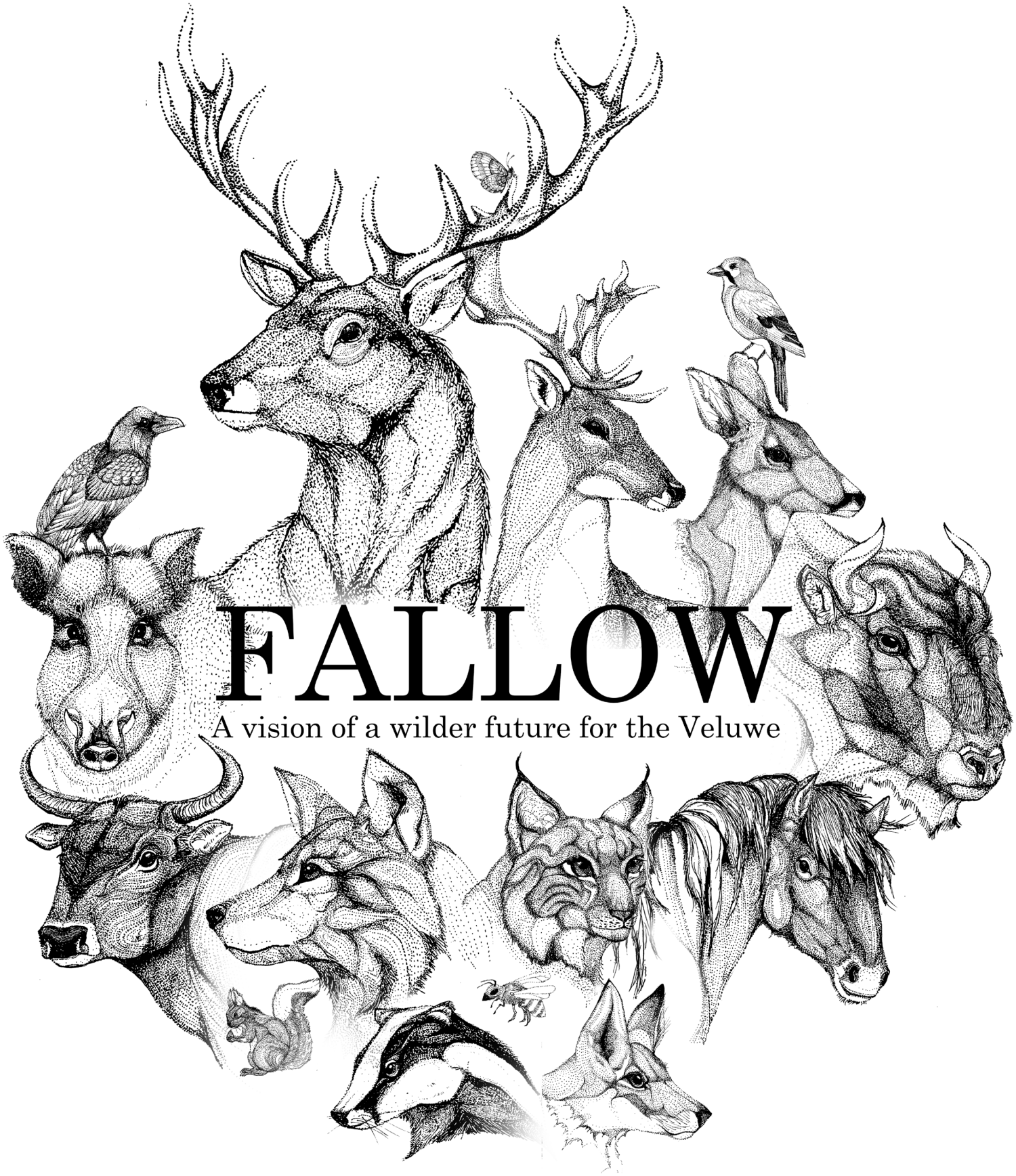


FALLOW

A vision of a wilder future for the Veluwe

Daan Kroon

“Have we fallen into a mesmerized state that makes us accept that which is inferior or detrimental, as though having lost the will or the vision to demand that which is good?”

- Rachel L. Carson, 1962



Colophon

FALLOW
A vision of a wilder future for the Veluwe

MSc Thesis

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Landscape Architecture of Rewilding 2025/2026
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All images and illustrations are made by the author, unless stated otherwise.

In light of recent developments within academic writing, the author deems it necessary to state the following:

No generative artificial intelligence was used for the creation and/or correction of any parts of this thesis, as the author disagrees with such practices.

This thesis was made by people, for people.

TU Delft

Abstract

This thesis explores the ways in which landscape architectural interventions can aid in restoring degraded ecosystems, while keeping human presence on the landscape visible and beneficial to this restoration. The design site is the Veluwe, the largest terrestrial Natura 2000 area in the Netherlands, that has a complex history of both natural and man-made processes. The design and research process went through different iterations to figure out how these processes can be integrated into a design, incorporating knowledge from the realms of ecological restoration, rewilding and landscape heritage. The final design combined habitat restoration on a regional scale, with localised intervention aimed to raise ecological and cultural awareness to visitors.

Key words

- Landscape Architecture
- Rewilding
- Natural Processes
- Heritage Design
- Veluwe
- The Netherlands
- Nature-inclusive design
- Ecological Restoration

Acknowledgements

This thesis is the culmination of both my personal interests in ecology, and everything I have learned in my academic career in landscape architecture.

I want to thank my responsible supervisor Eric Luiten for his guidance, especially in the design process, and the confidence he inspired in me to bring this thesis to completion. I also want to thank my second supervisor James Byng, for the informative and inspirational conversations we had about botany, and ecology. For additional guidance and support, I would like to thank Judith Slagt, and Frans Vera.

I want to thank my fellow students, both from landscape and architecture, for making me laugh even when I was a lot closer to crying, and for creating a supportive working environment where we all just wanted to see each other succeed.

I want to thank my room-mates, for listening to me explain the same stories over and over, and for also providing me with the necessary distraction when I turned into a thesis robot.

I want to thank my dear friends, who offered me so much understanding and support, even though they had no idea what I was talking about sometimes, yet always expressed their belief in my success.

And finally, I want to thank my parents, for their continued support during this thesis, for listening to my endless ramblings about my research findings, and for building me up when my self-doubt would get to me. Your faith in me has guided me not only through this thesis, but through my entire life.



Reading Guide and Table of Content

Part I: Setting up

The first part of this thesis will revolve mainly around introducing the problem statement, global context and relevance of this thesis. Based on this problem statement, the design location was chosen and will be introduced briefly. The next section goes into some of the theoretical principles that will help guide the design. On the basis of this theoretical framework, the design location and the problem statement, one main research question, and 4 sub-questions were formed.

Motivation and Fascination, p. 12

Societal Relevance and Problem Statement, p. 14
An Introduction to the Veluwe
A Global crisis, a Local catastrophe
Ecosystem Services
An Ethical Argument
Reflections on the Veluwe

Methodology p. 27
Research Questions, p. 28

Theoretical Framework, p. 30
A Wilder approach
The Future of the Past

Professional Relevance p. 34
Rewilding Landscape Architecture
Heritage as a Vessel

Design Objective and Assignment p.35

Part II: Taking a closer look

Since the explanation and exploration of natural processes is going to be vital part of the design process, it is important to highlight the mechanisms behind these processes. For this second part of the thesis, six natural processes that are most relevant to the Veluwe will be explained. At the end of the individual explanations, the chapter wraps up by discussing the design implications of these natural processes.

Introduction, p.38

Natural Processes p. 39
Vegetation Succession
Disturbance Dynamics
Grazing and the Wood-Pasture hypothesis
The Nutrient Cycle
The Importance of the Soil Seedbank
Ecology of fear

Designing Wilderness, p. 50

Part III: The lay of the land

The third part of this thesis dives a deeper into the landscape of the Veluwe. This was done by constructing an extensive landscape biography, to see how the modern-day landscape of the Veluwe came to be and how public perceptions of this landscape have shifted over time. The landscape analysis is engrained into this biography, and in the final conclusions it will become apparent that the modern day Veluwe, and its possible future, is best understood from a historical perspective.

Introduction, p. 54

The Pleistocene, p. 56
The Saalian
The Eemian
The Weichselian

The Holocene, p. 68
The Palaeolithic and Neolithic
The Medieval Period
The Industrial Age
The Modern Era

Conclusion and takeaways, p. 85

Part IV: Putting pen to paper

In the fourth part of this thesis, all the knowledge from the first three parts is translated into actions. First a vision was created for the entire Natura 2000 Area of the Veluwe. This vision is based on seven design principles, which are all focussed on ecological restoration and derived from the theoretical framework. The goal with this is vision is to identify what habitats of the Veluwe are the most in need of restoration, and which elements should be implemented to achieve this restoration. The Regional designs are all focussed on a Rewilding Basecamp, each located in one of the three main habitats, functioning as a starting point for the greater landscape restoration. For these regional designs, three additional design principles were devised with a more detailed approach that actively takes aspects of recreation and education in mind.

Vision, p. 90

Design Principles, p. 94
Habitat Based Restoration
Rewilding Basecamps

From Coniferous Plantations, to Mixed Forest, p. 101
Kroondomein, p. 104
Overview
Intervention and Perspective

From Malenbossen, to Woodland-Pasture, p. 116
Loenermark, p. 120
Overview
Intervention and Perspective

From Heathland, to Juniper Shrubland, p. 132
Radio Kootwijk, p. 136
Overview
Intervention and Perspective

Part V: A point on the horizon

The fifth and last part of this thesis will be used to discuss and reflect on the research and design process. The goal here is to see where the design could be further expanded upon, what further research could strengthen this thesis, and what was learned along the way. The appendix features any maps that guided part of this research, but were not specifically mentioned in the text. Finally, the full bibliography and image credit closes out this project.

Conclusion and discussion, p. 150

Design Reflection and final thoughts, p. 152

Appendix, p. 154

Bibliography, p. 160

Image and Illustration Credit, p. 169

Part I:

Setting up

Motivation and Fascination
Societal Relevance and Problem Statement
Methodology
Research questions
Theoretical Framework
Professional Relevance
Design Objective and Assignment

Figure 1: A young pine plantation

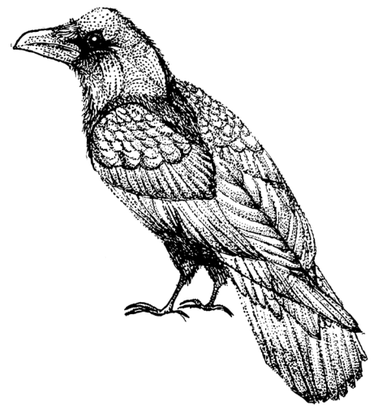
Personal Motivation and Fascination

For as long as I can remember I have been fascinated by the natural world. I always wanted to learn more about all the creatures that inhabited this earth. Over time, this grew into an interest in everything related to the biosphere: ecosystems, species interactions, evolution, etc. It is this fascination that initially brought me to Landscape architecture, to look at flora and fauna as part of a greater system, a system that people are also a part of. Growing up in the Netherlands was interesting in this regard, as the more I learned about the natural world, the more disconnected and critical I became of the nature I saw around me. From this, I developed a want to turn this disconnect and criticism into actions.

The Oostvaardersplassen rewilding project lit a spark of imagination for me, introducing me to rewilding, grazing dynamics, and the wood pasture hypothesis courtesy of Frans Vera. As I researched these topics more, I came across my next source of inspiration: Knepp Estate in Southern England. Knepp provided me with a new view of nature conservation, where instead of constantly trying to create a specific habitat for one specific animal, an ecosystem could be enriched by the completeness of its processes.

It is this novel philosophy surrounding ecosystem restoration that made me look more critically at the existing ecosystems I was familiar with in the Netherlands. I became intrigued by how we manage our natural landscapes, and how much knowledge about natural processes had been lost in our current conservation paradigm.





Societal Relevance and Problem Statement

An Introduction to the Veluwe

Site introduction

The Netherlands is widely known for being one of the flattest countries in the world, and one of the most densely populated. But amongst the sea of pastures, fields and ever-expanding cities, an anomaly rises in the landscape; The Veluwe. 150.000 years ago, glaciers pushed the sand and clay deposited by the Rhine and Maas upwards, creating a push moraine that currently covers about 1100 square kilometres of land.

Once the glaciers retreated, this sand ridge is assumed to have become covered by widespread oak-birch forests and woodlands (Vera, 2000), with small creeks carving a path through the undulating landscape, and pockets of peatland tucked away in the valleys. Once people arrived in the area, our agricultural practices fully transformed this landscape into what it is today, turning woodlands into sand drifts and forests into heathlands (Van Der Ziel, 2024).

Currently, the Veluwe is the largest Natura 2000 land area in the Netherlands, and it contains several protected areas, including National Park de Hoge Veluwe and National Park Veluwezoom (Programmadirectie Natura 2000, 2014).
The reason for this protection is focussed on the unique anthropogenic habitats, sometimes referred to as “half-nature” in the area, which are now considered valuable for the preservation of biodiversity and cultural legacy. On top of this, the Veluwe is for many an important place for outdoor recreation. From horseback riding and trail biking, and from canoeing to walking tours, recreational activities provide meaningful stress release, and an escape from people’s daily lives. (Brinkhuijsen, 2008).

Intensive management strategies are applied to large parts of the area to keep the Veluwe in its current state. This is done by removing new saplings in heath areas, cutting sod to keep heathlands nutrient poor, and grazing the area with heritage sheep breeds. The current management of these areas is meant to support the “unique biodiversity” and focusses on providing habitat for species on the Dutch Red List (Programmadirectie Natura 2000, 2014). A little research however, reveals that many of the Dutch Red List species are not internationally threatened (International Union for Conservation of Nature [IUCN], 2026). On top of this, the general trend for biodiversity in the Netherlands is still a negative one, with many species’== populations consistently declining, whether they are protected by local regulations or not (Naturalis Biodiversity Center, 2025).

Since 2015, the Veluwe has seen the return of an old friend, one that had been extirpated from this landscape for hundreds of years; the grey wolf (Canis lupus). Its presence on the Veluwe was immediately met with a critical response. What is such a large predator doing in this country? Does it even belong here? On top of these questions, many farmers were very displeased with the return of this native carnivore. After livestock losses started to ramp up, farmers called for permission from the government to allow the wolves to be hunted once again, most likely with the underlying goal of extirpating the wolf from Dutch soils once more.

However, the wolf is protected by EU regulations, and therefore the government had to resort to subsidizing farmers to make their pastures wolf-proof by using electric fencing, and employing guard dogs amongst their flocks. But the return of the wolf exposed a bigger issue in the current management of the Netherlands. Why would a native predator be a threat to our ecosystems and way of life? And what can this response tell us about the overall attitude we have in the Netherlands towards the management of our “nature” reserves? If we want to actually do something for biodiversity in this country, is our current approach sufficient? (Drenthen, 2015)



Figure 2: An Oak forest on the Veluwe

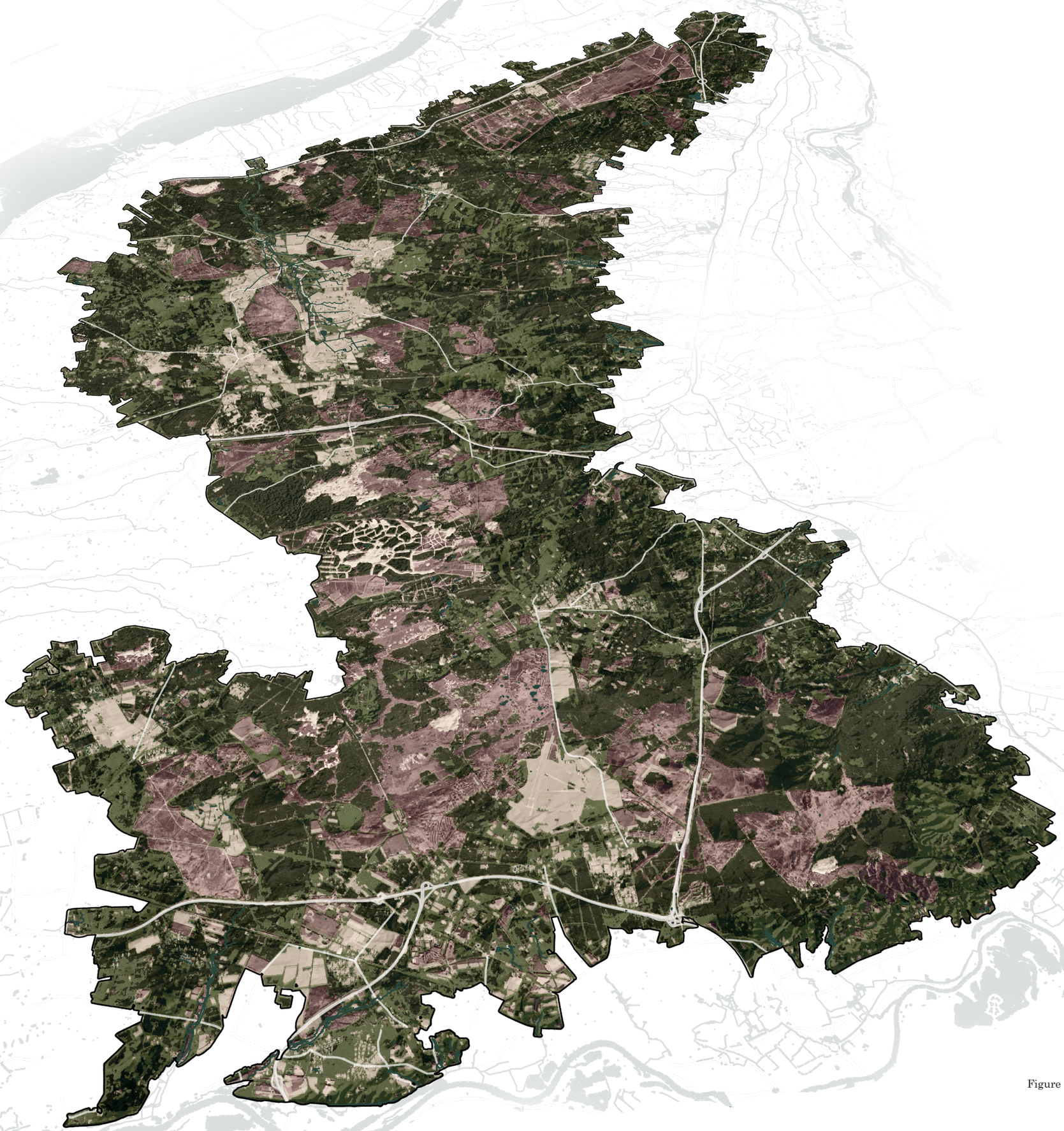


Figure 3: An Isometric Map of the Veluwe

"…around 25 percent of species in assessed animal and plant groups are threatened… around 1 million species already face extinction, many within decades unless action is taken to reduce the intensity of drivers of biodiversity loss."
(IPBES, 2019)

"Overall, 81% of protected habitats are in a poor or bad state, 60-70% of soils are degraded…" (European Environment Agency, 2025).

"89% of all protected habitats in the Netherlands are considered to be in a bad condition…"
(IUCN NL et al., 2025)

A Global Crisis, a National Catastrophe

Societal Relevance and Problem statement

The biosphere of our planet is currently facing a multitude of global challenges. In humanity's continued extraction and exhaustion of natural resources, the effects of anthropogenic climate change getting worse every year, and rapid decline and extinction of many species worldwide, it is becoming increasingly apparent that our current ways of interacting with the world around us are unsustainable. Several international agreements have been made to address these issues, one of the most significant being the Global Biodiversity Framework.

This framework was instated at the COP 15, also known as the United Nations Biodiversity Conference. The document was set up based on the Global Assessment Report on Biodiversity and Ecosystem Services, which makes a clear statement; "around 25 percent of species in assessed animal and plant groups are threatened… around 1 million species already face extinction, many within decades unless action is taken to reduce the intensity of drivers of biodiversity loss." (IPBES, 2019).

Following this report, the Global Biodiversity Framework has set worldwide goals to "halt and reverse biodiversity losses", emphasizing that the dependence of our survival as a species is also deeply rooted in the survival and proper functioning of the biosphere (Conference of the Parties to the Convention on Biological Diversity, 2022). Following this report and conference, the European Union has enacted its own documents, namely the European Green Deal, The EU Biodiversity Strategies for 2020 and 2030, and most recently the European Nature Restoration Regulation.

The Netherlands, as a part of the European Union, has an obligation to attempt to meet these targets. But the situation in the Netherlands with regards to reaching these biodiversity goals is even more dire. For starters, in a 2016 report from the CLO (Compendium voor de Leefomgeving), it was stated that the Netherlands only has 15% of its original Mean Species Abundance left. In 1900, this MSA was estimated at 40%, so not only is our current Mean Species Abundance incredibly low, it has rapidly deteriorated over the last century (Centraal Bureau voor Statistiek [CBS] et al., 2016).

On top of this, 89% of all protected habitats in the Netherlands are considered to be in a bad condition, and only 26% of the total land area of the Netherlands is protected. Not only will the Netherlands need to improve conditions in existing ecosystems and protected areas, it will also have to create new nature to meet the European goals (IUCN NL et al., 2025). While some plans have been made by the Dutch government in 2025, written down in the "Nationaal Biodiversiteit Strategie & Actieplan", only time will be able to tell if these plans are going to be enough.

Recent reports show that the current trend in acquisition of new natural areas, in order to realize the Dutch Ecological Network (NNN, Nederlands Natuurnetwerk), is on the decline, and that the 2027 target of expansion goals, will most likely not be achieved (CLO, 2026). One thing is clear from all of these documents, if we want to protect and restore the biosphere, we have to act and we have to act now.

Ecosystem Services

Societal Relevance and Problem Statement

When looking at these biodiversity targets, and the amount of money that needs to be spent to achieve them, an immediate question comes to mind; Why? Why invest all this time money and resources to save a single bug or butterfly? Why should we preserve habitats that seem destined to disappear?

To give a monetary value to, and shed light on the importance of protecting our planet's biodiversity the concept of ecosystem services was created. Ecosystem services can be roughly divided into four, not undisputed, categories: provisioning services, regulating services, cultural services and supporting services.

A provisioning service is defined as "direct use." It refers to the material or energy outputs of an ecosystem like food, medicine, and raw materials. These are some of the easiest to quantify, as its main example is the provision of food, water and building material. This service fulfils some of our most basic needs, and also takes up the most physical space on our planet right now.

Regulation services are the services of which me make indirect use. These services function as regulators of the environment. Examples include forests cleaning air pollution, swamps that filter water, and naturally flowing rivers that prevent flooding. Carbon sequestration, a valuable asset in the fight against climate change, is also a part of this. A final important part of this category would be pollination, something that indirectly, but critically, influences the productivity of most of our agricultural crops.

Cultural services have to do with the more intangible sides of our natural world. Cultural practices of Indigenous people, inspiration for arts, aesthetics and intellectual stimulation, are all a part of this. While this service might be the hardest to quantify, its importance cannot be understated; how much would you pay for a hike in the forest, or a walk on the beach? And how much would you have to be paid to give this up?

Supporting services have to do with a lot of the invisible process of nature. This category includes long-term processes, like soil formation, photosynthesis, and nutrient cycling. These services go unnoticed by many, but they reveal themselves in their absence. Without nutrient cycling, our fields would go barren, and without soil formation processes we simply would not have steady ground to stand on. (Wallace, 2007)

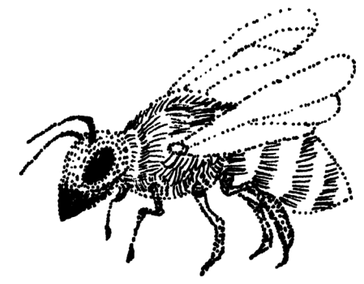
Overall, ecosystems services are estimated to be worth €171.521 million in the EU alone. However, it is also important to note that the value of an ecosystem, is depended on its proper functioning. Ecosystems that are incomplete or broken, simply cannot provide the services they are so valued for (Vysna et al., 2021).

But is that all? Is protecting, restoring, and aiding the natural world simply an act of self-preservation of our continued extraction and depletion of the natural world? Have we sunken so deep in a late-capitalist mindset that we need a monetary amount to ascribe value to something as eternal as the natural world?

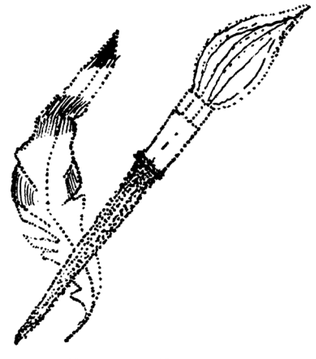
Perhaps there is more to this endeavour, a cosmic, philosophical, perhaps even ethical argument to be made to protect biodiversity, which underpins the inherent value of the biosphere.



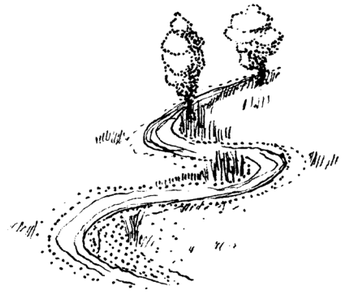
Provisioning Services



Regulating Services



Cultural Services



Supporting Services

Figure 4: Icons representing the Ecosystem Services

An Ethical Argument

Societal Relevance and Problem Statement

A gale of fresh ideas surrounding an ethical approach to conservation, and landscape architecture, is currently whirling through our professions and academic spheres, but with a clear critical note; “Stabilizing the climate seems to be a condition for capitalist life as we know it to continue” (De Block & Vicenzotti, 2018). This critical approach is essential if we want to avoid supporting strategies that only serve as a thinly veiled greenwashing of economic interests. It seems as though a sustainable future for landscape development and design lies in shifting the paradigm.

Conviviality presents us with a novel approach, placing humans as a species among species, and urging us to thoroughly investigate the interdependence we have on our surroundings. The idea revolves around realizing individual freedom through personal interdependence, from which would follow an intrinsic ethical value grounded in all things we depend on (Prominski, 2024). And it is this intrinsic ethical value that brings us to the bigger ideas surrounding an ethical argument for biodiversity and ecological restoration.

The idea of an ethical approach to the biosphere is a way of thinking that is long lost in the Western World. It was addressed directly by Aldo Leopold in his book A Sand County Almanac (1987), in which he has written the aptly titled essay “The Land Ethic.” In this essay, almost immediately the faults in the economic approach towards the biosphere are laid out: “A system of conservation based solely on economic self-interest is hopelessly lopsided.”

It draws attention to the idea that when we attempt to only protect the parts of nature we see as a direct benefit to humanity, we will inevitably end up doing more bad than good. We risk a continued disruption of the “biotic clock”, as it can only function properly in its complete and uninterrupted state. Leopold draws the metaphor of a “fountain of energy” where an ecosystem is in a constant state of circulation; “a sustained circuit, like a slowly augmented revolving fund of life.” This circuit involves not only the precious parts we seek to protect, but also the more unsavory parts. Dead trees slowly returning their nutrients, releasing them back into the soil that once provided for them. A sapling being overtaken by bramble that hides it from view, but also provides it with the shelter it needs to grow. An entire riverbank being taken out by a flood, but where the soil and gravel settle it provides a nursery for young fish.

When we attempt to intervene in these processes for our own gratification, or to foster a sense of control, often a deceptive exuberance is revealed. When removing dead trees from a forest, we might think we are creating room for new growth, which might indeed pop up in the first years, but we have in fact removed energy from the fountain with consequences that will Inevitably reveal themselves over time. From his essay three main ideas followed:

“The land is not merely soil.

The native plants and animals kept the circuit open; others may or may not.

Man-made changes are of a different order than evolutionary changes and have effects more comprehensive than is intended or foreseen.”
(Leopold, 1987)

The unforeseen effects of our interventions are also addressed in a book by one of the founders of environmentalism. Rachel L. Carson has written a series of books on these issues, the most impactful being her 1962 book “Silent Spring.”

