Centre for Economic Development, Transport and the Environment

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Centre for Economic Development, Transport and the Environment for Lapland

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Foreword

The NATNET Life+ project was launched in 2012 to increase ecological connections and coherence in South-West Lapland, particularly across conservation areas that are part of the Natura 2000 network. The project was carried out as collaboration between the Lapland ELY Centre (Centre for Economic Development, Transport and the Environment for Lapland), the Natural Resources Institute Finland, Metsähallitus and the Finnish Forest Centre in partnership with the Forest owners' association of Länsi-Pohja.

This report presents the actions carried out during the project and assesses the significance of the work to the ecological connections in the project area. The following people participated in preparing the report: Esa Huhta (calypso orchid and ecological connections) and Ari Nikula (Zonation and ecological connections) of the Natural Resources Institute Finland; Pauliina Kulmala (calypso orchid) and Mika Puustinen (mire restoration, nature management) of Metsähallitus; Pentti Olli (mire restoration, controlled burning) and Jukka Vähätaini (nature management plans) of the Finnish Forest Centre and Antti Tolonen, Jouni Rauhala and Sari Sivonen (establishment of METSO areas, counselling on natural values, common planning and overall project operations) of the Lapland ELY Centre.

We would like to thank all employees, partners and landowners involved in implementing the project. We would also like to extend a special thanks to the father of the project idea, Kyösti Palojärvi.

Rovaniemi, November 2017

Jouni Rauhala

Table of contents

Photo by Eerika Tapio.

Introduction

Natural environments that are rich in biodiversity are stable and resilient to changes. A decrease in biodiversity weakens the ecosystems' ability to adapt to, for example, climate change. The various forms of land use alter and fragment the habitats of local species, thus causing decrease in biodiversity. The disappearance of habitats deteriorates the quality and the living conditions of different species, reduces population sizes and increases the risk of extinction. The loss and fragmentation of habitats are the primary reasons for the decrease of biodiversity and the weakening of ecosystem functions not only in Finland but globally. Changes in forest habitats are the primary reason for the endangerment of 693 species in Finland (30.8% of all endangered species) (The 2010 Red List of Finnish Species). Less than 1% of the 10 million hectares of forest in the METSO programme area (the Forest Biodiversity Programme for Southern Finland) are natural forests. Approximately 1% of the area is protected.

The objective of the NATNET Life+ project was to increase the ecological connections and coherence in South-West Lapland, especially between the Natura 2000 conservation areas, in 2012–2017. The ecological connections most suitable for the project's objectives were mapped using Zonation analyses, which made it possible to target actions in areas where they could best contribute to maintaining biodiversity. A total of 121 permanent, privately owned conservation areas were established during the project under the auspices of the METSO programme. The total area covered by the conserved areas is over 2,800 hectares. This amounts to over a third of the METSO programme's goal in the entire province of Lapland (9,120 ha).

The project carried out restoration and nature management actions across more than 1,100 hectares of land used mostly for forestry, improving the biodiversity of the areas. Plans for restoration and nature management covering an area of 1,514 hectares were devised for the actions. In addition to establishing conservation areas and implementing restoration actions, nature management plans intended to replace forestry development plans were devised in the project area for private forest owners, across an area of more than 5,000 hectares. In addition to extensive briefings, the project gave counselling on natural values to forest owners to provide them with comprehensive and up-to-date information on the various options available for attending to biodiversity in their forests.

The endangered and protected calypso orchid (*Calypso bulbosa*), listed under appendices II and IV of the Habitats Directive and a Finnish species of special concern, was chosen as the project's indicator species. An inventory of all known calypso orchid findings within the ecological corridors defined through the Zonation analysis was compiled in the project. Suitable sites were searched for more calypso findings.

The NATNET Life+ project was funded by the European Union Life+ fund, and a majority of the national funding was covered by funds from the METSO 2008–2025 programme. The project was coordinated by the Lapland ELY Centre, in partnership with the Natural Resources Institute Finland, Metsähallitus and the Finnish Forest Centre. The Forest owners' association of Länsi-Pohja was also a partner in the project.

Photo by Eerika Tapio.

Image 1. Due to long-term forestry practices, Western taiga (9010) is primarily only present in conservation areas. The project created over 480 hectares of protected Western taiga. Photo by Kari Kemppainen.

Mapping and planning ecological connections in the network of protected areas

Common planning in the project area

The NATNET Life+ project covered an area of 542,000 hectares in a boreal zone in South-West Lapland, in the area known as the “Lapland triangle”. The calcareous and eutrophic soil in the “Lapland triangle” has yielded exceptionally diverse habitats in the naturally harsh conditions of the North, harboring several endangered species. A total of 80,140 hectares of the project area (inside the project area specification) are included in previously established Natura 2000 areas; one of the specific objectives of the project was to increase the ecological connections and biodiversity of the Natura areas and to ensure the preservation of rare and endangered species in the areas. The largest Natura areas partly or completely located in the project area include Kilsiaapa-Ristivuoma, Suuripää, Mustiaapa-Kaattasjärvi and Kirvesaapa. The habitat types on which the protection of the Natura areas is based include alkaline fens, aapa mires, bog woodland, natural dystrophic lakes and ponds, Western taiga, Fennoscandian herb-rich forests with *Picea abies* and Fennoscandian natural rivers. In 2016, the Ministry of the Environment prepared a proposal to supplement the network of protected areas with habitat types including active raised bogs, transition mires and quaking bogs, Fennoscandian springs and springfens,

Image 2. Aapa mires (7310) were the most prevalent individual Natura 2000 habitat type in the conservation areas established in connection with the project. They also include areas that fall under alkaline fens (7230) and bog woodland (91D0). Aapa mires are a typical combination type mire in Northern Finland. Nutrients from the mineral-rich soil surrounding the mires flow into the mires, specifically during spring floods. Photo by Antti Tolonen.

Table 1. Distribution of the most common Natura habitat types in the NATNET Life+ project area.-

	Natura 2000 areas		Areas outside Natura areas	
Aapa mires	45,191 ha	44.3 %	2,232 ha	10.0 %
Bog woodland *	16,458 ha	16.1 %	1,700 ha	7.6 %
Western taiga	15,399 ha	15.1 %	883 ha	4.0 %
Alkaline fens *	6,839 ha	6.7 %	380 ha	1.7 %
Fennoscandian herb-rich forests with Picea Abies	465 ha	0.5 %	163 ha	0.7 %
Natural forests of primary succession stages of land upheaval coast	309 ha	0.3 %	53 ha	0.2 %
Other Natura habitat types	5,599 ha	5.5 %	14,320 ha	64.2 %
Other habitat types (non-Natura)	11,789 ha	11.5 %	2,583 ha	11.6 %
In total	**102,049 ha**	**100.0 %**	**22,314 ha**	**100.0 %**

*including bog woodland overlapping combination type bogs

Images 3, 4, 5 and 6. Bog woodland (91D0) was a common Natura 2000 habitat type in the conservation areas established in connection with the project. Bog woodland was often found as part of and also classified as an element of aapa mires (7310).

