



Erik Andersson (edit.)

Indicator Species

**An important tool when preserving
the cultural landscape**



Erik Andersson (edit.)

Indicator Species



**An important tool when preserving
the cultural landscape**



Anthyllis vulneraria -meadow in Saluvere Salumägi, West Estonia. Photo: Iiro Ikonen

Erik Andersson from the Norrtälje Nature Conservation Foundation is the editor-in-chief of this publication. The following authors have been involved in compiling this publication:

Anna Haapaniemi (Centre for Economic Development, Transport and the Environment for Southwest Finland)
Iiro Ikonen (Centre for Economic Development, Transport and the Environment for Southwest Finland)
Leif Lindgren (Finnish Forest and Park Service, Metsähallitus)
Kaja Lotman (Keskkonnaamet, Environmental Board of Estonia)
Ilpo Mannerkoski (Finnish Environment Institute)
Marko Nieminen (Faunatica Oy)
Kari Nupponen (Faunatica Oy)
Mika Orjala (Centre for Economic Development, Transport and the Environment for Southwest Finland)
Juho Paukkunen (Finnish Museum of Natural History)
Timo Pitkänen (Department of Geography and Geology, University of Turku)
Tapio Saario (Centre for Economic Development, Transport and the Environment for Southwest Finland)
Tõnu Talvi (Keskkonnaamet, Environmental Board of Estonia)
Juhani Terhivuo (Finnish Museum of Natural History)

We acknowledge all experts of CEDTEs, Metsähallitus, MTT Agrifood Research Finland and the Finnish Environment Institute (SYKE) for their valuable comments.

ISBN 978-952-257-516-6 (printed)

ISBN 978-952-257-517-3 (PDF)

URN:ISBN:978-952-257-517-3

Front cover photograph: Per Bengtsson

Illustrations: Jonas Lundin

Proof-reading: Olof Enqvist

Layout: Päivi Lehtinen

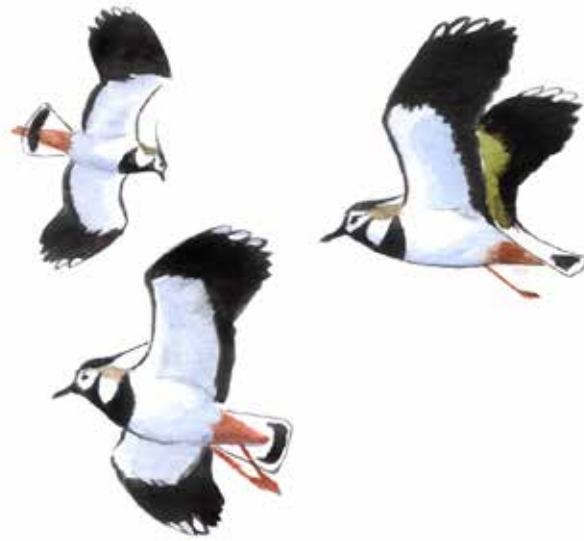
Cover design: Ulriikka Lipasti

Printing: Affärtryckeriet i Norrtälje

Contents

Preface	5
Introduction.....	6
The Coastal and Cultural Landscape in Sweden	7
The Finnish Coastal Landscape – Some Cultural and Environmental Aspects	10
Meadow and Pasture Habitats in the Estonian Landscape	17
Habitats and Indicator Species.....	23
Indicator Species	27
Introduction to the Species Descriptions	27
Species in dry to Mesic Meadows	28
Species in Coastal Meadows and Lagoons.....	64
References	80





Preface

This publication has been produced as a part of the Natureship project (2009-2013) coordinated by the Centre for Economic Development, Transport and the Environment (CEDTE) for Southwest Finland. Natureship project is an international project including members from Estonia, Finland and Sweden. It is funded by Central Baltic Interreg IV A Programme together with national financiers. There are eleven project partners: CEDTE for Southwest Finland, the University of Turku, Department of Geography and Geology, Metsähallitus (Finnish Forest and Park Service), the city of Hamina, the city of Raisio, the city of Salo, the municipality of Vihti, Norrtälje Nature Conservation Foundation, County Administrative Board of Gotland, Estonian Nature Conservation Centre, and the University of Tartu.

The goal of the project is to increase cooperation in nature management and water protection in Finland, Sweden and Estonia. This project aims to carry out shore planning according to the principles of sustainable development, and by means of which, all partners in cooperation try to find the best costeffective methods of promoting water protection and biodiversity. During the project Natureship partners test different planning methods in shore areas by combining geographic information (GIS) with historical material, make innovative management experiments and recommendations, and study the indicator species of traditional biotopes. In addition, this project examines ecosystem services, i.e. all the material and immaterial benefits, which are supplied for people by natural ecosystems.

The main outcome of the project is a series of six nature management publications. All the publications can be downloaded from Natureship's Internet pages, www.ymparisto.fi/natureship.

Turku 25.5.2012

Mika Orjala, Anna Haapaniemi and Annastina Sarlin

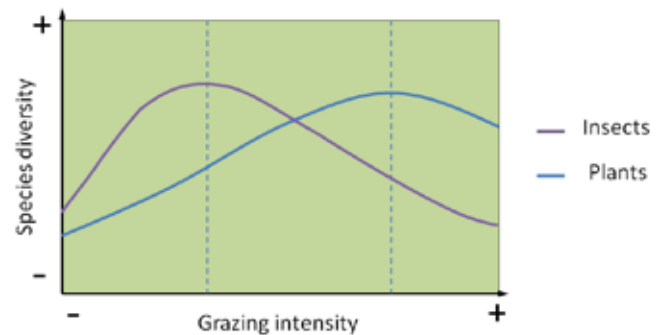
Coordinators of the Natureship project

Introduction

It is important that we keep an eye on the changes occurring in important traditional landscapes and understand that our policies and choices can have a significant impact on what happens to them. The overgrowth of the traditional landscapes described below (such as important coastal meadows, dry meadows, wooded meadows and coastal lagoons) is a common concern of Finland, Sweden and Estonia. The overgrowth has gradually led to a disappearance of open landscapes in many areas, a decline in biodiversity and the weakening of the recreation potential.