After witnessing the wide-ranging effects of pesticide use in the United States, she describes in vivid detail how attempting to eradicate a species from a system, and the means with which this is done, can devastate ecosystems in their entirety. And once the pesticides have entered the ecosystem, they travel through the food web, eventually ending up in our human bodies as well. When we poison the natural world in a fruitless attempt to control its processes, it seems we also inadvertently poison ourselves. This harkens back to the earlier mentioned ideas of conviviality and interdependence, presenting us as a part of the world around us; “Seldom, if ever, does Nature operate in closed and separate compartments.” (Carson, 1962)

When we fail to protect the biosphere, when we leave behind destruction in our wake as we aim for endless economic growth, we are paving the path for our own destruction as well. But this power for destruction also reveals a more hopeful side; in the power of destruction, lies the power for creation. Though we may have outsized our impact, in the grand scheme of things we are no different from a butterfly that pollinates a flower, or a jay that buries an acorn, an earthworm in the soil or a wolf chasing a herd of deer.

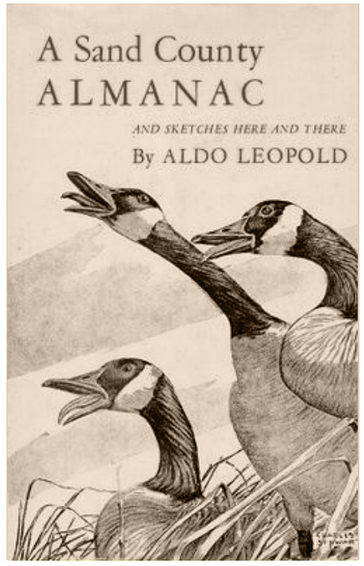


Figure 5: Cover of A Sand County Almanac (Leopold, 1987)

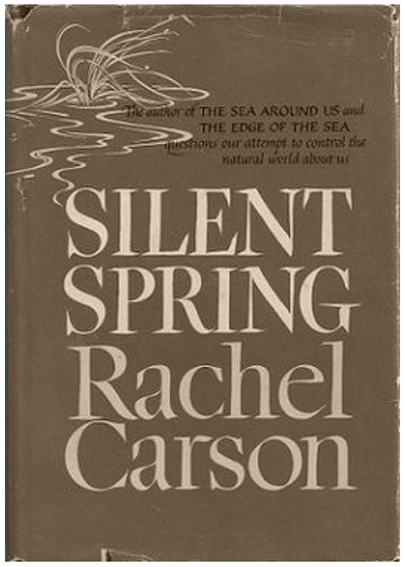


Figure 6: Cover of Silent Spring (Carson, 1962)

Reflections on the Veluwe

Problem Statement and Scope

With the urgency of global biodiversity crisis now in clear view, and a deeper understanding of the ethical arguments for a more inclusive approach to biodiversity, the issues surrounding the Veluwe become a lot clearer. It seems that in the case of biodiversity on the Veluwe, the development and management of the area has ran into an issue often encountered in ecological restoration; the shifting baseline syndrome or (SBS). This condition describes "the persistent downgrading of perceived 'normal' environmental conditions with every sequential generation, leading to under-estimation of the true magnitude of long-term environmental change on a global scale." (Jones et al., 2020).

In the case of the Veluwe, far-reaching man-made changes have impacted the landscape over several generations, and our current view of the Veluwe does not align with its ecological potential. On top of this, our constant well-intentioned interference of the Veluwe is not enough to maintain its current state. Nitrogen pollution, water shortages and wildfires are threatening the ecosystems we so diligently try to preserve (Provincie Gelderland, 2023).

Now that agricultural activities are focussed on other parts of the country, and with the reappearance of an apex predator it is time to assess and restore the ecosystem based on this ecological potential. Instead of a desperate attempt to keep the Veluwe in its current stasis, it is time to restore the fountain of energy. This restoration is entirely dependent on the restoration of the natural processes relevant to the Veluwe; nutrient cycling, vegetation succession, predator-prey dynamics, and countless other processes both big and small. In short, this requires more than restoration, it requires rewilding (Linnartz & ARK Rewilding Nederland, 2025).

But what is the role of a landscape architect in all of this? Should we not just leave this for the ecologists to figure out? Well, if it were that easy this thesis would simply not exist. A functioning ecosystem needs all its parts in place and is heavily reliant on interconnectivity and interventions on multiple scale-levels. But the Veluwe is not just an ecosystem, or a nature reserve. It is an area that tells a story of the Dutch landscape and the people inhabiting and experiencing it. The heathlands, sand-drifts and endless pine forests have memories and experiences attached to them, and however damaged or man-made these habitats might be, they still have an ecocultural value. It would be irresponsible to attempt to erase the heritage or recreational importance of the Veluwe, or to completely remove the human experience from this ecosystem. If we want to create a landscape that is sustainable, and can continue to evolve and adapt, it is imperative that people remain a part of this landscape. And this is exactly why this is not just an ecological challenge, but also a spatial challenge, a heritage challenge; a landscape architectural challenge.



Figure 7: The Leuvenumse Beek, one of the oldest creeks on the Veluwe

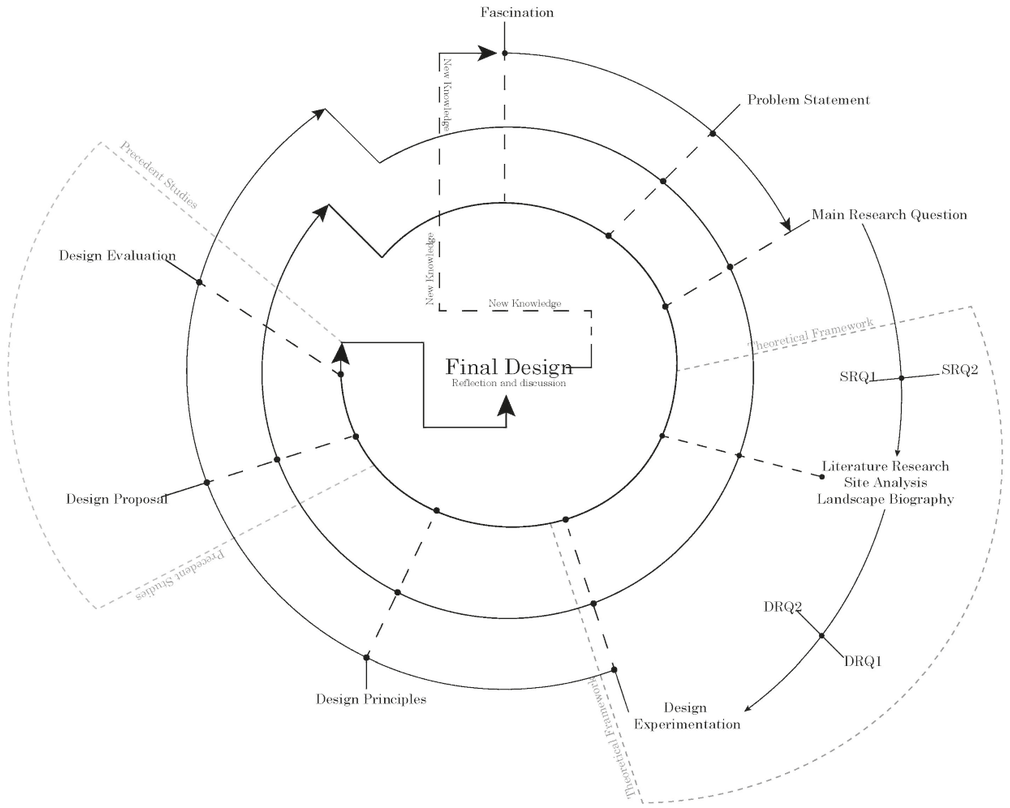


Figure 8: Diagram showcasing the method for this thesis

Methodology

The methodology of this thesis is a multi-faceted one. Overall, the goal is to go through a process of iteration before a final design is created. As can be seen in Figure 8, the methodology initially follows the conventional path when building up a thesis; fascination and motivation towards a problem statement, from which research and design questions arise, that are then translated into design principles and a design proposal.

But when this process is done, the thesis is not yet finished. The idea here is to have to go through different iterations, and when the first design proposal is finished it will then be weighed up against the earlier steps taken: Does the design proposal still align with the initial fascination? Does it properly respond to the problems stated, and research questions posed? What parts of the research were left and behind and could be re-incorporated? What new insights can be gained from creating new principles, or maybe removing some excessive ones?

By repeating this pattern X number of times, with every round the design can become more in-depth, theoretically sound, and at the same time artistically fulfilling. When the final design is made, this can be seen as the first “endpoint” of this process. However, as the graph portrays, the goal is to create a thesis and design proposal that can inspire new fascinations, and allow further research to apply a similar method when conducting their research.

Research Questions

Main Research Question

What can landscape architectural rewilding design do to improve biodiversity and ecological integrity in a landscape where management has focussed on the maintenance of heritage landscapes and facilitating outdoor recreation, without erasing these dimensions?

Answering this main research question will be done by dividing it into sub questions. These have been split up into different categories depending on whether the questions have a bigger focus on research *for* design or research *through* design. This distinction was made to ensure that both theoretical and design aspects will be incorporated properly into this thesis. As mentioned in the overall methodology, these questions do not exist in isolation, and a careful evaluation will be done to make sure that all questions enter different dimensions of design research.

Sub-research question 1
SRQ 1

What are the natural processes and principles of Rewilding, and how do they aid in improving biodiversity on the Veluwe?

Perhaps the most theoretical part of this thesis will be the selection and in-depth explanation of the natural processes relevant to rewilding the Veluwe. Literature reviews and site visits will be used to gain a good theoretical grip on this subject, which will guide the further development of the design strategy. Therefore, an important aspect to keep in mind with this question is to take note of the spatial implications of these processes.

Sub-research question 2
SRQ 2

How has the ecological and cultural landscape of the Veluwe changed over time, and what were the driving forces behind these changes?

A combination of two classic landscape architectural research methods will be applied to this question; layer analysis and a landscape biography. By combining these two approaches, the final result will be richer for it. The landscape biography will lay the foundation, but where landscape biographies have traditionally focussed on the human history of a landscape, this biography will integrate all layers of a landscape.

Design Research Question 1
DRQ 1

How can landscape architectural interventions reintroduce, kickstart, and facilitate ecological principles of Rewilding in the ecosystem of the Veluwe?

This design question will also be answered through design exploration, precedent studies and literature research. What will be interesting for this question, is to take a look at ecological restoration projects and what interventions were done. Now these might not be the traditional precedent projects for a landscape architect, but interventions like forest renewal, often bear a striking resemblance to the work of landscape architects. It is the harmonization of these interventions from different disciplines that will help answer this question.

Design Research Question 2
DRQ 2

How can the landscape heritage and recreational use of the Veluwe be integrated in a meaningful way in a rewilded Veluwe?

By applying heritage design frameworks to the Veluwe, this design exploration will function both as a way to deepen understanding of the landscape heritage of the Veluwe as explored in SQ2, and to figure out how this heritage might be used to facilitate and channel the development of outdoor recreational opportunities. In this way, the anthropological heritage of the past, can be used to support the anthropological presence of the future.



Theoretical Framework

A wilder approach

Rewilding

But how does one even begin to reintegrate these processes, disturbances, and cycles back into an existing ecosystem? An innovative approach has been trying to tackle this exact problem. Rewilding as a term has been gaining popularity in the last few years but its exact meaning is yet hard to define. Rewilding projects often aim to reintroduce species and restore natural processes, with the end goal of improving biodiversity within the ecosystem. Rewilding interventions can be very hands-off, an approach that is called passive rewilding where degraded land is simply left for nature to recolonize by itself. On the other hand, Active rewilding revolves around actively reintroducing species or making structural changes to an existing system to make room for natural processes to take hold (Lorimer et al., 2015).

Even within these broad definitions, rewilding has taken different forms depending on the project. As these projects and approaches started to develop over time, some form of consensus on the practice has emerged: rewilding aims to restore trophic interactions on a landscape-scale, to improve ecological integrity and biodiversity. On top of this, rewilding practices also acknowledge that ecosystems are supposed to be dynamic. Finally, to achieve success with rewilding projects local engagement and support by people is fundamental. Initially, rewilding seemed to focus mostly on single species reintroductions, but over time this has shifted to reintroducing processes as well as animals, like disturbance regimes and free-flowing rivers. The goal is to create a self-regulating ecosystem (Carver et al., 2025). Additionally, a focus on restoring ecological integrity and connectivity has also become more important. Currently, rewilding successes are measured on the restored functionality of these processes, using landscape connectivity and trophic complexity as an important criterion to deem a rewilding project successful (Torres et al., 2018).

One must be cautious however, that rewilding is not supposed to present itself as the “end-all be-all” of ecological restoration. For one, the natural processes discussed, are incredibly diverse in their spatial impact and application, and vastly complex. To successfully involve rewilding practices in a design, it is important that designers understand these processes and be able to identify ways to restore them. It provides a new direction that differs from traditional conservation practices and focusses on restoration over preservation. Practical and direct interventions of rewilding however, cannot be broadly defined as they are heavily site dependent. Careful site analysis, of both biotic and abiotic conditions, is crucial to determine intervention strategies (Carver et al., 2025)



Figure 9: Illustration on Rewilding,
(Jeroen Helmer, 2023)



Figure 10: Photo of Orongo station, a landscape architectural heritage design in New Zealand (Nelson Byrd Woltz Landscape Architecture, 2026)

The future of the past

Heritage Landscape Design

As mentioned in the problem statement and introduction, an important aspect of creating a sustainable design for the Veluwe that is supported by the general public, is the incorporation of its cultural heritage. Heritage design has a myriad of approaches, but these have often been focussed more on the realsm of architecture. When it comes to spatial planning and landscape architecture, heritage design approaches and practices have yet to be formalized in specific theories. Nonetheless, many have written on the diverse ways one can approach heritage landscape design.

One of these frameworks comes in the form of the Sector, Factor, Vector model, which going forward will be referred to as SFVM. The sector aspect of this framework refers to traditional approaches to heritage design "based on the notion that socio-economic and spatial dynamics pose a constant threat to the cultural heritage." (Janssen et al., 2017). One could also pose this approach as a form of protectionism. Heritage is seen as something that is to be conserved and protected in its original state as much as possible to safeguard its historical and cultural legacy. The factor approach presents a more dynamic perspective. "Rigorous protection is then reserved for a selection of the most valued heritage objects" (Janssen et al., 2017). In heritage sites with a little more flexibility regarding this protection, the heritage aspect is placed within the context of the spatial quality of that area. This allows for urban renewal of historic city centres, without sacrificing spatial quality for the sake of innovation. When looking at heritage from a more holistic perspective, the vector approach is applied. It defines heritage as something pertaining to "personal memories, genealogical links and scientific reconstructions of historical events [that] impart a narrative structure to the past." (Janssen et al., 2017). It involves not only spatial heritage, but also intangible heritage like cultural and oral traditions. This approach encourages active engagement with all the aspects that make up heritage, using the past as a catalyst for structuring the future.

The SFVM is most useful when looking at a landscape scale, but when it comes to localised design interventions, a more focused perspective can provide even more insight. In "Ontwerpen met Erfgoed – Leren van de Belvedere ervaring" (Designing with Heritage – learning from the Belvedere experience) Labuhn and Luiten (2021) present a framework that explores the essences of heritage designs; Material, Morphological and Semantic (MMS).

The material essence refers to the tangible remains of heritage, like construction ruins or archaeological finds. Often times, these remains can become the "main character" of a design, providing an anchor point for the material choices of the design interventions. To apply this to a landscape intervention, it is imperative that the designer figures out the physical ingredients that form the basis for the landscape. Morphological essence has a strong focus on compositional choices a designer can make when working with heritage. One can think of colour palettes, regional landforms, and the relationship that the physical and intangible heritage has with the surrounding landscape. The semantic essence dives into the meaning and symbology of various kinds of heritage. This involves cultural practices, but also the memories and historical events that are tied to a place.

Professional Relevance

The profession of landscape architecture is an ever evolving one. A simple look into the history of this profession sees it change from the design of royal gardens and public parks to a profession that concerns itself with much larger issues concerning the entire planet. To allow this profession to continue to change, it is important that we discuss how theories from other disciplines can be implemented into this profession.

Rewilding Landscape Architecture

Within landscape architecture, the approach seen in rewilding projects seems to be underutilized, but there is a possibility for a mutually beneficial relationship between these approaches. On the one hand, rewilding efforts can benefit from the landscape architectural site-based design and analysis principles. Rewilding efforts often involve attempts to reduce habitat fragmentation, and reconnect existing ecosystems through interventions like ecoducts. The question of where and how these interventions should and can take place, can be answered through landscape architectural system thinking, considering the restrictions and opportunities that might arise from human interaction with the landscape. On the other hand, studying rewilding principles as a landscape architect can provide new insights into the ways they can integrate natural processes in their designs in a meaningful way. Working with a landscape that is ever-changing and includes highly dynamic processes provides new opportunities to explore the existing paradigms of landscape design, and to embrace the possibility of designing a true wilderness.

Heritage as a vessel

Combining the aforementioned frameworks, SFVM and MMS, provides handholds for a heritage-inclusive design, and can guide the choices one makes on where and how to intervene in a landscape. On top of this, the heritage frameworks also provide ways to approach the integration of the human experiences into a landscape with a cultural significance. In the case of the Veluwe, it is important that the heritage is not just literally interpreted but also abstracted. By doing this, instead of being a constricting factor, the eco-cultural heritage of this landscape can become a vessel for its future evolution.

Design Objective and Assignment

The design objective for this thesis is to improve the ecological structure, and integrity of the greater Veluwe ecosystems by rewilding, focussed on (re)introducing natural processes. Designing is about taking control, but rewilding revolves around letting nature take control. When designing for rewilding, we tread a thin line between taking and relinquishing control. This ecological aspect of the design objective focusses on how we as designers can kickstart, reintroduce, and facilitate natural processes, and lay the groundwork for letting go of control.

However, the Veluwe is not a landscape without history. It is therefore important that this landscape heritage is studied and preserved where it is culturally relevant. On top of that, the Veluwe is an important area for outdoor recreation for many people, and is one of the few places in the Netherlands where people can escape from their busy daily lives. A meaningful incorporation of this recreational aspect should not be overlooked, not just for recreation but also to educate visitors on the motivation behind the design interventions. This design is about finding balance between that which is fully controlled by anthropological influences, and that which is allowed to develop under the control of nature's own processes.

To achieve this objective, a variety of landscape architectural design interventions can be applied. An important distinction will be on the basis of scale level: certain goals can best be achieved on a landscape scale, while others might be limited to a more local level. Keeping the scale continuum in mind will be imperative to this, and the final design will therefore have to include a combination of large-scale landscape strategies, with acupunctural interventions in specific areas.

In combination with the scale-continuum, the temporal dimension will also be part of the final design. The objective is to be able to address the way the ecosystem will change over time, and how different management strategies will affect the landscape in different ways. To bring this dimension to life, different scenarios can be explored, and to highlight how the interventions will evolve over time.



Part II:
Taking a closer look

Introduction
Vegetation Succession
Disturbance Dynamics
Grazing and the Wood-Pasture hypothesis
The Nutrient Cycle
The Importance of the Soil Seedbank
The Ecology of Fear
Designing Wilderness

Figure 11: Image of dead wood on the Posbank

Introduction

In the problem statement and site introduction, several complex natural processes and design approaches have already been mentioned. However, to understand these processes and approaches better, and be able to integrate them properly in a landscape architectural challenge, it is imperative that these are made explicit.

So, to start off the theoretical framework, six natural processes will be explained in more detail. It must be said however, that this of course does not tell the entire story of how ecosystems work, but for the sake of relevance to the project these six have been selected. The chapter is closed with the design implications of these natural processes.

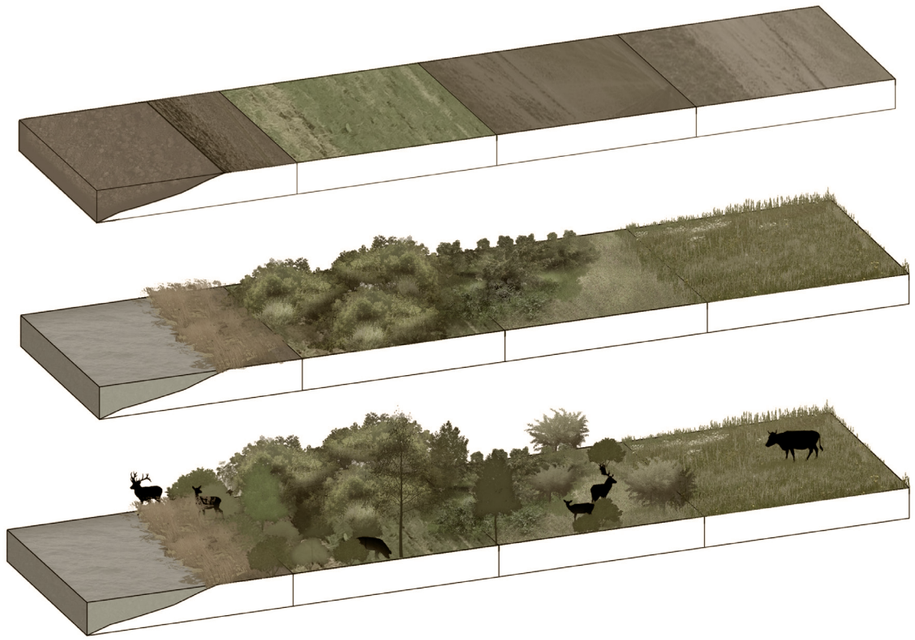


Figure 12: Diagram showcasing Vegetation Succesion over time, made by author for previous project

Natural Processes

Vegetation Succession

It has become clear that our current system of species and habitat conservation might not be enough to provide meaningful restoration to our ecosystems. Single-species protection, based on subjective country-based norms, fails to address the larger problem plaguing the biosphere; that many of our ecosystems are broken. Ecological restoration as a discipline has been wanting to address this issue by looking into the relation between ecosystem structure and function. This linear structure-function model, has been widely applied to many ecological restoration projects, revealing that the function and structure of ecosystems strengthen each other's effects: "the structure becomes more complex by an increase in the number of species and their ecological diversity … the function increases in terms of an increase in biomass and circulation nutrients" (Bradshaw, 1984). This expanding and increasing complexity over time is often attributed to the process of vegetation succession.

The concept of vegetation succession has been around for quite a while, and in general refers to the sequential change of an ecosystem and its composition as it develops over time. The different successional shifts change the vegetation association, until it arrives at a condition that is best suited to the abiotic (climate, soil, hydrology) conditions of its site; the climax community. This linear succession model allowed ecologists to effectively predict where a vegetation association was headed, based on the site conditions and analysis of the current state of the vegetation (Drury & Nisbet, 1973). In areas of the Northern Hemisphere with a temperate climate, this climax state was suggested to be that of a closed-canopy forest. If this climax state were to disappear due to some form of intervention or disturbance, the vegetation would over time naturally develop back into this closed-canopy forest, with renewal of trees taking place in clearings caused by stand die-off or perhaps storm winds (Clements, 1916).

However, the ideas of climax vegetation and linear succession have been subject to dispute for several decades now. A newer theory surrounding succession comes in the form of the State-Transition Model, or STM. An STM presents an ecosystem that is in a constant state of flux, varying between alternate steady states, which transition over time depending on the type of disturbance the ecosystem experiences (Bestelmeyer et al., 2017). This concept was also adapted within the realm of ecological restoration, as it provided a framework to analyse the current and desired state of the ecosystem. When this is clear, restoration efforts can be targeted to transition the ecosystem to a steady state. As the ecosystem reaches a functionality and structure that aligns with a steady state, the ecosystem can then respond resiliently to disturbance by shifting between these alternate steady states (Stringham et al., 2003). This theory supports the idea that ecological restoration must keep the successional cycles of vegetation in mind when trying to rehabilitate landscapes. An ecosystem is not static and should be allowed to change over time as natural disturbances change its circumstances (Cortina et al., 2006), (Poorter et al., 2024).

Disturbance Dynamics

A crucial part of state transition models is mapping what kind of disturbances can affect the ecosystem. But the definition of what a disturbance actually is has changed over time. Initially, disturbances were seen as an infrequent and often sudden departure from the stable climax community. But as was explained in the previous section, modern interpretations of ecosystems view this a little differently (Battisti et al., 2016). Nowadays, ecosystems are assessed based on their disturbance regime. These regimes describe a wide range of natural processes, and divides them based on aspects like intensity or severity, time, and natural or anthropogenic origin. In turn, the abiotic characteristics of the ecosystem cause the disturbances to play out differently, so the same disturbance regime can have widely different effects on different sites (Battisti et al., 2016b).

In terms of severity, natural disasters are probably highest on the list of disturbances. Earthquakes, tsunamis, and cyclones, can all severely impact ecosystems. These disturbances often take the ecosystem a long time to recover from, and are followed by many different steady or transitional states, with the consequence sometimes being that the ecosystem never returns to its original state (Burton et al., 2020). Fire is also included here, but also presents an interesting dichotomy. In certain ecosystems, fires occur naturally due to climatic conditions, and can often be a vital part of the health of the ecosystem. On the other hand, fires in ecosystems that are poorly adapted to fire can be disastrous and are often referred to as catastrophic fires (Yefremov & Shvidenko, 2004). And whether directly or indirectly, the blame almost always falls on the actions of people when it comes to catastrophic fires. Even the Veluwe has been subject to anthropogenic fires, with fires breaking out yearly at this point. These fires are sometimes caused by careless visitors, but more often as a result of military training exercises (NOS Nieuws, 2025) (NOS Nieuws, 2026).

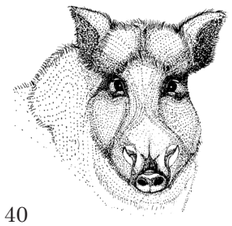




Figure 13: Picture of the 2026 fire on the military training ground at ‘t Harde (NOS Nieuws, 2026)

Grazing and the Wood-Pasture Hypothesis

The list of different disturbances goes on and on, from invasive species to landslides, but in the case of rewilding one disturbance stands out: grazing dynamics. In recent years, the effects of grazing on planting communities has been extensively studied and discussed. In Frans Vera's 2000 book "Grazing Ecology and Forest History" book, he posed a controversial statement, known as the wood-pasture hypothesis, regarding the traditional views held by forest ecologists. Vera questioned the traditional view about temperate forest ecosystems, after noticing that many light demanding tree species simply cannot regenerate under closed-canopy conditions. However, the palynological records of pre-agricultural Europe showed an extensive presence of light demanding species like hazel, oak and hornbeam, pointing towards a landscape that was much more open and park-like than the closed-canopy forests we are used to nowadays.

Vera presented the idea that grazing by large herbivores played a major role in this landscape. In their grazing of young trees, the grazers prevented tree regeneration of both shade tolerant and light demanding species. Tree regeneration instead would take place not within the forests, but under the protection of thorny scrub species that grew out in the open, or in the mantle of existing forest groves. The shrub species were either poisonous or had thorns to protect themselves from grazing, and had open canopies through which sunlight could reach young tree saplings growing beneath them. Once the trees grow up above the thorny shrubs, they will have escaped the so-called "browsing trap" and no longer have to fear the grazers. If groups of shrubs establish on the landscape, forested groves could start to appear, with a mantle-vegetation of the expanding shrubs. Within these shaded groves, shade-tolerant species could regenerate. Over time, the trees in forest groves will slowly age and at some point, die. This process is also aided by debarking behaviours of grazers. In winter, the mantle vegetation would be less of a barrier so grazers could have easier access to the groves, and tree bark can be a vital resource for many grazers. In spring and summer grazers will often rub up against trees and shrubs to get rid of their winter coats. A tree with damaged bark is more vulnerable to fungus and insect infestations, and this accelerates the decay of old groves (Linnartz et al., 2021).

With the old trees passing away and decaying they release their captured nutrients, creating new fertile openings in the landscape, which can be colonised initially by pioneer species of grasses and herbaceous species, and next by the thorny shrubs that can once again shelter new tree saplings, and the cycle continues. (Hodder & Bullock, 2009). The result of this pattern of regeneration and decay created a mosaic landscape with forested groves and individual trees constantly moving across a wood-pasture system. This long-term movement of trees is referred to as the "walking forest" (Linnartz et al., 2021).

