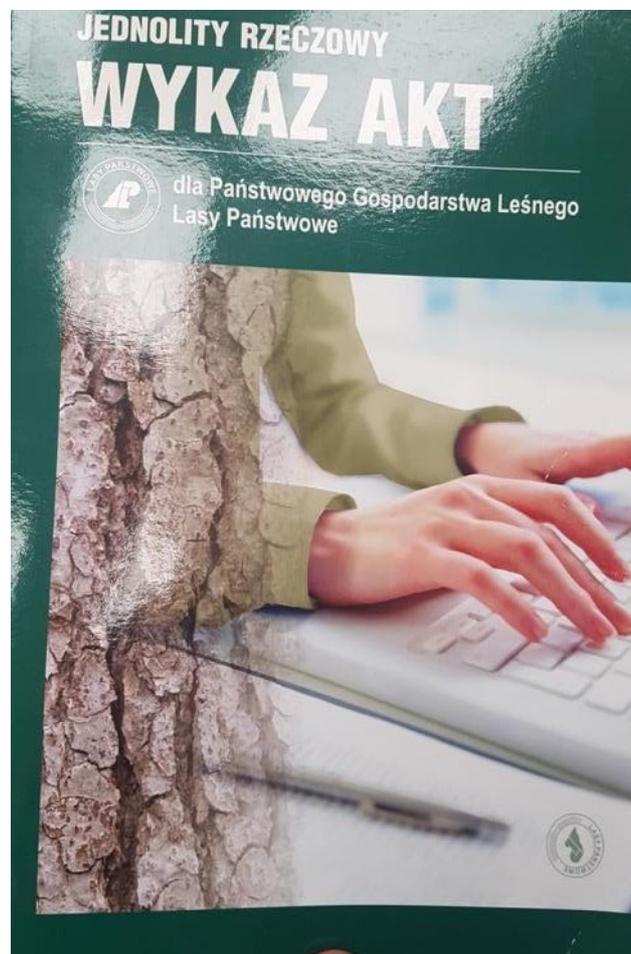


Fig. 6.1. Polish State Forests manual on data processing which translates to ‘List of Files for the State Forests National Forest Holding’. Photograph: the author, 2019

During the closing conversation of my stay at the Kostrzyca Forest Gene Bank (KFGB) in Poland in March 2019 I came across a document, the ‘List of Files for the State Forests

National Forest Holding’, issued by the Polish State Forests organisation (*Lasy Państwowe* in Polish; fig. 6.1). On the cover the typing hands of a worker merge with a pine tree in overlapping layers. The tree’s bark is semi-transparent in some areas. It blends into the keyboard and worker’s uniform, the textures of organic matter and technical instrument seep into one another. This assemblage of tree and human gives a possible image to the mastery of forest life through data, standards, and protocols. It encapsulated the management of and care for forests on a national scale that I had experienced at the forest gene bank – a technical and administrative human-vegetal ecology which opened questions of biosocial productivity, agency, and restoration in seed banking. Here I explore this under the overarching question of *can a forest be banked?* This chapter moves from the focus on seed banking protocols explored in the previous three empirical chapters to observe wider involvements in ecological conflicts, building on the discussion of border ecologies and nationalism in the previous chapter. It thus shows how seed banking practices make *interventions in the present*. To do so, I investigate a specific *conservation conflict* – the controversy surrounding the conservation and logging of the Białowieża forest – to explore relationality in seed banking.



Fig. 6.2. DNA samples in liquid nitrogen storage at Kostrzyca Forest Gene Bank. Photograph: Charles Pryor and the author, 2019

The Kostrzyca Forest Gene Bank, a unit of the Polish State Forests organisation, from 2017 to 2020 developed a project to conserve the Białowieża forest's genetic biodiversity in its cryo-preservation unit (fig. 6.2).¹⁴⁷ The project worked on molecular identification through DNA barcoding of selected species to create an inventory based on biological trace analysis. It stores seeds, tissue fragments, and herbarium specimens of herbaceous plants, mosses, and ferns. While the processes of seed treatment resembled what I observed in other practices across this thesis, the direct control of and interaction with forest ecologies was different here in that the forest gene bank is actively involved in *in situ* conservation, restoration, and the cultivation of trees. I visited the KFGB for one week at the end of March in 2019, observed *in situ* conservation projects, and conducted a range of semi-structured interviews with five practitioners to understand the approach to the management and conservation of the forest – as genetic and material resource and as a complex ecology.¹⁴⁸

Following this introduction, I investigate what it means to think with foresters and the forest through Macarena Gómez-Barris' (2017) 'intangibility of the forest', then map out the history of the Białowieża forest and cultural conceptualisations of forests more broadly, before focussing on disturbance, particularly Anna Tsing's reading of this (2015). This leads me to the KFGB's care for the Białowieża forest's genetic diversity before I close the chapter with reflections on national ecological imaginaries of restoration.

¹⁴⁷ Poland, after Romania, has the second highest amount of 'forest stands' in Europe. A forest stand is a forestry term for segments of a forest that share characteristics (such as species, size, condition, or age). The forest gene bank is a member of a range of international conservation networks, including the European Seed Conservation Network (ESCONET), founded by RBG Kew, as well as the European Forests Genetic Resources programme (EUFORGEN). The KFGB is also a focal point for the UN Food and Agriculture Organisation (FAO) on forest genetic resources. While much of this chapter focuses on care on a national scale, and the making of a national 'nature' by State Forests, these international collaborations are significant. The MSB has been an important partner in developing conservation protocols. Lech (as with other chapters, participants have been given pseudonyms across this chapter), the seed bank's director, stated: 'We are foresters, we almost knew nothing about dealing with herbaceous plants 15 years ago, it was *tabula rasa*, now we almost have 200 species and many populations, and we learned a lot from Kew' (Personal communication, 27 March 2019).

¹⁴⁸ Charles Pryor accompanied me on some of these interviews and visually documented the Kostrzyca Forest Gene Bank's practice for our collaborative film project *A womb of things to come and a tomb of things that were*, see note number 4 in the introduction to this thesis. Many of the images throughout this chapter are accredited to Pryor and allow for a more visual exploration in this last empirical chapter.

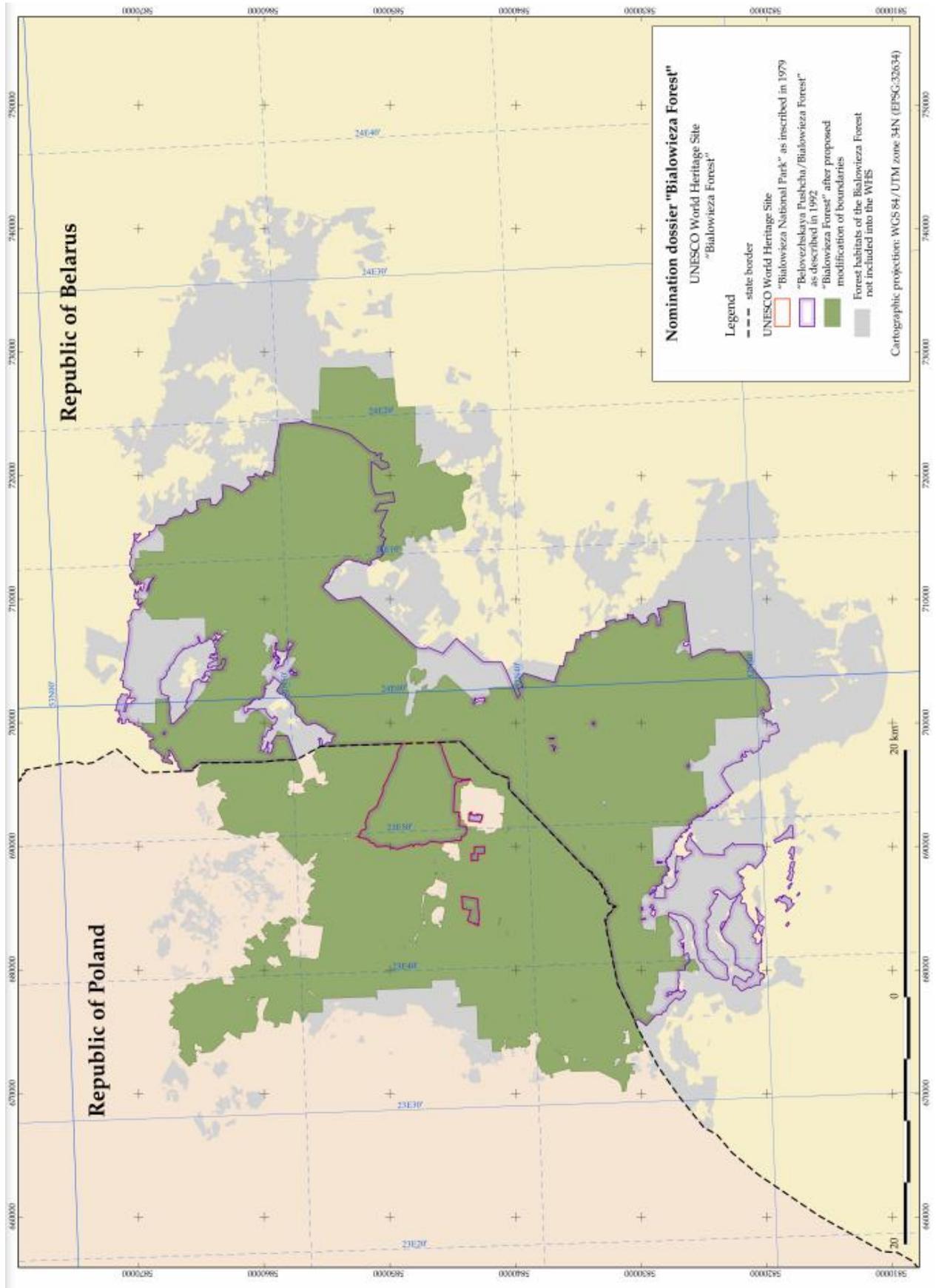


Fig. 6.3. Map of the Białowieża forest after an extension of the UNESCO site in 2014. Map: UNESCO, 2014, CC BY-SA 3.0 IGO creative commons license

To begin it is essential to introduce the Białowieża conservation conflict. Since 2016 the Białowieża forest, Europe's largest primeval forest, which stretches across the border in Eastern Poland and the Southwest of Belarus (fig. 6.3) and is partially a UNESCO world heritage site, has been a contested setting for divergent imaginaries of forest conservation, national nature, and diversity.¹⁴⁹ In spring 2016, in response to a spruce bark beetle outbreak the Polish environment ministry authorised the State Forests department to start 'salvage logging' of trees damaged by bark beetles in the unprotected area of the forest.¹⁵⁰ This led to intense protests and occupations in parts of the forests as campaigners feared for the integrity of Białowieża's ancient and biodiverse ecology and fought for international protection of the site.¹⁵¹ At present, the UNESCO world heritage site on both sides of the border has a strict human non-intervention policy. On the Polish side, outside the UNESCO site, the forest stretches further across three forest districts – Białowieża, Browsk, and Hajnówka – which actively manage the forest. It is in these managed parts of the forest, outside the UNESCO site, that the controversial salvage logging took place. On 17 April 2018, the Court of Justice of the European Union ordered the Polish government, led by the right-wing Law and Justice party (in Polish *Prawo i Sprawiedliwość*), to immediately stop its salvage logging operation to remove trees in the judgement of the case C-441/17 (2018).¹⁵² Throughout what follows I analyse the Białowieża forest as a *border ecology* where divergent imaginaries of 'nature' meet and overlap and ecological relationality escapes the containment of nation states.¹⁵³ In the

¹⁴⁹ 'Primeval' here refers to a multispecies, heterogeneously aged forest with high deadwood density that includes predators as well as old-growth species (Jędrzejewska and Jędrzejewski, 1998).

¹⁵⁰ Salvage logging is defined as 'removal of trees and other biological material from sites after natural disturbance events, [and] is an extreme case of clear-cutting appearing to be particularly damaging to the forest ecosystems.' (Mikusiński et al., 2018, pp.268-269). 'Salvage' also carries culturally inscribed ideas of rescue that will be interesting to keep in mind for this chapter.

¹⁵¹ Eunice Blavascunas' (2020) ethnography of the Białowieża conservation conflict offers an in-depth analysis of these protest movements alongside ethnohistories of the forest and a contextualisation within postsocialist developments.

¹⁵² The Law and Justice party has been in a majority government since 2015. Its politics have been populist, nationalist, and anti-environmental, and have resulted in multiple stand offs with the European Union. Salvage logging in the Białowieża forest followed the new Nature Conservation Act that came into force in 2017, which started large-scale logging across the country (Żuk and Żuk, 2020).

¹⁵³ In this border ecology tension, this chapter builds on the discussion of cultivation in Palestine's border ecologies in the previous chapter.

twentieth century the Białowieża forest was occupied by Russian and German military forces which removed large amounts of timber and oppressed local populations. This informs framings of ‘nature’ and ‘culture’, invasion, and national heritage in the present. The European spruce bark beetle (*Ips typographus*) outbreak rapidly affected Norwegian spruce trees (*Picea abies*) and, according to the Polish government, caused a dangerous disturbance to the forest ecology. However, ecologists have argued it was instead the logging operation that damaged the forest (Mikusiński *et al.*, 2018). In many ways the conflict that ensued between State Forests, ecologists, activists who occupied the forest, and the supranational bodies of UNESCO and the EU Court of Justice was an epistemic conflict around *productive* and *threatened* ‘nature’, between the disciplines of modern forestry and conservation ecology. At the centre of this were epistemically divergent discourses of *disturbance* and *intervention*.

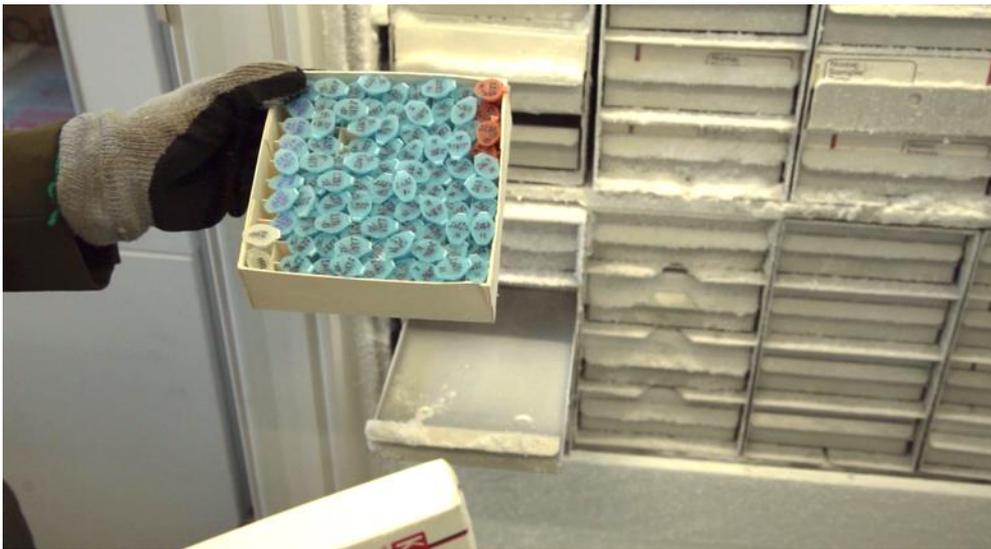


Fig. 6.4. Cryo-conserved needle collection. Photograph: Charles Pryor and the author, 2019

State Forests manages publicly-owned forests in Poland and is financially independent from the Polish government. It is the biggest forest organisation in Europe and has a strict three-tier hierarchy composed of a director general, regional directorates, and forest districts. It was established in 1928 and its holding totalled almost thirty percent of Polish territory (Blavascunas, 2020). In 1995 it was also the first forest organisation in Europe to build a gene bank for forest genetics. The Kostrzyca Forest Gene Bank is partially funded by State Forests

as well as by selling its seeds and services to forest districts. State Forests as an organisation gains its revenue directly from timber sales. It is thus deeply embedded in and dependent on a financialised 'nature' and the forest-as-resource. This points to an important intersection of nationalism and the financialisation of nature in this case study by turning forests into financially sovereign national spaces in the management of what I will call *national nature*.

Methodological Adaptations: Thinking with Forests and Foresters

I want to acknowledge that the place this chapter is centred in, the old growth Białowieża forest (in Belarus it is called *Belavezhskaya Pushcha*), remained at a distance during the research and writing stages of this chapter. I visited the forest gene bank and its surrounding forests, yet these are located 700km to the west of the Białowieża forest and a trip there was not possible.¹⁵⁴ The ongoing Covid-19 pandemic made travel impossible, and I accepted the tension of writing from a distance, of tracing relations remotely.