Image 3. A dwarf-shrub pine swamp. Photo by Jouni Rauhala.

Image 4. An Equisetum sylvaticum spruce mire. Photo by Kari Kemppainen.

Image 5. An alkaline fen swamp. Photo by Antti Tolonen.

Image 6. A sedge pine swamp. Photo by Antti Tolonen.

Fennoscandian decidious swamp woods and Fennoscandian herb-rich forests with Picea Abies.

The goal of the NATNET Life+ project was to promote, maintain and preserve biodiversity. A specific objective was to increase the coherence of the Natura 2000 network by establishing new conservation areas. Due to the extensive project area, the variety of different measures and the fragmented nature of the source data, it was deemed necessary for the project crew from the different organisations to convene regularly for common planning. The planning process was launched by compiling all the required geographical data from the different organisations. As the project engaged the parties in possession of the forest resource data of both privately owned and state forests, a comprehensive understanding of the project area was achieved early on.

The planning process was implemented in two phases. During the first phase, areas with the potential for ecological connections were identified using geographical data. Proposals from forest owners for areas to be conserved were included in the initial assessment. At the beginning of the project, a notice was submitted to request protection area proposals from the landowners. Another important element was getting communal forests and forestry companies interested in the project. As part of the planning process, a two-stage inventory was initiated at the earliest possible stage, which provided data on the proposed privately owned habitats. In the second phase of the planning process, following the assessment of geographical data, the selection of habitats and the planning of actions in detail took place in the field *in situ* in connection with the different actions.

A total of nine more extensive planning meetings took place as part of the planning process, attended by all parties included in the project. In addition to these, over 40 smaller planning meetings were held. The more extensive planning meetings focused on plans covering the entire project area, while smaller meetings usually dealt with planning some individual action or habitat. The planning meetings prepared the different actions so as to support the project's aims across the entire project area. The meetings were also important for their role in ensuring that all parties included in the project were kept up-to-date on the progress of the various actions. This also reduced expenses and avoided overlaps in, for example, terrain inventories.

The use of Zonation software in prioritising conservation values

The privately owned land in the NATNET project area included approximately 145,000 forest compartments or other habitat types and the project areas owned by Metsähallitus included approximately 43,000 similar compartments. Processing the data of approximately 188,000 compartments and manually searching for potential conservation areas would have been an insurmountable task without the possibility to analyse the nature values of the compartments using Zonation software. Zonation was developed by the University of Helsinki to support decision making of locating and optimising conservation areas among numerous candidates. The analysis and evaluation of forests and other nature areas is based on located data concerning their characteristics. Zonation analyses are based on the characteristics of the target areas and an examination of the habitat types in the surrounding areas. In analysing areas larger than an individual forest stand or other habitat types, the user can weight, for example, the connections of the areas. In analysing location properties, the user can choose to weight a desired forest or other habitat type, which allows taking into account the characteristics typical of each examined area. Zonation analysing yields a map of the examined forests and other nature targets ranked on the basis of their conservation values. A detailed description of Zonation analysis is presented by Nikula et al. (2017).[1]

The first phase of Zonation analysis involved defining the characteristics and other properties that indicate the diversity of forests and other habitat types. In mineral soil, the key objective was finding old forests including plenty of deciduous trees. As

1 Nikula, A., Miettinen, J. and Nivala, V. 2017. A general overview of Zonation analysis. In: Sari Sivonen (ed.) Increasing the ecological connections and coherence of the Natura 2000 network in South-West Lapland 2012–2017. Report of the planning process. Centre for Economic Development, Transport and the Environment. Regional viability 2/2017. p. 14–31.

Image 7. The protected lady's slipper orchid (*Cypripedium calceolus*) is listed under appendices II and IV of the EU Habitats Directive. Photo by Päivi Paalamo.

forestry planning data do not directly define forest biodiversity values, the team used data regarding the species, tree diameter and site type as proxy information. In peatlands, biodiversity value was determined on the basis of mire type, drainage status and the occurrence of brooks and specific endangered species. Unditched calcareous mires of mire types were rated to be the most valuable in terms of biodiversity. The presence of the Calypso orchid (*Calypso bulbosa*), the lady's slipper orchid (*Cypripedium calceolus*), marsh saxifrage (*Saxifraga hirculus*), the Siberian jay (*Perisoreus infaustus*), the black woodpecker (*Dryocopus martius*) and the three-toed woodpecker (*Picoides tridactylus*) in a forest or mire raised the biodiversity value of the target area. These species are listed in the EU Birds and Habitats directives. A peregrine falcon (*Falco peregrinus*) nesting within 1 km from a bog area also raised the conservation value of the mire.

The forest planning data regarding forests and mires on privately owned land was provided by the Finnish Forest Centre and the data on state-owned land by Metsähallitus. The data was supplemented with forest resource data generated by the Finnish Forest Research Institute/Natural Resources Institute Finland and maps supplied by the National Land Survey of Finland. Data regarding the distribution of the species listed in EU directives as well as specific other species was supplied by the ELY Centre, the Finnish Environment Institute and the Tiira system of BirdLife Finland.

A total of 26 combinations of forest tree species and site type were defined and then rated according to their biodiversity characteristics. Similarly, nine prioritised criteria combinations were created to rank mires on the basis of mire type and other properties. For the purpose of performing Zonation analyses, three more habitat models were created specifically for bird species in old forests, the calypso orchid and the lady's slipper orchid. Occurrences of scree, rocky terraces of the ancient seas and ice lakes typical of the NATNET project area, also formed a separate layer of analysis. A total of 37 layers of criteria were used in Zonation analyses and calculated for 50 m × 50 m areas or grid cells in the project area. A total of 2.3 million grid cells were used in the analysis.

Other analysis criteria included the connectivity of forests and other sites with conservation areas, other Natura 2000 areas and areas protected in accordance with the Forest Act. In practice, connectivity means distance from similar forests or conservation areas and is used to describe the likelihood of species migrating between target areas located at varying distances from a specific site. For example, connectivity with conservation areas means that the probability for a species to migrate to target area is 50% lower in an area two kilometres away from the conservation area compared with target area adjacent to conservation area. Similarly, the distance of areas protected on the basis of the Forest Act was determined to be 100 metres.

The analysis process yielded three slightly different final result maps, which will hereinafter be referred to as the variants. The first variant, or the best ecological model, covered the entire project area and all landowners. The best ecological model was produced using a starting point where all the forests and other habitat types of the area were ranked on the basis of biodiversity values and connectivity regardless of ownership (private or state). Because only privately owned land are qualified for conservation in the METSO programme, Zonation analyses were also used to create a "private land variant", which served to find the privately owned sites with the highest conservation value. The third variant, the "corridor variant" was created using the specific Zonation software designed to locate ecological corridors. The starting point for corridor planning was to find a network of old forests that optimally connect with each other and Natura 2000 areas that allows species to disperse between areas. By acquiring valuable conservation sites along the corridor network, it is possible to secure ecological connections between different areas in the future.