Vera's theory has not been without scrutiny, with many scientists attempting to disprove or fully reject Vera's hypothesis, also stating palynological records (Mitchell, 2004). Like in many cases of scientific dispute, the truth of the matter most likely lies somewhere in the middle (Birks, 2005). What is unequivocally true however, is that grazers and browsers most definitely affect forest ecosystems. On the Veluwe, exclosure experiments have proven that under the influence of a full grazing portfolio, tree recruitment is heavily reduced, and favours unpalatable species like Scots Pine (Kuiters & Slim, 2000).

New research also supports the idea that thorny shrub species like bramble facilitate the growth and recruitment of light tolerant species like oak, birch and poplar (Czyżewski et al., 2026). A study on the Knepp Rewilding site in the UK also looked at the effects bramble can have on the establishment of oak, revealing that thorny scrubs can indeed function as nurse species (King, 2019). Aside from the effects of grazing on forest regeneration, other scientific studies have proven that natural grazing of grass- and woodlands, improves plant diversity. Especially relevant for this thesis are the studies done on the Mol Rewilding Project in Denmark. The conditions of this site are very similar to the ones on the Veluwe. Year-round natural grazing of self-sustaining populations of grazers was found to improve plant biodiversity and ecosystem structure in this landscape (Kristensen et al., 2026) (Bonavent et al., 2023).



Figure 14: Illustration the processes facilitating a "Walking Forest" (Jeroen Helmer for Ark Rewilding, 2020)

The Importance of the Soil Seedbank

The soil seedbank is the lifeline of many terrestrial ecosystems. Many seeds can survive for years, sometimes even decades in topsoil, secretly conserving the vegetation diversity of an ecosystem. Now, not all seeds are equally viable in this regard: smaller seeds with a protective seed coat have the longest survivability, as they are more resistant to weathering and are easily incorporated in the less disturbance-prone deeper soil layers. Larger seeds, like the ones many fruit-bearing tree species produce, survive less often and last less long in many cases (Wakshum et al., 2018).

An ecosystem's resilience is heavily dependent on the diversity of its seed bank. Many plant species are adapted to specific conditions, filling their own niches within an ecosystem. These conditions are often determined by the disturbances of an ecosystem. Certain plants only germinate on the bare soil created from intense grazing, while others can only thrive in the shaded protection of other plants. Since vegetation forms the basis of an ecosystem, the soil seedbank grants the ecosystem the tools it needs to respond to different disturbances, and keep its productivity high.

But the survival of the seedbank has its limits, and human disturbance can often have a detrimental effect on the seedbank. Forests that have been cut down, then turned into agricultural fields and coniferous plantations after this, often retain very little of their original seed bank diversity. Specifically, recently established coniferous plantations have a measurable destructive effect on seedbank diversity, compared to old growth deciduous forests (Augusto et al., 2001) (Wakshum et al., 2018). Heathlands are another ecosystem very vulnerable to seed bank degradation, as the seeds of heather species only survive for a short time, and are limited to the topsoil layers. Sod-cutting, often done in an attempt to "restore" heathlands, removes these seeds from the ecosystem, decreasing species diversity, but also genetic diversity (Putwain & Gillham, 1990).

The seedbank is a viable asset when assessing the actions needed to restore a degraded ecosystem to a more natural vegetation pattern. In many cases, natural dispersal from surrounding ecosystems is preferred over introducing species. Species can disperse through wind, water or with the help of animals. But sometimes, when intact ecosystems are poorly connected, or simply located too far away from the restoration site, natural recolonization is deemed impossible. Therefore, restoration efforts often include the reintroduction, or assisted colonization, of species that were once present in the ecosystem. These plants will set seed, which will then be incorporated into the soil and with every year that passes the ecosystem becomes more resilient as the seed bank is rebuilt (Bakker et al., 1996).



Figure 15: A forget-me-not (*Myosotis arvensis*) growing out of leaf litter

The Nutrient Cycle

Nutrient cycling is a fundamental, though often overlooked, part of any ecosystem, and the concept itself has been extensively studied by ecologists. The nutrient cycle is the recycling of organic and inorganic matter within an ecosystem. In forested ecosystem specifically, the nutrient pump in combination with decomposition are especially important. First the nutrient pump will be explained, the process goes as follows; trees and other plants take up nutrients like minerals, nitrogen, carbon, phosphorus etc. through their roots from different soil layers and the water they consume. These nutrients, in combination with the sugars created through photosynthesis, create the building blocks for the growth of the tree.

In this process the nutrients are stored within the tree. When the tree drops its leaves or passes away, soil organisms, like fungi, bacteria and nematodes, work towards decomposing the plant litter. They use them for their own survival but also return these nutrients to the soil through their droppings (Attiwill & Adams, 1993) (Carson, 1962). There is another aspect of this, in the form of mycorrhizal networks. Many plant species have symbiotic relationships with mycorrhizal fungi, which form extensive underground networks. Within these networks nutrients can be moved around, increasing the capacity for a tree to take up roots beyond its immediate surroundings (Read & Perez-Moreno, 2003).

But this cycle does not only apply to plants and soil organisms, larger animals also participate. As animals consume organic matter, like plants or other animals, they also store nutrients in their bodies. When these animals defecate, they release some of these nutrients back to the soil, and when the animal passes away and the body is decomposed, all of the nutrients are returned. In many ways, living organisms borrow nutrients to sustain themselves, but in a healthy ecosystem, these nutrients are always returned. It is this nutrient cycle which ensures that an ecosystem can never be fully deprived of its nutrients (Leopold, 1987) (DeAngelis, 1980). This process is especially important on poorer sandy soils, as the porous sand grains are vulnerable to the flushing out of their precious nutrients (Linnartz et al., 2021). The result of these complex nutrient cycles is that nutrients are constantly moved around an ecosystem, and the mobilization of these nutrients keeps the ecosystem's balance in place.

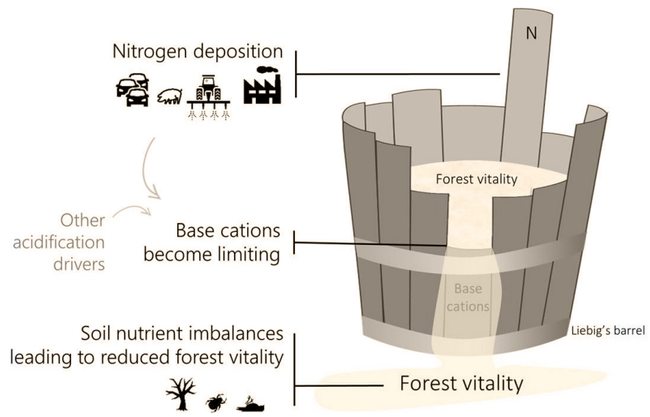


Figure 16: Forest on acidified, poorly buffered soil (Desie et al., 2019)

As was mentioned, decomposition is an absolutely essential aspect of the nutrient cycle. Decomposition rates are determined by a plethora of different factors, but in many Western European forested ecosystems these factors are heavily disturbed. This is caused by the following process: Agricultural activity in the surrounding areas causes nitrogen to be deposited on the forest soils. Nitrogen is a vital resource but it in excess it acidifies the soil, which reduces the decomposition rate. The result is a leaf litter layer that is constantly getting bigger, covering un-decomposed material, and keeping their nutrients locked up (Shen et al., 2021) (Jiang et al., 2022) (Berg & Matzner, 1997).

But the forests on the Veluwe have additional issues. These forests exist mostly of pine, beech and oak, all species that have leaf litter that has a naturally reduced decomposition rate and low buffering capacity. Buffering capacity refers to the availability of certain minerals in leaf litter that can help increase pH rate, which lower acidification. On top of this, almost all of the current "forests" in the Netherlands, most of which are actually pine plantations, have extremely closed canopies. This in turn reduces the effects that UV radiation can have on the weathering of the leaf litter. Due to this reduced decomposition rate, it takes a long time for nutrients to be returned to the soil, causing more nitrogen to accumulate which acidifies the soil further. The acidic soil is a limiting factor for the recruitment of many tree species, which is already limited by the aforementioned grazing effects in closed canopy systems, but not for the already over-represented pine species, which then become more dominant, creating more hard to decompose pine litter, and so on and so forth (Arnold, 1993) (Bergsma et al., 2018).

Recent studies have been trying to shed light on this issue and the importance of fixing the decomposition rates in the forests of the sandy soils, and cite the importance of reintroducing "rich-litter" trees; species that promote faster soil nutrient turnover through higher base cation (buffering compounds) presence in the leaf litter (Desie et al., 2019). But this whole process might still bring up some questions. If the current composition of the Dutch forests is so destructive to its nutrient cycle, how did it get to this point? And why can it not restore the nutrient cycle on its own? Why should we introduce seemingly "new" species to solve this issue? It seems that restoring forest ecosystems is a complicated puzzle, often heavily influenced by its past.

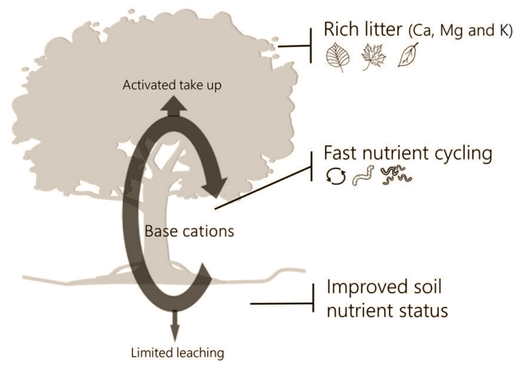


Figure 17: Rich Litter as a restoration measure (Desie et al., 2019)

The Ecology of Fear

The final layer of ecosystem complexity we will discuss comes in the form of predator-prey dynamics. In many areas around the world, humans have removed carnivorans (that is animals belonging to the genus *Carnivora*) from ecosystem for a long time, to both protect themselves and their livestock. In Western Europe, wolves, bears (*Ursus arctos*), and lynxes (*Lynx lynx*) have been extirpated from large parts of their former range. In many ways predators are seen as the ′bad guys" of the natural world, partially thanks to their representation in fairy tales, folklore and even modern-day media. But predators are a vital part of a healthy ecosystem, specifically through a concept known as the ecology of fear (Ripple & Beschta, 2004).

Traditionally, predators were seen as organisms that controlled population sizes of herbivores, something called a top-down control mechanism. However, as you might have guessed from how this thesis is going so far, the reality of these interactions is a little more complex. Top-down impact is often exaggerated, and populations of prey species are more often than not determined by food availability, also known as the carrying capacity of an area. This carrying capacity is based on many factors, but are dominated by availability of primary resources: food, water and shelter. When no predator is present, herbivore populations will often increase up to the carrying capacity, after which populations will either crash due to overgrazing and exhaustion of this carrying capacity, after which they stabilize. This is called bottom up-control (Kiffner & Lee, 2019).

And this is where the ecology of fear comes in. When prey have no predators, they can optimize their day-to-day lives based solely on their primary needs, and in areas where predators are removed, herbivore populations often sky-rocket as they can spend their lives focussing solely on feeding and reproducing. But when predators come in, their behaviour has to change to incorporate anti-predator strategies. This includes things like herding behaviour, increased vigilance, temporal avoidance, and so much more. The result is that animals can spend less time feeding, and their young risk much higher mortality rates. In this way, the predators control not population density or size, but they do curb the resource dependent population dynamics, which are often vulnerable to sudden disturbances and overgrazing, resulting in mass die-off of herbivores. Now it must be said that anti-predator strategies are incredibly sophisticated behavioural patterns, depending on predator size and prey-preference, hunting strategy, prey density, species diversity and much more (Mech et al., 2015) (Creel et al., 2014) (Lazzeri et al., 2024).

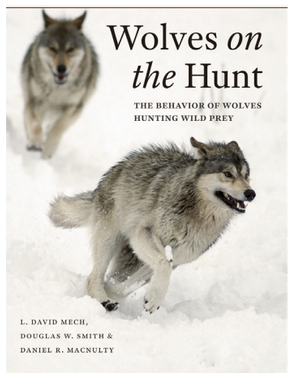


Figure 18: Cover page of *Wolves on the Hunt* (Mech et al., 2015)

The impacts of fear ecology is not the same amongst herbivore species. Larger herbivores are often more dangerous targets, and are avoided by predators in favour of smaller prey. The impact of predators on populations differs per species, but creates an important checks and balances system which goes as follows; larger animals have larger digestive systems, allowing them to consume large quantities of low-nutrition foods and digest them for a longer time so that they are still able to access their nutrients. This grazing makes room for new shoots to come up, which are then consumed by smaller herbivores with shorter digestive systems that require more nutrient- and protein-rich food. With no predators present the smaller herbivores, which also have shorter life spans and faster reproduction, can increase their populations incredibly fast. The result is increased competition amongst the different grazers, where the large grazers that are dependent on large quantities of food, will often suffer the most. When a predator is present, they can suppress these smaller herbivore populations through both fear-ecology and direct removal. The result of this, is that predator presence reduces competition between species, but also makes their interactions with their environments and each other more complex. The results is heterogenous disturbance patterns and indeed, a more diverse and complex ecosystem (Linnartz et al., 2021) (Zanette & Clinchy, 2019) (Brown et al., 1999).

The Veluwe has been an interesting case with regards to predation effects. The wolf has made its way to the Veluwe on its own accord, and the return of this predator has sent ripples through the ecosystem. Many studies are doing being done to observe the effects of wolves on the resident ungulates. For now, forest rangers have reported seeing an increase of herding behaviour amongst red deer, and an increase in calf mortality. In certain parts of the Veluwe, semi-wild cattle are more vigilant. Young calves, which spend their first weeks hidden away from the main herd, have been joining the herd earlier than before. Only time will tell what the larger effects will be on this ecosystem (Jansman et al., 2021) (Groen et al., 2025).



Figure 19: Camera trap footage of a grey wolf attempting to hunt a red deer (*Cervus Elpahus)* (Natuurmonumenten, 2024)

Designing Wilderness

There is an inherent contradiction when discussing the application of natural processes in landscape architecture. In many ways, landscape architecture revolves around taking control of our surroundings, drawing detailed design plans, and designing a specific kind of experience of the outdoor world, whether that is in an urban or rural context. Though we use natural ingredients, plants are a landscape architect's paint brush, the strength of the design comes from the deliberate placement of these ingredients. There is often little room for these elements to move around our designed landscapes. But if one thing is clear from nature of natural processes is that dynamism, complexity and room for adaptation should be at the forefront for a properly functioning ecosystem.

But there is also a kinship between these seemingly disparate concepts. Modern landscape architectural projects often aim to not only benefit people but also non-human participants, giving landscape architecture at least some focus on ecology, and addressing issues like climate change and the biodiversity crisis in our designs. On the other hand, for successful ecological restoration projects, plan drawings and project designs are necessary to ensure their success.

Evolving the discipline of landscape architecture will mean that we need to be able to look at our designs not as static paintings, but to see what kind of impulses we can provide for broken ecosystems in order to strengthen a living, breathing and, most importantly, moving canvas. On top of this, design can be an excellent educational tool. Being deliberate with the incorporation of plant and animal species can provide visitors with new insights into ecosystems that they might not have had if they were not confronted with them through these designs.





Figure 20: Picture taken of old military road in the Ark Rewilding Bison Project on the Veluwe

Part III:
A Lay of the Land

Introduction
Pleistocene
The Saalian
The Eemian
The Weichselian
Holocene
The Palaeolithic and Neolithic
The Medieval Period
The Industrial Age
The Modern Era
Conclusion
Design Implications

Figure 21:Picture of the heathlands on the Posbank

Introduction

In order to get a better sense of how the landscape of the Veluwe has changed over time, this landscape biography was created. The goal here is to showcase what factors have created, shaped and changed the Veluwe, and how the dominant factors have shifted as human influence increased. For each chapter, a landscape overview was written that marks the most significant changes of that time period. The chapters will then continue to expand on this and provide details of these changes, like their causes and consequences. The main division of this landscape biography is based on two most recent epochs; the Pleistocene and the Holocene. The detailed chapters within these epochs are divided based on eras of change, sometimes defined by climate shifts and glaciers and other times by the arrival or departure of people in the area.

To construct this landscape biography, extensive literature research has been done to create an image that is as complete as possible. From geomorphological records to palynological research and fossil finds, and from history books to scientific reports, the different layers that make up a landscape have been considered to their full extent. To anchor the research in a clear storyline, three main sources were consulted. The focus of these sources is mostly on the human history of the Veluwe. Additional sourcing for specific topics on the natural history, such as faunal- and floral assemblage, climate and fossil remains, has been referenced in standard APA style. The three main sources are as follows, and for the sake of readability, will from here on be addressed with their corresponding numeral.

I.
Van Der Ziel, T. (2024). Atlas van de Veluwe (W. Eikelboom, Ed.; 2nd ed.) . WBooks.

II.
Ten Houte De Lange, S. M., Maarleveld, G. C., Lange, G. W., Pape, J. C., Bannink, J. F., Van Der Brink, G., Van Der Werf, S., Van Den Wijngaard, J. K. R., Maessen, P. P. Th. M., Ten Houte De Lange, S. M., Weyland, W. A., Van Den Bergh, L. M. J., Notenboom-Ram, E., Higler, L. W. G., Vervloet, J. A. J., Klok, R. H. J., De Veer, A. A., Buitenhuis, A., Van Het Loo, H., . . . Brugge, T. (1977). Rapport van het Veluwe-onderzoek: Een onderzoek van natuur, landschap en cultuurhistorie ten behoeve van de ruimtelijke ordening en het recreatie beleid (No. 90-220-0651–4). Centrum voor Landbouwpublicaties en Landbouwdocumentatie Wageningen.

III.
Neefjes, J., Rijksdienst voor het Cultureel Erfgoed [RCE], & Staatsbosbeheer. (2018). Landschapsbiografie van de Veluwe. In Rijksdienst Voor Het Cultureel Erfgoed.



Figure 22: Map of the Veluwe in 1741, cut-out on the modern day Natura 2000 Area (Original Map Sourced from Geldersch Archief)

The Pleistocene

The Pleistocene was the last geological epoch before the Holocene, and marks a time of dramatic climatic shifts and little anthropogenic influence. It lasted from about 2.5 million BC. until 10,000 BC. This chapter will not cover the entire Pleistocene, but starts off near the end of the Pleistocene, when the Saalian ice age created the landforms we now identify as the Veluwe.

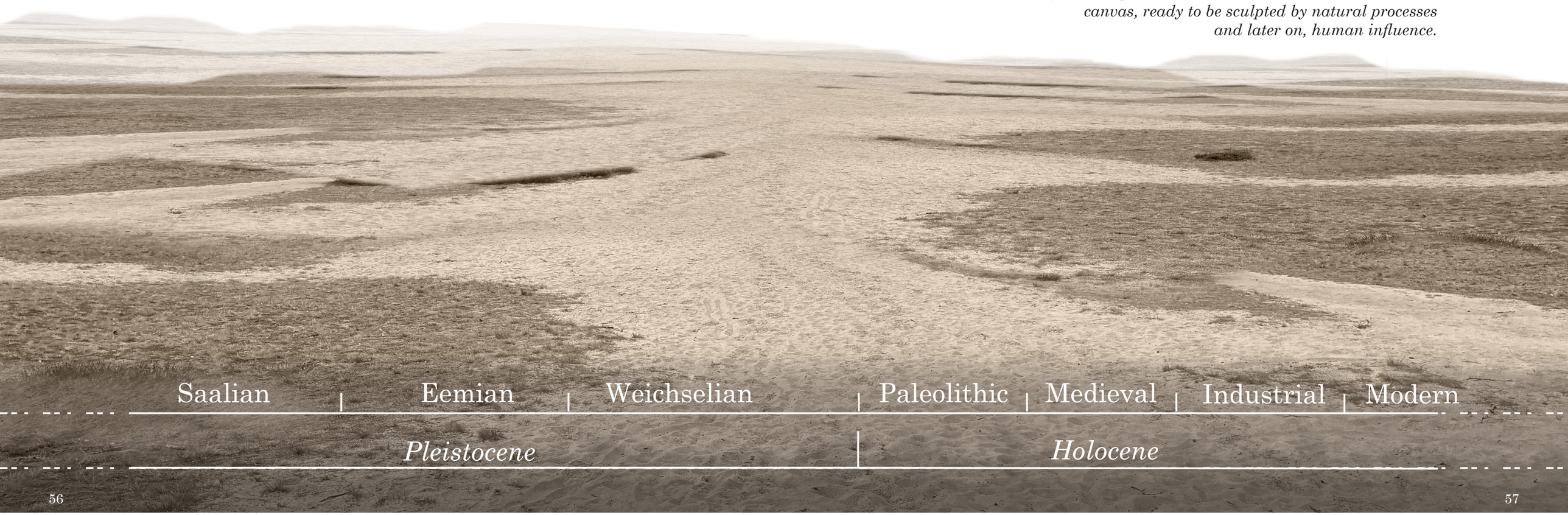
For this part of the landscape biography the sub-chapters were based on climatic and biotic shifts, and their respective effects on the landscape of the Veluwe. The sub-chapters have therefore been divided into two sections, those being climate and geomorphology and flora and fauna. Because modern humans during this time were either absent from the landscape, or behaved as a part of the ecosystem, human presence is mentioned under the flora and fauna sections.

The Saalian

c. 236.000 B.C. - 126.000 B.C.

Landscape overview

The Saalian Glaciation can be seen as the founding time period for the Veluwe. Masses of glacial land-ice pushed up the riverine sediments, creating the hills that define the modern Veluwe. Being in such close proximity to the glaciers, the landscape consisted of tilled soils, uninhabited by meaningful flora or fauna. The Veluwe was a blank canvas, ready to be sculpted by natural processes and later on, human influence.



<- Figure 23: Impression of the landscape of the Saalien

Climate and geomorphology

The story of the Veluwe begins at the tail end of the second to last Pleistocene glaciation events, also known as the Saalian glaciation. During this glaciation, glaciers from Norway and Scotland had formed a continuous glacial sheet that pushed its way down into the Netherlands. As the glaciers carved their way forward, they pushed up riverine deposits from the Rhine, forming distinct layers of mixed sediment. Before this ice age, the area that would one day become the Veluwe was part of the palaeo-Rhine river delta, forming a large floodplain where meltwater floods deposited gravel, sand and clay. Closer to the river, in the southern part of the Veluwe, rougher deposits like sand and gravel were deposited, and further up North clay deposits were dominant (III). As the glaciers moved from North to South, they chose the path of least resistance, initially filling up the river valleys and in turn pushing those sediments forward and to the side. The result of this is a landscape in which the preexisting relief is exaggerated, small depressions were carved into valleys, and levees were formed into steep slopes (Maarleveld, 1951). This is called a push-moraine complex and formed the basis for the major landforms of this region of the Netherlands: the Utrechtse Heuvelrug, the Gelderse Vallei, Eem-Vallei and the Veluwe.

A cross-section of the soils in this area reveals their tumultuous history. The glaciers fragmented the solid river clay layers, and placed them in ribbons across the sandy hills, forming impermeable layers that created a complex, tiered network of groundwater reservoirs (I). The soil profile is not uniform across the entire Veluwe, as the glaciers advanced and retreated following climatic and seasonal shifts within the Saalian (Maarleveld, 1951). As the glaciers partially melted in the warmer spells, the meltwater would run across the push moraine, starting the process of turning these jagged cliffs into rolling hills interspersed with creeks and ponds that still persist to this day.

One of the main traces of this pattern is a shallow valley and creek system in the Northern part of the Veluwe which is called the “laagte van de Leuvenumse beek.” This valley was created when a small outcropping of the glacier melted but was stuck between the remaining glacier in the North, and the hills it had pushed up around itself to its southern flank, creating a glacial lake basin, where eroded soil from the nearby hills would be deposited. As the ice on its north side disappeared, the water flowed out along the soil surface, carving a creek that can still be found there to this day. (III).

Flora and Fauna

During this glacial maximum, the Veluwe was either covered in land-ice or by a polar desert, as the glaciers withheld any moisture from its surroundings. It was almost impossible for any life, even those adapted to colder conditions, to gain a foothold in these ecosystems. Many of the plants and animals of northern Europe survived this intense glaciation in so-called “refugia” in Southern and Mediterranean Europe (Schmitt, 2007). As the glaciers retreated, The Veluwe was in many ways a blank slate; the glaciers and their associated effect on the local climate had left the land void of most vegetation. Looking at modern day studies of glacial retreat, a new ecosystem often rapidly develops on these barren grounds (Ficetola et al., 2024). But the ecosystem would not return to its former floodplain state; the new landform that was created had entirely new conditions with a different geology, hydrology, and relief, opening the door for a new type of ecosystem (Kasse et al., 2022).



Figure 24: Hillshade Map of the Veluwe and its surroundings

The Eemian

c. 126.000 B.C. - 116.000 B.C.

Landscape overview

The Eemian was an exciting time in the history of the Veluwe, and one of the last times when the landscape was fully controlled by natural processes. The result of a combination of a warming climate and complex grazing- and vegetation dynamics created a landscape brimming with life. A lush savannah woodland on the hill tops, and wetlands at the foothills, which were all inhabited by a menagerie of megafauna. These large grazers shaped the landscape, maintaining an open forest-mosaic.



Saalian | Eemian | Weichselian | Paleolithic | Medieval | Industrial | Modern

Pleistocene | *Holocene*

<- Figure 25: Impression of the landscape of the Eemian

Climate and Geomorphology

The Eemian interglacial, the last interglacial before the one we currently live in, provided a drastic change in the climate of the Veluwe. Across the Northern Hemisphere the climate warmed up rapidly in the first part of the Eemian, releasing the icy grip of the Saalian. This not only brought more habitable temperatures but also increased precipitation. The climate during this time was similar to our modern-day climate, if a little warmer. Over the course of the Eemian the climate also had its shifts. Specifically, the middle Eemian sees a drop in temperatures which in combination with decreased precipitation, would intensify into the late Eemian as the climate transitioned into the last Glacial period of the Pleistocene period (Brewer et al., 2008)(Zagwijn, 1989).

But the glaciers were not quite done with shaping the Veluwe. As the glaciers melted and retreated, the creeks that had formed during the shorter warmer spells in the Saalian, were now carrying massive amounts of meltwater down the hills, carving out meltwater valleys across the hillsides and depositing the sand on the lowlands. Increased precipitation run-off further eroded the sandy hills. The larger rivers started flowing stronger as well, causing the Rhine to carve out the southern edge of the Veluwe, creating a sharp southern delineation for the push moraine. The glacier valleys next to the sand ridges were filling up with water, both from the glaciers that were present and the increased precipitation run-off from the hills, creating vast wetlands in the Gelderse- and IJssel valleys (III) (I).



Flora and Fauna

When studying past climatic conditions, pollen analysis or palynology is often used. The idea behind this is that distinct species require different climatic conditions to thrive, so the presence of plants associated with certain climatic conditions can support climate estimates. But pollen analysis not only gives us an insight into the climatic shifts, but also the regime shifts of the local vegetation and what the resulting landscape might have looked like. During the early Eemian, the first settlers were lichens, mosses and grasses, which started the process of developing the soil. Following in their wake were wind-pollinated pioneer species such as birch (*Betula spp.*) and pine (*Pinus spp.*). The arrival of these trees further improved the soil conditions, adding organic matter and complexity. A combination of improved soil conditions and continued warming of the climate, caused the Veluwe to become covered in diverse deciduous forests and woodlands, where oak (*Quercus spp.*) and hazel, (*Corylus spp.*) were dominant, accompanied by ash (*Fraxinus spp.*) and elm (*Ulmus spp.*) trees. The previously mentioned wetlands next to the Veluwe were most likely covered in alder (*Alnus spp.*) swamp forests and extensive reed (*Phragmites spp.*) beds. But the vegetation cover was not exactly the same during this period; as the Eemian started cooling down we can see an increased presence of hornbeam (*Carpinus spp.*) on the hillsides, and we also see the return of coniferous species.
In terms of fauna, the Eemian ecosystem presents a stark contrast to the glacier tilled lands of the Saalian.