The forest provides a new entity to think with here. In comparison to previous chapters, it is one based on interdependence and complexity of relations. While relationality has been present in previous chapters, in particular at the MSB and UAWC, and is important to the carrier seed methodology, I am foregrounding it here through the forest ecologies the KFGB directly engages with. The forest offers an evocative overlap of imaginaries of 'nature', nation, and sovereignty. Building on the discussion of *persisting-with* as a practice of resistance in Palestinian seed saving, I have framed the formation of *becoming-with* explored here as *becoming-forest*. *Becoming-forest* speaks to the continuous ecological processes and relations that are needed to keep a forest alive. This process-relational framing asks if individual components of a forest can be extracted, suspended, or altered before the relationality of the forest is disturbed, or lost to disturbance. A forest here is a multi-layered, long-living collectivity of life forms, shaped by biosocial and biocultural forces and capable of

¹⁵⁴ At the time in March 2019, it was the first practice in the ecology of practices where I conducted fieldwork, and I had planned to return for follow up visits. Blavascunas' (2020) ethnography of Białowieża offers important direct engagements with local residents and is thus able to ground her analysis in the ethnohistories of the region. My focus instead will remain on the culture of conservation practiced by the KFGB as it relates to the conservation conflict.

complex communication, adaptation, and restoration across temporalities. In this chapter I therefore don't follow a carrier seed as in previous chapters but foreground relationality to focus on more-than-human dynamics of disturbance in the forest in order to observe power and care relations between *in situ* and *ex situ* conservation. In trying to understand the ecological complexity of seed conservation I draw on Anna Tsing's multi-sited ethnography of matsutake picking where she manages to simultaneously hold multiple scales in focusing on a specific species while considering its wider ecological and political entanglements. Tsing suggests that

species are not always the right units for telling the life of the forest. The term 'multispecies' is only a stand-in for moving beyond human exceptionalism. Sometimes individual organisms make drastic interventions. And sometimes much larger units are more able to show us historical action. (Tsing, 2015, p.162)¹⁵⁵

Following this, in an attempt to unravel the ecological relations of Białowieża, the forest itself becomes the focus as a historical, present, and future actor shaped by and responsive to human and more-than-human forces. In my overall investigation of more-than-human futures, ethics, and politics in seed conservation, the research question here then becomes: *can relationality be banked?* More specifically, *can a forest be banked?* And how does banking the forest relate to 'saving' the forest in its biosocial complexity? While previous chapters have shown that relationality often escapes seed banking protocols, this chapter observes how conflicting discourses of preservation frame the 'saving' of the forest in its relational complexity. These questions build on the previous chapter's discussion on biocultural conservation to now consider an example of more-than-human biosociality that has been shaped by extraction and disturbance. This chapter thus works towards a conclusion of what has escaped stabilisation in cryo-preservation throughout this thesis: in chapter three on the Svalbard Global Seed Vault I have shown the fugitivity of ecological vulnerability amidst cryopolitical fortification; in chapter four it became evident that meaningful futures disappear for banked seeds amidst the breakdown of collaborations in the face of organisational

¹⁵⁵ While Tsing uses 'multispecies' as a descriptor for the relations she analyses I continue to use the 'more-than-human' for consistency as they are often used interchangeably. See note number 2 in the introduction.

vulnerability as well as for recalcitrant seeds; and chapter five revealed how persistence through living cultural heritage in Palestine is carried into the future through foregrounding cultivation rather than cryo-preservation. I build on this analysis to suggest that conservation conflicts, such as those surrounding Palestinian border ecologies and the Białowieża conflict, can reveal different mobilisations of ‘nature’ and ‘culture’ in the freezing of seeds as divergent epistemic objects for different scientific disciplines. This chapter therefore offers the last segment in a cumulative opening to and troubling of the ‘relational’ in seed banking processes.

Situating this analysis in the conservation practice of foresters echoes the previous chapters’ thinking with food sovereignty activists (chapter five), seed conservation scientists (chapter four), and agri-scientists (chapter three) to capture the complexities of different scientific communities engaged in seed conservation as their epistemic objects. It continues the exploration of Haraway’s ‘becoming-with’ (2004), to trace how knowledges are produced in relation, in this case towards *becoming-forest*.

When driving to the KFGB complex in Miłków at the foot of the Karkonosze mountain range one of the first things I learned from Peter, who kindly helped to organise my stay, was that the incentive to start a gene bank for Polish forests came from an anthropogenic ecological disaster. As with seed saving in Palestine, conservation here is post-catastrophic: in the early 1990s acidic rains caused by surrounding heavy industrialisation and processing of raw materials brought irreversible damage to Polish tree stands, particularly in the Sudete mountains (Sienkiewicz et al., 2006; Korzybski et al., 2013). Consequently, the forest gene bank was established in 1996. Rather than anticipating the future loss of biodiversity it preserves and regenerates seeds of those tree species that survived the acidic rains. It focuses on the conservation of genetic resources of native forest-forming trees – particularly spruce, pine, fir, beech, oak, and birch – and shrubs, as well as endangered herbaceous plants and at the time of writing holds 239 species. The gene bank is thus much more informed by past ecological catastrophes and histories of forest management than future scenarios of biodiversity loss. It reveals banking as a response to the slow violence of anthropogenic

environmental change and as a means towards an ecological imaginary of repair and restoration.



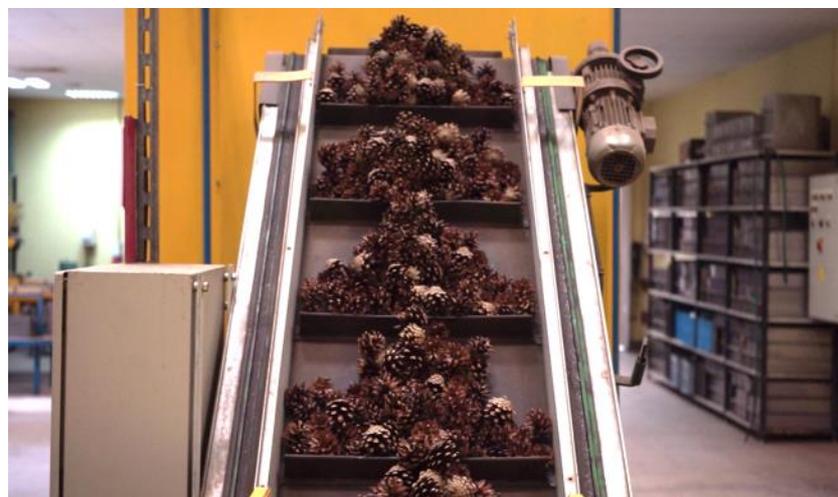
Fig.6.5. Entrance to the main building of the KFGB. Photograph: Charles Pryor, 2019, reproduced with permission

What I started to visualise in the initial conversation during the drive to the KFGB was not a rich naturecultural heritage of national forests but a toxic damaged landscape that, as Peter described, was increasingly suffering from water shortages and harsher summers. The seeds in the seed bank are stored and then distributed to regional forest districts for timber production. The buildings of the KFGB are arranged in a dark wooden complex surrounded by an arboretum, a reed bed system for sewage, and an extensive forest nursery. I noticed across multiple interviews that the foresters' personal commitment to the care for forests resonated with what I would later observe at the MSB in November 2019 – a scientific rigour and determination often paired with a feeling of helplessness in the face of environmental crises and their scale. The following personal reflection by Lech, the seed bank's director, stayed with me during explorations of the cold storage, new high-tech cryo-preservation units, the seed extraction room, seedling nurseries, seed plantations, and *in situ* conservation sites:

I love forests, I like plants. Personally, I have a garden and a piece of land, and I try to take care of that, it's a love-forever I would say. And of course, when I see that something has gone wrong with a piece of forest or a piece of land in general, even if

it's not mine or even if it doesn't belong to State Forests, it is someone's and it is destroyed and ruined, I'm sad. We try to do our best, also in doing educational projects, we try to do as much as possible to tell people how it works, that there's nothing wrong with cutting down trees when we recultivate the forest again. It's a living thing, the forest is a renewable ecosystem. (Personal communication, 27 March 2019)

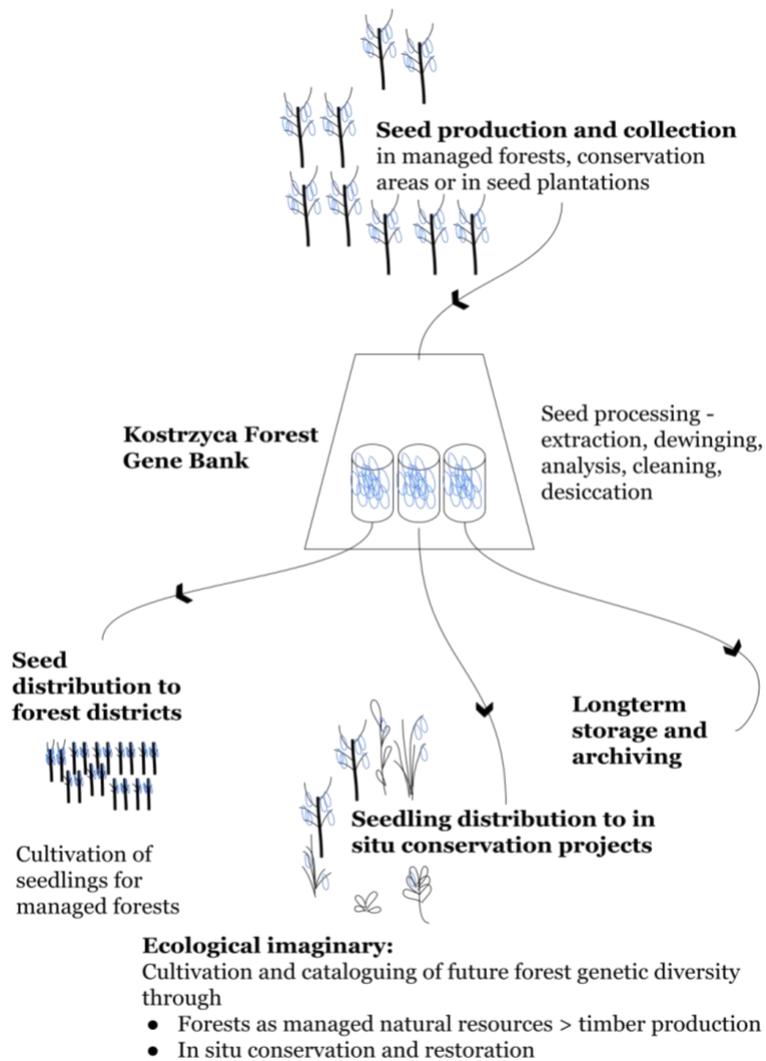
It is this deep care from the forester and respect for the forest that I want to keep present when discussing divergent perspectives on forest conservation, specifically surrounding the Białowieża conflict. I encountered multiple formations of the forest at the gene bank: a forest was a renewable 'living thing' as in the interview extract above that can be logged and recultivated, but also appeared as a 'forest in a box' when Peter prepared a small container of roughly 150,000 pine seeds for cold storage (Personal communication, 27 March 2019). The forest was also present as a genetic archive of DNA barcodes, and in a clone forest plantation. The following images show the movements of seed into storage, in sequence, as they enter the seed bank:







Figs.6.6-6.11. Seed processing at the KFGB in order of seeds entering the bank: from deseeding of cones to de-winging of seeds, to packaging of seeds in aluminium containers, to storage in the cold room at minus 18°C. Photographs: Charles Pryor, 2019, reproduced with permission



Diag. 6.1. Seed circuits at the Kostrzyca Forest Gene Bank. Illustration: the author, 2021

The temporality of seed saving at the forest gene bank is mostly built around flows and cycles of growth and harvesting rather than stasis.¹⁵⁶ In this management of forest economies, seeds leave the gene bank quickly and are purchased by individual forest districts to recultivate their forests (diag.6.1). The forest as a ‘renewable ecosystem’ in Lech’s words is approached pragmatically – it can be recultivated after trees have been extracted. Species that struggle in a specific location can be helped and might be better off elsewhere. Lech was particularly fascinated by this concept of ‘assisted migration’, described by the European Forests Genetic Resources programme as ‘transferring species or populations from a vulnerable site to a new site that is predicted to be more suitable under future climate projections’ (EUFORGEN, 2015, p.20). Lech believed that ‘conserving without intervention doesn’t usually work’ (Personal communication, 27 March 2019). Considering how the seed bank concept has an extractive tendency and operates through spatiotemporal delays this is an important statement for a masterful human-vegetal relation between seed collectors and ecologies. Lech went on to explain why some biodiversity expectations for rich ecosystems are unsustainable in the long-term in the forests he works in:

Very often it doesn’t work because sometimes the species for which the nature reserve was created is declining in nature reserves and it’s doing quite well in managed forests. Some species and ecosystem components *need intervention if we want to have it*. An example of such a situation is [the] wild service tree, which is a pioneer species and stays in the forest only for the beginning, for the first 100–150 years. And if we don’t do anything, there’s no natural disaster, no windfall, the species will die out, it has to. (Personal communication, 27 March 2019; emphasis mine)

I suggest, here ‘if we want to have it’ points to how, from the perspective of the forester, the forest as a living entity is constituted by a history of human interventions in and care for forest ecologies. What I observed across interviews at the forest gene bank was a deep respect for productive ‘nature’ and a belief that the health and productivity of forests can be managed through rigorous human oversight. Thus, the forest gene bank’s ecological imaginary is centred around a careful composition of future forest ecologies, their species composition, and resource value. Through its stabilisation of certain genetic materials in the present it

¹⁵⁶ This movement in seed circuits is similar to UAWC’s practice in the previous chapter.

assembles future forests and their genetic diversity. *It manages time and space through seeds.* In this context forest genetics are intricately linked to forest economies and their financial value.

The forester perspective is also embedded in State Forests' approach to the management of national natural resources. State Forests described the need for a DNA archive of the Białowieża forest as follows on its website:

The project's goal is to find fragments of tissues and seeds of the most precious plants within the Białowieża Forest area. [...] Most of the species selected for collection is [*sic*] currently endangered, therefore it is absolutely essential to secure their genetic resources in Kostrzyca Forest Gene Bank. Experts claim that because of the expansive spruce stands' dieback within the Białowieża Forest, it was the last chance to collect seeds and parts of plants from certain habitats. (State Forests, 2018a, n.p.)

This framing of the spruce dieback caused by the spruce bark beetle as the reason for the cryo-preservation of the forest's biodiversity is the crucial link for unravelling the power dynamics of *caring extraction* in the Białowieża conflict for this chapter. Which human and nonhuman actors are presented as *disturbances* and as *interventions* is important for understanding divergent projects of valuing relations in the forest ecology. In its justification for logging State Forests released a statement on its website which declared 'the foresters only carry out works in areas planted by *man*, those subjected to forest management for ages, or those which should be reshaped to better fit the local conditions according to scientists' (State Forests, 2017. n.p; italics mine). A feminist, non-anthropocentric critique of this statement which places all ecological agency on 'man' as a proxy for 'human' is needed. Indeed, State Forests has stated elsewhere that 'the forest is a work of man' (Żuk and Żuk, 2020) pointing to its anthropocentric notion of forest governance. Modern forestry is framed as a productive human mastery of the natural world. Often this mastery is described as care for vulnerable forests. Yet, the forest – its managed and protected zones – is assembled by many actors, whose agency and intentionality need to be considered.

Thus, while remaining with this 'thinking with foresters' (and its separate meanings on the level of the scientific practice of the forest gene bank and the political, national dimension of State Forests), the forest as such offers an important theoretical intervention here. There are differences in thinking with seeds, as spatially and temporally mobile, speculative capsules

as they were framed in chapter one, and in thinking with forests. The herbaceous plants, shrubs, and trees that seeds turn into have so far been put aside, as have their interactions with other life forms. This concerns in particular their biosocial complexity, temporalities, and situatedness. The time spans and life cycles of trees are different to herbaceous plants. ‘Trees are very special organisms’ Lech stated in addressing the ability of trees to respond to environmental changes:

they have huge adaptive potential. It’s incredible, not like herbaceous plants, it’s a completely different level. [...]. They can survive because they are long-living organisms. [...]. Within this time, in the process of mutation, new genotypes can appear, that are better adapted to local conditions and environmental change. They can stay for a long time, not suffering from the external factors. (Personal communication, 27 March 2019)

What is noticeable here is the spatiotemporal resilience Lech evokes both on the level of the place-based long-living organism and across generations in making genetic adaptations. How forests as living entities react to their conditions beyond genetic responses through forms of communication, defence, and awareness has been of increasing interest in recent research on mycorrhizal networks and tree communication (Mancuso and Viola, 2015; Sheldrake, 2021; as well as Struik et al., 2008; Marder, 2012; and Trewavas, 2014 for explorations of plant intelligence more broadly) and the socio-natures of forests inclusive of ecological and social complexity (Hecht et al. (eds.), 2014). Another scale for considering responsiveness, on a philosophical level is offered by anthropologist Eduardo Kohn, and his approach to analysing relations in *How Forests Think* (2013). He argues for not separating human and nonhuman entities in the forest in their capacity to respond to each other in what he calls an ‘ecology of selves’ and observes the many ways the nonhuman represents and expresses interspecies futures.¹⁵⁷

¹⁵⁷ This inclusion of vegetal ontologies in considering the more-than-human politics and vegetal agency of the forest also echoes Roncancio’s (2017) productive combination of multiperspectivism, animism, and Latin American legal theory discussed in chapter one.



Figs. 6.12.-6.13. *Hebeloma crustuliniforme* mycelium propagation at the KFGB. Photographs: Charles Pryor, 2019, reproduced with permission

In *Deforesting the Earth* (2006) Michael Williams argues that deforestation and the changing of forest environments is as old as humanity; forests have always been treated as a resource, particularly in a European context. They have often been cultivated for hundreds of years (Linebaugh, 2008) and exist across a range of thresholds, material and symbolic, that will be explored more in-depth in the following section. This creates an interesting parallel to the blurry lines of ‘wild’ and ‘cultivated’ in the earlier chapters’ focus on the harnessing of resilience found in wild relatives. European forests are naturecultures. Naturecultures, as explored in chapter one, are a concept Haraway (2003) uses to challenge the constructed duality of ‘nature’ and ‘culture’ to focus instead on relationality and inseparability. It

reappeared as a productive concept when Lech described human agency in the making of Polish forests as a careful assemblage:

In Poland almost 90 percent of forests which are established are artificially planted. It's not because we like that, it's because of the climatic conditions that we have here in the middle of Europe with very little rain fall, quite poor soils, 60 percent of the soils are sandy soils, covered with Scots pine. It's not easy to renew the forest naturally, so we plant forests. Some people say 'that's a forest plantation', no, it's not because gathering seeds from the stand we collect them from 50 to 100 mother trees. This way we conserve more than 90 percent of genetic diversity from the population. Ensuring that as well as suitable mixture of tree and shrub species for a given habitat, we can't call it a plantation. (Personal communication, 27 March 2019)

This *careful curation of forest genetics* and 'artificial' planting of forests is common across European forests. For the forest gene bank, it shows the sensitive relation between *ex situ* and *in situ* conservation. The genetic records of 'mother trees' also called 'plus-trees', are held in the seed bank's cold storage to recultivate forests across the country, *alongside* caring for these trees as living *in situ* objects of conservation. Diversity – intraspecies and interspecies – is valued in this approach to conservation: the KFGB cultivates a mycorrhizal substrate that it distributes to forest districts to improve tree-fungi collaborations (see figs. 6.12–6.13).

