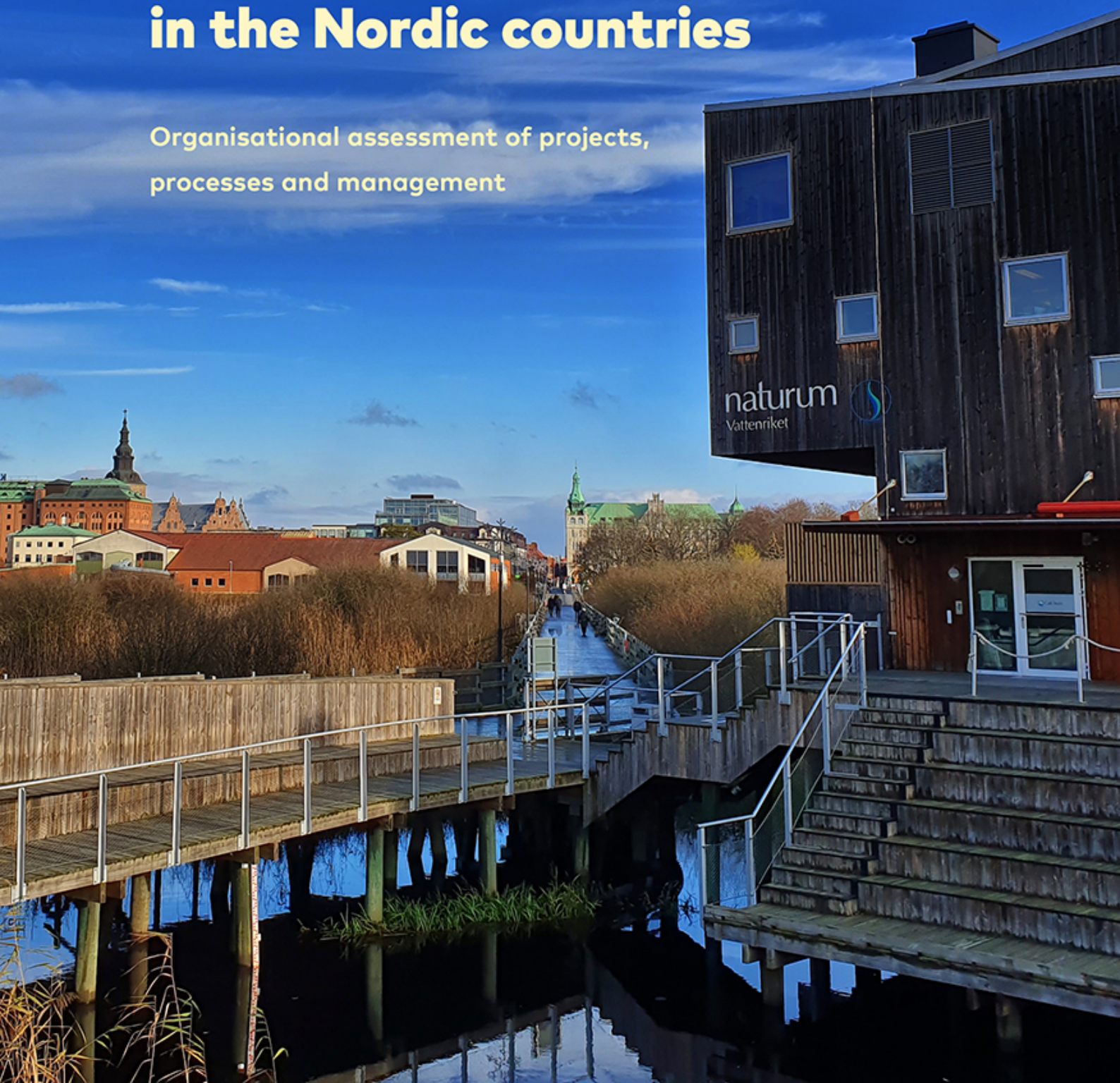


Multifunctional Ecosystem Restoration in the Nordic countries

Organisational assessment of projects,
processes and management



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Organisational evaluation of projects, processes and management

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Fact sheet

Multifunctional Ecosystem Restoration in the Nordic countries

Organisational assessment of projects, processes and management

Urged by the complex ecological and socio-economic challenges in modern ecosystem restoration, the topic of this TemaNord publication is the processes of multifunctional ecosystem restoration.

The complexity and interrelatedness of ecosystem degradation drivers requires more than sector-specific policy development and action. Policies need to identify synergies and trade-offs between ecosystem restoration and societal challenges. They must be mutually supportive and not prioritise success within one domain at the expense of another. Solutions need to be multifunctional. This poses immense challenges on policy makers, administrations, as well as corporate and civil agents. Nonetheless, this multidimensional lens is a sine qua non if we are to sustainably succeed in reversing current levels of degradation of ecosystems, and instead safeguard and restore our base for existence while accommodating and feeding the population growth of future generations.

Nature-based Solutions	Organising projects
The assessment of cases is based on the methodological basis of the IUCN's global standard for Nature-based Solutions (NbS)	The assessment deals with the organisational level of projects, evaluation of project, processes, and management structures.

Figure 1. Methodological considerations and project scope (Source: Habitats, 2022).

This catalogue represents an awareness of the need to address the interlinkages between the various dimensions of ecosystem restoration, and a contribution towards identifying and presenting relevant case stories and their contextualised tools, methods, and guidelines. With this catalogue it is our hope that the cases and guidelines may inspire, stimulate, and support new restoration projects in the Nordic region.

Six case studies

Six Nordic multifunctional ecosystem restoration projects has been assessed in order to create an overview of successful projects, tools, and guidelines for their implementation and policy options that can support new restoration projects and policy (see figure 1).

Geographical scales The cases represent a geographically broad distribution. In terms of scale, they represent both local, municipal, regional, and national projects.	Ecological contexts The ecological context of the cases varies from restoration of wetlands, rivers, forests, sunlit habitats, marine habitats, and to a mosaic of habitats at a landscape scale.	Administrative units Three of the case projects are administrated by state authorities, one project is an administrative sub-unit of the municipality, one project is a partnership between scientific institutions, and finally another project is initiated and driven mainly by a group of indigenous people.
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Figure 2. Overall case characteristics (Source: Habitats, 2022)

The six cases in this report differ much and represent different characteristics of ecosystem restoration projects in the Nordic context (see figure 2).

This report highlights different main challenges and successes of planning and implementing ecosystem restoration at the project level in the Nordic and Arctic region, which can be seen in table 1 and is visually represented in figure 4.

Dimension	Projects' overall challenges and successes
Biodiversity	High success, an overall tendency of identifying the drivers of ecosystem degradation. Defining clear and measurable biodiversity conservation outcomes and employing rigid monitoring.
Climate mitigation	Represents an area of improvement for some cases. Improvements consists of identifying the drivers of climate mitigation degradation. Defining clear and measurable climate mitigation outcomes and employing rigid monitoring.
Socio-economic benefits	Represents an area of improvement for some cases. Improvement consists of identifying the most pressing societal challenges associated to the project. Identifying right holders and beneficiaries and documenting the direct and indirect costs and benefits.
Sustainable land management	Overall, the cases were successful at acknowledging and responding to the interactions between nature, society, and the economy.
Stakeholder involvement	Some cases are characterised by a generally high success, while other represents areas of improvements. Improvements consists of documenting decision-making processes and how they respond to the rights and interests of all affected parties. Establishing and periodically reviewing safeguards for mutually agreed trade-off limits.
Knowledge sharing and policy facilitating	High success, an overall tendency to share information about project designs, implementation, and lessons learned to trigger transformative change.
Synergetic adaptation and increased resilience	Overall, the cases were successful at formulate the intended outcomes and how they should be achieved, developing monitoring and evaluation plans, addressing the need to base management on trial-and-error processes and iterative learning and iterative learning. Two criteria were neglected: Integration with complementary interventions and incorporating risk identification and management.

Table 1. Description of the main challenges and success derived from the case studies (Source: Habitats, 2022).

The total score for each dimension in percentages

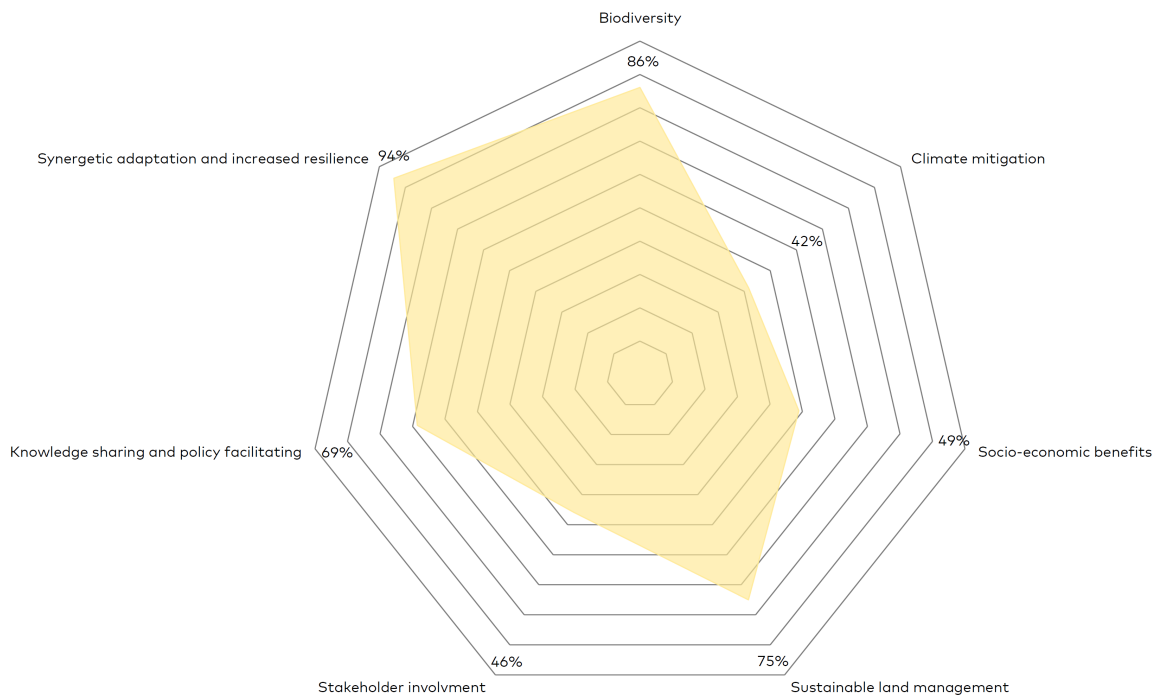


Figure 3. The total score for each dimension across all cases in percentages (Source: Habitats, 2022).

Ten Nordic policy options

This report provides inspiration to how the Nordic countries can integrate ecosystem restoration in national policy and action plans considering conservation and the strengthening of biodiversity, climate change mitigation and socio-economic challenges. Based on the six case studies this report concludes with ten policy options. A comprehensive presentation of each policy option can be found in chapter 8 in the report.

1. Promote partnerships around ecosystem restoration projects in order to minimise knowledge gaps, improve funding options, and improve resilience.
2. Include modern multifunctional standards in the criteria for funding ecosystem restoration projects.
3. Promote close contact between projects, authorities, and public destinations.
4. Develop multifunctional land consolidation schemes.
5. Develop Nordic tools for assessing long-term socio-economic benefits at the Nordic political level.

6. Put emphasis on socio-cultural surveys and approaches.
7. Update existing monitoring platforms and make them more user-friendly and accessible for stakeholders.
8. Share knowledge on all levels and educate people in modern ecosystem restoration practices at the operational level.
9. Promote bottom-up approaches.
10. Require collaboration skills in the project group, build up trust among stakeholders and promote proudness of the ecological values in the landscape.

Contents

Executive summary, EN	9
Resumé, DA	12
1. Introduction	14
2. Background and context	16
2.1. Nature and Humans in coexistence in the Nordic countries	16
2.2. Ecosystem restoration revisited	16
2.3 Social science and the environment – a summary	17
3. Approach and methodological considerations	19
3.1 Preselection of cases	19
3.2 Literature search	19
3.3 Scoring cases for final selection	20
3.4 Interviews	20
3.5 Framework for analysing and evaluating cases	21
3.6 Policy options	23
4. Introduction to case studies	24
5. Case studies	26
5.1. Kristianstad Vattenriket Biosphere Reserve, Sweden – "Benefiting nature and people"	26
5.2. Näätämö Watershed, Finland – Collaborative river restoration with indigenous people	37
5.3. Hekluslógar – Restoring birch forest in co-operation with farmers, Iceland	43
5.4. Light & Fire, Finland – Collaborative restoration of sunlit habitats	52
5.5. Lille Vildmose, Denmark – Peatland restoration for biodiversity, climate, and tourism	58
5.6. Fjordkalk, Norway – Restoring kelp forest by removing sea urchin with quicklime in Porsangerfjorden	67
6. Cross-cutting themes from all cases	72
6.1 Socio-economic aspects	74
6.2 Stakeholder involvement and collaboration	75
6.3 Monitoring and adaptive management	76
6.4 Dissemination and knowledge sharing	76
6.5 Institutional instruments and funding	76
7. Project tools	78
7.1 Socio-cultural instruments	78
7.2 Narrative interviews	78
7.3 Multifunctional land consolidation	79
7.4 Locally Based Monitoring	80
8. Nordic policy options	82
9. A future perspective on ecosystem restoration	85

9.1 European nature restoration targets	85
9.2 The invisible biodiversity and nature rituals	85
9.3 Blue biodiversity in urban development	86
9.5 Multifunctional land consolidation	87
9.6 Habitat banking	87
Acknowledgements	89
References	90
About this publication	94

This publication is also available online in a web-accessible version at <https://pub.norden.org/temanord2022-543>.

Executive summary, EN

Urged by the mutually linked global crises of climate change and the loss of biodiversity, the present decade has been dedicated to Ecosystem restoration by the United Nations General Assembly. These priorities co-exist with the need to house, feed and secure employment, income and human wellbeing of a vastly increasing global population. Needed by the complex ecological and socio-economic challenges in modern ecosystem restoration, the topic of this TemaNord publication is multifunctional ecosystem restoration. Six Nordic multifunctional ecosystem restoration projects have been assessed in order to create an overview of successful projects, tools and guidelines for their implementation and policy options that can support new restoration projects and policy making.

The complexity and interrelatedness of ecosystem degradation drivers requires more than a sector-specific policy development and action. Policies need to identify synergies and trade-offs between ecosystem restoration and societal challenges. They must be mutually supportive and not prioritise success within one domain at the expense of another. Solutions need to be multifunctional. This poses immense challenges on policy makers, administrations, as well as corporate and civil agents. Nonetheless, this multidimensional lens is a *sine qua non* if we are to sustainably succeed in reversing current levels of ecosystem degradation, and instead safeguard and restore our base for existence while accommodating and feeding the population growths of future generations.

This catalogue represents an awareness of the need to address the interlinkages between the various dimensions of ecosystem restoration, and a contribution towards identifying and presenting relevant case stories and their contextualised tools, methods, and guidelines. With this catalogue it is our hope that the cases and guidelines may inspire, stimulate, and support many new restoration projects in the Nordic region.

Case studies

Six Nordic multifunctional ecosystem restoration projects have been assessed at an organizational level, evaluating project structures and management, in order to create an overview of successful projects, tools and guidelines for their implementation and policy options that can support new restoration projects and policy.

The six cases in this report differ much and represent local, municipal, regional and national restoration projects as well as different contexts, and a wide range of context and broad geographical distribution is represented in the cases. Three of the case projects are administrated by state authorities, one project is an administrative sub-unit of the municipality, one project is a partnership between scientific institutions, and finally another project is initiated and driven mainly by a group indigenous people.

Overall, the projects were successful at implementing synergetic adaptation and increased resilience. This stems from a prevalent tendency to formulate the intended outcomes and how they should be achieved, from the development of monitoring

and evaluation plans, and from addressing the need to build management on trial-and-error processes and iterative learning. Two criteria were neglected: 1) integration with other complementary interventions, while seeking synergies across sectors, and 2) incorporation of risk identification and risk management. The cases were also very successful within the biodiversity dimension. This is due to the fact that there is a strong tendency in the project towards identifying the drivers of degradation, clear and measurable biodiversity conservation outcomes, and rigid monitoring. Climate mitigation, stakeholder involvement, and socio-economic benefits are represented in the case studies, but compared to biodiversity, they represent areas for improvement.

This report highlights different main challenges and successes of planning and implementing ecosystem restoration at the project level in the Nordic and Arctic region. (See chapter 6 for more details). Furthermore, based on the case studies and supplemented by an academic expert panel, this report has provided inspiration to how the Nordic countries can integrate ecosystem restoration in national policy and action plans considering conservation and the strengthening of biodiversity, climate change mitigation and socio-economic challenges.

Nordic policy options

Based on the six case studies This report concludes with ten policy options (see chapter 8 for details).

1. Promote partnerships around ecosystem restoration projects in order to minimise knowledge gaps, improve funding options, and improve resilience.
2. Include modern multifunctional standards in the criteria for funding ecosystem restoration projects.
3. Promote close contact between projects, authorities, and public destinations.
4. Develop multifunctional land consolidation schemes.
5. Develop Nordic tools for assessing long-term socio-economic benefits at the Nordic political level.
6. Put emphasis on socio-cultural surveys and approaches.
7. Update existing monitoring platforms and make them more user-friendly and accessible for stakeholders.
8. Share knowledge on all levels and educate people in modern ecosystem restoration practices at the operational level.
9. Promote bottom-up approaches.
10. Require collaboration skills in the project group, build up trust among stakeholders and promote proudness of the ecological values in the landscape.

”

What if we could fashion a restoration plan that grew from understanding multiple meanings of land? Land as a sustainer. Land as identity. Land as grocery store and pharmacy. Land as connection to our ancestors. Land as moral obligation. Land as sacred. Land as self.
(Kimmerer, *Braiding Sweetgrass*, 2013, p. 337).

Resumé, DA

Som en konsekvens af de gensidigt forbundne globale kriser med klimaændringer og tab af biodiversitet har FNs generalforsamling dedikeret det nuværende årti til genoprettelse af økosystemer. Disse prioriteter findes sideløbende med behovet for at huse, brødføde samt sikre beskæftigelse, indkomst og velfærd for en voksende global befolkning. På grund af de komplekse udfordringer i forbindelse med moderne genopretning af økosystemer er emnet for denne TemaNord publikation multifunktionel økologisk restaurering. I denne rapport, er seks Nordiske økologiske restaureringsprojekter med en multifunktionel tilgang blevet vurderet på et organisatorisk-niveau, med det formål at vurdere projektstrukturer og -forvaltning. Dette danner et overblik over vellykkede projekter, værktøjer og retningslinjer for deres implementering, samt policy-anbefalinger, der kan understøtte nye genopretningsprojekter og politik inden for feltet.

Policy-udvikling skal identificere synergier og trade-offs mellem genopretning af økosystemer og samfundsmæssige udfordringer. Det kræver policy der er gensidigt støttende og ikke prioritere succes inden for et domæne på bekostning af et andet. Løsningerne skal være multifunktionelle. Dette stiller politiske beslutningstagere, administrationer såvel som virksomheder og civile repræsentanter over for store udfordringer. Ikke desto mindre er et multidimensionelt perspektiv en uundværlig forudsætning. Multifunktionalitet er nødvendigt for at løse opgaven om at beskytte og genoprette økosystemer, samtidigt med vores jord skal rumme og nære fremtidige generationers befolkningstilvækst.

Dette katalog repræsenterer en bevidsthed om behovet for at adressere sammenhængen mellem forskellige dimensioner i restaureringen af økosystemer. Kataloget er et bidrag til at identificere og præsentere relevante case-historier og deres værktøjer, metoder og retningslinjer. Det er vores håb, at case-historierne og retningslinjerne kan inspirere, stimulere og understøtte mange nye restaureringsprojekter i Norden.

Casestudier

Seks nordiske cases er blevet vurderet for at skabe et overblik over succesfulde projekter, værktøjer og retningslinjer for deres implementering, samt at skabe et sæt af policy-anbefalinger, der kan understøtte nye genopretningsprojekter.

Vurderingen af cases baseret på det metodiske grundlag i International Union for Conservation of Nature's (IUCN) globale standard for Nature-based Solutions (NbS), som omhandler det organisatoriske niveau af projekter, evaluering af projektstrukturer og -ledelse. Ifølge SER's International Standards for Practice of Ecological Restoration anvendes udtrykket økologisk restaurering bredt. De seks cases i denne rapport adskiller sig derfor meget og repræsenterer lokale, kommunale, regionale og nationale restaureringsprojekter samt forskellige kontekster med bred geografisk fordeling. Tre af case-projekterne administreres af

statslige myndigheder, et projekt er en administrativ underenhed af kommunen, et projekt er et partnerskab mellem videnskabelige institutioner, og endelig er et andet projekt igangsat og drevet hovedsageligt af en gruppe oprindelige folk.

Vurderingen af de valgte case-historier fandt at: Det lykkedes for projekterne at implementere processer for øget økologisk tilpasning og modstandskraft. Dette grunder i en udbredt tendens til at definere en række restaureringsmål, midlerne til indfrielsen af mål, udviklingen af overvågnings- og evalueringsplaner og at adressere behovet for at basere projektstyring på trial-and-error-processer og iterativ læring. To kriterier blev forsømt: 1) integration med andre projekter, samtidig med at man søgte synergier på tværs af sektorer, og 2) identificering af risici og risikostyring. De valgte cases var også meget vellykkede inden for biodiversitetsdimensionen. Dette skyldes, at der i projektet er en stærk tendens til at identificere årsagerne til ødelæggelse af økosystemer, at opstille klare og målbare resultater af bevarelse af biodiversitet, samt rigid overvågning og evaluering. Processer som omfatter klimaforbedrende tiltag, involvering af interessenter og socioøkonomiske fordele er repræsenteret i casestudierne, men sammenlignet med biodiversitet repræsenterer de områder for forbedring.

Denne rapport fremhæver primære udfordringer og succeser med at planlægge og implementere genopretning af økosystemer på projektniveau i Norden og i Arktis (se kapitel 6 for flere detaljer). Desuden giver denne rapport, baseret på casestudierne og suppleret af et akademisk ekspertpanel, inspiration til hvordan de nordiske lande kan integrere genopretning af økosystemer i national politik og handlingsplaner, der omfatter bevaring og styrkelse af biodiversitet, afbødning af klimaændringer og socioøkonomiske udfordringer.