The now-scattered occurrence of many plant and insect species is mainly an indication of the once-extensive network of traditional landscapes. As recently as half a century ago, there were large areas of grazed forest, landscapes were more open and seeds spread quickly in open environments and trampled areas with hay transports and extensively wandering animals. Nowadays a large proportion of the threatened species in our countries are species occurring in traditional landscapes that currently have an extinction debt. Extinction debt means that, in the long run, these species will disappear as a result of the lack of sufficiently extensive and diverse natural habitats and ecological connections. For this reason, sufficiently extensive and effective management measures should at least be taken in the most important areas. While the management approach and intensity should vary within the areas, careful consideration should be given to the methods traditionally used. The management should also be planned and focused so that the favourable conservation status of the populations of threatened species can be strengthened. The status of the populations should also be monitored so that, if there is any worsening of the situation, quick action can be taken by, for example, adopting new management methods.

The publication presents indicator and flagship species of traditional landscapes in our coastal areas and coastal lagoons. Indicator species occurring in traditional landscapes are a measure of the level of management and the 'health' of the areas. They are typically sensitive to environmental changes and can quickly disappear if management measures are abandoned or altered. However, it is important to keep in mind what we want to measure, and firstly choose indicators accordingly, and secondly select an appropriate data collection method being ei-



Grazing and biodiversity of plants and insects (Artdatabanken Sweden)

ther qualitative (free search) or quantitative (sample points). Plants, for example, are usually site-specific, slow, local scale indicators which indicate many different factors and are easy to monitor, but are not necessarily representative for other organisms (Jacobson 2012). On landscape scale insects and especially birds are usually better indicators. Different species use landscape differently.

Flagship species are easily identifiable species that create positive images. Good indicator species are often also flagship species. These include Elder-flowered Orchid (*Dactylorhiza sambucina*), Rattle Grasshopper (*Pshophus stridulus*) and Clouded Apollo (*Parnassius mnemosyne*). In this publication some effects of the management measures are detailed after the description of each species.

The aim of the project and this publication is to promote cooperation in order to enhance exchange of information and best guideline practices of management, restoration and monitoring of traditional rural biotopes and coastal areas between Finland, Sweden and Estonia.

Turku 23.11.2012

Iiro Ikonen

The Coastal and Cultural Landscape in Sweden

by Erik Andersson

Sweden is today facing a major challenge due to changes that take place within the agricultural landscape. A large proportion of the vascular plants in Sweden are only available in traditional rural biotopes created by humans, cattle and fire. The agricultural landscapes in Sweden vary greatly and are, in many areas where there used to be an active management, threatened by overgrowth. With the help of indicator species, one can get an estimate of how well an area is doing and what status it is in. It is especially plants and insects that serve as indicator species but also birds, amphibians and reptiles may be used.

It's not just animals and plants that will suffer when the agricultural landscape disappears. There are many of us that have a strong connection to the open countryside that for a long time has characterized large parts of Sweden. Restoring and preserving this unique part of our cultural history is thus important.

The Agricultural Landscape throughout History

Sweden's cultural landscape is often synonymous with farmland areas and has long been a natural part of the Swedish countryside. This is about to change though and these areas are now quickly disappearing as a result of overgrowth and reduced grazing pressure. To trace the origin of the agricultural landscape one has to go far back in time, specifically around 4000 BC, when the major clearing/cutting to make way for cattle and arable land for crops began.

Around 2500 BC there was arable and pasture land even in the northernmost parts of Sweden and 500 years later there was a strong agriculture expansion in the country to provide more room for pasture and fodder lands. Between 600-1100 AD there was an increase in the number of active settlers and farmers and it was also during this time that the scythe and the rake were introduced. This meant that farmers now could reap larger amounts of feed and keep a larger number of cattle; the manure from the animals also allowed for retaining more permanent fields. During this time people also started to divide their land into in- and outfields, where all the arable land, hay fields and the farm belonged to the infields while pastures and forest meadows belonged to the outfields.

Around the 1800s the cultural landscape changed even more when industrialization took off and farmers began to use their lands even more effectively; this era has since come to be known as the agrar-

ian revolution. What really happened was that the amount of arable land increased sharply, while hay and pasture areas decreased.

The numbers of farm animals also increased, which led to great difficulties regarding animal keeping and the agriculture were strained to the utmost to provide enough food for animals and fertilizer for the fields. A new cropping system was thus introduced, where farmers started to grow grass which reduced the needs of hay fields and manure from livestock. At the end of the 1800s people also began to realize the value of wood and forest pastures went from being the most common type of pasture to only represent about 3% of the total pasture area.

This reformation continued into the 1900s and the balance that existed between agriculture and nature is now increasingly disappearing, resulting in extensive damage to the environment in many areas. The landscape has also become gradually more homogeneous as many of the open ditches, barns and ponds have been abandoned or overgrown.