Forest ecologies remain managed by human mastery in this relational silviculture, a word which refers to the growing and cultivation of trees and aptly describes the blurring of 'nature' and 'culture' in forest cultivation. State Forests doesn't make explicit reference to the models of Natural Capital and ecosystem services, but these are implied in its care for a productive 'national nature' and emphasis on the cultural importance of trees. State Forests declared in its annual report from 2018 that forests are managed according to 'environmental' (regulation of water cycles, flood and soil erosion preventions), 'social' (health-enhancing, recreational, environmental education), and 'productive' (renewable biomass through timber and hunting) 'functions' (State Forests, 2018b). These functions clearly frame forests as resources. Forest ownership structure in Poland is 81.2 percent publicly owned with 77.2 percent of this land managed by State Forests according to the European Forest Genetic Resources Programme (EUFORGEN, n. d.). This far exceeds the European average for publicly owned forests as a consequence of the nationalisation of land during the Polish

communist government until 1989 which introduced the approach that forests are a collective public good (Żuk and Żuk, 2020).

Looking at the Białowieża conservation conflict specifically, it is necessary to consider the implications of what it means to extend the reading against mastery of human-vegetal ecologies practiced in the previous chapters to a place-based investigation in central Europe. The methodological adaptation I seek to make in this chapter is thus to analyse the Białowieża forest as a *postcolonial ecology*, shaped by, but not reducible to, different models of valuing, extracting, and preserving ‘nature’ applied by its occupying forces. While the ecological angle of this postcolonial reading is novel, Korek (2007) and Ureña Valerio (2019) have analysed Poland as a postcolonial space in recent years,¹⁵⁸ and Chari and Verdery (2009) have put postcolonial readings of Eastern Europe in relation with post-socialist scholarship, which was fundamentally informed by postcolonial theory. The wider framing of the postcolonial, rather than the post-socialist, is of particular relevance for the Białowieża forest as it went through different time periods of occupation and resource extraction by German and Soviet forces during the twentieth century, explored in further detail in the next section. Today, between national and natural heritage, the forest’s history of extraction is paradoxically both used as an argument for protectionist conservation and for further caring extraction, as will become evident.

Sociologist Macarena Gomez-Barris’ objective in *The Extractive Zone: Social Ecologies and Decolonial Perspectives* (2017) of analysing the complexity of what she terms ‘social ecologies’ alongside capitalist extractions is insightful here in relation to intervention in the Białowieża forest. These social ecologies describe shifting and adaptive relations between human and nonhuman life shaped by ‘networks of relationality’. Gómez-Barris’ analysis is rooted in a decolonial, ‘femme’, and queer approach towards Latin American extractivism where she observes a logic of national programmes of protection ‘with little understanding of the intangible complexity practiced by the vibrant social ecologies that reside

¹⁵⁸ Drawing from the work of the Subaltern Studies Group in India in the 1980s Ureña Valerio’s research is grounded in the field of postcolonial studies in its relation to the centres of power in Europe and the colonisation of Poland by German and Soviet forces.

within the forest' (2017, p.22).¹⁵⁹ These social ecologies have often been shaped by long histories of human involvement in the forest sphere. I want to add that the framework of social ecologies can be seen as inclusive of conflicts, rather than assuming the peaceful equilibrium often associated with the concept of 'ecology' in cultural readings of the term. Gómez-Barris explores a specific 'intangibility of the forest' in the Yasuní National Park in Ecuador that resists commodification and systems of scientific classification. Instead, intangibility describes a decolonial multiplicity that cannot be catalogued. Gómez-Barris has a Latin American decolonial positionality, rather than the above postcolonial framing, that observes the continuance of coloniality in the present through extractive practices. Intangibility is what 'escapes the condition of monoculture' (2017, p.18) and building on discussions of radical ecological agency (in Deleuze and Guattari (1987), and Maturana and Varela (1980)) 'reaches beyond reductionist models of representation toward enlivened social ecologies that [...] extend categories of biological life' (2017, p.18-19). In the following 'intangibility' is a helpful concept for approaching ecological complexity that resists categorisation, classification, and management in the Białowieża forest as an environment that also carries colonial trauma.

¹⁵⁹ 'Femme' here means a valorisation of 'nonnormative, embodied femininity' (Gómez-Barris, 2017, p.9).

Protection, Extraction, and Intervention in the Białowieża Forest



Fig. 6.14. European spruce bark beetle. Photograph: Gilles San Martin, Creative Commons license CC BY-SA 2.0. **Fig. 6.15.** Norway spruce tree. Photograph: Ivar Leidus, CC BY-SA 3.0 EE Creative Commons license, via Wikimedia Commons, 2011



Fig 6.16. Impact of spruce bark beetle on trees. Photograph: Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, CC BY-SA 3.0 EE Creative Commons license, via Bugwood.org, 2003



Fig 6.17. Still from State Forests video on the spruce bark beetle ('the dead trees are already in the forest'). Image: Screenshot Lasy Państwowe, *Dlaczego leśnicy muszą działać w Puszczy Białowieskiej?* (2017) https://www.youtube.com/watch?v=sJd7d3Z37ck&feature=emb_logo [accessed 27/02/2022]

Spruce bark beetles burrow deep into the weakened bark of spruce trees and build extensive tunnel networks where they lay their eggs (see figs. 6.14–6.16). Through pheromone release they signal other beetles towards the affected tree, and if conditions are right, this can lead to explosions in beetle populations across forests with large spruce populations. Usually, trees would be able to use defences such as resin, which is why spruce bark beetles focus on damaged, unhealthy trees. From an ecological perspective bark beetles feed on dead plant matter, therefore accelerating renewal in the forest, as well as feeding those nutrients from deadwood back into the ecosystem in support of preserving biodiversity (Müller et al., 2008). Spruce trees are often artificially planted in managed forests and in the Białowieża forest, the Norway spruce population is dominant in actively managed areas. Importantly, in the National Park zone of the forest, an area with a focus on non-intervention in ecological processes, the bark beetle impact was less noticeable (Mikusiński et al., 2018). Since the ecological relations of the spruce bark beetle are destructive yet beneficial for ecologies depending on the temporal scales of observation it is fundamental to trace how disturbance was instrumentalised by the Polish State Forests organisation to legitimise the salvage logging of the forest and its cryo-preservation project. A careful analysis is needed of this 'rhetoric of biological invasions' (Subramaniam, 2001). My analysis makes a small contribution to this in

looking at how otherness and calls for intervention are constructed in the Białowieża case in political readings of the situation that mobilise different temporalities. As Blavascunas suggests: ‘the forest mediates nostalgia and othering’ (2020, p.8).

The conservation conflict in the Białowieża forest is grounded in its inscription as a UNESCO world heritage site, which will bring to the surface problematic notions of ‘cultural’ and ‘natural’ valuation. The Polish side of the forest, which covers an area of 620 km² and was added as a UNESCO ‘property’ (this is the term UNESCO uses) in 1979. The Belarusian side was added in 1992 and covers an additional 870 km² to form one cross-border UNESCO site – what I refer to as a border ecology. Of this area only 105 km² are located inside the Polish national park, which has special protective status and is not overseen by State Forests (Żuk and Żuk, 2020) but the Ministry of the Environment instead. Only 16 percent of the forest is protected by the National Park (Szulecka and Szulecki, 2019). The UNESCO assessment noted in its 1979 report that the forest ecology offers a unique research site for observing undisturbed ecological processes given the age and *largely* undisturbedness of the old-growth ‘primeval’ forest ‘as a reservation from which all human interference is excluded’ (1979, p.6). In 1992, when the Belarusian side was added, the Outstanding Universal Value (OUV) of the forest was described as follows by UNESCO:

Its uniqueness stems from its *relative* biological richness and its *largely undisturbed* nature. BP’s [Belovezhskaya Pushcha, the Belarusian side] free-ranging herd of European bison is its third major feature and led to the World Heritage inscription of the Polish portion of the forest in 1979. The extent of old growth virgin forest found here is the largest in lowland Europe. (UNESCO, 1992, p.29; italics mine)

Rather than seeing the forest as an ecology that has been shaped by human intervention for hundreds of years, as State Forests will argue, the UNESCO heritage value of the site is grounded in the ‘relative’ absence of human intervention – a clear separation of ‘nature’ and ‘culture’. In the above statement human presence is framed as disturbance. This somewhat problematic assessment of heritage value can be seen in UNESCO’s list of heritage criteria, which are either purely cultural, or entirely natural.¹⁶⁰ What makes the primeval forest

¹⁶⁰ The two UNESCO world heritage criteria applied to the Białowieża forest are criterium IX and X:

uniquely 'valuable' are its long-lasting life cycles; as an uncultivated forest it contains twice as much deadwood as managed forest sections. These old, decomposing trees are crucial for high biodiversity, which turns the old-growth forest into a unique site for long-term ecological research.



Fig. 6.18. Extensive sanitary cuttings, wood extraction, and soil preparation after a Bark beetle outbreak in the Forest District 'Białowieża'. Photograph: UNESCO/C. Ossola, 27 September 2018, reproduced with permission



Fig. 6.19. Extensive safety cuttings in the Forest District 'Białowieża' with wood removal. Photograph: UNESCO/G. Debonnet, 27 September 2018, reproduced with permission

(ix)

to be outstanding examples representing significant on-going ecological and biological processes in [...] ecosystems and communities of plants and animals;

(x)

to contain the most important and significant natural habitats for *in situ* conservation of biological diversity [...]. (UNESCO, n.d)

This ‘undisturbed’ spatio-temporal uniqueness was disrupted in 2016 when, following the European spruce bark beetle population growth, an annex was added to the Polish Forest Management Plan that increased the timber harvesting limit substantially (Żuk and Żuk, 2020). On 17 February 2017 this was followed by Decision 51 by the Director General of State Forests allowing the removal of trees infected by spruce bark beetles and those that pose a safety threat or fire hazard (Żuk and Żuk, 2020). The salvage logging that ensued was stopped in 2018 following the EU Court of Justice decision. The multi-layered ecological impacts of salvage logging are complex and

may reduce or eliminate biological legacies, modify rare postdisturbance habitats, influence populations, alter community composition, impair natural vegetation recovery, facilitate the colonization of invasive species, alter soil properties and nutrient levels, increase erosion, modify hydrological regimes and aquatic ecosystems, and alter patterns of landscape heterogeneity. (Lindenmayer and Noss, 2006, p.949)

In 2018, a UNESCO Reactive Monitoring mission observed a harsh contrast in the Belarusian and Polish responses to the spruce bark beetle: ‘the Belarusian component of the property privileges a strict non-intervention policy, in line with the objective of maintaining unimpeded natural ecological processes forming an essential part of the property’s OUV’ (UNESCO, 2018, p.5). However, on the Polish side the mission noted that ‘these activities have disrupted the ecological and natural processes in the property and therefore have impacted negatively on the Outstanding Universal Value of the property’ (UNESCO, 2018, p.36; figs. 6.18–6.19). While logging was framed as local interventions in the actively managed parts of the forest, Mikusiński et al. showed through a cover change detection visual analysis the extent of forest loss. They argue that logging contributed to a 26 percent increase in fragmentation of the forest for the Natura 2000 protected area thus ‘the ecological impact of logging extends beyond the logged areas by modifying landscape structure and affecting ecosystem functioning’ (2018, p.266).¹⁶¹ Since the logging had already been suspended by the time of the UNESCO mission no further action was taken.

¹⁶¹ Natura 2000 is a European Union network of nature protection areas.

To conclude this analysis of the UNESCO status' impact on the conflict, I suggest that several problematic binaries and valuations emerge in the UNESCO framing. The notion of 'universal value' creates a masterful view of cultural practices and ecosystems. These are perceived separately rather than acknowledging human and nonhuman dependencies and collaborations – only exceptional ecosystems are protected. A similar paternalistic approach is noticeable in the use of 'property' in reference to all UNESCO world heritage sites to describe complex ecosystems and often culturally sacred heritage sites. Agro-ecologies and naturecultural assemblages slip through the gaps of these frameworks.¹⁶² Yet, the UNESCO status also creates an insightful zone of exception to national, territorial sovereignty as the EU Court of Justice decision demonstrates and opens an avenue for more-than-human sovereignty, as discussed in the previous chapter. However, continuing the discussion on 'worldly sovereignty' (Azoulay, 2019), the UNESCO status is not an embodied more-than-human expression of sovereignty, but an extranational, masterful sovereignty where 'nature' is conserved and protected from human interference.



Fig. 6.20. Abraham Bosse's etching for Thomas Hobbes' *Leviathan* published in 1651. Image: Wikimedia

¹⁶² This links back to the difficulty of conserving agricultural knowledges in the previous chapter on seed saving at UAWC in Palestine, where the UNESCO heritage status of Battir was compared to sites and practices that cannot appeal to this tangible cultural value.

After observing the divergent strategies of human non-intervention on the Belarusian side and salvage logging on the Polish side, it is crucial to backtrack to analyse the history of European forests and their enclosure and management before looking at Białowieża's past. In his analysis of subsistence rights, the 1217 Charter of the Forest, and a history of the commons, historian Peter Linebaugh (2009) describes a medieval European age of timber that depended on forests as the main source of hydrocarbon energy.¹⁶³ Deforestation in Europe later allowed the building of shipping fleets and subsequently enabled deforestation and commercial expansions in the colonies (Williams, 2006). Yet, Williams suggests that human land cover transformation through forest use is much older than this. Linking the management of European forests to Enlightenment philosophy Eyal Weizman analyses Abraham Bosse's etching for Thomas Hobbes' *Leviathan* published in 1651 (fig. 6.20). Drawing on Giorgio Agamben's analysis of the etching, Weizman describes deforested hills as a representation of the European imagination of the time: 'the forest line still marked the limit of sovereignty, the areas of productive economy and thus also the threshold of the law. Sovereignty could only rise over cultivated nature—that is, over a destroyed ecosystem' (2018, p.79). What is visualised is an ecological imaginary of extraction and mastery. Paulo Tavares also explores this liminality, suggesting that forests signify a threshold 'against which civilisation is defined' (2018, p.162). Tavares describes how the forest realm was incorporated into concepts of productive 'nature' that could be harnessed and managed as a resource: 'The forest was conceived and visualized as a *limitless resource terrain* open for capitalist exploits, on which a series of cartographic imaginaries, government discourses, and spatial strategies would be projected and implemented' (2017, p.129; italics mine). Both Weizman and Tavares link this imagined limitless terrain with imaginaries of enclosure, colonial economies, and the expansions of zones of sovereignty. Thus the export of European technologies for the management and classification of 'nature' also created its opposite: 'culture'. The very vessels that carried back plant germplasm from European colonies to build botanical collections were

¹⁶³ The Charter of the Forest gave subsistence rights for the use of royal forests for fuel, grazing, foraging, and hunting. It partially remained in place in England until 1971.

built from wood extracted from Europe's rapidly vanishing forests. Or, as Françoise Vergés argues 'we often forget that to build one slave ship a hundred oak trees had to be felled' (2019, p.94), directly linking European projects of forest management with the dehumanising economies of slavery, which are both conjoined in the term 'property'. These brief glimpses into the role of forestry in Europe make evident how European forests have been partially shaped by human involvement.

Lech's earlier thoughts on recultivation are echoed here in the management of forests and silviculture. He continued

It will never be natural as most forests in Europe are never natural. And it can still be beautiful. [...] Yesterday I was at the Institute of Dendrology near Poznan for PhD presentations about the biodiversity of fungi in nature reserves and managed forests, it didn't differ. It was the same, the spectrum of species was different but the number of species was the same. How should we do that? Should we only have natural forests? Then we would use the spectrum of species from the managed forests. (Personal communication, 27 March 2019; emphasis mine)

He emphasised a biodiversity of specific species that have adapted to human cultivation and histories of forest management. Yet, while some species might thrive in a managed environment, for many of those species present in the reserve, a managed forest wouldn't be a possible habitat.

Enclosure of the forest-as-resource can be traced throughout the history of the Białowieża forest, revealing afterlives of human intervention. Counter evidence to the UNESCO position of the 'undisturbed' forest traces human intervention in the forest since the fifteenth century on a commons-use basis – first through access rights to haymaking, beekeeping, and fishing, and with the onset of the industrial revolution for the manufacturing of products such as wood, tar, and charcoal (Samojlik, 2010). In 1811 large parts of the forest and its biodiversity were destroyed by fire. The following year Napoleon's troops passed through the forest and used it as a hunting ground. After that, Białowieża saw waves of largescale logging throughout the nineteenth century until it was officially protected as a hunting ground for tsar Nicholas II in 1888, mainly due to its remaining bison herds which were almost extinct elsewhere in Europe. During World War I Germany extracted 4.5 million cubic metres of timber via a newly constructed railway, followed by a period of Polish

governance of the forest that gave logging rights to the British company ETC, which extracted more than 1 million cubic metres annually (State Forests, 2017). In 1939 the forest became a Soviet nature reserve only to be occupied by German forces again during World War II when Hermann Göring imagined it as the world's largest hunting ground. After the war, it returned to the status of a nature reserve on the Polish and Soviet side. The histories hinted at here point to intervention in the forest across periods of occupation and the different ecological imaginaries at play during these stages of occupation. To what extent the ecological consequences of these occupations are still present in the forest is hard to say. As Gómez-Barris asks regarding Latin American decolonial forests, 'what do we really know about the invisible, the inanimate, and the nonhuman forms that creatively reside as afterlives of the colonial encounter?' (2017, p.xx). In response to criticisms of logging in Białowieża, State Forests emphasised the restoration of past damage:

The Białowieża Forest is a priceless treasure for foresters. For over 90 years, they have been striving to protect it and to repair all damages it suffered in the early 20th century. [...] If the foresters had not been persistent, many valuable parts of the forest wouldn't exist today. The Second World War was also tragic for the Białowieża Forest. In just two years of occupation, the Soviet authorities logged over 1.5 million cubic meters of timber. *Only after the end of war the nature, with the support of Polish foresters, could begin to heal the wounds made by the oppressors.* (2017, n.p., italics mine)

In the temporality and urgency of biodiversity conservation this is again a post-catastrophic framing as encountered in the previous chapter; a labour of care for damages inflicted in the past by invasive forces. It is worth analysing the above statement more closely. First, the invasive threats to the forest were consistently foreign and extractive. Second, foresters were able to support the forest's recovery. Third, paradoxically this history of extraction and injury to the forest is now used as a justification for further *caring* extraction, this time of deadwood resulting from the spruce bark beetle. Here, the forester, as an extension of the state, becomes an aid to the forest in a move that constructs the forest as vulnerable and abused. Białowieża is transferred into a realm of national heritage, where 'nature' is part of the national body, symptomatic of the nationalist populism by Poland's right-wing Law and Justice ruling party. State Forests' use of language is political here creating a biocentric bind that aims to heal the

connection between a protected ‘nature’ and the Polish people and that frames the Soviet occupation as the oppressors.