Nordiske politiske anbefalinger

Baseret på de seks casestudier konkluderer denne rapport følgende ti politiske anbefalinger (se kapitel 8 for detaljer).

1. Frem partnerskaber i forbindelse med økologiske restaureringsprojekter, for at minimere videnshuller, forbedre finansieringsmuligheder og forbedre modstandsdygtighed.
2. Inkluder moderne standarder for multifunktionalitet i kriterierne for finansiering af økologisk restaurering.
3. Frem tæt kontakt mellem projekter, myndigheder og offentlige destinationer.
4. Udvikling af multifunktionelle omfordelingsordninger for grundejerskab.
5. Udvikling af nordiske værktøjer til vurdering af langsigtede samfundsøkonomiske fordele på nordisk politisk niveau.
6. Læg vægt på sociokulturelle undersøgelser og tilgange.
7. Opdater eksisterende monitoreringsplatforme, og gør dem mere brugervenlige og tilgængelige for interessenter.
8. Del viden på alle niveauer, og uddan folk i moderne praksis for genopretning af økosystemer på det operationelle niveau.
9. Styrk bottom-up tilgange.
10. Kræv samarbejdsevner i projektgruppen, opbyg tillid blandt interessenter og frem stolthed omkring landskabernes økologiske værdier.

1. Introduction

Urged by the mutually linked global crises; climate change and the loss of biodiversity, the present decade has been dedicated to Ecosystem restoration by the United Nations General Assembly. 2030 has been identified as the last chance to avert the catastrophic climate change.

The United Nations sustainable development goals outline the urgent need to combat climate change, protect, and restore biodiversity and ecosystems. These priorities co-exist with the need to house, feed and secure employment, income and human wellbeing to a vastly increasing global population. In some cases, meeting the need of an increasing population accelerates the existing drivers of biodiversity loss, hereunder land-use change, non-sustainable use of natural resources, the increase in invasive species, and pollution. Modern ecosystem restoration faces complex ecological and socio-economic challenges.

The complexity and interrelatedness of ecosystem degradation drivers requires a more than sector-specific policy development and action. Policies need to identify synergies and trade-offs between ecosystem restoration and societal challenges. They must be mutually supportive and not prioritise success within one domain at the expense of another. Solutions need to be multifunctional. This poses immense challenges on policy makers, administrations, as well as corporate and civil agents. Nonetheless, this multidimensional lens is a *sine qua non* if we are to sustainably succeed in reversing current levels of degradation of ecosystems, and instead safeguard and restore our base for existence while accommodating and feeding the population growths of future generations.

The topic of this TemaNord publication is multifunctional ecosystem restoration. The aim is to assess five Nordic multifunctional ecosystem restoration projects and create an overview of successful projects, tools and guidelines for their implementation and policy options that can support new restoration projects and policy. The assessment of the cases is supported by the International Union for Conservation of Nature's (IUCN) global standard for Nature-based Solutions (NbS), which addresses the organisational level of projects, evaluating structures and project management.

The term ecosystem restoration is defined as "a process of reversing the degradation of ecosystems, such as landscapes, lakes and oceans in order to regain their ecological functionality; in other words, to improve the productivity and capacity of ecosystems to meet the needs of society." (UNEP, 2019). Found in the restorative continuum from SER's International Standards for the Practice of Ecological Restoration, the term is used broadly, enclosing the restorative actions of reducing societal impact on ecosystems, improving the ecosystem management, repairing ecosystem functions, initiating native recovery, partially recovering native ecosystems, and fully recovering native ecosystems.

Based on the assessment of the six cases, the report will highlight the main challenges and successes of planning and implementing ecosystem restoration at the project level in the Nordic and Arctic region. Furthermore, this report will discuss how the Nordic countries can integrate ecosystem restoration in national policy and

action plans considering conservation and the strengthening of biodiversity, climate change mitigation and socio-economic challenges.

It is important to stress that this publication is not as such an attempt to provide a scientifically adequate and complete answer to the questions posed. Rather, it represents an awareness of the need to address the interlinkages between the various dimensions of ecosystem restoration while underlining the socio-economic dimensions, and a contribution towards identifying and presenting relevant case stories and their contextualised tools, methods, and guidelines. With this catalogue it is our hope that the cases and guidelines may inspire, stimulate, and support many new and multifunctional restoration projects in the Nordic region.

2. Background and context

2.1. Nature and Humans in coexistence in the Nordic countries

Ecosystem restoration projects are depending on local and regional natural conditions and historical land use. In the south of the Nordic region, comprehensive and intensive agriculture and human settlements takes up a large part of the landscape. Restoring ecosystems to a natural reference state in this anthropogenically impacted context may not always be possible. However, it is possible to recover key ecosystem functions and construct solutions for societal challenges through ecological engineering. Contrary to the southern agriculturally defined areas, the cause of ecosystem degradation in the middle and northern regions stems from large-scale forestry resource extraction, mining, and hydropower. Due to harsh environmental conditions and high costs, restoration projects in the arctic are challenging (Halldórsson, G., 2012). As with the physical conditions, cultural aspects are also varying a lot depending on the natural environment they are responding to. For example, the Sámi people, living in the arctic regions of Scandinavia and the Kola-peninsular in Russia, are depending on natural resources for their livelihood, cultural values, and indigenous identity.

An Icelandic study has identified the strongest drivers for initiating ecosystem restoration in a historical context. Although this is seen in an Icelandic context, it is believed to illustrate the motivation in a broader Nordic context. In most of the 20th century, socio-economic development has put an increasing pressure on ecosystems, motivating a corresponding rise in ecological restoration. As the numbers and diversity of drivers increased with time, the relative importance of these provision drivers decreased. Moral values and construction of hard infrastructure became strong motivators for ecological restoration in the 1960s and 1970s. In the 1990s, as the importance of recreation and nature conservation increased, the United Nations Climate Change Convention was a driver on ecosystem restoration (Aradóttir, 2013).

2.2. Ecosystem restoration revisited

Traditional restoration projects tend to have a narrow focus on isolated biological objectives such as planting and seeding native species, restocking fish populations etc. Biological aims were inclined to focus on improving individual species conditions. In some cases, the focus on the individual is still highly relevant, but the aim of these conventional activities had little focus on restoring broader ecological processes and solving several other societal challenges (Aradóttir & Halldórsson, 2011). In EU, ecosystem restoration projects have broadened the scope to consider specific habitat types, such as the restoration of protected habitats and species under the Habitat Directive (92/43/ECC) (Maes et al., 2012).

In the recent years, many restoration projects, such as the Landscape Rewilding Programme in Finland and Rewilding Europe initiative including the Swedish Lapland project, have expanded their scope to restoring habitats at the landscape level. Working on the scale of landscapes provides opportunities to restore ecosystem

gradients, with the potential of achieving a diverse range of interactions between ecosystem processes. When expanding the scope and scale of the restorative initiatives, this inherently affects more actors and stakeholders in the processes and outcomes. Today, it is not only important to deal with biological diversity, but we also need to consider stakeholder diversity and embed ecosystem restorations in society and vice versa.

Ecosystem restoration projects are moving towards a more integrated view between ecology and society. The concept of ecosystem restoration has developed into a more multifunctional approach solving several societal challenges in one initiative and improved environmental quality. Multifunctional ecosystem restorations include enhancement of native biodiversity and ecological integrity, increased ecosystem resilience, and the promotion of human well-being (Halldórsson, G., 2012). Ecosystem restoration projects have also been identified to be able to produce socio-economic benefits like job –creation and ecotourism, and to support sustainable development. Dealing with an increasing number of societal interests such as human well-being while maintaining natural ecosystems and processes generates trade-offs in the relation between the natural world and human society in the form of different ecosystem services. Navigating these trade-offs can be a great challenge (King, 2015). Large-scale restoration projects have demonstrated how ecological functioning can be improved in order to sustain both human well-being and biodiversity. The framework of ecosystem services provides a tool for identifying restorative intervention types. This can be used to target the different forms and degrees of degradation and to reach goals of ecosystem functioning and services for humans more effectively (Alexander et al., 2016).

The capacity of a landscape or ecosystem to provide multiple socio-economic and ecological benefits to society is referred to as multifunctionality. (Hölting, 2019)

2.3 Social science and the environment – a summary

In the human and social sciences, the quest for breaking with the ontology of the Cartesian dualism of mind/matter, culture/nature etc. and rethinking human agency in ecosystemic terms picked up speed after World War II, particularly in US anthropology, where the concept and methodology of cultural ecology was introduced, understanding cultural change in terms of adaptations to the environment (Steward, 1955:30–42). Criticised, however, for its environmental deterministic framework, efforts soon moved into ecosystemic approaches with much more processual thinking (Rappaport, 1968, 1979; Moran 1990) combined with general systems theory, cybernetics, and epistemology (Bateson 1972, 1979). This ecological turn in anthropology merged with similar trends in geography, sociology, and other disciplines condensing into the field of Human Ecology, an interdisciplinary approach to humans and their relations with the natural environments (Tengström, 1985; Dyball and Newell, 2015; Hornborg and Pálsson, 2000). The American geographer Carl O. Sauer, a fierce critic of environmental determinism,

simultaneously developed the idea of cultural landscapes as a phenomenological approach to geography and became highly influential in the formation and development of Human Ecology (Sauer, 1925, Denevan, 2009).

The need to address the global environmental and climate problems pushed human ecology to embrace political science and political economy in order to incorporate the structures of power in the analyses and not least in applied science and policy development. Thus, political ecology was born, a multidisciplinary approach with no settled paradigms and in constant development and transformation since its initial formation in the 1970s (Bryant, 2015; Dove and Carpenter, 2008; Peet, Robins and Watts, 2011; Robins, 2012). One tentative definition of political ecology sees the field as "the study of manifold constructions of nature in the contexts of power (Hvalkof and Escobar, 1998:426) aiming to understand and participate "in the ensemble of forces linking social change, environment, and development" (Escobar, 1996). Informed and inspired by the general framework of political ecology, numerous ethnographic studies of conservation, land use, and natural resource management have been published and used in policy development (Biersack and Greenberg, 2006), generally embracing the concept of "multifunctional ecosystems".

The proposal in 2016 by earth scientists to label a new geological time unit, the Anthropocene, for the current epoch (British Geological Survey <https://www.bgs.ac.uk/geology-projects/anthropocene/>), characterised by unprecedented anthropogenic planetary disturbances and cataclysmic loss of biodiversity, greatly motivated the scholars of multiple disciplines within environmental research to search for solutions (Salasiewicz et al., 2017). "The Anthropocene is also a political label designed to call attention to this change and evolving notions of agency and responsibility in contemporary life" (Moore, 2015:1). One of the responses to this, with particular relevance for the present study, is *multispecies ethnography*. Multispecies ethnography refers to a more-than-human or other-than-human approach to ethnographic research rapidly gaining foothold in environmental anthropology and related fields. It attempts to go beyond anthropocentric thinking and dualist ontologies and recognise the agency of nonhuman species (Locke, 2018). "The term is deployed for work that acknowledges the interconnectedness and inseparability of humans and other life forms, and thus seeks to extend ethnography beyond the solely human realm." [...] "pointing to the meaningful agency of nonhuman others, and to highlight the intersections between ecological relations, political economy, and cultural representations" (Münster and Locke, 2015).

All the Nordic countries have research programmes in several universities and independent research institutions, focusing on the themes and approaches mentioned. This has not only been manifested in terms of the conceptual and theoretical development, but also in more tangible contributions to environmental and natural resource management, grounded in empirical research and cases, often embracing cross-disciplinary approaches. Although studies within human ecology, political ecology and multispecies ethnography have focused mainly on scenarios and cases in the global south or outside Europe, scholars of the Nordic countries are showing an increasing interest in their own region, including the Arctic (cf. e.g. Bubandt and Tsing, 2018; Swanson, 2017, 2018, 2019, 2020; Thyrsted Laursen, 2022; Christensen, 2019).

3. Approach and methodological considerations

The selection of cases is underpinned by the imperative of multifunctionality. Ecosystem restoration projects eligible for this report will thus be scrutinised for their success rate along these seven dimensions identified as being important aspects of multifunctional ecosystem restoration:

1. Biodiversity
2. Climate mitigation
3. Socio-economic benefits
4. Sustainable land management
5. Stakeholder involvement
6. Knowledge sharing and policy facilitating
7. Synergetic adaptation and increased resilience

In the assessment, focus will be on the extent to which processual tools and guidelines are used in both implementation and monitoring of the seven dimensions. An overview of the dimensions used in the investigation of the six cases are provided below. For more detailed information, see the IUCN Global Standard for Nature-based Solutions (IUCN, 2020).

3.1 Preselection of cases

The selection of cases has been carried out in two steps. First, compiling an initial gross list of projects that meet the selection criteria of representability in three different ways; a) a geographical wide distribution across the Nordic countries, b) a range of non-overlapping ecosystems and contexts, c) completed and successful projects.

3.2 Literature search

Second, a search for project materials was undertaken through several methods of literature search as following below. Open search for studies within the overall field of ecosystem restoration was the gateway to many potential projects. Further screening was done according to the selection criteria. Search engines such as google scholar were used to find studies mentioning concrete projects. A list of searching keywords has been developed during this process for use in the further search. Citations were tracked and used in a snowballing effect to find more studies and projects related specifically to multifunctional ecosystem restorations in the Nordic countries. To ensure the geographical representability, an additional search for restoration projects was carried out country-by-country. Several types of materials were included in the assessment, including project descriptions, annual reviews, scientific studies, and communication materials.

3.3 Scoring cases for final selection

Based on the material from the literature search, each case was scored (1–3) on each of the seven dimensions. Score 1: Dimension not mentioned in relation to the case. Score 2: Dimension not mentioned directly but can be interpreted to be present. Score 3: Dimension mentioned with concrete examples of implementation.

Finally, total scores across all potential projects were compared, and the six highest ranking cases were selected for interviews. It was anticipated that it would be difficult to find cases sufficiently exhibiting or having documented results on all dimensions. Therefore, the presence of three dimensions – biodiversity, climate mitigation, and socio-economic benefits – was prioritised in the selection of cases.

3.4 Interviews

Upon case selection, a sample number of cases were visited on site, and associated key stakeholders were interviewed. For cases not visited, virtual meetings were held to interview key project staff.

Interviews with project managers and scientists were conducted for all six cases. In the planning stage of the interview process, the organisations responsible for the respective cases were contacted with a request for an interview with the relevant stakeholders, such as project managers, scientists, and volunteers. Three interviews were conducted online, and the other cases were visited physically (See figure 4 for a map overview).

	Interviewees	Online interviews	Physical visits
Vattenriket Biosphere Reserve (Sweden)	Project manager, various project staff, and municipal tourism manager		X
Näätämö Watershed (Finland)	Project manager/scientist	X	
Hekluslógar (Iceland)	Project manager, municipal employees, and two local stakeholders		X
Light & Fire (Finland)	Two project managers and one scientist	X	
Lille Vildmose (Denmark)	Project manager and manager of the local visitor centre		X
Fjordkalk (Norway)	One scientist/project staff	X	

Table 2. Showing who participated in interviews and how case studies were conducted.

An interview guide based on the seven mentioned dimensions was created using the criteria from IUCN's Nature-based solutions standard - a process which is described in the next paragraph. The interviews were semi-structured in the sense that all questions in the interview guide received attention, but the structure and time spent on each answer was individual to each case. This flexibility allowed an interview process able to ask follow-up questions, ensuring that each topic was sufficiently answered. During the interview, answers and key points were noted for each criterion. All online interviews were recorded for internal referencing.

The online interviews were conducted as group interviews, with project managers and scientists as participants. Each interview took between ca. 1,5 and 2 hours. For Näätämö Watershed (Finland), a project manager/scientist from Snowchange was interviewed. An appointment for an interview with a person within the project representing the Sámi was also attempted but was not successful. The Light & Fire (Finland) project was represented by two project managers from the Finnish forest department and a scientist. Fjordkalk (Norway), was represented by one scientist who also acted as project staff. In Kristianstad Vattenriket Biosphere Reserve (Sweden), in-person interviews were conducted, and the case was represented by the Biosphere Office including the project manager, project staff and the tourism manager of the municipality. In Hekluškógar (Iceland), in-person interviews were conducted, and the case was represented by the project manager, a municipal employee, and two local stakeholders. In Lille Vildmose (Denmark), in-person interviews were conducted, and the case was represented by the project manager and the manager of the local visiting centre.

3.5 Framework for analysing and evaluating cases

IUCN's Global Standard for NbS was chosen as the underlying analytical framework due to its ability to address a broad range of topics such as society, economy, biodiversity, and resilient project management, while also including a sustainable land management perspective. Other evaluation standards such as SER's International Principles and Standards for the Practice of Ecological Restoration, were also considered. However, Global Standard for NbS identified as most compatible with the project parameters.

A methodological framework based on the IUCN's Nature-based solutions (NbS) standard (IUCN, 2020) was developed to analyse and evaluate the five cases along the seven dimensions. NbS prioritises leveraging the potential of single interventions to provide multiple benefits, thus making this approach suitable for analysing multifunctional restoration projects. As an umbrella concept, NbS covers several different ecosystem-based approaches where human needs are placed in the centre of biodiversity management. The standard can be used by both local and national governments, and in a wide range of contexts spanning from protected areas and production landscapes to the urban environment.

The NbS standard is developed by the IUCN to provide a global framework for designing, verifying, and scaling up NbS and thereby measuring the strength of such initiatives. The standard is applicable in both small-scale and large-scale interventions and is therefore following the needed variation of the selected cases to illustrate different contexts and scales.

The NbS standard is structured through eight main criteria consisting of a total of 28 indicators. The eight criteria include: Identifying societal challenges, design at scale, biodiversity net gain, economic feasibility, inclusive governance, adaptive management, mainstreaming and sustainability. The 28 indicators were re-organised and structured to fit the seven dimensions. The indicators for biodiversity net gain were adjusted to also fit the dimension of climate mitigation, as its focus is not on specific targets, but rather the process behind the benefits. The table below shows a general overview of the NbS criteria content included in each dimension, for more details see The NBS standard guidance (IUCN, 2020):

Dimensions	NBS indicators included
1) Biodiversity	Includes measures of evidence-based assessments of the state of ecosystems and identification of prevailing drivers of ecological degradation. Biodiversity outcomes should be identified, benchmarked, and periodically assessed. The assessment should also include unintended adverse consequences arising from the project as well as revealing opportunities to enhance connectivity and ecosystem integrity.
2) Climate	Includes measures of evidence-based assessments of the state of ecosystem functioning on climate and identification of prevailing drivers of degradation of climate-related ecosystem functioning. Climate outcomes should be identified, benchmarked, and periodically assessed. The assessment should also include unintended adverse consequences on climate arising from the project as well as revealing opportunities to enhance carbon sequestration and storage.
3) Socio-economic	Reveals how the project has achieved socio-economic benefits for society by identifying the most pressing societal challenges and incorporate these into the project strategy. Right holders and beneficiaries should be identified as well as the documentation of the direct and indirect costs and benefits for these forming cost-effectiveness studies that can be used for supporting decisions and for comparing alternative solutions.
4) Sustainable land management	Provides examples on how the project acknowledges and responds to the interaction between nature, society, and economy.
5) Stakeholder involvement	Describes the project governance arrangements and how these are acknowledging and involving concerns of stakeholders and supporting their rights. Good governance structures ensure that stakeholders which are directly or indirectly affected have been identified and involved in the project's processes and that feedback mechanisms are set up and available for stakeholders.
6) Knowledge sharing and policy facilitating	Provide insights on how project design, implementation and lessons learnt are informing best practice to other restorative projects and support mainstreaming of these within a jurisdictional context. An explicit contribution to relevant national and global targets for biodiversity, climate change, human well-being and human rights is part of the assessment as well.
7) Synergetic adaptation and increased resilience	Includes assessment of risk management, monitoring and evaluation plans, frameworks for iterative learning, and whether the project has been integrated in ways which seek synergies across other sectors.

Table 3. An overview of the NbS criteria re-organised into each dimension.

In general, the original 8 criteria of the NbS standard are process-oriented, and the analysis will therefore provide information about tools and guidelines that can be replicated in other new ecological restoration projects regarding their context and specific biological, climate and socio-economic goals. The selected cases are assessed on the extent to which they contribute to each indicator following a four-grade traffic light system. By giving each grade a descriptive and guiding text, this tool is aiming to deliver a transparent assessment of processes behind generated beneficial outputs, but it will also reveal challenges of the cases.

Strong (3)	Adequate (2)	Weak (1)	Insufficient (0)
Addressed and implemented fully	Addressed and implemented partially	Addressed but only implemented with minimal impact	Not addressed nor implemented

Table 4. Four-grade traffic light system with a descriptive assessment guidance.

The case studies will reveal how and to what extent the processes and organisational structures of an ecosystem restoration project are meeting the criteria of a NbS in terms of implementation and monitoring. This will be visible within each dimension as well as an overall assessment of the case. Information will be extracted from individual cases and a conclusion will be drawn by finding common characteristics across cases with the purpose of forming final policy options.

The method used in this report is not focusing on specific targets, but rather the process behind the outcomes. The success of each case is therefore an assessment of how well the project was organised and structured to fulfil the criteria of the NBS standard.

3.6 Policy options

Relying on the results from the case study analysis and experts’ input, the policy options presented in this catalogue will provide policymakers with examples of successful projects, tools, and guidelines in restorative interventions in order to support policymaking in the field of restorative multifunctional interventions. Based on the IUCN NbS standard, the policy options will also contain best practices of how to handle planning and implementation processes. These practices are applicable across countries, contexts and habitats, as they are concerning a wide range of processual issues rather than focusing on context-specific outcomes. Furthermore, the policy options should also be inspirational for planners and stakeholders wanting to initiate new multifunctional ecosystem restoration interventions that meet the standard of nature-based solutions.

4. Introduction to case studies

Six case studies from five Nordic countries are presented in this report. Information about the process for case selection and analysis can be found in chapter 3, Approach and methodological considerations. The investigation of cases has relied solely on existing information, thus no field data collection has been carried out. Due to the COVID-19 situation as well as harsh weather conditions in the arctic, planned physical visits were cancelled. Instead, online-interviews were carried out.