Finally, Zonation result data were combined with the compartment-wise forest planning data of both private land and state-owned land, and the combined data regarding their respective areas were submitted to the Finnish Forest Centre and Metsähallitus. The forest planning data supplemented with Zonation analysis result data can be used to search further sites with, for example, the best combination of tree species, soil and age of forest stand. The target sites identified for conservation using Zonation analyses and compartment data were also assessed on site to check their eligibility for METSO agreements. If also the field inventory showed that the location complied with the METSO criteria, the landowner was offered a conservation agreement.

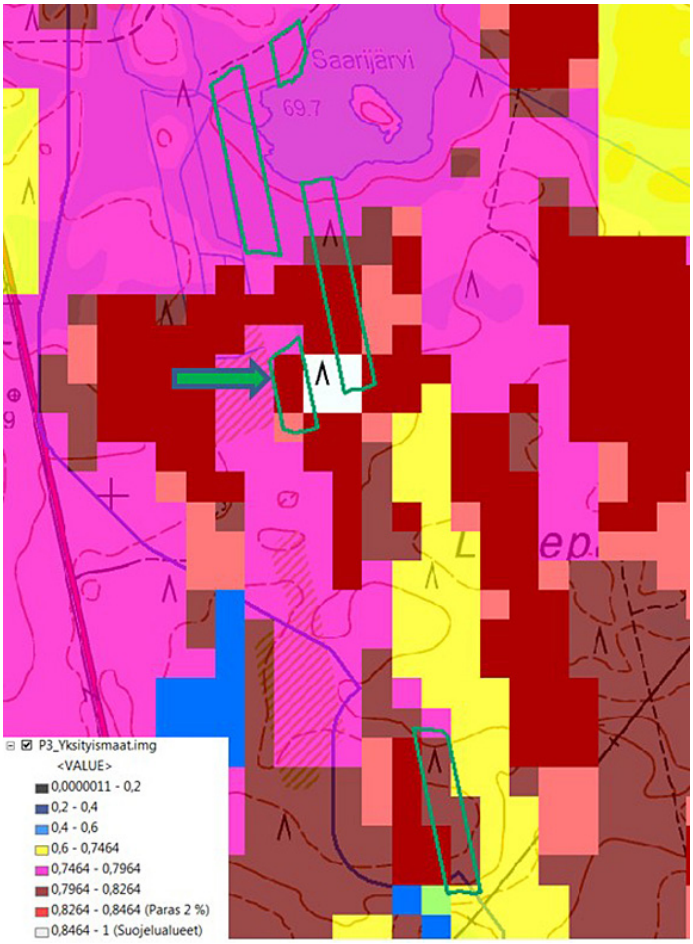

Image 8. Zonation map.

Case example of utilising a Zonation analysis

The Zonation analyses undertaken in the project were utilised in selecting the METSO habitats. Our case example comes from Louepalo in the Municipality of Tervola. In 2014, two separate private conservation areas (YSA areas) were created in the habitats marked with green borders in the image 8 on the left. They are located on the lands of two different estates. The location indicated by the arrow emerged in the preparatory phase of the Natural Resources Institute Finland's (LUKE) analyses, during which the institute's researchers explored the habitat on foot and found it highly suitable. The habitat consisted of, for example, a 200-year-old spruce grove as well as old-growth, large aspens, and its site type was that of mesic and herb-rich forest. There were also several calypso growths within the area.

Following the discovery, the Lapland ELY Centre contacted the landowner and inquired about their readiness to conserve the habitat. After a joint excursion around the area, an agreement was reached to conserve a total of 16 hectares, divided into four sections. Along with the initial habitat, the conservation plans were made to include, for example, bog woodland and alkaline fens.

Image 9. Members of the NATNET project crew in an aspen-dominated old-growth forest that was located with the aid of Zonation analysis. The forest was later conserved on the basis of an agreement with the landowner. Photo by Janne Miettinen.

Landowner-oriented nature conservation

Cooperation with landowners

Most of the project area in South-West Lapland and the different actions of the project were situated in privately owned areas. This is why it was important to inform the forest owners of the possibilities of the project directly as well as to make nature value counselling a part of the forest owner cooperation. The nature reserves were based on the proposals of the landowners, which meant that extensive visibility and smooth cooperation were needed to achieve the project goals. A notice letter was sent to all landowners in the area immediately after the project was launched. The letter presented the goals of the project and the landowners' opportunities for concluding voluntary conservation agreements and gaining a forestry development or nature management plan that observes natural values. The letter included an enquiry on the landowner's willingness to participate in the project actions. In February 2012, the letters were posted to a total of 2,800 landowners in the project area. Get-togethers were also organised during the project. The meetings held in different villages helped to offer landowners more information and bring them together to share experiences of different conservation solutions. Previously, information was mostly available from traditional forestry operators and was mostly based on so-called "hard" forest treatment methods.

Nature value counselling was an important part of stakeholder cooperation and involved distributing information to landowners concerning the different options for taking natural values into account in their forests. Nature value counselling served to establish optimal cooperation with the landowners;

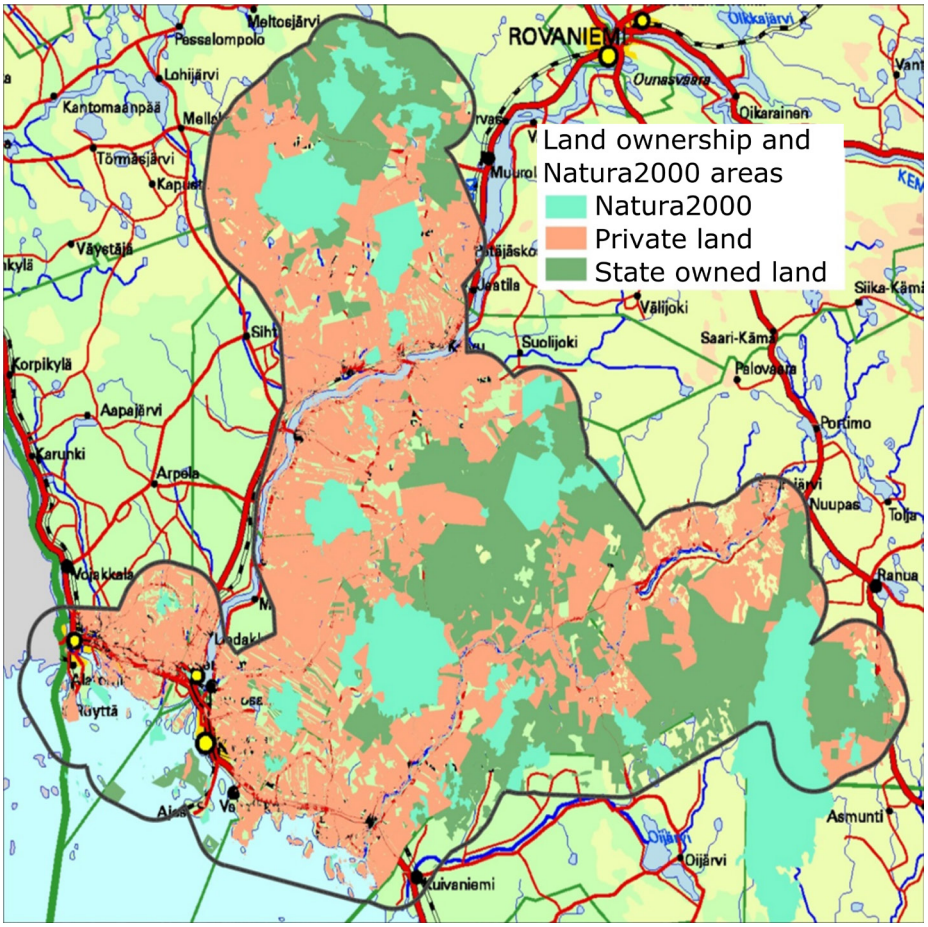

Image 10. Landownership in the NATNET Life+ project area and Natura 2000 areas.

