Kasper Koskela and Marko Sievänen (eds)

Restoration, environmental management and monitoring in the Vattaja Dune Life project 2005–2009

Nature Protection Publications of Metsähallitus. Series A 181
Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 181

Kasper Koskela
Metsähallitus
Meriluontokeskus, Jukupolku 5
85100 Kalajoki
Finland
kasper.koskela@metsa.fi

Cover photo: Aerial view of the Vattaja Dunes. Lentokuva Vallas Oy.

Translation: Traduct Oy.

ISSN 1235-6549
ISBN 978-952-446-716-2 (pdf)

Kasper Koskela and Marko Sievänen (eds)

Restoration, environmental management and monitoring in the Vattaja Dune LIFE project 2005–2009

DOCUMENTATION PAGE

PUBLISHED BY	Metsähallitus	PUBLICATION DATE	15.4.2009
COMMISSIONED BY	Metsähallitus	DATE OF APPROVAL	
CONFIDENTIALITY	Public	REGISTRATION NO.	2408/021/2004
PROTECTED AREA TYPE / CONSERVATION PROGRAMME	esker conservation programme, shore conservation programme, Natura 2000 area		
NAME OF SITE	Vattajanniemi		
NATURA 2000 SITE NAME AND CODE	Vattajanniemi FI1000017		
REGIONAL ORGANISATION	Natural Heritage Services, Ostrobothnia		

AUTHOR(S)	Kasper Koskela and Marko Sievänen (eds)
TITLE	Restoration, environmental management and monitoring in the Vattaja Dune LIFE project 2005–2009
ABSTRACT	Vattajanniemi is an area in Europe containing boreal zone dune habitat types. It is also one of the Finnish Defence Forces' most important training areas and a popular recreational area. To reconcile the various uses and natural values, a LIFE project funded by the EU was implemented in the area during 2005–2009. This publication includes a summary of the reports drawn up during the project, concerning the area's natural values and use. This summary includes: – a description of the most important habitat types and species in Vattaja and their status – a look at the mechanism through which dunes form and the factors affecting the flora and fauna of the Vattaja dune area – a description of the land-use history and present use of the Vattaja dune area – a specification of the threats caused by land use for the natural values and their formation mechanisms, especially activities causing erosion of the dunes – a specification of the factors threatening the area's other natural values – a description of the adaptation of the Defence Forces' operations to the area's natural values – a presentation of the restoration and maintenance measures for open sand habitats, damaged dunes, traditional rural biotopes, mires and forests as well as minor bodies of water. All of the six dune habitat types in Finland, defined in the EU Nature Directive's Appendix I, can be found in Vattaja exceptionally extensively. The area's expansiveness allows for wind and the movement of sand, essential to the natural disturbance dynamics of dunes, which allows succession to continue to take place in the area. Vattaja's natural values are supplemented by small-scale paludified areas, wetlands and traditional rural biotopes formed through long-term grazing. Especially species of butterfly which are dependent on moving sand are known to be significant in the area. The erosion of the dunes through the Defence Forces's training, but also through recreational use to a lesser extent, forms the most significant threat to the eolian sand area's delicate natural values. The signs of land use are visible in places as substantial damage to the dune habitat. The most important threat, apart from this, is the end of traditional land use and the overgrowth of the open shoreline habitats, caused by the eutrophication of the Baltic Sea. The eroding effects on the terrain have been minimised during the LIFE project by, for example, moving the Defence Forces' firing positions away from the most important dune areas, by standardising the access routes and locations of practice facilities, by increasing the facilities directing recreational use and by drawing up information material for recreational users and the Defence Forces. A wide range of environmental management and restoration plans for various biotopes have been drawn up and completed during the LIFE project: damaged dune formations, open sand areas which are overgrown and under excess erosion, traditional rural biotopes, mires and forests as well as gloes have been provided with their own specialised plans. The reports and plans drawn up during the LIFE project form the foundation for the Vattajanniemi Natura 2000 area's long-term maintenance and use planning.

KEYWORDS	Vattaja, Vattaja LIFE, dunes, gloes, habitat types, restoration, environmental management, flora, erosion, Defence Forces, traditional rural biotopes, endangered species		
OTHER INFORMATION	The Vattaja Dune LIFE project (Restoration of dunes and wetlands in the Vattaja training and firing area)		
SERIES NAME AND NO.	Nature Protection Publications of Metsähallitus. Series A 181		
ISSN	1235-6549	ISBN (PDF)	978-952-446-716-2
NO. OF PAGES	39 pp.	LANGUAGE	English
PUBLISHING CO.		PRINTED IN	
DISTRIBUTOR	Metsähallitus, Natural Heritage Services	PRICE	

KUVAILULEHTI

JULKAISIJA	Metsähallitus	JULKAISUAIKA	15.4.2009
TOIMEKSIANTAJA		HYVÄKSYMISPÄIVÄMÄÄRÄ	
LUOTTAMUKSELLISUUS	Julkinen	DIAARINUMERO	2408/021/2004

SUOJELUALUETYYPPI/ SUOJELUOHJELMA	harjujensuojeluohjelma, rantojensuojeluohjelma, Natura 2000 -alue
ALUEEN NIMI	Vattajanniemi
NATURA 2000 -ALUEEN NIMI JA KOODI	Vattajanniemi FI1000017
ALUEYKSIKKÖ	Pohjanmaan luontopalvelut

TEKIJÄ(T)	Kasper Koskela ja Marko Sievänen (toim.)
JULKAISUN NIMI	Ennallistaminen, luonnonhoito ja seuranta Vattajan Dyyni Life-hankkeessa 2005–2009
TIIVISTELMÄ	Vattajanniemi on boreaalisen vyöhykkeen laajin dyyniluontotyyppien esiintymisalue Euroopassa. Se on myös yksi Suomen puolustusvoimien tärkeimmistä harjoitusalueista ja suosittu virkistyskohde. Eri käyttömuotojen ja luontoarvojen yhteensovittamiseksi alueella toteutettiin 2005–2009 EU:n tukema Life-hanke. Tähän julkaisuun on koottu tiivistetysti hankkeen aikana laaditut alueen luontoarvoja ja käyttöä koskevat selvitykset. Tässä julkaisukoosteessa – kuvaillaan Vattajan tärkeimmät luontotyypit ja lajiesiintymät sekä niiden tila – tarkastellaan dyynien syntymekanismia sekä Vattajan hietikkoalueen kasvillisuuteen ja eliöstöön vaikuttavia tekijöitä – selostetaan Vattajan dyynialueen maankäyttöhistoria sekä nykyinen käyttö – eritellään maankäytön luontoarvoille aiheuttamat uhkatekijät ja niiden syntymekanismit erityisesti dyynejä kuluttavan toiminnan osalta – määritellään muut alueen luonnonarvoja uhkaavat tekijät – kerrotaan, miten Puolustusvoimien toiminta sopeutetaan alueen luontoarvoihin – esitellään avoimien hietikkoalueiden, dyynivaurioiden, perinnebiotooppien, soiden ja metsien sekä pienvesien ennallistamisen ja hoidon toimenpiteet. Vattajalla tavataan poikkeuksellisen laaja-alaisesti jokaista Suomen kuudesta EU:n luontodirektiivin liitteessä I listatusta dyyniluontotyypistä. Alueen laajuus mahdollistaa dyynien luontaiselle häiriödynamiikalle olennaisen tuulisuuden ja hiekan liikkumisen, minkä johdosta dyynien luontainen sukkessiokehitys jatkuu alueella edelleen. Vattajan luontoarvoja täydentävät pienialaiset soistumat ja kosteikot sekä pitkäaikaisen laidunhistorian myötä muodostuneet perinnebiotoopit. Erityisesti liikkuvaa hiekkaa vaativa perhoslajisto tiedetään alueella merkittäväksi. Puolustusvoimien harjoituskäytöstä sekä vähäisemmässä määrin virkistyskäytöstä aiheutuva kuluttava toiminta muodostaa merkittävimmän uhan herkästi vaurioituvan lentohiekka-alueen luontoarvoille. Maankäytön jäljet näkyvätkin paikoin voimakkaina vaurioina dyyniympäristössä. Muista uhkatekijöistä merkittävin on perinteisen maankäytön loppumisen ja Itämeren rehevöitymisen aikaansaama avointen rantaympäristöjen umpeenkasvu. Life-hankkeen aikana maastoa kuluttavia vaikutuksia on vähennetty mm. siirtämällä Puolustusvoimien tuliasemia pois merkittävimmiltä dyynialueilta, vakioimalla kulkureittejä ja harjoitustoimintaan liittyvien rakenteiden paikkoja, lisäämällä virkistyskäyttöä ohjaavia rakenteita ja palveluvarustusta sekä laatimalla virkistyskäyttäjille ja armeijalle suunnattua opastusmateriaalia. Life-hankkeen aikana on laadittu ja toteutettu laaja kirjo erilaisiin biotooppeihin kohdistuvia luonnonhoito- ja ennallistamissuunnitelmia: vaurioituneet dyynimuodostumat, umpeen kasvavat ja liialliselle kulutukselle altistuneet avoimet hietikkoiset alueet, perinnebiotoopit, suot ja metsät sekä kluuvijärvet ovat saaneet erityissuunnitelmansa. Life-hankkeen aikana tehdyt selvitykset ja suunnitelmat toimivat Vattajanniemen Natura-alueen pitkäaikaisen hoidon ja käytön suunnittelun tausta-aineistona.
AVAINSANAT	Vattaja, Vattaja-Life, dyynit, kluuvit, luontotyypit, ennallistaminen, luonnonhoito, kasvillisuus, kuluneisuus, puolustusvoimat, perinnebiotoopit, uhanalaiset lajit
MUUT TIEDOT	Vattajan Dyyni Life -hanke (Dyynien ja kosteikoiden ennallistaminen Vattajan harjoitus- ja ampuma-alueella)
SARJAN NIMI JA NUMERO	Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 181

ISSN	1235-6549	ISBN (PDF)	978-952-446-716-2
SIVUMÄÄRÄ	39 s.	KIELI	englanti
KUSTANTAJA		PAINOPAIKKA	
JAKAJA	Metsähallitus, luontopalvelut	HINTA	

PRESENTATIONSBLAD

UTGIVARE	Forststyrelsen	UTGIVNINGSDATUM	15.4.2009
UPPDRAGSGIVARE		DATUM FÖR GODKÄNNANDE	
SEKRETESSGRAD	Offentlig	DIARIENUMMER	2408/021/2004
TYP AV SKYDDSOMRÅDE/ SKYDDSPROGRAM	åsskyddsprogram, strandskyddsprogram, Natura 2000-område		
OMRÅDETS NAMN	Vattajanniemi		
NATURA 2000 -OMRÅDETS NAMN OCH KOD	Vattajanniemi FI1000017		
REGIONAL ENHET	Österbottens naturtjänster		