Another factor that has been contributing to the current status of the agricultural landscape was the policy at the time. Before the World War II, taxes were introduced on imported agricultural products to ensure that the Swedish peasantry had an adequate income. Mortgage loans were also introduced with the purpose to reduce urban migration and instead promote the countryside. After the war things changed however and the politicians now instead wanted to make sure that Sweden could be self-sufficient if the borders closed. Several goals were introduced; an income objective, an efficiency objective and a production objective. These made it more profitable to merge several small farms to larger units. Chemical fertilizers and herbicides were also introduced to increase the agricultural production.

In the 1960s, these measures were implemented and many farmers were forced to leave their homes and those who were left specialized in either crop or livestock. The expected income growth did fail though and the government had to instead introduce a number of subsidies to ensure that the, sometimes severely, indebted farmers could cope financially. At the end of the 1970s politicians again changed the objectives and now introduced restrictions on chemical fertilizers and pesticides, something which they had previously had encouraged. People were now also beginning to realize the importance of the agriculture landscape and in 1986 the first national program was introduced to support people working with the maintenance of biological and historical values.

The Coastal Landscape in Sweden

The archipelago is a unique type of environment that only exists in a few parts of the world. This is because archipelagos almost exclusively exist in areas previously covered by ice sheets and since been affected by land uplift. The archipelago that runs along the Swedish east coast over to Finland is the world's largest contiguous archipelago. The combination of the water of the Baltic Sea and coastlines are found only here and together they create conditions that are optimal for plant and animal life. Therefore many areas are protected as a part of the environmental objective "Oceans in the Balance, and Living Coast and Archipelago", where the aim is to preserve the coastal and archipelago landscape, buildings and settlements from different periods.

These environments also have a unique biological and historical value on the mainland, many of which are closely tied to the cultural landscape. Some of the habitats found here are coastal meadows; a meadow with low vegetation which at times is flooded by sea water, grazed sandy beaches; here cattle have eaten most of the vegetation and left a thin grass cover and some resistant plants. Other common habitats are wooded and mesic meadows. In order to protect these areas, Sweden has assumed another environmental objective, called "A rich agricultural landscape", which strives to preserve the diversity that is generated in agricultural areas and protect the habitats that are threatened.

The people along the Swedish west coast have generally always had fishing as their primary occupation, since there has always been free fishing rights here compared to the Baltic coast. Many of the islands here show traces of a once active fishing industry and are of a great cultural value.

On the east coast, from Blekinge in the south to the Gulf of Bothnia in the north, the conditions differed greatly from that of the west coast. Here, people have been able to settle on the large archipelago islands outside Småland, Östergötland and Södermanland and operate large farms. When the rationalization of agriculture occurred it became increasingly difficult for people to make a living on farming alone and thus many islands and farms were abandoned.

The landscape on the island of Gotland is unique for Sweden. The island's foundation consists of limestone bedrock that made it possible for unique flora to prosper here. The residents have been, ever since the Iron Age, occupied with agriculture and there are still traces of an early natural landscape. The open pastures and meadows have been used for a long time and the forest pastures are still grazed by Gotland Russ, an ancient pony breed possibly descending from the Tarpan (*Equus ferus gmelini*).

Ever since the islands got a permanent population, there have been farmers in the Stockholm archipelago. The first islanders are believed to have arrived in the early Bronze Age, at a time when hunting and fishing were the main chores together with small-scale farming on the side. However, agriculture grew, and the farmers used all suitable land area available. Since then, farming has been restricted by the limited space and has therefore not been able to keep up with the evolution of agriculture

in the last 150 years. From the northern coast of Upland and up to the High Coast the cultural landscape becomes increasingly rare along the coast and the archipelagos.

What Will Happen?

From being in a steady expansion over thousands of years, agriculture is now in decline. How long this will last and what the consequences will be, it is difficult to predict. One fact is that more and more of the open farmland that we have today will be overgrown, and many animals and plants will be affected. There is a new agro-climate, which gradually becomes more and more centered around major cities and the grazing pressure will be a lot harder on the surrounding landscape. Of the 4000 species that today are endangered in Sweden more than half are associated with the agricultural landscape.

The changes taking place today do not resemble in any way the old-time farming. In many forest areas and middle districts the grazing animals have disappeared and where they still occur, the grazing regime has changed and forest and natural pasture is becoming increasingly rare. The new type of fertilizers and the nitrogen deposition that occurs only favors a few species which quickly out-competes the less competitive ones. The implementation of new tools and the removal of ditches and mounds have also led to the disappearance of many small habitats and important havens.

The policy that has been driven, and which has long been a contributing factor to rationalizing, changed in the late 1970s, and began introducing measures to preserve the cultural landscape. This has continued and more and more areas are now protected and have individual action plans. UNESCO decided in 2000 to include the southern part of Öland as a UN world heritage site. The main reason was the long cultivation continuity that has been conducted there, from the Stone Age to the present day and hopefully it will stay this way.

For it to be profitable to work in agriculture today, farmers often need to have large areas and a large number of livestock which is impossible in many places, such as the archipelago. Costs for transporting livestock and machinery are also a factor that hampers profitability further. Many of today's farmers therefore have several businesses started, but this is often not enough, and farming has gone from being, historically one of the most common industries, to today only engaging 1.4 % of the residents living in the Stockholm archipelago.

Seminars and Field Demonstrations

An important part of the Central Baltic Natureship (CBN) program has been to educate and engage the public in the importance of preserving our cultural landscape. During a series of eight workshops and eight field demonstrations, in the years 2010 to 2011, the public has had the chance to get information and practical experience from people who have great knowledge in various aspects in this topic. The curiosity, and also the interest, of the visitors have been great and many of the events were well attended. The total amount of visitors was almost 400 people.