Three of the case projects are administrated by state authorities, one project is an administrative sub-unit of the municipality, one project is a partnership between scientific institutions, and finally another project is initiated and driven mainly by a group indigenous people. The cases differ much and represent local, municipal, regional, and national restoration projects as well as different contexts. The scope of this investigation was to include a wide range of context and broad geographical distribution. In the search for restorative cases with a multifunctional approach, a higher number of projects was identified in the southern parts of the Nordic countries than in the mid and northern part, which is also reflected in the geographical distribution of cases.

All the cases have reached their official projects' end date, but this does not mean that all project actions are ended. In some cases, the actions are continued in form of management plans or in other forms. In other cases, the projects are seen as a continuing process of sustainable land management reaching into the future, and another project is relying on natural regeneration after the restorative actions have been carried out.

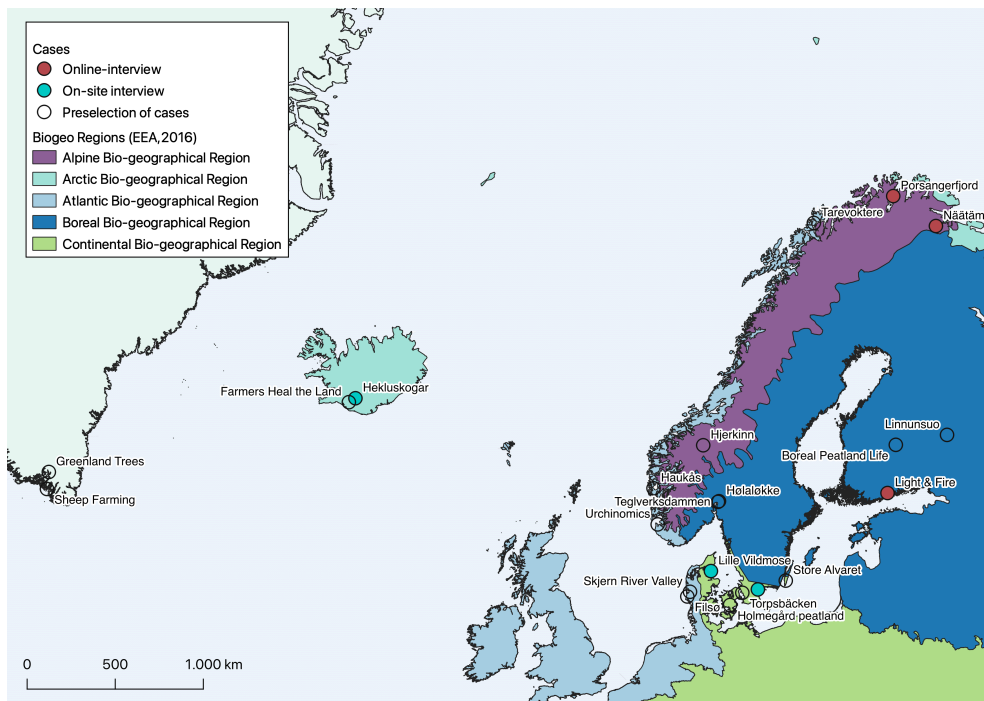


Figure 4. Map of biogeographical regions in the Nordic countries showing the gross list of preselected cases' geographical distribution and the final selection of case visits and online interviews.

Case	Location	Project area	Project period	Administrative unit
Vattenriket Biosphere reserve	Sweden	100.000 ha	2016–2020	The Biosphere Office under the municipality of Kristianstad
Näätämö collaborative river restoration by indigenous groups	Finland	296 ha	2017–2019	The Skolt Sami, indigenous people, Snowchange
Heklusoggar forest restoration in co-operation with landowners	Iceland	100.000 ha	2007–2021	The Icelandic Forest Service, The Soil Conservation Service of Iceland
Light & Fire restoration of sunlit habitats by volunteers	Finland	841 ha	2014–2020	The Finnish Forest Agency
Lille Vildmose, restoration of raised bog, with recreational and climate mitigating benefits	Denmark	7600 ha	2011–2020	The Danish Nature Agency
Restoration of kelp forest in Porsangerfjorden	Norway	1877 ha	2005–2016	Norwegian Institute of Marine Research

Table 5. The projects represented in the case collection and their details.

5. Case studies

5.1. Kristianstad Vattenriket Biosphere Reserve, Sweden – "Benefiting nature and people"

Location: Scania, Sweden

Project period: 2005–ongoing

Total area: ~100.000 ha

Administrative unit: The Biosphere Office, under the municipality of Kristianstad



Figure 5. The Naturum visitor centre in Vattenriket located in the restored wetland area, close to central Kristianstad. Photo credit: Kristianstad Municipality/Claes Sandén.

Introduction

This case story describes how the UNESCO Biosphere Reserve called Vattenriket (The Water Kingdom) of Kristianstad has achieved a myriad of benefits by creating a strong relationship between human and nature through a co-adaptive management approach.

The designated areas of Vattenriket are covering two thirds of the municipality of Kristianstad. The landscape is rich in cultural values but is also gifted with nearly all type of natural habitats that can be found in Sweden.

The work of ecological restoration and a focus on changing attitudes towards natural values in Kristianstad started before the area was designated as a Biosphere reserve. The wetlands along River Helge Å have been grazed since the withdrawal of the last ice age. In the 1980's, when grazing practices were no longer profitable, large grazers disappeared from the landscape, and the wetlands were starting to get overgrown. At that time, the wetland area contained a local landfill that threatened many water values and was generally perceived as a waterlogged problem area that should be dug out. But a biologist, employed at the county museum, saw the potential for restoring the wetland ecosystems that had been a result of millennial grazing. He then started to organise farmers, authorities, and nature conservation organisations so that they could work together for a healthy ecosystem providing various benefits for Kristianstad and its citizens (Schultz & Treijs, 2021).

In the process, he contacted several partners and asked about what they needed in order to continue to support the restoration of the land. Steadily the city's adjacent wetlands became an asset for the city, and the Municipal of Kristianstad saw the opportunity to take part in the project when asked about possibilities to establish a water kingdom that would put Kristianstad at the world map. A one-year project was launched by the municipality to restore the wetland and build visitor sites such as an outdoor museum and a nature school. This project developed into a permanent activity.

In time, this changed the population's general perception of the wetland, from a waterlogged problem area to a flourishing valuable natural resource. The cleaning of the local landfill created better conditions for wildlife, and at the same time this made room for a visiting centre established with minimal impact on nature.

Case background

In 2005, UNESCO designated Vattenriket as a biosphere reserve. At the same time, Vattenriket was included in the 'Man and Biosphere' which is a UNESCO Biosphere reserve program, to be recognised as one of the best examples in the world of how the nature-human relationship can work. This was the beginning of the creation of a more official branding of Kristianstad as a city that has a strong relationship between humans and nature in the area.

When the reserve was designated, River Helge Å was yet a central feature in the focus of their work, but later and up to now, the project turned its attention to other habitats in the landscape, like the sandy grasslands, countryside close urban areas,

dune landscapes, the Hanöbukten Bay and more. The reserve is in fact covering two thirds of the municipality and the work is now naturally addressed from the landscape perspective. The work of Vattenriket is aiming to fulfil the criteria of UNESCO's Biosphere Programme:

1. Identifying ten theme areas of high natural value, based on ecosystems in the landscape and cultural land uses. In the theme areas, Vattenriket has worked to integrate conservation, development, and logistic support, and these are now guiding the land management in close collaboration with stakeholders. Concurrently, the project has aimed to raise the level of knowledge about cultural and natural values in the landscape by drawing on knowledge from successful development projects with various partners, nature interpretation and dissemination in visitor sites.
2. In order to promote and coordinate the work of Vattenriket, an administrative unit called the Biosphere Office and Naturum Visitor Centre have been established under the Municipal Executive Office for Kristianstad Municipality.
3. Making nature more accessible. The Naturum visitor centre has been built as a signpost for Vattenriket for people to explore the nature and learn about the landscape values of Vattenriket. The visitor centre is also an important meeting place for stakeholders involved in the project.

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Biosphere reserves are 'learning places for sustainable development'. They are sites for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity.
(UNESCO, 2022)

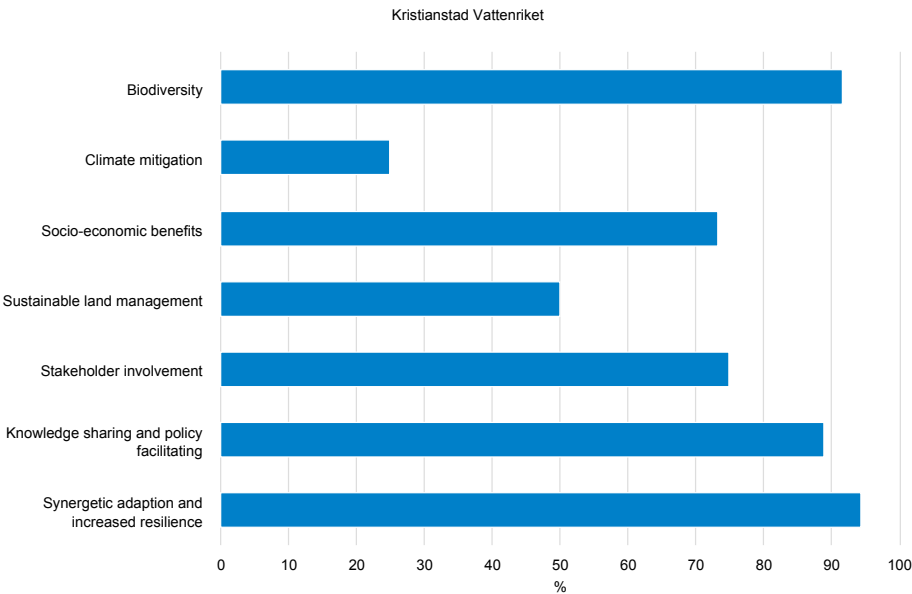


Figure 6. Vattenriket's score across the seven dimensions in percentages.

Biodiversity

The Biosphere Office's work is founded in evidence-based decision making. The Biosphere Office is continuously collecting and reviewing new information regarding natural assets, protection, and management methods. From gathered information, the brownification of River Helge Å and decline of wading birds have been identified as major ecological challenges across intervention boundaries.

One central theme has been the restoration of degraded wetlands. Today the area hosts the largest area wet grasslands used for grazing and haymaking in Sweden, app 2000 ha. This is an increase of 500 ha since the work began in 1989. Many new wetlands have been created in recent years in the cultivated landscape to remove nutrients from the water, even out water flows and promote biodiversity. Approximately 250 hectares of wetland have been created and today the work is continuing by restoring around 25 hectares each year.

Furthermore, awareness and implementation of measures have been increased by collaborating with landowners for the purpose of investigating the consequences of brownification in River Helge Å. Water quality and the return of wading birds are some of the monitoring measures that are used to evaluate the restoration efforts.

The work in Vattenriket is addressed through the scope of ecosystem services. An initiative on Natura-2000 areas, called unique sandy grasslands, is aiming to conserve bio-cultural remnants of human use in their landscape. The sandy grasslands are managed though a landscape-based approach and are planned and carried out in several different cultural land use scenarios, including pine forests, agricultural landscapes, roadsides, private gardens and golf courses. Thus, the Biosphere Office is working with various partners to manage these sandy grasslands, and here involvement and participation are the key to success. For example, practical nature management techniques are taught to school children in an interdisciplinary approach by ecologists, and educators and garden owners are encouraged to safeguard their natural values.



Figure 7. Restoration of sandy fields which have been made in collaboration with neighbours and school classes. Credit Habitats.

Site-specific management is organised through smaller nature reserves, having their own local management and cooperation plans. In these reserves, both conservation and restoration actions are carried out. A wide range of biophysical measures and species counts are included in the monitoring of initiatives in Vattenriket. In general, the reserve has started to provide increasingly more information on the subject of threatened species. Follow-up on measures and work for Vattenriket's red-listed species are one example of comprehensive monitoring implemented in restorative projects. Abiotic sampling, species monitoring, and inventories are some of the activities carried out by local based monitoring.

The gathering of knowledge is not only carried out by officials, as collaboration with farmers and other local stakeholders are central in the work of restoring and conserving ecosystems and species in Vattenriket. One successful initiative has been the collaboration on seasonally flooded grasslands, where landowners and the county administrative board are collaborating in developing the needed knowledge to develop and manage the conservation of grasslands for threatened birds, insects, and plants. By rewetting to retain water longer, adjacent areas are also restored for wading birds.

Climate

Although climate mitigation measures have not been a part of Vattenriket's work from the beginning, derivate climate mitigating functions in rewetted wetlands have later been identified as important measures to be integrated in current and future work. The improvement of coastal ecosystem health in Hanöbukten bay due to the creation of wetlands along River Helge Å have increased the production of aquatic vegetation and algae, which have positive climate-mitigating effects.

Socio-economic

Ecosystem services that indirectly or directly benefit people and are important for human well-being have been identified in each of seven main ecosystems in Vattenriket. The analysis of ecosystem services in Vattenriket has been carried out in consultation with experts possessing local knowledge and was supplemented with existing knowledge of ecosystems in Sweden. Beneficiaries of the ecosystem services have also been identified based on primary benefits. However, the categorisation of these beneficiaries is rather general and thus not comprehensive, as the aim was to provide a simple and clear overview.

The nature areas combined with a strong branding of Vatttenriket has attracted tourists, both from the Scania region, but also from other Scandinavian countries. Since the designation as a UNESCO Biosphere Reserve in 2005, the tourism industry has expanded in the municipality of Kristianstad – particularly the number of visits that involve nature tourism and active holidays has been increasing.

Naturum Vattenriket collects and keeps detailed statistics of visitor and participation activities related to the visitor centre. Each month, these figures are provided to the Swedish Environmental Protection Agency. Qualitative interviews are made with visitors and participants with the purpose of acquiring knowledge about their motivations for showing interest in Vattenriket. In order to be able to better understand the economic effects of increased tourism in Vattenriket and its

implications for the local economy and employment, the Biosphere Office has collected a great number of interviews, which have been analysed by an external consultancy company.

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Turnover of the tourism industry in Kristianstad Municipality in 2013 exceeded SEK 860 million, representing an increase of almost 30 percent since 2005, where the turnover was just over SEK 600 million. This has resulted in new employment opportunities. Between 2005 and 2013, the number of full-time employees rose from around 600 to 750 people, resulting in higher tax revenues for the municipal authority. (Vattenriket, 2015).

Due to the work of Vattenriket Biosphere Reserve, nature areas have been restored and conserved, and recreational facilities in these areas have been improved. This has resulted in an increase in visitors, positively affecting the local economy through an increased demand in the traditional tourism sectors, such as accommodation, transport, and other commodities. Additionally, the branding of Vattenriket has also benefitted the branding of local farmers' produce. The conclusion is that Vattenriket Biosphere Reserve and Naturum visitor centre have generated – directly or indirectly – jobs and tax revenues that would not otherwise have been generated.

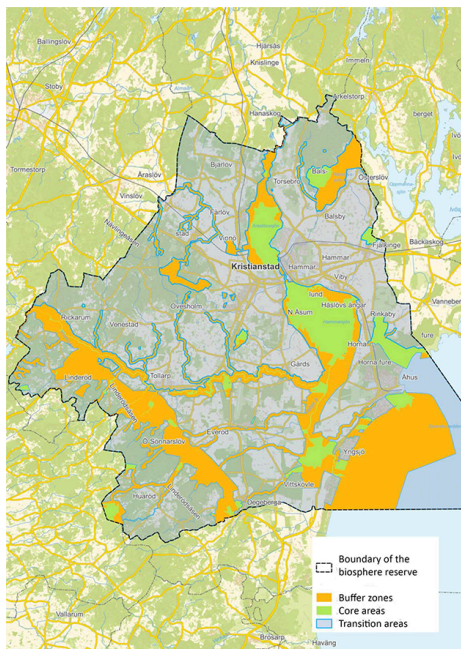


Figure 8. Topographic map showing the boundaries of The Vattenriket Biosphere Reserve designation. Source: The Biosphere Office.

Sustainable land management

The lack of natural hydrology in the catchment area is one of the main challenges in the landscape of Vattenriket. Restoring natural hydrology around River Helge Å has been identified as a viable multifunctional solution benefitting both nature and people. These benefits have been addressed through the framework of ecosystem services. Environmental aspects of increasing biodiversity and mitigating climate change are often connected with restoration of wetland, but when rewetting initiatives are carried out in collaboration with landowners, the benefit for each stakeholder is identified. As an example, communication has been aimed towards farmers that now experience benefits in the protection against flooding on arable land and production of ground water for irrigation. Increasing numbers of farmers in Vattenriket are changing to environmentally friendly cultivation methods, and some are using the brand value of Vattenriket to sell their products locally.

One good example has been an innovative wetland project where farmers and the Biosphere Office have collaborated to establish a multifunctional wetland divided in two water bodies. One water body for sedimentation of eutrophicated water that can be used for irrigation on nearby arable land, and at the same time mitigating the negative eutrophic effects on the adjacent wetland with high biodiversity value.



Figure 9. Vattenriket's staff explaining the multifunctional wetlands that is visible in the background. Credit: Habitats.

Stakeholder involvement

The work in Vattenriket is based on dialogue and cooperation with various stakeholders including landowners, organisations, associations, and authorities. The Biosphere Office is continuously trying to build trust among stakeholders. This process often starts with small scale restoration, conservation, and sustainable land management projects. As trust and cooperation between stakeholders increases, more stakeholders are included and the size of the initiative is scaled up. This method is sometimes referred to as adaptive co-management. Stakeholder involvements are mainly organised through a consultation group representing

various stakeholder groups. The consultation group is functioning as an arena for dialogue where landowners, authorities and organisations can establish contact and share knowledge across different sectors. A close cooperation between the Biosphere Office, various administrations in Kristianstad Municipality and the administrative county board of Scania, has been crucial for delivering information about recreational interest and knowledge related to the natural values of the landscape in order for the project to be included in municipal and county strategies and action plans at an early stage.

Every tenth year, a periodic review is produced in order to assess and evaluate the effects of the initiatives in Vattenriket. The recent periodic review was prepared with inputs from two workshops that were facilitated by researchers from Stockholm Resilience Centre. All stakeholders from the consultation group were participating with genders equally represented. The first draft of the periodic review was made available to the public in order to allow all persons to voice their opinions on the Vattenriket initiatives.

Vattenriket is working actively with the UN convention on the Rights of Persons with Disabilities in order to create areas of interest accessible to everyone. Accessibility is not only improved by changing physical conditions, but also comes in the shape of regular guided tours for disabled and elderly persons.

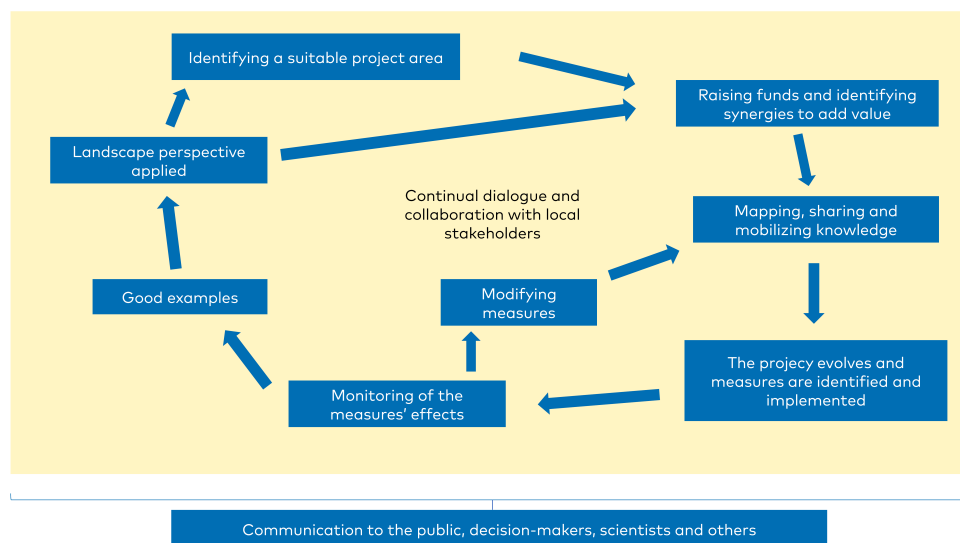


Figure 10. The management structure of Vattenriket can be described as adaptive co-management. Source: The Biosphere Office.

Knowledge sharing and policy facilitating

Vattenriket makes use of a broad palette of communication means for reaching many target groups through a numerous variety of communication channels. A comprehensive website is one of the Biosphere Office's communication tools. Furthermore, information about the work of Vattenriket is disseminated through folders and other text material in over 20 specific visitor sites. This has been essential in gaining visitors' interest in the landscape.

The positive changes in public attitudes towards the wetlands of Kristianstad is exemplified by the decision to build the Naturum visitor centre, granted by the Swedish Environmental Protection Agency and the politicians of Kristianstad.

Naturum is a meeting place for stakeholders and is often the starting point for excursions to other visitor sites – the visitor centre has from the beginning been a popular bio-cultural hub in Vattenriket. The visitor centre regularly holds lectures, provides guides and hosts cultural activities such as concerts and art exhibitions. In order to increase the general awareness of the efforts at Vattenriket and in order to create interest in the local community, the Biosphere Office have also trained biosphere ambassadors. Each year, 30 ambassadors are being trained. All these initiatives have led to the fact that the general community is supporting the work of Vattenriket.



"The long-term overall goal of the communication is to bring about a change in attitudes towards sustainable social development that is benefiting man and nature." (Periodic review, 2015)

The Biosphere Office and stakeholders are collaborating with several academic institutions and sharing their knowledge in different subject areas. Vattenriket is attracting researchers globally, and the reserve is mentioned in several international scientific journals. The collaboration with researchers and courses at educational institutions have produced valuable knowledge in a synergy, benefitting both similar projects and the Vattenriket itself in terms of research and monitoring.

Issues concerning both regionally and globally threatened species and ecosystems are targeted in the work of Vattenriket. The three main environmental frameworks used are the Natura-2000, EU bird directive, and the red list of endangered species. For example, red-listed species in Vattenriket are monitored and categorised on a global, EU and national scale.