FÖRFATTARE	Kasper Koskela och Marko Sievänen (red.)
PUBLIKATION	Restaurering, naturvård och uppföljning i anslutning till projektet Vattajan Dyyni Life 2005−2009
SAMMANDRAG	Vattajanniemi är det största europeiska förekomstområdet för dynnaturtyper i den boreala zonen. Det är även ett av den finska försvarsmaktens viktigaste övningsområden och ett populärt rekreationsmål. För att underlätta samordningen av olika nyttjandeformer och naturvärdena genomfördes åren 2005–2009 ett EU-stött Life-projekt i området. I denna publikation ges en sammanfattning av de utredningar om områdets naturvärden och nyttjande som gjordes under projektets gång. I denna sammanfattande publikation – beskrivs Vattajas viktigaste naturtyper och artförekomster samt deras tillstånd; – granskas dynernas uppkomstmekanism samt de faktorer som påverkar vegetation och övriga organismer i Vattaja sandmarksområde; – återges Vattaja dynområdes markanvändningshistoria samt den nuvarande användningen; – specificeras de hot som markanvändningen innebär för naturvärdena samt deras uppkomstmekanismer särskilt i fråga om verksamhet som nöter på dynerna; – fastställs övriga hot mot områdets naturvärden; – berättas hur försvarsmaktens verksamhet anpassas till områdets naturvärden; – presenteras vilka restaurerings- och vårdåtgärder som vidtagits med avseende på öppna sandmarksområden, skadade dyner, vårdbiotoper, myrar och skogar samt mindre vattendrag. I Vattaja förekommer i osedvanligt vid utsträckning alla de sex finska dynnaturtyper som listas i EU:s naturdirektivs bilaga I. Områdets utbredning möjliggör den blåsighet och sandrörlighet som är så väsentlig för dynernas naturliga störningsdynamik, vilket medför att dynernas naturliga successionsutveckling fortsättningsvis pågår i området. Naturvärdena i Vattaja kompletteras av mindre sankmarker och våtmarker samt vårdbiotoper som formats genom långvarigt nyttjande av marken för bete. Man vet att förekomsten av fjärilsarter som kräver rörlig sand är särskilt betydande i området. Den nötning som förorsakas av försvarsmaktens övningar samt i mindre utsträckning av rekreationsbruket utgör det största hotet mot naturvärdena i det skadekänsliga flygsandsfältet. Spåren av markanvändningen märks ställvis som kraftiga skador i dynmiljön. Det främsta av de övriga hoten är upphörandet av den traditionella markanvändningen och att de öppna strandmiljöerna växer igen på grund av eutrofieringen av Östersjön. Life-projektet begränsade de nötande effekterna på terrängen bland annat genom att flytta bort försvarsmaktens eldstationer från de viktigaste dynområdena, skapa standardrutter och standardplatser för de konstruktioner som anknyter till övningarna, utöka serviceutrustningen och antalet konstruktioner som styr rekreationsbruket samt genom att utarbeta guidematerial riktat till rekreationsanvändarna och armén. Under Life-projektet utarbetades och genomfördes en mångfald naturvårds- och restaureringsplaner för olika biotoper: specialplaner har upprättats för skadade dynformationer, igenväxta och för alltför kraftig nötning utsatta öppna sandmarksområden, vårdbiotoper, myrar och skogar samt glosjöar. De utredningar och planer som Life-projektet genererade utgör bakgrundsmaterial för långtidsplaneringen av vården och nyttjandet av Vattajanniemi Natura-område.
NYCKELORD	Vattaja, Vattaja-Life, dyner, glon, naturtyper, restaurering, naturvård, vegetation, nötning, försvarsmakten, vårdbiotoper, hotade arter
ÖVRIGA UPPGIFTER	Projektet Vattajan Dyyni Life (Restaurering av dyner och våtmarker i Vattaja övnings- och skjutområde)
SERIENS NAMN OCH NUMMER	Forststyrelsens naturskyddspublikationer. Serie A 181

ISSN	1235-6549	ISBN (PDF)	978-952-446-716-2
SIDANTAL	39 s.	SPRÅK	engelska
FÖRLAG		TRYCKERI	
DISTRIBUTION	Forststyrelsen, naturtjänster	PRIS	

Foreword

Cape Vattajanniemi is the most important conservation site in Finland of the dune habitat type protected by the EU Habitats Directive. It is reserved in the regional plan as a special area for use by the Finnish Defence Forces as well as being an important recreation area for local inhabitants. The areas used by the Defence Forces for military exercises were transferred to the administration of Metsähallitus in 2002, in the same year as the Government's decision to incorporate Vattajanniemi into the EU Natura 2000 network came into force. The Lohtaja live fire and military exercise terrain on Cape Vattajanniemi has been in operation since 1952.

Reconciling the various uses of Vattajanniemi is a challenging task, requiring a sufficient number of baseline studies on the needs and impacts of the different forms of use. For this purpose Metsähallitus, the Finnish Defence Forces and the West Finland Regional Environment Centre applied for funding from the EU Life Programme, which is intended for the support of nature conservation projects in Natura 2000 areas. The Geography Department of the University of Helsinki participated in the project as an expert on dune habitats. The four-year Vattaja Dune Life project (Restoration of Dunes and Coastal Habitats in the Vattaja Military Area) ended on 30 March, 2009. The overall budget for the project was about EUR 2 million, EUR 900,000 of which was co-funded by the Life Programme and the remaining amount by national funding from the parties involved.

The measures carried out during the project included

- drawing up a plan for adapting the Defence Forces' activities to the Natura 2000 values of the area, and its implementation was started
- starting measures to restore the area's forest, mires and waters to their natural state
- starting measures to restore the area's heritage biotopes by grazing and clearing
- starting restoration work on damaged dunes and management of open dune habitat types
- compiling training material targeted at different user groups, e.g. a DVD film
- making a baseline inventory of the area's ecological and cultural values
- starting a system of continuous monitoring of vegetation, erosion and use of the area
- drawing up a management and use plan for the area

This publication contains the inventory and monitoring reports drawn up during the projects as well as the plans implemented for environmental management, restoration and adaptation work. Environmental management and monitoring will not stop with the Life project, and will require continuous cooperation between the authorities and the users of the area.

Kari Hallantie
Park Superintendent, Metsähallitus
Chairman of the Steering Group

Contents

1 Introduction 11

2 Archaeological Inventory 13

3 The Habitat Types and Vegetation Succession of the Vattaja Dunes 14

4 Insects of Vattajanniemi 2006–2008 16

5 Shore Birdlife in Vattajanniemi 18

6 Erosion of the Terrain in the Vattaja Dune Area – baseline inventory 20

7 Adapting the Defence Forces' Activities to Ecological Values 22

8 Management Plan for Vattajanniemi Open Dune Areas 25

9 Remediation Plan for Landscape and Erosion Damage at Vattajanniemi 29

10 Management of Vattajanniemi Heritage Biotopes 31

11 Action Plan for Restoration of Mires and Forests 33

12 Restoration of Vatunginjärvi Lake 35

13 Restoration of Lahdenkrooppi 36

14 Geomorphological Monitoring 38

1 Introduction

Kasper Koskela and Marko Sievänen

Cape Vattajanniemi is the most extensive and representative area of the dune habitat types in the boreal zone of Europe. Its most important ecological values are based on the fact that it comprises many different representative dune habitat types as well as extensive and complete series of dune succession stages. Vattaja is also one of the most import military exercise terrains used by the Finnish Defence Forces as well as a popular recreation area. In order to adapt the different forms of use to the ecological values of the area, the Life project was launched on 1 April 2005, with EU support and under the leadership of Natural Heritage Services of Ostrobothnia, a unit of Metsähallitus. The project came to an end on 31 March 2009. The reports and plans drawn up during the project have been published in collected form in the work Koskela, K. (ed.) 2009: Vattaja dyynialue – Luonnonarvot ja niiden parantaminen Life -projektissa 2005–2009 (The Vattaja Dune Area – Ecological Values and their Improvement within the Life Project 2005–2009) (Series A 180). This summary gives a brief account of the issues dealt with in the Finnish publication.

The Vattaja Natura 2000 area (FI1000017) is situated in the municipality of Lohtaja in Central Ostrobothnia, about 30 km north of the town of Kokkola (Figure 1). The area was purchased for the state as a military exercise terrain for the

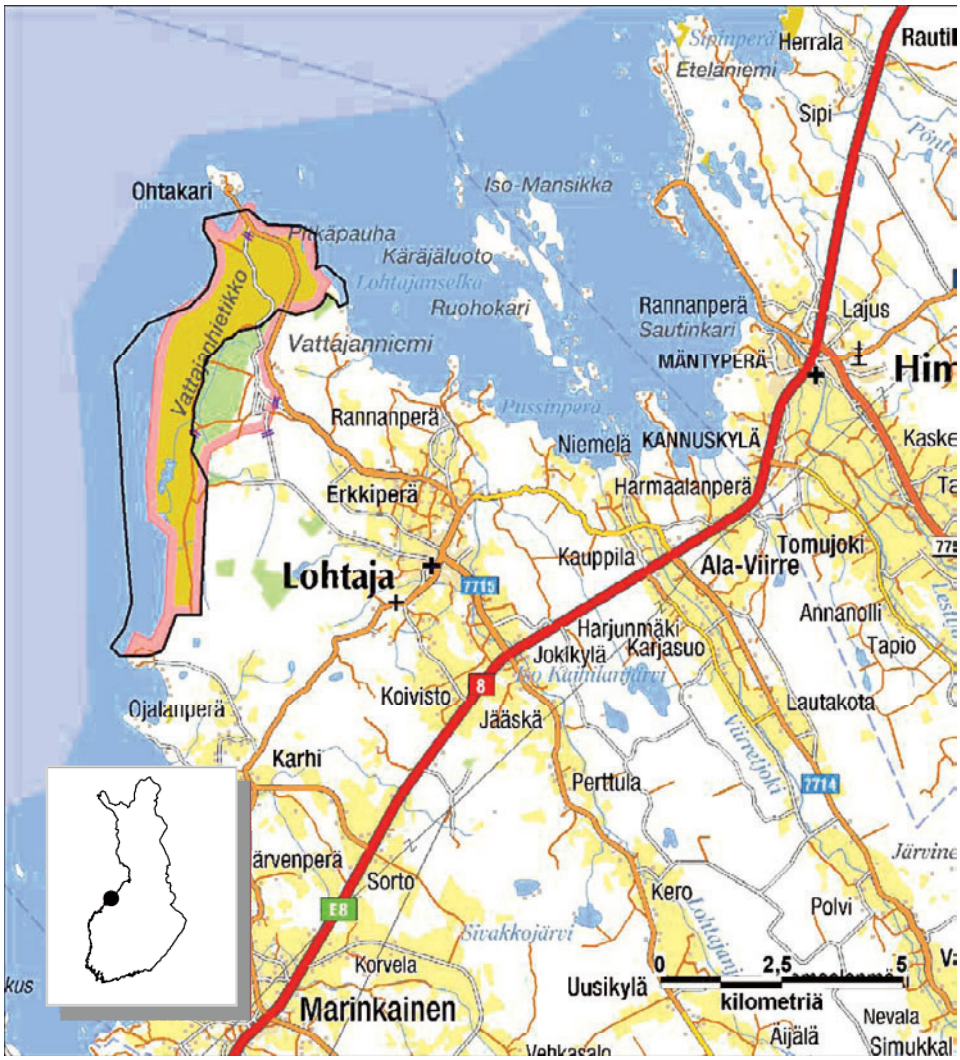


Figure 1. Location of Vattajanniemi Natura 2000 area. © Metsähallitus 2009, © Karttakeskus, Licence L5293.

Transverse sandbank and drift lines. Photo: Pirjo Hellemaa 2008.

Finnish Defence Forces in the years 1952–1956. It was later incorporated into the Natura conservation network as a SCI area, i.e. as a habitat type designated for special protection as referred to in Annex I of the Habitats Directive. The Natura site consists of two different sub-areas, covering a total area of approx. 4,000 hectares. The Vattaja Life project concerns the northern part of the area owned by Metsähallitus, an area of about 1,500 hectares.