The Eemian ecosystem can be seen as a “European Serengeti,” a mosaic landscape with open park-like oak woodlands, interspersed with open grassy plains and groves of dense early successional forest (Sandom et al., 2014) (Czyżewski et al., 2026). The straight-tusked elephant (*Palaeoloxodon antiquus*) roamed, accompanied by fallow (*Dama dama*), roe- (*Capreolus capreolus*) and red deer, and droves of wild boar (*Sus scrofa*). Herds of aurochs (*Bos primigenius*), wild horses (*Equus spp.*) and steppe bison (*Bison priscus*) thundered across the hilltops and valleys. In the wetlands below, European moose (*Alces alces*) and European water buffalo (*Bubalus murrensis*) grazed on water plants alongside the European hippo (*Hippopotamus amphibius*). These large herbivores were followed and chased by a wide range of predators, like packs of cave hyena’s (*Crocuta crocuta spelaea*) and grey wolves, and prides of cave lions (*Panthera leo spelaea*). In the forests, the Eurasian lynx (*Lynx lynx*) and leopard (*Panthera pardus*) used the cover of trees to stalk their prey (Van Kolfschoten, 2000).

Evidence of human activity in this particular part of Europe is scarce, but some flint fragments have been found in Germany (Speleers, 2000) and along the river sediments of the Meuse, and evidence of human occupation along the Dutch Coast has also been discovered (Cohen et al., 2011). Whether ancient humans were present near the Veluwe during this time is speculative, but considering the climatic and habitat conditions, it is not unlikely that our ancestors also roamed this European savannah.

The Weichselian

c. 115.000 B.C. - 10.000 B.C.

Landscape overview

The Weichselian saw the return of the ice, being the most recent major glaciation event. Instead of glaciers however, this time wind and cold chipped away at the sandy hills and covered large expanses beyond the Veluwe in a layer of sand. To the south of the Netherlands, a steppe ecosystem existed, but the Veluwe during this time was closer to a modern-day tundra. Cold-adapted herbs, mosses and grasses covered a tree-less expanse, inhabited by reindeer, mammoths and woolly rhinoceroses.



<- Figure 26: Impression of the landscape of the Weichselian

Climate and Geomorphology

The Weichselian glaciation event marks the last glacial phase of the Pleistocene, and as expected is defined by a distinct decrease in temperatures. These temperatures dropped gradually. The transition from the Eemian to the Weichselian was notably less harsh than the previous climatic shift, but the seasonal differences became more pronounced. In the winters, large areas would freeze over, which would consecutively melt in the summer, further carving out the creeks created by the glacial meltwaters of the Saalian. Especially the tail-end of the Weichselian, also known as the Würm glaciation, saw the climate becoming colder and drier.

This change marked the end of the woodland savannah, and it turned the Veluwe into a vast open expanse where wind erosion became a prevalent force. The wind would blow exposed sand from the hilltops down into the surrounding valleys, overall reducing the topographic contrast created in the previous glaciation event (III) (I).

Another force that shaped the landscape of the Veluwe were permafrost dynamics. As permafrost freezes, groundwater can create a sub-soil “ice bubble.” Because water expands as it freezes, these bubbles created “ice volcanos.” When these ice volcanos melted again, the soil built up on these volcanoes would collapse upon itself creating a pothole in the landscape that overtime could fill up with water creating a “pingo-ruin.” (Vandenberghe, 2013). It must be said that the landscape still maintained some of its former characteristics, as wetland depositions were still present at the foothills of the Veluwe (Van Geel et al., 2010).



Flora and Fauna

With the shifting climate, the vegetation had to respond accordingly. The pollen diagrams of the early Weichselian show a decrease in light-demanding deciduous species in favour of more cold-adapted species like pine and birch. This transformed the Veluwe into a taiga-like landscape, dominated by coniferous trees instead of deciduous ones (Kasse et al., 2022).

But even these trees had to give way to the dry and cold climate of the ice age, and by the middle Weichselian a steppe-tundra had established itself on this once forested landscape (Büdel, 2021). Dwarf birch (*Betula nana*) and willow (*Salix spp.*) were present in the landscape, but overall, an increase in mosses and grasses support the idea of a tundra-steppe ecosystem (Cappers & Bottema, 2003) (Van Geel et al., 2010).

In terms of animal life, the fossil record is less rich than it was in past interglacials, indicating that once again many animals were forced to leave this tundra to find greener pastures in southern Europe. Only the hardiest stayed behind. Populations of woolly mammoths (*Mammuthus primigenius*) grazed on the tundra grasses, accompanied by woolly rhinos (*Coelodonta anitquitatis*), reindeer, (*Rangifer tarandus*) and a giant cousin of the fallow deer, known as the Irish Elk (*Megaloceros giganteus*). Some familiar faces from the Eemian also stuck around in this changed ecosystem, like red deer, European wild horses, cave hyenas, and cave lions (Van Kolfschoten, 2001).

In terms of the presence of humans, we have to look beyond the Veluwe to the North Sea. Until now, the Netherlands had marked the Northern extent of the range of the Neanderthals (*Homo neanderthalensis*), and their remains are scarcely represented in the fossil records. Even so, during this cold period, their presence has been confirmed by findings from the soils under the North Sea. During this time, this region was not a sea but a land bridge connecting the British Isles to mainland Europe, and had a similar steppe-tundra climate to the rest of the Netherlands (Hublin et al., 2009). The fossil remains were dated to the middle Pleistocene, correlating with either the late Eemian or early Weichselian. But these Neanderthal remains were not the only hominin traces found in the Netherlands. The first fossil remains of modern humans (*Homo sapiens*) were also found in the North Sea, marking the arrival of the “first dutchman” (Amkreutz et al., 2018).

The Holocene

When moving into the contemporary geological epoch, the landscape biography will use a different structure. The Holocene covers much less time than the Pleistocene, but due to increasing anthropogenic influences and subsequent ecological shifts, sees rapid changes of the landscape. To address these changes, shorter intervals have been chosen for the subchapters. The climate has remained fairly stable during the Holocene returning the world to an interglacial state, with a similar climate to the Eemian. Because the dominant drivers of landscape change have shifted, the subchapters have instead been divided into chapter-related sections, that loosely correlate to anthropogenic technological advancements.

Flora and Fauna will be mentioned alongside human influence, as these forces are constantly in responding to each other, and often times work in tandem. The attentive reader might note that these chapters do not necessarily correlate to formal historical divisions, this is because the purpose of this landscape biography is to address the changing landscape of the Veluwe specifically, so the subchapters have been devised to accommodate this.

Palaeolithic and Neolithic

c. 10.000 B.C. – c. 400 B.C.

Landscape overview

This time period describes the initial settlement of the Veluwe, first by hunter gatherers, then by early Germanic farmers, which were then accompanied by Roman outposts. The Veluwe ecosystem had recovered since the last ice age, but the number of large mammals in the area had decreased as a result of the Quaternary extinction event. The deciduous forests and woodlands returned to the Veluwe, but these forests were not going to last. The forces that shaped the landscape had become vastly different than those seen in the past.

Saalian | Eemian | Weichselian | Paleolithic | Medieval | Industrial | Modern

Pleistocene | *Holocene*

<- Figure 27: Impression of the landscape of the Palaeolithic and Neolithic

Hunter-gatherer societies

In the Early Holocene, right after the last glacial event the earth started to warm once more. Pioneer species like pine (*Pinus spp.*) and birch (*Betula spp.*) quickly colonized the remnants of the Weichselian steppe landscapes. The lower wetlands were covered in alder (*Alnus spp.)*, willow (*Salix spp.)*, and poplar (*Populus spp.*) forests, and overtime the mixed birch-pine woodlands would transition into deciduous woodlands. This transition into a deciduous forest was gradual, with hazel (*Corylus spp.*) entering the pine forests first, and eventually linden (*Tilia spp.*), oak (*Quercus spp.*), and elm (*Ulmus spp.*) became dominant species in these forests. This vegetation succession turned the Veluwe into an increasingly richer ecosystem with much to offer for early settlers (Brouwer, 2011).

The first people in this area were Hunter-gatherer people, which hunted the large game that remained on the landscape and gathered resources from the forest and wetland environments (I). Their settlements were often next to areas of open water, on the edges of the Veluwe, foreshadowing later settlement patterns (III). Their impact on the landscape during this time was relatively minimal, but the increased hunting pressures, and introduction of more frequent fires definitely impacted the fauna present. Speaking of fauna, the transition into a temperate forest ecosystem pushed out some species that had called this place home (Czyżewski et al., 2026). However, red deer, wild boar and roe deer did very well in the ecotones between the different habitats, and there are also traces of wild horses and aurochs found from this area, though in smaller numbers than in previous times. In the lower lying wetlands, beavers (*Castor fiber*) and moose found a home. Living alongside these herbivores, wolves, lynx, and brown bears also inhabited the landscape (Brouwer, 2011).

The geological forces that had once heavily impacted the Veluwe had a comparatively small impact during this time. With the glaciers out of the picture, and the climate becoming more temperate, the most important shift was that the hilltops of the Veluwe started to dry out. With the departure of the permafrost, water could flow freely in the creeks and brooks, transporting more water to the lowland wetlands next to the flanks of the sand hills. In certain areas on the hilltops, water would be slowed done by the impermeable clay ribbons, and together with the aforementioned pingo-ruins and “dead-ice holes” water became concentrated in fens and ponds (Verhagen et al., 2014) (III).



Early Farming

As mentioned, the early hunter gatherer societies depended on what the land had to offer, and their impact on the land was more in balance with the carrying capacity of the ecosystem. However, this way of life was about to change drastically, with rise of agriculture. The earliest farmers on the Veluwe, were people from the Trechterbekercultuur, dated to about 3400 B.C (Raap & RCE, 2022). These early farmers made their presence well-known, burning forests to create room for crop-fields and pastures for their livestock, chopping down the remaining trees for firewood and construction material for their growing settlements. Traces of these agricultural practices and settlements of this time can still be found in the landscape. So-called Celtic fields (which in this case were not courtesy of the Celts, but of Proto-Germanic people), were small rectangular plots marked with earth mounds on their edges. The mounds can still be seen in detailed elevation maps. They are accompanied by grave mounds, some of which date back to the hunter gatherer societies (II).

The soil in and around the Veluwe, was of variable fertility due to being a combination of sand, clay, and loam. The most fertile soils were found underneath the woodland canopy, where decaying organic material created a rich and complex topsoil. Additionally, the trees that covered large parts of the Veluwe played a significant role in bringing minerals back to the hilltops with their extensive root systems. When these trees were removed the soils quickly lost their minerals and nutrients, and as the organic layer was not replenished with new litter, the soils would degrade over the course of successive harvests. The farmers of this time had to employ crop rotation and extensive grazing of livestock over large areas, to maintain some productivity (Jongemans et al., 2013). The result of this was a landscape in a constant state of flux. The nutrient-depleted crop fields and pastures would be abandoned and recolonized with heath and grasses, forming the basis for the modern-day heathlands. Some forest regeneration would also take place, but the degraded soils prevented them from returning to their former glory (III). Settlements on the Veluwe were located on the flanks of the push-moraines, in the zone between 10- and 30-meters elevation. This once again aligns with earlier settlement patterns, and highlights the importance of combined use of both the wetland and hilltop ecosystems of the Veluwe for the Veluwe’s early inhabitants (Brouwer, 2011) (II).

The Roman Empire, though very influential in the Southern and Central Netherlands, had relatively little impact on the Veluwe. The Roman Empire had expanded up until the Rhine River, so the Veluwe found itself on the edge of this empire, resulting in the establishment of border patrol encampments on the Veluwe. The most influential part of the Roman presence was in the form of trading agreements between the Romans and the early farmers of the Veluwe, which supported population growth and encouraged permanent settlement of the area (II).



The Medieval Period

c. 400 A.D. – c. 1600 A.D.

Landscape overview

The Medieval period has a similar split in landscape transformation as the palaeolithic and pre-medieval period. Initially, with the fall of the Roman Empire to the south and trade connections lost, the Veluwe saw a depopulation trend in its early Medieval times, with forest regeneration as a result. But this trend would quickly change and especially in the 7th century. The Veluwe once again became inhabited by farmers and nobles alike, who wanted to make the most of what these hills had to offer. With farming intensifying, it is at this point that the extensive heathlands and sand drifts were created and expanded, and the groundwork was laid down for many modern-day settlements.

Saalian | Eemian | Weichselian | Paleolithic | Medieval | Industrial | Modern

Pleistocene | *Holocene*

<- Figure 28: Impression of a Schaapskooi

Early Medieval Period

The early Medieval period was a period of recovery for the ecosystems of the Veluwe. After the fall of the Roman empire, around 400 B.C., the Veluwe was abandoned by its earliest inhabitants, and the burnt, ploughed, and overgrazed fields were allowed to regenerate to a forest ecosystem. The open fields of heath and grass became filled with oak, and specifically beech (Fagus sylvatica) which would set the landscape up for new exploitation in the later Middle Ages (III).

European beech is a relative newcomer to the Veluwe, as in past pollen records its presence was not especially prevalent, up until about 550 B.C .This shade-tolerant species is often associated with closed-canopy forests in mountainous ecosystems, but oak was also still very present, which is a more light-demanding species, indicating a more open landscape (Vera, 2000). The agricultural impact on the landscape had significantly decreased, leading to an increase in wild animals. Red deer, roe deer, moose, and wild boar increased in numbers, gratefully inhabiting the recently renewed forests. A new character, from way back in time, was also making its way back to the Veluwe; the fallow deer. Though present in the Netherlands during the Eemian, it had departed from this area during the last ice age, and had not returned on its own. The Romans brought this species with them in their conquest, and released them into the wild to ensure a steady supply for hunting. Remains of fallow deer dated to the Roman times have been found in Belgium (Pigière et al., 2020) (II). The aforementioned predators, bears, lynx and wolves, were also present, and most likely followed prey populations as they recolonised the forests of the Veluwe (Çakirlar et al., 2019).

It was near the end of this time period that we see an exciting new geological process taking place: the formation of the IJssel river. The IJssel rivers is a tributary of the Rhine, but before this time, it was nowhere to be found in the landscape. A creek and wetland network in the eastern glacial valley of the Veluwe was present, however, this wetland area was not connected to the Rhine in the South. Around c. 950 this changed, after years of the Rhine seasonally flooding its banks and carving deeper into the glacial valley of the Paleo-IJssel channel. This was a gradual process that eventually connected an arm of the Rhine to the IJssel, creating the two-river ribbon that now surrounds the Veluwe on its southern and eastern extent (Makaske et al., 2008).



Late Medieval Period

Nearing the 7th century, the Veluwe would once again be settled by farmers, and this time they were in it for the long run. It is during this period of time that most modern-day towns and cities were settled, most of these being located on the hillsides in a zone between 10 and 30 meters. These settlements would form the base of operations for the large-scale cultivation of the Veluwe (II). The forests that had returned in the wake of the previous farming operations would once again be cut down, but the sandy soils were not as productive as they might once have been. The result of this was that farmers would use sod-cutting and fertilization with animal manure, which was captured in the winter stables of sheep and cattle, to make the nutrient deficient soil more productive for crops. This pattern caused a disjointed distribution of nutrients in the soil, being concentrated on the crop fields and further depleting the heath pastures. This also started the process of acidification on the entire Veluwe. The fertilized soils with their high nitrogen content were breaking down any calcareous material in the sub-soil. On the other hand, the complete lack of organic material due to the overgrazing, led to a decreased buffering capacity of the soil, making it vulnerable for acidification. Cattle was initially the dominant form of livestock in the area, but as the soils of the heath- and grasslands became increasingly less productive, sheep herding became the dominant form of animal husbandry. The heathlands were sometimes burned to remove tall grasses that the sheep refused to eat, and to encourage new shoots on the heather bushes. The result was widespread areas of purple heather (Calluna spp.), one of the few plants that could still survive amongst the extreme grazing pressure, burning and acidified soils. Because of the low productivity the “woeste gronden” were managed communally, and divided into commons known as “marken.” (III)

It is in these Marken that we see the first sand-drifts appear as well. Sand drifts appear when overgrazing and anthropogenic burning leads to patches of barren soil, which allow the sand to be blown away by passing winds. These sands are then deposited in areas that still had some vegetation left, smothering these plants, and creating new areas of bare soil, starting the cycle anew and creating ever-expanding sand drifts and dunes; desertification in one of the wettest regions of Europe. During the middle medieval times, these sand drifts were still manageable, but nearing the end of the Middle Ages these sand drifts became so widespread that it became a true environmental disaster (III).

“Malenbossen” were forests used to create coppice-woods, that were harvested for firewood. These forests are often located away from the settlements on the flanks, which probably has to do with the fact that the relatively slow-growing trees would only be harvested annually and left alone for the rest of the year. Some of these Malenbossen can still be found today, but the coppiced trees are now all grown-up, recognizable by their distinct multi-stemmed appearance (I).

It is likely that any remaining fauna would also find reprieve in these remnants of forest during this agricultural expansion, but in greatly decreased numbers. Specifically, the red deer population suffered under the extensive grazing of sheep, and farmers trying to protect their livestock also put pressure on predators. Moose, aurochs, and wild horses had disappeared from the landscape at this point, and the lynx had most likely also been extirpated (Lelieveld et al., 2019). New game species like ringneck pheasants (*Phasianus colchicus*) and European rabbits (*Oryctolagus cuniculus*) were introduced during this time period, putting more competitive pressure on the remaining native fauna (Çakirlar et al., 2019).

The Industrial Age

c. 1600 A.D. – c. 1900 A.D.

Landscape overview

After centuries of intense agricultural exploitation, the Veluwe had once again been returned to a desert-like landscape, almost similar to the glacial landscapes of the past in their appearance but instead of mammoths and reindeer, sheep and people now dominated the landscape. With increasingly unproductive pastures of heather and ever-expanding sand drifts, the Veluwe needed a new source of productivity. In the early industrial age, the creeks, and brooks so characteristic of the Veluwe became the new target for exploitation. By canalizing the creeks and digging new canals, paper mills could be constructed, powered by early hydroelectricity turning the Veluwe into an early "energy landscape." Forestry became a sudden prominent land-use for the depleted Veluwe. The sand drifts and heather fields were afforested with fast-growing pine trees for timber. This relatively short time period saw one of the most dramatic landscape transformations the Veluwe had ever seen.



Figure 29: Impression of the reforested landscape at the end of the industrial time

Pre-Industrial period

During the agricultural revolution of the Veluwe, many nobles also found a place in this landscape, building estates and castles specifically in the Southern part of the Veluwe, also known as the Veluwezoom. During the 17th century, a new influx of aristocracy bought the relatively cheap heath grounds, to build summerhouses. The estates had large gardens, constructed in the landscaping style of the time: baroque gardens with a strict geometry. Overtime this would switch to the romantic English landscape style (III). Though impressive, these estates did not affect the wider landscape of the Veluwe which was at this point still left in ruins by the agricultural exploitation.

In an attempt to control the further deterioration of the heath fields, sand drifts and croplands, the government appointed specific Meesters (literally translated to “masters”). A main goal of this was to control the burning of heathlands, which exacerbated the expansion of sand drifts. There was even a “Zandmeester” who was tasked with fixing the problem of the expanding sand drifts. The effectiveness of these master’s seemed to have been limited however, as the farming communities that controlled “marken” had become increasingly organized and autonomous over their stretches of land. This expanded to the point that there was even some class-division within these farming communities, with poor farmers (keuters) being forced to live in the smallest houses, up on the hill tops. These keuters often formed their own communities as well, and were sometimes allowed to attempt to cultivate some of the unproductive heathlands (II).

Another important influence of the changing economy and production on the Veluwe was new crops and paper mills. Tobacco was introduced from the Americas, and buckwheat could grow on the depleted soils, especially when new types of fertilizer were also introduced. Along the hills, artificial and natural creeks of water flowed down, which was used to power water- and papermills. Around these mills, paper factories were established which eventually also led to small “paper-factory towns”, naturally, situated at the historic zones of settlement on the Veluwe (I) (II).



Industrial Revolution

The most important landscape change the Veluwe has experienced in recent times is the widescale reforestation of the open heath and sand fields, in combination with further expansion of croplands. Three key factors made these changes possible: the disbanding of the autonomy of the farming communities that managed the Marken, the introduction of new crops and fertilizers and new hydrological infrastructure. During the early industrial times, buckwheat and tobacco had already expanded the agricultural portfolio in the area, and potatoes and other bulb crops added to this. This wider variety of crops could be rotated to avoid soil depletion, and in combination with artificial fertilizers, many of the hillsides of the Veluwe were once again transformed into croplands. What aided this process was new hydrological infrastructure, so that the shallow valleys where wet heathland had developed, could also be cultivated (Jongemans et al., 2013). Even though these landscape changes might not seem as dramatic as other ones, this agricultural expansion onto the “woeste gronden” greatly decreased the size of the area known as the Veluwe, pushing it into its modern-day extent (III).

But the most dramatic change followed the disbanding of the Marken. Even though the government of the Netherlands had wanted to develop the area for forestry for a while, the presence of the communally owned marken prevented these plans from taking root. After the Markenwet of 1886, the marken were divided into larger plots, managed by private individuals or public organisations. Staatsbosbeheer (State Forest Management) (1899) and de Nederlandse Heidemaatschappij (The Dutch Heath Society) (1888) introduced new techniques to convert the sand drifts and heathlands. The sand drifts were converted into dense pine plantations within the span of half a century. Native Scots Pine (*Pinus sylvestris*) and the exotic Douglas fir (*Pseudotsuga menziesii*), Stone pine (Pinus nigra), Japanese larch (*Larix kempferi*), and Norway Spruce (*Picea abies*) became the most widespread trees (Jongemans et al., 2013). These trees were planted in monocultures and in straight rows to make harvesting easier. To ensure the forests would not be inundated, shallow ditches were created alongside the plantation plots. Birch (*Betula spp.)* was planted along these edges as well, to prevent the fire prone pine plantations from burning down multiple plots (II). This change might seem like a positive one, more trees are often seen as a sign of ecological improvement, but in the case of the Veluwe it only worsened the conditions. Due to the lack of soil organisms in the bare sand drifts, the hard to digest coniferous needles would blanket the sand in a thick, impermeable, litter layer.

The only deciduous forests that were left were those planted by the aforementioned aristocracy, and some of the old Malenbossen. The nobles expanded their hunting retreats on the Veluwe, fencing off large areas of forest to keep large game for organized hunts. In the remaining heath fields and sand drifts, which were no longer grazed by the sheep, the pine trees were able to establish as well, though they grew in a different manner than the plantation pines. Because these rogue pine trees did not have to compete as intensely for sunlight, but were subjected to intense wind, they grew in irregular shapes and even got their own name: de vliegden (The Flying Pine) (III). The faunal communities of the Veluwe at this point were heavily depleted, with some of the final survivors, like wolves, beavers, and otters being extirpated. Even the red deer and wild boar populations were removed. This was done because the deer were often suffering from malnutrition, stunting their growth and antler development making them less interesting for trophy hunting. Red deer and wild boar from eastern Europe were then introduced, and often fed, by hunting lords to replace the decimated native populations (Çakirlar et al., 2019).

The Modern Era

c. 1900 A.D. – Present

Landscape overview

The final chapter of the Veluwe marks the time period that was most influential in shaping our modern-day use and perception of the Veluwe. Though initially regarded as an unappealing landscape, this perception was transformed by painters and poets who were inspired by the landscape of the Veluwe and its, seemingly, untamed beauty. This would change the Veluwe from an unproductive agricultural landscape to a popular recreational destination. With its vast "forests" interspersed with the "Atlantic Deserts" and extensive purple tinged heathlands, the Veluwe also garnered interest from rich families from the West of the Netherlands, creating our very first Dutch national parks.

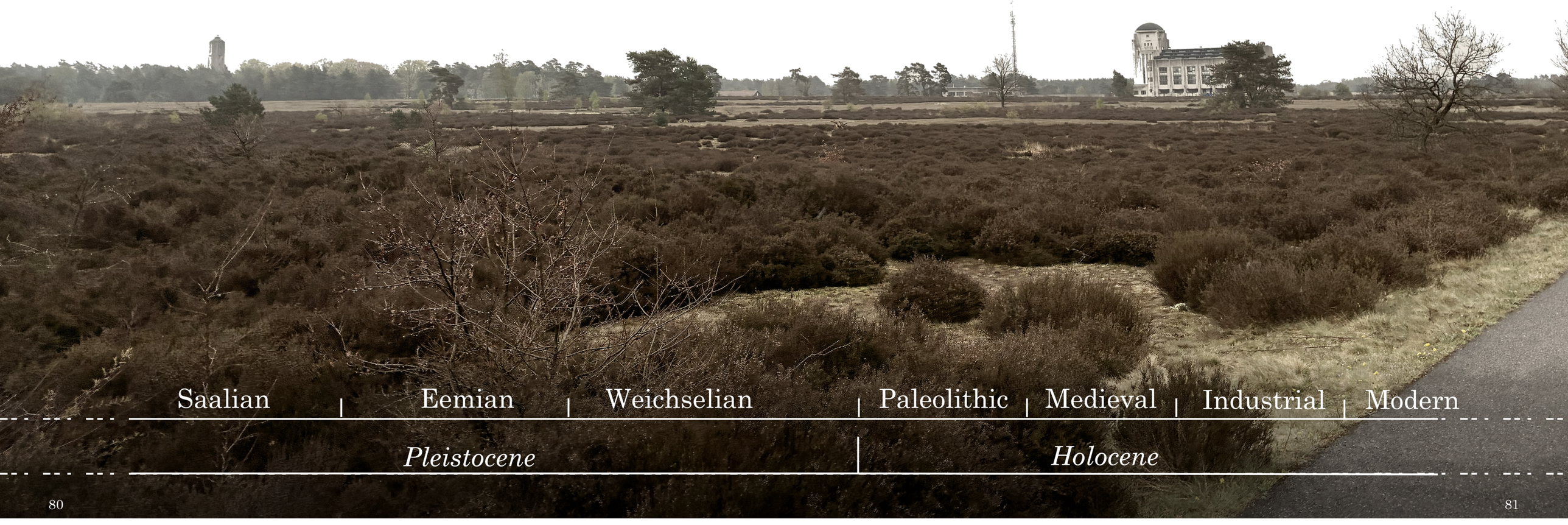


Figure 30: Image of Radio Kootwijk and the surrounding heathlands

Arts and National Parks

At the end of the 19th century, the Veluwe had become increasingly popular among Dutch artists (I). The artists, who originally resided in wealthy cities like Haarlem and Amsterdam, had caught wind of the natural beauty of the Veluwe. Up until this point, the Veluwe had mainly been popular amongst nobility who would stay in their hunting estates and spend their summers engaging in staged hunts on their estate grounds. After the opening of the train line between Arnhem and Utrecht, many artists would follow in the wake of nobility, and establish artist communities on the edges of the Veluwe. With these artists painting impressive pictures of the Veluwe and the increased accessibility thanks to the rail connection, the Veluwe became increasingly attractive for tourists. Two important people drawn to the wilderness of the Veluwe, were the Kröller-Müller couple. They bought a relatively cheap piece of land in the south of the Veluwe, and kept expanding their estate over time. They also built the Sint Hubertus hunting lodge, designed by the architect Berlage. Their intention with the estate was to preserve the "iconic" landscapes of the Veluwe, and this has continued to this day. Helene Müller was an avid art collector, being one of the first to recognize the genius of Van Gogh's paintings. This eventually led to the Construction of the Kröller Müller museum (Veldhorst, 1965).

The Hoge Veluwe however, was not the first true National Park on the Veluwe. This title goes to the Veluwezoom. This area was bought in 1911 by Natuurmonumenten, a citizens' association concerned with protecting Natural Monuments in the Netherlands. Initially, the park was heavily managed to improve the natural conditions, like planting deciduous saplings to improve forest diversity. A large part of this area was still managed for forestry, but this shifted in the 1970's. Intense storms felled vast stands of trees, and it was decided that instead of cleaning out the deadwood and replanting it, the area would be allowed to recover on its own. Additionally, large grazers in the form of Scottish Highland cattle were introduced in 1982, with a test grazing site which was later expanded throughout most of the park (Ten Hoedt et al., 2011). The Veluwezoom, can be seen as one of the first rewilding projects in the Netherlands, though the concept had not been given this name as of yet.

Before the Second World War, the Veluwe was also a popular place to construct Sanatoria, a specific type of hospital where people with tuberculosis and other infectious diseases were placed. One of the requirements for a sanatorium was clean air and views of the outdoors, so the Veluwe was the perfect place for these hospitals (III).