In Vattenriket, human-wellbeing aspects are addressed through Ecosystem Services. Activities and programs of the Naturum visitor centre aim to be inclusive and benefit as many different user groups as possible. Guided tours to the nature visitor sites are popular and promote good physical and mental health. An overall target in Vattenriket is that there should be access for everyone – following the UN convention on the Rights of Persons with Disabilities. Therefore, many of the visitor sites and hiking trails have been adapted to be wheelchair friendly.



"As part of the Swedish conservation policy at a national level, the biosphere reserve has become a tool in a similar way to that of nature reserves and national parks, with the aim of achieving sustainable development." (Vattenriket periodic review, 2015)

Synergetic adaptation and increased resilience

Vattenriket has attracted many researchers who as a result are now collaborating to share evidence-based knowledge about their work. Researchers at the Stockholm Resilience centre evaluated the effectiveness of the management and coordination at Vattenriket. A study of adaptive co-management has explored the relationships between learning, collaboration, and outcomes in four biosphere reserves including Vattenriket, showing positive results for this approach. Vattenriket uses collaboration processes such as transparency, constructive debate and trust building, which have proven to have a positive impact on social and ecological outcomes. The analysis of the study also showed that individuals reported an increase in collaborations with partners with connection to Vattenriket, and that this gave a more sustainable use of resources within the reserve.



"We identified a myriad of positive results both from an ecological perspective as well as from a livelihood perspective" Ryan Plummer, lead author in the 2017 article: "Is adaptive co-management delivering? Examining relationships between collaboration, learning and outcomes in UNESCO Biosphere Reserves". (Plummer, 2017)

The Biosphere Office has built an extensive network that allows them to act as a bridge between stakeholders from local to national levels. Vattenriket has showed their capability to facilitate multi-level cooperation between stakeholders across different sectors. This is not only strengthening Vattenrikets' level of knowledge, but it has also created funding opportunities.

Vattenriket's management is challenged by a lack of continuity: stakeholders and people in general come and go. This creates the need for a continuous search for experienced and competent people as well as a need for updating people's knowledge about the initiatives at Vattenriket.

Based on monitoring results following negative impacts by both natural and anthropogenic causes on the ecosystem, focus has been adjusted in several initiatives in the conservation function.

In 2007, wet grasslands in Vattenriket were flooded with the result that farmers risked losing their EU subsidies for not having livestock on their grasslands. The Biosphere Office managed to acquire knowledge and inform authorities about the temporary problem, which ensured that the farmers were not affected financially. Further, the risk of flooding was assessed and managed, thus reassuring farmers, and the rewetting and conservation could continue.

The work in sub-projects under the ten landscape themes is blending conservation and restoration measures with development work, meaning that Vattenriket works in a transdisciplinary way in both economic, social and ecological dimensions.

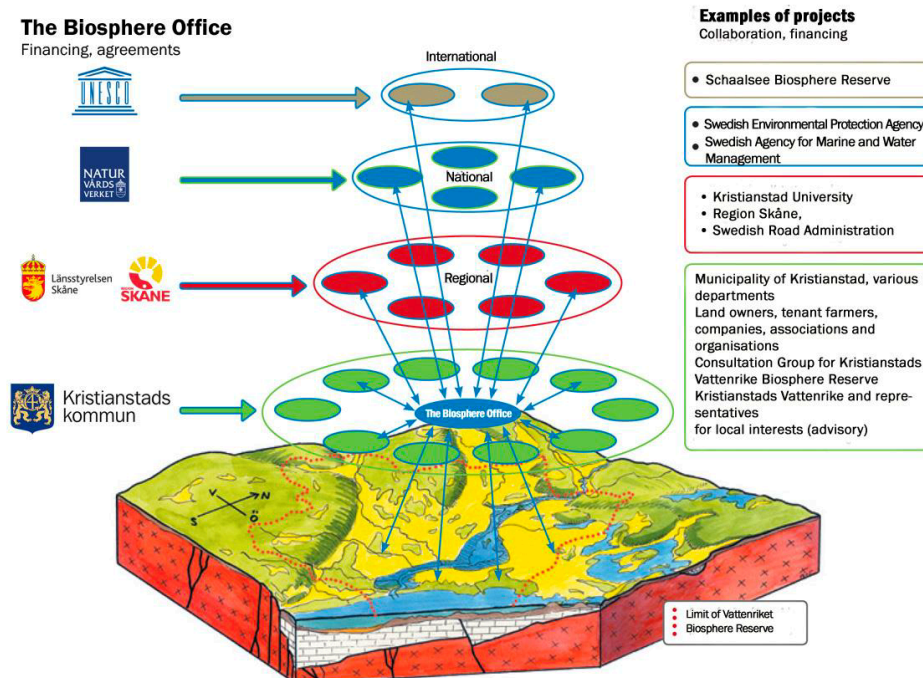


Figure 11. Model of how the Biosphere Office acts as a bridge between stakeholders at local, regional and national levels. Source: The Biosphere Office.

Conclusions

The restoration and conservation work in Vattenriket has been successful. Trust is the basis of the long-term success that happened in Vattenriket. Dialogue and cooperation together with small successful projects form larger projects.

Establishing an administrative unit and working close to the local visitor centre has been important. Dissemination of natural and cultural values of the landscape as well as the projects actions have been carried out from the Biosphere office which has ensured a strong and long-term communication strategy. With the biosphere office's placement in the wetlands, stakeholders have always been invited into the actual nature areas rather than to a centralized administration office. The visitor centre has increased the potential for collecting and sharing information about the work in Vattenriket. Municipal commitment and co-operation among other municipal departments has been crucial for the overall planning of nature in Kristianstad. Vattenriket has showed how building trust among stakeholders and changing attitudes can create transformational change towards sustainable landscapes.

Acknowledgement

Many thanks to project manager, Carina Wettemark and the project staff from the Biosphere Office in Vattenriket for participating in the interviews and for facilitating visits to selection of project sites. We also thanks to the tourism manager at the municipality of Kristianstad, Eva Berglund for taking part in the interviews and providing perspective to the case. Furthermore, the project staff has provided us with feedback and quality assurance on the case study.

5.2. Näätämö Watershed, Finland – Collaborative river restoration with indigenous people

Location: Näätämö, Northern Finland

Project period: 2011–ongoing

Total area: The river runs for ca. 50 km. in Finland, but the watershed consists of many smaller rivers, streams, and lakes, making the project area much larger.

Administrative unit: Snowchange, Skolt Sámi community, Metsähallitus – the National Finnish Forest Administration



Figure 12. Researcher Tuomo Soininen (left) and lead scientist Emilia Uurasjärvi (right) sample a lake ecosystem for microplastics, Summer 2021. Credit: Snowchange.

Introduction

For the indigenous Skolt Sámi in northern Finland, the Atlantic salmon is deeply embedded in both culture and livelihood. Climate change impacts the salmon's chance of reproducing in the Näätämö river basin by raising the water temperature, which is putting the salmon under stress during upriver migration to the spawning grounds. As a response, a research project co-managed by Skolt Sámi, Snowchange

and University of eastern Finland has since 2011 carried out monitoring and restoration of the Näättäjä river where applicable.

The Skolt Sámi are documenting the weather, water levels, salmon health, land use and biodiversity changes along the watershed. The data is reviewed monthly by researchers for the purpose of mapping how climate change is impacting the area. Through interviews with the Skolt Sámi fishermen and elders, the project has incorporated traditional knowledge of old spawning sites, current spawning sites, cultural and occupancy sites. Furthermore, reindeer herders and fishermen were equipped with digital cameras to record new or strange observations in the area.

Case background

The project was initiated in 2011 by the Skolt Sámi community. Snowchange Cooperative, a pan-Arctic non-profit Indigenous and local community organisation, has been facilitating the restoration and observational work in Näättäjä. Snowchange was founded in 2000, by Sámi, Inuit and Finnish delegates in order to seek solutions to northern climate change and Indigenous empowerment.

Since the 1950's, human activities have degraded the state of the Näättäjä watershed. It remains in relatively good condition, but the sub-catchment areas of Sevetijärvi, Vainosjoki, Kuosnijoki and Solomusjoki have been altered. Kallojoki river has been diverted for hydropower development into Norway. Resource extraction and infrastructure projects have submitted parts of the river basin to eutrophication, altered the natural flow and polluted the water. Restoration efforts have been made from 2017–2019 in the Vainosjoki and Kirakkakoski area. Here, manual relocation of boulders and rocks and the spreading of spawning gravel has restored some of the original conditions of the river. The baseline and target ecosystem information for the restoration project is a result of both traditional knowledge of spawning sites and scientific records (Mustonen, 2021).

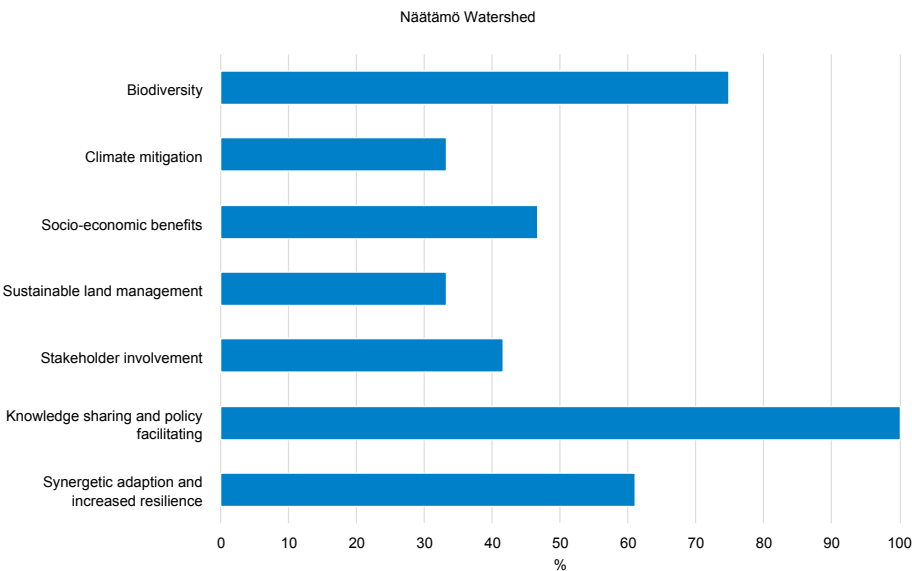


Figure 13. Näättäjä's score across the seven dimensions in percentages.

Biodiversity

The project responds to an evidence-based detection of rapidly proceeding climate change impacts, species range shifts, and algae blooms. The drivers of ecosystem degradation fall in two categories: the indirect effects of climate change raising the water temperatures, and the direct effects of human operations close to the watershed. This includes past infrastructure projects altering the river flow in different parts of the basin, deposition of pollutants, and present eutrophication and mining activities.



Figure 14. Researcher Tuomo Soininen (left), Sámi knowledge holder Juha Feodoroff and lead scientist Emilia Uurasjärvi (right), measuring microplastics in the river Silisjoki sub-catchment, July 2021. Credit: Snowchange.

As a response to these circumstances, the Skolt Sámi efforts consist of monitoring and reporting on the effects climate change has on the ecosystem they live in. The spawning and habitat areas of the Atlantic Salmon are protected by a self-imposed limitation on Sámi salmon harvest, which follows a stricter set of rules than the general state fishing legislation. Furthermore, Snowchange has engaged in conversation with state agencies and officials in order to fund and allow restoration actions. Such actions have been successful in the case of the Vainosjoki and Kirakkakoski river, where ecosystem restoration work has been carried out, addressing the damages imposed on river systems since the 1950's, but especially in 1968–72. Monitoring efforts in reporting on the success of the action have delivered some early results – mother trout have been reported on the restored spawning areas and been documented with underwater cameras. The changes are periodically tracked through a joint Sámi and research effort and are benchmarked using the traditional knowledge of the area obtained through oral interviews, and by reviewing scientific archives.

Climate

The project at Näätämö does not have a climate mitigation perspective, such as carbon storage, however the river restoration project does have focus on resilience and adaptation. The organisation Snowchange is involved in several peat restoration projects (Jukajoki), which follows the same principles for co-management and uses traditional knowledge.

Socio-economic

The project was initiated bottom-up and was initiated by a community recognition of the decreasing salmon population as a major societal challenge for the Skolt Sámi. Rights-holders and beneficiaries have been identified by mapping the traditional land and water occupancy of the Skolt Sámi. The monetary benefit of individuals influenced by the project is not calculated.

The direct and indirect benefits and costs associated with the project are not documented. A cost effectiveness study has not been carried out. For the Sámi, salmonid fish generally have a high cultural and traditional value, placing it in a special context, compared to the more conventional perspective of salmonid fish as a source of monetary gain or nutrition.

Sustainable land management

The project recognises and responds to the interactions between economy, society, and ecosystems through its bottom-up approach. The Skolt society's livelihood is connected to the quality of the Näätämö ecosystem and its ability to spawn salmon. The restoration was carried out in the Vainosjoki and Kirakkakoski area by means of donated funds to pay a team of 10 Skolt Sámi, a restoration consultant, and Snowchange staff.

Stakeholder involvement

It has not been possible to obtain information on stakeholder involvement. A strong involvement from the Skolt Sámi and researchers has been observed. Relations to the Finnish state has been hard to establish, and no mechanisms established to enable joint decision-making was found. Potential costs and benefits of associated trade-offs for the intervention have not been calculated, and as such cannot inform safeguards ensuring that the most disadvantaged elements of society are not negatively affected by the intervention. However, the project was initiated as a response from the marginalised Skolt Sámi, negatively affected by the previous management of the Näätämö area. The Sámi in Finland have a constitutional right to fish in their 'home rivers', likewise the Sámi in Norway also hold special fishing rights in various river sections. However, the Sámi raise the concern that the sale of fishing permits in tourist seasons undermines Sámi rights.

Knowledge sharing and policy facilitating

The project partner, Snowchange, is an international organisation formed by Indigenous peoples, -groups, local communities and Finnish scientists. This has ensured international sharing of knowledge between the involved groups. The approach and the lessons derived from the Näätämö project has triggered a sister Sámi-project in the Ponoj River watershed, Murmansk, Russia.

An important point when formulating policy focused on co-management with indigenous communities is the need for a dynamic framework able to integrate the diversity of communities and contextual differences. The actions were awarded the St. Andrews Prize for the Environment 2021.

Synergetic adaptation and increased resilience

The project showcases a strong connection between Skolt Sami and Finnish academia. However, contact and cooperation with the Finnish state was reported as a slow and difficult process.

Through Snowchange, the project is integrated with complementary projects documenting the effect of climate change on the region.

A risk management plan was developed as part of the project. The project describes and maps how the ecological condition of the watershed is expected to change. A monitoring and evaluation plan has been developed and implemented throughout the project's life cycle. Furthermore, a call for more recognition from the Finnish state authorities is also a substantial part of the project's further work.

Conclusions

The project is initiated as a response from the indigenous Skolt Sámi acting on the impact of climate change on the ecosystem to which both their culture and livelihood is connected. The co-management incorporating scientists have been successful at both documenting changes in the region, and at restoring spawning habitats for the Atlantic salmon.

The socioeconomic benefits of the project have not been documented in monetary terms. However, the rights-holders and beneficiaries have been identified by mapping the traditional land and water occupancy of the Skolt Sámi, and the socio-cultural benefits have been documented. The project does not have an explicit carbon/climate mitigation perspective.

The project recognises and responds to the interactions between economy, society, and ecosystems. The bottom-up stakeholder involvement has ensured that especially the indigenous Skolt Sámi interests are represented. The bureaucratic barrier between the Skolt Sámi and the Finnish state indicates an uneven decision-making process. The project has been successful at knowledge sharing, triggering a sister-project in Ponoj, Russia. After a decade of negotiations with the Finnish state, the project was allowed to carry out a defined restoration project, which can be seen as a symbolic first.

The cost of carrying out assessments of the socio-economic costs and benefits are in some cases too high for smaller projects. Prioritising restoration actions over socio-

economic analysis will undoubtedly improve habitat-conditions, but in a long-term perspective, knowledge of associated trade-offs for society is important when planning multifunctional nature projects. In the case of restoring the natural Salmon stock in the Näättämsö watershed, Salmonoid fish carry a high socio-cultural value.

Cooperation and funding between state and grassroots organisations should be improved. Bottom-up initiatives often imply the participation of highly motivated citizens, in which the removal of autonomy through regulations and bureaucracy decreases the motivation of the movement.

Acknowledgement

We thank the President of Snowchange, Tero Mostonen for participation in the interview and for providing us with academic background literature and images concerning the project. Furthermore, he has provided us with feedback and quality assurance on the case study

5.3. Hekluskógar – Restoring birch forest in co-operation with farmers, Iceland

Location: Suðurland, Iceland

Project period: 2007–2021

Total area: 100.000 ha

Administrative unit: Skógræktin - Icelandic Forest Service and Landgræðslan – The Soil Conservation Service of Iceland



Figure 15. One the first birch forest restoration sites. Mt. Hekla in the background.
Credit: Habitats

Introduction

The Hekluskógar project aims to restore native birch forest in the vicinity of the Mt. Hekla volcano in southern Iceland. This is done by restoring vegetation and planting birch seedlings in parts of the area. Historically, most of the project area was covered with birch woodlands until humans came to Iceland and started settling. Before the settlement, the woodlands helped stabilise pumice and volcanic ash from eruptions on the forest floor, thus preventing secondary distribution.

Intensive grazing and forest clearance that occurred along with the settlements resulted in a reduced resilience of the ecosystem. The land around Mt. Hekla then became more vulnerable to volcanic eruptions and the large-scale soil erosion that arose with it. Today, most of the land is extensively eroded mainly because of wind erosion, but also due to thaw water erosion. The soil is generally poor in nutrients, having low water holding capacity, hence natural reestablishment of seedlings is very limited. Frost heaving on the barren soils is also a contributing factor to slow natural

regeneration of vegetation in the area.

In 1907, the Icelandic government adopted their first forest act to protect and conserve birch woodlands which were managed by the state forest board (now Skógræktin). Meanwhile, the Soil Conservation Service of Iceland (SCSI) was working to combat soil erosion. Later, forest associations were developed by local citizens. Eventually, the SCSI, the Skógræktin and local forest associations, and landowners came to work together in the forest development and soil erosion.

Today, the area around Mt. Hekla is sparsely populated with different types of landowners ranging from farmers, tourist companies, summerhouse owners and a hydropower plant company. Outside the project area, local communities from nearby towns have shown interest in the areas. Local schools have taken part in plantings and are using the area for excursions. The large nature area is also used for tourism purposes.

Case background

The main objective of the Hekluskógar project is to restore native birch woodlands in the project area. The primary goal is to increase ecosystem resilience to ash deposition of future eruptions of Mt. Hekla, meanwhile improving ecosystem functioning and biodiversity, enhancement of carbon sequestration, reintroduction of natural hydrology, and improving future land use in the vicinity of the volcano. Thus, the restoration of woodlands is expected to bring multiple benefits for humans and nature. The restoration is made in collaboration with landowners in the area, who have been participating in planning and practical activities in varying degrees.

The initial idea of the Hekluskógar project was first developed within the SCSI around 2000. In 2005, the SCSI invited representatives of local stakeholders, relevant governmental and NGO organisations to form a collaboration committee. Meanwhile governmental funding was raised and secured in 2007, and then the project changed form to an independent governmental project.

From 2005 to 2007, the committee was active in planning and promoting the project, but after the project was incorporated as a governmental project the committee changed to mainly having an advisory role. Today the SCSI and the Iceland Forest Service are formally responsible for the Hekluskógar project.

The project area of the Hekluskógar project covers over 100.000 ha. Restorations takes places on many smaller sites (2.500 ha in total). The approach has been to initiate actions at many sites strategically distributed in the large project area. The actions involve establishment of plant cover and plantings for future seed dispersal creating a basis for natural regeneration of birch in order to facilitate further natural distribution of woodlands.

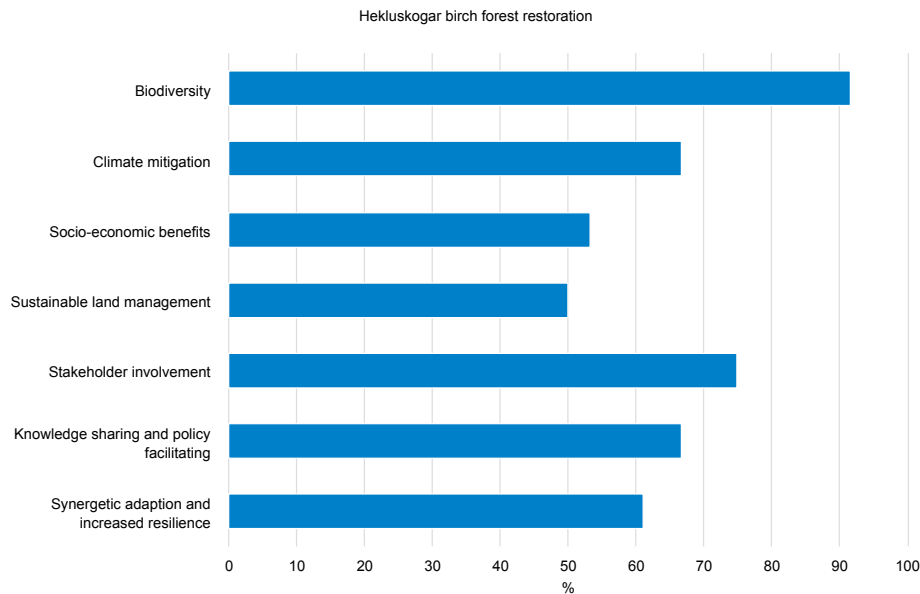


Figure 16. Heklusógar's score across the seven dimensions in percentages.

Biodiversity

The restorative actions of the project are a response to the evidence-based assessments of the drivers of degradation of the land and regional causes of biodiversity loss. In most places of the project area, forest ecosystems have completely vanished. Therefore, the project relies on written historical sources for information about the past state of the area. Monitorings of natural birch colonisation close to old birch forest have been used to suggest that the current method employed is able to restore woodlands. In order to assist the process, human planting actions, the project aids the natural colonization in the area. Because of the highly unstable soil surface, the project manager explains that it has been necessary to get plant cover established for the first successional stage before moving on. Even though fertilisers and foreign grass species are used in the initial restoration phases, ecosystem integrity is supported using native tree species (*Betula pubescens*) and bush species (*Salix* sp.) that will form later stages of the ecosystem. At first glance, the strategical wide distribution is not contributing to a better connectivity between existing functioning ecosystems, but in time the patches of land are predicted to meet and form coherent nature areas and ultimately improve large scale ecological connectivity in the landscape. Research projects in the project area have showed improvement of biodiversity, especially in rivers and lakes.