Image 11. A NATNET Life+ briefing for landowners in Tervola in 2012. Photo by Eerika Tapio.

for example, personal meetings helped to create a trusting relationship and to offer detailed counselling. The project made a cooperation agreement with the largest forest owner organisation in the project area, the Forest owners' association of Länsi-Pohja. The association distributed information to the forest owners regarding the project and its actions. Information flowed both ways: the association also delivered information to the Lapland ELY Centre on potential conservation areas with the consent of the landowner. Moreover, the association conducted terrain inventories at the conservation sites and some of its personnel attended project briefings. The project also involved cooperation with all the other forest owners' associations in the project area, and all the project operators took part in counselling on natural values.

Nature value counselling took many forms in addition to landowner letters and one-on-one meetings: the project included briefings and village get-togethers as well as phone and email communications with landowners. Nature value counselling also included training for officers in the forestry industry to discuss the selection of METSO areas and the different project actions. The training highlighted that protection is not a threat to forestry; instead, protection is often the most financially sound solution for low-yielding sites or areas that are difficult to restore.

Information was actively distributed in social media and project employees participated in numerous public events. A website and a Facebook page were also created for the project, and a traditional printed project leaflet was published. The project received excellent added exposure in regional radio and in television broadcasts and newspaper articles. The role of information distribution was significant in helping reach the project's conservation goals.

Image 12. During the project, forestry professionals were trained to identify conservation areas at their worksites. Photo by Eerika Tapio.

Image 13. NATNET Life+ project info point at the Northern Finland Outdoor Life Fair in 2013. Photo by Eerika Tapio.

Nature management plans

Nature management plans were prepared with the aim of taking the diversity values of the area into consideration and providing recommendations to retain and increase these values. The purpose of the plans was to create ecological connections in the project area as a part of the other actions of the project. The purpose of nature management planning is to provide an alternative for traditional forest development plans which usually focus on maximal wood production. A nature management plan includes basic information about the forest (habitat type, tree species and other vegetation), information regarding sites that fulfil the METSO criteria, compartment-specific recommendations for the preservation and increase of natural values, and instructions for logging and forest management in accordance with the forest owner's objectives. Compartment-specific recommendations may include bog restoration, ensuring a sufficient percentage of deciduous trees in connection with early stand management or thinning, leaving areas uncut or performing light selection felling in forest areas with different age structures.

The Finnish Forest Centre was in charge of making the nature management plans. Before beginning planning, the Finnish Forest Centre investigated the preconditions for preparing the plans. Plans were not made for all the offered locations. In these cases, the reason was usually the fact that the site primarily consisted of, for instance, a seedling stand or clearcutting areas. The aim was to create the plans for areas with more potential for biodiversity.

Planning was started with negotiations between the planner and landowner to examine the landowner's objectives regarding wood production, nature management and forest treatment. The nature management plans took the landowners' wishes into consideration regarding, for example, game management, landscape and diversity. After the meeting, the planner performed a terrain inventory at the site, and soil and tree stand information was defined for each compartment. The amounts

Image 14. The quantity and quality of tree stands were key factors in planning nature management and calculating conservation compensation. The assessment was performed according to tree species, usually using the angle-gauge method.
Photo by Eerika Tapio.

of decayed wood vital for biodiversity as well as information on tree species were also specified in the tree stand information. The planner additionally recorded all the endangered vascular plants. Counselling on nature management was also provided in connection with submitting the plan. The planner presented both the content of the plan and the action proposals to the landowner. The nature management plans prepared during the project were free for the landowners.

A total of 27 nature management plans were prepared for 35 estates, covering an area of 5,018 hectares. The nature management plans also served as a foundation for establishing conservation areas across 710 hectares. In addition, the planning took into account the sites in need of restoration, and some restoration work was also implemented during the project.

Preparing conservation agreements and establishing nature conservation areas

Nature conservation areas were established in the project area in order to promote biodiversity and ecological connections of the Natura 2000 network. A total of 121 new conservation areas were established during the project, spanning an area of over 2,800 hectares. The nature reserves were established within the framework of the METSO programme (the Forest Biodiversity Programme for Southern Finland), which is intended to stop the decline of wooded habitat types and forest species and to establish the favourable development of biodiversity. The implementation of a METSO protection programme usually begins with the landowner's proposal to place an area they own or a part of it under protection. After this, a representative from an ELY Centre preliminarily inspects the natural values of the site with maps and aerial images and, if necessary, on site. With the landowner's consent, a tree stand assessment and a more detailed specification of natural values is carried out. After this, a potential protection method, i.e. selling the area or establishing a private conservation area, is negotiated and agreed. In the NATNET Life+ project, the implementation method was, without exception, the establishment of a permanent nature reserve with the site remaining the property of the landowner. The negotiations also cover the protection regulations and limitations of the conservation area. After the negotiations, the ELY Centre makes the landowner an offer on a conservation compensation or purchase price. The compensation is mainly based on the value of the tree stand and, in cases of purchase, the value of the soil is added to the price. If the landowner is satisfied with the offer, they will sign a sales contract or a written consent. After the ELY Centre has made a decision on establishing a private conservation area, the case is forwarded to the administrative court. If appeals regarding the case are not received within the prescribed time, the administrative court will concede that the decision is legally valid. After verifying the legality of the decision, the compensation is paid to the landowner tax-exempt in one instalment. The conservation area is recorded in the land register, maps and, if necessary, the terrain.