All seminars, and many of the field demonstrations, were held on Färsna farm, which is an old farm with high conservation and cultural heritage values. Prehistoric remains show that the farm has been inhabited since the Iron Age and farming has been an active part for a long time. The entire Färsna farm includes nearly 100 hectares consisting of arable land, pastures and old pine and spruce forests. The farm also keeps livestock in form of cattle, sheep and goats which helps to keep the surrounding land open. Today the aim is to restore and maintain the farm as it once was and to inform and educate the general public about the importance of conservation and Sweden's cultural landscape.

During the seminars that were held, many interesting topics were discussed and the curiosity, not only of the locals, but also people from other places was inspiring.

Feedback from Visitors

The feedback from visitors has been extremely positive; we find that both the seminars and field demonstrations have been interesting and rewarding. There has been a good variation of content, which dealt with everything from historic features to more current topics such as how to apply for money and how to go about keeping the landscape open.

"Many people take nature for granted and do not know all the work that lies behind our cultural landscape. This, I believe, however, is changing and the CBN project has helped to increase the understanding of this". (Bertil, visitor)

There have been plenty of visitors from the start, but interest seemed also to have increased over time as more and more people participated. The lecturers have been good and engaging, and the audience curiosity has been notable.

"The seminars and field demonstrations have been extensive and instructive. Would have loved to have seen a more obvious link between them, however". (Rolf, visitor)

One perception among those interviewed was that the visitors were a mix of people and that many took the opportunity to attend both field demonstrations and seminars, even though this was not the original idea.

"Our cultural landscape is an important part of our history and it is extremely important to do our best to preserve it for future generations". (Kjell, visitor)

A type of traditional rural biotope is a pollard meadow. The pollarding practice, in which the upper branches of a tree are removed, was used to promote growth of dense foliage that could then be harvested as winter forage. The resulting characteristic meadow type has vegetation adapted to continuous removal of nutrients, leaf litter, and shading. Photo: Iiro Ikonen, CEDTE



The Finnish Coastal Landscape - Some Cultural and Environmental Aspects

by Mika Orjala

Coastal Habitat Types in Finland

Geographically, coastal habitat types in Finland can be divided into five different areas. The northernmost coastal area in Finland is the Bothnian Bay area, which is characterised by a flat and stony landscape and few islands. Thick ice in wintertime and significant changes to the sea level in summertime shape the areas near the coastline. Sand-based soil is very typical of the area, which naturally also affects the type of vegetation in the area.

Land uplift in the Bothnian Bay area is very fast, and new land is revealed as the coastline moves further towards the sea. In the south, the Bothnian Bay coastal habitat type ends at the Jakobstad area, which marks the beginning of Kvarken. It is located at the narrowest point of the Gulf of Bothnia, joining the Bothnian Bay to the Bothnian Sea. The shallowness of the sea area at Kvarken creates an undersea threshold, where the lowering of salinity (from five to four per ml) renders this the northernmost point in the distribution of several marine species. The land uplift is also fast in the Kvarken, which constantly transforms the vast and fragmented archipelago landscape of the region.

The coastal habitat type of the Bothnian Sea is characterised by scarcity of islands, particularly in comparison to the Archipelago Sea, even though southern parts of the region contain some islands with rocky outcrops. Towards the north, coastal areas of the Bothnian Sea become more flat in profile and are defined by gravel, shingles and boulders. The coastal area of the Bothnian Sea extends from the southern part of Kvarken to the north of Åland.

A vast archipelago area made up of the Archipelago Sea and Åland represents the Finnish coastline at its most fragmented. Thousands of islands shaped by ice, water and wind have created different flada lakes, gloe lakes, straits, bays, basins, sandy beaches and stony coasts. The bedrock in the coastal and archipelago area of the Archipelago Sea also contains limestone, whereas the Salpausselkä ridge system created by the ice age can be seen as several moraine or sand islands and beaches in the Archipelago Sea area.

The southernmost coastal habitat type, the Bay of Finland area, is limited in the west to the tip of the Hanko peninsula. A general characteristic of this area is a relatively narrow archipelago zone; the widest stretch of the archipelago is located in the sea

area between Ekenäs and Inga and Sibbo and Porvoo. Here, the fragmented coastline of the archipelago consists of stony, rocky and moraine coasts as well as sandy beaches, of which the latter can be found especially in the eastern Bay of Finland, and the Hanko peninsula. The western and eastern Bay of Finland also differ in terms of height – in the east, the coastline is relatively flat and lower in character, whereas the western shores with rock outcrops are more elevated and of varying height.

Development of the Finnish Archipelago and Coastal Landscape throughout the Centuries

The Stone Age man inhabits the archipelago

The archipelago and coastal areas provided the people of the Stone Age (8600–1500 BC) with a wide variety of different resources in the warming period that followed the ice age. The salt content of the Baltic Sea and its nearby sea areas was higher than at present and numerous species of birds, fish and seals could be found in the coastal areas. According to studies, during the Bronze Age (1300–500 BC) the entire archipelago, as it was at the time that it was inhabited, the spread of population was enhanced by a warm and dry climate, which also meant a diverse flora and fauna.

The appearance of the archipelago was in many ways similar to what it is today, with the exception that, for example, 4,000 years ago the current skerries of outer archipelago were 20 to 25 metres below sea level. The Bronze Age archipelago was located about 100 to 200 kilometres northeast, east and southeast of the current archipelago.