At first, plans included regular monitoring of ecosystem development, but due to a lack of funding, monitoring was limited to seedling survival. Although the project does not have any monitoring plan, actions and results are monitored regularly. Mapping of the spreading of fertilisers, plantings and sowing of grass has been stored in a GIS database. A random selection of new planting sites is monitored and measured every fifth year. The knowledge gained from monitoring results is discussed with participating landowners to take the best future decisions. Despite the lack of planned ecological monitoring, collaborations with external research institutions have provided the project with important information on biology and vice versa.



Figure 17. Rivers has re-emerged and biodiversity has improved after re-establishing birch forest ecosystems. Credit: Habitats.

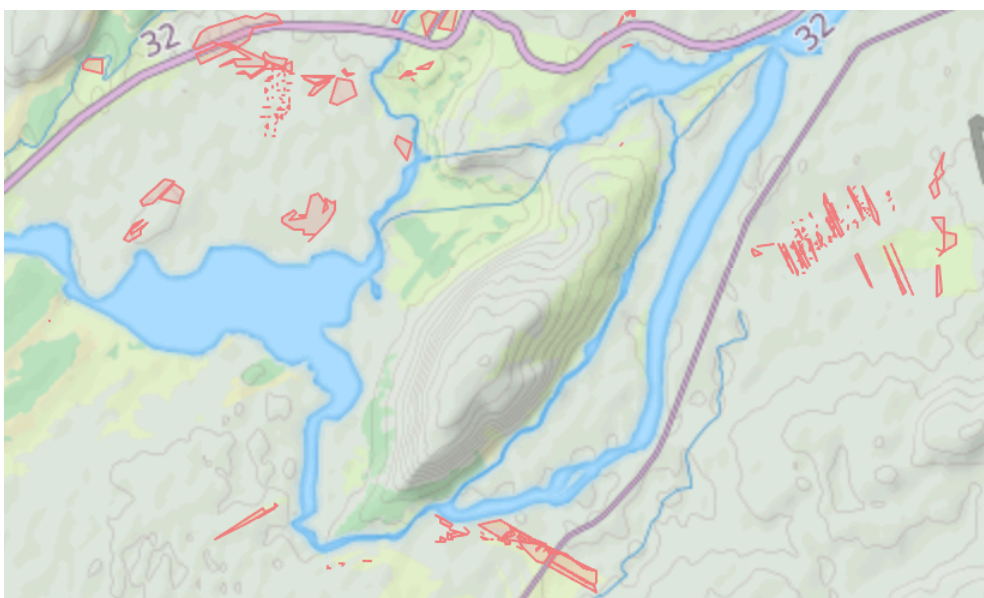


Figure 18. Representation in web database of monitoring results from birch planting (University of Reykjavik, 2015)

Climate

Carbon sequestration has been identified as a global benefit derived of the project, but no specific targets were set when the project was started. The argument of increased carbon sequestration in Hekluskógar is supported by the national Icelandic Forest inventory. This inventory has been monitoring the growth of biomass and accumulation of CO₂ of the most common tree species (including deadwood and other organic matter) at different altitudes in Iceland in over 20 years. With this national tool, it has been possible to assess the expected CO₂ sequestration and storage of woodland restoration projects. The estimated carbon sequestration based on the results of the national forest inventory is publicly accessible at <https://reiknival.skogur.is/mat/>. The data from the inventory is providing evidence used as statistics for the UN's IPCC.

Based on calculations with data from the inventory, at Hekluskógar, the project management expects appx. 40.000 tons CO₂ in average per year, with a forest cover of 10.000 ha after 15 years.

Socio-economic

At first, project plans included assessment of socio-economic impacts, but a lack of funding resulted in a periodisation of monitoring seedling survival.

Due to the large size of project's land area, low-cost methods have been developed to ensure cost-effectiveness. The method practiced in Hekluskógar is supporting natural colonisation of trees and bushes rather than large scale plantings. The project has been using different solutions for soil erosion issues and compared the success rate of these. They found that woodlands were more resilient to new ash dispersals than open grasslands.

The local municipality has included Hekluskógar in their master planning as a restoration project. A visitor centre and other recreational facility such as hiking trails have been planned within the project area and accessibility has been improved since the project started. This has not been an integrated part of the project and was developed recently by the municipality.

Benefits for the local farming community and other landowners have been an important part of the project, but the effect of them has not been measured. Local landowners say that the project has improved their livelihood, and positively impacted farming in the area, but the project has not made any comprehensive investigations substantiating this conclusion. In general, assessment of socio-economic benefits has been limited by a lack of resources. In interviews for this catalogue, farmers reported that they got better grazing lands, and thus larger animals, when woodlands are present. They are also experiencing more insects, birds, and mammals, and the landscape is perceived as a healthier ecosystem after the project. The interviewed farmers argued that more efforts should be put into developing people's knowledge about restoration practices and benefits, as they admit that initially they needed to be convinced that this approach would improve their livelihood.

Sustainable land management

The Hekluskógar project work within the Forest landscape restoration (FLR) framework, which is characterised by an ongoing process of regaining ecological functionality and enhancing human wellbeing in degraded forest landscapes (IUCN, 2022). Multifunctionality is embedded in the FLR framework, and thus recognise the interactions between ecology, society and economy. This approach is also reflected in the stakeholder involvement described below.

Stakeholder involvement

Due to the extent of the degraded ecosystem, restoration actions are planned at a large scale. In Hekluskógar, many landowners are directly or indirectly affected by the project. The project is carried out in cooperation with project partners and various types of landowners in the area. In general, all landowners were encouraged to participate in the project, but many did participate mostly in practical restoration efforts such as planting seedlings. The restoration on private land is mostly carried out by the landowners themselves, even though it is voluntary to participate. Since the official project start in 2007, more than 300 landowners have joined the project. In the first years of the project, ideas were presented at meetings with farmers and other stakeholders. Feedback resulted in adjustments of the extent of some areas, as farmers had concerns about not being able to continue their use of grazing commons.



Figure 19. Picture from one of the stakeholder visits and interviews in Hekluskógar. This image is from local sheep farmers and resident in the project areas which have taking part in the restoration. Credit: Habitats.

Although some of the participatory processes were improvised along the way, an intensive contact during the first collaboration phase contributed to a strong ownership of the project by collaboration partners. The main objective of inviting stakeholders was product-oriented towards the realisation of tangible ecological restorations. Most partners were satisfied with the process, but some complained of a lack of interaction and influence in the later phases of the project, when the project became administrated by the SCSL.

Public meetings were held in the first phases of the project, and 20–30 stakeholders attended each meeting. A stakeholder committee with different stakeholder groups were set up. The stakeholders included farmers, cottage owners, local forest associations, and NGOs with a representative for each group. In the recent years, new groups of stakeholders have taken initiative to participate, but a lack of project funds (for coordination) has limited the uptake of new stakeholder groups. For example, groups of motorcycle and 4x4 enthusiasts, who before the projects were causing problems damaging biological values, have now become motivated to participate in yearly plantings, and that means that they have gained increased awareness for the biological values in the landscape and the reclamation work.

Knowledge sharing and policy facilitating

Guidelines for practical restoration work regarding plantings, seed collection and the use of fertilisers has been developed and shared with the participating landowners, entrepreneurs, and volunteer groups to ensure implementation of best practices. Monitoring of the results has provided the project managers with information that has later enabled them to adapt guidelines and future practical restoration work. The project has shared annual reports on the project website. The Hekluskógar project has been subject to several scientific research projects over the years. The research projects include both growth techniques and ecological factors.

Hekluskógar is used as a model for collaborative restoration of degraded land in other places in Iceland and has now been adopted as a part of the Bonn challenge, where Iceland has set the goal for increasing their birch forest cover from 1,5% to 5%. The municipality of Rangárping Ytra, located at Hekluskógar, has implemented Hekluskógar in its planning strategy, and many of Iceland's municipalities have stated that they are supporting new and similar initiatives like Hekluskógar.

Synergetic adaptation and increased resilience

The project is mainly funded by the government, but smaller private companies have also contributed financially. The main aim of the project is to enhance ecological resilience of the woodland ecosystem around Mt. Hekla., therefore efforts have been put into output-based resilience rather than concrete social or cultural resilience of the local community. Nevertheless, there have been created jobs for the people carrying out practical restoration actions.

Monitoring results in the field of revegetation and planting activities were reported from practitioners, landowners, and contractors to the project management team, thus providing feedback for adaptive implementation. The results from monitoring show an increase in natural regeneration year by year. This makes the birch woodlands more resilient.

Long-term planning is necessary for restoring slowly developing ecosystems such as the birch forests in Iceland. Short-sighted decision-making due to a changing political environment has made the funding and management process difficult.



Figure 20. A sheep enclosure (left) next to a restoration site where new birch forest is emerging (right). Green big bags are bone meal fertilizer used to improve revegetation. Location near Galtalækjarskógur. Credit: Habitats.

Conclusions

Around Mt. Hekla, restoring native birch forests has been identified by the project to be the most effective solution to solve the challenge of soil erosion and to bring multiple benefits for society in degraded land areas in Iceland. A wide range of landowners has been involved in the process, which has enhanced ownership of the project. Nevertheless, at some point the involvement of stakeholders reached a barrier because of a lack of time for coordinating voluntary groups. The project focused merely on biological targets, and thus these were the only ones measured. An assessment of the socio-economic benefits that derived from the project has not been carried out because of a lack of funding. Nevertheless, the interviews by officials and stakeholders indicated that benefits for the local society have evolved throughout the project period and afterwards – or as they put it: there is no need to analyse this, as it seems quite clear to the locals.

Today the Hekluskógar project is not an independent project anymore, but now a part of Iceland's contribution to the Bonn-challenge managed under Skógræktin and SCSl. The concept of forest landscape restoration is still the core of restoring birch forest in Iceland.

Acknowledgement

We are grateful that the project manager, Hreinn Oskarsson took his time to participate in the case interview and show us a selection of sites in the project area – without his guidance we would not have been able to experience the great but rough landscape around Mt. Hekla. Furthermore, Hreinn has provided us with feedback and quality assurance on the case study. We thank the mayor and project

staff of Rangárþing Ytra Municipality, for being interviewed about their role in the project. We are grateful for the hospitality two homes of farmers showed us by inviting us into their homes to talk about their experience with the project.

5.4. Light & Fire, Finland – Collaborative restoration of sunlit habitats

Location: Degraded Annex I habitats in Finland.

Project period: 2014–2020.

Total area: >40.000 ha.

Administrative unit: Snowchange, Skolt Sámi community, Metsähallitus, Parks & Wildlife Finland.



Figure 21. Burning excessive vegetation at Oro Island in the Light & Fire LIFE project. Credit: Liisa Huima.

Introduction

In the Finnish boreal conifer forest, occasional wildfires are a natural process of the ecosystem. Commercial forestry has suppressed the natural occurrence of fire, thereby minimising the natural mechanism for creating special biotopes for fire-dependent species and for keeping esker forest's sunlit habitats open. Changing praxis of land management results in degradation of meadows, heath and shrublands, as these become overgrown. Further invasive species such as *rosa rugosa* threaten the ecosystems of fixed dunes and sandy beaches. Based on Finland's Article 17 of the Habitats Directive report (2001–2006), Annex I habitats reported as unfavourable-bad or unfavourable-inadequate were chosen. The Light &

Fire project utilised controlled burnings as a tool for restoration of forest and maintaining the sunlit habitats. Prescribed burnings were carried out in Natura 2000 sites, covering 487 ha. Fire continuum plans were made for Natura 2000 sites covering more than 40 000 ha. Restoration of sunlit habitats such as coastal meadows, heathland, and dunes by using fire and other techniques, including removal of invasive species was carried out in 34 sites, covering 354 ha. Species, biotope inventories and cultural heritage inventories were carried out were needed in order to provide background for the planning process. Lastly, the endangered species *Thymus serpyllum* and *Pulsatilla patens*, were nursed and reintroduced to specific sites where the habitats had been restored.

Case background

Throughout Finland, the Light & Fire project 2014–2020 has focused on restoring 69 Natura 2000 areas with habitats characterised by outbreaks of fire or extreme solar radiation and luminosity. The project was coordinated by the Metsähallitus, Parks & Wildlife Finland, incorporating both state-owned and privately-owned protected areas for the restoration, and the project showcases a flexible ownership approach. The project has been publicly embedded through media, volunteer workcamps arranged with WWF Finland, and employing local citizen organisations like sports clubs, hunting clubs and scout groups in the restoration work. The restoration sites have been monitored in order to evaluate the results of the actions. The project was evaluated, and the results were published as a report.

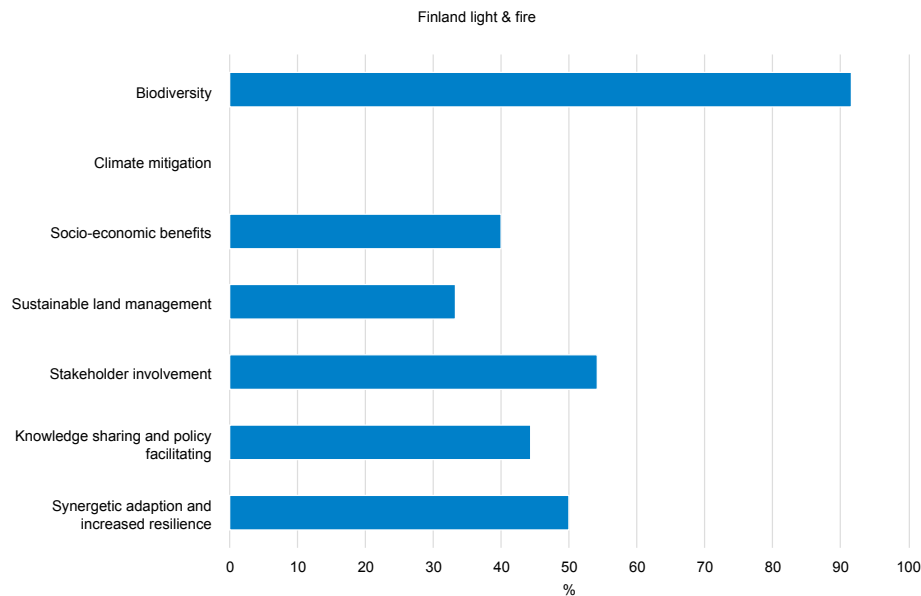


Figure 22. Light & Fire's score across the seven dimensions in percentages.

Biodiversity

The project areas are composed of Habitat Directive Annex I habitats, which were assessed as being in an unfavourable-bad or unfavourable-inadequate state in Finland's Article 17 Habitats Directive report (2001–2006). The main drivers of degradation were identified as effective fire prevention, forestry in esker forests, overgrowth of sun-lit habitats, overgrowth of previously open coastal areas, habitat fragmentation and isolation, *Rosa rugosa* occupying space from typical native species on sandy habitats and a lack of knowledge on natural values in the Natura 2000 sites.

The objective of the project was to conserve the identified degraded Habitat Directive Annex I habitats, by restoring the previous characteristic structural features of habitats shaped by fire or extreme solar radiation and luminosity. The outcomes of the project were benchmarked through species inventories, and periodically monitoring plans were completed. The monitoring includes assessments of unintended adverse consequences on nature. A year or two after a controlled burning, an inventory of the status of trees, including the related fungi, polypore, and insects was created. A remeasure is intended after five years. An implicit effect of the restoration practices is an enhancement of the ecosystem integrity. Ecosystem connectivity was not an objective of the project.



Figure 23. *Pulsatilla patens* flower, one the plant species that the Light & Fire project has improved the conditions for. Credit: Teijo Heinanen

Climate

Climate mitigation was not part of the scope of the project. No measurements of the carbon mitigation related to the burnings were carried out.

Socio-economic

Key stakeholders were mainly identified as the owners of private protected areas and local communities in proximity to restoration areas. Through communication efforts and citizen meetings, the Light & Fire project has connected and identified societal challenges among rights-holders and beneficiaries. A tool to calculate the socio-economic impacts of the project was developed together with Professor Emeritus Eero Vatanen from University of Eastern Finland. However, it calculated the overall benefits of the project, and was not used in the project planning. The main objective of the project was to restore habitats, with socio-economic benefit as a secondary passive objective.

Apart from the newly developed socio-economic tool, human well-being outcomes arising from the project were not identified, benchmarked, or periodically assessed.

As a part of the restoration of esker forest, the project purchased land from private landowners with esker forest. Here, the direct monetary gain for each owner is documented. Further local organisations such as hunters, scouts, and sports clubs were hired to watch areas where controlled burnings had taken place. Apart from that, the direct and indirect benefits associated with the project have not been documented. A summary of costs per action documenting foreseen and final cost for each restoration action is provided in the final report.

A study assessing alternative restoration options was not produced. This is partly due to the initial aim of imitating natural fire. The newly developed tool for examining socio-economic impacts operates with a 2,5 economic coefficient. The amount of 4,15 million euros spent on the project is projected to create a 10,38 million euros in benefit for the society. However, the project staff noted that the tool is better suited for assessing mire restoration, and therefore a more specific tool should be designed for dry sunlit habitats.

Sustainable land management

The project recognises and responds to the interactions between economy, society, and ecosystems through its integration of both local stakeholders, landowners, and volunteers. However, a climate mitigation perspective is not included.

Stakeholder involvement

Directly and indirectly affected stakeholders have been informed of the project. Communities affected by the burnings have been reached through public communication, and in some cases local meetings have been held to voice concerns and to promote cooperation.

The project has been successful in incorporating different levels of civil society in the restoration effort. Local organisations were recruited to take part in the work, and volunteer camps were arranged together with WWF Finland.

Landowners with forest on esker were contacted and informed of the different

possibilities for conservation and the related compensation schemes.

The project has not reported on its efforts to ensure that participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)

Knowledge sharing and policy facilitating

The project is a part of the LIFE Nature projects financed by the EU. A joint workshop was hosted the LIFE Taiga project, a Swedish project also utilising controlled burnings as a nature restoration tool. The World Wide Fund for Nature (WWF) Finland was also a cooperation partner in relation to the volunteer camps. Furthermore, knowledge was shared within the Finnish state.

Synergetic adaptation and increased resilience

The project consisted of a wide range of partnerships across private and public sectors, linking everything from hunting clubs, forestry companies, and the Finnish Nature Agency together by a common goal: improved ecology. As such the project was integrated across other sectors and was synergetic in the way it canalised funding to small local NGOs, created recreation for volunteers both from countryside and larger cities, and helped forestry companies and individual forest owners to combine timber production with sustaining the ecology of the esker.

The project identified the following risks related to the restoration efforts: the ecological effects of prescribed burning, and the negative sentiment, that the change of local nature areas can cause from local communities.

A monitoring plan was implemented through the project and will continue to evaluate the outcomes of the work. A future management plan, describing how the sunlit areas should be kept open, has been developed. It is essential that the prescribed burning of the forests is continued. The same goes with the restoration of the sun lit and coastal habitats, and the need to be kept open. *Pulsatilla patens* still needs more habitats to grow. Knowledge and awareness of the Nature 2000 areas must be maintained and developed.

Funding from the project was sourced through EU LIFE funding. Further voluntary work also supported the project.

Conclusions

The project was initiated as a response to the mapping of degraded sunlit Annex I habitats. The restoration practices consisted of controlled burnings in forests on esker, removal of invasive species, and nursing and translocation of the endangered species *Thymus serpyllum* and *Pulsatilla patens*.

Based on earlier studies of degraded sunlit habitats, the project worked with defined restoration goals, benchmarking, and periodic assessments. Climate mitigation efforts were not a part of the project scope. The socio-economic benefits of the project were estimated on a society level with a 2,5-coefficient resulting in a society benefit of 10,38 million euros. Costs and benefits for rights-holders and other

stakeholders were only documented in the case of land purchase and hiring of local organisations.

A strong link between habitat restoration and civil society was established through the inclusion of local organisations and volunteers. Neighbours and other stakeholders to restoration areas were informed and in areas with local concerns, dialogue was established.

The knowledge gained from the project was shared with the similar Swedish fire restoration LIFE Taiga project through a workshop.

The project builds on previous assessments of sunlit habitats in Finland, and establishes a wide partnership across sectors, connecting with authorities, forestry companies and local organisations. The project was successful in partnering with the national branch of WWF which gave access to a large pool of volunteer workers. Here the benefits are multiple: Cost reduction of the restoration action, recreational value for citizens, and a chance to engage in knowledge sharing dialogue.

The restoration actions are based on the knowledge of absence of the forest fires and on mapping of degraded sunlit habitats from 2001–2006. They demonstrate how continuous monitoring and management is essential for the state of habitats threatened by either invasive species or a changing management of cultural landscape.

In some cases, local communities did not view an area designated for restoration as degraded. From their perspective, removal of biomass or controlled burnings would make an area 'unnatural' and decrease its recreational value. When physical change is imposed top-down, it is important to engage in dialogue with the affected stakeholders. Recruitment of local organisations can also be a way to legitimise planned restoration.

A general lack of identification of socio-economic trade-offs for direct and indirect stakeholders is noticed through the cases (Light & Fire, Näättä, and Porsanger). In all cases, the biodiversity reporting has been prioritised. Without insight of associated trade-offs, a project cannot evaluate its socio-economic impact and thereby make sure that the project has unintended negative effects. Furthermore, without the understanding of how new or changed actions affect stakeholders, new multifunctional restoration projects are not able to assess and implement good and bad practices.

Acknowledgement

We thank Sanna-Kaisa Rautio for setting up the interview and inviting partners from the project to participate, as well as providing us with additional literature and images broadening the perspective on the case story. For participating in the interview and taking their time to talk to us, we thank Henrik Lindberg from HAMK, Häme University of Applied Science and Mrs. Anne Grönlund, Biologist working as Senior Conservation Officer in Centre for Economic Development, Transport and the Environment in Northern Savo area (POSEELY Centre).