The voluntary conservation agreements concluded during the project yielded over MEUR 4.0 in tax-expempt compensation to landowners. As protection often constitutes an alternative to cutting, the compensation was mainly based on the value of the tree stands. Tree stands were evaluated on the basis of tree species and wood product. The unit price for tree stands was the average price for area-specific stumpage sales felling during three years, in accordance with the Natural Resources Institute Finland's statistics database and adjusted on the basis of stand difficulty factors. Stand difficulty factors include area size, location, felling conditions and the hectare-specific quantity and quality of the stands. The sum was reviewed with a so-called total value adjustment to establish the net value of the site. The total value adjustment is a percentage reduction assessing the costs caused by owning, restoring and managing the forest. The reduction is usually 5–25% of the gross price. The conservation areas sometimes include small quantities of sapling stands, which can be included in the area in order to, for example, clarify the boundaries of conservation areas or as areas of developing biodiversity values. The sapling stands were priced according to tree species, habitat and stand length, thickness and quality. As the areas

Images 15 and 16. Runs and brooks (3260 Water courses of plain to montane levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation), including the waterfront areas, are significant habitats for biodiversity. Photos by Antti Tolonen and Eerika Tapio.

remained in landowner's ownership after private nature conservation area was established, the value of the soil was not compensated. The protection orders did not significantly adjust the recreational use of the selected area, meaning no compensation was paid for recreational use. Any construction rights regarding the sites were limited to areas outside the reserves.

Table 2. Natura habitat types were inventoried in the METSO areas that were established by the end of 2016. The habitat type distribution is presented in the table below.

Natura habitat type	Area (ha)
1130 - Estuaries	0.01
3130 - Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto- Nanojuncetea*	1.4
3160 – Natural dystrophic lakes and ponds	3.47
3260 – Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	2.63
6270 – Fennoscandian lowland species-rich dry to mesic grasslands	1.42
6430 - Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	1.01
6450 – Northern boreal alluvial meadows	0.39
7110 – Active raised bogs	0.99
7140 - Transition mires and quaking bogs	23.42
7230 - Alkaline fens*	35.43
7310 - Aapa mires*	1,301.06
9010 – Western taiga	501.18
9030 - Natural forests of primary succession stages of land upheaval coast	121.96
9050 - Fennoscandian herb-rich forests with Picea abies	108.30
91D0 - Bog woodland*	253.44
91E0 - Alluvial forests with Alnus glutinosa and Fraxinus excelsa	0.6
Non-Natura type	478.61
IN TOTAL	**2,835.32**
*Aapa mires include 211.40 ha of alkaline fen and 711.71 of bog woodland	

Photo by Eerika Tapio.

Nature management actions and restorations

Planning of restorations, production of decayed wood and controlled burnings

Means for creating a more connected network of protected areas include preserving and increasing biodiversity and reducing the fragmentation of habitats. The project was designed to implement different nature management actions, such as improving, maintaining and restoring habitats. Planning is a vital part of restoring habitats, and all the implemented actions were based on premeditated plans. Restoration planning includes making an inventory of the natural values and endangered species of the area and assessing the current state of the area to be restored. The plans prepared during the project defined the objectives of the actions and laid out the restoration actions, taking into account the effects of the actions on water systems and, in terms of forest restoration, the amounts of decayed wood. In addition to assessing the effects of restoration, the plans included calculating the costs of the actions and laying out plans to monitor the work in the planning area.

The objective of the project was to implement various restoration and nature management actions in an area spanning more than 1,000 hectares. The area consisted of private land, Natura 2000 areas and the forest management areas of Metsähallitus. Some of the restoration plans of the Natura 2000 areas had already been made by Metsähallitus before the project was launched. For most of the areas, the plans were made during the project. Metsähallitus was in charge of drafting the plans for state-owned land, whereas the Finnish Forest Centre was in charge of the plans for privately owned land. All in all, restoration and nature management plans were made for an area covering 1,514 hectares.

Mire restorations

The primary mission of nature reserves is to preserve biodiversity. Biodiversity entails the diversity of nature habitats, diversity of species and genetic diversity. Restoration actions are intended to improve the value of these properties, which has been impaired by human activities.

The goal of mire restorations is to return ditched mires into their natural state. The first step is to attempt to restore the hydrological balance of the mire, involving the peat, dried up due to ditching, gradually absorbing humidity. Simultaneously, forest vegetation gives way to peatland vegetation that covers the mire in a few years' time. When the water level remains high, the vegetation begins to form peat - the restored mire begins to function normally again. Another objective was to restore the original peatland landscape. The restoration of the vegetation and landscape gradually leads to other mire species returning. However, mire restoration can take decades. In Lapland, mire restoration is most extensively needed in South-West Lapland, an area of extensive ditching that includes much of the rich land of the "Lapland triangle". Restoration performance is monitored at each site. The sites are monitored for water level, changes in vegetation and tree stand and the impacts of technical restoration work.

Mire restoration involves blocking forest ditches and, if necessary, constructing dams to ensure successful restoration. Trees are removed along the ditch lines to allow excavator work. Filling up all the ditches expedites the mire restoration process. If necessary, trees are also felled in the compartments located in the restoration area. The objective of felling is to imitate the condition of the tree stands in the mire before ditching and to reduce evaporation due to trees that slows the restoration process.

At the sites of the Finnish Forest Centre, a sufficient number of dam walls were constructed in the restoration compartments using tree trunks that

Image 17. Ditches were mechanically filled during mire restoration. The fill primarily consisted of earth dug in connection with ditching. Photo by Jouni Rauhala.

Image 18. An entirely filled ditch will blend into the landscape within a few years. Photo by Mika Puustinen.

had been felled and trimmed in the restoration site. The trunks were sharply bevelled at the base and pressed into the peat using the excavator ladle, side by side across the ditch. The dam structure was further reinforced using horizontal pile driving. The wooden dam was sealed with filter cloth and peat. The dam wall constructions prevent the erosion of the peat and earth in the filled ditches and expedite mire formation by directing the surface water to an extensive area. The filter cloth prevents solid material from travelling to the filled forest ditches and from there into bodies of water below the area. Dam constructions helped restore the bed of a brook at the Kätkäjärvi site.

The project also involved restoring mires from the viewpoint of game management in forestry areas owned by Metsähallitus. The mires restored during the project were treated to improve the living conditions of the willow grouse and bean goose. Restoring the habitats of game animals also helps to improve biodiversity more extensively. Game habitats that could potentially be restored through proper planning and implementation and even at low cost include wetlands that have dried up due to ditching, woodlands located near brooks, former peat bogs and natural nutrition ponds used for fish breeding. The mires restored for game animals add wonderful variety to the scenery from the human perspective, increase the possibilities of recreational use, serve as water reserves in dry seasons and balance flood peaks. Mire restoration planned and implemented in connection with the core forestry functions are also well suited for water conservation purposes in connection with forestry. A total of 195 ha of bogs were restored in Natura areas (goal: 156 ha). A total of 149 ha of mires were restored in areas of Metsähallitus forestry operations (goal: 100 ha). A total of 466 ha of mires were restored in privately owned areas (goal: 500 ha). A total of 146.3 km of ditches were filled and 163 dams were built.

Production of decayed wood

Decayed wood is a typical structure in old forests. The reduction of decayed wood has led to many forest species becoming endangered. Decayed wood is a vital habitat for, for example, many hole-nesting birds, beetles and polypores. Many endangered species also need charred wood in their habitat. Decayed wood can be generated by girdling live trees, which will die standing, and by felling trees. This helps to introduce some of the properties of old forests in the area.