In the Stone and Bronze Age, the high cliff tops of today's outer islands were small treeless outer skerries, outer archipelago was located around the main islands of Nagu and Houtskär, and inner archipelago was situated more or less around the coast of Turunmaa. The movement of innovations, goods and people was based on waterways. Permanent habitation on the coasts and the archipelago was established little by little, as crop growing began to gain ground alongside the main sources of livelihood, i.e. fishing, hunting and fowling.



The term coast is used to refer to areas where water and land meet. The steepness of the coastal profile affects aspects such as the zoned nature of vegetation. For example, in the case of a flat coastline, changes in the sea level have a significant impact on the width of the coastal zone.

The quality of soil is of great importance to coastal habitat types. For example, sandy beaches, gravel, shingle and boulder shores as well as shores with rock outcrops are generally very scarce in terms of vegetation, provided that coastal vegetation is exposed to the wearing effect of wind, water and ice.

More sheltered coasts where the soil is finer, consisting of sand, silt, clay or mud, develop mainly meadow vegetation that is gradually transformed into different forest habitat types through different phases of bushes and alder stands.

Coastal habitat types range from coastal meadows, reed beds and dried seaweed washed ashore to primary succession forests slightly further inland that may be located several kilometres away from coastlines affected by land uplift. The number of different coastal habitat types and type combinations identified is 44, out of which the main "dry land" types include geolittoral habitats, dune habitats, hydro- and geolittoral reed beds, coastal scrub and deciduous, coniferous and mixed forests of the land uplift coast.

First indications of agriculture in the Archipelago Sea area are from Högssar on Nagu, dating from approximately 3,500 to 4,000 years ago. In the Bronze Age, animal husbandry and crop growing continued much in the same way as they had in the Stone Age. Crop growing was based on a rotating burn-beating (slash-and-burn), and, in addition to barley, wheat was an important crop. Clear signs of burn-beating can be found from as early as 2,500 years ago.

Long-term use of burn-beating has had a significant transformative effect on the environment in the coastal area as well as inland, changing the succession of forests and the species found in them.

Permanent habitation in the archipelago and coastal areas changes the landscape

In the coastal areas, the use of scythe was adopted in the Iron Age, around year zero. It was around this time that the archipelago gained its current shape. The adoption of the scythe enabled the harvesting of grass and reed in moist coastal meadows possibly as early as the Iron Age. Settlers from Northern and Central Sweden arrived in the Archipelago Sea area between 1150 and 1300. This period witnessed the establishment of many of the villages in the Archipelago Sea area.

According to estimates, the number of homesteads in the area between Korpo and Houtskär increased four to five-fold between the end of 13th century and the mid-16th century. Around the same time, at the turn of the 14th and 15th century, effective cultivation of barley, wheat and particularly rye began on the main island of Korpo. More effective cultivation dramatically altered the number and quality of forests in the Archipelago Sea area, as the most fecund forests were burned down to make room for fields.

As the Middle Ages wore on, the amount of juniper increased, which indicates a development towards a greater amount of open pastureland. Livestock dung was used to fertilise the fields, and it is also likely that the widespread use of the common reed as fodder had begun by this time. Even though the main sources of livelihood in the coastal regions and particularly the archipelago in the Middle Ages were fishing, fowling and seal hunting, animal husbandry and crop growing already constituted noteworthy subsidiary industries.

Still today, it is possible to find the common hop (*Humulus lupulus*) near deserted cottages in the archipelago; its cultivation was probably begun by Franciscan friars on Kõkar already in the Middle Ages. Hop is a good example of a cultural plant species that was favoured by people and thrived throughout the country. Already in the Middle Ages, the natural resources and the amount of land available limited the amount of population in the coastal regions and particularly the archipelago. Forests, outer islands, grazed pastures and other areas in joint ownership of the homesteads were utilised for example for hunting and animal husbandry.

Even though open-sea fishing was not subject to permission, seine fishing and net fishing were based on land use rights. The main product from animal husbandry was dung to fertilise the fields, in addition to which dairy products and meat were also used.

Population growth, famine years and new methods

The development of the Finnish cultural landscape has been essentially affected by economic policy and legislation. The oldest way to distribute land was the open field system in use in Southern and South-western Finland in the 16th century. In connection with the Great Land Reform, which was carried out in the late 18th century, it was decided to revoke the ban on the partitioning of land that had been in force since the mid-16th century and that had aimed to prevent the formation of estates that would not have provided a sufficient livelihood for the owner.

The welfare of the Finns improved and infant mortality was reduced in the course of the 18th and 19th centuries. The peaceful and prosperous years resulted in an explosive growth in population rate: for example, the population of Korpo more than doubled between the years 1749 and 1900. By the mid-19th century, life in the archipelago was also affected by technological reforms: in the 1840s, fishermen began using hook nets to catch European sprat and Baltic herring and, in the 1860s, also adopted the use of drift nets. The development of nets also enabled the start of open-sea fishing, upon which no restrictions were placed at this point.

In the 19th century, Finnish agriculture and rural areas were undergoing an age of stagnation. Despite the constant clearing of new farmland, the productive capacity of agriculture was not sufficient for the needs of the growing population. Homesteaders were not adopting innovations developed abroad, but their knowhow was based on information obtained from older generations, the so-called old agriculture. At the same time, the practice of agriculture was becoming increasingly one-sided: the role of animal husbandry was diminishing as crop growing began to overpower the industry. Knowledge on the profitability of new farming methods, such as artificial fertilisers, was



not adopted by the public until after the famine years 1866 to 1868, when almost 10 per cent of the population, amounting to a total of approximately 140,000 people, had perished from malnutrition and epidemics.