The project area in its entirety is included in the National Esker Protection Programme (HSO 100093). Besides this, 702 hectares of the area belong to the National Shoreline Protection Programme (RSO 100064). In addition, the area is counted among Finland's most important areas for birdlife (FINIBA). In the regional plan for Ostrobothnia, Vattaja is marked out as one of the region's significant landscape areas. The aim of the National Shoreline Protection Programme is to keep the shores included in the programme unbuilt and in a natural state. Activities in the Vattaja area are restricted on account of landscape values and also by the National Esker Protection Programme; these include activities that would irreparably damage the natural state and impair the landscape of the sites in question, such as large-scale soil extraction.

According to a planning provision of the regional land use plan, the area is to be developed as a special military area of the Finnish Defence Forces. However, the use and further planning of the area must take into consideration the conservation values, special ecological, landscape and Natura values of the area, as well as general recreational needs and measures required to protect groundwater.

2 Archaeological Inventory

Ville Laurila and Jari Okkonen

The esker that forms the substrate of the Vattaja dune area, continuing westward on the sea bed for another 30 km, was deposited by an ancient glacial river. Cape Vattajanniemi is located on a part of the coast where the rate of land uplift is the fastest in Europe, the land rising by about 8 mm a year. Due to the rapid rate of uplift, the area is relatively young, so no prehistoric ancient relics of a permanent nature are found. Most of the Vattajanniemi sand dunes are situated less than five metres above sea level. According to the land uplift reference curve for the Lohtaja area, the sea level at Vattaja was at the height of five metres some 600 years ago and at 2.5 metres about 350 years ago. According to a general map of the coast of the Gulf of Bothnia from the year 1690, only a small part of the Vattajanniemi Natura site was above sea level at that time.

The archaeological inventory work included a review of books and articles dealing with the Vattajanniemi area's history, as well as old plans drawn up by Metsähallitus and inventory material provided by the National Board of Antiquities. In addition, local experts on the history of Vattajanniemi were interviewed. Sites that had been discovered while reviewing the background material were inspected in the terrain.

In the shore area of Cape Vattajanniemi itself there was no fixed habitation, and most of the settlement was concentrated in the nearby villages of Karhi and Lohtaja, a few kilometres away. It was mainly the inhabitants of these villages who began to use Vattajanniemi for various purposes as the sea receded.

Pitkäpauha was already a small island by the 1690s. Three old boat landing places were found at the southeastern tip of Pitkäpauha, far from the present shoreline, almost at the highest point of the headland. The boat landing places probably date back to the same era as the oldest buildings on Pitkäpauha, which have long since disappeared.

The oldest reliable reference to a fisherman's hut in Vattaja dates from the year 1861. On Cape Vattajanniemi there were fishermen's huts at least at Pitkäpauha, Kalsonnokka and Lahdenkrooppi. The dismantled remains of three fishermen's huts were located in the inventoried area.

Before the beginning of the 20th century animal husbandry was dependent on natural meadows, where winter fodder was gathered all the cultivated land being needed for growing cereals. The natural meadows were mostly situated in the shore areas and mires.

The Vattajanniemi area was generally used as pasture. Cows, horses and sheep were taken there and allowed to graze freely. According to tradition, the grassy meadows in Lahdenkrooppi, Hakunti and at the northern tip of Vattaja were widely used for pasture. The best strips of meadow were fenced off so that the animals could not reach the hay meant for winter fodder. After haymaking was over, the gates were opened and the animals were allowed to graze those areas as well. As late as the 1760s, most what is now the Vattajanniemi Natura site was under water or consisted of open, barren stretches of sand with little vegetation and was therefore not suitable for pasture or meadows. The meadow areas are situated mainly outside the Natura site, except those around Lake Vatunginjärvi and Lehtilampi and in the present Kylmäperä area. The growth of new meadows and pastureland followed the advance of the shoreline towards the west. New areas were brought into use for grazing as the water receded and vegetation began to take hold. On the other hand, as the dunes advanced eastward, they took over meadow areas and made them unusable for grazing. It is known, for example, that as late as the beginning of the 20th century, a hayshed might be covered by a shifting dune. In the Vattajanniemi Natura site or its immediate vicinity there were more than 60 haysheds before the 1950s as well as several other buildings, including villas. After the buildings were dismantled or moved, the remains soon disappeared from sight.

3 The Habitat Types and Vegetation Succession of the Vattaja Dunes

Aino Kaila

With land uplift, the waves levelled out and spread the sand from the underwater esker over a wider area and the forces acting at the shoreline caused the sand to drift into extensive driftlines and dune formations.

At the end of the 19th century and the beginning of the 20th century, when the shores were widely grazed, the lymegrass was eaten by sheep, and the sand piled up into large parabolic dunes on the periphery of extensive deflation areas. Cape Vattajanniemi is still divided into two large drift sand areas, the northern area of Vattaja and the southern area of Karhi. The largest open sand stretches are situated in the artillery target area on the shore side of the old shifting dunes. The open sand area is at its widest about a kilometre wide between the Tarkastajanpakka dune and the shore.

The geomorphology and the development of vegetation cover on the dunes are interdependent. If the vegetation cover is destroyed, the sand is blown away by the wind. Tarkastajanpakka was formed in this way. The impact of grazing has been replaced by the later military use of the area, and Tarkastajanpakka still has an active slip face, even though it is more than a kilometre from the shoreline.

Several fairly small ponds and wetlands have been cut of by the dunes, representing the fladaglo-lake development stages of the land uplift coast.

Fixed coastal dunes with herbaceous vegetation. Photo: Aino Kaila 2006.

The conditions in dune areas are barren, and the vegetation includes species adapted to exacting growth conditions. They must be able to survive in windy, dry and sometimes hot conditions. In the inventory of the vegetation and habitat types of the Natura site, a total of 99 vascular plants, 27 mosses and six lichens were encountered.

Succession

An important factor in the development stages, i.e. succession, of the area's vegetation is land uplift, which leads to drying out of the area and lowering of the groundwater level. The species that take over the lowest shoreline areas and the embryonic dunes are those that have extensive horizontal root systems and can withstand salt water spray, strong winds and at times being buried by sand. These species include Sea Sandwort (*Honckenya peploides*) and Blue Lymegrass (*Leymus arenarius*).

On the lee side of embryonic dunes and on large sandy stretches from the dunes inland, the actual development of vegetation begins with the growth of species that stabilise the conditions. These grasses and mosses that can survive in the sandy conditions finally cover the sand with a dense mat of vegetation. In the dunes proper, the first plants to become established include Leafy Hawkweed (*Hieracium umbellatum*), Red Sorrel (*Rumex acetocella*), various fescue grasses (*Festuca* sp.) and some mosses and lichens. On more densely vegetated dunes the fescue grasses are replaced by Wavy Hairgrass (*Deschampsia flexuosa*). Usually mosses spread to the dunes before lichens. Pioneer species of mosses that can withstand partial burial in sand are Fire Moss (*Ceratodon purpureus*) and Polytrichum and Juniper Polytrichum moss (*Polytrichum piliferum, P. juniperinum*). Of the lichens, the first to take hold are usually the cup lichens (*Cladonia* sp).

As succession proceeds, the lichens tend to gain ground.

When this mat of vegetation covering the dunes has developed, species of scrub, bushes and finally trees take hold. As the land rises it becomes drier and at the same time nutrients are washed out. As the stratification of sand ceases, nutrients diminish, acidification increases and deciduous trees are replaced by the Scots Pine (*Pinus sylvestris*), grasses are replaced by dwarf shrubs and lichen, and even the growth of pines slows down.

As the bare dunes stabilise, the vegetation succession usually progresses from dune meadow to moor growing Crowberry (*Empetrum nigrum*) and to dry or nutrient-poor pine-dominated sandy heath, which becomes continuous in the higher coastal zone behind the heath and wind deflation area. In addition to the pine and crowberry, species that thrive in the nutrient-poor, acid and dry soil also include Heather (*Calluna vulgaris*), Cowberry (*Vaccinium vitis-idaea*) and certain lichens and mosses.

Between the coastal dunes, deflation faces occur in smaller patterns. Large deflation plains are generally found behind the embryonic dune ridges. The continuous erosion and lowering of the deflation surface may eventually reach a stage where it is affected by the capillary rise of groundwater. The moisture then binds the surface of the sand, and vegetation can gain a foothold more easily. Deflation plains are dotted with small hummocks often covered with crowberry or Creeping Willow (*Salix repens*). Willow is also commonly found where the surface of the ground is moist. The moist depressions in deflation areas rapidly become wooded and often grow dense birch stands.

Habitat types

According to an updated assessment carried out in 2008, a total of 17 of the habitat types listed in Annex I of the Habitats Directive (92/43/EEC) were found on Cape Vattajanniemi, 7 of them being among the priority habitat types (Table 1). The representativity of a habitat type is defined for each site as a sum of its area, the number of Annex II species present on the site and its degree of conservation.

Table 1. The habitat types of Vattaja and their areas before management actions. Habitat type 2320 "Dry sand heaths with *Calluna* and *Empetrum nigrum*", which occurs in the area, has not been included in the Table, because the exact area had not been defined by the time of publishing. Also omitted from the table are the habitat types 9010 "Western taiga" and 91D0 "Bog woodland", which have developed at the site due to restoration work carried out during the project. The exact area and structure of the habitat types will be defined when all the management actions have been completed in 2009. * = priority habitats.

Habitat type	Area (ha)	Representativity
Coastal lagoons	4.2	moderate
Boreal Baltic sandy beaches with perennial vegetation (1640)	27.1	moderate
Embryonic shifting dunes (2110)	9.9	good
Shifting dunes along the shoreline with Ammophila arenaria ("white dunes") (2120)	21.8	good
Fixed coastal dunes with herbaceous vegetation ("grey dunes") (2130)*	67.7	poor
Decalcified fixed dunes with Empetrum nigrum (2140)*	67.6	moderate
Wooded dunes of the Atlantic, Continental and Boreal region (2180)	81.4	moderate
Boreal Baltic coastal meadows (1630)*	0.4	poor
Humid dune slacks (2190)	1.2	good
Natural forests of primary succession stages of landupheaval coast (9030)*	27.4	moderate
Transition mires and quaking bogs (7140)	12.8	good
Fennoscandian wooded pastures (9070)	1.4	moderate
Water courses of plain to montane levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation (3260)	0.6	good
Fennoscandian deciduous swamp woods (9080)	0.3	good
Open deflation area	214.6	good

4 Insects of Vattajanniemi 2006–2008

Matti Ahola and Mikko Pentinsaari

Although the butterfly and moth species (*Lepidoptera*) of the area have been inventoried to some extent in previous years, the monitoring carried out in the years 2006 and 2007 was the most efficient, with two light traps, eight baited traps, 20 pheromone traps and two malaise traps in use. In addition, active observation was carried out at surveillance lights and using baits and regularly repeated line transect studies. A separate study of *Scythris empetrella* was made by counting the crowberry hummocks inhabited by the species. A hummock was regarded as inhabited if a fresh cocoon or even one adult moth was found. Beetle species were charted using ten window traps in the years 2006 and 2007 and altogether 30 pit fall traps in 2007. In addition, observations on beetles had been provided by material from excursions made by the Expert Group on Coleoptera in 2001.