A radio-military landscape

The Veluwe has seen relatively little military action throughout its history. It was not located at a particularly strategic position, except maybe for in the Roman times. The lands were not coveted for their natural resources, and were generally perceived as marginal farmland. However, the relatively low population density and open terrain made it appealing for military training camps and shooting ranges (III). In 1960 the military encampments had reached their peak with 32 military barracks, which were reduced over time as the focus for the Veluwe shifted towards its appeal as a nature conservation site (I) The most important military event that occurred around the Veluwe was the battle of Arnhem during the Second World War. As a part of Operation market garden, soldiers with parachutes were deployed from aircrafts and many landed in the Veluwe. The soldiers would then march towards Arnhem. The goal here was to capture key bridge sites along the Rhine, to then launch a two-sided attack on the German frontier, together with soldiers from the southern Netherlands. The operation was less successful than expected and the allied forces suffered many losses. To this day, the operation is honoured with staged aerial landings, as part of remembrance ceremonies. Aside from this operation, the extensive forests and uninhabited lands of the Veluwe were also used by people forced into hiding by the Nazi regimes. One of the larger hiding spots was the "Verscholen Dorp" (Hidden Village), located near the small town of Nunspeet (III).

The wide-open landscapes that were still present on parts of the Veluwe were also of interest for radio operators. To maintain contact with occupied Dutch colonies in Indonesia, a large radio station was constructed on the Veluwe, with a ring of 5 transmission poles, each 212 metres high. To house the staff and the electrical infrastructure, concrete buildings were constructed, the main building being now colloquially known as the Cathedral of the Veluwe, due to its church-like aesthetic. The radio channel is now out of use, but is still a popular recreational destination (Hier Radio Kootwijk, n.d.).

A Holiday Resort

After the post-war economic recovery, the Veluwe has solidified itself as one of the most popular recreational destinations in the Netherlands, second only to the Dutch Coast. With rising wages, and paid holidays, going on a vacation become a lot more universal among the Dutch. No longer were summer holidays reserved for the rich, but became a popular pastime for a much larger group of people. In the early 2000's, recreational infrastructure like picnic benches, walking paths and cycling networks were rapidly built and expanded. Nowadays, the Veluwe sees about 28 million visitors a year, and especially the edges of the Veluwe, once home to palaeolithic and medieval settlements, are now home to holiday villages. Another interesting aspect of the expanded recreational value, was that the highways that cross through the Veluwe, were designed as so-called "parkways", designed to allow drivers to experience the landscape as they passed through it (III).

The next chapter

With the shift to recreation and nature conservation the Veluwe has reached its final stage in its current history, but the story is far from over. In 2014 the Veluwe was officially designated as a Natura 2000 area, making it a region that is protected not only nationally, but on a European level as well (Programmadirectie Natura 2000, 2014). With the Veluwe now being focussed on nature recreation and conservation, efforts are put in to naturalize the pine plantations, and protect the heritage landscapes we have come to associate with the Veluwe in the past 70 years. The result of this was the construction of many new ecoducts across major roads crossing the landscape, to reduce wildlife collisions, and in many areas, nature is trying to regain its grip on the landscape and start the restoration of this degraded, overexploited and often underappreciated landscape. The sand drifts are now exposed to primary vegetation succession, with lichens and mosses starting the process of soil formation, just like they did when the glaciers retreated. In the pine plantations, the broadleaf trees are slowly establishing themselves in gaps in the canopy. And there is another character from our past that has been returned to a small part of the Veluwe. In a pioneer rewilding project by ARK Rewilding and Staatsbosbeheer, there is now a small herd of European Bison (*Bison bonasus)* living on the Veluwe, near the Cathedral of the Veluwe (Klein Lebbink et al., 2020).

But the current management of the Veluwe is not necessarily cohesive. Different perceptions on nature management are interfering with one another. Large parts of the Veluwe are still treated with "traditional" management techniques like sod-cutting, sheep grazing and even heath burning. On top of this, since the Atlantic desert sand drifts are such a rare habitat, it is even mandated by the European Union that the Netherlands destroys new topsoil to make more room for the shifting sands. On top of this, the wild game numbers are diligently moderated and maintained by hunting, though the wolf is currently applying for a position as the regions new game warden.

It seems the modern day Veluwe is on a crossroads, between its past and its future, and in true Dutch polder-model fashion, until a decision is made, it will be kept in stasis.



Conclusion

In the discipline of landscape architecture, acknowledging and researching the layered nature of many landscapes is a core principle, often referred to as the concept of the landscape as a ´palimpsest.' Palimpsest is a term derived from a past practice of wiping away text on a manuscript, so that the paper could be reused. This method of course was not perfect and often traces of the former writing would still be visible, creating a document that was as much its current state as the sum of its parts. For the Veluwe, I personally feel that another term might be more appropriate; A pentimento: "the presence or emergence of earlier images, forms, or strokes that have been changed and painted over." This landscape biography shows the creation of the painting of the Veluwe, from making of the canvas to the many different paintings that have been placed upon it.

Design Implications

The biggest takeaway from this landscape biography is that even though in modern times the Veluwe has become a staple of "Dutch Nature" the history of the area reveals that this is an incredibly recent perception. For the longest part of human history, the Veluwe has been an agricultural production landscape, much like the rest of the Netherlands. The Veluwe is not an untouched wilderness, nor was it ever intended to be a national park in the way that, for example, Yellowstone national park is. But the fact that it is now part of the National parks network of the Netherlands provides us with some perspective for what this area could become if we give it the care and attention it deserves.

What is important to keep in mind though is that, because the entire landscape has been actively degraded and exploited since the early medieval times, counting on the natural recovery of the ecosystem will not be enough. A major result of continued and varied exploitation is that the soils in the area are heavily depleted, and the same can likely be said for the soil seedbank. Another issue with this is that the Veluwe is quite a unique area of the Netherlands. Like mentioned before, it is one of the few areas that is not considered a wetland ecosystem, but a dry lowland sand hill ecosystem. This means that the unique species adapted to the conditions of the Veluwe will have a hard time recolonizing the area without human assistance, because the conditions of the Veluwe simply have very little in common with the ecosystems in its immediate surroundings. Its closest neighbour is the Utrechtse Heuvelrug, which has, unsurprisingly, experienced a very similar history of exploitation.

On top of this, the perception of the Veluwe as a wilderness is currently detrimental to its continued existence. This is a broken and damaged ecosystem, not a thriving one, but ask the average Dutch person and they will react surprised by that statement. This not only affects the visitors, but also the people currently managing the Veluwe. The ecological restoration of the Veluwe needs to be paired with the re-education of its visitors and managers, so we can turn around the shifting baseline syndrome that now hinders its ecological progression.

With the knowledge of the past, we can more accurately assess the situation that the modern day Veluwe finds itself in and be more precise and targeted with the restoration efforts. With this knowledge, we can see which design interventions are necessary to both enrich the ecosystem and educate its visitors. With this knowledge, we can start to imagine a new future for the landscapes of the Veluwe.



Figure 31: Compilation of the historic landscape impressions

Part IV

Putting Pen to paper

Vision, p. 90

Design Principles,
Habitat Based Restoration
Rewilding Basecamps
From Coniferous Plantations, to Mixed Forest
Kroondomein
Overview
Intervention and Perspective
From Malenbossen, to Woodland-Pasture
Loenermark
Overview
Intervention and Perspective
From Heathland, to Juniper Shrubland
Radio Kootwijk
Overview
Intervention and Perspective

Figure 32: Picture of a recently cut pine plantation near Planken Wambuis

Landscape Vision

One of the main goals of this design is the full-scale restoration of the Natura 2000 area known as the Veluwe, to allow it to function as one complete ecosystem. To achieve this, a design vision was created to give this project a point on the horizon to work towards.

When we look at the Veluwe of today, and we isolate the different habitat zones we can clearly see that there is a distinct separation going on. The harsh lines between different habitat zones are a result of the usage patterns of the past. With the pine plantations planted in neat rows and measured out rectangles, and the heathlands being held to the confines of the former pasture divisions, it becomes clear that this is an ecosystem held in stasis. This is strengthened by the current management paradigm, which further isolates different habitat zones and prescribes specific requirements per zone. The largest percentage of the Veluwe is currently covered in the following habitat zones: Coniferous Forest, Mixed Forest and Heathlands (BIJ12 & Interprovinciaal Overleg [IPO], 2025). However, when looking at the dominant leaf types, we get a clearer picture of the actual ecosystem distribution. The mixed forests are often still dominated by coniferous forest, and many of the true deciduous forests exist in isolated pockets that are surrounded by coniferous forests. There are also some areas left out of this map, which include sand drifts, agricultural fields and other occupational land cover. Many of the larger villages and agricultural lands are not included in the Natura 2000 area, and will therefore not be addressed in the design. The sand drifts are heavily protected and, in comparison to the past situations, cover only a small percentage of the Veluwe these days, so the restoration of them is not crucial for the transformation of the ecosystem as a whole.

The future of the Veluwe imagined in this vision, is an ecosystem that is interconnected, diverse, resilient and self-sufficient, where natural processes take centre-stage. Where visitors can explore what a true Dutch wilderness can look like, with all the beautiful, messy and complex aspects that accompany wild nature. Where flora and fauna can adapt to local conditions, and where the nutrient cycle keeps the fountain of energy flowing ever onward.

But how will we achieve such an ecosystem? What ecosystem aspects will need to be addressed and reformed? What flora and fauna are currently missing, and how should be go about reintroducing them? And in doing all of this, how can we ensure that people understand the reason for this restoration?

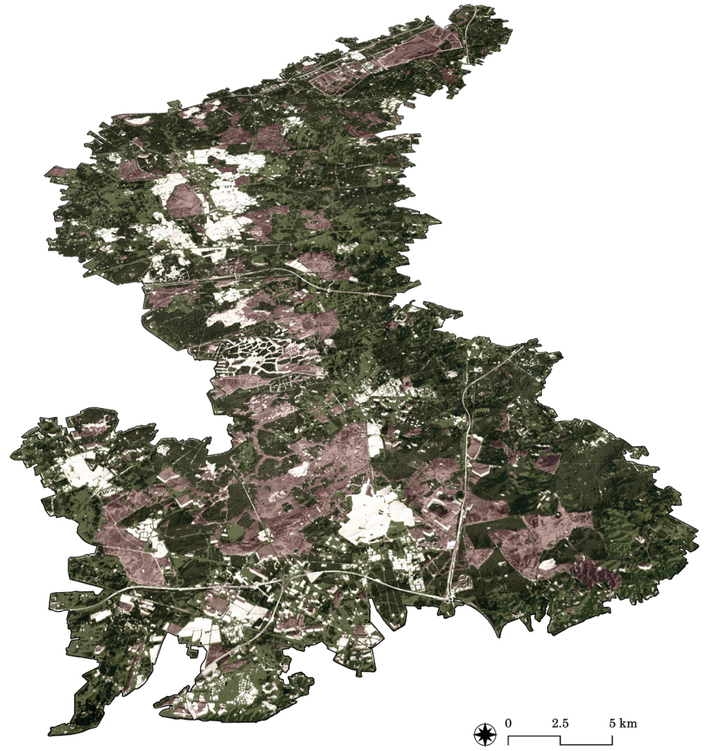


Figure 32: The current state of the Veluwe, with the 3 main habitat zones

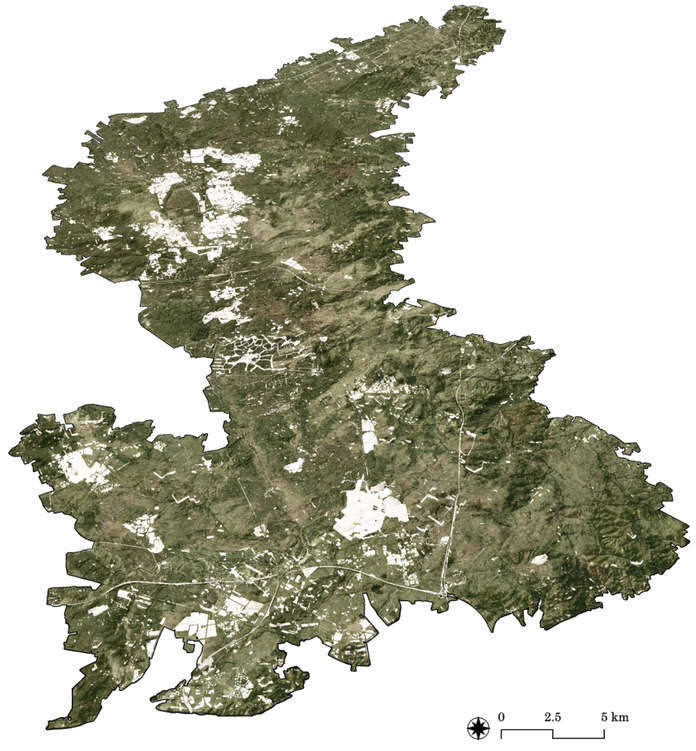


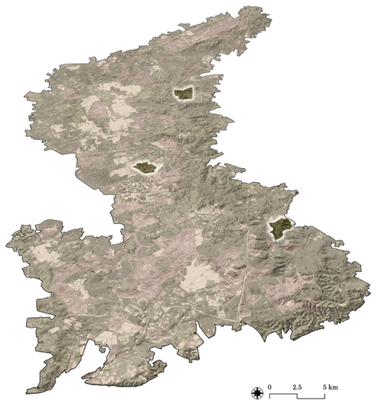
Figure 33: Vision of the Future of the Veluwe, where all habitats are interconnected and flow into each other

LANDSCAPE VISION

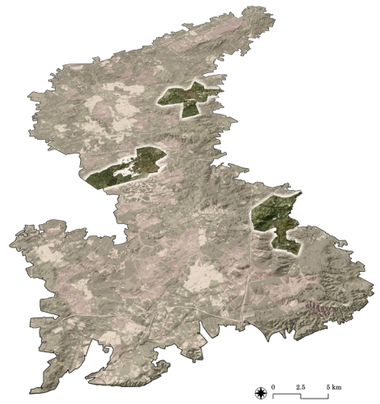
Figure 64: Panorama of the future landscape of the Veluwe



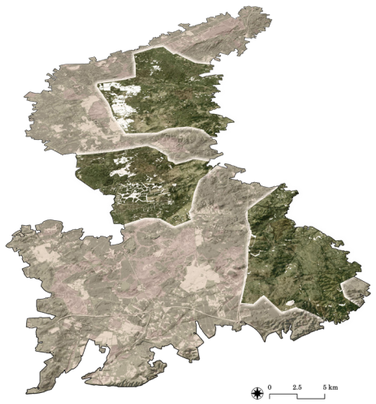
Phase 1: Basecamps



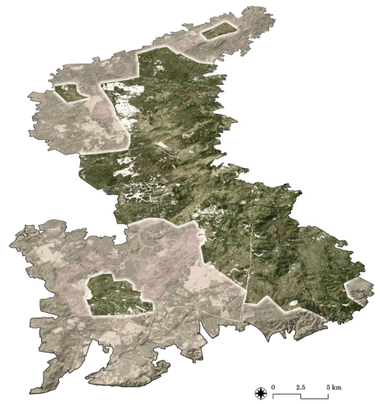
Phase 2: First Expansion



Phase 3: Second Expansion



Phase 4: Connection



Phase 5: New Horizons



Phase 6: A Wilder Veluwe



Figure 35: Phasing of the vision, by applying the design principles

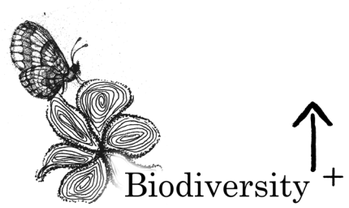
Design principles

In order to make this vision a success, 12 design principles were developed. These principles are split into two categories: Habitat Based Restoration and Rewilding Basecamps. These categories showcase that the aim of this vision covers two distinct scales; the basecamps being focussed on localized intervention, while the habitat based restoration focusses on the broader habitat zones

Habitat Based Restoration

Habitat Based Restoration principles focus on the bigger picture of restoring the three main habitat zones. They guide the ecological restoration process, and allow the prioritisation of specific interventions.

These principles are based on the natural processes the vision aims to reintroduce, like the ones seen in the theoretical framework, combined with the biotic and abiotic conditions of the present-day habitats. The landscape biography gives us the background for how these habitats came to be, and also provides information on the processes that were removed or disturbed as the Veluwe arrived at its contemporary state. This information was then combined with common practices in ecological restoration, as mentioned in the 2013 book´Ecological restoration: Principles, Values, and Structure of an Emerging Profession' by Clewell and Aronson, and any new claims will be supported by additional references.

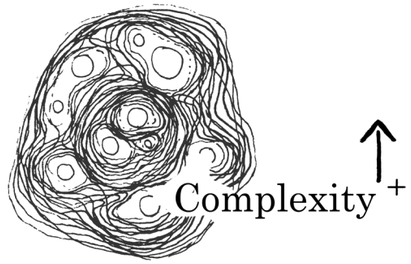


This design principle focusses on addressing the species diversity in the different habitat zones. The habitat will be assessed on its existing biodiversity, and how important the reintroduction of specific species will be for the design intervention. Since biodiversity is an overall goal of the entire vision, and its interventions, this design intervention will have a dominant presence in all habitats.



Management $^{-}$

The Veluwe has a long history of active management, in some areas more than others. The two aspects of active management that immediately jump out are the control of ungulate populations through hunting, and the grazing of heathlands by sheep. By creating self-sufficient and self-regulating ecosystems, active management can be reduced over time.



Complexity $^{+}$

Habitat complexity refers to the structure of the habitat, which includes variety in terms of vegetation height, and the interplay between open, half-open and closed landscapes. The structure of a habitat is essential to its functioning, as it creates micro-habitats within the habitat zone which add niche variety, that supports additional biodiversity.



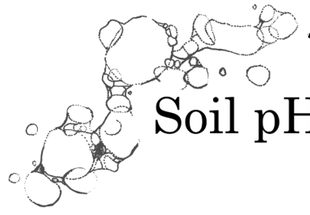
Fire risk $^{-}$

Even though many ecosystems have a fire ecology that is essential to their diversity and structure, the Veluwe is not one of those ecosystems. Fires in the case of the Veluwe are anthropogenic in nature, and are extremely damaging to the already fragile ecosystems. Addressing this fire-risk will be done by incorporating fire-resistance into the system.



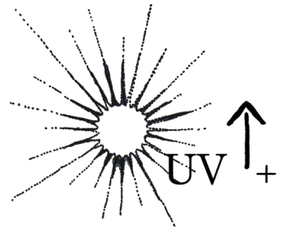
Decomposition $^{+}$

Decomposition of organic matter is part of the nutrient cycle, and due to past usage patterns and the biotic and abiotic conditions of the habitats, the decomposition rates on the Veluwe are extremely low. This can be attributed to a multitude of factors, like soil pH and the degradation of soil health. The main goal should be clear; decomposition rates need to increase, and the nutrient cycle should be restored.



Soil pH $^{+}$

The soil pH affects a variety of aspects, like germination rates of plants, soil formation and subterranean micro-organisms, but also the previously mentioned decomposition rate. The pH map of the Veluwe showcases that this is a major issue affecting the ecosystems of the Veluwe, with pH ranging from as low as 2.8 to 4.8. This is the same pH as vinegar and wine. Increasing the pH levels to more basal conditions will be a pivotal part of the restoration efforts.



UV $^{+}$

UV radiation is another principle that covers different aspects of ecosystem restoration. Most obviously, access to sunlight is the foundation of photosynthesis. A thriving vegetation community is at the root of every ecosystem, so creating varied conditions in terms of access to sunlight supports different types of vegetation. But that is not all as sunlight affects local temperatures, it creates micro habitats. UV radiation also aids the process of decomposition through both physical and chemical weathering.

Rewilding Basecamps

The Vision for this landscape is based on the large-scale restoration of the entire Veluwe, but as they say, Rome was not built in a day, and neither will this project be. The approach here is to smart small, and expand the project over time, until it encompasses the entire Natura 2000 area.

This is an approach similar as what is currently happing in the Veluwezoom, which has been steadily expanding to surrounding areas since its founding. To still ensure that the ecological restoration covers the three main habitat types, heathland, coniferous forest and deciduous woods, the three rewilding basecamps will each focus on one of these types. But the basecamps have a second, more important aspect. It gives the project a chance to include aspects of recreation, education, and cultural heritage, as these aspects are best approached at a more localised level. Therefore, to guide the design process for the basecamps, five additional design principles were developed.

Landscape as a painting

Following the conclusion of the Landscape Biography, the landscapes of the Veluwe will be approached from the idea of landscapes as a pentimento. This means looking at the layers that covered the landscape before, to guide the design of its future. Not only will this help with figuring out the ecological restoration needs, but can also deepen the historical relevance of the designs. In the recent transformations of the Veluwe, due to land being purchased from locals by national organisations, many subtle aspects of the landscape heritage were lost. This principle will guide the process of bringing this heritage to light.

Landscape as a classroom

It is hard to love what you do not understand. Many people in the Netherlands suffer from nature-amnesia, as is describe in Marc Argeloo's 2022 book "Natuuramnesie." In this book, Argeloo exposes the erasure of the richness of past Dutch ecosystems from the collective memory of the Netherlands. This aligns with the earlier mentioned issue of the Shifting Baseline Syndrome. To involve people in the rewilding and restoration of the Veluwe, the Basecamps provide a way to educate people on this concept, and dispel illusions they might have about the current state of Dutch nature. This manifests itself in a combination of pathing design, and the emphasis of a central information point in the designs. The goal here is to introduce people to the tools of ecological restoration as they wander through the rewilding basecamps, and explain these concepts further at the central information points.

Landscape as a laboratory

Many aspects of ecological restoration involve some sort of experimentation. Natural processes are often unpredictable and may respond in unforeseen ways. By starting the habitat restoration process in the smaller basecamps, different restoration methods, like assisted colonization, restructuring and grazing, can be tested for their impacts on the ecosystem. Over time, the lessons learned from these initial restoration efforts can help with upscaling the restoration process, making each expansion into neighbouring areas a little more effective than the previous one. This monitoring will also partially depend on citizen science initiatives, that can help with capturing the transformation over time.

Landscape as a foundation

Reintroducing large grazers is at the centre of many rewilding projects. But one cannot simply release these large animals uncontained into an area, and by Dutch livestock laws are required to be fenced in and monitored. Even though the end goal is to have free-roaming herbivores across the entire Veluwe, once again, we need to start a little smaller. Introducing these animals into these contained basecamps will help build up local populations, especially of threatened species like the European bison. This will also be a controlled way to teach visitors how they ought to interact with these animals. The second part of this principle is about the assisted recolonization of plant species that were lost on the Veluwe. By helping these plants re-establish themselves, we can ensure that they will find their place throughout the ecosystem.

Landscape as a timepiece

One of the most exciting parts of temperate habitats is probably their seasonality. A 2025 report revealed however that the busiest time of the Veluwe is in August, when the heathlands are blanketed in hues of purple heather flowers (Vervaart, 2025). But if we want people to connect more to all aspects of seasonality, and the ebbs and flows of ecosystems, every habitat should have their time to shine. A secondary goal of this principle is to spread out the visitor numbers throughout the year, instead of having such a focus on late summer. Since the winter is a rest period for many plants and animals, this season will not be explicitly involved. But for spring, summer and autumn, every basecamp should have a specific seasonal appeal.



Note on Habitat Research and Basecamp sizes

Before we dive into the specific basecamp designs, additional habitat research was done using two main sources; the official habitat description provided by BIJ12, and the SynbioSys database. Additional sourcing is mentioned in -text.

Another important thing to note is the size of the basecamps. Based on past research of the Rewilding Mols project, a stable grazing biomass of 100kg per hectare was established for a self-sustaining population. From this, one can create mathematical formulas to calculate how many grazers of different weight classes an area can hold. The larger the area, the less intensely the herd will have to be managed (Bergin et al., 2023). Since these rewilding basecamps are meant to function as starting points for future expansion, but still need to be able to have healthy grazing populations, the size of the basecamps therefore varies between 200 and 400 hectares.

Figure 36: Areas of Coniferous Forest in the Veluwe



From Pine Plantations...

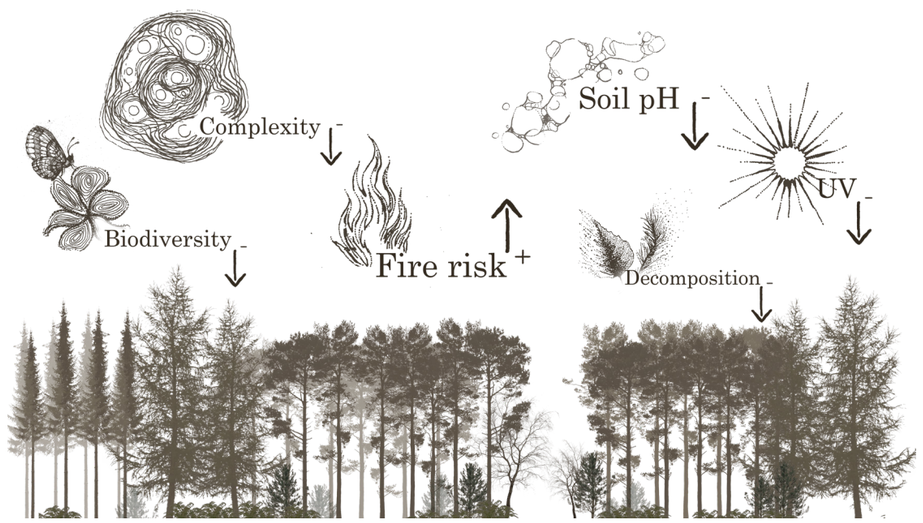
Maybe one of the most challenging habitats comes in the form of the pine plantations. All of the habitat restoration principles are applicable to this habitat. It is a relative newcomer to the Veluwe, with most pine plantations established when State Forestry Management turned the sand drifts into production forests. Pine trees were chosen for this purpose because they can thrive in the harsh conditions of the sand drifts, which had no productive topsoil and was extremely nutrient deprived as a result of nutrient leaching. Pine trees also grow relatively fast, making them suitable for productive timber harvests. Many of these “forests” are no more than 50 years old, in line with harvest cycles of pine plantations.

The issues this habitat now faces are many; the pine plantations exist almost exclusively of Scots pine, Japanese Larch and Norway spruce, of which only the Scot’s pine is considered native to the Netherlands. Aside from this issue, the trees were planted in a grid, creating an extremely monotonous habitat structure. The result of this is that these habitats have a low biodiversity and lack structural complexity. Because of the planting patterns, barely any sunlight can penetrate the canopy, even though pines usually have pretty open crowns. The pine plantations were often planted in a grid formation, ignoring existing landforms, acting as a true overlay over the landscape. Nowadays many of the birch lined fire-breaks have also been invaded with pine trees, increasing the risk of catastrophic forest fires. The understorey in these pine plantations is, unsurprisingly also very monotonous, being dominated either by purple moor-grass(*Molinia caerulea)*, or blueberries (*Vaccinium spp*.).



Figure 37: Impression of a pine plantation

Figure 38: Structure of pine plantation and the problems that it currently faces



... to Mixed Woodland

The restoration efforts in this habitat focus mainly on three of the restoration design principles: Increasing Complexity, Biodiversity and Decomposition. Secondarily, reduction of fire risk, increasing soil pH, and allowing more UV radiation to hit the soil, will further guide design choices. The goal here is to transform the monospecific pine forest into thriving and diverse forest ecosystems.

Aside from thinning the pine stands, which has proven to improve structure and biodiversity of the understorey (Pielech et al., 2024), the introduction of rich-litter species will play a major role in this design as well. Thes species include hardy species that can withstand the acidic conditions, but have deep root systems which can pull nutrients from deeper soil layers. Initially, grazing and browsing will be excluded from this area, to ensure that the freshly planted tree saplings will have the best chance of establishing. On top of this, the introduction of thorny species like brambles (*Rubus spp.*) and alder buckthorn (*Rhamnus frangula*) will support the continued recruitment of these species, once grazers are allowed into the area. The grazers for this habitat will include Wisent and Red Deer, species that are adapted to forage in both forested and more open habitats.