The archipelago and the coastal areas were also affected by the hard times, many rocky and barren islands had been adopted into farming use in the archipelago, when even small patches of land were harnessed to grow crop and hay. Between 1880 and 1910, it was often necessary to resort to the use of heather, reindeer lichen and pine and coniferous trees as emergency fodder for livestock in densely populated archipelagic areas. On the whole, it can be concluded that at the turn 19th and 20th century, the impact of human activities on the nature of archipelagic and coastal regions was great, much greater than ever before.

How did human activity impact the (cultural) environment of coastal areas and the archipelago at the turn of the 19th and 20th centuries, when the archipelagic regions were densely populated? As an example, we can take Jungfruskär, where botanist Ole Eklund carried out his research in the early 20th century. At the time, much of the island consisted of land used to grow and harvest hay, unharvested pastures and rocky wasteland used for grazing livestock.

The low pollard meadows at Jungfruskär were characterised by very few trees, growing at intervals of approximately ten metres. Bushes were even less common than trees. Among others, the following plants were identified by botanist Ole Eklund in the vast and open meadows of Jungfruskär: Dwarf Milkwort (*Polygala amarella*), Grass-of-Parnassus (*Parnassia palustris*), Dropwort (*Filipendula vulgaris*) and the demanding Blue Sedge (*Carex flacca*). In his publications, Eklund described the island as a diverse and beautiful flower garden, where, in addition to plant life characteristic of meadows, trees such as goat willow, aspen, alder, bird cherry and rowan could also be found.

Yet, Eklund perceived agriculture and farmland as a threat – he was afraid that the lush pollard meadows of Jungfruskär would disappear, should the island be divided into farmland. The total area of arable land almost doubled in Finland between 1880 and 1910; a number of natural meadows were adopted into farming use during this period.

Contemporary and Future Challenges in Coastal Regions and the Archipelago

Ole Eklund's view of the future threats of Jungfruskär did not come true, as the beautiful dry meadows, wooded pastures and pollard meadows of the island did not disappear with the division of the island into farmland. Instead, the traditional rural biotopes of Jungfruskär overgrew and reverted to woodland, after the need for grazing and crop growing ceased almost completely with the dwindling of agriculture in the archipelago.

When the grazing of cows, sheep, goats, and horses ended in the meadows, wooded pastures, and other grazed woodlands in the course of the 20th century, the natural succession of vegetation began to proceed at a rapid pace in these areas. For example, ungrazed coastal meadows are threatened by overgrowth and transformation into reed beds and alder stands.

Coastal meadows generally develop on coastal and archipelagic regions with high clay, silt or fine sand content. As a result of the land uplift phenomenon, vegetation on seashore meadows is changing constantly; typically, they display a variety of different zones parallel to the shoreline, the structure of which is affected by changes in humidity, quality of soil, moving ice, changes in sea level and average sea level.

The above-mentioned forces of nature combined with human activities, such as burn-beating and the grazing of animals, function to preserve the openness of seashore meadows. Seashore meadows left in their natural state will inevitably overgrow as succession progresses.

Pollard meadows with their diverse range of plant and insect species consist of open meadow areas and groups of trees. The majority of the total area of pollard meadows consists of open meadow; the portion of trees and groups of trees is 15 to 25 percent. The term pollarding means the cutting of the smaller branches of aspen, birch, rowan and other species of deciduous trees using, for example, a leaf knife made for the purpose. Such branches, rich in protein and vitamins, were still commonly used in the feeding of sheep and cows in the early 20th century.

Out of the total area of current seashore meadows (some 4,200 hectares), more than half located on the shores of the Bothnian Bay, where vast coastal areas are still commonly used for grazing. The amount of seashore meadows remains very small compared the 1950s, for example, when, according to estimates, the total area of seashore meadows was approximately 57,000 hectares. Traditional agriculture and the grazing of coastal meadows waned in the 1940s and the 1950s, and many seashore meadows overgrew during the 1960s and 70s. In addition to the spreading of reed, willow bushes and other plant species benefiting from eutrophication, the digging of forest ditches and shore construction have reduced the number of seashore and freshwater meadows. With the mechanization of agriculture, Finland achieved self-sufficiency in terms of domestic animal products in the 1950s.

Seashore meadows are typically treeless and bushless areas dominated by low grass. Seashore meadows can be classified into subtypes based on their dominant species, such as tall sedge seashore meadows and *Eleocharis parvula* - *E. acicularis* seashore meadows. In addition to Needle Spikerush (*Eleocharis acicularis*), typical plant species in seashore meadows include Mackenzie's sedge (*Carex mackenziei*) and Arctic Silverweed (*Potentilla anserina* ssp. *groenlandica*).

Seashore meadows constitute important nesting and feeding environments for many bird species. The nowadays rare Dunlin (*Calidris alpina schinzii*) and the Eurasian Curlew (*Numenius arquata*), among others, can be seen especially in seashore meadows.

Dry meadows on sand, gravel and moraine land are highly diverse in terms of flora and fauna. A large variety of insect species live in the shade of the Common Milkwort (*Polygala vulgaris*), Northern Moonwort (*Botrychium boreale*) and other endangered species. These include many rare species of beetle, butterfly and hymenopteran.



In the late 1960s, measures were taken to curb overproduction using a so-called field reservation system, one of the aims of which was for small farmers to give up farming. Reduction in the number of small holdings, the favoring of large farming units, as well as the specialization and greater efficiency of production are trends that continue to be active even today.

In the last 40 years, the percentage of Finnish people living in population centres has increased from 55 to more than 80 per cent, which has meant a significant reduction in the population of rural areas. Despite urbanization (or as a result of it), spending time in lake- or seashore cottages remains, for many Finns, an important way to enjoy holidays.