All in all, in the years 2006–2008, 550 Lepidoptera species were found, and the number of individuals recorded was 66,512. Of the butterflies and moths in the area during that time representatives of 22 superfamilies were found, the ones with most species and individuals being the moths (Noctuoidea) (160 species, 44,931 individuals), geometrids (Geometroidea) (96 species, 5,984 individuals), torticids (Tortricoidea) (94 species, 2,922 individuals), gelechiids (Gelechioidea) (59 species, 4,062 individuals) and pyralids (Pyraloidea) (40 species, 3,576 individuals). The most numerous species in terms of individuals were the Common Rustic (*Mesapamea secalis*) 23,094, the Dotted Clay (*Xestia baja*) 2,411, Scythris empetrella 2,400, the Golden-rod Brindle (*Lithomoia solidaginis*) 1,747, the Ingrailed Clay (*Diarsia mendica*) 1,623, the Common

Scythris empetrella* requires for its habitat an especially fine-grained, open decalcified fixed dune with *Empetrum nigrum. Photo: Marko Sievänen.

Lutestring (*Ochropacha duplaris*) 1,155 and the Suspected (*Parastichtis suspecta*) 902 individuals.

A total of four nationally threatened Lepidoptera species were found (Table 2). In addition one nationally near threatened species was found. Altogether 14 species regionally threatened in the mid-boreal zone were found in Vattaja, nine of which were also found in the years 2006–2008. In addition, a total of seven species new to the Central Ostrobothnia sub-region were found. A total of 25 species new to Vattaja were found during the study. Altogether 820 species of Lepidoptera have now been recorded in Vattaja.

A total of 23 species especially adapted to the xerothermic, nutrient-poor environments of the dunes were found during the study. A large population of the endangered *Scythris empetrella* moth, which is dependent on the priority habitat type "Decalcified fixed dunes with *Empetrum nigrum*" (crowberry dunes) is found in the area. The number of individuals was estimated in 2006 at about 1,400 and in 2007 at about 1,030, but probably the actual number is many times more. All in all 4,800 crowberry hummocks suitable for *Scythris empetrella* were studied, and 1,665 were found to be inhabited by the moth.

On the basis of the excursions of the Expert Group on Coleoptera in 2001 and the catches in 2006 and 2007, a total of 588 species of beetle are known in Vattaja. No nationally threatened species have been observed, but there are altogether five near threatened species, of which the *Sphaeristes stockmanni* is a species typical of areas affected by forest fires, and *Heterocerus hispidulus* and *Anthicus bimaculatus* are species characteristic of sandy environments.

In addition, one nationally threatened species of bug (Hemiptera) specialised in xerothermic environments such as Vattaja is known (Table 2).

Table 2. Threatened Lepidoptera and Hemiptera species in Vattaja. VU = Vulnerable.

Species	Conservation status
Scythris empetrella	VU
Euxoa recussa	VU
Standfussiana simulans	VU
Eulamprotes superbella	VU
Gonianotus marginepunctatus	VU

It was not possible to gain a comprehensive picture of the beetles of the dry, xerothermic sandy environments characteristic of Vattaja during this study, as the traps were mainly placed in areas with rotting or charred wood and in dune meadows. The species characteristic of xerothermic sandy environments were difficult to catch in traps and they require active observation and capture. Some of the observations of rare species of sandy beaches are from the excursions of the year 2001 by the Expert Group on Coleoptera. During the study period fairly reliable reference material was collected, even though two years is too short a time for studying changes in Lepidoptera populations. A repeat study should be carried out in the years 2011–2012.

5 Shore Birdlife in Vattajanniemi

Rainer Hakanen, Marko Sievänen and Hannu Tikkanen

From the perspective of birdlife, the goals set for the Vattaja Life project involved measures to reduce unintentional disturbance to birdlife during the nesting season by means of control measures and increased dissemination of information. Other goals were to restore overgrown shore meadows and to return the water level of a dried up lake to its former state. Further, in connection with the project, monitoring of changes in the populations of endangered bird species and birds mentioned in Annex I of the Birds Directive was carried out throughout the whole project area. The impacts of management actions on these bird populations were also monitored. In addition, the impacts of the use of the areas concerned on breeding bird populations were monitored in two areas of significance for birdlife.

The area's birdlife had been inventoried once in 1989. During the project a complete inventory of the area's shore birdlife was made in 2003 and 2005. The birdlife at the restored sites at Jussinpauha, Lake Vatunginjärvi and Lahdenkrooppi was also inventoried in 2007 and 2008. In order to establish the impacts of disturbance, the shore birdlife was inventoried several times during the nesting season in the years 2007 and 2008 at Kalsonnokka and Hakunti.

Altogether 18 bird species mentioned in the Birds Directive (79/409/EEC) were found, 12 of which probably breed here. Eleven of the species are classified as nationally or regionally threatened (Table 3). In addition, four nationally or regionally threatened bird species were found in Vattaja.

On the basis of counts, it seems that small changes have taken place in the area's shore birdlife during the monitoring period. New directive species that have become established in the area are the Slavonian Grebe and Whooper Swan. The Lesser Black-backed Gull and Temminck's Stint seem to have disappeared from the area. Changes in birdlife seem to be similar to those that have been observed elsewhere in Finland.

Table 3. Threatened bird species and species mentioned in Annex I of the Birds Directive (79/409/EEC). Conservation status: CR = Critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, RT = regionally threatened, LC = least concern.

Species	Conservation status	Directive species
Dunlin (*Calidris alpina schinzii*)	CR	x
Tengmalm's Owl (*Aegolius funereus*)	LC	x
Common tern (*Sterna hirundo*)	LC	x
Woodlark (*Lullula arborea*)	RT	x
Common Crane (*Grus grus*)	LC	x
Temminck's Stint (*Calidris temminckii*)	VU	
Arctic Tern (*Sterna paradisaea*)	LC	x
Whooper Swan (*Cygnus cygnus*)	LC	x
Wood Sandpiper (*Tringa glareola*)	RT	x
Western Capercaillie (*Tetrao urogallus*)	LC	x
Slavonian Grebe (*Podiceps auritus*)	NT	x
Grey Partridge (*Perdix perdix*)	VU	
Whinchat (*Saxicola rubetra*)	NT	x
Red-backed Shrike (*Lanius collurio*)	NT	x
Little Tern (*Sterna albifrons*)	EN	x
Three-toed Woodpecker (*Picoides tridactylus*)	RT	x
Hazel Grouse (*Bonasa bonasia*)	LC	x
Lesser Black-backed Gull (*Larus fuscus*)	VU	
Ruff (*Philomachus pugnax*)	NT	x
Eurasian Black Grouse (*Tetrao tetrix*)	NT	x
Chiffchaff (*Phylloscopus collybita*)	VU	x
Common Ringed Plover (*Charadrius hiaticula*)	RT	

The seriousness of the impacts of disturbance could not be established with certainty, but signs of disturbance impacts were found, e.g. failure of nesting of Common Ringed Plover, Arctic Skua and Little Tern. The Little Tern has only nested in the area for one year, but it may be that, due to disturbance, the species will not become established, even though there are plenty of suitable sandy beaches in the area. The impact of restoration measures on birdlife can be established by comparing the results of bird counts already made with those of counts made after the restoration measures, once the status of the habitat types has stabilised.

The living conditions of shore birds have been improved, for example at Pitkäpauha, by reclaiming the area for grazing. The high reed beds have all but disappeared. Photo Photo: Pirjo Hellemaa 2008.

6 Erosion of the Terrain in the Vattaja Dune Area – baseline inventory

Satu Lehto

Wear, or erosion, of the terrain means partial or complete destruction of the field and bottom layer of vegetation and the soil surface structure. This may be the result of natural erosion or of pressure caused by use of the area, such as trampling. Erosion of the terrain usually begins when water or wind can reach the soil, for example, when the surface is broken as a result of being trampled. It can also be affected by changes in the moisture balance of the soil. The most common forms of natural erosion are wind erosion, water drop erosion and erosion by above-ground water flow. The resistance of different areas to erosion and their ability to recover depend on various factors, for example, on the characteristics of the vegetation and the soil.

In studying the erosion of the Vattaja live fire and exercise area, the aim was to find out to what extent erosion affects different habitat types and to what degree different types of erosion are present in different areas and habitat types.

Erosion was studied along monitoring transect lines placed systematically over a distance of almost 8,000 metres. There were altogether 54 lines and they were placed in the terrain at intervals of about 250 metres. In addition, aerial photographs were used to establish the area and location of the eroded sites.

A foxhole at the foot of a tree on a wooded dune. Photo: Satu Lehto.

Wear on the area is caused by the Finnish Defence Forces' military exercise activities and by recreational use. The Defence Forces conduct exercises in the area on about 220 days a year, and visitor days number about 106,000. The number of recreational users has been estimated at about 5,000–10,000 users annually.

The most intensive eroding activity during military exercises is concentrated around the fixed firing positions, where heavy weapons and ammunition are brought in by motorised vehicles during live fire exercises. In addition, fortifications related to the training are constructed in the area of the firing positions. The central part of the firing position area, which is most heavily used, typically has an open deflation area that remains open. Erosion has spread from the shore firing positions to the grey dunes as a result of ruts caused by motor vehicles and trampling, and also to some of the wooded dunes behind the firing positions. The eroding effect of the firing positions is still clearly visible at the old positions, which were moved away from the top of the dunes at the beginning of the 2000s. Erosion at the firing positions further from the shore has spread to the wooded dunes.

In addition to the firing positions, the target area has also been subject to severe wear and tear by the army. For the most part the area is an open deflation plain, so that the harmful effects of erosion have remained minor in the extensive area in question. The erosion of the target area has been caused both by vehicles and by the explosion of ammunition.

The wear and tear cause by recreational use has remained concentrated in specific areas and at certain times. The time when the area is most heavily used is summer, especially on warm weekends, and the heaviest erosion caused by recreational use occurs in the area around the beach. There are other sites eroded by recreational use in the areas of Hakunti and Lahdenkrooppi. A feature that all the recreational areas have in common is that clear paths have been formed, and they are the most worn areas. Although there are also

paths in flat areas, for example near the beach, the formation of paths seems more pronounced and more intensive on the slopes, especially in the grey dune areas. Other habitat types subject to heavy erosion from recreational use are the crowberry dunes in the beach area. The beach is the most heavily used and also the most eroded recreational area. As regards erosion of the grey dunes, Lahdenkrooppi is more eroded than the beach area. At the Lahdenkrooppi site there are more paths on the grey dunes and they are more branched than in the beach area, while the paths near the beach form deeper ruts. In the Lahdenkrooppi area the army is also a factor causing erosion, which makes it difficult to compare the two areas. Of the areas in question Hakunti seems to be the least affected by erosion.

The most eroded areas are the open deflation surfaces. In the study, some of the grey dunes which have eroded to form open sandy surfaces are included among these. The most eroded habitat types were "Grey dunes with fixed herbaceous vegetation", "Decalcified fixed dunes with Empetrum nigrum" and "Wooded dunes" (see Table 4). Of the different types of erosion, most is caused by vehicles and second most by trampling.

The erosion caused by decades-long use of the area takes various forms in the different habitat types. Representative lichen-covered grey dunes are almost completely absent from the area. Local damage caused by excavations for structures connected with army activities and by wear are widely found in different parts of the area.

A deflation basin, created by erosion and wind, at the R1 firing position's grey dune. Photo: Satu Lehto.