In *Exploiting the ‘Urwald’* (2012) environmental historian Thaddeus Sunseri explores German postcolonial forest management in linking Poland and Tanzania through the Białowieża forest as a case study. He states that paternalistic state control of forests has a long history in ‘claims about dying forests and wood famines’ (2012, p.332). In this way State Forests’ response to the spruce bark beetle outbreak echoes the caring-controlling constructed vulnerability of seeds in earlier chapters. Sunseri describes how after Germany’s loss of its African colonies in 1919, German foresters used the ‘Białowieża model’ to maintain scientific authority in international scientific forestry. He analyses the German occupation and management of the Białowieża forest as a model for tropical forest exploitation to be exported to the (now) Global South. The Białowieża forest is therefore intimately linked to the establishment of forestry as a modern science internationally. The management of the Białowieża forest economy was a spatial strategy since German forests were in need of conservation, which was made possible through deforestation abroad. Sunseri deconstructs the ‘Urwald model’ of the Nazi occupation – the Polish *Urwald* (translation ‘primeval’ or ‘virgin forest’) became a close-to-home ‘colonial laboratory of modernity’ (2012, p.324). The justification for forest use followed a colonial narrative of ‘mismanagement’ and lack of ‘technical knowledge’ that quickly resulted in labour coercion of the local population. It encapsulated the combination of ‘backward human populations and diverse, uneconomic hard-wood trees [...] a misnomer for forests that had a long history of human use’ (ibid., p.341) and proved challenging to colonists’ initial extraction plans. It is important here to directly connect the exploitation of ‘nature’ alongside its human inhabitants in a paradoxical relationship: ‘the Urwald model was premised from the start on economic imperialism that prioritised the protection of forests from peasant misuse while diverting peasant labour to forest work’ (ibid., p.308). Sunseri reveals how in many projects of extraction, violence against the environment goes hand in hand with violence against local populations, including the execution of Białowieża’s Jewish residents. Between 1941-1944 Białowieża became a human

and non-human ‘working forest’ (ibid., p.337), a *Wirtschaftswald* (translation ‘economic forest’) or *Kulturwald* (cultivated forest, or literally ‘cultured’) to fuel the energy needs of Nazi Germany.¹⁶⁴ But it was also a site of resistance. ‘Partisan guerrillas harried German forces and subverted production throughout the war’ (ibid., p.337), hinting at how the forest has long been a sphere where state sovereignty is challenged and undermined.¹⁶⁵ What this interlinking of present and past framings of the Białowieża forest as *in need of rescue and management* has shown is the denial of a long history of human-nonhuman coexistence in the forest. Arguably, it also shows the political use of conservation and forest management discourses in brutal nationalist projects on the basis of a rhetoric of human and non-human nativeness, purity, and usefulness.

Reflecting on the discussions of anticolonial, worldly and more-than-human formations of sovereignty in chapters three, four and five, this history of the Białowieża forest enables a challenge to the concept of sovereignty itself in state practices of ecological mastery. In *Against Ecological Sovereignty: Ethics, Biopolitics and Saving the Natural World* environmental philosopher Mick Smith contests through perspectives from radical ecology the very idea of ‘human dominion over the natural world’ (2011, p.xi). To clarify for the purposes of my argument, most seed banking practices create a form of mastery over the natural world and interference in its temporal patterns. But there is a particular dynamic in the *state protection* of ‘nature’ worth considering more in-depth here in the debate surrounding the Białowieża forest. Smith argues that states employ an ecological rhetoric for natural stewardship based on the ‘objectification of nonhuman nature as a resource’, where nature reserves become the exception against which nature-as-resource can be applied everywhere else. He observes the paradoxical quality of ecological sovereignty: ‘without all nature being

¹⁶⁴ It is important to note the equation of economics and culture in the term *Kulturwald*.

¹⁶⁵ There is another, geopolitical scale at which the Białowieża ‘Urwald model’ became a blueprint for human-forest-care. In the years after World War II German forestry science recovered fairly quickly from the impacts of the Third Reich. Arguably, this was due to the management of ‘nature’ being perceived separately to the racialised ‘management’ and extermination of people. German forestry science was influential in shaping the FAO’s forestry department and its practice of scientific hegemony whilst liberation and decolonisation processes were gaining pace in the (now) Global South.

initially assumed to be a resource, there would be no original justification for political sovereignty: And yet, without political sovereignty, so the story now goes, nature cannot be preserved' (ibid., p.xiii). Here, he sees a danger in how the declaration of 'states of emergency' is a political decision as to what constitutes a danger to a nation state and/or its people. According to Smith, the framings of risks and 'ecological crisis' by states, who are often implicit in bringing about these ecological crises, simultaneously protect states from ethical and political responsibility.¹⁶⁶ This echoes the many ways vulnerability has been instrumentalised across this thesis in the conservation of seeds. It is particularly resonant with the divergent crises and interventions surrounding the Białowieża conflict. The court decision in case C-441/17 found that Poland had violated the law in its obligations under the Birds Directive and the Habitats Directive for birds (here, a pygmy owl) that are particularly given to nesting in the Norway spruce trees. The EU Court of Justice decision brought a challenge to state sovereignty; the forest's UNESCO heritage status protected the forest from an extractive reconfiguration of the nature-as-resource and nature-as-reserve dynamic.

From 2016–2018 protesters and activist demonstrated in sections of the Białowieża forest in response to logging activities. This resonated with a history of alignment between environmental justice movements and experiments in commoning.¹⁶⁷ State Forests referred to the Forest Protection Act and described its response to protestors, who were criminally prosecuted until the EU ruling, as follows: 'people blocking work in the forest and staying in prohibited areas violate the law, so it is the duty of forest guards to intervene' (2017, n.p.). Żuk and Żuk argue in an analysis of the political discourses during the protests that 'the persecution of ecologists organising peaceful grassroots protests were a case in point that limiting civil rights and a crisis of democracy threaten prospects for environmental protection' (Żuk and Żuk, 2021, p.14). This is a clear example of the ecological emergency framework

¹⁶⁶ Rafi Youatt also speaks to this crisis discourse in *Interspecies Politics* (2020) where he argues that crisis environmentalism obscures questions of representation of nonhuman life. He calls for an acknowledgement of the nonhuman in international politics by considering states as practices, specifically interspecies practices.

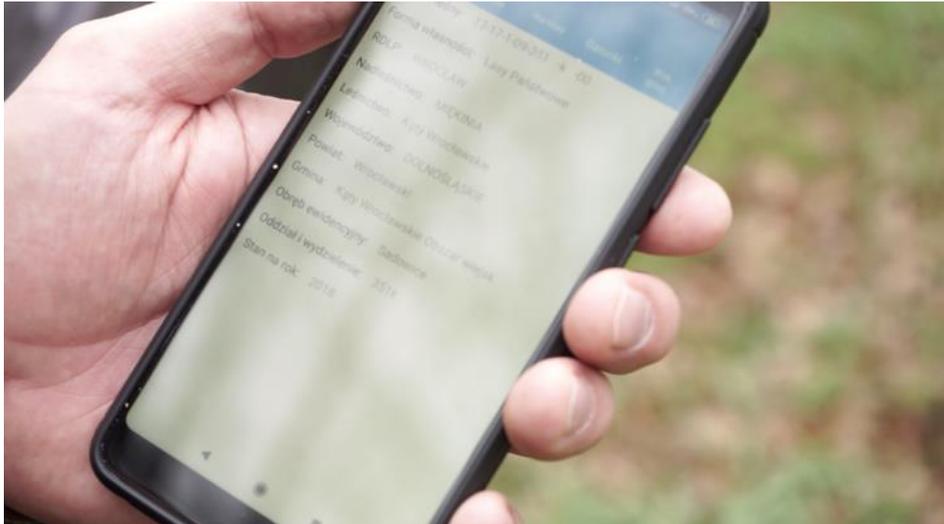
¹⁶⁷ See for instance Mauvaise Troupe (2018) and Joy Jordan and Isabelle Fermeaux (2021) for discussions of the occupied forest and wetlands declared as a Zone to Defend in Notre-Dames-des-Lands in France in the early 2000s.

discussed by Smith above and its application against human and nonhuman actors. Żuk and Żuk suggest that government intervention through logging feeds off a discourse of protecting local heritage and livelihoods. At the same time, it frames ecological conservation discourses and the efforts of activists to preserve the integrity of the forest as ‘cosmopolitan’ and ‘detrimental to national interests.’ The state position here is both undemocratic and anti-ecological and driven by an economic perspective of the forest that seeks to make the forest vulnerable, frames the protestors as a threat, and simultaneously extracts from the forest. This section has historically contextualised the Białowieża conflict and given an overview of its history of occupation.

Disturbance

So far, the Kostrzyca Forest Gene Bank’s DNA collection of the threatened plants of Białowieża has appeared detached from the conservation conflict. In the following I observe moments of the KFGB’s practice and sites of work to outline its relationship to mastery and the careful management of ‘nature’. I work with Tsing’s notion of ‘disturbance’ as it can make tangible the ecological precarity of the Białowieża forest on temporal and spatial scales.





Figs. 6.21–6.23. Visits to multiple conservation and forest management sites with KFGB team. Photographs: Charles Pryor, 2019, reproduced with permission

On one of the last days at the KFGB, Peter and Anya, a botanist who attended the seed conservation course at the MSB and was involved in the DNA collections in Białowieża, took me on a tour of different sites which the KFGB monitors or maintains. These included a seed plantation for silver firs, a Natura2000 conservation area for *Gallantus nivalis* (a snow drop that is protected but not endangered), and an actively managed seed stand for Scots pine (fig.6.23). Each of these sites makes tangible the blurry lines between monitoring ecologies and intervening in them more actively, and the spectrum of forest classifications from plantations to managed forests and nature reserves. They also show the wider processes of ecological care, intervention, and responses to disturbance tied to the cold storage seed bank

at the KFGB, thus pointing to how ‘the bank’ and its seed circuits relate to managed ecologies and create multiple futures for seeds and ecological imaginaries.



Fig. 6.24–6.27. Silver fir plantation and surrounding actively managed forest activity. Photographs: Charles Pryor and the author, 2019

When we arrived at the seed plantation the parking lot was surrounded by large piles of timber, waiting to be collected (fig.6.27). Peter clarified that these were logged in the surrounding forests and had no connection to the seed plantation. We climbed over a wooden ladder; the whole plantation was surrounded by a wire fence. Inside were 1600 silver firs (*Abies alba*), consisting of 250 genetically distinguishable trees, which corresponds with six to seven clone trees per individual genetic record. The seeds and the genetic diversity they contain are used in forest nurseries to grow seedlings that will be transplanted into managed forests.

Wandering through the plantation and looking at its gridded map I considered what this collection of clones implies for forest genetics overall where specific trees are reproduced to represent the genetic make-up of their variety in future forest ecologies. It was a somewhat eerie feeling returning to the notion of proxies for species explored in chapter three. In the seed plantation, the proxies are large organisms rather than small seed parcels. I wondered if there is a specific configuration of the Plantationocene at play here in what Haraway had described uniformly as

the devastating transformation of diverse kinds of human-tended farms, pastures and forests into extractive enclosed plantations, relying on slave labour and other forms of exploited, alienated, and usually spatially transported labour [...] moving material semiotic generativity around the world for capital accumulation and profit - the rapid displacement and reformulation of germplasm, genomes, cuttings, [...] plants, animals, and people. (Haraway, 2015, p.162)

Importantly, the Plantationocene of this seed plantation is *national* in scope in turning the forest into enclosed and managed spaces after the violences of the oppressive encounters outlined in the previous section. It is a practice of mastery that preserves specific genetic traits in curating future forest genetics for State Forests. In her multi-sited multispecies study of matsutake mushroom pickers, Tsing visits forests in the US, EU, and Japan where she observes ‘more-than-human sociality’ in the relationship between pines, matsutake mushroom, and their pickers. In a forest in Northern Finland, she describes what appears to be ‘an industrial tree plantation’ – clean and homogenous, ‘both natural and artificial’. Tsing explores what is lost in these approaches to the management of forests: ‘With modern forestry,

we forget that trees are historical actors. How might we remove the blinders of modern resource management to regain a feel for the dynamism so central to the life of the forest?’ (2015, p.168). Arguably, this ecological history and dynamism are what needs to be tuned into in the Białowieża conflict, specifically in how they relate to the framing of ‘invasion’ in the Białowieża forest (State Forests, 2016). State Forests has framed disturbance as that which necessitates the DNA collection project as a techno-ecological record of the Białowieża forest. Disturbance makes tangible the relationship to precarity in the Białowieża forest – past, present, and future. Tsing defines disturbance as

a change in environmental conditions that causes a pronounced change in an ecosystem [...] Disturbance can renew ecologies as well as destroy them. How terrible a disturbance is depends on many things, including scale. (Tsing, 2015, p.160)¹⁶⁸

Scales of disturbances are spatial and temporal – the spruce bark beetle ‘invasion’ is a disturbance, as is, arguably, the salvage logging that followed, as are the effects of anthropogenic climate change felt across Polish forests. Tsing explores the different geographic and epistemic understandings of disturbance in Japanese forestry outside of Euro- and US-centric conventions. She uses disturbance to reveal different layers and ecological imaginations of invasion, restoration, and scientific objects of protection. Rather than the state of emergency explored earlier in Smith’s consideration of ecological sovereignty, Tsing proposes that ‘disturbance is ordinary’ (ibid., p.160). In this unexceptional sense disturbance is multiple across this thesis, yet its implications are charged differently according to the practices’ ecological imaginaries. The water seeping into the SGSV tunnel was a technical disturbance to a practice of fortification in chapter three. The waste waters from settlements in Palestine were an ecological disturbance to a practice of persistence. Human-vegetal ecologies respond to these dynamisms and unpredictable events, often through practices of technical stabilisation such as seed banking. Tsing’s matsutake mushrooms flourish in

¹⁶⁸ This resonates with ecological definitions of disturbance that frame it as a ‘generic’ event, rather than extraordinary. Edward Rykiel Jr. gives the following definitions of ecological disturbance: ‘A cause; a physical force, agent, or process, either abiotic or biotic, causing a perturbation (which includes stress) in an ecological component or system’ (1985, p.364).

disturbance, as do the banana wild relative in chapter four. As Lech pointed out, cited earlier in this chapter, some species are better adapted to hybrid naturecultures of disturbance.

Yet, State Forests' response to the spruce bark beetle 'invasion' describes a different politics of disturbance, an ecological othering of invasive species. This instrumentalisation of disturbance on a national scale, of ecological dynamism, is maybe something Tsing doesn't anticipate when she suggests that 'restoration requires disturbance – but disturbance to enhance diversity and the healthy functioning of ecosystems' (ibid., p.152) as it places the control of what counts as healthy functioning with those who hold ecological sovereignty. Another level of 'disturbance' suddenly entered the forest in autumn 2021 when the authoritarian Belarusian president Alexander Lukashenko falsely offered Middle Eastern refugees passage into the EU via the Belarusian-Polish border. Poland closed its border and the Białowieża forest became the site of a humanitarian crisis and further fortification through border fence enforcements: refugees were trapped in the forest on the Belarusian side of the border in freezing temperatures for weeks, and at least 19 people lost their lives (Tondo, 2022). I'm unable to go into more detail here, but would like to explore this in more depth elsewhere as these developments are important for observing which humans and non-humans are framed as a 'disturbance' and othered by the Polish government.

The more-than-human politics of the Białowieża logging controversy describe a friction in what Tsing sees as 'the overlapping world-making activities of many agents, human and not human' (2015, p.152). The ecological imaginary of the foresters is asynchronous with the ecological imaginary of UNESCO and the ecological imaginary of the spruce bark beetle. The dynamisms of the ecologies they assemble differ in purpose, temporality, and diversity. Comparing the Polish to the Belarusian side of the forest the UNESCO monitoring mission noted that the Belarusian forest was flourishing and recovering after the spruce bark beetle outbreak. Norway spruce trees have mostly been planted artificially in the Białowieża forest, are less abundant in the National Park and more present in the managed parts of the forest, as are invasive species more generally according to the mission's report:

During the visit, the mission could observe the presence of invasive species particularly in the active management zone. In other areas where the active forest management is not permitted, the mission observed few invasive species. (UNESCO, 2018, p.31)

In the construction of national forests as natural heritage and forest genetic diversity this reveals that these flourishing species are often invasive species themselves, or species that have been artificially introduced, such as spruce and pine in managed forests. To conclude this discussion on disturbance ‘deciding what counts as disturbance is always a matter of point of view’ as Tsing argues (2015, p.161). I want to add, it is therefore crucial to observe the political dynamics, not just ecological dynamism, in how disturbance is articulated to establish vulnerability and mastery.