The construction of holiday homes has led to the destruction of several dry meadows and rock meadows especially in coastal areas. In the 1950s, the total area of dry meadows in Finland amounted to more than 10,000 hectares, which is now estimated to have been reduced to less than 10%, or some 800 hectares. Ungrazed or unmowed dry meadows will outgrow quickly, in addition to which dry meadows with fertile soil have been transformed into fields.

Dry meadows adopted into pasture use are affected by eutrophication, when additional nutrients are carried to the areas in the form of urine and manure. In addition, chemical pest control and artificial fertilizers have not improved the state of the environment let alone biodiversity.

Flada lakes, or coastal lagoons about to lose their connection to the sea as a result of land uplift, and gloe lakes, already detached from the sea, have become less common. Overgrowth caused by eutrophication, forestry, dredging, waterborne traffic and the construction of holiday homes pose a great threat to flada lakes. For example, it has been estimated that out of the flada lakes and gloe lakes in the Kvarken area, only about 10 per cent remain in their natural state.

The total area of sandy beaches amounts to just 800 hectares, and a significant part of these are threatened by wear caused by human activity, nutrient emissions, invasive alien species, households' abstraction of sand and overgrowth. According to a study carried out in the eastern Bay of Finland, only about 40 per cent of sandy beaches were in their natural state - 60 per cent of the areas could be classified as overgrown or affected by frequent use by humans.

Overgrowth is a threat particularly to sheltered coastal areas prone to gathering easily decomposing plant mass that functions as a good growth medium for the common reed (*Phragmites australis*). Unless the area is regularly grazed and mowed, the common reed is quick to occupy growing space, at the same time suffocating other vegetation.

Coastal areas covered by reeds have increased significantly in the last few decades. The eutrophication of water systems and reduction in the amount of grazing has contributed to the increase in areas dominated by reed. Loss of open landscapes, reduced recreational value of the areas, and diminished biodiversity in plant life are seen as significant problems caused by the increase of coastal reed beds.

For example, the quality and quantity of coastal meadows and bulrush beds (*Schoenoplectus spp.*) have been reduced as a result of the increased dominance of reed in coastal areas. Reed forms thick growths in the best habitats, at the same time suffocating other vegetation. As usual, there is another side to the coin, however. Many species of frogs, fish, insects and birds benefit from reed-dominated areas. For example, the Bearded Reedling (*Panurus biarmicus*) and the Sedge Warbler (*Acrocephalus schoenobaenus*) - like other warbler species - have expanded their area of distribution. As for species of butterflies, the Southern Wainscot (*Mythimna straminea*) and Fenn's Wainscot (*Chortodes brevilinea*), among others, benefit from the increased quantity of reed beds.

In traditional agriculture, coastal alder stands, i.e. coastal *Alnus glutinosa* and *A. incana* dominated moist herb-rich forests, were valuable areas for the grazing of livestock and the harvesting of hay, in addition to which they were also cleared into meadows and fields. With the transformation undergone by agriculture and forestry in the course of the 20th century, the alder stands were no longer threatened so much by transformation into meadows or fields, but by reverting to woodland - as a result of the draining and felling of coastal alder stands, the succession development of seashore forests has been altered, and coastal *Alnus spp.* dominated herb-rich forests in their natural state have become rare.

A large proportion of rotten wood is typical of alder stands and conifer forests in their natural state. With modern forestry, trees felled by wind are quickly cleared away, which is why significant amounts of rotten wood are rarely encountered in forests anymore. For example, the amount of *Pinus sylvestris* dominated dry heath forests in coastal and archipelago areas are estimated to have decreased by some 80 per cent in the 20th century due to intensive forestry.

Measures to Conserve Nature and Benefit the Environment

A number of threats affect cultural landscapes in the archipelago and coastal areas what can be done to benefit/save traditional landscapes that have been with us for centuries? Since 1995, Finnish farmers have had the opportunity to apply for special aid for the management of traditional rural biotopes from the Finnish Agri- Environmental Programme in order to conserve traditional landscapes.

Since 2008, it has also been possible to apply for so-called non-

productive investment aid for the initial restoration of the target. Non-Governmental Organizations (NGOs) also have an opportunity to contribute to the work, as they are eligible for special aid for the management of traditional rural biotopes as part of the agri-environmental aid scheme through the so-called Leader method.



The concept of Green Infrastructure was developed in the United States in the mid-1990s. The thinking and design process highlights consideration of the natural environment in the designing of urban infrastructure. Consideration of natural values is particularly important in densely populated areas in order to prevent the destruction of natural environments where cities are constructed.

The green infrastructure of cities consists of closely interlinked natural ecosystems that can be joined by ecological corridors to preserve the diversity of flora and fauna. The aim of the concept is to provide ecosystem services for both the surrounding nature and people using the environment. Green infrastructure also has a clear positive impact on the promotion of people's well-being.

The significance of green environments is also highlighted in Finnish urban planning. The first national classification of green areas was published in 1992 by the Ministry of the Environment. After this, other classification guides for green areas have been published, the most recent of which, "Vihealueiden hoitoluokitus" (Management classification for green areas), was published in 2007.

The above-mentioned special environmental aid is the most significant funding instrument in support of the conservation of traditional rural biotopes, and it has functioned to slow down the reduction in the amount of wooded pastures, grazed woodlands and traditional rural biotopes in coastal areas in an important way. The significance of the special aid for the conservation of heaths, dry meadows and rocky meadows has, however, been slight. Different traditional rural biotope management projects of a fixed duration, such as Life projects, have also enhanced the management of these biotopes.