Nevertheless, the activities of the Defence Forces have also had considerable positive effects. The long-term use of the area for military purposes has restricted large-scale use for recreation and tourism and prevented wear and erosion caused by building. It has also partly replaced the impact of traditional grazing in maintaining open habitat types. This has promoted the formation of priority habitat types, especially Grey dunes and Decalcified fixed dunes with Empetrum nigrum.

The baseline erosion inventory produced good, comprehensive reference material for monitoring adaptive and restorative measures to be carried out in the area.

Table 4. Estimated surface areas (ha) of different erosion classes and proportions (%) of habitat types. Classes: 0 = Intact vegetation in natural or almost natural state, 1 = Mostly intact or intact and depressed vegetation cover, 2 = Most of the vegetation destroyed, 3 = Vegetation completely or almost completely destroyed, bare sand. * = priority habitat type.

Habitat type	Class 0 (ha)	Class 1 (ha)	Class 2 (ha)	Class 3 (ha)	Habitat types, total area (ha)
Embryonic shifting dunes (2110)	9 (97.8%)	0.2 (2.2%)	0 (0%)	0 (0%)	9.2
White dunes (2120)	17.3 (82%)	0.2 (0.9%)	1.7 (8.1%)	1.9 (9.0%)	21.1
Grey dunes (2130*)	19.3 (32.3%)	17.3 (28.9%)	17.6 (29.4%)	5.6 (9.4%)	59.8
Decalcified fixed dunes with Empetrum nigrum (2140*)	4 (17.6%)	5.7 (25.1%)	7.6 (33.5%)	5.4 (23.8%)	22.7
Wooded dunes (2180)	29.1 (69.4%)	8.43 (11.6%)	4.83 (6.7%)	8.9 (12.3%)	72.5
Natural forests of primary succession stages of landupheaval coast (9030*)	29.1 (83.6%)	3.5 (10.1%)	1.2 (3.4%)	1 (2.9%)	34.8
Boreal Baltic coastal meadows (1630*)	3.96 (99%)	0.04 (1.0%)	0 (0%)	0 (0%)	4.0
Open deflation area	9.9 (3.7%)	21 (7.9%)	59.1 (22.2%)	176.1 (66.2%)	266.1

7 Adapting the Defence Forces' Activities to Ecological Values

Panssariprikaati and Sigma Konsultit Oy

The principal user of the Lohtaja live fire and exercise area is the ground-based air defence corps. The area is used by all units giving ground-based air defence training and by nine other units. The live fire and exercise area is used all year round on about 220 days a year. There are about 160 days in the year when movement is significantly restricted. The size of the exercising troops varies from a few dozen to more than two thousand. There are most troops at the national air defence exercises at the end of May and in November.

The Defence Forces have made an effort adapt their activities so that they cause only minor disturbance to the environment. All the troops using the military exercise areas are subject to the rules and regulations for the live fire and exercise area, which includes orders on environmental protection and the prevention of oil spills.

The plan for adapting the Defence Forces' activities to accommodate ecological values presents the Defence Forces' operations at the Natura site, the goals and methods of adapting them to ecological values and an assessment of their impacts on Natura habitat types and the species listed in the Birds Directive.

A general objective stated in the adaptation plan is that all activities not necessarily located at the Natura site for safety or operative reasons should be moved outside the conservation area. The activities to be moved include all grouping of troops that requires digging of fortifications and some combat exercises and operations relating to logistics and accommodation. In the context of the Vattaja Life project, the use of the R8 firing position was discontinued and the damaged sites repaired in the years 2005–2006.

Restored grey dune ridge at the R8 firing position, summer 2008. The vehicle dugouts are still visible as bare, sandy surfaces. Photo: Pirjo Hellemaa.

According to the adaptation plan, the environment-eroding activities that remain in the area are to be moved away from the prioritised Grey dunes and Decalcified fixed dunes with *Empetrum nigrum*. Besides these priority Natura habitat types, exercise activities remain at several sites in various other habitat types. At these sites, effective measures are to be taken to standardise activities involving pedestrian and motorised traffic and live fire exercises. The activities located at other sites in the Natura area are to be standardised, taking into consideration erosion resistance and landscape factors. Outside the Natura habitat types, at sites that do not meet the natural conditions for restoration as dune habitat types, lesser standardisation measures are considered sufficient. All vehicle traffic with a few exceptions is to be directed to surfaced roads and tracks marked in the terrain.

More precise objectives were set for the firing positions and various other sites depending on the specific area. To control and standardise the movement of troops exercising in the terrain, firing position areas and tracks will be marked. In addition, impacts on Natura habitat types will be reduced by moving the posts marking the position of the gun line at six firing positions. The total length of the firing positions to be moved is about 2 km. Firing positions R3–R5P will be moved 150–200 metres away from their current locations, farther back from the shore to the eastern part of the deflation areas, which are becoming wooded. The total length of the firing positions will not be changed. This arrangement allows more efficient use of the positions: a total of 27 guns can be placed at the firing positions instead of the previous 18.

Established locations will be allocated for the most important activities causing erosion outside the areas of the firing positions, and these will be marked with wooden signposts. The amount of off-road and off-track driving will be reduced by erecting barriers. The Natura site will be marked to improve awareness of the conservation area and to make it more easily discernible. Erosion of the wooded dune slopes will be reduced by providing wooden steps for the use of walkers. These will be built at five sites and their total length will be about 100 metres. In addition, paths and eroded areas will be covered with wood chips over an area of about 2,800 m^2.

Fixed fortifications will be built for different purposes, and the gun locations, missile firing positions and other exercise sites will be standardised and marked in the terrain. The main tracks and parking places for use by heavy vehicles and passenger cars will be surfaced with aggregate for a distance of about 5,000 meters, and another 23 parking places.

The plan also involves moving the Lahdenkrooppi sector watch tower from its present location 180 metres to the southeast, away from the Natura habitat types. The possibility of moving the Kalsonnokka tower is also being considered.

A separate plan will be drawn up for training and supervising the exercising troops in awareness of ecological values. The plan will describe in more detail the forms and content of training. The obligation to provide training will be added to the rules and regulations for the exercise area. The training will be implemented in three stages: training provided in the units, instructions given at the start of the exercise in the live fire and exercise area and feedback given during the exercises.

The material for information and instruction are a DVD film, a sheltered information point at the camp site where 5 to 7 A0-sized boards will be placed, information boards at the firing positions, a guide leaflet, and a map of the exercise area, to which the key information regarding conservation and exercise operations will be added. The rules and regulations for the camp area will be updated to take into account the changes caused by the above-mentioned factors. In addition, binding instructions will be drawn up in text and graphical format for the exercising troops. These instructions will cover the use of sites for national air defence exercises and firing positions,

Test planting of lichen patches at firing position R8's restored grey dune in November 2005. Photo: Marko Sievänen.

the construction and use of target equipment, the flying and searching of target drones etc.

In the plan for adapting the Defence Forces' operations to accommodate ecological values, the impacts of exercise operations on ecological values were also assessed both before and after the adaptive measures. According to the assessment, only operations causing very minor damage will remain in the Natura habitat types, and in many cases after the adaptive measures, the amount of damage caused will decrease significantly (Table 5).

According to assessments, none of the of the bird species requiring special protection mentioned in Annex I of the Birds Directive (79/409/EEC) that occur in the area suffer significantly from the area's current use or the extent of its use. Of the other species mentioned in the Birds Directive, the following may suffer from disturbance by movement and the noise of firing: Western Capercaillie, Little Tern, Common Tern, Arctic Tern, Woodlark, Common Ringed Plover and Red-backed Shrike. Disturbance to the Little Tern nesting on Kalsonnokka may be significant. Even after the adaptive measures, the use of Kalsonnokka for missile firing and military exercises will clearly cause disturbance, for example, to the Tern and Common Ringed Plover, despite more efficient standardisation measures.

If successful, the proposed adaptive measures will reduce erosion over extensive areas. After the adaptive measures, exercise operations will affect 3–15% of the different dune habitat types. It must also be noted that, even though they cause

some detrimental impacts to individual Natura habitat types, the current activities have also had positive impacts on the ecological functions and structure of the whole dune area.

Moving the firing positions and standardising operations will enable various types of ecological management work to be carried out at the Natura sites. This work will make it possible to increase the area of Natura habitat types by restoring the most eroded exercise areas which are no longer to be used, and also by restoring formerly open deflation areas that are becoming overgrown. Exercise operations in these potential Natura habitat types cover an area of more than 40 hectares (about 20% of the total area). Standardisation and ecological management work will make it possible to add some 140 hectares to the Natura habitat types.

Table 5. Impacts of Defence Forces' operations on Natura habitat types. * = priority habitat type.

Habitat type	A) Area (ha)	B) Firing position and other operations (h)	C) Tracks (ha)	B+C total	Percentage/total area of area eroded by FDF operations (B+C)/A x 100	Percentage before adaptive measures (land use plan 2004)	Reduction in percentage of area eroded by FDF operations
Grey dunes (2130*)	67.7	1.46	0.7	2.2	3.2%	46%	93.1%
Decalcified fixed dunes with *Empetrum nigrum* (2140*)	67.6	2.8	2.5	5.4	7.9%	65%	87.9%
Wooded dunes (2180)	81.4	2.5	1.1	3.6	4.4%	40%	90.1%
White dunes (2120)	21.8	0.2	0.5	0.7	3%	30%	89.8%
Embryonic shifting dunes (2110)	9.9	0.1	1.4	1.5	15.4%	32%	51.5%
Natural forests of primary succession stages of landupheaval coast (9030*)	27.4	0.4	0.3	0.7	2.5%	9%	71.0%
Deflation areas	214	39.4	2.6	42	19.6%		

8 Management Plan for Vattajanniemi Open Dune Areas

Hannu Tikkanen

In order to prevent shrinking of the area of open dune habitats, a management plan was drawn up for these sites. The plan presents the principles of management of the open dune habitats located in the Natura site by habitat type, as defined in the Habitats Directive. The objectives are to improve the representativity of the present Natura habitat types, to restore the sites damaged by use and to increase the area of Natura habitat types by managing the wooded sites capable of restoration.

The open dunes of Vattaja have become overgrown relatively quickly during the past 60 years. According to aerial photographs taken in the 1940s, the area of open dunes was considerably greater then than it is now. At that time there were 470 hectares of completely open sand dunes and in 2006 only about 280 hectares. A similar development has been general in other extensive drift sand areas. Aeolic functions and the shifting of dunes were still actively in progress in the 1920s–1930s. The dunes at Kalajoki and Hailuoto also began to stabilise and become wooded in the 1950s.

In the development of dune areas, e.g. at Kalajoki, the following stages have been distinguished: 1) the areas began to rise from the sea about 900 years ago, 2) the rising land quickly became covered with vegetation, which was unbroken for more than 500 years, 3) at earliest 500 years ago, a chain of dunes formed near the shore, 4) the dunes began to advance inland in the 19th century, burying the forest, and 5) the advance of the dunes has slowed down and stopped since the 1950s. The course of development was probably similar in the Vattaja dunes.