5.5. Lille Vildmose, Denmark – Peatland restoration for biodiversity, climate, and tourism

Location: Northern Jutland, Denmark

Project period: 2011–2019

Total area: 7600 ha

Administrative unit: The Danish Nature Agency



Figure 24. Red deer at the raised bog in Lille Vildmose. Credit: Jan Skriver.

Introduction

Lille Vildmose is the largest protected land area in Denmark, located in both Aalborg Municipality and Mariagerfjord Municipality. The 7600 ha. large, protected nature area contains habitats that are valuable on a European level, counting 2068 ha of active raised bog and 361 ha of bog woodland. For the same reason, the area is designated in EU's Natura-2000 framework as well as representing one of rarest nature types in EU's Habitat directive, and thus part of the prioritised habitats in EU and national nature conservation. Lille Vildmose contains one of the largest remaining raised bogs in Northwestern Europe. Like many other places, large parts of the raised bog in Lille Vildmose have been excavated for peat, drained and cultivated, and as such they have been threatened by overgrowth and eutrophication, but nonetheless leaving 405 ha of degraded raised bog which is still capable of natural regeneration. Lille Vildmose ended up having an unfavourable conservation status in the Habitats directive.

Since 2001, large parts of Lille Vildmose have been acquired by the private nature

foundation, AAGE V. JENSEN NATURFOND (AAVJ), and today the foundation is the biggest landowner in Lille Vildmose. The area acquired the status of protected land in 2007, and peat extraction was abolished in 2011 in the protected area. Currently there are still ongoing extraction licences outside the protected area. In 2013, Lille Vildmose was designated as the first international wetland area for climate-friendly nature by the Ramsar Convention.

Mainly because of the high occurrence of raised bog areas and the designation as a Natura-2000, the restoration project of Lille Vildmose was granted 4 million € by the EU Life+ program.

Case Background

The purpose of this LIFE+ project has been to restore and conserve the natural values of the largest remaining raised bog in northern Europe, Lille Vildmose. The project has been realised in a collaborative partnership of the private AAVJ nature foundation, the municipality of Aalborg and the Danish Nature Agency, and supported by the EU LIFE+ program.

The main aim of this project has been to conserve the remaining parts of the raised bog area, and to re-establish good hydrological and ecological conditions for the degraded parts, so that active raised bog can be restored in these areas, in order to connect the remaining active raised bogs. By raising the water level in degraded areas and promoting the reestablishment of sphagnum mosses, the ecosystem is now slowly restoring. All in all, over 900 ha of degraded raised bog (7120), larger areas with dystrophic lakes (3160), and transition mires and quaking bogs (7140) have been restored and have improved the conservation status of these habitats (Annex I, EU's Habitats Directive habitat code).

This has been done through a combination of various technical and biological interventions at the landscape scale. The former drain channels and ditches have been filled in order to restore a more natural hydrology in the raised bog and in order to conserve the remaining functional ecosystem. Along with the restoration of natural hydrology, large populations of bushes and trees have been cut to avoid overgrowth. The threat of problematic and invasive predators on birdlife has been mitigated through innovative regulation methods. Finally, through a rewilding approach, large ecological key species of the ecosystem such as cattle, red deer and moose have been released in a large, fenced area to fulfil a natural role in creating a wilder nature area and in order to keep the landscape open through grazing.

Although reintroducing former hydrological conditions and releasing moose into the landscape have generated some challenges related to neighbouring farmers, the restoration of Lille Vildmose has resulted in improved ecological conditions regarding ecosystems and individual species and is now highlighted as a global successful example of large-scale ecosystem restoration.

Thanks to the local visitor centre, Lille Vildmose Centret, the natural and cultural values of the landscape have been disseminated in a modern and inclusive way. The restoration and rewilding of Lille Vildmose has now become a strong brand for the local area, with particular focus on ecotourism, and is now attracting many visitors to the area, both on a regional and national level.

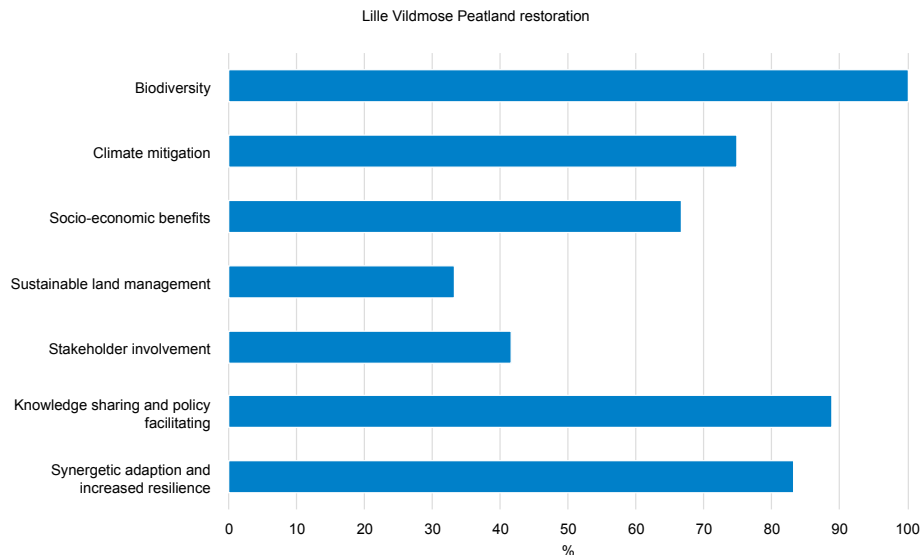


Figure 25. Lille Vildmose's score across the seven dimensions in percentages.

Biodiversity

The actions and measure of this project are focusing on improving conditions for designated species and habitats in the Natura-2000 site of Lille Vildmose. Extraction of peat, which has been going on for centuries, and prior draining have been identified as the prevailing drivers of degradation of active raised bog in Lille Vildmose. The extent of the degradation has been investigated by comparing historical and contemporary maps, and the state of the hydrological network affecting the conservation status of the raised bog have been benchmarked and compared to end results. The biological status of the raised bog has been benchmarked by monitoring results from the Danish national survey, NOVANA. Habitat types included in the Annex I of the EU Habitats Directive are mapped, and conservation status and threats are assessed in all habitat areas in a 6-year cycle. The monitoring results indicate that there has been a change towards a better conservation status of the designated habitat types.

Even though the results show a tendency of better conservation status in targeted habitats in the short perspective, it is important to note that regeneration and growth of sphagnum peat mosses is a very slow process which happens over long timespans, meaning that it takes a long time for the bog to regain size. Therefore, the long-term effects cannot be measured yet. The Environmental Protection Agency will continue to carry out the monitoring of habitats and habitats species in the national monitoring program, NOVANA.

Lille Vildmose is a very popular site for bird watching and thus it has been natural to include voluntary ornithologists in the monitoring of birdlife. Reporting species and numbers has been carried out as a citizen science activity and reported to the national bird database, DOF-basen as well as more systematic counting of breeding birds have been reported directly to the project. A continued monitoring in the area will indicate the success of improved breeding and feeding site for annex-I species in the EU Bird Directive. Another monitoring method that has been used is the counting of large grazers.

This case shows how it is possible to connect fragmented valuable habitats by re-establishing natural hydrology in the landscape and conserve the integrity of remaining bogs. Reintroducing natural hydrology has not only affected the raised bog, but also other adjacent valuable habitats such as a species-rich forest north of the raised bog, which has also been included in the project.

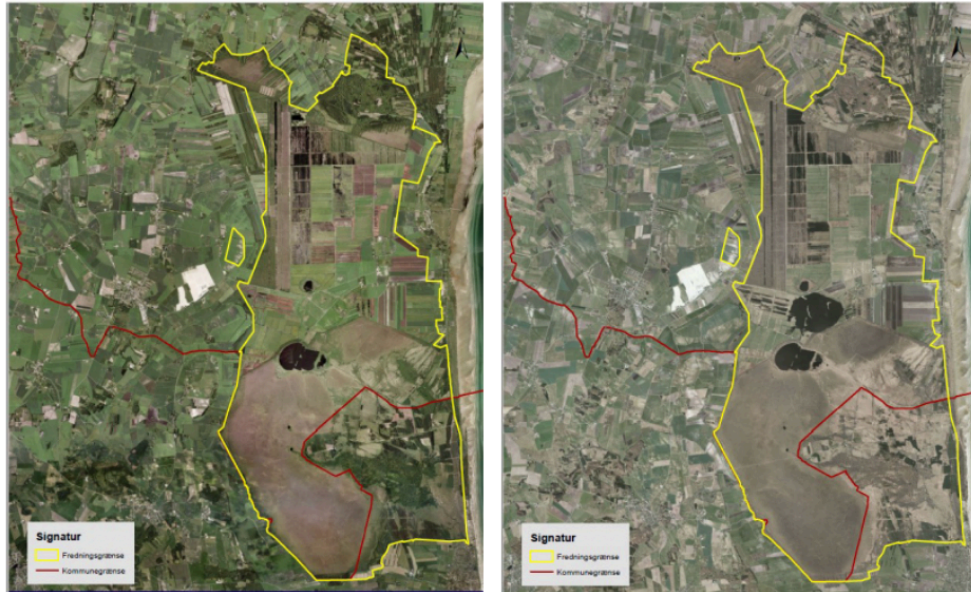


Figure 26. Aerial photo of the project area from 2010 and 2019, respectively, showing the increased area with raised water levels (Lille Vildmose final report, 2020)

Climate

The restoration of Lille Vildmose has not only increased biodiversity but has also had significant climate change mitigation impacts. Lille Vildmose has gained international attention, by being the first Ramsar site considering a criterion on climate regulation in the Ramsar Convention. Lille Vildmose is highlighted as a global model for how wetlands can be restored, not only for ecological conservation purposes, but also for increasing CO₂ storage and absorption from the atmosphere.

The project has benchmarked the potential for storing CO₂ in the peat of the remaining parts of the raised bog and thus avoiding emission due to former peat land degradation. Calculations on emissions have been made by external experts. These show a reduction of approximately 10,500 tons CO₂-e per ha per year after the restoration.

The intact raised bog consists of huge amounts of CO₂ stored in peat. The estimated carbon content in the organic soil (peat) of Lille Vildmose is approximately 7.4 million ton or approximately 10% of the Danish peat carbon volume. Calculation of emissions made by Greifswald Mire centre using the default values for tier 1 (IPCC Wetlands Supplement 2014), arrived at net GHG emissions of 17,780 CO₂ -eq. per year before the major restoration activities started in 2011 reduced to 7,294 CO₂ -eq. per year after restoration. Thus, a reduction of approximately 10,500 tons CO₂ -e per ha per year, due to the rewetting. (Lille Vildmose final report, 2020).

Socio-economic

Two of the project owners, the municipality of Aalborg and the AAVJ nature foundation are represented in the administrative board of the local visitor centre, Lille Vildmose Centret.

There is a remarkable synergy between the restoration project and the local visitor centre. The visitor centre is using the Life+ project as a lever to gain funding so they can continue to disseminate knowledge about the restoration actions and the natural values of the landscape. According to the visitor centre, knowledge and good nature experiences have given people a reason to care and want to help protecting the natural values because they are proud of their landscape. The visitor centre is recruiting ambassadors who are proud and want to promote it. All volunteers are getting a training course in the LIFE+ project.

Cost-efficiency has been assessed for individual actions in the project. For example, in the public procurement for hydrology restoration actions, entrepreneurs have been selected according to their specific skills in working in wet conditions, which ensured the most cost-effective offer.

The local visitor centre has estimated the socio-economic benefits and cost-benefits of the restoration of Lille Vildmose. Even though the socio-economic benefits are most noticeable locally in terms of job creation and increased tourism, economic benefits for the state such as return taxes have also been included in the calculation.

Based on visitor numbers and economic assumptions, the visitor centre calculated that the restoration of Lille Vildmose generates 1.4 million € pr. year in tourism revenue to the local community. Especially the introduction of large herbivores – especially the moose – has created huge awareness about Lille Vildmose, which can be seen in a steep increase in visitor numbers in the period between 2015–2016 (see figure 27).

In combination with the LIFE+ project, the introduction of large herbivores and the establishment of a modern visitor centre with a strong network to the local society, Lille Vildmose has developed a valuable brand for eco-tourism. The overall promotion of Lille Vildmose has been important for the future conservation work in the surrounding landscape, and also for developing and attracting eco-tourism to the area.

The increase economic flow is creating new jobs both in the local community as well

as in the visitor centre. Many volunteers are working in different work areas at the visitor centre, and the centre is also coordinating volunteer groups who are carrying out practical restoration tasks.

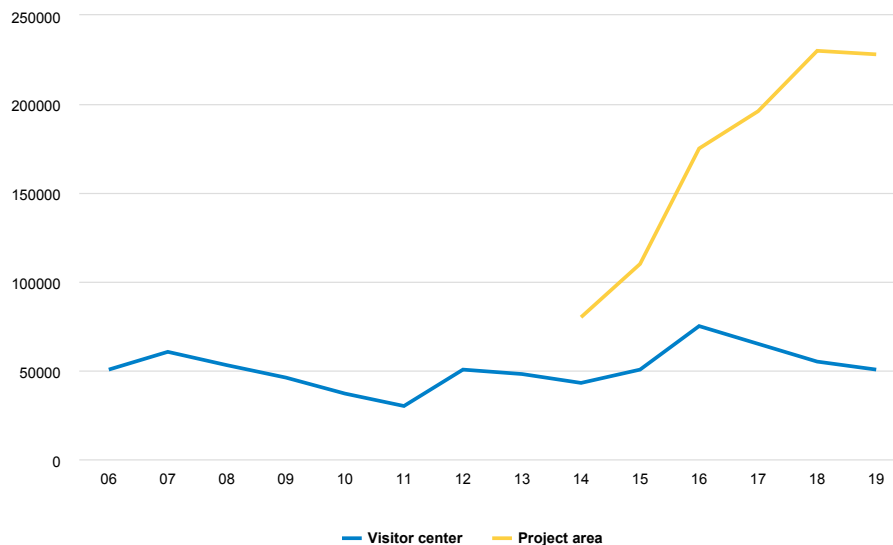


Figure 27. Visitor counts in the project areas as well as paying visitors to the visitor centre from 2006 to 2019. Source: Lille Vildmose visitor centre.

Sustainable land management

The LIFE+ project acknowledges interactions between economy, society, and ecosystems in several ways. New dikes have been built in order to be able to increase the water level in the project area without compromising production on neighbouring farmers' land. Due to concerns of unintended flooding on neighbouring farmland, a continuous monitoring of water levels and maintenance of dikes are carried out by the municipality of Aalborg.

Recreational facilities such as view towers, boardwalks and visitor sites are incorporated in the project, guiding visitors in order to avoid high pressure on nature areas. In peak tourism periods, this is important for ensuring a sustainable recreational use of the landscape.

Working with large-scale grazing and the introduction of large herbivores have required new methods in the management of nature areas. In order to achieve a sustainable grazing regime, assessments of grazing pressure were carried out by national and international experts. These assessments have been important for the development of the final population structure of large herbivores.

Stakeholder involvement

The Lille Vildmose project has collaborated with several partners and contributors from different sectors including local and national entrepreneurs, businesses and associations. Five public meetings and seven meetings with a focal group have been held throughout the project period. The purpose of the focal group has been to inform local stakeholders and to create a platform where stakeholders and the

project management group can discuss issues directly. It has been important to include neighbours for the purpose of collecting knowledge about local conditions. This has been done in an informal manner, and according to the project manager it helped increase ownership for the affected neighbours.

A group of landowners have been dissatisfied with the economic compensation provided for the lost right to use the land for agriculture and complained about all permissions and dispensations to the restoration actions. The landowners did not object to the actual restoration of Lille Vildmose, but the conflict has roots in the landscape protection from 2007 affecting their land. The local peat extraction company has been included in a side project of the restoration with the purpose of developing new innovative methods for regenerating sphagnum mosses. The cooperation is now continued in another site outside Lille Vildmose.

Citizen's science such as annual bird counting events and public BioBlitz have contributed to important monitoring results. Workdays have been held annually with the purpose to involve the local community, inform about the LIFE-project, and carry out practical nature restoration. In order to continue an open and public dialogue after end of the LIFE project, the municipality has set up an interest group representing stakeholders linked to Lille Vildmose.



Figure 28. Stakeholders participating in the restoration of the raised bog in Lille Vildmose. Credit: Bo Gregersen.

Knowledge sharing and policy facilitating

The LIFE-framework required international knowledge sharing of the project. Lille Vildmose has shared and disseminated its best practices through local and international forums to support the uptake and mainstreaming of raised bogs restoration.

Locally, a communication channel has been set up between the project, local hunting associations and neighbouring hunters for sharing knowledge about the development of new methods to control invasive mammals like the racoon dog.

Lille Vildmose has been promoted by the Ramsar convention as a global model for the Ramsar site designation for restoring and protecting peatlands in order to enhance climate change mitigation. The restoration of Lille Vildmose was represented at Ramsar COP12 in Uruguay in 2015 and UNFCCC COP21 in Paris in 2015. In order to highlight the role of peatlands in climate change mitigation, a film about Lille Vildmose was produced and presented at COP21 in Paris. Furthermore, Lille Vildmose has collaborated and shared knowledge with the Nordic-Baltic Wetlands initiative, which is a regional initiative under the Ramsar Convention. In workshops supported by the EU Interreg North Sea Region Programme, new methods have been shared in partnerships for innovating new restoration methods in raised bogs. The demonstrating project of kickstarting sphagnum regrowth received attention from both Danish, German, and Dutch scientists. People from other similar projects have visited the site to learn about best practices.

Synergetic adaptation and increased resilience

According to the manager of the local visitor centre, the LIFE-project along with increased awareness about natural values in Lille Vildmose and its surrounding nature areas have started a process of development in the local community. As he puts it, the restoration of Lille Vildmose established a place-identity for the landscape and for the people visiting it. The brand of Lille Vildmose is now used by several local businesses and small towns who want to be associated with the nature in their local area. Through a meeting every second week, the project's manager, entrepreneur and consultant were able to handle the unforeseen problems they encountered, ensuring an adaptive approach to the construction work.

Unforeseen issues have been discussed in short meetings with the stakeholders to ensure an adaptive and forthcoming progress. Physical adaptations and compromises have mainly been made to ensure that surrounding farmlands are not negatively affected by the rewetting of Lille Vildmose.

The municipality of Aalborg and the landowner AAVJ nature foundation have developed a management plan to ensure the future conservation work in Lille Vildmose. The overall objective of the plan is to ensure an open landscape and to ensure that the habitat types are moving towards favourable conditions. Monitoring is an important task in the conservation plan, and includes data on water levels, vegetation, structure and species for selected organism groups. The effect of restoration activities will be evaluated every four years and is providing basis for adaptive management into the future. More details about the monitorings are described in the biodiversity part above.

Conclusions

This case has showed how it is possible to restore a degraded raised bog by reintroducing natural hydrology and large grazers into the landscape at a large coherent landscape scale. Many raised bog restorations have been carried out in Denmark and elsewhere, but the special thing about Lille Vildmose is the particularly large scale of the project area. Climate change mitigation effects of the restoration have been addressed and best practices has been shared with both academics and practitioners. The case demonstrates how participation and collaboration with stakeholders can be simultaneously challenging and beneficial to a large-scale restoration project.

Due to increased natural values and thanks to a broad dissemination by the local visitor centre, ecotourism is now thriving in the area and the branding value of Lille Vildmose is spreading to nearby towns.

Because of the nature of raised bog vegetation, the full potential of ecological benefits is expected to reveal itself at a longer time horizon. This requires a continuous monitoring and an adaptive approach to the future conservation work.

Acknowledgement

We thank Project Manager, Peter Hahn for taking his time to show us around in the project area and providing insights of the project via interviews throughout the day. We also thank Bo Gregersen his hospitality at the visitor centre and his participation in the interview. Both have sent images that have been used in this case study.

5.6. Fjordkalk, Norway – Restoring kelp forest by removing sea urchin with quicklime in Porsangerfjorden

Location: Troms and Finmark county, Norway

Project period: 2011–2017

Total area: 1877 km²

Administrative unit: Norwegian Institute of Marine Research



Figure 29. Two years after the lime treatment. The ecosystem now supports fry of cod and pollack. Credit: Frithjof Moy, Havforskningsinstituttet

Introduction

Along the northern shore of Norway, a decline of kelp forests was noticed by fishermen between 1970–75 and has been ascribed to overfishing of predator fish such as cod, which feeds on green sea urchins (*Strongylocentrotus droebachiensis*). This led to a rapid increase in sea urchin population and overgrazed kelp forests along the Norwegian coast. Throughout the case area Porsangerfjorden, kelp forests have been heavily reduced and in places left as barren ground due to sea urchin grazing. Especially in shallow areas with a depth of less than 15 m, sea urchins were abundant (Pedersen et al. 2018).

Kelp forests are associated with a range of benefits for society. They act as habitat for invertebrates, fish, mammals, and seabirds, providing food, nursery and shelter. They generate value through kelp harvesting, industrial and recreational fishing, and tourism activities. In addition, kelp forests can serve as an uptake for excessive nutrients, often as a product of aqua-culture. Sequestration of carbon happens as the kelp grows, and as kelp debris and fragments are transported to deep ocean basins, where the CO₂ is stored. Furthermore, the kelp debris is an important nutrient for deeper sea ecosystems (Hynes et al, 2020). To reverse the decline of kelp forest ecosystem services, a field pilot project testing the spread of quicklime as a way of decreasing sea urchin populations was conducted between 2008–2011 in Porsangerfjorden. In 2017 follow-up lab experiments were conducted, and in 2018–2019 new field tests were carried out.

Case background

The Porsangerfjord is located in Troms and Finnmark county in the most northern Norway. The fjord covers 1877 km², has a length of 123 km, and a width of 10–15 km. In the northern end it is connected to the Barents Sea. Here, the maximum depth is 300 m and in the inner parts the maximum depth is 110 m. The northern part of the fjord has an average annual temperature of ca. 5°C. The water character is Atlantic. In the inner southern part, the average temperature is ca. 0°C with seasonal ice coverage. The inner water is characterised by a freshwater influx from three important salmon spawning rivers, the large Lakselv River, the smaller Stabburselva river, and Børselv River (Pedersen et al. 2018).