The divergent discourses of disturbance – the spruce bark beetle as disturbance versus salvage logging as disturbance – present in the affectively charged Białowieża conflict reveal multiple conservation paradigms at play. Crucially, in the Białowieża conflict these concepts are produced *in practice* and differ across the two sides of Białowieża border ecology. A fence runs alongside the Polish-Belarusian-border.¹⁶⁹ This means, for instance, that there are two distinct bison populations, however other species such as birds, fish, small mammals, insects, and wind- and waterborne seeds can cross the border. The two ecologies are entangled and porous yet politically separate spatiotemporal zones; they depend on different conservation approaches and their histories of extraction and the building of natural heritage differ. In explaining why intervention through extraction-as-conservation is necessary to respond to the disturbance of the spruce bark beetle State Forests stated that ‘research conducted within a strict nature reserve shows that leaving the forest to itself leads to reduction of biodiversity and disappearance of many valued species’ (2017, n.p.). How this reduction would unfold and which species would be affected remains unclear here. Fundamentally, the value associated with these species remains vague. In conclusion to this section, I suggest there is a liminality at play in how this value is constructed in the moment of disturbance.

¹⁶⁹ In a large-scale invasive operation this fence will be replaced by a border wall following the refugee crisis in the forest in autumn-winter 2021 (Tondo, 2022).

Care for Białowieża's DNA

The following observations of the practice of care at the forest gene bank explore the Białowieża DNA Barcoding project specifically to ask if and how the forest can be banked. The DNA barcoding archive is held at the forest gene bank, 700km from the Białowieża forest, and thus spatially removed from the conflict. Yet it makes tangible other dimensions of human-vegetal-ecologies in national forest care. During my stay at the forest gene bank practitioners in different units gave careful and detailed descriptions of the technical processes the seeds go through and the haptic and affective dimension of this work.

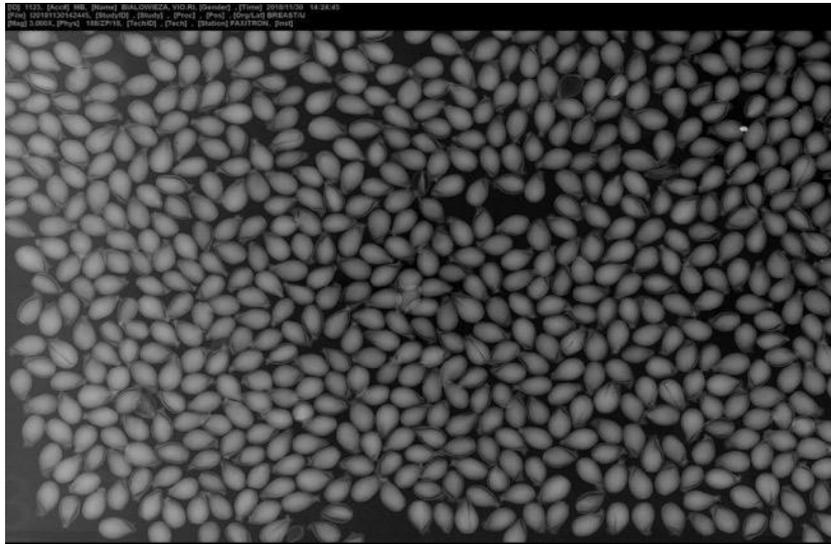


Fig. 6.28. X-ray seed testing. Photograph: KFGB, 2019, reproduced with permission.

Fig. 6.29. X-ray analysis of seeds. Photograph: Charles Pryor, 2019



Figs. 6.30–6.32. Germination and viability testing as seeds go through purity analysis at the KFGB. Photographs: Charles Pryor, 2019, reproduced with permission

Practitioners were extremely hospitable and often curious about what had brought me here from the field of Cultural Studies to the Polish forests as they walked me through the processes of seed extraction, seed quality testing, germination testing (figs. 6.30–6.32), and the recently expanded ambitious cryo-storage facility. In multiple conversations interviewees emphasised a wish for me to understand the importance of managed forests, of not demonising the cutting and recultivation of trees.





Figs. 6.33–6.36. Seed microscope analysis, and cryo-storage facilities of the Białowieża DNA project. Photographs: Charles Pryor, 2019, reproduced with permission



Fig. 6.37. Exterior of the new cryo-storage facility at the KFGB including liquid nitrogen tank. Photographs: Charles Pryor, 2019, reproduced with permission

To understand the Białowieża barcoding project I explored the DNA analysis laboratory and cryo-conservation unit. Here, Hanna, the head of the cryo-conservation unit,

and her colleagues introduced me to the DNA sequencing and extraction equipment they use, the new liquid nitrogen cryo-storage unit and what we jokingly referred to as their ‘cryo babies’ – oak embryos that were slowly waking up after being frozen. The scale of the cryo-conservation unit (all samples are preserved below minus 150°C) was considerably larger than what I had encountered at the MSB. Many tree species, such as oaks, are recalcitrant or sub-orthodox (beech, for instance), which makes liquid nitrogen storage at much lower temperatures essential.¹⁷⁰ Similar to the MSB’s work on the conservation of recalcitrant species explored in chapter four, the forest gene bank was considering the needs of recalcitrant species, those that cannot be stored under normal seed banking conditions. The unit had recently moved into a new building, a hall with a colossal door, ready for the future arrival of two large-scale nitrogen tanks. These, Hanna described, will – if funding can be secured – one day house a cryo-storage facility for two million samples operated by an automated arm. It was an ambitious technoscientific ecological imaginary that reminded me of the Cryosphere plans at RBG Kew and the prestige attached to cryo-preservation technology.



¹⁷⁰ While sub-orthodox seeds can be stored under the same conditions as orthodox seeds this only works for shorter periods of time because of thin seed coats or high lipid content.



Figs. 6.38–6.39. Oak embryos at varying stages of growth after waking up from cryo-preservation. Photographs: Charles Pryor, 2019, reproduced with permission

Observing oak embryos that were ‘waking up’ from cryo-preservation I was struck by how much care they needed to be ‘reactivated’, how much their organisms had slowed down (figs.6.38–6.39).¹⁷¹ Patience was needed. From the oak acorn only the *plumules*, the part of a seed embryo that develops into the shoot, can be preserved in liquid nitrogen. Prior to freezing all water content is replaced by sucrose and glycerol to avoid tissue damage from crystallising water. When emerging from ‘cryo’ the plumules need to be given hormones and nutrients to stimulate growth – everything that the acorn would have included as a survival package. I noticed that the small seedlings were not growing roots into their substrates. Hanna explained that this information was not included in the plumules – root development needs to be encouraged separately. These oak seedlings were fragile and vulnerable, revealing the level of dependency they entered when submerged in liquid nitrogen. Arguably, this is not the techno-fix solution cryo-conservation is often portrayed as but a slow labour of care for a species that would otherwise be hard to preserve. Yet, I want to contest, if this kind of invasion into the organism and separation of its parts is necessary for its suspension and continuance, what

¹⁷¹ During the demonstration of the gene sequencing equipment and DNA visualisations, the programmes and computers used repeatedly slowed down. I derived a strange satisfaction in observing this synchronicity between vegetal processes of metabolic slowing to *almost* stillness in cryogenic storage and a computational slowness in representing the associated data.

does this reveal about the nature of care for trees as active, dynamic ecological participants? The passive oak seedlings resonate with Carrie Hamilton and Yasmin Gunaratnam's hesitations around environmental ethics of care from a feminist perspective:

Care also carries with it the risk of turning the other into an object, a victim, and the carer into the rescuer. An urge to 'save' trees may frame other-than-human vegetation as 'passive participants' in their own destruction or salvation, rather than as active forces of environmental change. (Hamilton and Gunaratnam, 2018, p.3)

This 'saving' also echoes Thom van Dooren's (2014) notion of 'violent care', to which Hamilton and Gunaratnam refer. Van Dooren describes how conservation priorities for specific species according to threat assessments can be to the detriment of less valued species. But I want to ask here if there is another violence at play in the dissection and re-nourishing of oak embryos, not to do with the ethics of scientific processes of species selection but on the level of denying nonhuman agency, of compartmentalising and abstracting the functions of an organism and cutting it into separate parts. This dissection-as-care strongly echoes the discussion of Julietta Singh's notion of mastery that ran through the previous chapters, in particular her suggestion that 'mastery requires a rupturing of the object being mastered', (2017, p.10) in objectifying colonial power relations. After the compartmentalisation into pieces the oak plumules can continue living in the frozen realm; their organisms can cross thresholds inaccessible to human life. Considering Gómez-Barris' earlier notion of the 'intangibility of the forest', that which escapes what can be monocultured, colonised, and cultivated, this to me was a moment where a trace of this intangibility enters the frozen realm – beyond the record of individual species there is something about the intangibility of vegetal life, its cycles temporalities, and interconnections, that can carry into suspended states where human life cannot.¹⁷² Encountering the oak embryos and the complicated power dynamic of their care was therefore also a moment of appreciating the epistemic and ethico-political differences in what it means

¹⁷² During the tour of the facilities Hanna and her colleagues opened one of the fridges in the cryo-conservation unit. It appeared to be empty, they apologised and opened the second one as they joked 'we only have a body, no seeds'. There was an amusing pattern to these references to frozen human bodies that ran through my stay at the forest gene bank. Practitioners were clearly fascinated by the slightly morbid associations of freezing life and the fact that plants can continue to live in these frozen states.

to freeze and preserve these organisms in my cultural approach as a researcher and the forestry scientists I spoke to.

When listening to Hanna describe the Białowieża barcoding project I wondered about the restorative vegetal agency that Lech had described earlier as a ‘huge adaptative potential’ (Personal communication, 2019). From 2017 to 2020, DNA samples were collected from the National Park – the protected area, not the area actively managed – by State Forests to create a DNA bank of threatened and endangered species. DNA barcoding is an identification process that uses a short sequence of chloroplast or nuclear DNA which has high variability between species and low variability within species to identify an organism. This sequence is present in every cell and can thus be used to identify fragments. After DNA extraction barcodes are assigned to each species (figs.6.40–6.41). The organism is thus translated into its representation as digital data.¹⁷³ In January 2021 the collection project had just been completed and 105 species from the Białowieża forest have entered the bank which is stored in two small fridges in the enormous new cryo-conservation hall.

¹⁷³ This turning into data evokes a comment Peter had made, that the paper trail proxy of the seed bank, including seed passports and documentation, is larger in size than the actual seed collections in the seed bank – a paper bank that is also partially constituted of processed vegetal tissue.



Figs. 6.40–6.41. Herbarium specimens from the KFGB’s DNA barcoding of the Białowieża forest. Specimens include plant segments, in particular flowering stages and leaf structures as well as information about the DNA barcode location. Photographs: KFGB, 2017, reproduced with permission.

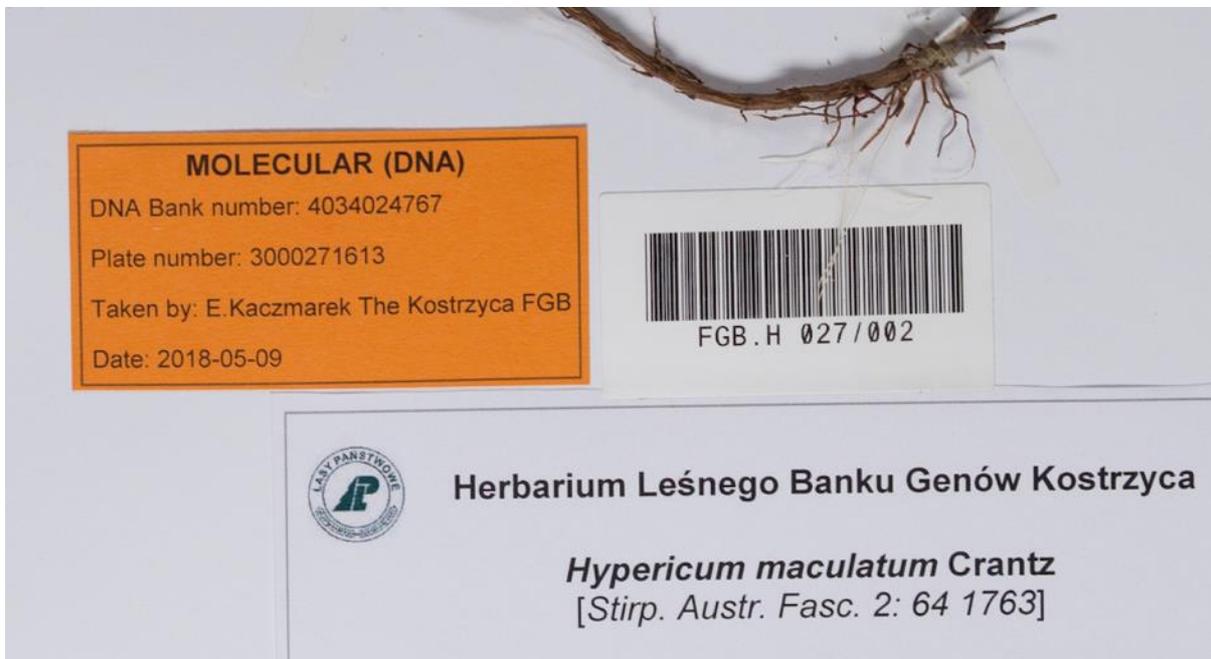


Fig. 6.42. Close up of the barcode from the KFGB Herbarium sheet. Photograph: KFGB, 2017, reproduced with permission.

For the Białowieża barcoding project, the focus is on assembling a DNA archive of endangered species; seeds for potential reproduction and restoration are also collected. For

the barcoding project futures for those seeds in the bank currently mainly exist as digital data, not as individual organisms. I was left wondering if the taking of a genetic record alongside simultaneous salvage logging of the Białowieża ecology in other areas was violent care of another kind – not on the level of gene bank practitioners but of the governance of the forest as an interconnected living entity that can be reduced to taxonomic data, archived, and reproduced.

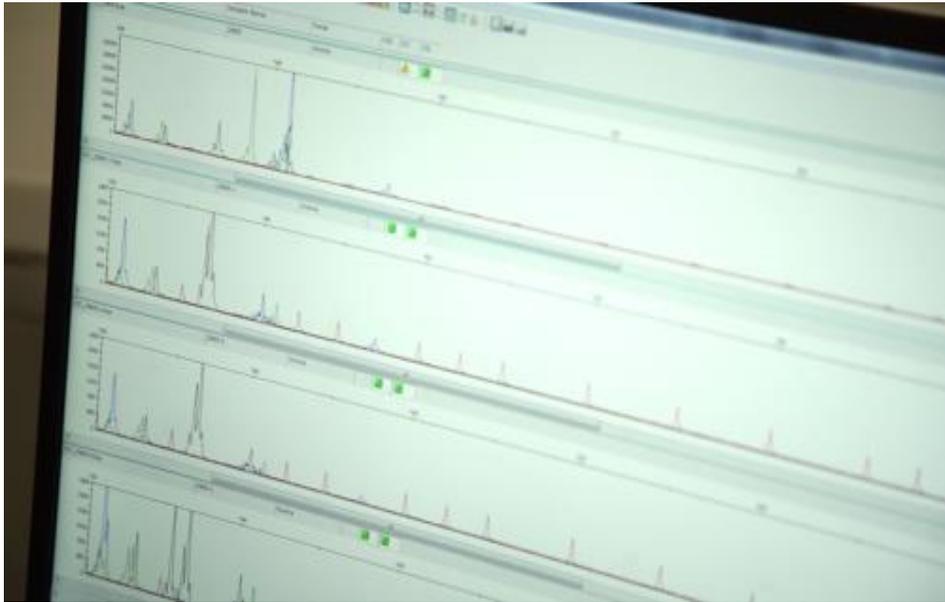


Fig.6.43. DNA barcoding process. Photograph: Charles Pryor, 2019, reproduced with permission

fragments have been collected (during my visit the archive contained seeds for 45 species out of 105). What will the future value of this genetic diversity be when plants cannot be grown from many of the samples?

After Cryo: Towards Restoration

Working towards a conclusion I draw out aspects of the KFGB's practice that work *with* biosocial entanglements and are acutely aware of the limitations of cryo-storage, pointing to the co-existence of multiple dynamics within one conservation practice. In a conversation with Peter, I started to get a deeper sense of the ways in which the biosocial enters care in the KFGB's practice, beyond DNA records of diversity and far away from the Białowieża conflict. We had just returned from the nursery where seedlings for different forest districts are prepared. Peter emphasised, again, that for him it was important to show that the labour of care in forestry isn't destructive but a careful cultivation and reforestation that also involves the cutting of trees. He described that in sharing his perspective as a forester, 'I think it's better to see the situation on the ground I feel. I don't want to convince you to my point of view, I want you to have your own point of view, to see the things and have your own opinion' (Personal communication, 29 March 2019). This sharing of ground-level perspectives and respect for our respective methods echoes the 'thinking with' foresters I introduced at the beginning of this chapter. I was reminded that the image of a falling tree is culturally more violent than the harvesting of crops. A tree can be a majestic organism, that grows over long periods of time, more akin to human life spans whereas the life of crops and annual vegetables is fleeting and seasonal. In some ways both are comparable if seen as forms of cultivation – *silviculture* and *agriculture* – outside the protected spheres of national parks and nature reserves.



Fig. 6.45. A *Cyclamen purpurascens* Mill. plant in the KFGB office cultivated from a cutting from the Góra Milek nature reserve located in Lower Silesia. Photograph: Charles Pryor, 2019, reproduced with permission

I asked Peter if, from a personal perspective for him the timelines of seed banking were about the present or the future.

P – I think gene banks are needed now and will be needed in the future. As I have told you and shown you, we have a lot of very visible changes in our environment here, even on a very local scale. And we collect the information from the books and publications about the size of protected species and then we go to the field and sometimes we cannot find the species anymore. That's very sad for us. So now we also want to collect seeds and prepare the seedlings for restoration programmes. We had these opportunities of producing seedlings since 2018, before we could only store seeds, now we can also produce seedlings.

MB – [interjects] so you're slowly moving into restoration?