According to Alestalo (1971), the Laakainperä shifting dune (now Tarkastajanpakka) advanced about 140 metres from the years 1750–1905 and from 1905–1970 only 8 metres. In the 1930s the rate of advance was already very slow, although

Removing trees from overgrown decalcified fixed dunes with *Empetrum nigrum* to improve their representativeness. Photo: Hannu Tikkanen.

there were exceptional years at that time too. One of these years was 1931–1932, when, for example, a shed built on peatland at Laakainperä was completely buried by sand. The activation of dune formation in the 18th and 19th centuries is considered to have been due, among other things, to forest fires. Probably erosion caused by grazing also influenced the development. In traditional farming methods at that time, the forests and shores were used more intensively as pasture for animals. The fact that grazing in these areas stopped in the mid-20th century is considered to be one of the most important reasons for the sand becoming fixed and for the formation of vegetation cover on the dunes. The entire shore area of Vattaja was used as common grazing by the villagers in the traditional way until the mid-20th century. In addition to sheep and cattle, horses also grazed on the dunes when they were set free after the spring ploughing for the whole summer until September. According to Luukko (1938), you might see herds of ten or more horses on the sand in the 18th and 19th centuries. The most numerous animals were, however, sheep, and it is said there were several hundreds of them in Vattaja (Luukko 1938). Other factors that have probably influenced the changes in the open areas include the diminishing frequency of forest fires, air pollution, land uplift and possibly changes in the ground water level.

Nowadays less than half of the open dunes fall under the Natura 2000 habitat types listed in the Habitats Directive. Most of the open and semi-open dunes are nutrient-poor sand plains, i.e. deflation surfaces. Deflation areas can be divided into those located on dunes (dune slopes), where the material is fine sand, or those on gravelly and stony surfaces eroded by the wind, which change slowly into grassy heaths growing lichen. Typical vegetation of deflation areas includes tough grasses such as Wavy Hairgrass and Sheep's Fescue, as well as various lichens and mosses. Crowberry dunes appear in belts in the treeless and lightly wooded areas behind the grey dunes in Vattaja. In addition, dunes forming hillocks which collect sand and are characterised by Creeping Willow and Bearberry, but also grow Crowberry, are classified as Decalcified fixed dunes with *Empetrum nigrum*. In these belts of dunes there are often extensive deflation surfaces almost completely bare of vegetation.

According to the management plan drawn up, the long-term effects of management will be as follows:

- The areas of grey dunes, crowberry dunes and heaths growing heather and crowberry will increase, and their representativity will improve. The present habitat types and their proposed areas are presented in Table 6.
- The naturally open nature of the dune areas will increase, and the conditions for the aeolic processes essential for the formation of dunes will improve.
- The diversity of open habitat types will increase as the lichen-covered grey dunes increase in area and different types of heath develop.
- The conditions for the survival of species characteristic of open and dry environments will improve. Of endangered species, the management measures will benefit, among others, Scythris empetrella.
- The shifting dune at Tarkastajanpakka will continue to shift at its present slow rate.

Areas that were earlier open are divided according to the goals of management into the following classes:

1. Naturally open dune types

The need for management only concerns ground and vegetation damage caused by earlier use. In places there is also a need for direction of traffic. The necessary measures have been proposed in other plans.

2. Natura habitat types that are becoming overgrown and are to be cleared to make them open

This class includes all the sites classified as "Grey dunes" and "Decalcified fixed dunes with *Empetrum nigrum*" that are becoming wooded.

3. Wooded and eroded sites to be restored as Natura habitat types

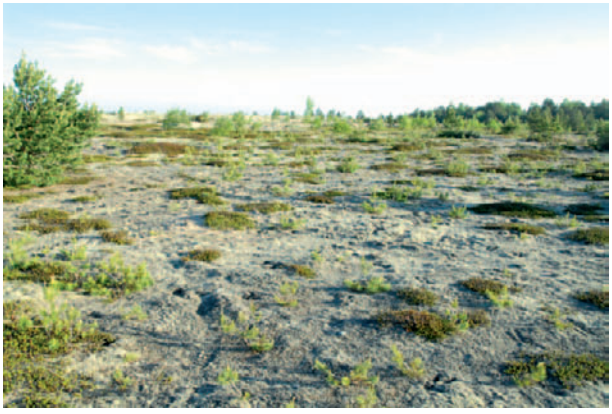
3A Expansion of grey dunes

– Wooded grey dunes.
This class includes former grey dunes, now wooded, where the undergrowth is still characterised by dune species. The sites can be classified as "Grey dunes" immediately after the management measures have been carried out. By clearing, the area of rare lichen-covered grey dunes can be increased. The plan proposes a total of 1.7 hectares of this type of habitat.

– Deflation areas to be converted into grey dunes by management measures.
The areas to be managed include the deflations eroded bare of vegetation that border on the shoreline grey dunes at Hakunti and the R7–R8 firing positions and the almost bare deflation situated further back from the shore between the Tarkastajanpakka and R2 firing position. The total area of the sites is 12 hectares.

3B Expansion of Decalcified fixed dunes with *Empetrum nigrum*

– Wooded deflations capable of restoration and former Decalcified fixed dunes with *Empetrum nigrum.*
This class includes wooded, closed or semi-open Western taiga near the shore, which were earlier open deflations or Natura habitat types and where there are still open stretches of sand in places and tussocks of crowberry binding the sand. The sites are situated in front of the firing positions to be moved, in places that will be cleared for firing position operations. The goal is to change these sites into Decalcified fixed dunes with *Empetrum nigrum* in the long run. The sites are potential areas for this type of habitat due to their location and the structure of the sand. Part of the area was of the above dune type before it became overgrown. Some of the sites can be classified as Natura habitat types immediately after clearing. The total area of the sites is 10 hectares.



This heath-like deflation surface with emerging seedlings is managed so that it forms undisturbed, uneroded dry heath. Photo: Hannu Tikkanen.

– Open deflations to be converted into Decalcified fixed dunes with *Empetrum nigrum* by management measures.
This class includes both eroded, bare, open sand stretches such as the Vonganpakka deflations and the partly wooded, previously open deflations between Lahdenkrooppi and the target area. The sites are open or semi-open areas, where the location and other conditions are such that they can potentially develop into Decalcified fixed dunes with *Empetrum nigrum*. The total area of the sites is about 40 hectares.

3C Deflation areas to be converted into heath habitats by management measures
The management measures are to be targeted at open or semi-open deflations, which are suited by their location and other conditions for development into heaths. The total area of the sites is about 81 hectares.

4. Open and semi-open deflation areas that are becoming wooded, where the succession will not be halted

The sites include fifteen semi-open and closed sand stretches surrounded by woods not belonging to the above-mentioned deflation areas, with poor conditions for development into Natura habitat types. The total surface area of the sands is about 30 hectares.

The overgrowth of this deflation surface will not be impeded. Photo: Hannu Tikkanen.

5. Areas that will remain open deflations due to firing position operations

These are sites that will remain open due to the amount of wear and tear caused by military operations.

The management methods to be used are:

- clearing of trees and stumps at sites that are becoming overgrown
- directions for use
- pasturing
- prescribed burning
- remediation of damage
- maintaining a suitable level of erosion.

Table 6. Current and projected areas of open dune habitat types at Vattaja.

Habitat type	Current area (ha)	Projected area (ha)
Embryonic shifting dunes	10	10
Shifting dunes with *Leymus arenarius*	22	22
Fixed coastal dunes with herbaceous vegetation	68	82
Decalcified fixed dunes with *Empetrum nigrum*	68	118
Dry heaths	0	80
Total (ha)	**168**	**312**

9 Remediation Plan for Landscape and Erosion Damage at Vattajanniemi

Marko Sievänen and Hannu Tikkanen

One aim of the Life project is to remedy and restore some of the damage caused to dune ecologies and to collect information on the suitability of different restoration methods in the dune areas. During the baseline inventory and assessment of erosion damage, 314 damaged sites were recorded in the terrain. The sites that are most extensive and most clearly visible in their environment are the deep and often large worn areas between the grey dune and the woods, caused by wear at the former shore firing positions, whose use was discontinued at the beginning of the 2000s. At individual damage sites, the position of the site was recorded together with coordinates and habitat type and information on the size and nature of the damage. As regards the nature of the damage, the time and manner of its origin was recorded and the need and possibility for restoration assessed. Of the damage sites inventoried, 15 were situated wholly or partly on the white dunes, 119 wholly or partly on the grey dunes and 10 on crowberry dunes. Of the damage to the wooded dunes, the majority are small excavations and paths. A total of 135 different point-type damage sites were inventoried on the wooded dunes. The rest of the damaged sites were not included in the Natura habitat types.

During the project, a plan for remedying the erosion damage was drawn up. In the context of this plan, the goal of the remediation and restoration work is to prevent the area of valuable Natura habitat types from shrinking due to the effects of erosion, and to increase the area of priority Natura habitat types. At the same the aim

Continuous walking on the beach's white dune has damaged the vegetation and caused deep tracks to form in the soil. If the vegetation is not allowed to recover and the erosion continues, the damage to the vegetation may turn into more significant soil damage, causing the dune to be cut off at the path due to the wind. Photo: Marko Sievänen 2005.

is to ensure that there are sufficient open dunes so that the natural processes that cause the formation of dunes in the area will continue in the long term. The plan proposes several small areas for restoration, with a total area of 6.43 hectares. Most of the area is situated on the grey dunes, crowberry dunes and wooded dunes.

The plan deals with the position and extent of the different damage types and lists by habitat type the remediation principles to be used. It also proposes an order of urgency for the remediation of the damaged sites (Table 7). According to the plan, extensive eroded pits and excavations will be restored by filling with sand collected from the area behind the site to be restored, where it is supposed that the sand has been blown from the eroded sites.

According to the plan there is no need to restore small paths. Only paths on slopes that have deepened so as to damage the soil can be filled and covered. Later wooden steps will be built on heavily used slopes to prevent erosion of the vegetation and soil.

In addition, the plan proposes the principles for restoring vegetation. According to the plan, the development of vegetation on eroded areas or those to be restored can be speeded up by sowing seeds of the species of plant characteristic of the vegetation type. The sowing of seeds is most suitable for restoring fast-growing grasses and annual species. In sowing seeds the principle is to gather the seeds from as close as possible to the site to be restored, and from the same type of vegetation as that found at the area where the restoration site is located. According to a restoration experiment made in 2005, it was found that planting root systems and partial roots of lymegrass was a quick way to help vegetation to develop on open sandy surfaces. Suitable for planting on white and grey dunes are small tussocks of lymegrass, which can be dug up carefully here and there from the embryonic dune zone. On the grey and more barren wooded dunes, the plan proposes that bearberry (*Arctostaphylos uva-ursi*) and crowberry (*Empetrum nigrum),* as well as small patches of lichen and moss can be planted.

Table 7. Prioritisation of restoration sites.

Priority restoration sites
1 Firing position R8
2 Dunes in front of firing position R3 up to firing position R4
3 Dunes in front of firing position R5
4 Lahdenkrooppi dunes: sites of breaks and tracks etc. in dunes
5 Excavations in Vonganpakka wooded dunes
6 Command and control unit fortification at Tiirankivi barrier
7 Firing position R6: shore-side edge
8 Excavations on back slope of Tarkastajanpakka
9 Pit at side of Pitkäpauha road
10 White and grey dunes on beach, where clear tracks have been worn
11 Excavation at intersection of old Ohtakarintie road and new road
12 Unofficial tracks between Kalsonnokantie road and Ohtakarintie road
13 Ditch in dry soil beside Hakunti road
Secondary restoration sites
14 Edge of dune in front of southern edge of firing position R7P
15 Slopes of wooded dunes, e.g. on back slope of Kommelinpakka
16 Old vehicle trench at northern end of Vonganpakka

10 Management of Vattajanniemi Heritage Biotopes

Lena Wargén

The landscape of Finland's coastal areas has changed radically during the past 50 years, during which time grazing of the shore areas has stopped. The shore meadows and other open areas have become overgrown, and the process has been accelerated by eutrophication and nutrients from airborne deposits. The heritage biotopes created by grazing are still to be seen in places behind the Vattaja dune area. There are a few shore meadows, altogether about 2 hectares, in Vattaja in the Lahdenkrooppi area. Since 2004 there has been sheep pasture in the northern part of Vattaja covering about 23 hectares. Before the implementation of the plan, 11 hectares of this area could be classed as forest pasture and about one hectare as wooded pasture.