Figure 39:Design location marked among coniferous forests

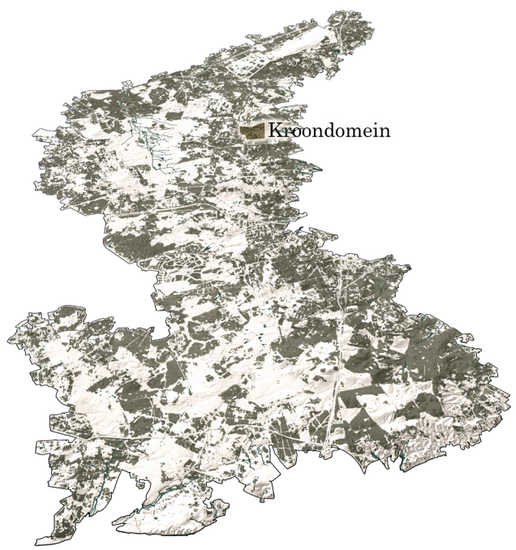
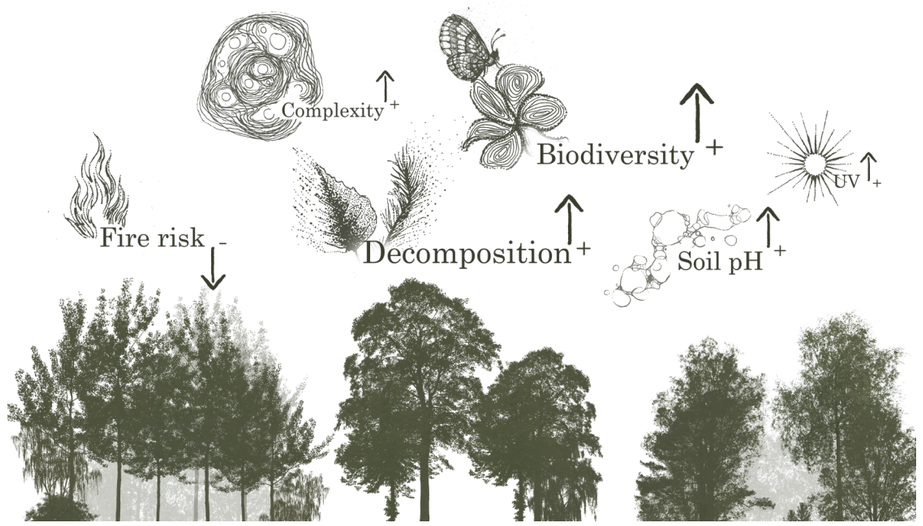




Figure 40: Impression of the pine plantation after intervention

Figure 41: Structure of the transformed habitat and its beneficial processes



Kroondomein
Site Overview

The Kroondomein is a large, forested area, that once belonged to the Dutch royal family as part of Kroondomein het Loo, connected to the royal palace located near Apeldoorn. In the early 1900's queen Wilhelmina purchased the heath fields surrounding the villages of Gortel and Niersen, to support her husband's love of forestry and hunting. The result of this was that the former heath fields, which came to be after a large forest fire in late medieval times, were turned into a pine plantation. Large game-alleys were integrated into the plantations, to ensure the king could perform a type of hunting known as "drive hunting." Game would be chased out of the forest towards the king, who could then easily target and shoot them.

In 1959 the forest was gifted to the Dutch State by the Crown, and the management over time shifted to naturalise the forests in this area. The new management was simple: the forest would no longer be harvested and left to naturalise on its own, which brings us to the present day (Horst & Cultuurland Advies, 2015).

Currently, the forest is no longer used for timber harvesting, but is primarily used as a recreational destination. The actual Kroondomein spans over 10.000 hectares, and even thought the management of the area was aimed to naturalise the forests, this process has been very slow-going. The design area for this basecamp encompasses a specific plot, located near the small town of Niersen. The traces of the pine plantations are still easily identified in the area, and the grid-like structure now forms the basis of the recreational network. What makes this area special as well is that it is actually located on a slope, formerly being part of a small creek system, which has sadly been disrupted by the building of the pine plantation. The main body of water is a loam-pit, known as the Cannenburgergat, which sits right at the intersection of two different hunting alleys. The higher up the ridges, the lower the groundwater levels are, and the more nutrient run-off has taken place. The result is the soil turning more and more acidic further uphill.



Figure 42: Photo of a Pine platation in the Kroondomein

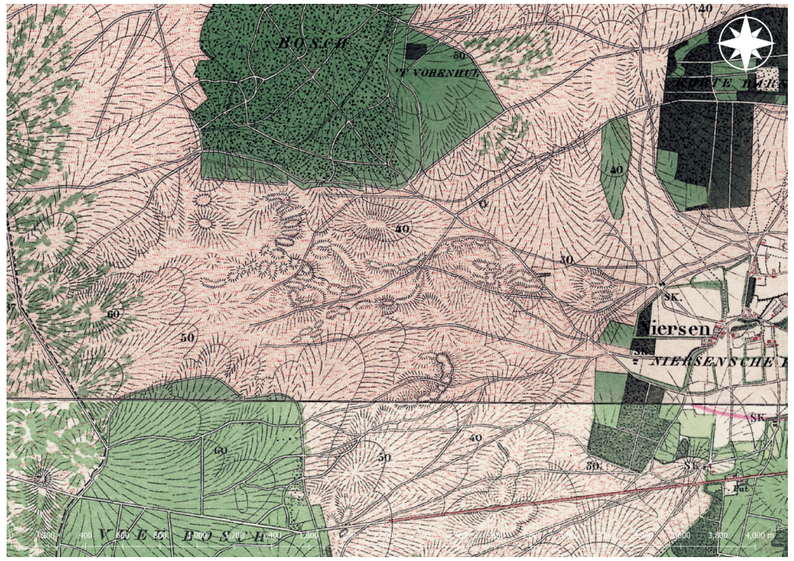




Figure 43-46: The Kroondomein Design area over time, 1889 -> 1930 -> Present

Kroondomein
Intervention and Perspective

The interventions on the Kroondomein will turn this monotonous pine plantation, into a thriving multi-layered forest ecosystem. The new pathway system follows the elevation lines of the valley, with a 5-meter elevation interval between the different paths. The paths will be characterized by specific rich-litter species. The lowest path, at a height of +35 meters NAP, will be planted with different willow species, specifically shade tolerant species like sallow (*Salix caprea, Salix cinerea)* and the broadly applicable eared willow (*Salix aurita)*. This planting will be accompanied by the creation of small depressions in the landscape, which will capture and hold rainwater runoff making the soils in this area slightly wetter.

The next path up will be at the +40 meters NAP elevation. This path will be planted with Sycamore maple (*Acer pseudoplatanus*) and linden (*Tilia cordata, Tilia platyphyllos*). These trees are not particularly adapted to high acidity but provide major benefits in terms of restoring the nutrient cycle. To help these trees get a foothold in this tough environment, the path next to these trees will be enriched with calcareous material, which will locally reduce the pH, giving the rich-litter species a fighting chance. At the 45+ meter NAP path, we find the hardiest of the rich-litter species, this being Common Aspen (*Populus tremula*), Silver birch (*Betula pendula*), and Rowan (*Sorbus aucupuria*). The reintroduction of these species is also an essential part of its seasonal appeal. In fall, the different species will create shades of orange, red and yellow.

The pine plantation itself will be thinned using a range of methods, combining clearcutting, ringbarking and stand thinning. On top of this a mix of shade and acidity tolerant grasses and forbs will be planted to not only boost the biodiversity, but also to create a rich understorey and reducing the amount of bare soil. This will hopefully hinder the recruitment of new pine trees (Cuevas & Zalba, 2009), and favour the introduced rich-litter species, which have heavier seeds. In the centre of the area, near the loam pit lake, a lookout tower will be constructed, surrounded by all of the rich-litter species, and this is also where the information centre will be located. The lookout tower is located at the intersection between 4 intersecting sight-lines, providing views of the entire rewilding basecamp.

The fencing in the area will be an electric wire, accompanied by brush piles fences, made from the pine trees that are cut down from the area. Initially, this will prevent the deer in the surrounding area from entering, and the electric fence will keep the reintroduced European bison in. As the piles degraded over time, only the electric fence will be left, which the deer can easily jump over, but this will still keep the bison contained.

Over time, the result will be a truly mixed forest, with trees from different ages, species and niches. The grazing will keep certain areas open, while the bramble and alder buckthorn can support the growth of new forests, creating a dynamic and rich forested environment.

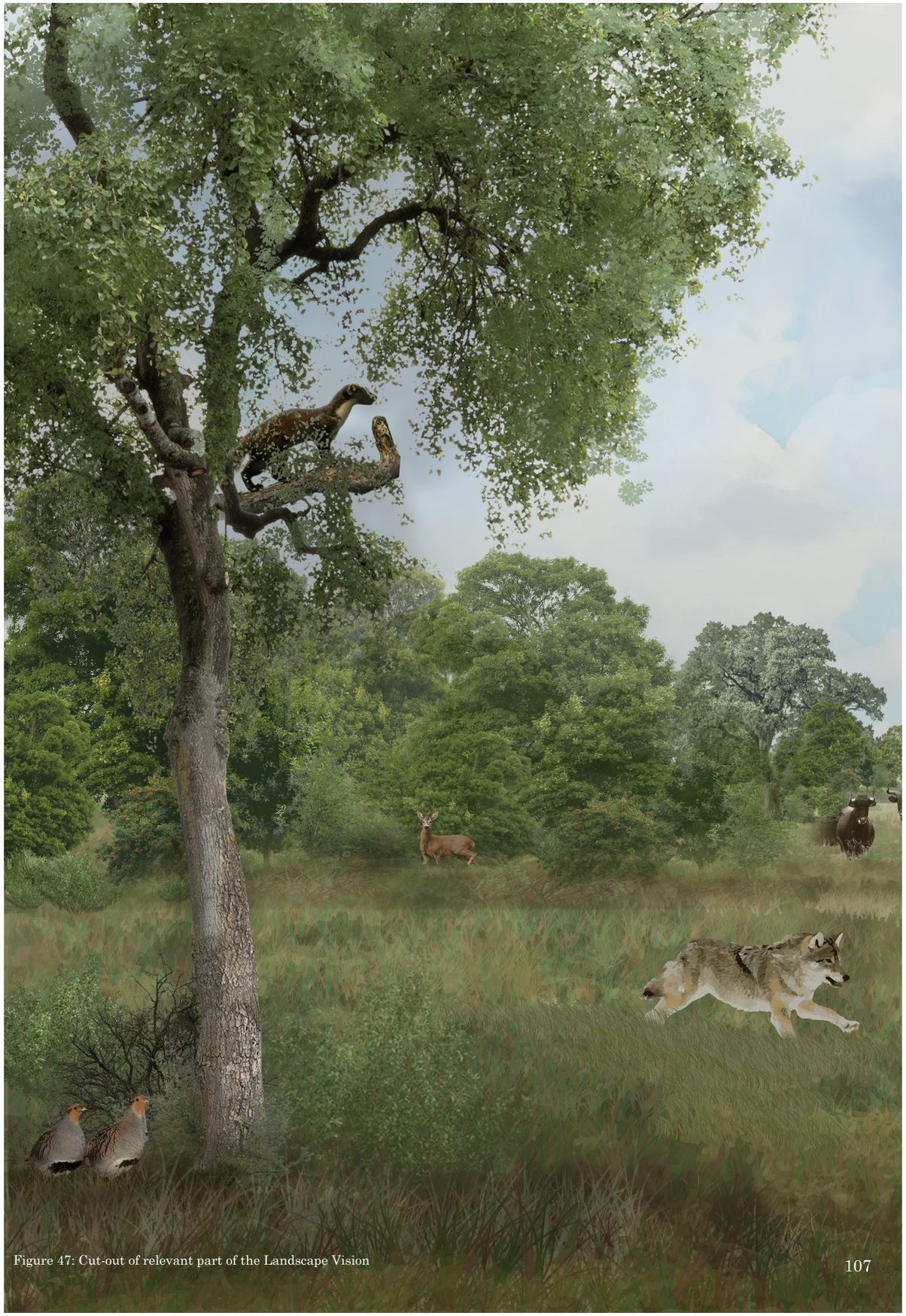


Figure 47: Cut-out of relevant part of the Landscape Vision

KROONDOMEIN

INTERVENTION

Figure 48: Design drawing showing the establishment of the rewilding basecamp

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800 3,000 3,200 3,400 3,600 3,800 4

KROONDOMEIN

PERSPECTIVE

Figure 49: Design drawing showing how the basecamp will develop over time, moving towards expansion

Legend:

Entrance

Fence

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800 3,000 3,200 3,400 3,600 3,800 4

KROONDOMEIN

DETAIL DESIGN

Figure 50: Zoom-in of the information centre lookout tower



KROONDOMEIN
PATHS AND FENCING

Figure 51: Image of a brushpile fence, which will be installed around the Kroondomein Basecamp (Kaakinen, 2025)



Figure 52: Section of the path situated at 35+ meter NAP

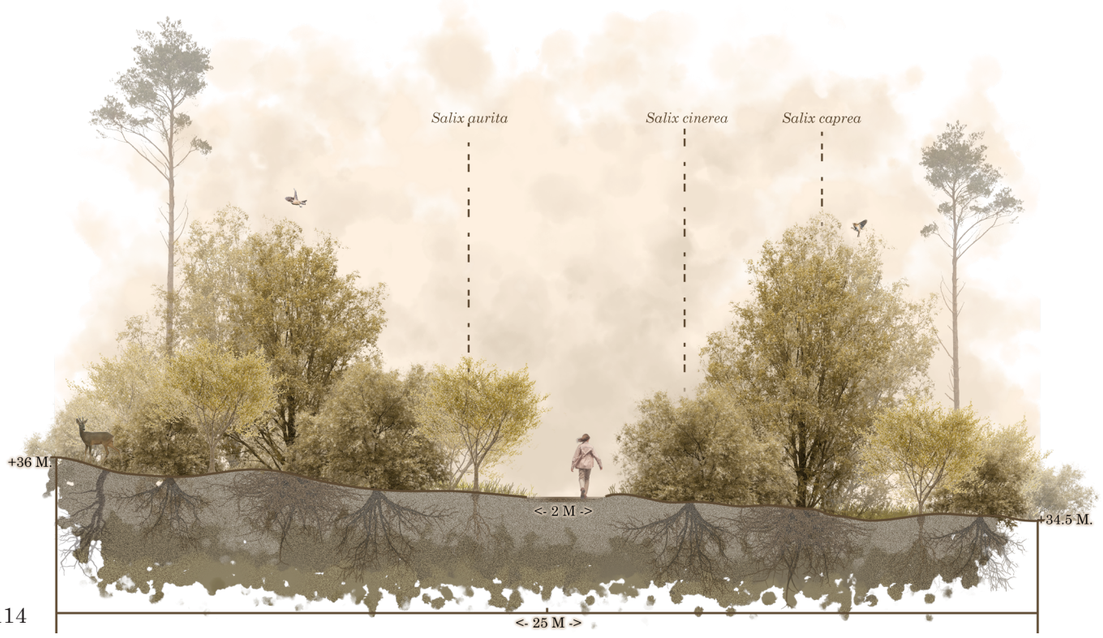


Figure 53: Section of the path situated at 40+ meter NAP

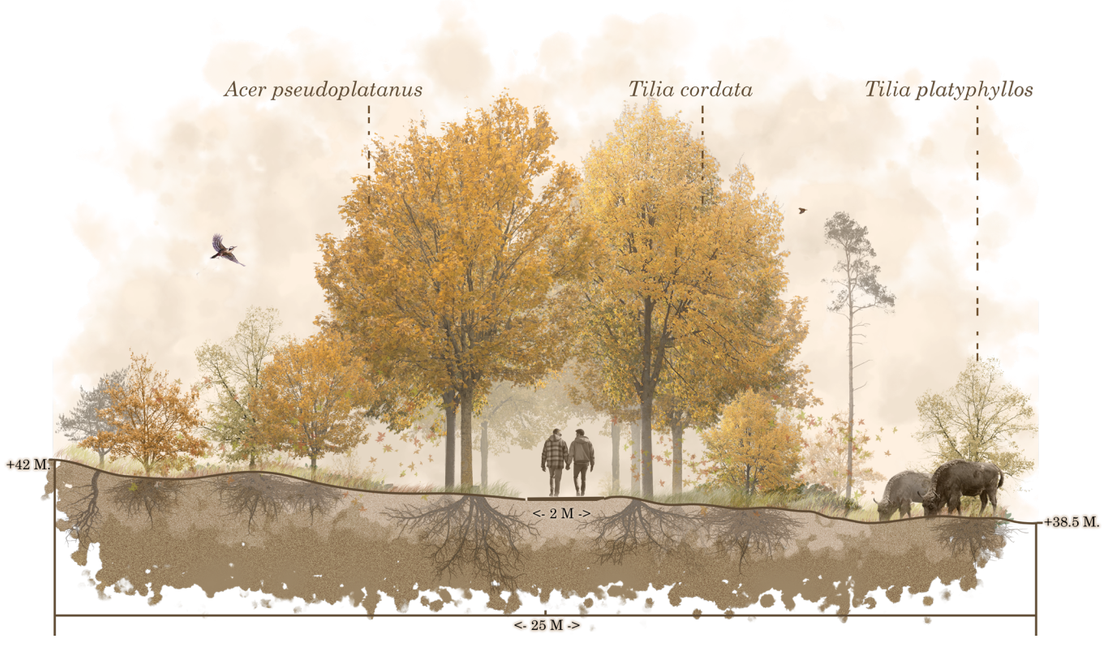


Figure 54: Section of the path situated at 45+ meter NAP

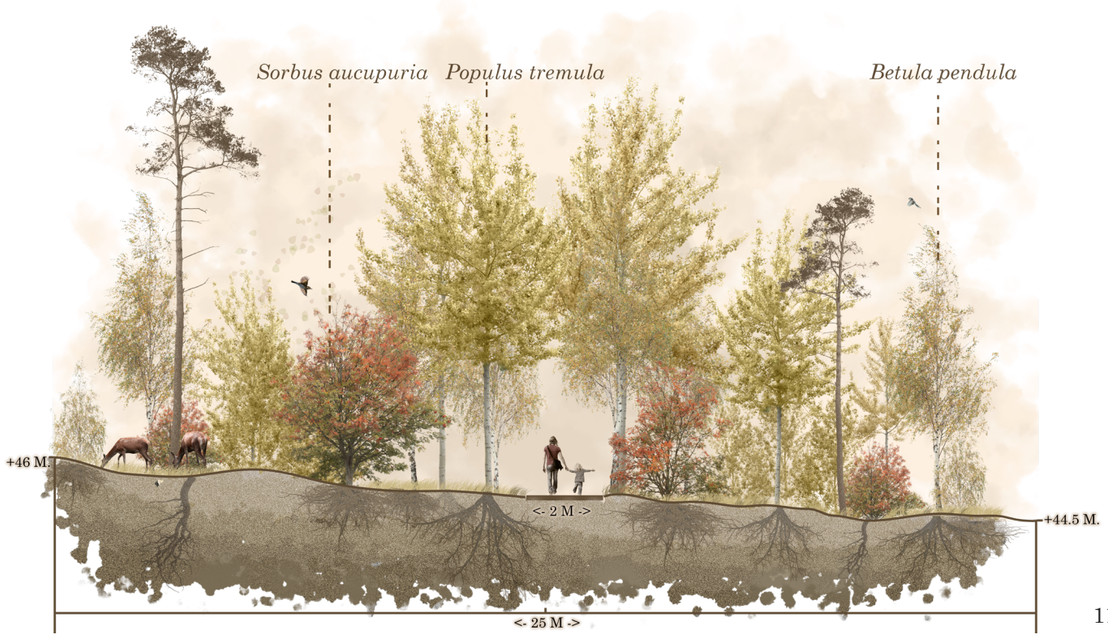
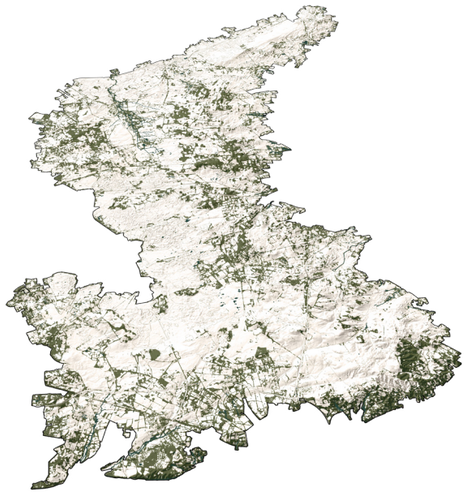


Figure 55: Areas of deciduous forest in the Veluwe



From Malenbossen...

The deciduous forests of the Veluwe are an interesting case when it comes to habitat restoration. At first glance, the presence of the deciduous trees would make one assume that this would be what the end goal of the pine plantation restoration looks like. In part it is correct that these ecosystems require less intense restoration efforts, but this does not tell the full story.

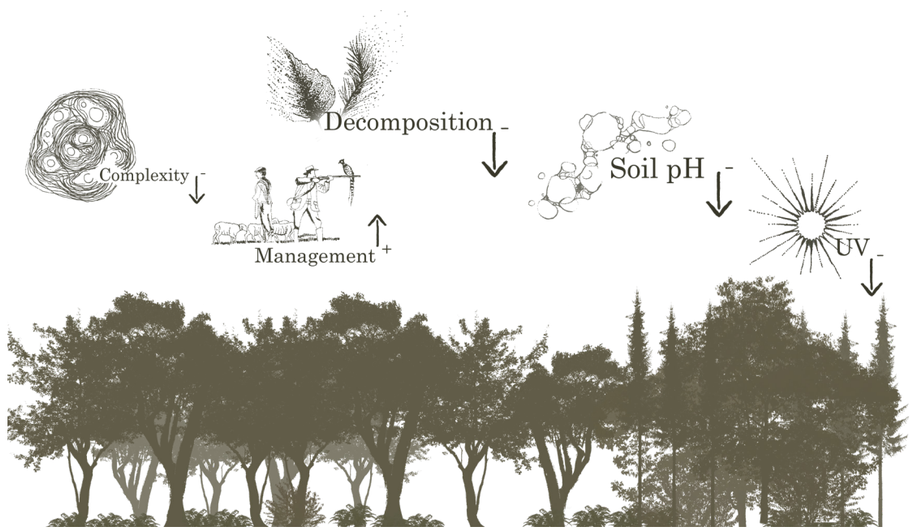
These forests are remnants of the Malenbossen: coppice woods that were harvested for firewood and construction materials. Sadly, even these forests are not as diverse as they should be. They often consist exclusively of oak (*Quercus spp.)* and beech (*Fagus sylvatica)* trees, as these were preferred for their hardwood, and their bark was harvested for leather-tanning. After their harvest was no longer necessary, these forests developed an extremely closed canopy, and a leaf litter layer that is difficult to decompose. This means that the soil has very little buffering capacity left, with resulting low acidity. The beech trees deal with this a little better than the oaks. Many deciduous forests are currently seeing mass die-offs of oak trees, and very little recruitment of younger trees (Van Den Burg et al., 2015). Due to the lack of native understorey, these forests are also very vulnerable to invasive species, specifically American Bird Cherry (*Prunus serotina)* and American oak (*Quercus rubra)* are notorious for this.

Because of the lack of new sapling recruitment, these forests see very little age variation within a stand, creating very little structural complexity. Management often includes exclosure experiments with fencing to attain some renewal, however this seems to mostly benefit beech saplings, making the habitat even more monospecific. In the past, standing deadwood was often removed as well, reducing critical habitat for many different species. In modern forestry, these so-called “snags” are left more often, which is already a massive improvement. Still, the lack of sunlight reaching the forest floor, and the low species diversity means that these habitats are not reaching their full ecological potential (Wagenaar et al., 2025).



Figure 56: Impression of a modern-day Malenbos

Figure 57: Structure of a malenbos and the problems it faces



... to Woodland Pasture

The forests of the Veluwe used to be lot more diverse than what we see today, and this habitat restoration aims to take a page out of the book of the woodland-pasture hypothesis. By reintroducing thorny shrub species along the edges of deciduous stands, and removing the pine trees that grow in between them, the forests gain more species diversity and complexity.

A strong mantle vegetation is key to forest renewal, as it provides the protection new saplings need to avoid being browsed. The newly opened up areas can be seeded with a mix of grassland species adapted to the poor soil conditions, which can help rebuild the soil. What is interesting is that the traditional agricultural landscapes often included all the different parts of a healthy woodland; hedgerows and pastures, interspersed with individual trees and groves (Stichting Landschapsbeheer Gelderland, 2026). This restoration will aim to restore these landscape elements as well.

Figure 58: Design location Loenermark marked among the deciduous forests

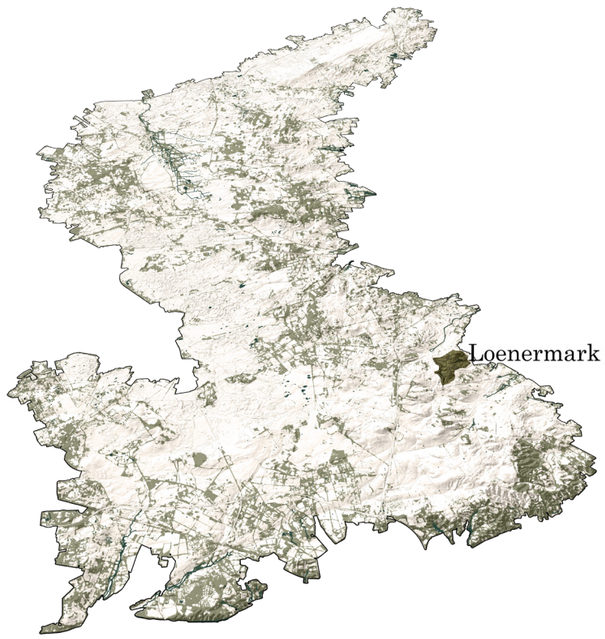
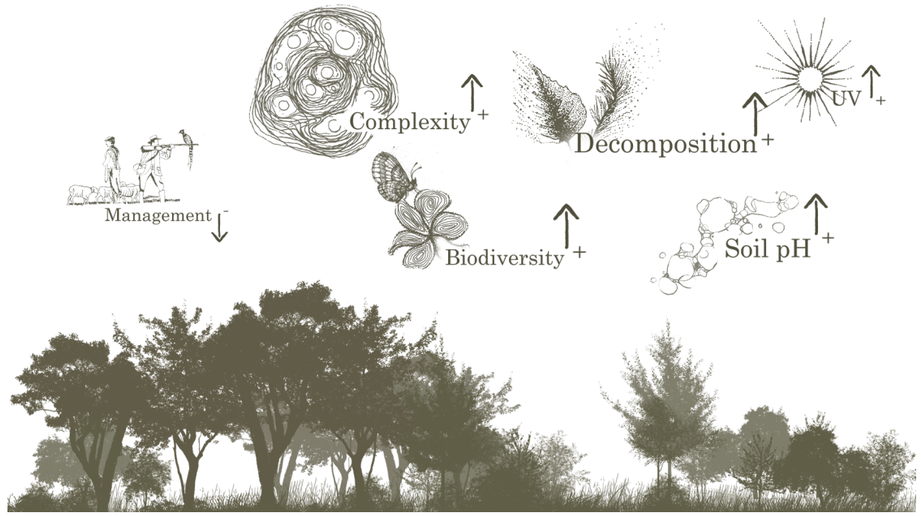




Figure 59: Impression of the woodland-pasture habitat transformation

Figure 60: Structure of the wood-land pasture and its beneficial processes



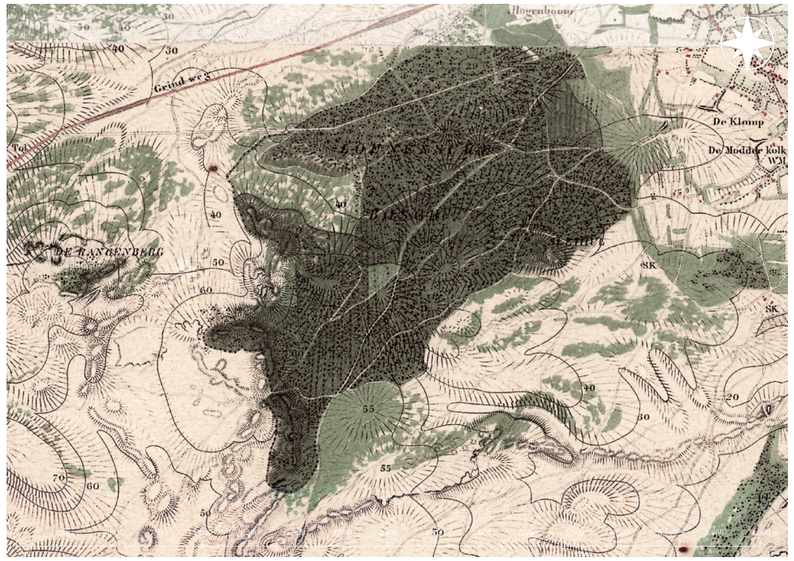
Loenermark
Site Overview

The Loenermark is one of the older forests still present on the Veluwe, tracing its existence back to the early medieval times. The forest itself and its surrounding area were part of the same markgenootschap, a collection of farmers that shared larger pieces of land for extensive use. The result was a varied landscape, of heath pastures and forested groves. However, this area too was a victim to the pine plantation takeover, causing large parts of the area to be formalized in the all too familiar grid like structure. What is interesting about the Loenermark however, is that many of the old carriageways remained present amongst the new grids, with the main thoroughfare still being used to this day: de Droefakkers. The name gives a hint to the former perception of the area; poor agricultural soil, mostly used for extensive sheep grazing. Schaapskooien, sheep stables, were present along the edges of the forest, where the sheep would be stabled after grazing on the heathlands. Most of these had disappeared by the by the early modern times, but to highlight this landscape heritage, a new schaapskooi was constructed in 1956 which now functions as a sort of living museum.