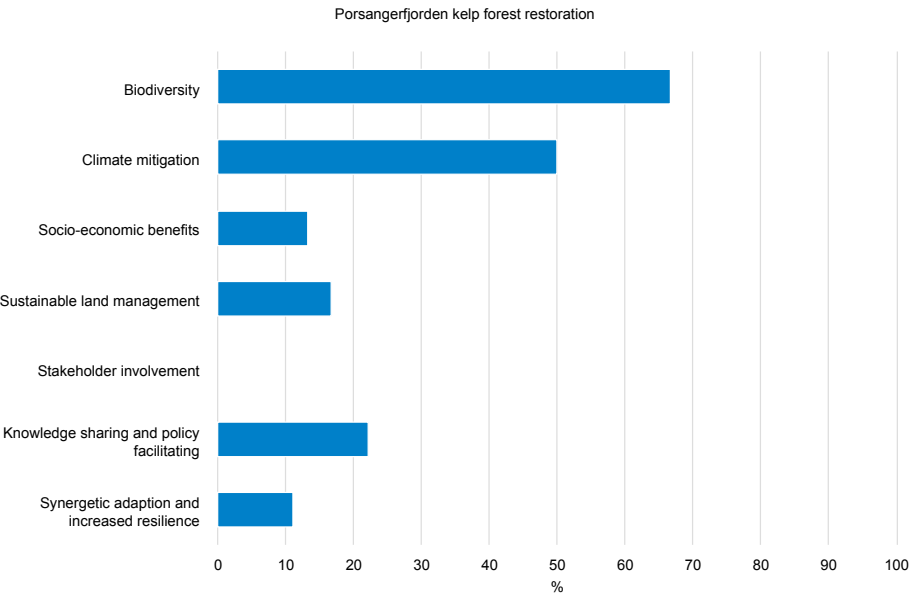


Figure 30. Porsangerfjordens's score across the seven dimensions in percentages.

Biodiversity

Sea urchin (*Strongylocentrotus droebachiensis*) was identified as the prevailing driver for degradation of the ecosystem. Between 2005–2011 a pilot study examined the prospect of using quicklime as a way of culling sea urchins. Two pilot areas were identified, and sea urchin density was measured in 2005. In 2008 and 2009, quicklime was applied at the two control areas. In 2010 and 2011 the sea urchin density was remeasured, showing a partial revegetation a year after treatment. In 2017 lab studies was carried out to which quick lime particle size is most efficient at culling sea urchins. In 2018 and 2019, further field experiments with quicklime were carried out at two different sites. In total 200t quicklime has been sprayed along 3km of coastline, covering a total of 17 km².

An unintended adverse consequence of the practice could be the harm of other animals, such as starfish. However, the degraded seabed hosted only sea urchins, and therefore the quick lime treatment was determined as harmless for the rest of the ecosystem.

Climate

The loss of carbon storage and sequestration as a result of sea urchin grazing was addressed by the Norwegian Institute for Water Research in 2010 (Grundersen et al., 2010). The report estimated that kelp restoration on a national level would result in a one-time gain of 36 million tons bound CO₂. Further sedimentation of kelp material will yearly deposit an increasing amount of CO₂ estimated to 1,1–2,3 million tons CO₂ per year (ibid).

Based on this, the project in Porsangerfjorden established a goal of binding 10kg CO₂ per m² of kelp forest.

Socio-economic

The cost of spreading quick lime in the pilot area was approximately 1500 euros per ha. The project has not completed its own socio-economic study, but broader research on the effect of kelp restoration along the Norwegian cost line has been done. Rights-holders and beneficiaries in regard to ecosystem restoration in the Fjord are not mapped.

Sustainable land management

The project has acknowledged how ecosystem restoration efforts creates a positive interaction between biodiversity and climate change mitigation. At a society level, socio-economic benefits of an improved ecosystem restoration are also acknowledged, however the project does not offer an estimate of the socio-economic benefits in regard to a restored ecosystem in the Porsanger Fjord.

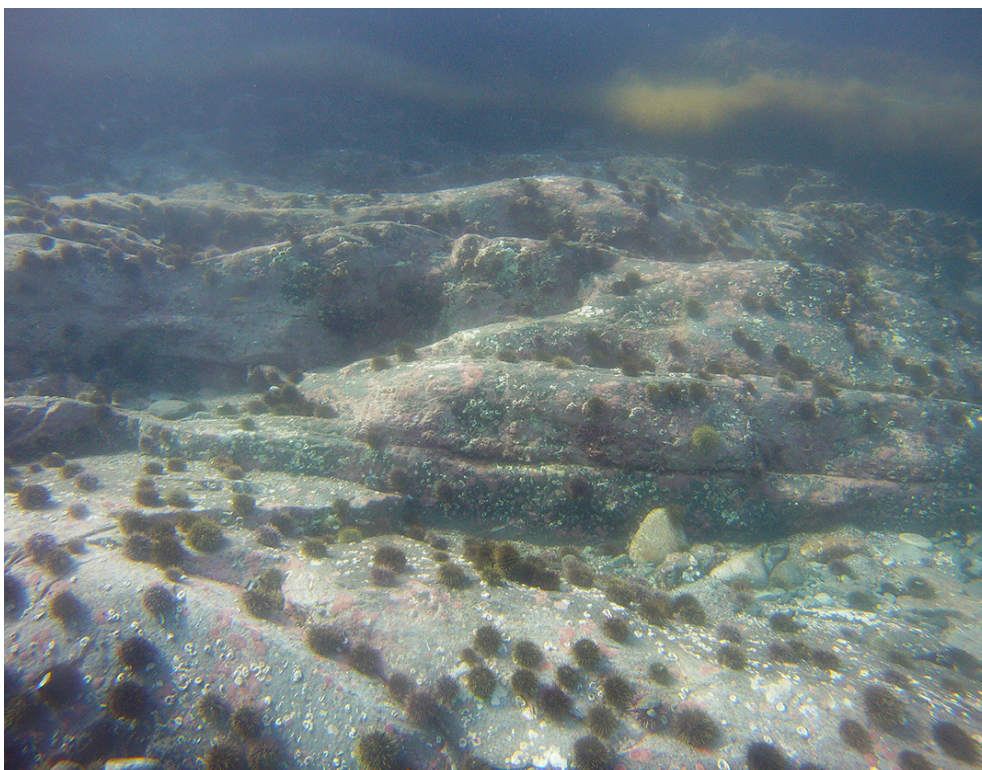


Figure 31. This is what the seabed looks like where the sea urchins have grazed the kelp forest. Credit: Frithjof Moy, Havforskningsinstituttet

Stakeholder involvement

Although, there was not found any evidence that this particular project has mapped or contacted local stakeholders, the stakeholder involvement has been comprehensive in other projects in the restoration of kelp in Porsangerfjorden.

Knowledge sharing and policy facilitating

The project was structured as a research project. As a result, most project-related knowledge is available in the form of articles. Opportunities to directly facilitate policy at a local, national or international level were not identified.

Synergetic adaptation and increased resilience

The project solely relies on public funding, which was mentioned as a limitation to the ambitions of expanding the scope of the project.

Conclusions

The Porsangerfjorden project identified by this paper seems to be very research-oriented with especially focus on restoration of biodiversity and climate mitigation. The project identifies sea urchin grazing as the main driver for kelp degradation and sets up a range of clear and identified restoration outcomes, which were

benchmarked and periodically assessed. Estimations of socioeconomic benefits in regard to the project were not identified, but a general reference to socioeconomic benefits derived from kelp restoration was provided. The project did not have a sustainable land management scope on its own. No participatory or stakeholder collaboration process was identified, as the project is limited to an academic scope.

It was documented that kelp was able to naturally restore after the sea urchins had been removed with quick lime. However, further progress with the project has been halted, partly due to a lack of funding, and due to other projects looking to commodify sea urchins.

Reviewers note:

In the recent years, red king crabs have migrated to the Porsanger Fjord. There have been concerns that the crabs might impose a threat to the restoration of kelp. However, the king crabs eat negligible amounts of kelp and have no role in removing the kelp forests. Thus, there is now abundant kelp forest in the Porsangerfjord, and no urgent need for new kelp recovery efforts.

Furthermore, the stakeholder involvement is comprehensive. The municipality of Porsanger has cooperated closely with the involved scientists since the early 2000s, and the current large scale liming project is a direct consequence of this cooperation, even though its implementation was conducted by Niva and IMR scientists. In addition to this, the municipality is currently leading the Porsangerfjord 3.0 project, which in cooperation with IMR scientists aims to restore the local cod stock and create more value from the king crab at the same time, as its ecological footprint is reduced.

Acknowledgement

We thank Hartvig Christie, senior researcher at the Norwegian Institute for Water Research (NIVA) for providing us with information and background knowledge about project by sending us articles and participating in the interview. Although, the project manager, Hans Kristian Strand for we thank him for redirecting us to Hartvig Christie and taking his time to give feedback on the case study.

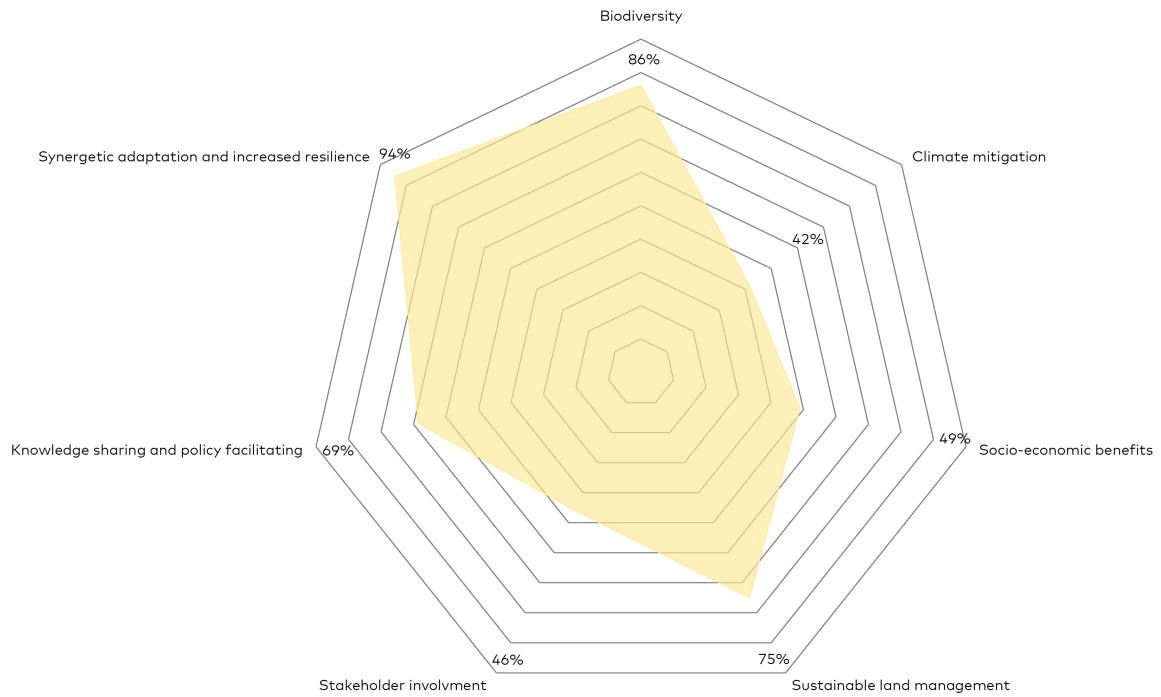
6. Cross-cutting themes from all cases

Based on the IUCN framework for evaluating how well the criteria of the dimensions were met, each criterion was scored from 0–3, where 0 (insufficient) would indicate that a criterion was not addressed nor implemented, 1 (weak) indicated that a criterion was addressed but only implemented with minimal impact, 2 (adequate) indicated that a criterion was addressed and partially implemented, and 3 (strong) indicated that a criterion was addressed and implemented fully. The number of criteria varies between dimensions and therefore their score is calculated as percentages in order to make them comparable.

It is important to stress that even though the cases have been scored, this has not been done to imply a ranking between the cases. The IUCN states that the standard for evaluating nature-based solutions enables users to identify areas for improvement, and that a score over 25% qualifies as adhering to the IUCN Global Standard for NbS. Each case represents a response to a unique set of societal challenges and circumstances.

Overall, the projects were successful at implementing synergetic adaptation and increased resilience. This stems from a prevalent tendency to formulate the intended outcomes and how they should be achieved, from development of monitoring and evaluation plans, and from addressing the need to base management on trial-and-error processes and iterative learning. Two criteria were neglected: 1) integration with other complementary interventions, while seeking synergies across sectors, and 2) incorporation of risk identification and risk management. The cases were also very successful within the biodiversity dimension. This is due to the fact that there is a strong tendency in the project towards identifying the drivers of degradation, clear and measurable biodiversity conservation outcomes, and rigid monitoring. Climate mitigation, stakeholder involvement, and socio-economic benefits are all above 25%, but compared to biodiversity, they represent areas for improvement.

The total score for each dimension in percentages



Figur 32. The total score for each dimension across all cases in percentages.

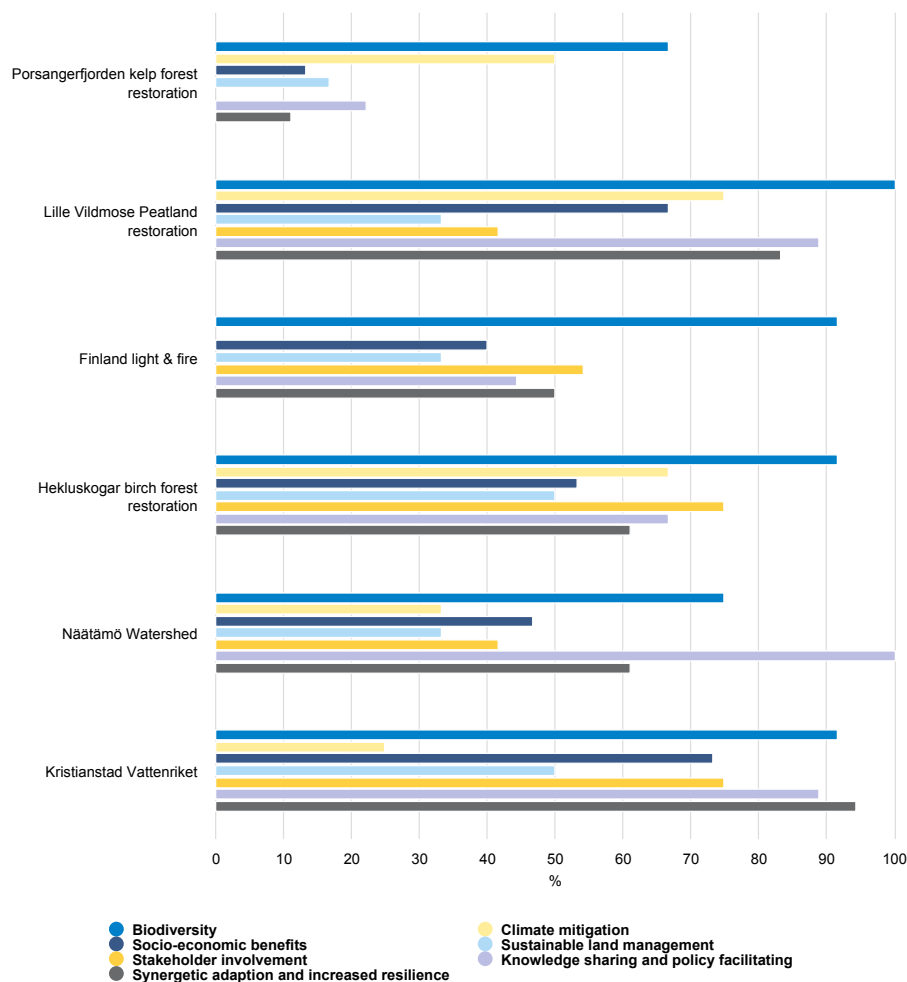


Figure 33. Overview of the score of each case within the dimensions.

6.1 Socio-economic aspects

The socio-economic aspect of the restoration cases was generally lacking. Estimations of derived cost and benefits are a new territory for natural scientists' ecological restoration work, but in the ecologically oriented human and social sciences, these estimations have been an integrated part of their approach for years. Increased integration of project staff with different disciplinary backgrounds is desirable. The work related to the estimations is in some cases costly and has a low certainty, therefore the utility of a project might, in the short run, not benefit from a focus on socio-economic functions compared to the utility from habitat restoration. In a longer perspective, investments in a socio-economic perspective will create cheaper, faster, and more precise tools for estimating costs and benefits. However, the individual restoration projects often perceive increased ecological conditions as their main objective, and socio-economic goals as sub-objective, therefore they are discouraged to bear the cost of developing better socio-economic tools. But also, in the social sciences, the use of cost-benefit analysis in environmental restoration projects is receding as an overall tool, as socio-economic analysis is increasingly being taken over by the broader approach of socio-cultural analysis, where economic benefits are but one element, but where the cultural value of a restoration project for a local population or indigenous people may be of higher value, in the long run, than short term economic benefits or the lack of them.

Ecological restoration taking place in cultural landscapes at a larger scale with many different land uses have benefitted from the establishment of dissemination units in the form of local visitor centres. A close collaboration between restoration projects and visitor centres has improved socio-economic as well as socio-cultural benefits. The socio-economic benefits seem most prevalent in close proximity to the project area, but in some cases, eco-tourism and job creation expands further beyond project boundaries. In both cases, having a local visitor centre raises the level of awareness and brand value of the local area, which was beneficial for eco-tourism and local businesses. Partnerships with nearby development projects serve as an inspiration to create multifunctional ecosystems in other contexts such as urban environments. Ongoing projects are trying to get more influence in the urban development sector, so restoration can be a part of new infrastructures.

6.2 Stakeholder involvement and collaboration

The identification of direct and indirect stakeholders is important for the implementation of restoration projects. Communication regarding planned physical changes is essential for gaining the acceptance of local communities. Resistance or distrust from a local community can downscale the restoration effort and restoring trust can impose an unexpected high cost on the project. If possible, local organisations should be mobilised to support the work, either through payment or through volunteering. Nature-oriented NGOs can also be mobilised to connect with larger networks of motivated individuals. A clear and public project structure for communication and inclusion for stakeholders is highly advisable. Here the benefits are multiple: cost reduction of the restoration action, recreational value for citizens, and a chance to engage in knowledge sharing dialogues. Historical events in relation to degraded ecosystems have often created complex interactions with local stakeholders that can have a positive or negative impact on the process. When physical change is imposed top-down, it is important to engage in dialogue with the affected stakeholders. For example, when restoring ecosystems that hold human production systems, it is important to establish contact with the company or the individuals that might be extracting value from the area. Here narrative interviews, as described in Chapter 7 below, can be a powerful tool for the development of consensus in multifunctional ecosystem services and restoration.

Cases based on partnerships between landowners, municipalities and state agencies have experienced synergies in terms of increased funding opportunities, a broader knowledge base and practical execution methods. Although partnerships can be challenging as the partners need to find common ground and align their aims, the tool of anthropological narrative interviews can catalyse a process of a collective place-based narrative or place-based story making, and can ultimately create a sense of collective belonging, ownership and identity.

6.3 Monitoring and adaptive management

Within all the projects, monitoring has been essential for understanding the drivers of ecosystem degradation and societal issues. In some cases, the project has been able to adapt its management in relation to ongoing monitoring.

Monitoring efforts can be established through different ways in the field of citizen science. For instance, locally based monitoring and community-based monitoring can enhance ownership and built trust in the local society. Synergetic knowledge sharing is ensured through attracting researchers and educational institutions.

Implementing knowledge obtained from previous projects and ensuring continuous monitoring have been successful tools in the planning and management of restoration projects. Continuous dialogue based on ongoing monitoring between stakeholders, project managers and researchers has proven to be a successful way of establishing adaptive co-management.

6.4 Dissemination and knowledge sharing

Conferences have been useful for sharing knowledge with a broader audience and help mainstreaming best practices for ecological restoration, where knowledge sharing is rewarding for both the sender and the receiver. Sister projects have created synergies in sharing practical knowledge with similar projects in other places. Also, alliances with the public education system, from basic school to upper secondary school, can be highly beneficial. Co-production of educational and didactic material with relation to the specific restoration project may generate high social value, both in the short and in long run. This could be done for school subjects such as math, biology, local history, cultural history and what not. Children grow up and will surely remember their excursions and fieldwork in restoration areas.

Local stakeholders trained in documentation methods collected indigenous historical knowledge that was verified by scientists. This created strong local knowledge, which was used to counter the societal challenges met by local communities. Bio-cultural science organisations can facilitate cross-disciplinary work by including cultural values and by including verified stakeholder-collected data in the ecosystem restoration. What characterised the organisations is that they cover a broad geographical area, that they are multicultural and collaborative, and form a strong network for knowledge sharing that gives local stakeholders a voice in the discussion and a place in history.

6.5 Institutional instruments and funding

Funding for ecosystem restoration is an institutional instrument that was used on a local, national, and international level. Local funding stems from regions, municipalities or other sub-national administrative areas. On a local level, funds can reach desired projects more quickly, but are also economically limited, therefore local funding, is best used for smaller projects that do not need much planning. With smaller budgets, extensive and costly planning might not create as much benefit as a more action-oriented approach. As the national and international funding level is

reached, and larger sums are available, it is important to ensure that actions are aligned through an overarching strategy and a set of shorter running action plans, fine-tuning and ensuring practical implementation. This should be paired with a funding instrument capable of screening proposals, monitoring, and documenting the costs and effects. This type of institutional management has been present at projects funded by EU LIFE, which now also require a socio-economic/socio-cultural monitoring and evaluation component.

Incorporating the project in local administrations (e.g., municipality or county level) can help implement the project in existing administrative frames, ensure local funding and take advantage of already existing communication networks. Additionally, broad collaboration with others outside the environmental sectors and project's boundaries helps reach external funding.

Frameworks such as the UNESCO Biosphere Reserve have created transformative changes in people's attitude towards nature, and thus enhancing the acceptance for new restoration projects in the local community and thus producing knowledge for mainstreaming good practices. Preparing and achieving a UNESCO designation may require many resources and a large organisation, therefore it applies mostly to places that already have an existing cultural basis for sustainable development. In Vattenriket, grassroots have over time developed enough momentum and legitimacy to get support from administrative units that made it possible to get the UNESCO designation. The UNESCO Reserve framework has been beneficial in structuring the process. Periodic reviews and reports are overall tools to organise the work. This demands the project owners to position themselves in contemporary standards of ecological restoration and promotes transparency in the process.