In the context of the Life project a management plan was drawn up specifically for the heritage biotopes. The aim is to restart grazing in the area where it has shaped the environment over a long period of time. Another of the aims is to continue extending the area of pasture in the future. By extending the pastured area it is hoped to increase the area and representativity of the shore meadows and wooded pastures. In the case of shore meadows the target is 5 hectares and of wooded pastures about 11.5 hectares. By taking measures to restore the overgrown shore meadows, it is hoped to diversify and increase the birdlife of the shore meadows. Another purpose of management is to ascertain whether grazing is a suitable management method for conserving open dune types.

The most natural way, and especially in wooded areas, the only way to manage heritage biotopes is grazing, as it increases the amount of light and heat reaching the growth site and reduces the amount of nutrients in the soil. The pressure of grazing allowed in an area is decided according to the breed of animal grazed and the

The low, sandy, sometimes dry aro wetland at Pitkänpauha pasture. Its vegetation includes the bog myrtle, for example. The forest pasture in the background is managed through thinning and removing conifers. Photo: Pirjo Hellemaa 2008.

erosion resistance and management status of the area in question. Especially at the stage of basic restoration, grazing pressure can be higher than the average recommendation. Of the areas included in this plan, the grazing pressure on Pitkäpauha may not exceed 1.5 animals/ha. The pasture area on the northern side of Lahdenkrooppi is notably barren, and so a suitable grazing pressure is 0.5 animals/ha. The recommended grazing pressure in the pasture on the southern side of Lahdenkrooppi is about l animal/ha.

The management plan for heritage biotopes proposes as basic rehabilitation measures clearing of the trees and scrub on wooded pastures and shore meadows. By clearing forest pasture the amount of light reaching the soil surface is increased, thus encouraging herbaceous vegetation and the development of wooded pasture. In basic restoration and clearing, old trees and deadwood are to be left. All young spruce trees and spruce seedlings are to be removed but individual larger spruces and groups of spruces are to be left. Junipers are to be cleared so that only groups of juniper remain. Other trees are to be thinned, and especially young birch and willows are to be removed. After the measures, there should be distinct groups of trees left standing.

The shore meadows, which have long been untended, have to be restored before actual management, i.e. grazing, is started. The most common rehabilitation measures are clearing of trees and scrub, mowing of hay or burning of dense reeds. The smaller trees are to be uprooted.

In the Heritage Biotope Management Plan four different pasture areas are proposed:

Pasture area 1: Pitkäpauha

A 23 hectare area to the north of the Ohtakarintie road has been grazed since 2004, when the area's overgrown wooded pasture area was restored. After basic restoration measures the Pitkäpauha pasture comprises a pasture area of 31 hectares, 8.48 hectares of which can be classified as forest pasture and 11.76 hectares as wooded pasture. An additional area of about 3 hectares is to be added to the pasture, 1.7 hectares of which will be restored as wooded pasture, while the remaining part will develop with grazing into forest pasture. As a separate measure to improve the habitats for shore birdlife, scrub that has spread to the shore meadow will be removed from an area of 1.5 hectares. The grazing pressure on Pitkäpauha has been about 2 sheep/ha. In the future a maximum grazing pressure of 1.5 sheep/ha is recommended, i.e. a total of 45 sheep.

Pasture area 2: Northern side of Lahdenkrooppi

The area of the pasture on the northern side of the Lahdenkrooppi glo-lake is about 20 hectares. Five hectares of this is on the dunes and nine hectares are classified as forest pasture. The area will be extended to the north by about 22 hectares. No removal of trees or thinning will be carried out in the pasture. The pasture area is notably barren, and for this reason the grazing pressure must be kept very low, at about 0.5 animals/ha.

Pasture area 3: Southern side of Lahdenkrooppi

The pasture on the southern side of Lahdenkrooppi is about 30 hectares in area. Of this about 13 hectares will be forest pasture and 2 hectares dune pasture. The rest of the area is shore meadow with different degrees of reed and scrub vegetation. An area of about 2 hectares with dense growth of reeds will be cut. The recommended grazing pressure is 1 sheep/ha.

Pasture area 4: Hakunti

At Hakunti a new pasture area will be established, with an area of 3.4 hectares. The area consists of birch forest and an open deflation area. The birch forest has distinct features of wooded pasture. This will be enhanced by removing small spruce and pine and half of the conifers more than 20 cm in diameter from an area of about 2 hectares.

The plan includes an assessment of the impacts of heritage biotope management on Natura habitat types. Its finding is that grazing does not reduce the representativity of primary succession stage forests, but only slows down the succession. Neither does grazing have negative impacts on other Natura 2000 habitat types in the pasture area.

11 Action Plan for Restoration of Mires and Forests

Reijo Hokkanen

During the Life project a restoration plan was drawn up for the forests and mires in the Vattaja Natura site that have been impacted by forestry. The mires in the plan area have a thin covering of peat and are influenced by groundwater. Classification of the mires is fairly difficult, as there may in places be little of the characteristic mire vegetation, even though the soil is definitely moist. There is thus no distinction between these and mineral soils, and the situation is further complicated by the fact that the areas have been drained. The trees on the mire areas are nearly all mixed forest, at either mature or regeneration stage. In terms of nutrient content the mires are almost without exception herb-rich due to the effect of groundwater. Nutrient-poor ombrotrophic mires have not yet had time to develop. The ditches are all in quite good condition, and the soil dug from the ditches is also still present as it is mainly sand.

In the Vattajanniemi Natura 2000 area there are mires to be regenerated at three different sites. Iso Lehtilampi can be seen in a photograph taken in 1952 to have been a pool with an almost completely open (3.5 ha) water surface. The eastern side of the pool towards the sea was a mosaic of varying types of mire with open rich fens, and between them, evidently on sandy ridges, more wooded sites. The mire area is open with small trees, presumably broadleaf-dominated. Nowadays in the area there is mainly mixed regeneration-stage forest, where birch is in places the predominant species. The pool itself is covered with scrub and there is no longer any open water. In the Iso Lehtilampi area, the mires have been restored by damming the ditches over an area of about 15 hectares in 2001. The plan proposes further restoration of the already dammed area by filling in the ditches completely.

The aerial photograph taken in 1952 shows that Lahdenkrooppi area was at that time a mosaic of varying small fens and more wooded sites. Nowadays the eastern side of Lahdenkrooppi is a broadleaf-dominated area with drainage ditches, in which the succession stage of the trees varies from mature to regeneration stage. Birch is the predominant species but interspersed with pine and spruce. Here, too, there are thinned birch stands in places. The ground moisture variation is fairly small, and again it is difficult to draw the line between mire and mineral soil. In places features of spring fens can also be observed. In the south the drained area reaches as far as the Tiirakivenlammensuo mire. Tiirakivenlammensuo is very wet and alluvial and seems to be clearly inclined to the west. The ditch dug in the area does not seem to have affected the mire.

The Anttilanniittu area seems also to have been a similar mosaic of varying fens and more wooded sites judging from the 1952 aerial photograph. Nowadays the area is completely without open sites mainly as the result of forest drainage. On the northern side of Anttilanniittu there is a ditch flowing north in a mineral soil depression. The ditch is small in the southern parts but after a bend it widens. The area is oligotrophic spruce swamp, in places mesotrophic.

The forests of the area affected by the action plan are on sandy heath. In places the trees seem to be growing better than could be expected purely on the basis of the vegetation, evidently due to the proximity of ground water. The forests are sparse and the quality of pines is poor, as they are bent and knotty. Only a few of the compartments have more than 5 m^3/ha of decomposing wood.

The following is stated as far as the need for restoration work is concerned: The measures proposed in the plan are important as they will enable the restoration of significant habitats that are now absent from the area. These include herb-rich spruce swamps belonging to the habitat type 91D0, "Bog woodland", at present absent from the area. The representativity of transition mires (7140 "Transition mires and quaking bogs") will also improve. The drained sites were probably also aro wetlands in the past. These are mires where the moisture content varies seasonally and where the layer of peat may be very thin. Aro wetlands are a poorly known habitat that is interesting from the point of view of biodiversity. By res-

toration measures the natural flood dynamics of these mires could be restored.

When ditches are blocked the trees are weakened, and they then more easily become the rotting wood necessary for the survival of some species. Depressions that were cut off from the sea and became paludified were usually drained on the Ostrobothnian coast. However, it must be remembered that the whole of the Cape Vattajanniemi area is continually changing due to land uplift. At the same time the mires will probably change to become more barren as the thickness of the peat layer grows. In addition, the wetlands in the area have become overgrown due to natural processes. In this sense the aim of restoration is not to return, for example, to the situation in 1952, but to allow the natural flow of water without drainage ditches. After restoration, the mires will be allowed to develop without human intervention.

By restoring forests, more deadwood will be available for the organisms that depend on them, and thus the forests will develop into more diverse natural forest at a significantly faster rate. The aim will be to make deadwood from large-diameter trees, which are more valuable for the species that are dependent on rotting wood.

The measures proposed for restoring mires are complete blocking of the ditches and removing trees from the ditch lines. The methods for restoring forests are the artificial production of deadwood and clearing of small gaps.

The deadwood will be produced by loggers using power saws, at the same time as the ditches are blocked using excavation machinery, and also by the use of explosives by the army. The target is to produce 10–20 m3/ha of deadwood in the selected compartments. The clearing of small gaps will be carried out in even-structured young forests or sapling stands. Overall the area of forest to be restored is 100 hectares.

It is estimated that the plan for restoring mires and forests will have the following impacts as a result of the measures undertaken: There will be two Natura 2000 habitat types in the areas subject to restoration measures: 7140 “Transition mires and quaking bogs” and 2180 “Wooded dunes of the Atlantic, Continental and Boreal region”. Due to the proposed measures, the representativity of the area’s mire habitats will improve. No measures will be carried out in the wooded dune areas. Restoration will not harm the possibilities for survival of the species mentioned in the Habitats and Bird Directives. Restoration measures will be carried out at such times that the species will be a caused a minimum of disturbance (autumn, winter). In the long run, restoration will improve the conditions for survival of the species mentioned in the Directives as well as other rare species. In addition, new habitat types will be created in the area: 91D0 “Bog woodland” and 9080 “Fennoscandian deciduous swamp woods”.

12 Restoration of Vatunginjärvi Lake

Susanna Airiola

Vatunginjärvi Lake situated north of the Ohtakarintie road was dried a long time ago and there is hardly any water in it. There is no precise information on when, how much and by whom the water level was lowered. In an aerial photograph taken in 1945 it would seem that a drainage ditch had been dug from the lake to the sea and that the natural shoreline had retreated. In 1978 the water level in the lake was N60+2.09. From the contours of the terrain, it appears that the lake water level was about a metre higher than at present and that the surface area of the lake was about 20 hectares

During the Life project a restoration plan was drawn up, the aim being to restore the drained and overgrown Lake Latunginjärvi to its natural state. As a result of the restoration measures, the area of the priority habitat type 1150 "Coastal lagoons", will increase by a total of 16 hectares, and a new nesting environment will be created for Bird Directive species, including the Whooper Swan, the Slavonian Grebe and the Common Crane. The restoration of Vatunginjärvi will improve the significance of the lake as an area for fish spawning and waterfowl hunting, and it will increase the landscape value of the lake.