P – It was an internal regulation of State Forests [until 2017], that gene bank means seeds and forest nursery means seedlings. But we don't want to produce 2 million seedlings of scots pine but 50 seedlings of a protected species. You understand the idea, yes? So, it's small scale to keep the population or even the species in Poland. (Personal communication, 29 March 2019)

He observed how the integration of conserving protected and endangered plants has opened a space for working on restoration for the KFGB, rather than just the reproduction of commercially sold tree seeds for the management of forest economies. This new interrelation between *in situ* conservation, restoration, and *ex situ* conservation was important for Peter – not just from a hopeful perspective on the importance of the gene bank's work but also scientifically in supporting ecological processes. What became evident here is a much more

co-dependent, tangible relation between cryo-storage collections and endangered populations than in the Białowieża barcoding archive. The shift towards focusing on restoration and *in situ* populations challenges both the State Forest position in the Białowieża conflict and some of the critiques of the cryopolitics of seed conservation that have repeatedly surfaced across this thesis. Van Dooren explores this paradox of forest conservation through banking in *Banking the Forest: Loss, Hope, and Care in Hawaiian Conservation* (2017), an ethnography of endangered species conservation. He argues:

While seed from ho‘awa (and a whole host of other species at risk) might itself be tucked away in freezers, the forest is a complex biosocial achievement from which individual species or even groups of plants and animals cannot simply be banked, thawed out later, and then slotted back in. The multiple interwoven and shifting relationships that constitute the forest—like any other ecosystem—cannot be put on ice. (2017, p.270)

Van Dooren criticises the reductivism of *ex situ* conservation in addressing relational complexity beyond ‘ecological’ or ‘cultural’ diversity. He is sceptical of attempts of banking the relationality of the forest, yet he concludes by hinting at how banking projects could become a more responsible intervention in the present, rather than a saving for the future:

my hope is that we might reimagine and rework [banking projects] in ways that would enable us to develop fuller forms of responsibility for all those things that we cannot quite hold on to and all those that we cannot ever restore. [...] In short, it would be a place that continually asks of itself and its practices, why and at what cost to whom. (2017, p.276; italics in original)

Hints of these imagined banking projects that acknowledge limitations and develop responsible relations to disappearance are present in all practices across this thesis. They are found in the moments when practitioners reimagine the flows and circuits of seeds, and in Peter’s statement above in connecting more with the restoration and support of *in situ* populations.

As the previous chapter’s consideration on vegetal plasticity has also shown, plants – and trees in particular – have unique abilities to respond to environmental processes. While it has become clear across this chapter that forest relationality – what has been discussed as the ‘intangibility of the forest’ (Gómez-Barris, 2017) – cannot be banked or put on ice, it has also become evident that cryo-conservation projects, like the forest gene bank, are increasingly

involved in the restoration of *in situ* ecologies. This chapter has shown that there can be no relational extractivism of genetic resources from their ecologies, that arguably the process of extraction itself removes relations through its reliance on the species category. But banking protocols can be developed that prioritise cultivation and restoration and are therefore actively engaging in the continuance of ecological relations. Yet, how and if ecologies are managed and restored depends on the ecological imaginaries of ‘nature’ and ‘culture’ they are based on (often this is a ‘national nature’ as observed in this chapter, or a ‘national culture’ as explored in the previous chapter), and how caring and controlling relations – of mastery, of dependency, or something in between – are configured when seeds re-enter the world after cryo-conservation.

Conclusion



Fig. 6.46. Turtle in the KFGB atrium space. Photograph: the author, 2019

The KFGB has a pet turtle that lives in a water feature in the atrium space of the forest gene bank (fig. 6.47). During my stay I often saw it swimming under the gene bank's large lettering. As I was told, to everyone's surprise, one day during my visit it decided to leave the water feature for the first time. Peter described how they were wondering whether to put it back in the water or let it explore the gene bank. We observed it for a while as it made its way across the room and members of staff who passed by were curious and excited. It was wandering, very slowly, away from its enclosure. Had the turtle suddenly become tired of its contained space? Was it missing something? This moment stayed with me as a friendly reminder of the complexity of living organisms, their agency, and the artificial liminality and detachment of human containment. It might offer a productive reflection on the limits to conserving and caring for ecological needs and relations that have run through this chapter.

What does the KFGB's work on restoration explored in the previous section mean for an ethics of care in ecological imaginaries of the forest? The practical care of restoration after cryo-preservation is now entangled with creating the conditions of where and how a species is able to survive. The conservation conflict surrounding the border ecology of Białowieża has shown a nationalist politicisation of more-than-human entanglements, of who gets to care and what care means here. In working towards a conclusion of this chapter it is important to recognise how close the salvage logging came to threatening the intangibility of the forest. Fragmentation in particular is detrimental to protecting ecological complexity across different management and conservation zones in the forest. Problematic value judgements about which species are preserved and which are not were grounded in questions of natural resource management throughout the history of the Białowieża forest. The complexity of Białowieża's social ecologies and its history of occupation have shown the limits of territorial and national sovereignty; as Smith argues 'the problem for national sovereignty seems to be the inescapable territorial permeability of causes and effects in an ecologically interconnected world' (2011, p.196). When considering this alongside the critiques of sovereignty as Euro- and anthropocentric explored in the previous chapter's discussion on 'worldly sovereignty', the fact that the right-wing nationalist Polish government was forced to stop State Forests' logging

campaign points to the possibility of situated formations of non-national sovereignty on the scale of ecosystems and small-scale restoration, but also across national borders. However, this challenge to a nation-state-based understanding of sovereignty was only possible by referring to the transnational sovereignty of the UNESCO property system, which carries its own problematic vision for how living value is upheld and constructed as either ‘natural’ or ‘cultural’.

This chapter has strayed somewhat from a narrow focus on seed banking practices to open up their wider involvement in ecological conflicts as *interventions in the present* and the complexities entailed in this. The border ecologies explored in this and the previous chapter have revealed conflicts as productive sites for deciphering practice-based constructs of what is worth saving, what is worth cultivating, and what is worth extracting. Transitioning towards a larger conclusion for this thesis, this chapter has shown the permeability of national ‘natures’ and ‘cultures’, diverging conservation practices, and more-than-human agency within this. I have opened questions of what a more-than-human understanding of the nation state and sovereignty might entail in practice in the Białowieża conflict and its framings of disturbance and intervention. In thinking with the forest, the Białowieża recovery in areas of human non-intervention has revealed the forest’s capacity for restoration and its agency in co-cultivation.

Yet, I have also argued for grounding these political analyses in concrete and haptic practices, as in the KFGB’s approach to forest conservation and management and its focus on transitioning towards restoration. Here, the discussed spatiotemporal human-forest-interventions such as clone forests, assisted migration, and restoration support arguments for a more-than-human forest that works with rather than against human practices in conceiving political capacities of more-than-human recovery. The KFGB has shown more tangible and situated seed futures than I was able to observe at the MSB and SGSV; seeds are actively cultivated, distributed, and returned as seedlings to restoration projects and managed forests. The fundamental shift this chapter has performed therefore is to integrate *in situ* conservation and restoration projects in following seeds out of the bank.

Conclusion: Beyond a World on Hold

Introduction



Audio 1. [Selection of sound recordings from outside the MSB's cryochambers](#) (follow link).
Recordings: the author and Tommie Introna, 2019

It started from a cold, oscillating hum. When I initially visited RBG Kew's Millennium Seed Bank (MSB) in the winter of 2019, I was fascinated by the soundscape of its cold storage chambers. The steady droning of the air circulation system was punctuated by a pumping sound, whirring extractor fans, and the constant buzz of cooling units. I imagined this extraction of air as the sound of removing warmth, literally *life*, until this life could be returned when seeds would eventually leave their frozen states. The cooling technology at the source of this soundscape kept seeds in cold storage chambers in their liminal states between life and death – a masterful form of techno-care that could go on forever, what Thom van Dooren (2017) terms 'technologies of stasis'. This humming sound of cryo-conservation gave resonance to the reassurance of a world on hold. I found out during the conversations that followed across multiple seed banking spaces that use a similar technology, that exiting from and maintaining this protective hold and liminal space is not as straightforward as it might seem.

What will happen to the seed banks that have been discussed here, their seeds, and worlds? During the last three and a half years, while the seeds that carried this research through the previous empirical chapters were frozen in cold storage spaces in the Norwegian Arctic, UK, Palestine, and Poland, the ground has shifted in the ecologies and worlds they

engage with – ontologically, epistemically, and politically. The moment of seed extraction in Dura and the yellow river of seed pulp that this thesis began from, feel distant. Yet, seed circuits, collections, and dispersals have continued, often amidst violent ruptures to the environments practices engage in. I highlight four such developments:

In September 2021, the Białowieża forest became the site of a humanitarian crisis at the borders of ‘fortress Europe’ in a political standoff between the Belarusian and the Polish governments. Alexander Lukashenko, the authoritarian Belarusian president, had encouraged refugees from Afghanistan, Iraq, and other countries to travel to Belarus (not a EU-member state) with the promise of entry into the EU through Poland. Poland was refusing the refugees asylum and entry, and in the process of militarising and fortifying the forest and surrounding border area. By February 2022, at least nineteen people have died in the cold conditions without shelter and access to food while the Polish government has sent 1,800 soldiers to control the area, installed barbed-wire coils, and enforced a state of emergency zone (Tondo, 2022; Neumayer, 2021). Journalists and aid organisations cannot enter this border zone. In derogatory language the Polish interior minister warned the public of the threat posed by those seeking to enter Poland through the Białowieża forest. In these violent events the forest has once again become a border zone for imaginaries of ethnic purity and othering where the protection of national ‘nature’ is practiced alongside dehumanisation and a dangerous withdrawal from public scrutiny. At the same time reports emerged that logging has been taken up again in the managed parts of the forest (Euronews, 13 October 2021).

At 3am on 7 July 2021, the head office of the Union of Agricultural Work Committee (UAWC) in Ramallah was raided and closed for six months by Israeli military forces (UAWC, 7 July 2021). UAWC continued its work from other sites, but alongside the funding suspension announced by the Dutch government in 2020, this shows the growing difficulties of operating the agricultural NGO and supporting its farmers in the continuous cultivation of crops. Moreover, in October 2021, alongside five other humanitarian Palestinian organisations, UAWC was declared a ‘terrorist organisation’ by the Israeli Ministry of Defence. These threats

to what I have described as *persisting-with* made possible through more-than-human collaborations are a serious obstacle to imagining futures for UAWC's seed saving in the West Bank. These developments in Poland and Palestine show the tensions of conservation and ideologically-motivated violence in charged nationalist spheres of *border ecologies*, the name I have given to ecosystems that cross the borders of separate nation states. Further research in both these cases is urgent and important for understanding nation states as naturecultural practices that mobilise selective notions of 'nature' and 'culture'.

In October 2021, the Crop Trust, one of the managing organisations of the Svalbard Global Seed Vault (SGSV), announced a new scheme to encourage crop collections (such as NGOs, community seed banks, Indigenous organisations, and universities) in lower- and middle-income countries to create safety deposits at the SGSV (Crop Trust, 4 October 2021). What will be the implications of more and more collections of alternative, and from the SGSV's perspective *valuable*, formations of diversity and sovereignty – such as the Cherokee Nation's seeds deposited previously in 2020 – entering the SGSV's cryopolitical imaginary of fortification while their worlds are slowly eroding?

In early 2022 RBG Kew planned to release the report produced by the Decolonise Kew working group, although it seems this date keeps getting extended. Amidst a climate of culture wars and funding precarity this report will not use 'decolonisation' in its title and throughout the document following the removal of decolonisation from the *Manifesto for Change* (2021a), and instead focus on diversity, equity, and inclusion (Dhanda and Boschen, 2021). In one way this can be seen as a sensitive stance: how could a global botanical institution claim decolonisation without a radical rebuilding? Alternately, I argue it also speaks to the complicated and disturbing entanglements of an increasingly authoritarian and racist UK government and the funding for public conservation institutions.

What these developments make evident is that the cultures of seed banking practices are not static. Instead, practices directly contribute to these complex, politically and culturally contested understandings of what vulnerability and diversity are and how they are valued, of who gets to care and who gets to receive care, and how formations of sovereignty shift and can

absorb each other. Fundamentally, these developments point to the urgency of taking seriously the transformations initiated and the persistence practiced by the ecological imaginaries I have explored in this research. This conclusion thus starts from acknowledging the dynamics the practices I observed are actively engaged in *in the present moment*. Becoming-with in seed conservation is as much a reconfiguration of the present as it is of the past and future.

While existing scholarship on seed banking practices has strongly focused on biopolitical and infrastructural aspects of banking (Curry, 2017; Peres, 2016; Harrison, 2017), my analysis has sought to contribute to research on the tactile and caring relationships (van Dooren, 2009; Chacko 2019a; Lewis Jones, 2019) that constitute organisational practice through following the seed circuits, and departing from this, to describe how ecological imaginaries and more-than-human ethico-politics are practiced in these formations of care. I have argued that what had been overlooked so far is what I have described as an ecology of seed banking practices, composed of the relations between practices and their shared and conflicting ethics and cultures of saving. Whilst practices grapple simultaneously with the loss of biodiversity, tracing the seed circuits has shown that the ecology of seed banking is shaped by different conceptions and practices of vulnerability, sovereignty, and mastery.

In what follows, I discuss how the more-than-human and the anti-colonial have met in seed banking imaginaries to reflect on what focusing on collaborative survival and shared loss could entail. I then retrace what the method of the carrier seeds has revealed about seed circuits, before discussing what wild relatives have made evident regarding understandings of diversity. I then present considerations on seed banking as a spatio-temporal intervention where the dynamics of stabilisation and transformation diverge. This is followed by discussions of formations of recalcitrance to conclude this thesis by reflecting on the potential of thinking with more-than-human worldly sovereignty.

Retracing Seed Circuits: Towards a More-than-Human, Anti-colonial Worldliness

How do conservation practices make sense of the scale of ecological crises; or, put differently, as the overall research question of this thesis has asked – *what are seed banking practices saving (for)?* This research had two set tasks. First, to explore the practices of care of seed banks and their objects of saving across temperature, material states, and zones of sovereignty. And second, to link these caring ontologies to ecological imaginaries of present and future human-vegetal relations, including those of conflict and violence, their more-than-human politics, and ethics. Exploring these two strands of questioning alongside each other was possible through framing each seed banking practice as a constellation of becoming-with where material states and ecological imaginaries were intimately linked. I have shown throughout that seed banking practices manage time and space through their care for seeds. *They are spatiotemporal ecological interventions.*

What has become evident in the empirical chapters, beyond a surface of ‘cold optimism’ (Radin and Kowal, 2017) as a hopeful trust in technologies of preservation, is an acute awareness of collective vulnerability amongst practitioners. Beneath seed banks as positivist insurance policies moves a time-sensitive urge to imagine and enact alternatives for human-vegetal relations. Throughout the previous chapters I have explored these undercurrents as *ecological imaginaries*. Ecological imaginaries are about storytelling and organisational rhetoric, yet they also create real, material consequences. This rhetoric describes how present and future ecosystems will be curated and assembled through the archives of data and dormant life held in seed storages. Each of the seed banks analysed here has told a different story of the protection of biodiversity and future assemblages of ecologies. As the discussions about what’s at stake in ‘remaining in the world’ in the empirical chapters have shown, these imaginaries can seem passive and extractive in how they respond to loss – seeds are removed from their ecosystems to be kept safe in banks with the hope that someone in the future will have the capacity to cultivate them. Retracing the steps of the previous

chapters, across the cryosphere through the seed circuits, collection, containment, and cultivation, what are the imaginaries that these practices create?

The SGSV is assembling a vision of protected genetic data for future plant breeding. It claims to be preserving seeds *forever*. In my exploration of *becoming-safe* the vault has revealed the limits of human mastery and the ‘forever’ temporality in the face of ecological vulnerability. It showed the absorption of struggles for biocultural sovereignty into ‘genetic resource communities’ through an iconic imaginary that saves vegetal diversity for a future humanity. A more-than-human perspective through the Cherokee Trail of Tears black bean opened a politicisation of food security in challenging the future uses of seeds held in Svalbard. Yet, it also became clear that most seeds held in the vault are not grown in fields anymore. Instead, we can see a living archive of agricultural memory where seeds are trusted as multiplication technologies, primarily used in future breeding programmes.

The MSB is striving to collect living records of the totality of global wild plant biodiversity, painfully aware of the impending loss of many species in the wild. The analysis of *preserving-with* internally challenged the understanding of seed banks as ‘insurance policies’, as they are often described in statements issued by seed banks.¹⁷⁴ Through a focus on vulnerable listening to practitioners, of listening ‘against mastery’ drawing on Julietta Singh’s ‘vulnerable reading’ (2017), both the absence of meaningful futures for seeds as well as the affective impact of loss became clear. The ecological imaginary that emerged here then through following the banana wild relatives is one of collaborative survival amidst organisational vulnerability. In acknowledging the absence of relationality in *ex situ* seed conservation, practitioners were acutely aware of the limitations of the cold storage conservation imaginary. Amongst these relational concerns, with shifts towards restoration and the reintroduction of seeds, a tension emerged between the outwardly advocated masterful insurance of seed banking and the internal pressures this creates for organisations and individual practitioners.

¹⁷⁴ In relation to insurances and backups it would be particularly interesting to further explore in future research the idea of indebtedness (of those who have extracted seeds) from a decolonial perspective.

Following this, the discussion on seed saving at UAWC's seed bank in Palestine demonstrated a vastly different proposal of circulation, sharing, and open access to seeds. The future ecologies imagined here are grounded in histories of co-cultivation, persistence in hostile conditions of settler-colonial border ecologies and struggles for food sovereignty. Following the dispersal and circulation of seeds across the Palestinian West Bank challenges Eurocentric temporalities of seed conservation for future catastrophes to ask what if this loss of one's world has already happened. *Persisting-with* can be an unmasterful collaboration with the more-than-human, a relational practice of radical care. The relation between seed conservation and access to land arises as a significant link in grounding imaginaries of sovereignty in a cyclical temporality of co-cultivation. The agroecological imaginary encountered here is embodied and connects memory and identity to land.