The project involved producing decayed wood in, for example, the Saariaapa area. The restoration work in Saariaapa served to improve the representativity of the nature conservation network in all of South-West Lapland. Production of decayed wood was intended to improve the living conditions of species that need sturdy, decaying tree, whereas creating small clearings was aimed to create more living space for deciduous trees and to diversity the structure of cultured tree stand. Inventories were conducted in the area in 2004 and 2013–2014 to measure the amount of decayed wood in the area. The areas with mineral-rich soil include approximately 6.6 m^3 of decayed wood per hectare, which is very little for a natural forest. For example, the mineral-rich soil in the adjacent Runkaus Strict Nature Reserve includes approximately 23.3 m^3 of decayed wood per hectare. The natural forests in South Lapland, such as the Pisavaara Strict Nature Reserve, can include approximately 50 m^3 of decayed wood per hectare.

The inventories showed mild selection thinning in the Saariaapa area. Moreover, the heath groves had been systematically burnt. A winter route was completed in the western area after the 1950s and the nearby forest areas are comparatively processed. The structure of the forest stand in Saariaapa indicates that the area includes 81 hectares of old Western taiga of excellent representativity. The area also includes 191 hectares of forests that still fulfil the criteria for a Western taiga but have deteriorated representativity due to human actions. Restorable forests that do not fulfil the criteria for Western taiga span an area of 17 hectares. The area includes 72 hectares of old-growth forests and 27 hectares of young cultured forests.

Restoration actions yielded 10–17 m^3 of decayed wood (with a circumference of over 17 cm) over a hectare, depending on the original quantity of decayed wood in the area. The aim is to produce approximately 15–20 m^3 of decayed wood per hectare in the compartments. The vicinity of the Runkaus Strict Nature Reserve increases the importance of restoring the area. The populations of endangered species that benefit from sturdy decayed

wood are located within an easy spreading range. The project produced decayed wood in an area spanning 201 hectares (original goal: 200 hectares). After restoration, the compartments included 872 m^3 of decayed wood, with a density of approximately 20.6 m^3 per hectare.

Controlled burnings

Controlled burning in connection with nature management involves burning a cutting area and standing forest. The procedure is intended to produce charred wood for organisms that need it. The controlled burning carried out on privately owned land during the project supplement the network of ecological corridors and allows the revival of species that are dependent on forest fires. Controlled burning is also used as a soil conditioning method in Northern Finland. Controlled burning improves the pH value of the soil, providing good resources for forest growth over decades. The best sites for controlled burning are spruce groves with thick mor growing on mesic heath land and surrounded by swamps. Controlled burning is also suitable on medium-coarse, coarse and dry to mesic moraine land, with the aim of improving pine growth.

Controlled burnings during the project involved burning logging residue, retention trees, retention tree groups, undergrowth and mor. A sufficient number of correctly placed water holes ensured safe controlled burnings and facilitated active damping down and the fire watch after the procedure. A fire corridor of five metres in width was constructed to ensure fire safety at the sites. Mor and humus were eliminated along the fire corridor using an excavator to reveal non-combustible mineral-rich soil. The removable layer of mor was lifted inside the controlled burning area because it becomes highly combustible after drying; if it was placed outside the fire corridor, it might ignite even after the fire watch ends. Sufficiently large water holes were dug

Image 19. Controlled burning is a way to create habitats for declining species that benefit from forest fires. Photo by Jouni Rauhala.

Image 20. The first species benefitting from the fire appear on the controlled burning site within hours of the fire. Photo by Pentti Olli.

Image 21. Successful controlled burning takes careful planning and preparation. The burning site is demarcated using fire corridors, areas from which vegetation has been removed to prevent the fire from spreading. The operations also require a sufficient number of people and extinguishing equipment. Photo by Antti Tolonen.

in connection with excavating the fire corridor. The water holes were two metres deep and had ramps to facilitate work on the day of controlled burning. The minimum size of a water hole is 5 x 5 x 2 metres. After the day of controlled burning, the fire watch team managed extinguishing any smouldering fires and deadwood at the site. The speed and direction of the wind as well as any rain showers determined the duration of the fire watch after the operation as well as the size of the watch team.

The goal area for controlled burnings in connection with NATNET Life+ nature management was 100 ha on privately owned land and 50 ha on state forestry land. Action plans were prepared for a total of 155 hectares at eleven different sites. All plans were carried out. The most important advance planning tools were new notifications of forest use, new METSO agreements and the material generated using the Zonation geographical data application.

Table 3. Project plans and actions in figures.

Action	Hectares – km – estates
Conservation agreements, established conservation areas	2,860 hectares – 121 estates
Nature management plans	5,018 hectares – 35 estates
Mire restoration plans	960 hectares
Forest restoration plans	401 hectares
Controlled burning plans	155 hectares
Mire restorations	810 hectares – 146 km of ditches
Controlled burnings	155 hectares
Production of decayed wood	201 hectares

The significance of an ecological corridor network and conservation areas

Threats: habitat loss and climate change

Forest fragmentation is the breaking of continuous forest areas into relatively permanent other habitats, including fields, logging areas, residential areas and other non-forest habitats. Then again, fragmentation can also refer to the loss of specific types of forests, such as the loss of continuous old-growth forests and the separation of the remaining forest patches. The remaining forest patches are of different sizes (often small) and surrounded by non-forest habitats or a matrix of different types of forests.

The survival of organisms in these forest patches is affected by, for example, the size of the patch and its edge. The smaller and more irregular the patch, the greater the size of its edges in relation to the core area. Species that live in commercial forests and at the edges of forests thrive in such patches. Species requiring a large core area, often an old-growth forest habitat, diminish.

The survival of populations or sub-populations in a forest patch is also affected by the degree of the area's isolation and the quality of the surrounding habitat. Migration plays a significant role in the dynamics and viability of species in a fragmented environment. Migration is a necessity for the long-term survival of species in metapopulations made up of small local populations that are in grave danger of extirpation. A short distance between the patches as well as physical connectivity improve gene exchange between populations and reduce the risk of inbreeding. Populations that live in isolated habitats and are often small risk inbreeding and consequent genetic deterioration. Mere chance can destroy a sub-population in an isolated patch more easily than in a better connected patch.

Conservation areas often form isolated "islands" surrounded by commercial forests. For this reason, they suffer from similar problems with isolated habitats. The larger a conservation area is, the better suited it is as a habitat even for demanding species. Moreover, larger conservation areas often harbour more species than small conservation areas because they are more likely to offer several diverse habitats that include enough space for many species. The habitats included in small conservation areas do not offer an equally diverse selection of habitats. Additionally, the area of the habitats is often small. Smaller conservation areas are also more susceptible to the impact of the environment than larger conservation areas.

Studies have shown that small conservation areas have a weaker ability to maintain the special characteristics of its species than large conservation areas. Commercial forest species have better chances of taking over habitats from old-forest species in a small conservation area than in a large conservation area. Isolation further enhances this impact. This is why conservation areas should preferably be clustered together as closely as possible to allow for migration between areas. The most effective way of protecting species is to place new conservation areas near previously established large conservation areas. Many studies have shown that ecological corridors increase species mobility. Preserving forest corridors between conservation areas, for example, might therefore help to improve opportunities for species mobility.