The Loenermark of today is an interesting patchwork of its recent and distant past. The original coppice woods are surrounded by pine plantations, but amongst these we also see some leftover pastures, one stands out in the eastern part of the design area. We can see a single open field with a lone oak tree at the centre, reminiscent of the assumed pre-industrial landscape. In terms of elevation, the Loenermark is located on a gradual slope, leading towards one of the taller hills of the Veluwe. The Trapjesberg, features a lookout tower that was recently renovated by a local initiative (Mink et al., 2013). The transformation of this habitat will attempt to highlight these little snippets of cultural heritage, and interesting natural landforms



Figure 61: Picture of the meadow near the Schaapskooi in Loenermark



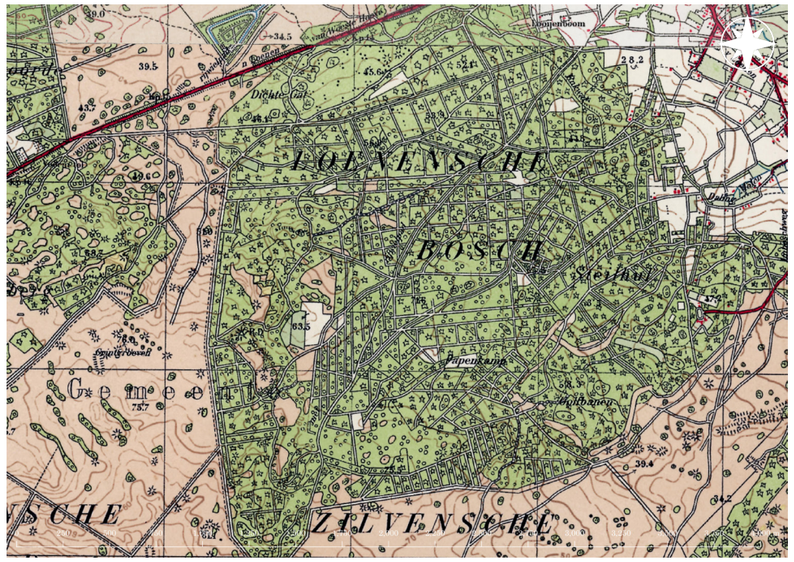




Figure 62-65: The Loenermark design area through time: 1889 -> 1930 -> Present

Loenermark
Intervention and Perspective

The design for the Loenermark was heavily inspired by the historical maps of the area, as the network of carriageways and footpaths provides an interesting basis for the path network. On top of this, the habitat restoration revolves around removing the existing pine trees, and reinstating forest mantle vegetation around the remaining deciduous cores.

Another interesting aspect of the design is that the main thoroughfare will gain a more prominent role in the landscape, being lined with wild fruit trees, specifically wild cherries (*Prunus avium, Prunus padus*) and wild apple trees (*Malus sylvestris*). Aside from providing important resources for pollinators and fruit eating animals, these will form the basis of the seasonal appeal of the area. In spring, these blossoming trees will mark the start of the growing season.

This main artery connects different pathways, the larger ones of which will be lined by two different oak species (*Quercus robur, Quercus petraea*). Oak trees thrive best in more open surroundings, allowing them to provide more ecosystem services in this configuration. The final pathway type will wander through the newly seeded flower rich meadows, and are lined with thorny vegetation such as blackthorn (*Prunus spinosa*) and hawthorn (*Crataegus monogyna*), accompanied by elderflower (*Sambucus nigra*) as well.

In terms of grazing, fallow deer and Exmoor ponies will be allowed to graze in this area, to ensure the biodiversity of the new grass- and woodlands. These animals can also help with seed distribution, specifically of the fruit trees. The area will be fenced using a combination of a houtwal and a hedgerow. A houtwal is a linear structure consisting of a small, raised mound planted with trees, that was previously used to mark the edges of agricultural plots. The hedgerow will be placed on the outer edge of the fence, providing a natural barrier for the grazers, but a valuable habitat for the smaller inhabitants like grey partridges and turtle doves. The central information point will be the schaapskooi, which will also be expanded with an orchard of wild fruit trees. This orchard will only cover half of the clearcut area next to the schaapskooi, meant to inform visitors about the differences between planting of trees and their natural establishment. Once again, the previously mentioned landscape interventions will all be represented surrounding this information point. This will allow visitors to learn about the landscape restoration as they travel to and from the schaapskooi.

Over time, with all the ingredients now present in the landscape, this forest can develop into a diverse woodland-pasture, providing different habitats for a much wider array of species. What will be interesting to see, is how the different tree species will fare in this rewilded landscape, and what the final structure of the habitat will end up looking like.



Figure 66: Cut-out of the relevant part of the Landscape Vision

LOENERMARK
INTERVENTION

Figure 67: Design drawing showing the establishment of the rewilding basecamp

Legend:

Entrance

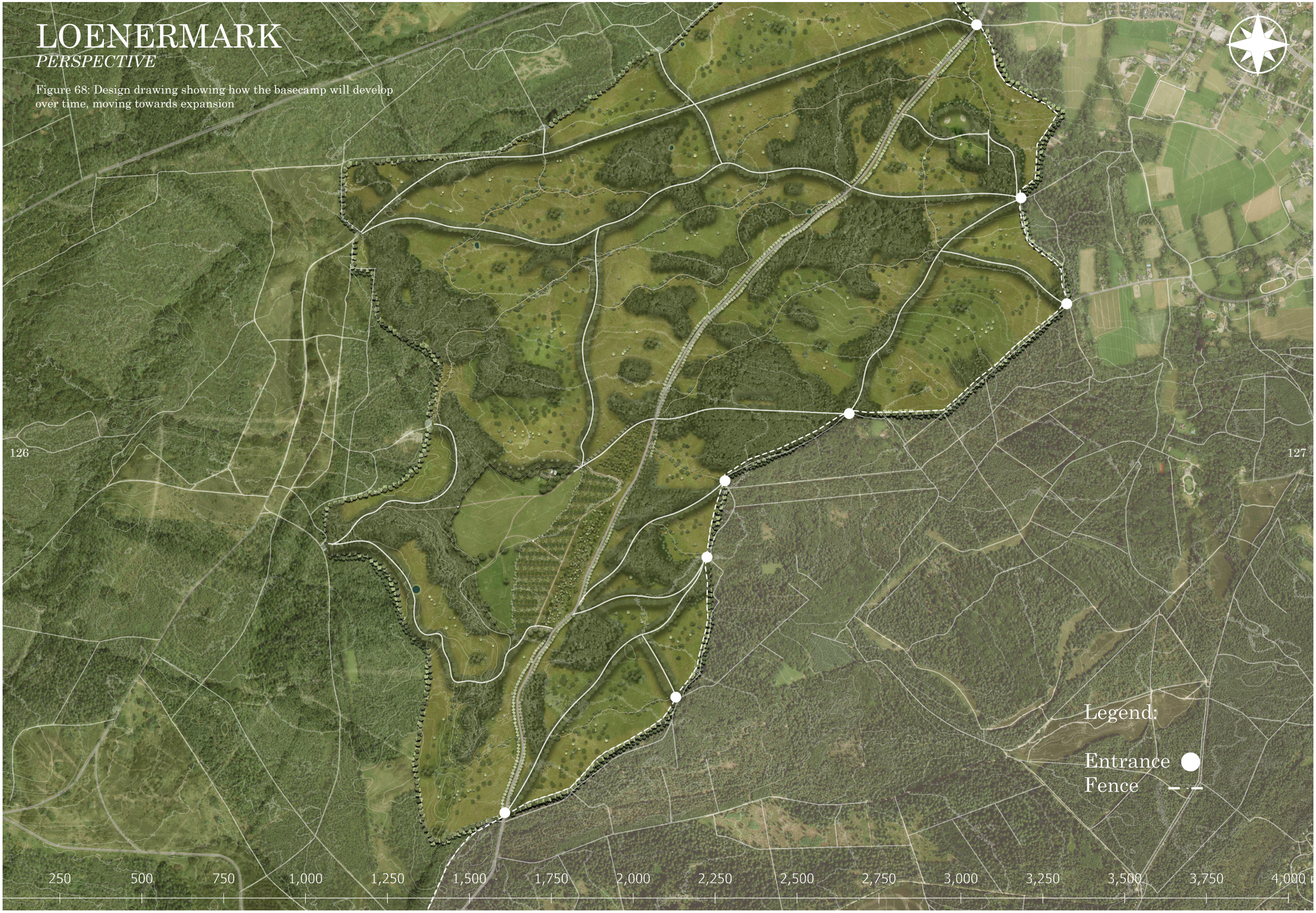
Fence

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LOENERMARK

PERSPECTIVE

Figure 68: Design drawing showing how the basecamp will develop over time, moving towards expansion



LOENERMARK
DETAIL DESIGN

Figure 69: Zoom-in of the information centre at the Schaapkooi

0 75 150 225 300 375 450 525 600 675 750

LOENERMARK
PATHS AND FENCING

Figure 70: Image of a houtwal, which will be installed around the Loenermark Basecamp (Het Drentse Landschap, 2025)



Figure 71: Section of the Droefakker, the main artery through the basecamp

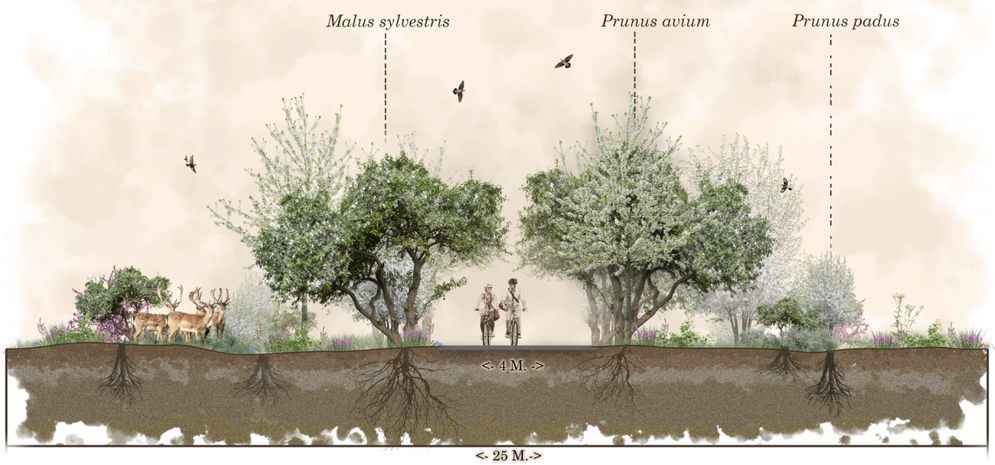


Figure 72: Section of the oak lane path

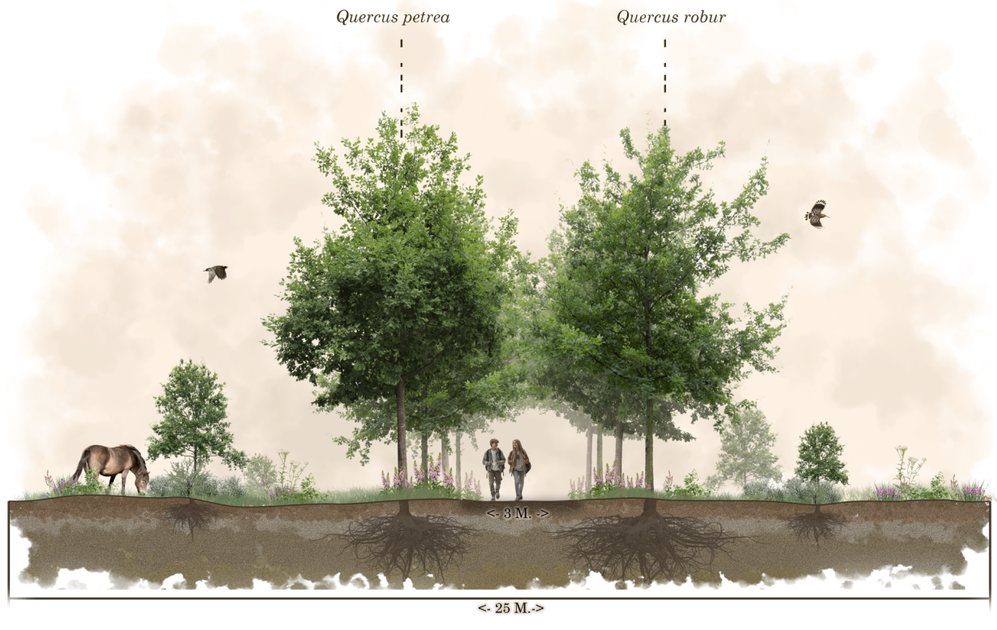


Figure 73: Section of the pasture paths

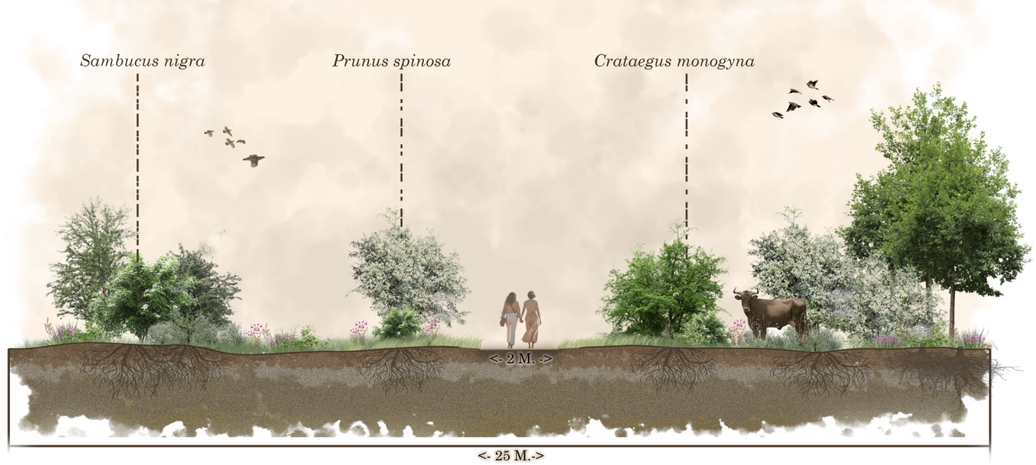
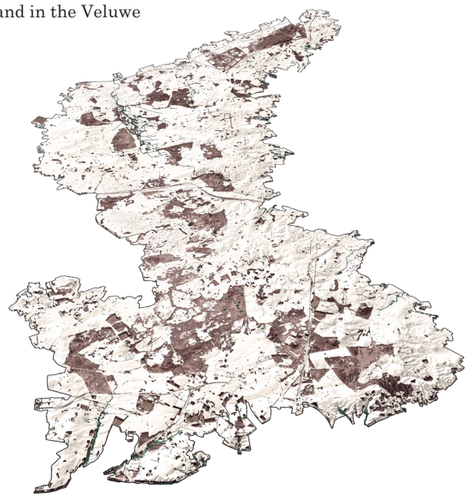


Figure 74: Areas of heathland in the Veluwe



From Heathland...

We now arrive at the most iconic landscape of the Veluwe; the heathlands. The rolling hills of purple are the first thing you see when you search the internet for images of the Veluwe, and many people visit the Veluwe in august to witness the spectacle of the flowering heather. But what many people might not know is that these landscapes are anything but natural. The heather meadows are a direct effect of longstanding sheep grazing, starting in the early medieval times. Initially, heathland ecosystems were most likely more complex than their modern-day representatives, being part of a mosaic of meadows and forest groves, often times representing the transition between these ecosystems.

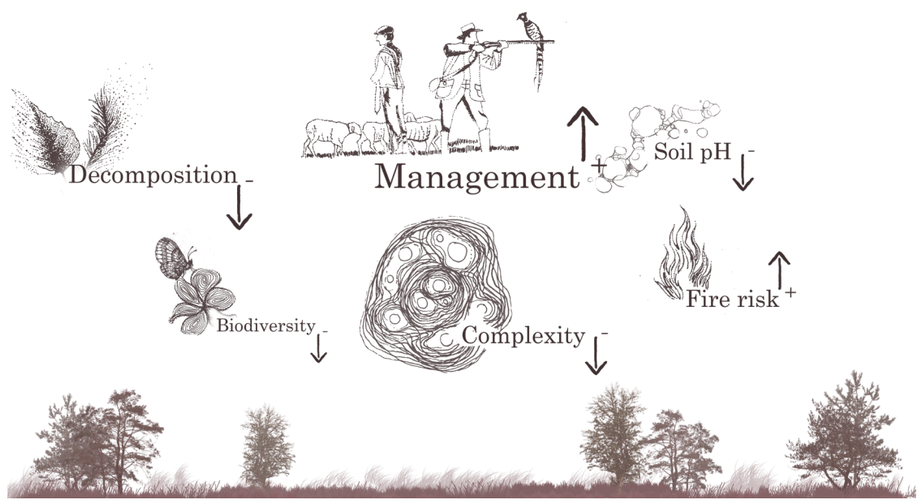
But as the exploitation of the heathlands continued, the heath started to dominate more and more. Nowadays, you would be hard pressed to find any other plants in between the dense stands of heather (*Canulla vulgaris)*, save for maybe a rogue birch or pine tree that managed to escape the grazing sheep. The heathlands are probably the most intensely managed habitat, being dependent on sheep grazing to maintain their openness and monospecific character.

However, the heathlands are being invaded, as a result of nitrogen deposition. Purple-moor grass (*Molinia caerulea)* is gaining increasing dominance over these ecosystems. The tough stems are avoided by sheep, allowing these tussock forming grasses to slowly but surely push the heath out. The modern-day heathlands face more than just the threat of grasses. With their low structural complexity and biodiversity, and their vulnerability to fire, their dominant presence on the Veluwe has been losing ground for centuries. The final issue of the heath is that heather plants have extremely hard to decompose leaf litter, making the soils vulnerable to acidification. It seems that the time is now to give the heathlands a new, but just as iconic character. (Schepers & Arnoldussen, 2025)



Figure 75: Impression of the modern-day heathlands

Figure 76: Structure of modern day heathlands and the problems it faces



... to Juniper Shrubland

The future of the heathlands sees, surprisingly, a return to form in many ways. The earlier heathland fields were much for structurally complex and biodiverse. One of the most iconic species of heathlands would be the common Juniper (*Juniperus communis*). This globally distributed shrub has been silently departing from Dutch ecosystems, but are an important part of a diverse heathland ecosystem. Juniper can greatly improve structural diversity in a heathland, by creating microhabitats in the otherwise monotonous landscapes. A big part of this habitat restoration will therefore include the planting of juniper (Hommel et al., 2007). To further improve biodiversity, gorse (*Ulex europaeus*) and scotch broom (*Cytisus scoparius*) will also be planted and seeded. These thorny shrubs can help the regeneration of both trees and juniper shrubs, and their early season flowers are an important source of nectar for insects coming out of hibernation. Together with these shrubs, different species of grasses and forbs will also be seeded into the landscape, and the goal here is that they can once again find their niche in this landscape.

The final piece of the puzzle for heathlands comes in the form of grazing, but this time without sheep. Semi-wild cattle and Exmoor ponies can trample through the heathlands, opening up new areas for the reseeded grasses and forbs to settle in.

Figure 77: Design location Radio Kootwijk marked among the deciduous forests

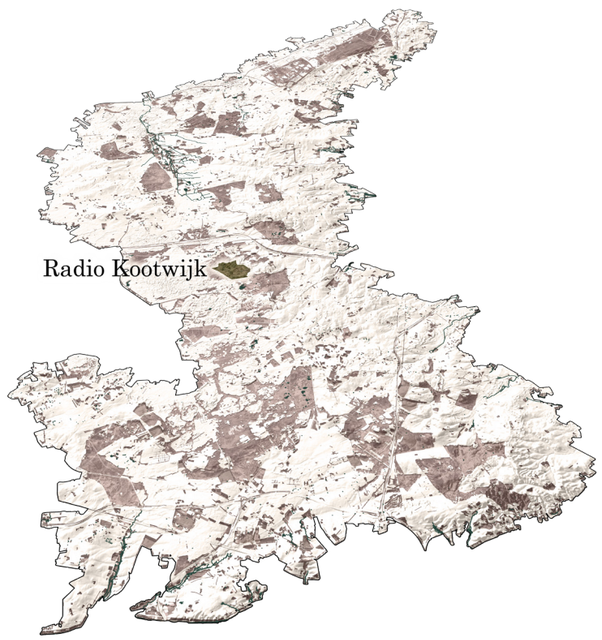
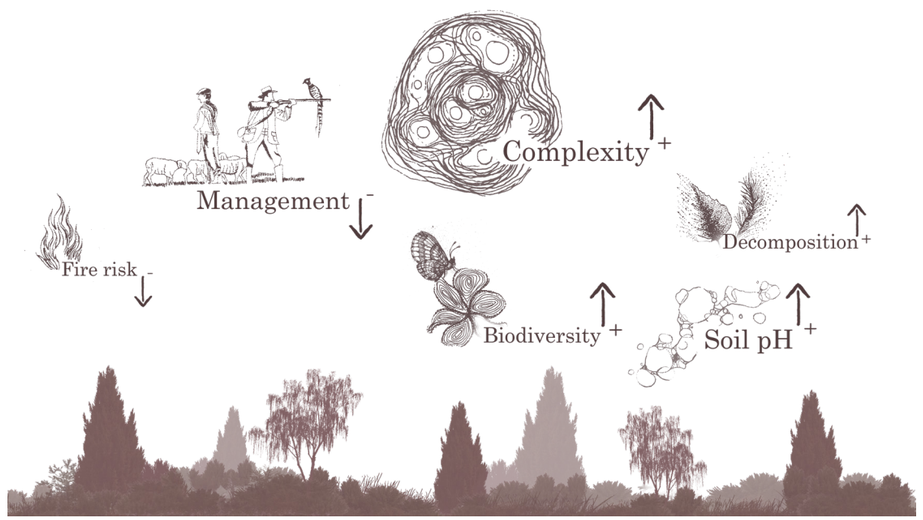




Figure 78: Impression of the transformed heathland

Figure 79: Structure of juniper shrubland and its beneficial processes



Radio Kootwijk
Site Overview

Located in one of the most iconic landscapes, we also find one the most iconic structures of the area: the Cathedral of the Veluwe, Radio Kootwijk. A brief description of this site has already been given in the landscape biography, so this part will be kept brief. The main buildings of Radio Kootwijk still stand tall to this day, but with the loss of its functionality the radio towers were also removed, only one is left standing next to main building. Radio Kootwijks location amongst the heathlands is no coincidence: the open terrain provided a clear path for signals to be picked up.

The forests surrounding this clearing help this even more, focussing the signals into the central point of the field where the main satellite was located. Designing in this area is a delicate balancing act of retaining its cultural legacy, but also giving new life to the region. Part of this revitalisation of Radio Kootwijk is its proximity to the European Bison rewilding project, located just south of the main building.

The bison have successfully roamed in this area since 2016, and are steadily increasing in numbers. Because natural grazing can be an important asset to heathland restoration, connecting the basecamp to this project is an exciting prospect



Figure 80: Main building of Radio Kootwijk



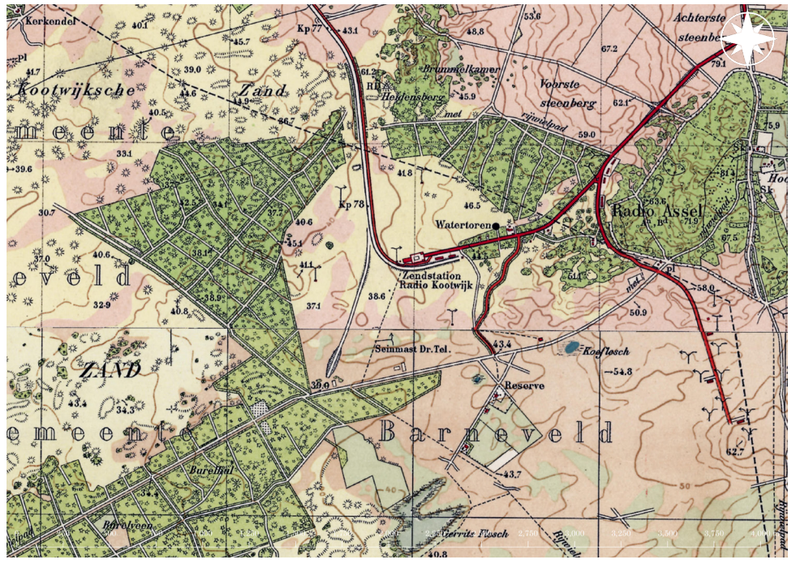




Figure 81-83: The Radio Kootwijkdesign area through time: 1889 -> 1930 -> Present

Radio Kootwijk
Intervention and Perspective

The intervention in this area revolves around bringing the landscape heritage of Radio Kootwijk to the forefront, while also improving ecological conditions.

Naturally, the main building of Radio Kootwijk will attract visitors, and the information centre will therefore be located near this building. The pathing system is based on a combination of old pathways, the existing recreation network, and the educational purpose of shifting people's perceptions of heathlands. The main path leads visitors along a lane of oak, linden and birch towards the main building. This path then splits into a circle that follows the locations of old satellite towers, which are marked with beech trees. Along this path, the outer rim of the satellite will be lined with birch trees. The other paths all connect to this main circle, and will mostly be planted with juniper. As connecting paths, visitors will be able to stroll through the renewed heathlands, accompanied by gorse, scotch broom, a mix of flowers iconic for acidic grasslands, and perhaps a rogue Scots pine, growing in its natural capricious fashion. The fencing will be similar to that of the Loenermark, existing of a thicket of the aforementioned thorny shrubs, like blackthorn and alder buckthorn.

With all of these new ingredients, the heathland can return to its former glory, being an important half-open landscape for many species. The juniper can spread across the area with the help of the grazers, bison included. The thorny shrubs ensure that new trees can also pop up. The signal tower beech trees can grow in their characteristic columnar shape, and harebells (*Campanula rotundifolia*) might pop up in the shade of their canopies. No longer will the heathlands be a purple wasteland. While keeping their seasonal late summer appeal, they can now expand their palette to cover a broader range of colours.