In the last empirical chapter, at the Kostrzyca Forest Gene Bank (KFGB) in Poland, what is being saved is the genetic record of an ancient forest. The conservation conflict around the Białowieża forest revealed the impossibility of containing the complex relationality of forest ecologies – the 'intangibility of the forest' in Macarena Gomez-Barrís' (2017) terms – through seed banking if it is only approached as a genetic archive. But it also pointed to how banking can holistically feed into larger projects of restoration and *in situ* conservation. What I discovered is a non-homogenous, sometimes nationalist, ecological imaginary of productive 'nature' in the governance of the State Forests department that was forced to respect the extra-national sovereignty of the Białowieża forest through its UNESCO world heritage status in the conflict surrounding logging in the forest. The imaginary of a 'national nature' that can be extracted from, banked, and put to work, was challenged by the ecological interconnectivity of the Białowieża forest. The haptic care observed at the forest gene bank also revealed how seed banking is an intervention in the present and often into the organism, as in the case of the cryo-preserved oak plumules. It actively shapes *where* and *how* species survive on a localised scale. This care is based on a view of forests as adaptive, resilient, and responsive to human interventions, yet in a way that foregrounds diversity as a means to ensure forest productivity.

Seed circuits in the chapters on seed saving in Palestine and forest conservation in Poland have revealed the permeability of national ‘natures’ and ‘cultures’ through the agency and complexity of vegetal life. In both cases divergent conservation practices in border ecologies have revealed how seed banking is embedded in wider, often conflicting, imaginaries of ‘nature’, ‘culture’, sovereignty, and cultivation. Thus, the plurality of ecological imaginaries ranges across scales from the protection and survival of *individual species as genetic data* to the conservation of *relational (agro)ecological complexity*.

As a conservation technology seed banks are designed around ‘species-thinking’ (Chrulew, 2011) in the preservation of representative genetic data, rather than of individual seeds or relational care, although adaptations to this logic are beginning to take place (chapters four and six). What is also included in these imaginaries is the reality of extinction, ecological collapse, and erasure rather than escapist retreats from these threats. Sometimes this includes the continuation of practices of mastery over ‘nature’, often through ongoing coloniality. Yet gaps and challenges to this approach exist. The MSB and UAWC’s seed bank especially, have shown in very different ways that imaginaries and material practices can be grounded in collective vulnerability leading to the emergence of new ethical imaginations.

Reiterating Donna Haraway’s discussion in *When Species Meet*, becoming-with is a process ‘where who is in the world, is at stake’ (2008, p.244). Ecological imaginaries shape these becomings, ‘we can think of becoming-with as an *ecology*’ (Wright, 2014, p.279, italics in original). I have proposed that the overlaps, exchanges, and movements – of life forms and practices – across the empirical chapters assemble an ecology of seed banking. What I have shown across this ecology is that ‘being in the world’ can be ‘worldly’ in Haraway’s sense of a noninnocent troubling and more-than-human becoming grounded in feminist STS. Yet, it can also be ‘worldly’ in Ariella Aïsha Azoulay’s sense of an anti-imperial, localised practice of persistence, of ‘worldly sovereignty’ through ‘intimate knowledge of the world’ (2019, p.388). This duality of ‘worldliness’ – of the more-than-human and the anti-colonial – describes some of the ecological imaginaries that seed banking can shape and intervene in. Seed banking in struggles for sovereignty can be a practice of *becoming worldly through persistence, of more-*

than-human worldly sovereignty, both as a remaining in the world in diverse, caring, and complicated ways and as a transformative resistance to other forms of extraction, loss, and extinction.¹⁷⁵ My reading of, and vulnerable listening to, these practices has sought to open Haraway's notion of 'world' to political tensions and formations of sovereignty. It has also introduced considerations of the more-than-human, agency, and collective vulnerability into Azoulay's concept of worldly sovereignty. In this way I have worked towards a more-than-human cultural analysis and anti-colonial reading of scientific knowledge practices. This is one instance of the important theoretical dialogue between feminist STS and anti-colonial cultural theory that points to the shared emphasis in their respective critical approaches to positionality, the politics of representation, and challenges to Eurocentric notions of 'nature', science, and 'the human'.

Reimagining Banking

A critical shift has occurred since I started this project. In the wake of the heightened Black Lives Matter movement, particularly after June 2020, a public conversation on what decolonisation could mean for global botanical institutions, conservation, and scientific practices is gathering pace. The implications of this for practices of what I have termed 'global care', such as the MSB and the SGSV, would be fascinating to observe and analyse further in future research. The banking, access to, and sharing of seeds will change, as the recently announced grants programme by the SGSV indicates. While the argument for interlinking more-than-human and anti-colonial, anti-racist ethics for conservation practice has become noticeably louder throughout the period that I have developed this thesis, it has also become evident that the ecological crises we face, their scales and temporalities, are by no means containable through the technical intervention of seed banking. The linear Eurocentric

¹⁷⁵ The complications inherent in the concept of ecological sovereignty discussed in the previous chapter need to be kept in mind here. In the previous chapter I pointed out, through Mick Smith's conceptualisation of ecological sovereignty (2011), that ecological sovereignty is connected to a view of nature as a resource and governed by legal apparatuses in nation-state practices to protect 'nature'. Alternately, Azoulay's concept of worldly sovereignty allows for a consideration of grounded and embodied formations of sovereignty that resist the Western universalism of a supreme authority.

temporality of progress, where the totality of global flora – wild and domesticated – can be banked and reinserted at any moment in the future, has irreparably shifted. I argue that a decolonisation of seed banking can only happen in a way that is not merely performative (a temporary gesture) but speaks to a fundamental organisational restructuring and reimagining of futures for seeds, particularly in relation to land and land sovereignty.

In her conclusion to *Decolonizing Extinction* (2018) Juno Salazar Parreñas calls for an ethics of decolonisation that acknowledges the collective vulnerability of life on this planet. In her proposal, the decolonisation of extinction is a caring labour, one of letting go of control narratives and accepting uncertainty. She asks ‘when we make conservation interventions, can we be less enamored with the proliferation of new life and be more concerned with the process of dying well?’ (2018, p.188). This is a crucial question for seed banks. In chapters three and four on the SGSV and MSB I have shown that even how new life proliferates is often not imagined, what is banked is *potential life*. What could a seed banking practice of collaborative survival, but also the collaborative acknowledgements of loss, in the face of vulnerability entail? For one, it could make the sharing of seeds, their crossing of borders, and processes of scientific selection more straightforward. These struggles for inclusion were shown in the challenges UAWC faces to access the spaces of global care in Svalbard and at the MSB. Additionally, it could be less focused on the survival of individual species, and the genetic backing up of specific resilient traits, but on embodied knowledges (such as in the handbook on agricultural practice and memory that UAWC was working on in chapter five) and complex ecological diversity (such as explored in the experiments on cucumber irrigation timelines, also in chapter five, or germination testing at the MSB in chapter four). Lastly, it could foster thoughtful restoration and struggles for localised sovereignty and biocultural identity alongside the freezing of seeds.¹⁷⁶ The potential of this reimagining of collaborative practice has been shown across this thesis in connecting discourses in STS and anti-colonial cultural

¹⁷⁶ However, critical discussions of restoration voiced throughout this thesis need to be kept in mind here; restoration is not inherently ‘good’ but often a planned component of extractive projects (Anne, Personal communication, 2019) or part of the salvific promise of seed banking that remains unactualised.

scholarship to observe the epistemic politics and ethics of each practice, of how vulnerability and resilience are made, unmade, and reconfigured *in practice*, of how mastery of living vegetal diversity is learned and crucially can be unlearned.

Stabilisation, Translation, and Transformation

The attempt to understand how conservation knowledges are produced *in practices* has shown that seed banking can at once be stabilising and transformative – of an organism and of a world. In rooting this research in concrete practices, dialoguing for instance with Myers' (2015) approach of working with plant scientists, I have sought to empirically draw out the world-making and unmaking inherent in these practices. Despite being based on remarkably similar technologies of cooling and storing I have shown that the ecological imaginaries of the practices assembled here are divergent. While the conservation technology of seed banking was developed in agro-industrial science to store away diversity as an insurance for increasingly homogenous crops, interventions such as the MSB, which is in the process of tweaking this technology for wild seed conservation (and thereby discovering tensions in the logic of banking), and UAWC's seed bank, which is adapting seed banking for localised, dispersed struggles for sovereignty, reveal an important finding: *the world-making of seed banking is not inherent in the technology*, thus it can be utilised for different kinds of ecological imaginaries that extend beyond mastery of life as a resource. Remembering Myers' call for 'ungridable ecologies' (2017) and Gómez-Barris' 'intangibility of the forest' (2017), this research has shown that while some practices work with masterful, reductive translations of seeds into genetic data, alternatives can emerge from the very same technologies, despite the practices sharing an archival impulse.

What seed banking in Palestine has revealed is that saving seeds, if perceived as a relational practice that extends beyond the saving of individual varieties to the preservation of complex agroecological relations, can be practiced in radical and creative ways that utilise delays and suspensions as much as circuits and cultivation. Those practices that put an emphasis on imagining where seeds will be dispersed to, and how they extend and continue

existing (agro)ecologies, are able to realise embodied and localised forms of more-than-human sovereignty. Thus, they are able to *use seed banking to work towards a radical imaginary*, radical here in the sense that it is both rooted in land practices and wants to manifest a complete transformation of socio-political conditions. In practices like this the adaptation of the often-paternalistic technology of banking seeds that has historically restricted the circulation of seeds, in particular since the Green Revolution, now feeds into food sovereignty, co-cultivation, and more-than-human justice. It is worth bearing in mind here that seeds have been saved for millennia in practices of sharing and storing, yet the practices addressed in this thesis have explicitly taken on the terminology of the ‘seed bank’ and thus reveal that forms of resistance and recalcitrance can exist within wider cultures of seed banking. Therefore, while cryopolitical technologies are designed around stabilisation I argue that ecological and ethical imaginaries found in some seed banking practices go far beyond containment, masterful translations, and stasis and include shifting organisational responses which confront coloniality, address collective vulnerability, or feed into struggles for sovereignty.

Conflicting Understandings of Diversity in Wild Relative Conservation

A pattern that has emerged across the practices is the research on and conservation of wild relatives, wild plants that are closely related to domesticated crops. Wild relatives have opened challenges to the constructs and separations of ‘nature’ and ‘culture’ and ‘traditional’ and ‘scientific’ knowledge. The observed pattern describes the harvesting of the ‘wild’ resilience for agricultural purposes, and futures of genetic extraction. Yet most importantly, it reveals the paradoxical nature of seed banking’s dependence on *living*, flourishing ecological diversity, relationality, and adaptation. Temporally, wild relatives are often the ancestors of those crop varieties that evolved through human-vegetal co-cultivation. In the sense that in this thesis I have traced processes of becoming-with in seed conservation, wild relatives point to a temporality before domestication and cultivation, that is, before human intervention in ecological processes.

Crop wild relatives are sought after for their diverse resilience in increasingly extreme climates, such as low water availability, high salinity, and heat. Maya Montenegro de Wit argues that they have become an ‘emerging frontier’ (2017), where scientific practices of conservation science, agri-science, and data science converge in a new process of primitive accumulation. At the nexus of an accelerating climate crisis and the genetic erosion caused by industrial agriculture, wild relatives are viewed as resilient time capsules in the *ex situ* Crop Wild Relatives project headed by the Crop Trust with support of the MSB (see chapters three and four). These new collaborative scientific knowledge practices show how the epistemological separation of ‘nature’ and ‘culture’ is increasingly blurred in seed conservation. In pre-breeding programmes useful genes that contain resilient traits will be bred into agro-industrial cultivars, a forceful ‘rewilding’ (Montenegro de Wit, 2017) as masterful becoming-with of domesticated crops and their wild cousins. This extraction and engineering of resilience is one of the dominant ecological imaginaries to be found in seed banking. It is an ecological imaginary that envisions diversity in a purely genetic sense. Yet crucially, it is an imaginary based on relationality, but of a techno-ecological kind where specific ‘wild’ relations are extracted and bred into crop varieties. Similarly, Anna-Katharina Laboissière describes the ‘constitutive paradox of crop wild relative conservation’ (2021, n.p.) as a dependence on the absorption of wild relatives into the homogeneity of domestication which might eventually cause their disappearance if their habitats are not protected. I wonder if this paradox is also a testament to the failure of masterful ‘forever’ approaches to seed banking overall: if domesticated cultivars can only be ‘saved’ by their living wild relatives, does this not point to a breakdown of the logic of extracting life forms in order to save them? The lessons learned from wild relatives support the advocating for a co-cultivated genetic and biocultural commons that appreciates the living, ecologically rich epistemology of diversity and persistence. Despite all efforts of extraction and stabilisation, it has become evident that seed banks that pursue a practice of mastery remain reliant on this continuous ecological relationality. And yet, the afterlives of wild relative conservation projects imply that a genetic version of ‘the wild’ has now been turned into a permanent set of future potentials for agro-

industrial plant breeding. The banana wild relatives being preserved at the MSB have also pointed to another limitation of standard seed banking protocols – what happens to those species that are recalcitrant and cannot be preserved under normal conditions? Here, wild relatives show the need to imagine a more holistic approach to banking biocultural diversity.

Spatiotemporal Interventions through a Plurality of Care

Across the practices discussed here a multiplicity of human agencies has surfaced. I have observed a range of epistemic communities that employ seed banking technologies through the lowering of temperature across the fields of agri-science, wild seed conservation, food sovereignty movements, and forestry. The practices of care across this thesis have reflected this multiplicity, care has been inherently extractive and sometimes violent, yet transformative and deeply personal at other times revealing a multiplicity of perspectives within scientific institutions and a diversity of perspectives of what role ‘the human’ should occupy amidst the loss of diversity. One of the tasks here has therefore been to describe this plurality, and coordinate and explore overlaps. Amidst the described loss of worlds, what purpose does this focus on plurality serve? And more broadly, for whom might the research pursued here be useful?

One such purpose has been to explore how the process of writing between the disciplines of cultural studies, STS, conservation science, anthropology, and the environmental humanities more broadly can describe human-vegetal ecologies *whilst they transform and are in conflict*. What Elaine Gan calls the ‘urgent political task in defining the relations between words and worlds’ (2016b, p.152) has been tested in putting words to the worlds the practices constitute, reassemble, and change. While I have dialogued with and traversed different disciplines the process of writing and thinking them alongside each other has revealed the complexity of the relation between words and worlds. I have thus sought to converse with scholars who have explored writing as a witnessing of loss across a range of temporalities (Rose, 2012, 2013; van Dooren, 2014). In writing these diverse relations I wanted to go beyond a genetic understanding of diversity to instead explore the complex

differences between imaginaries of 'banking' and 'saving' and their respective, situated relations to the biocultural diversity of worlds they seek to preserve.¹⁷⁷

The considerations on temporality present throughout, manifest the potential of interlinking more-than-human time with challenges to Eurocentric epistemic dominance encouraged by decolonisation debates. First, the carrier seeds have shown some of the gaps in imagining futures for seeds and revealed non-human timelines of recovery. Here, methodologically, the device of the carrier seed has created an engagement with the temporalities of seed reproduction and seed ecology that shows how seed banking as a technology is based on naturally occurring seed processes. Through each carrier seed I have described particularities of its human-vegetal ecology and demanded insights into the current limitations of banking protocols. The Cherokee Trail of Tears black bean has shown how narratives of indigenous sovereignty are absorbed by an institution of global food security in Svalbard. The banana wild relative at the MSB has made evident that while banking infrastructures keep seeds alive, if the global partnerships that have deposited these seeds break down there are no ways for seeds to leave seed banks again. It has also pointed to the fact that many seeds are recalcitrant and therefore resist long-term cold storage with standard protocols. The serpent cucumbers preserved by UAWC have demonstrated the unique adaptive potential when plants remain connected to land, when the seed bank is 'in the field' with farmers, rather than extracted into cold storage spaces. And lastly, the parasitic spruce bark beetle-Norway spruce relationship has revealed the politicisation of conflicts and the role of the nation state in shaping conservation frameworks. In the focus on practices of conservation of biocultural heritage (Cherokee Nation and UAWC) I have shown how indigenous temporalities of conservation are often much older than disciplines of 'scientific' conservation. These reflections on temporalities are insightful for arguing against Eurocentric anthropogenic conservation narratives in the shadow of modernity in the Anthropocene. In

¹⁷⁷ *A tomb of things that were and a womb of things to come*, the film project developed alongside this thesis in collaboration with Charles Pryor seeks to give a different kind of visibility to seed banking as a remaining in the world through tactile processes of care (an interview discussion of the film can be found in Kießling (2020)).

this way the practices assembled here have made evident the dynamic interlinking of time and temperature in understanding seeds as time-bending devices.

Second, seed banking as a technological intervention remains grounded in seed phenological processes of waiting for appropriate developmental conditions to initiate germination. It is thus in many ways modelled on the temporalities and communication capacities of seeds during dormancy and germination. In this sense ecologically-determined responses (of sensing environmental cues and triggering germination when conditions are right) are the very reason why seeds can be banked. In a similar shift towards more-than-human temporalities, the discussions on wild relatives have shown the possibility of reversing teleologies of domestication and mastery. Alongside this, the concept of ‘thermal memory’ (Fernández-Pascual et al., 2019) has opened questions of vegetal capacity to contain temporalities in ways that seed science is beginning to understand. This adds an interesting dimension to experiments with stratification (stimulating conditions needed for seeds to germinate) and vernalisation (cold treatments to simulate winter and encourage flowering (Sgamma and Jackson, 2015) in the nineteenth and early twentieth century.

Third, through the moment of time this thesis has observed – a slowly shifting ground when global botanical institutions must confront their colonial histories – I have been able to explore the time scales of institutional transformation, of shifting organisational visions. Holding these multiple temporalities, the choice of which temporalities are enacted, and which temporalities remain speculative, is often left open. In this process I have observed a rewriting and refocusing of material histories of vegetal accumulation. While existing scholarship on the colonial roots of botanical collections (Brockway 1979; Schiebinger, 2007) has focused on historical foundations, the analysis here has shown how power relations continue into the present but are also challenged from within these organisations as they shift and adapt.