The most essential benefit of NATNET Life+ is that the project protects sites that form important "stepping stones" between separate Natura areas, thus improving habitat connectivity. The preservation of sites which improve species mobility helps to secure the genetic diversity of sub-populations in conservation areas and to reduce the risk of extinction. The corridor areas also serve as habitats for specific species. The areas may be the only habitats suitable for specified species in the middle of young commercial forests and ditched areas. Overall, the NATNET Life+ project is a significant nature management effort.

Commercial forests only include a fraction of the decayed wood found in natural forests. Forests harbour a large number of species that need all degrees of decayed wood and snags in their habitat. Specifically insects and polypores have become endangered due to small amounts of decayed wood. Birds also need decayed wood to find nutrition and to nest. The production of decayed wood and controlled burnings in connection with the project significantly promote the ability of commercial forests to maintain red list species that are dependent on decayed wood in the project areas. The effects of controlled burning will become visible with a delay; controlled burning of standing trees for restoration purposes generally begins to yield significant amounts of decayed wood 10 years after the burning operation.

Climate change also impacts conservation areas. The conditions in the areas may become unfavourable for specific species, which then face the risk of extirpation in the conservation area. The good connectivity of the conservation area network offers species the opportunity to move in accordance with climate conditions. In Europe, the Natura 2000 network forms a good foundation for protection measures. However, the network planning does not observe a level of connectivity that can accommodate the impact of climate change. The NATNET project remedies this defect particularly well.

Restoration is needed because endangerment is often caused by the scarcity or fragmentation of habitats. Restoration can help to, for example, provide more habitats for species that have diminished due to forestry practices. The restoration sites should also be selected to enhance the connectivity of conservation areas. The NATNET Life+ project area includes some of the boggiest land in Finland and has been vigorously ditched in the past decades for forestry purposes. The bedrock in the area is highly calcareous, which accounts for the valuable alkaline fens in the area. A major part of the alkaline fens has been destroyed through ditching. Mire restoration is particularly important in such areas. Restoration helps to restore the natural water balance of previously ditched areas and to reduce leaching. Restoration has contributed to creating new habitats for mire species, particularly for rare alkaline fen vegetation and species of moss as well as fungi, mushrooms, insects and game animals.

Calypso orchid as the indicator species

The calypso orchid is an endangered and protected species that grows in calcareous herb-rich forests of predominantly spruce, listed under appendices II and IV of the EU Habitats Directive. The calypso orchid was selected because it is a suitable indicator species in natural or natural-like calcareous and potentially species-rich forests. South-West Lapland is a core area of occupancy for the species in Finland. However, many populations have died over the past 30 years. This is primarily due to the felling of old spruce groves. Even though the calypso orchid is protected, a lack of information poses a serious threat to the species outside protected areas. Only some of the habitats of the calypso orchid are located on sites unavailable for logging in accordance with the Forest Act. The calypso orchid is very difficult to detect outside the flowering period that only lasts for a few weeks. As the location of its occurrences is not fully known, some may be inadvertently destroyed during cutting in spite of the good will of the forest owner.

The project included an inventory of all known calypso orchid findings within the ecological corridors defined through the Zonation analyses. Old observations, known already before the project, were counted as a total of 49 within the project area in 2012–2016, and they contained approximately 3,400 shoots. In addition to this, new observations were searched for on the private land located within the ecological corridor. With the help of aerial photography, field work was focused on promising-looking old spruce groves, the vicinities of known calypso orchid findings and to areas known to contain other species favouring calcareous soil, such as the Lady's slipper orchid (*Cypripedium calceolus*). A total of 210 new calypso orchid growths were discovered during the project's field inventories, of which 189 are located on private land and 21 on state-owned land. Approximately 2,770 calypso orchid shoots were counted from the new findings. It can be stated that calypso orchid has benefited from the project considerably as the knowledge on the occurrence of the species within the "Lapland triangle" region has been significantly

Image 22. The calypso orchid (*Calypso bulbosa*) is a protected species listed under appendices II and IV of the EU Habitats Directive. Finland bears a special responsibility for protecting the species. Photo by Eerika Tapio.

improved and the risk of the loss of growths due to lack of information has been reduced. In the calypso orchid inventories, information was collected not only on the numbers of calypso orchid shoots and the total area of the growth but also on the biotopes, tree stand and potential risk factors of the area. The size of the area suited for calypso orchid growths was also assessed. The information was utilised in finding potential METSO conservation sites. The information on calypso orchid growths was stored in the Hertta Eliölajit geographical data system of Finland's environmental administration, making it available to the authorities and other operators making decisions on land use.

The calypso orchid can also be expected to clearly benefit from conservation actions carried out during the project and from the increased connectivity of Natura areas. The concrete impact of the project actions on calypso growths and habitats will be monitored in accordance with the project

plan. A small sampling will be selected from among the privately owned land that were inventoried. The sample areas will be inventoried again using the same method three and six years after the end of the project in order to examine the effects of any conservation measures.

As nearly a third of the calypso orchid growths in the “Lapland triangle” are located in privately owned areas with forestry activities, it would be essential for protecting the species that we examine how the calypso orchid reacts to forestry activities over the short and long term. The Natural Resources Institute Finland has monitored the survival and reproduction of the calypso orchid in cooperation with Metsähallitus in two logging areas located in state-owned commercial forests since 2004. In the winter of 2006–2007, three forms of thinning were carried out, leaving 100, 300 or 600 trunks per hectare in the tree compartments. The soil was not processed and the logging residue was not piled over calypso orchid growths. During the NATNET project, team members have visited nine calypso orchid growth sites in June every year to count the flowering and non-flowering shoots and then again in late July to count the seed cases in the fertile shoots. After a monitoring period of ten years, calypso orchid growths have not diminished in any area. The flowering and pollination rates varied in the same way in the test and control areas annually. Additionally, the intensity of processing did not appear to affect the preservation or reproduction of the calypso orchid. It would appear that thinning or small clearing logging that does not include soil processing may be a suitable method of forestry in areas of calypso orchid growth. However, we must take into account that the monitoring period was short and any long-term effects, such as the drying of soil and scrub growth will only become evident later.

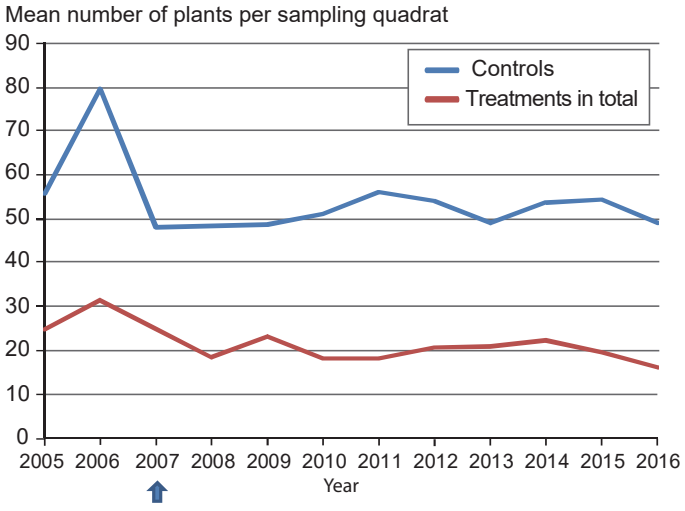

Image 23. Calypso orchid growth rates in the control and thinning areas (treatment) in different years. The arrow shows the year the logging experiment was started.