7. Project tools

This chapter lists comprehensive processual tools and guidelines for implementation of best-practices in the field of multifunctional ecosystem restoration which have been identified throughout the development of this report. Some of these are included in the six case studies, others can be found in frameworks such as the following:

- The SER international standard for ecological restoration provides guidance on the practice of ecological restoration (SER, 2019).
- The UN Decade of Ecological Restoration Playbook, which is a hands-on guide that helps to identify opportunities for bottom-up restoration initiatives (UN, 2021).
- The Swedish standard, Changing Land Use Impact on Biodiversity (CLIMB) is addressing the challenge of measuring and valuing biodiversity. The standard is still under development, but it is expected to be able to integrate biodiversity into business models, create a basis for green bonds and cost-effective habitat banking (Ecogain, 2022).
- The UN Biodiversity Lab (UNBL) provides a global digital platform for open-source spatial data and analytical tools, for both planners and stakeholders that take part in projects within the field of nature and sustainable development (UNDP, 2022).

7.1 Socio-cultural instruments

Moreover, the current climate and biodiversity crisis has urged Nordic scholars based in the ecological traditions in anthropology and social sciences to actively engage in projects concerning restoration of nature, landscapes, and habitats in their own backyard.

7.2 Narrative interviews

To shed light on the underlying motives for stakeholders' positions in respect to nature restoration projects in general, Narrative interviews can be a useful tool. A way to implement narrative interviews in a project is to carry out a baseline interview at the start of the project, and after a defined set of project actions has been carried out. This tool can help project managers to understand if stakeholders share a common narrative of the project, and if this common narrative includes co-creation and co-ownership. As another outcome, the narrative methodology and the anthropological approach itself have been catalysts of participation, the narrative interview approach appeared to turn what had initially been hesitant and ambiguous attitudes to the restoration project in general, on the part of some of the local landowners, into support of the project after the landowners had agreed to participate in narrative interviews (Hvalkof, 2017a, 2017b).

Experience shows that components of cultural history, prehistory, archaeology, cultural heritage, and local folklore is highly motivating for local stakeholders in

restoration projects and holds great potentials for synergetic effects on the restoration efforts as such. It can be concluded that narrative interviews proved to be a very powerful instrument in the process of creating identity and local ownership of the restoration projects and positive dynamics in project management and local support. But narrative methodologies also generate very different results depending on the type of landowners. Local landowners with a long history and attachment to the landscape, where their families have had economic or subsistence interests in the cases of raised bogs in peat production, have quite a different understanding of the value of restoration than landowners with no personal history of attachment. Thus, narrative methodologies may generate quite different results, although the restoration objective and end-result may be the same. In other words, the route map may be quite different according to the case. There is no size that fits all.

7.3 Multifunctional land consolidation

One of the instruments used in conservation and restoration projects in Denmark involving private landowners is land consolidation. Land consolidation is an institution in Denmark, where the agricultural authorities facilitate a reorganisation of land ownerships in a specific area involving multiple plot owners, through buying, selling and swapping land plots in such a way that smaller plots or dispersed production areas are joined, establishing more effective agricultural production systems and simultaneously facilitating the withdrawal of low value production plots (e.g. low lying soils), leaving them for restoration purposes, for example restoration of wetlands and raised bogs. Participation is voluntary, and it involves a process of negotiation where agreements must be based on consensus between all the involved parties. Land consolidation has been the basis for the realisation of most habitat restoration projects in Denmark. It has turned out to be a very efficient instrument for building acceptance and support of conservation and restoration projects by local landowners, allowing their lands to be incorporated in the restoration of habitats and landscapes.

Two main criteria must be fulfilled:

- a. The landowners must be reasonably compensated in cash or in compensation areas that match the potential they lose.
- b. The agreement to join the restoration project must be voluntary

But also, a third criterion is emphasised, which is particularly interesting in the present context:

- c. That the landowners will be continuously informed of/involved in the restoration process, to guarantee that the land they give up for restoration is used for this purpose.

The last criteria clearly state that the landowners are supportive of restoration processes, and that the use of marginal agricultural areas to this end is seen as positive. This has also been corroborated through interviews and surveys (Hvalkof, 2017a, 2021).

It should be noted here that experience shows that land consolidation, combined with just compensations for land taken out of production and set aside for

restoration processes, is a very powerful instrument, if compensations are reasonable. There has been a tendency from state authorities to squeeze compensation prices to a minimum in the land consolidation negotiations, leaving a trail of disgruntled landowners, rather than giving them e.g., 10% more as an acknowledgement of goodwill and interest in supporting the habitat restoration, which would leave a trail of very satisfied and supportive landowner, who feel that they have contributed something to the common good. The latter would create a win-win situation. By paying minimum compensation, the state will risk spending much more on lawsuits from dissatisfied landowners and losing both momentum and support of the restoration project, with negative spill-off effects on other restoration projects.

7.4 Locally Based Monitoring

Locally Based Monitoring (LBM) and Community-Based Monitoring (CBM) are concepts with roots in Citizen-Science (CS), concepts that can be defined as "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions" (*Oxford English Dictionary, 2016*). However, the use of the term "citizen" has some questionable connotations to state-belonging, formal juridical recognition, and other socio-political issues. Therefore, some biodiversity monitoring specialists have chosen the alternative terms LBM and CBM for these processes to avoid some of the pitfalls. For the simplicity of the argument in this summary, we will use the terms synonymously. SC has become a well-established concept and a widely used methodology and practice that has been documented and analysed in hundreds of scientific publications (Bonney, 2021). The Danish ecologist Finn Danielsen and colleagues (Nordic Foundation for Development and Ecology - nordeco.dk) investigated the extent to which CS/LBM techniques could be used to monitor 186 indicators described in 12 international environmental agreements. The research showed that although 37% (69) of the indicators would require monitoring by professional scientists, 63% (117) of them could be monitored by a range of citizen science activities, exposing a huge opportunity for further growth of the citizen science field (Danielsen et al., 2014b; Bonney, 2021).

Danielsen et al. also made a series of comparative tests demonstrating that data collected by citizen science participants can be more accurate than data collected by professional scientists working on the same issue in the same location, and that community members and scientists produce closely similar results across a range of monitoring methods and types of natural resources monitored (Bonney, 2021).

Besides documenting the scientific validity and quality of Locally Based Monitoring, the method also has other important benefits with a triple win effect: the method a) provides data of value to multiple users beyond the local, b) functions as a catalyst for the emergence of social organisations for monitoring and management, and c) contributes to knowledge generation at the local level about natural resources and resource management in general, and about local practices of resource use in particular (Danielsen et al.). However, the most important long-term impact by Locally Based Monitoring systems for local stakeholders is possibly the strong

process of stakeholder engagement, empowerment, and a sense of ownership engendered by such methodologies and practices.

Citizen Science and Locally Based Monitoring stretches over a continuum of possible monitoring protocols, from full stakeholder control and monitoring with no scientists involved as one extreme, the other extreme being a scenario of monitoring, where the execution, data control and analysis are exclusively done by scientists. The types of monitoring systems of most relevance for the present context in terms of stakeholder involvement and participation are mainly to be found in different hybrid protocols distributed in the middle part of the continuum, the applicability and relevance being defined by the specific empirical context.

Natural resource monitoring and management systems with strong local stakeholder involvement and control have gained foothold particularly in communities whose livelihoods and production systems are intimately linked to the natural environment and its resources, while stakeholder communities with less or no dependency on natural resources may be less motivated to participate actively in participatory monitoring schemes. Particularly indigenous peoples and communities have a strong interest in autonomous monitoring regimes, where indigenous knowledge becomes a key element in both data generation and analysis and in resulting natural resource management strategies. Several attempts have been made to integrate Indigenous and Local Knowledge (ILK) systems in citizen science, community-based monitoring, and other locally based biodiversity monitoring systems (Tengö et al., 2021). According to UNESCO, "local and indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life." (<https://en.unesco.org/links>) It may, however, be relevant to distinguish between indigenous knowledge and local knowledge. Indigenous knowledge is stored in the cultural memory of specific peoples and situated in specific landscapes and places. It has been accumulated during centuries or even millennia of interaction with and use of the natural environment and all its nonhuman components and agents and is often stored in the mythology and cosmology of the indigenous people, which serves as a dynamic storage system of collective experience that may provide information for important decision making and policy decisions when needed by the indigenous people or person in question. It is obviously also a local knowledge system, but not all local knowledge systems are indigenous and may have fundamentally different epistemologies (Hvalkof, 2006, 2013).

8. Nordic policy options

The policy options presented below are based on the investigation of the six cases and inputs from this projects' academic feedback group. Creating the right conditions through beneficial processes will increase the chance of successful outcomes regarding the seven dimensions presented in this investigation. The policy options provide inspiration for policymaker as well as for practitioners starting new restoration projects. The headlines in bold can be found in the executive summary. The policy options are listed in a non-prioritised order.

1. **Promote partnerships around ecosystem restoration projects in order to minimise knowledge gaps, improve funding options, and improve resilience.** Partnerships can potentially generate more knowledge with different perspectives on societal challenges which ought to be solved by the initiative. Having more actors involved can be challenging because of diverging aims that need to be aligned. However, partnerships can increase funding opportunities, as different actors can seek funding options at places such as EU programmes, private companies, and investment funds.
2. **Include modern multifunctional standards in the criteria for funding ecosystem restoration projects.** Earmarking funding for multifunctional ecosystem restoration projects instigates a change away from restoration projects solely focused on biology. A realistic relation between funding size and project criteria should be found. Multifunctional projects constitute a way of increasing value found between sectors by identifying and benefitting from cross-sector synergies.
3. **Promote close contact between projects, authorities and visitor centres.** At the project level, it is recommended to assign a dissemination unit to ecosystem restoration projects early in the process. Many misconceptions can be avoided if the projects' processes are clearly and transparently communicated to stakeholders and the general public. Depending on the scale of the project and available resources, solutions can vary from an individual expert to a local visitor centre. By establishing a close contact between the project' management unit and a local visitor centre, synergies can be generated between the two. Furthermore, having a close connection between the public administration at county or municipality level, project management, and visitor destinations such as a visitor centre often results in strong synergies, allowing for the creation of multifunctional benefits that surpass the initial project plan.
4. **Develop multifunctional land consolidation schemes.** Multifunctional land consolidation exhibits a noticeable parallelism in objectives and management instruments with Multifunctional Ecosystem Restoration in the Nordic Countries presenting important results for comparison and inspiration. Taking part in land consolidation should be voluntary, and landowners should be continuously involved or informed about the restoration process with a guarantee that the

land they give up for restoration is used for this purpose. Regarding potential conflicts with adjacent landowners about unintended adverse effects such as rewetting of their farmlands, a more generous compensation and open-minded land consolidation process, e.g., multidimensional land consolidation, would solve the problem and corroborate the win-win situation of ecosystem restoration projects.

5. **Develop Nordic tools for assessing long-term socio-economic benefits at the political level.** It might be in the Nordic states' overall interest to invest in and supply socio-economic tools as a public good to restoration projects in order to lower the overall cost and help projects optimise the multifunctional value of those restoration projects. Assessment tools for socio-economic benefits in ecosystem restoration projects should be developed in such a way that they can be easily adapted to different contexts and nature types. Furthermore, socio-economic measures should be included in the early phase of project development at the operational level.
6. **Put emphasis on socio-cultural surveys and approaches.** Incorporate some of the personal stories and narratives from interviewed stakeholders in the historical presentation of restoration areas and landscapes in order to create immediate interest and enthusiasm among landowners and other local stakeholders. A huge body of experience shows that the restoration of valuable nature, habitats and biodiversity is much higher valued among local stakeholders if they feel that they have contributed to something great and have become part of history. In particular, methods should be designed that capture the socio-cultural value of local ontologies of the landscape and habitat being restored, as this may create a strong local attachment and a spirit of ownership. However, feeling ownership and belonging is of much higher value, if landowners have no immediate economic loss by selling off or swapping lots for restoration.
7. **Update existing monitoring platforms and make them more user-friendly and accessible for stakeholders.** Utilise monitoring and adaptive management to ensure robust decision making and improved long-run management outcomes. Locally Based Monitoring and citizen science methodologies are essential for adaptive management. However, there is a need for ensuring that stakeholders have access to user-friendly digital monitoring platforms. Lowering the technical and professional knowledge barriers through digital solutions can benefit participation, and it also increases the integration of local stakeholders in adaptive management practices. This practice, which can strengthen a continuous cycle of obtaining knowledge, evaluating, and making management decisions, constitutes a learning process, which will aid projects in responding to changing circumstances, finding efficient solutions, and setting new goals. Ideally, this process includes project managers, stakeholders, and researchers.
8. **Share knowledge on all levels and educate people in modern ecosystem restoration practices at the operational level.** On the Nordic regional level, it is recommended that conferences are held to promote Nordic guidelines for recommended processes in ecosystem restoration projects in order to fill the

post-operational gap. The knowledge sharing should both be aimed towards practitioners, academics as well as laymen in order to mainstream best practice. Representatives of local stakeholder groups from ongoing or finished projects should be invited to participate in such events, where they can share their experiences with the process. Knowledge sharing can also happen through regional and international online databases and platforms. Furthermore, international or national courses on project management in multifunctional ecosystem restoration should be established. At the project level, it is recommended to establish sister-projects for sharing practical knowledge.

9. **Promote bottom-up approaches.** Improve conditions for bottom-up initiatives by acknowledging local stakeholders' rights, by providing local organisations with documentation tools, and by funding. Inclusion of grassroots organisations and indigenous groups can increase the legitimacy of the restoration project, since inclusion is able to produce verified knowledge that demonstrates the human causes of ecosystem degradation and climate change. Furthermore, funding options can be improved for grassroots organisations and indigenous groups when they can document the state of ecosystems, causes of degradation and tested practices. Bottom-up initiatives often consist of highly motivated citizens, and therefore it is crucial to limit bureaucracy and to be careful with direct regulations.

10. **Require collaboration skills in the project group, build up trust among stakeholders and promote pride in the ecological values in the landscape.** Dialogue and collaboration are crucial for inclusiveness and the perceived success of the process by stakeholders, and collaboration with local stakeholders enhances ownership and long-term transformative change. Start the collaboration with stakeholders early in the process. Both forces of agreement and opposition should be identified at this stage. In practice, trust among stakeholders can be enhanced by starting with small projects, and by using best-practice examples of similar contexts to form larger projects and collaborations. Recruitment of local organisations or ambassadors can also be a way to legitimise planned restoration.

9. A future perspective on ecosystem restoration

This catalogue intends to inspire, stimulate, and support many new ecosystem restoration projects in the Nordic region, and may, at best, motivate actions towards addressing the underlying causes for continued ecosystem degradation.

Multifunctional cases like the ones presented in this catalogue contribute with multiple benefits for society and have a potential for supporting the relationship between people and nature. The perspectives presented below look into the future of ecosystem restoration efforts with a multifunctional focus.

Even though natural environments experience a continuously increasing human pressure and pressure from economic interests, and even though radical ecosystem restoration compatible with the increasing demand of ecosystem services can help solving several societal challenges, there will still be a need for ecosystem restoration just for the sake of ecological integrity.

9.1 European nature restoration targets

As a key element in the European Biodiversity Strategy for 2030, the European Commission is proposing legally binding targets for ecosystem restoration, particularly those with the most potential to capture and store carbon and prevent and reduce natural disasters. These targets will build on existing legislation such as the Bird and Habitat Directives, the Water Framework Directive and the Marine Strategy Framework Directive. In addition, the targets will apply on habitats and species not covered by any European legislation, such as urban ecosystems, soil health and pollinators. By implementing binding targets – which are rarely seen in present legislation and directives – with timelines and criteria of restoration, it is expected that these targets will contribute to achieving the goal of the 2030 Biodiversity Strategy. The proposition is under assessment and is expected to be announced by the end of 2022.

9.2 The invisible biodiversity and nature rituals

Nature restoration with a focus on improving human well-being might tend to prioritise the tangible aspects of nature and neglect the invisible parts and often neglected organisms or even whole ecosystems. A stronger awareness on the often-overseen parts of biodiversity – fungi, insects, and other microbial life – is needed. Therefore, a discussion about the often-invisible loss of biodiversity that happens due to destructive land use practices is a natural extension of the ongoing biodiversity discussion. For example, the loss of biodiversity due to the use of pesticides is invisible to most people but is of great importance for the conservation success of biodiversity.

Another example of 'invisible biodiversity' can be found in marine environments. As a result of the inaccessibility of underwater habitats, these habitats are less recognised and valued among the general public compared to commonly accessible terrestrial ecosystems. When small organisms and hidden ecosystems are lost, we lose our relations to them, and ultimately our relation to the natural world. Therefore, we see a need to reconnect to nature – not only to the tangible and seemingly most useful parts of nature. Maybe we need to train our ability to pay attention to the things we currently aren't aware of, and ultimately reinvent new sets of rituals in relation to nature so that a sense of spiritual attachment to the natural world can be re-established.

9.3 Blue biodiversity in urban development

The project Urban Development and Blue Biodiversity (Larsen et. al, 2021), a project initiated by Habitats with the aim to increase awareness of the practical possibilities and manageable qualities that will make it easier to promote 'blue' marine biodiversity in as a natural part of sustainable construction in harbours and coastal areas.

The dissemination is happening through a catalogue of ideas and several exhibitions around the country, with focused on the development, gathering, and dissemination of practically applicable knowledge targeted at developers and their partners and users.

It is also the partners' hope that the result will be able to inspire other countries, especially the Nordic neighbouring countries.

The reconstruction of Nyhamnen in Malmö is an inspirational case for this new blue biodiversity field. Nyhamnen has a clear green profile associated with a blue profile to the sea. The green environments ought to be multifunctional in a way where several functions coexist. For instance, areas for walking, playing or practising casual sports should be designed in such a way that they can delay and retain rainwater in extreme rain events, and with high biodiversity and a good potential for ecosystem services. The reconstruction of the bottom of the harbour basins also focus on biodiversity with a lift from now 8 to 4 meters to facilitate a recreation of the fauna and flora as it was 200 years ago.

9.4 Commercial biodiversity, a business case for marine multifunctional restoration

In the search for cases, we looked into the Urchinomics project, which is an innovative aquaculture venture working to restore kelp forests by turning invasive and ecologically destructive sea urchins into valuable seafood products. Urchinomics' aim is to protect ocean biodiversity while also promoting economic development. The restored kelp forest contributes with carbon binding and sequestration in the form of the kelp itself and the associated species-rich marine life. By creating a better economic alternative to overfishing, the initiative is creating meaningful job opportunities in rural society and supporting a sustainable use of marine

ecosystems. Urchinomics are working across sectors with rural communities, scientists, voluntary divers, and restaurants. With this case in mind, the private sector exemplifies, how to address ecological, socio-economic and biological aspects, and how to achieve multiple benefits for society by unlocking private investments. It will be interesting for decision makers to look further into how such approaches can be implemented in future politics and planning, at a national and regional level.

In many other cases, businesses are gearing up to address biodiversity issues in light of the EU taxonomy regulations that will become mandatory in 2023. Through national, EU and global Business@Biodiversity networks, business has already been a strong voice in developing tools such as restoration to achieve biodiversity net gain.

9.5 Multifunctional land consolidation

Over the recent years, the concept of land consolidation and its use has expanded its inclusiveness and scope evolving into "Multifunctional Land Consolidation", a concept that the Danish Nature Agency defines as land consolidation which facilitates multifunctional projects combining and integrating "agricultural production ...with e.g., biodiversity, reduction of greenhouse gas emissions, climate adaptation, clean aquatic environment, outdoor life, and rural development."

An ongoing Danish anthropological research project in cooperation with project partners from "EU LIFE IP Nature man – the farmer as a manager of nature" (<https://life-natureman.dk/english/>) in northern Jutland (*Local land acquisitions: Landscape tales and collective efforts of multifunctional land consolidation 2021–2024* (Krøijer 2020)) is currently developing the multifunctionality of land consolidation using the mentioned narrative interview methodology framed by the anthropology of landscape (Hirsch, E. and M. O'Hanlon 1995), where landscapes are understood as a continuous process of co-creation between multiple agents, humans as well as nonhumans, and not just a passive canvas for human activity.

Multifunctional Land Consolidation exhibits a noticeable parallelism in objectives and management instruments with Multifunctional Ecosystem Restoration in the Nordic Countries, presenting important results for comparison and inspiration for policy makers.

9.6 Habitat banking

Habitat banking, or biodiversity banking, is a possible instrument for nature compensation with biodiversity offsets. It is based on the principle that biodiversity loss, as an effect of economic development, can be compensated equally with biodiversity gains elsewhere. With that in mind, stakeholders can buy and establish areas of nature, which translates into a nature or biodiversity credit, which then can be traded and bought by other stakeholders in need of compensating for a project. In addition, it is also seen as a trading system combining the need for compensating nature and the societal trend involved in creating new areas of nature and hoping for a more sustainable future.

In the Nordic Countries, a version of habitat banking is used by private developers

and NGOs, but the tool has the potential to become an innovative financial instrument used by every government, or even as a European legislation, in regard to achieving the goal of the 2030 Biodiversity Strategy. Before the tool can be used governmentally, a compensation rate, a nature valuation scheme and criteria for biodiversity needs to be established.

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Expert panel

Finally, we thank the group of academic experts that have been consulted throughout the process and have provided feedback and quality assurance in the manuscript for this report. The expert group consist of the following persons:

Søren Hvalkof¹ is a social anthropologist from the University of Copenhagen. He is specialised in environmental anthropology and political ecology and is the owner of a consultancy company. He has done extensive research in the Amazon Basin, and numerous consultancies and projects on territorial issues of indigenous peoples in Latin America, as well as nature restorations projects in the Nordic countries.

Christian Prip² is a senior researcher at the Fridtjof Nansen Institute Norway.

Sarah Carlsén³ is an environmental consultant with expertise in ecosystem restoration. She works with environmental impact assessments and evaluation of ecosystem services.

Niklas Lindberg Alseryd⁴ is a senior with long experience in challenging permit trials related to species protection and Natura 2000. He is often given the role of independent third-party reviewer and authorities regularly hire him for research-related assignments.

Nina von Lachmann-Steensen⁵ is an anthropologist with expertise in sustainable development.

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