The plan gives the surface area of Lake Vatunginjärvi's watershed at the lake outlet as 79 hectares. At present the lake is so overgrown that the lake percentage of the watershed can be considered to be almost 0%. After raising the water level, the lake percentage will rise to 23%. The soil in the watershed is sandy and it is very permeable to water. The watershed area is predominantly pine forest.

In the topography of the planning area the old drift line is clearly visible, especially in the southern part of the area. The drift line rises from the level N60+3.00–3.20m. The ground level behind the drift line is about N60+4.00m. On the basis of the topography, the water level was originally at about N60+3.00m.

Water samples taken from the lake show that its iron content is very high. Presumably this is due to the anaerobic conditions prevailing under the peat as result of overgrowing, causing the iron in the sediment to dissolve in the water. The lake is almost in a natural state as there are no activities that cause significant nutrient loading of the water in the watershed area. The digging of forest drainage ditches and logging carried out in the watershed area did cause nutrient loading of the waters in the years following these operations.

In the chosen planning alternative, the water level of Lake Vatunginjärvi will be raised to the level N60+3.00m (mean water level), which on the basis of the topography was the water level of the lake in its natural state. The water level will be raised by building a natural weir in the outlet ditch. The road leading to Ohtakari will be raised to the level N60+4.00. At the lake a culvert will be built under the road.

All the trees in the area remaining under the water level, that is lower than N60+3.00, will be removed, as well as the biggest conifers at the level N60+3.00–+3.50, which will presumably not thrive in the new moisture conditions. Altogether 9.8 hectares of trees will be felled in the area. The scrub remaining in the area to be under water will be removed as carefully as possible. There are some 5.0 hectares of scrub to be cleared in the area.

Before the water level is raised, the peat and vegetation floating on the water surface will be removed. It is estimated that a total of about 2,000 m3 of peat will have to be removed from an area of 1 hectare.

When the water level is raised to the level N60+3.00, the area of the lake will be about 18.3 hectares. Within the estimated water level variation range, the water area will be 14.5–19 hectares. In addition, in the southern part of the watershed area there are 1.5 hectares of low-lying land at less than N60+3.00 which will become paludified with the raising of the water level. Waterlogging damage will be caused over an area of about 22.4 hectares due to the rising water level. On state land, waterlogging will affect about 10.2 hectares.

In restoring Lake Vatunginjärvi, land will be permanently covered by water, so that the project will require permission under the Water Act, Chapter 2, section 2. According to the plan the project meets the requirements for permission stipulated in the Water Act, Chapter 2, sections 4, 5 and 6.

13 Restoration of Lahdenkrooppi

Susanna Airiola

According to local residents Lahdenkrooppi was a fine, clear-watered, sand-bottomed glo-lake in its time. Its surface area is about 10 hectares, and the area of the watershed is about 10 km^2. The lake's water level has been lowered by 50–80 cm from its natural level. Nutrient loading has been caused by the Defence Forces' camp area, as wastewater from the army camp was run into Lahdenkrooppi after cleaning with peat. The lake was also loaded by effluents from agriculture and forest drainage. There are about 58 hectares of fields in the watershed, about 5.8% of the total area. Ditches have been dug in the northern part of the watershed. At times the direction of flow turns and seawater enters Lahdenkrooppi, so that the lake's water level is affected by the seawater level. In terms of nutrient content, the water of Lahdenkrooppi is not exceptionally nutrient-rich.

The Lahdenkrooppi restoration plan was drawn up in connection with the Life project. The purpose of the plan is to investigate the alternative restoration methods suitable for Lahdenkrooppi, to assess the advantages and disadvantages of the methods and to collect background information for a more detailed plan. The restoration of priority Natura habitat type 1150 "Coastal lagoons" can be set as the objective of the plan.

The decision on the project's final targets and measures has not yet been made. This plan presents the various alternatives and their advantages and disadvantages. No decisions have been made at this stage on the implementation of restoration. Table 8 gives a summary of the possible measures, their advantages and disadvantages and a rough estimate of the costs.

Lahdenkrooppi. Photo: Lentokuva Vallas Oy.

Table 8. Summary of possible restoration measures.

Measure	Advantages	Disadvantages	Costs	Permission needed
Raising water level	Will slow down overgrowing process. Will improve landscape. Will restore natural water level.	Waterlogging damage in nearest farming areas, over an area of 1.5–5 ha (depending on amount by which water level is raised). Waterlogging damage on land managed by Metsähallitus (amount not assessed)	8,000 € excluding compensation for waterlogging damage.	Requires permission under Water Act
Dredging	Will remove unpleasant sludge from lake bottom. Will control overgrowing of lake.	Carried out in the whole lake area, will temporarily reduce the diversity of the lake's ecosystem. A suitable area will have to be found for dumping dredged material. Turbidity of water in the lake and the area below it during the works. Possible negative impacts on the area's Natura values	Carried out in the whole lake area, 100,000–130,000 €	Carried out on a small scale does not require permission. If carried out in the entire lake area permission is required from Environmental Permit Authority. Natura assessment required.
Temporary drying of lake and excavation of material on dry lake bottom	Will remove unpleasant sludge from lake bottom. Will provide very effective control of overgrowing of lake. Handling of material easier and more accurate result of work than by traditional dredging.	Radical measure, which will reduce diversity of lake ecosystem, at least temporarily. Lake will be dry for at least one summer during work. Pumping of water will have downstream impacts. Possible negative impacts on area's Natura values. Unfavourable weather conditions during work could cause a significant rise in costs.	approx. 90,000 €	Requires permission under Water Act and Natura assessment.
Removal of aquatic vegetation	Will control overgrowing of lake. Will improve landscape. Possible positive impacts on lake's ecology?	Possible negative impacts on lake's ecology? Impacts will be short-lived if the measure is not repeated regularly.	Depending on extent and method 4,000–25,000 €	Notification to Regional Environment Centre. Probably requires Natura assessment.
Removal of bushes and scrub at shoreline	Will make the landscape tidier.	Possible negative impacts on area's Natura values / ecology?	Cost of single clearing approx. 1,000 € or costs of pasturing	No permission required. Possibly requires Natura assessment.
Reduction of nutrient load	Will reduce nutrient loading of incoming water.	Alone this measure will not affect the lake's state or overgrowing as the bottom is covered with a nutrient-rich sludge. Together with other measures this would help to slow down eutrophication of lake.	Depends on measures to be carried out.	No permission required.

14 Geomorphological Monitoring

Pirjo Hellemaa

In the course of the Vattaja Life project, monitoring of changes in the area's dune topography was started, as well as monitoring of the restoration measures planned and already partly implemented in the area. The monitoring will make use of the transects established during the baseline inventory of erosion and vegetation. Aerial photographs and elevation maps will also be used.

Nine of the erosion monitoring transects were reviewed in summer 2008. In addition, the success and effects of management and restoration measures have been followed. The profiles of the three restored dunes at the R8 firing position have been measured repeatedly.

Changes in the erosion monitoring transects established by Lehto are minor, but the impact of management measures is beginning to be seen. The boardwalks to the beach on transects 7 and 8 serve to direct access and reduce the amount of trampling.

The first pits at firing position R8 were filled in autumn 2005. At the same time experimental sowing and planting of Blue Lymegrass and transplanting of lichen patches were tried out on the dunes. Actions of this kind seem to have to some extent speeded up the spread of vegetation to bare sandy stretches. At the restored sites the dune sand has settled to some extent and has trickled down the slope, but on the whole the restoration work has been extremely successful.

The line of lichen grids at the top of the dune, parallel to the shoreline, has clearly become more open after the willows on the lee side of the dune were removed. Photo: Pirjo Hellemaa.

As is well known, grazing also has an effect on dune topography. At the pasture at Pitkäpauha there is a white dune bordering on the sandy accumulation bay. The Blue Lymegrass has been cropped by sheep and in particular the willows on the dune have been almost completely stripped of leaves. The dune's slipface has clearly been activated. Its height was 2.3 metres in summer 2008. On the side of the dune facing the sea low sandy shelves have been formed as a result of trampling by the sheep. This means that the inclination of the slope is gradually becoming less. Trees are spreading to the dunes. As the current shore material is finer and no new sand is brought in by the waves, the dune is evidently stabilising and will become forested in spite of grazing. However, grazing may lower the dune's height. Grazing has also effectively destroyed the shore reeds, and as a result, the erosion caused by forces at the shoreline has extended further along the shore and worn away the sandbank.

Despite the short monitoring period, the following can be put forward as a preliminary conclusion: The characteristic features of the Natura site's dune types have been well preserved, with the exception of the grey dunes which have suffered the worst damage. Since grazing has been started, the growth of reeds has clearly been held in check. The shore meadows benefit from grazing, but on the other hand, grazing also probably affects the composition and numbers of species occurring there. As a result of repeated fires on the grey dunes, a lush dune meadow rich in species develops, where especially Sea Pea (*Lathyrus japonicus*) grows in abundance. The lush meadow withstands trampling and other wear fairly well. The sandy deflation areas may return to grey dunes as a result of restoration if the measures become sufficiently well established and access is directed so that wear is significantly reduced. The results of erosion monitoring show a slight recovery of the vegetation cover even during the short project period. The crowberry dunes are a boreal habitat type which has evidently been created partly as a result of grazing. The habitat type is not found in Finland on dune shores that have not been used as pasture, for example, at

The boardwalks direct visitors and make it easier to walk across the dunes. Photo: Pirjo Hellemaa.

Yyteri. The crowberry dunes have benefited from the clearing of seedlings. In general, clearing also increases the area of xerothermic habitats. Crowberry dunes were moved to make way for the new target track. However, the crowberry's growth was disturbed and the tussocks that had been moved looked brown and dead in summer 2007. Moving of dunes can therefore not be recommended as a management measure.

The filling of the biggest pits has returned the dune landscape to its former state. Direction of access to the dunes also seems to have significance. Besides the grey dunes, the wooded dunes habitat type also clearly benefits from the stabilisation of activities.

The clearing of seedling stands may increase the amount of herbaceous vegetation, as disturbing the natural succession usually encourages the growth of grass. Clearing work also makes the landscape more open, and as the vegetation cover is broken, deflation may result. This makes the control of activities and access more important than ever. There should be as little traffic as possible on the lichen-covered dunes in the southern part of the area, and at least motor traffic should be prohibited. Grazing carried out within the project has not yet had time to bring about major changes in the species present in the area.

The real significance of the management and adaptation measures carried out during the Vattaja Dune Life project will only become visible with the future monitoring of vegetation cover and erosion of the terrain in 3–5 years' time. In the follow-up it will be worthwhile to extend the monitoring beyond the priority and predominant habitat types at least to the "Humid dune slacks" habitat type. The profiles or sample areas to be reviewed should represent different forms of land use, intensity of use and areas that show differing intensities of erosion in the baseline situation.

ISSN 1235-6549
ISBN 978-952-446-716-2 (pdf)

www.metsa.fi/julkaisut