Figure 84: Cut-out of the relevant part of the Landscape Vision

RADIO KOOTWIJK

INTERVENTION

Figure 85: Design drawing showing the establishment of the rewilding basecamp

Legend:

Entrance

Fence

0 250 500 750 1,000 1,250 1,500 1,750 2,000 2,250 2,500 2,750 3,000 3,250 3,500

RADIO KOOTWIJK

PERSPECTIVE

Figure 86: Design drawing showing how the basecamp will develop over time, moving towards expansion



RADIO KOOTWIJK

DETAIL DESIGN

Figure 87: Zoom-in of the information centre at the main building of Radio Kootwijk

Legend:

Entrance

Fence

0 75 150 225 300 375 450 525 600 675 750 m

RADIO KOOTWIJK
PATHS AND FENCING

Figure 88: Image of a gorse thicket, which will be installed around the Radio Kootwijk Basecamp (Chris, Woodlands UK, 2013)



Figure 89: Section of the Satellite path, which follows the old radio tower locations

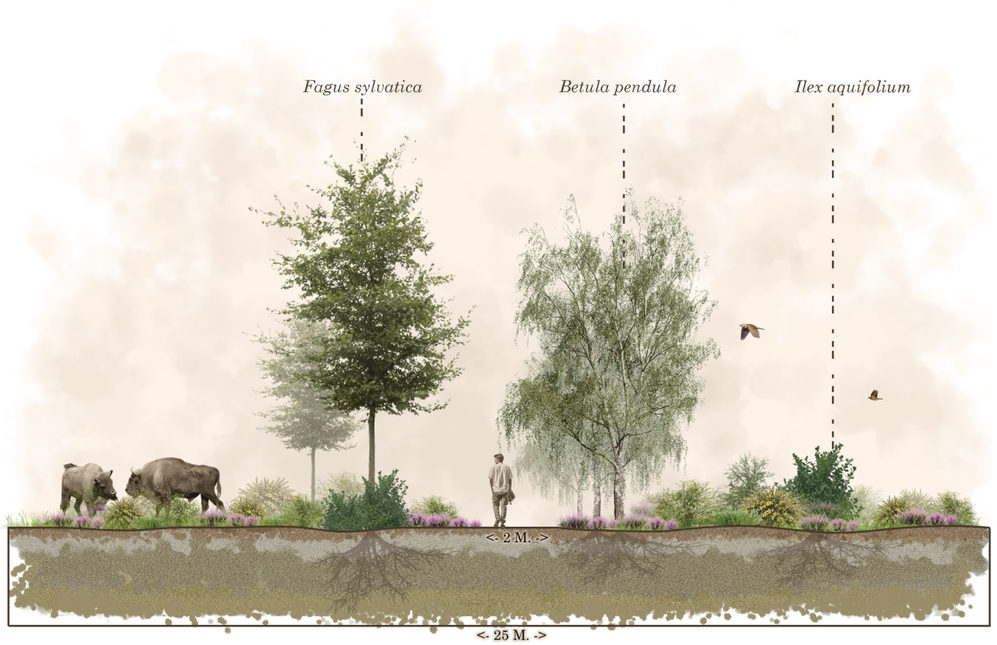


Figure 90: Section of the Signal path, which brings visitors in towards the Satellite path

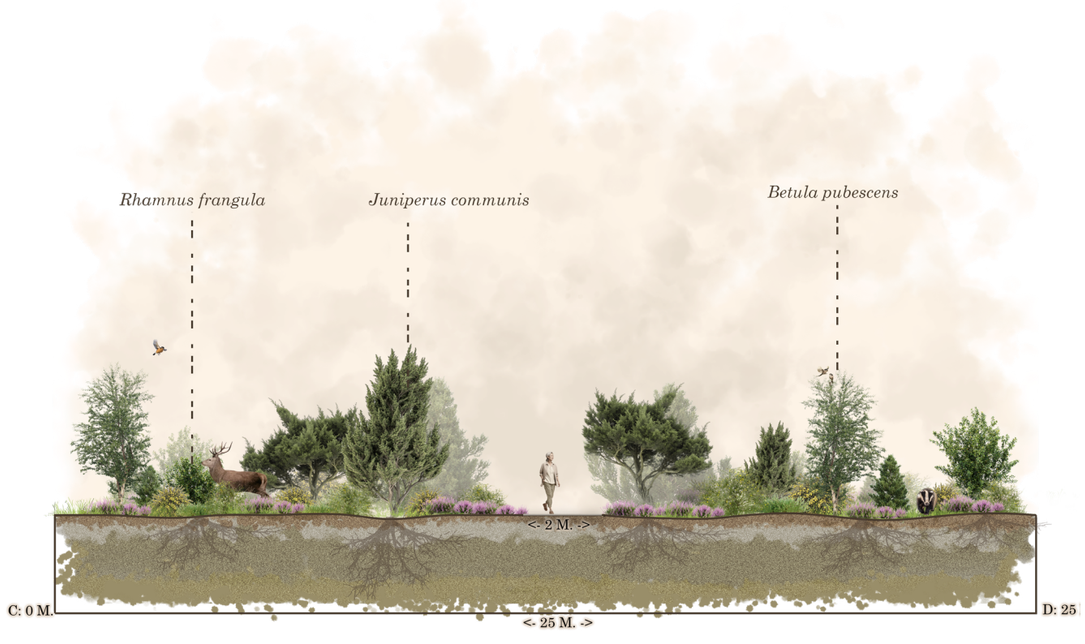
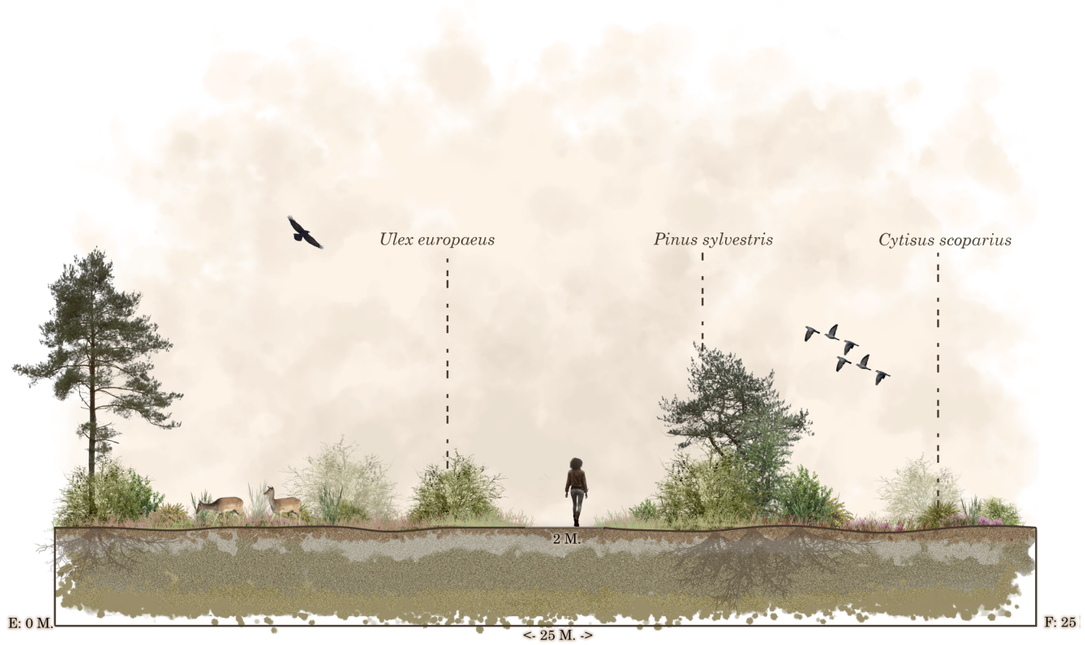


Figure 91: Section of the Radar paths, that connect the Signal paths



Part V

A Point on the Horizon

Conclusion
Design Reflection
Final Thoughts
Appendix
Bibliography
Image credit

Figure 92: Picture of the sun through two Scots pines

Conclusion

To wrap up this thesis, the research questions are examined again, with the added knowledge of this research and design project. Every question will be assessed through a short conclusion, followed by a discussion and reflection on degree of completeness with which the question was answered.

Sub-research question 1

What are the natural processes and principles of rewilding, and how do they aid in improving biodiversity on the Veluwe?

Complexity is the key word here: every natural process plays its own role in an ecosystem, and biodiversity is closely connected to the completeness of these processes. Natural processes are the at the root of the diversity of ecological niches, and allow different species to take their rightful place amongst these processes. Moreover, the research on this question showcased that natural processes not only aid in species diversity, but are at the core of the resilience of an ecosystem.

For this specific thesis, a selection was made on the natural processes relevant for the chosen site. However, this also affects the completeness of the research. Interactions between ecosystems with different abiotic conditions throw in additional processes not yet addressed in this project. If we want to expand our understanding of the interaction between these different ecosystems, additional research will be needed, and will have to go beyond the scope of just the Veluwe.

Sub-research question 2

How has the ecological and cultural landscape of the Veluwe changed over time, and what were the driving forces behind these changes?

The landscape biography revealed that the Veluwe has had many faces over the course of time. The impact people can have on a landscape seems to know no bounds, sometimes bringing about more dramatic changes than natural forces can. But with the revelation of this impact comes not only destruction, but also the potential for restoration and creation; it simply depends on the intentions and goals of the people enacting the change.

Because this thesis focusses on the ecological and cultural processes of the landscape, certain aspects may have been left behind. Once again, the impacts of the bigger context in which the site exists has also impacted its story. To tell the full story of the Veluwe, looking at this bigger context can deepen the answer to question even further.

Sub-design question 1

How can landscape architectural interventions reintroduce, kickstart, and facilitate natural processes and rewilding in the ecosystem of the Veluwe?

Complexity is the key word here: every natural process plays its own role in an ecosystem, and biodiversity is closely connected to the completeness of these processes. Natural processes are the at the root of the diversity of ecological niches, and allow different species to take their rightful place amongst these processes. Moreover, the research on this question showcased that natural processes not only aid in species diversity, but are at the core of the resilience of an ecosystem.

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Sub-design question 2

How can the landscape heritage and recreational use of the Veluwe be integrated in a meaningful way in a rewilded Veluwe?

While seemingly obvious, this design aspect probably brought about the most complex design considerations. Landscape heritage can often lead towards a “do not touch” approach, where heritage is best conserved and left alone. Recreation on the other hand, requires active intervention. But these recreation-focused interventions sometimes become seemingly facetious, creating a design purely for shallow enjoyment of visitors. What was revealed in the process, however, is that cultural heritage and recreational use can strengthen each other, especially when it comes to the more subtle aspects of heritage. Making heritage explicit and educating visitors as they experience the landscape, can deepen and fortify the basis upon which design choices are made.

In terms of discussing the completeness of the conclusion to this question, it is important to note that once again the scope of the thesis was a limiting factor, though in a different manner. The Veluwe is a large and varied landscape, with immeasurable amounts of stories both big and small. When researching the designs for the rewilding basecamps, so much information was found, and continued research on a smaller scale, can bring these stories to the light even more.

Main research question

What can landscape architectural rewilding design do to improve biodiversity and ecological integrity in a landscape where management has focussed on the maintenance of heritage landscapes and facilitating outdoor recreation, without erasing these dimensions?

Finally, the main research question. Combining the conclusions from the sub-questions, we can see a clear pattern starts to reveal itself; landscape architectural design can most definitely improve biodiversity and ecological integrity, even in a landscape that may not have prioritised these dimensions in the past. On top of that, the realms of heritage and recreation can contribute to this process as well, becoming vital in teaching people about their surroundings and all the natural and anthropological processes that work together to create these surroundings.

Now, one major limitation of this plan, is that it would of course require quite a lot of time, money, and labour to be realized. But what is interesting, is that because the vision is divided into phases, the impact of the design can be seen from different perspectives. Even if only the first three basecamps would be realised, this would still boost the biodiversity and complexity on a local scale. The idea therefore is that the completion of the vision is dependent on goodwill, and public understanding of its importance. Once people see the impact that rewilding can have, maybe the entire Veluwe can one day embrace its ecological potential.

Future research can explore other sites in which this method can be applied to improve ecological conditions. There are so many unique ecosystems in this world, that are all created by a specific set of natural processes, so the possibilities are truly endless.

Design Reflection

In this design process, I found a way to harmonize my personal and professional interests, and strengthen my view on what kind of landscape architect I want to be. When I started this project, I strongly doubted whether an interesting design could come forward from such a deeply theoretical basis, with a seemingly hard to define spatial application. But what I found is that it really comes down to perseverance, and believing in the vision of the world you yourself want to create. I truly feel like I managed to incorporate so many of my personal beliefs an interests in this design, without turning this thesis into a subjective passion project. The research actually ended up guiding my design in surprising ways, and as the project went on, I started to realise more and more how powerful landscape design can be in translating these highly theoretical concepts into spatial designs. What became clear is that the strength of a design can be found in its variety of theoretical underpinnings, and the design decisions made to bring this theory forward.

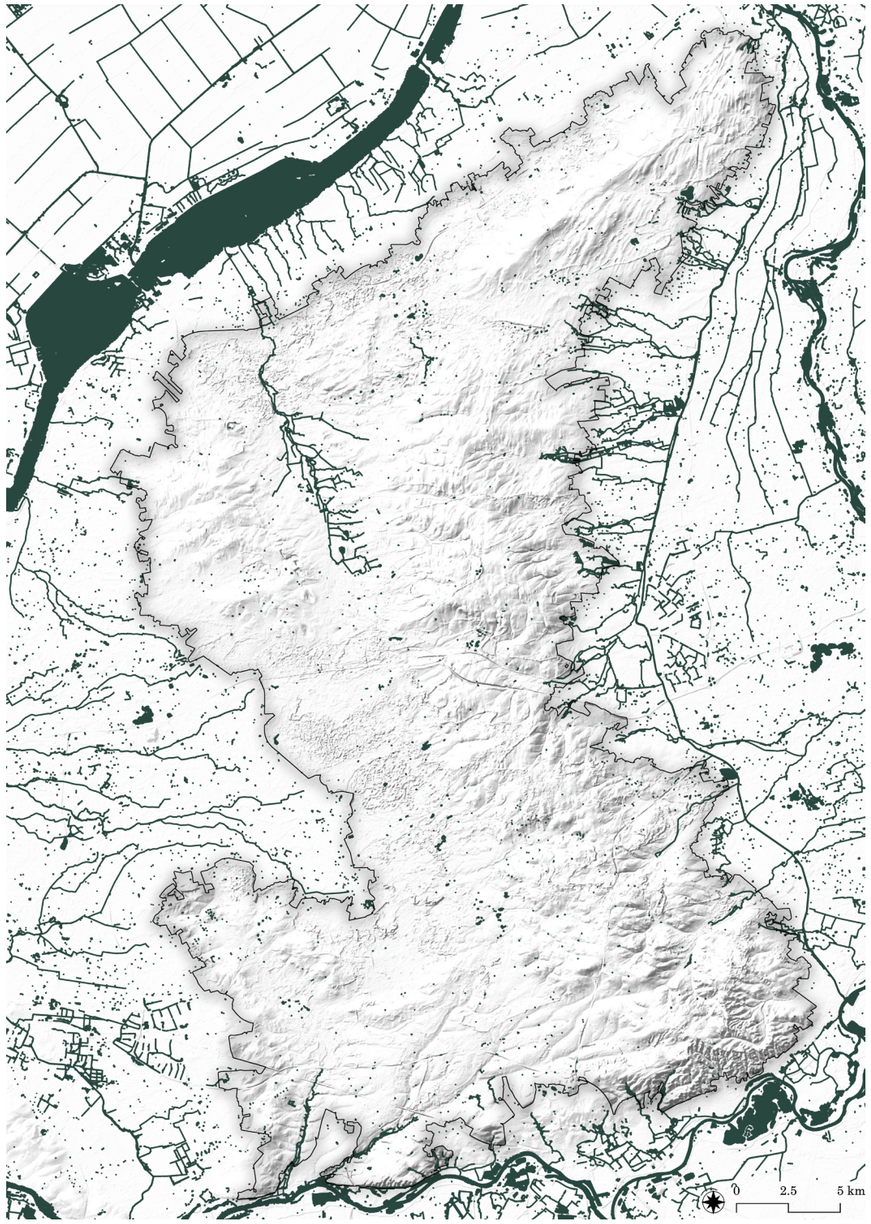
Final Thoughts

Landscape architecture is a discipline more varied than it is sometimes given credit for. Landscapes are incredibly complex, and span a vast range of disciplines. What makes landscape architecture so powerful, is that it can take these disciplines in stride in the design process.

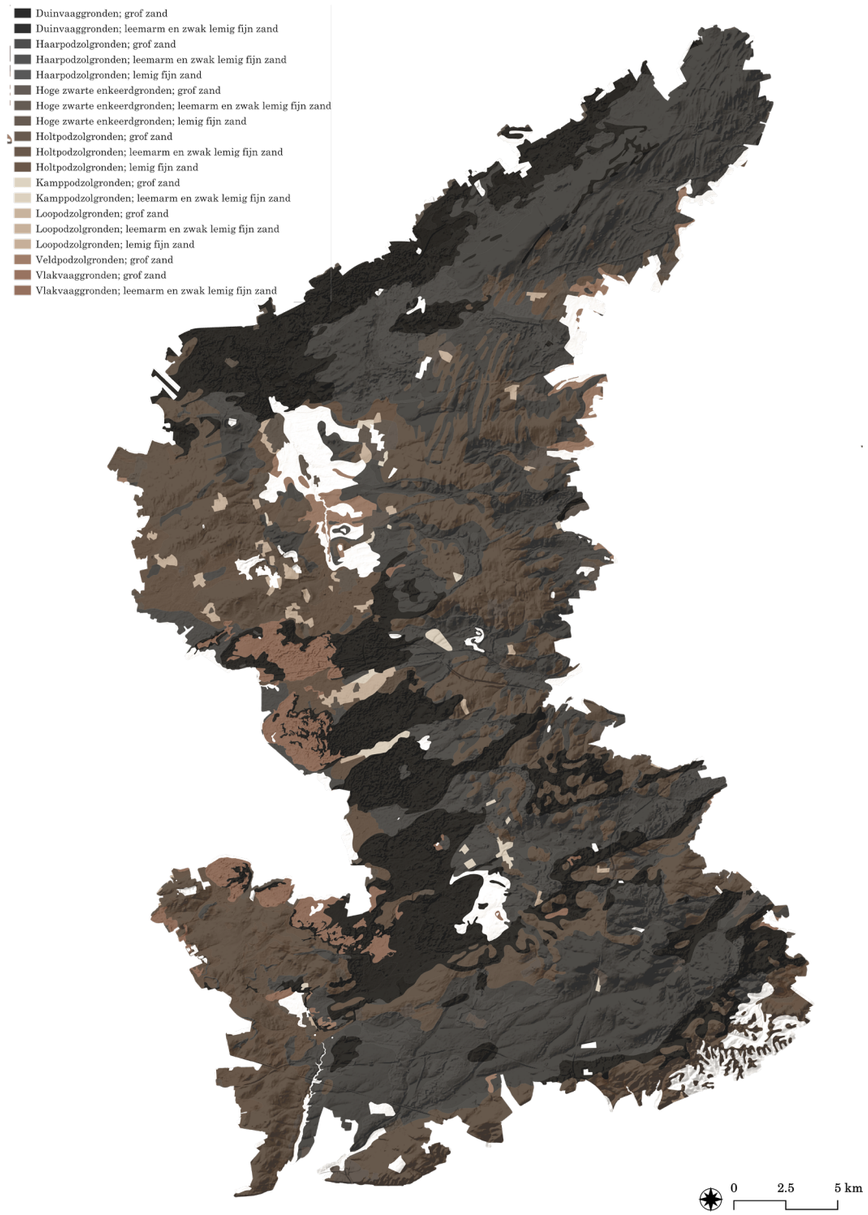
One may not be an ecologist, but still is able to shape ecosystems. One may not be a politician, but can still progress society and public knowledge. One may not be a historian, but can still bring forth stories of the past.

One may not be able to save the entire world, but one might as well try.

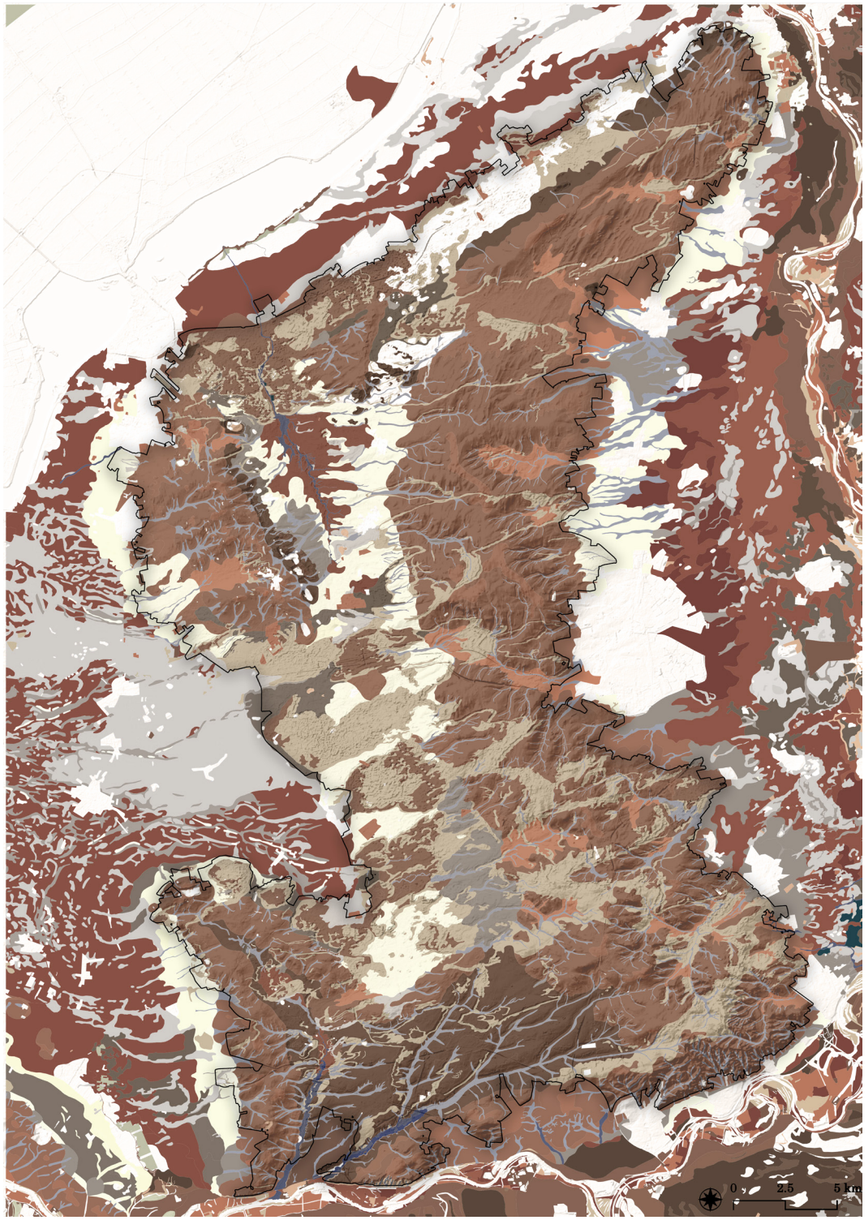
Appendix



Appendix 1: Hydrological map of the Veluwe



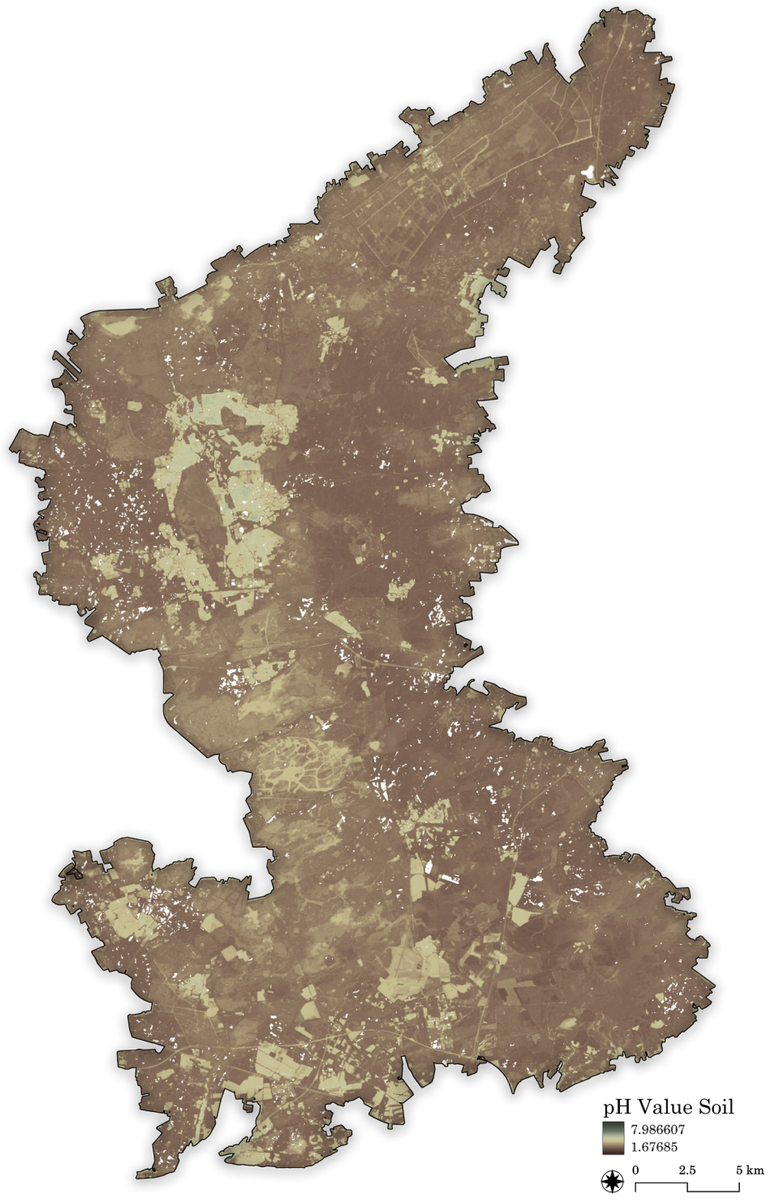
Appendix 2: Soil map of the Veluwe



Veluwe Geomorphology

- Beekdalbodem
- Beekdalbodem met meanderruggen
- Beekoverstromingsvlakte
- Complex van dekzandwelvingen
- Complex van gordeldekzandwelvingen
- Daluitspoelingswaaier
- Dalvormige laagte
- Dekzandrug
- Dekzandvlakte
- Dekzandwelving
- Doodijsgat
- Doorbraakwaaier
- Droogdal
- Geulranddekzandrug
- Glooiing van hellingafspoelingen
- Glooiing van sneeuwsmeltwaterafzettingen
- Gordeldekzandglooiing
- Gordeldekzandrug
- Gordeldekzandvlakte
- Kronkelwaardgeul
- Kronkelwaardrug
- Kunstmatig gecreëerd reliëf
- Kustduinen
- Landduin
- Landduinen met bijbehorende vlakten
- Meanderruggen en -geulen
- Oeverwal
- Ondergraven stuwwalzijde
- Overloop- of crevassegeul
- Periglaciale laagte
- Pingoruïne
- Plateau-achtige storthoop
- Plateau-achtige veenrest
- Rivier- of beekbedding
- Rivier-erosielaagte
- Rivierdalbodem
- Rivierduin
- Rivierkom- en oeverwalachtige vlakte
- Rivierkomvlakte
- Smeltwaterheuvel
- Smeltwaterrug
- Smeltwaterterras
- Smeltwaterwaaier
- Storthopen met grind-
- Strandwal
- Stroomrug of stroomgordel
- Stroomrugglooiing
- Stuifzandvlakte
- Stuwwal
- Stuwwalglooiing
- Stuwwalplateau
- Terrasvlakte
- Trechtervormig droogdal
- Vlakte ontstaan door afgraving en/of egalisatie
- Vlakte van rivierafzettingen
- Vlakte van smeltwaterafzettingen
- Vlakte van sneeuwsmeltwaterafzettingen
- Vlakte van ten dele verspoelde dekzanden of löss
- Welvingen in rivierafzettingen
- Welvingen in sneeuwsmeltwaterafzettingen

Appendix 3: Geomorphologcial map of the Veluwe



Appendix 4: pH map of the soil on the Veluwe



Appendix 5: road infrastructure around the Veluwe

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