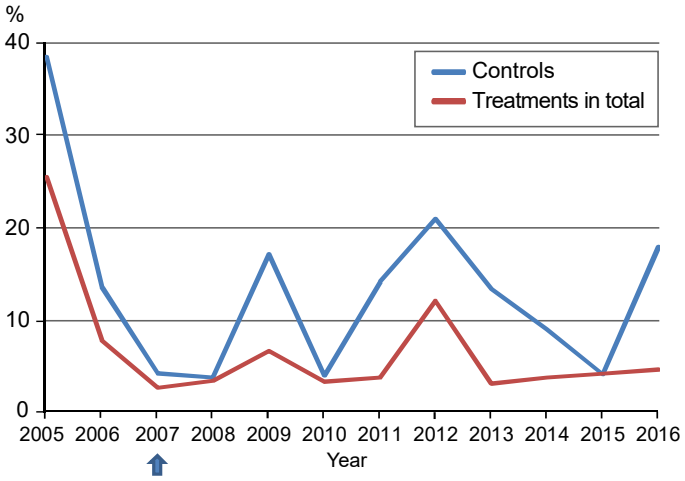

Image 24. The pollination percentage for all plants in the control and thinning areas (treatment) in different years. The arrow shows the year the logging experiment was started.

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Abstract
The NATNET Life+ project was launched in 2012 to increase ecological connections and coherence in South-West Lapland, particularly across conservation areas that are part of the Natura 2000 network. The ecological connections most suitable for the project's objectives were mapped using Zonation analyses, which made it possible to target actions in areas where they could best contribute to maintaining biodiversity. A total of 121 permanent, privately owned conservation areas were established during the project under the auspices of the METSO programme. The total area covered by the conserved areas is over 2,800 hectares. This amounts to almost a third of the METSO programme's conservation goal in the entire province of Lapland (9,120 ha).
The project carried out restoration and nature management actions across more than 1,100 hectares of land used mostly for forestry, improving the biodiversity of the areas. Restoration and nature management plans were prepared for an area spanning 1,516 hectares. In addition to establishing conservation areas and implementing restoration actions, nature management plans emphasising biodiversity values were devised in the project area for private forest owners, across an area of more than 5,000 hectares.
The protected calypso orchid (*Calypso bulbosa*), listed under appendices II and IV of the Habitats Directive and a Finnish species of special concern, was chosen as the project's indicator species. An inventory of all known calypso orchid findings within the ecological corridors defined through the Zonation analysis was compiled in the project.
The NATNET Life+ project helped to increase habitat connectivity in the Natura 2000 areas and thereby to promote species mobility between the sites. The project actions also contributed to preserving the genetic diversity of species populations in conservation areas and thereby reduced the risk of extinction. The corridor areas also serve as habitats for specific species. Overall, the NATNET Life+ project is a significant nature management effort. The production of decayed wood and controlled burnings in connection with the project also significantly promote the ability of commercial forests to maintain endangered species that are dependent on decayed wood in the project area. Moreover, restoration has contributed to creating new habitats for mire species, particularly for rare alkaline fen vascular plants and species of moss as well as fungi, mushrooms, insects and game animals.

Keywords
biodiversity, conservation areas, ecological corridors, ecological networks, Forest Biodiversity Programme for Southern Finland (METSO), Natura 2000, Zonation

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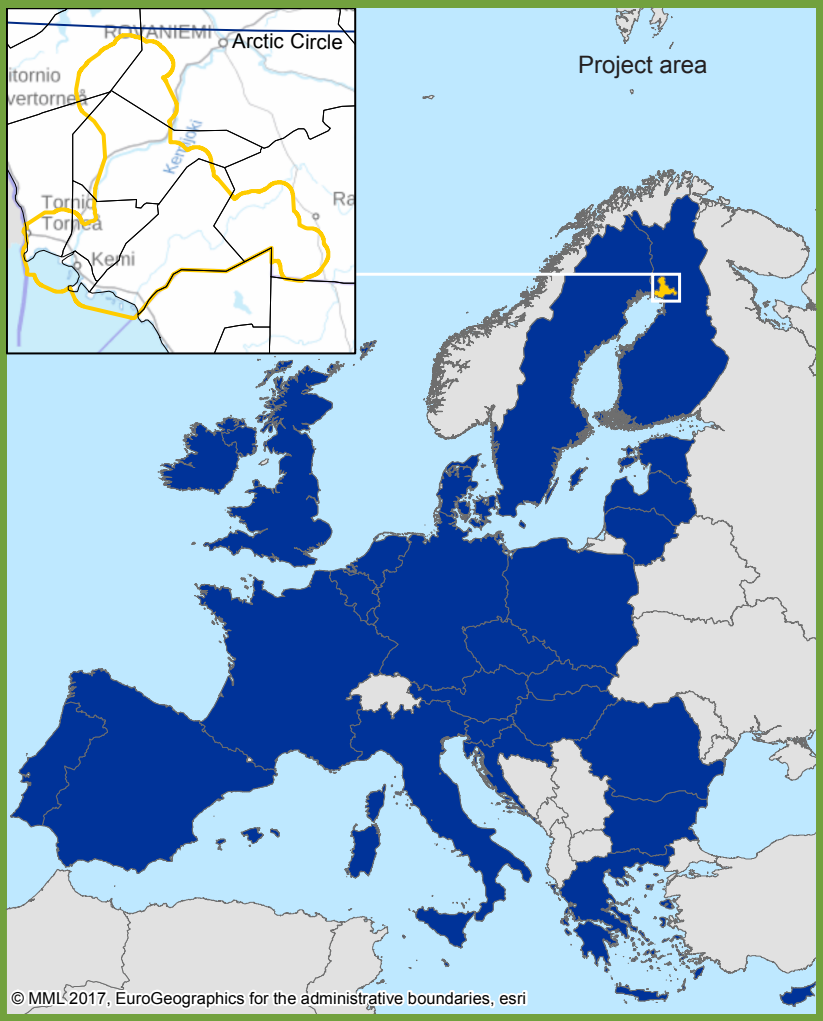

The NATNET Life+ project was launched in 2012 to increase ecological connections and coherence in South-West Lapland, particularly across conservation areas part of the Natura 2000 network. Project actions implemented during the project included for instance establishing of privately owned conservation areas, restorations and nature management actions as well as drawing nature management plans emphasising biodiversity values. This report presents the actions carried out during the project and assesses the significance of the work to the ecological connections in the project area.

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