Beyond insights into non-linear temporalities seeds have also made evident important challenges to established spatialities. This research thus contributes to spatial discourses around mobility, enclosure, migration, and problematisations of the ‘global’ and ‘national’ in seed politics (Kloppenburger, 2010; Breen, 2015; Harrison, 2017). What the observations of

UAWC, but also of the MSB and KFGB, have shown is that seed circuits can be adapted from a static model of ‘banking’ to one that is increasingly about dispersal, locating the seed bank *in* its corresponding world. Additionally, the focus on border ecologies in the previous two chapters has revealed the complexity of localised formations of more-than-human sovereignty. In both these case studies conflict – of settler colonialism and of the nationalist protection of ‘nature’ – has been a useful lens for addressing the links seeds form to place, identity, and heritage. Moving across the scales of the molecular, organismic, and ecosystemic and the spheres of the cultural and social has enabled fissures in and inversions of these scales to locate where care is applied and contested, how classificatory politics are enacted, and what it means to ‘save’ a seed. Seeds have been instruments in the construction of a ‘national nature’ and ‘national culture’, revealing the ways in which conservation is often tied to a national value system of indigeneity and otherness. Yet, seed mobility has also allowed the transversal of these borders and the crossing of multiple formations of sovereignty. From the critical considerations of ‘global care’ as steeped in paternalistic, controlling conservation frameworks (chapters three and four) and from the critique of ‘national nature’ I develop the following question: What would a planetary approach to seed conservation entail, where the planetary can hold a plurality of worlds (as in sovereign, localised ecologies) while acknowledging their shared and overlapping socialities, spatialities, and temporalities? The research presented here might thus be insightful for a critical rethinking of the ‘global’ and the ‘national’ through the ecological. How would the practice of *planetary care* in seed conservation differ from global care? In my understanding the planetary, as mapped out in the introduction, focusses on an ecological perspective that treats the entire planet as an interdependent ecosystem whereas the global is anthropocentric and socio-politically determined. Planetary care would thus be less about conservation where seeds function as national representatives in globally orchestrated conservation frameworks but are instead embedded in a locally specific plurality of worlds.

Recalcitrant Relationality

Through this research a range of ethico-political tensions, gaps, and frictions emerged across ecological imaginaries that echo often-voiced critiques of seed banking (such as in van Dooren, 2017). The carrier seeds, and their seed circuits, have been a useful methodology for revealing challenges that arise from the speculative, temporal delay of banking seeds. First, one of these tensions has been the question of accessibility. While it remains vague who the beneficiaries of the SGSV are beyond agri-scientific institutions, the MSB is currently actively challenging and questioning the barriers in place for accessing its seeds within certain parameters, and UAWC distributes its seeds for free for each growing season. Who exactly is the beneficiary of the future universal ‘humanity’ that the SGSV is saving its seeds for? Seed banking ethics are thus shaped by the inclusion and exclusion of specific histories and futures. These questions of accessibility are closely tied to the commons and to new enclosures of seeds as in the earlier discussion of wild relatives.

A second tension emerges around relationality. As practices of global care in particular have shown it is impossible to consider relationality (as in the living complexity of ecological relations and interactions between plants and their environments) amongst the preserved varieties when the focus is on individual species targets. Initially, ecological relationality appeared to escape banking: I have pointed out that relationality at the SGSV is only perceived as human mastery over genetic resources and at the MSB there currently is no organisational capacity to address the conservation of relations. Yet, the previous two chapters have shown that it is possible to connect to restoration, *in situ* conservation, and complex agro-ecosystems – to conceive of seedbanking *as a relational practice*.

A third tension arose from the temporality of seed banking as grounded in the suspension and stabilisation of life cycles. Crucially, this means plants cannot adapt to changing ecological conditions. For instance, the very reason wild relatives are sought-after dissolves when they are banked as they lose their ability to respond and adapt to changing, harsh living conditions (Laboissière, 2021). Additionally, many practitioners, especially at the

MSB, were concerned about the scale of the restoration and revitalisation their collections would be able to address. When seeds become proxies (Peres, 2016) as genetic representatives for entire species and varieties, the scale of what they could grow remains small in relation to the multi-sited and interconnected loss of ecosystems and limited human capacity. I wonder if there is then a different kind of ‘violent care’ at play, different from van Dooren’s (2014) violent care in the prioritisation of some species for conservation to the detriment of others, when practitioners know the scale of their conservation efforts will simply not be enough. In the end, in the practical, institutional realities of seed banks arguing for the human usefulness of the plants they are saving, is more successful for funding than an argument for the conservation of biodiversity *as such*. This means the organisational principle of seed banking remains anthropocentric. Many of the interlocutors I encountered were acutely aware of these ethico-political tensions in seed banking protocols and working towards updating and changing them.

Recalcitrance, the resistance and intolerance to the drying and freezing of seeds in *ex situ* cold storage, has been a useful concept to think with across these tensions. From oak embryos that are slowly waking up after cryo-preservation to banana wild relatives whose storage behaviour is somewhere in-between categories of orthodox and recalcitrant, recalcitrant seeds make evident the limits of standard seed banking protocols. As a technology, seed banking fails many tree and shrub species since their seeds cannot tolerate dehydration (Lidder and Sonnino, 2012). As observed at the MSB, species prioritisation of those seeds that are orthodox and easy to bank reveals the dangers of numerical conservation targets – species with difficult seeds that would require more costly conservation measures are put aside for the time being, placing them in a different kind of liminality. This is yet another level of violent care in conservation through organisational species prioritisation. Yet, recalcitrance in seeds speaks to an adaptation to the surrounding water ecology. Recalcitrant seeds do not have to respond to dehydration because it does not occur in their cycles of reproduction (many recalcitrant species are in the tropics). This echoes the ecological adaptation of the rainfed seeds in Palestine to extreme water scarcity. I want to propose another kind of recalcitrance

here, too, drawing on Omar Tesdell's reading of recalcitrance (2013). Through persistence, as observed in UAWC's resistance to the slow disappearance of land or in the Białowieża protests against logging, *recalcitrance as radical care extends to cultural practices* beyond the banking of seeds in cold storage in grounded and embodied formations of sovereignty. These embodied formations of sovereignty are recalcitrant to control by the nation state, as observed in Palestine, and form a subversive counterpart to practices of mastery. They do not read seeds as manageable organisms containing valuable genes made up by the sum of their parts but as complex, living, and adaptive life forms and carriers of biocultural histories.

From Mastery to More-than-Human Worldly Sovereignty?

This research started by asking if seed banking – the extraction of seeds from their ecologies and their temporary withholding – is always a practice of mastery of the more-than-human, of life as a resource. What I have arrived at is a slow *undoing of mastery* – of control through care – *from within* the ecology of practices. Starting with the performance of masterful *becoming-safe* observed at the SGSV what followed, through vulnerable listening, was a steady unravelling of this control and scientific authority. What became evident instead was, I argue, a spatiotemporal possibility for the aforementioned localised formations of more-than-human sovereignty. They show the possibility of a more-than-human politics that considers sovereignty not as a practice of ecological mastery but as embodied.

This more-than-human sovereignty can take many forms. The MSB and UAWC's seed bank demonstrated through their ethics of care how seed banking can be practiced through the acceptance of collective vulnerability, co-cultivation, and fundamentally, through learning from seeds. It allows for an exploration of the divergent more-than-human politics grounded in the previous discussion on relationality. There are substantial differences between these two practices and their world-making, as I have pointed out. The MSB is aiming to shape a tentative space for decolonial questioning and collaboration in paternalistic and often neo-colonial global conservation frameworks and partnerships. In the practice of UAWC and in the observation of the border ecologies they attend to, seed banking as a practice of care can

feed into subversive challenges beyond the sovereignty of the nation state, thus undermining this Western form of sovereignty as supreme authority. The situated formations of sovereignty found in the previous two chapters – in the Palestinian persistence towards food sovereignty and in the supra-national sovereignty of the Białowieża forest ecology – are on the scale of local (agro)ecologies and restoration projects, and can extend across national borders. Ravi Youatt argues in *Interspecies Politics* that:

If states are generated by practices and those practices are not just human but *interspecies* practices, including humans, animals, plants, trees, bacteria, insects and others, then in many ways we have misunderstood what sovereign states *are*. States are an ecological process, not just in the sense that they organize resource extraction and consumption, [...] but more deeply, they are ecological through the interspecies generation of meanings that form and constrain political life, even in non-resource related contexts. (Youatt, 2020, p.2)

Responding to Youatt's conceptualisation of states as ecological processes, and the role of the nonhuman in claims to sovereignty, I ask what the unique qualities of more-than-human sovereignty discovered in this research are. When I spoke to Morgan, a cryobiologist at the MSB, he strongly advocated for shifting the focus of conservation away from what I have called a 'national nature':

But we're working on conservation, whatever protocol we produce, it's not for us, it's for the species. It belongs to the ecosystem, not to a country. In the end we're trying to create knowledge to improve the species' resilience. (Personal communication, 14 November 2019)

This situating of epistemic practice for the benefit of the more-than-human demonstrates a culture of seed banking grounded in the conservation of ecological complexity as a practice of research and care. It extends beyond the borders and conservation regimes of nation states. Yet, it also raises critical questions as to who categorises a species as resilient and vulnerable, and what the parameters for these choices are. This is one expression of what more-than-human sovereignty might entail, here specifically in the conservation of wild plants and threatened ecosystems.

A different formation of more-than-human sovereignty could be found in UAWC's seed banking practice. Here, resilience and resistance are intimately tied to the co-cultivation of plants in a struggle for food, land, and seed sovereignty. Explicitly aligned with anti-colonial

peasant movements, more-than-human sovereignty here is ‘worldly’ in Azoulay’s sense in that it is situated in agroecological knowledges, textures, and histories, against seed enclosures. In this way UAWC’s seed banking practice, originally set up by volunteer agronomists, challenges the logic of seed banking at the intersection of conservation, plant breeding, and data science. Instead, it combines and adopts the technology of seed banking alongside a focus on the preservation of biocultural memories, cultivation, and grounded resistance. As Montenegro de Wit argues:

agroecology aims for a reflexive, participatory practice that is grounded in a subversive politics: a commitment to disrupt the homogenizing forces of the globalization project with biological and cultural diversity. It offers renewal of such diversity, in situ, instead of its capture in a commodity form. (2017, p.205)

This renewal of biocultural diversity manages to reshape the logic of seed banking to include the fields of farmers, the knowledges of elders alongside the technoscientific genetic protection of these co-cultivated plants that are ‘deeply imprinted with human knowledge and practice’ (Montenegro de Wit, 2017, p.206). This is a non-extractive sovereignty that remains spatiotemporally grounded in cultivation and significantly introduces the more-than-human into Azoulay’s concept of ‘worldly sovereignty’ discussed earlier. More-than-human worldly sovereignty thus takes plants seriously as political actors. It considers questions of politics in the context of multispecies studies and enables an exploration of the political implications of concepts developed for more-than-human worlds (as also explored in Tsing, 2015; Puig de la Bellacasa, 2017; Singh, 2017). As an emergent concept, more-than-human worldly sovereignty has the potential to enable an analysis of interactions, dynamics, and power relations between anti-colonial and ecological imaginaries and their ontologies. It could develop beyond the scope of this thesis and resonate with different ecologies, scales of analysis, and understandings of sovereignty.

Postscript



Figs. 7.1–7.2. Cherokee Trail of Tears black beans grown in my cultivation experiment. Photographs: Barbara Boschen, 2019, reproduced with permission

I want to close this thesis by returning to the growing cycles of seeds and the slow practices of care that have co-cultivated many of the plants encountered throughout this thesis. As mentioned in previous chapters, in the spring of 2020, while the world ground to a slow halt, I planted Cherokee Trail of Tears black beans in my mother's garden in the South of Germany. By the time the beans were ready to harvest I had returned to London. The bean plants thrived in the dry, hot summer and my mother kept the harvested seeds to replant them the next year, waiting until I would be able to return so we could cook them together. Throughout the summer and the following spring caring for these plants remotely was a tangible point of connection, a joint investment in a growing experiment. It was a powerful reminder of the labour of care and temporalities beyond the storage of seeds – the seed ecologies, cycles of growth and co-cultivation – that the banking of seeds depends on. It was also an example of how much cultivation is based on patience and slow observations, on reading plants and their environments to determine how they will be cared for, of working with the seasons and natural

cycles. Returning to Ursula Le Guin's concept of the carrier bag, and reiterating that science and technology are cultural carriers too, what I hope the analysis presented here has shown is an insight into the ecologies of seed banking beyond what Le Guin calls the 'techno-heroic' in grounded formations of more-than-human sovereignty. She suggests that '[it] is hard to tell a really gripping tale of how I wrested a wild-oat seed from its husk, and then another, and then another, and then another, and then another' (1996, p.149). While I have followed a seed bank's practice, then another's, then another's, then another's, I have sought to make a small contribution to putting words to these worlds of saving seeds, their material effects, and imaginary potential.

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Appendix

I include short summaries of two projects here, one artistic, one curatorial, that give a sense of what the theoretical analysis pursued in this thesis has fed into, and what the potential of continuing these arguments visually, sonically, and performatively might be. They are not components of the thesis as such.

Appendix 1: *The great conversation (still as someone passes by)*



Fig. A.1. Performance still, Manifesta13, Marseille. Photograph: Fabrizio Scarpignato, 2020

An audiovisual piece by Marleen Boschen, Charles Pryor, Sara Rodrigues and Lou-Atessa Marcellin commissioned for Manifesta13 that follows the soil as a narrator and witness to the unfolding histories of human cultivation practices and environmental acts of violences. It seeks to make audible the soil as a living global infrastructure, a container for past and present cultivation knowledges and extraction processes and how these stories can be told through something we often unknowingly depend on for the survival of human and non-human ecologies alike. This project is born out of a larger research-led film project titled *A Womb of Things to be and a Tomb of Things That Were* by artists Charles Pryor and Marleen Boschen which combines elements of historical and scientific research with speculative fiction about seeds and conservation during times of ecological breakdown.

Film link: <https://youtu.be/g5trC12V4wg>

Commissioned for Diaspore.

Performed for Diaspore programme 'Scenes of the World' at Coco Velten, for Les Parallèles Du Sud, Manifesta 13, Marseille, France, 2020.

Performed by the New Maker Ensemble in 2021 for 'I transgress borders and boundaries' at Oficinas do Convento, Zaratan, Casa das Artes / Sismógrafo (Portugal) and Splendor Amsterdam.

Text and imagery: Marleen Boschen and Charles Pryor. Sound composition: Sara Rodrigues. Produced with: Lou-Atessa Marcellin

Including visual materials filmed at the Millennium Seed Bank, UAWC's seed bank, the Kostrzyca Forest Gene Bank, and the John Innes Centre for Plant Science.



Fig. A.2. Performance still, New Makers Ensemble, Splendor, Amsterdam. Photograph: Wilbert Bultsink, 2021

Appendix 2: *Soil is an Inscribed Body. On Sovereignty and Agropoetics*

Exhibition link: <https://www.savvy-contemporary.com/en/projects/2019/soil-is-an-inscribed-body/>

Soil Is An Inscribed Body. On Sovereignty And Agropoetics was a project examining both the anti-colonial struggles of the past and the current land conflicts across the world to resist the invasiveness of neo-agro-colonialism and its extractivist logic. It germinates through a series of readings, interventions and workshops, and materialises in an exhibition (30.08.–06.10.2019) and a performance/discursive programme at SAVVY Contemporary (13.09.–15.09.2019). The project seeks dispersed and yet networked moments of cross-pollination between artistic strategies and agroecological initiatives from molecular to geopolitical scales.

We reflect on state and capital devastation of natural landscapes as well as on forms of self-determination and autonomy performed by local communities as a rejection of the capitalist and colonial model of agriculture, engaging in a critical analysis of certain techno-scientific epistemologies and biopolitical practices. From the free women's village of Jinwar in Rojava to the work of communities such as the Associação para o Desenvolvimento Integrado da Mulher (ADIM) in Guinea Bissau and the agroecological activism of the Beni Aïssi village in Morocco, amongst others, we are learning from these possibilities of enacting cooperative farming practices and alternative communal life, of cultivating and building living spaces of emancipation and liberation. And yet agriculture is also being weaponised as a warden for national identity: the relationships between blood and soil, between identity and land are being essentialised and made terrain for xenophobic argumentations and paranoid constructions of the other.

How can anti-colonial and environmental alliances nurture each other? How can we sustain interspecies entanglements and polyphonic multidirectional futures? How can we transform ruins, erosion and damaged landscapes, and embrace tactics of precarity to make living possible despite economic and ecological ruination?

We take cue from what Filipa César named “Amílcar Cabral’s agropoetics of liberation” to articulate ways in which political theory can be informed and subverted by agricultural practice. Cabral is most known as leader and Secretary-General of the African Party for the Independence of Guinea and the Cape Verde Islands (PAIGC) and was assassinated by Portuguese agents in 1973. As Filipa César suggests, Cabral’s practice as an agronomist for the Portuguese academy should be read as a subversive strategy that germinated in his political formation and militancy, “to advance the liberation struggle from inside, using colonial resources to inform and strengthen the liberation movement”. Is it now possible to engage with some of his studies and writings on a soil epistemology to analyse and enlighten some of the most interesting current struggles against monoculture, land grabbing and neo-colonial extraction across the globe.

Artistic Director Bonaventure Soh Bejeng Ndikung
Curators Elena Agudio, Marleen Boschen
Project Team Onur Çimen, Cornelia Knoll
Exhibition Production Antonio Mendes
Management Lynhan Balatbat-Helbock
Communications Anna Jäger
Graphic Design Elsa Westreicher, Lili Somogyi
Telling Trees Arlette-Louise Ndakoze
Tech Bert Günther
Art Handling Wilson Mungai, Kimani Joseph
Exhibition Design Ola Zielińska
Film Bona Bell

Image selection:



Fig. A.3. Luis Berríos-Negrón. *Wardian Table*. Photograph: Raisa Galofre, 2019



Fig. A.4. Filipa César, Ahmed Ismailin & Ali Yass. *Mapping Agropoetics of Liberation* Photograph: Raisa Galofre, 2019



Fig. A.5. Pedro Neves Marques. *Linneaus and the Terminator Seed*. Photograph: Raisa Galofre, 2019.