In the management of traditional rural landscapes and biotopes, the aim is usually to tip the development of plant life from overgrowth towards restoring the openness/semi-openness of centuries-old cultural landscape. For example, wooded pastures used in traditional agriculture that have since reverted to forest have been cleared and readopted into grazing use. In an ideal situation, the management of a traditional rural biotope can be done using traditional working methods, although this does not exclude the use of new, innovative methods. In any case, the management of a traditional landscape can be divided into two different stages: a one-off restoration and continuous management to be carried out on an annual basis.

Basic restoration aims to remove living and dead plant mass that has piled up on the traditional rural biotope as effectively as possible in order to be able to reduce the amount of nutrients accumulated in the area. Often, the clearing of areas that have reverted to woodland is followed by a nutrient explosion, as a large amount of nutrients remain in the roots of trees and bushes to be exploited by so-called nutrient opportunists, such as nettle and cow parsley.

The situation can be controlled only through annual management, as this is the only way to prevent eutrophic vegetation from re-occupying the area through overgrowth. Prior to the initial clearing, it is thus necessary to ensure the continuity of the management of the area also in the future. The managed areas should be as large and well-connected as possible, rather than small-in size and geographically dispersed, as this may result in consequences as grave as the local extinction of the rarer species of fauna and flora.

If the area managed is too small, external disturbances, such as forest clearings, in nearby areas may affect the quality of the (protected) area and thus compromise the conditions of the species to be protected. For example in the case of dry meadows, incorporating the fields surrounding the meadow as part of the managed area would also be important.

The selection of a suitable management method always depends on the target in question. Grazing cattle, a herd of sheep and horses are the traditional managers of coastal meadows. As the number of people practicing agriculture continues to decrease, it is often necessary to resort to mechanical mowing. For example, last year's reeds can be easily removed using a mower-conditioner in order to make room for fresh sprouts more appealing to the grazing animals. When needed, thick reed growths can also be harrowed particularly around the water's edge, which crushes the roots of the reeds. This creates open sludge shore as a feeding area for waders, as birds feeding at the water's edge are not found in overgrown coastal meadows.

Traditional landscapes can also be managed using fire. Dwarf shrub-dominated heaths have traditionally been managed by burning. Fire was used to remove old heather, which provided the grazing sheep with fresh and tasty heather shoots to feed on. If the burning was done sufficiently early in the spring, i.e. in April or May, the roots of the heather would be left intact.

In case the burning was carried out towards the autumn, the destroyed dwarf shrubs were replaced by hay and grass. The burning produced a mosaic of patches of heath and dry meadowland such as can be seen on Jurmo, even though the last time the heather was burnt off in the area was in the 1920s.

Ring-barking (i.e. removing the bark from the width of about 20 centimeters from around the trunk) is often a more effective clearing method than use of a chain saw or a clearing saw. If trees such as black alder or aspen are felled with a chain saw, they tend to generate a large number of new root shoots next to the stump. Ring-barking prevents the transportation of nutrients from the top of the tree to the roots in the vascular cambium layer immediately below the bark, with time rendering the roots starved of energy and thus unable to generate new root shoots.

The chainsaw does, however, remain an effective tool for example in the clearing of brushes. Also light loaders, such as tractor-mounted models, have been utilized in the management of traditional rural biotopes. For example, juniper bushes forming dense growths in many of the pastures and meadowlands in the coast and the archipelago have been cleared by pulling them out using a light loader. Traditionally, juniper bushes have been destroyed by burning, which also eliminates the topsoil stratum containing a large amount of needles from the trees and acidifying the soil.

Irrespective of the restoration method used, the management of traditional rural biotopes generally requires large amounts of workforce. In the old days, the entire village joined together to do the work on the common land. Today, this tradition of working together is revived in work camps, in which the participants manage traditional landscapes using old working methods. The first work camps in the Archipelago Sea national park were organized in 1979.

The restoration of outgrown meadows, pastures and other cultural environments is expensive and requires many hours of work. The payoff, however, is restoring the biodiversity of the traditional landscape and conserving the centuries old cultural landscape.

Meadow and Pasture Habitats in the Estonian Landscape

by Kaja Lotman

The meadow and pasture habitats are under threat due to agricultural intensification, abandonment and building development. The first two, acting locally in opposite directions, can both lead to severe deterioration of the habitats' conservation status while the third can totally destroy the habitats.

While being locally opposite these factors form one complex at a larger scale, since intensification of agriculture leads to abandonment of agriculturally less favorable sites, which in turn tends to open these for building development. It must be stressed that due to the big decline in agricultural production during the 1990s, the problems resulting directly from agricultural intensification are minor in Estonia while those related to abandonment are much more serious. Building development was also becoming a more and more serious threat during the economic boom years in the 1990s but is currently not very severe.

The wet grassland habitats are also threatened by drainage but this is not a priority threat at present. It should also be added that at a more global scale the meadow and pasture habitats are under threat from long-range air pollution, climate change and deterioration of water quality. However in Estonia these threats are currently significantly smaller than those of abandonment and building development.

Agricultural practices like grazing and mowing and to some extent related activities like bush-cutting, burning of dead grass etc. have been instrumental in forming landscapes rich in these habitats. This kind of agriculture, resulting in significant biological and landscape diversity as a "by-product" is nowadays often called High Nature Value (HNV) agriculture.

The Formation of the Habitat Patterns in the Estonian Landscape

The history of land use alongside with natural factors has created the habitat patterns of today. The natural factors include sediment accumulation, coastal abrasion, erosion, land-lift, fires, floods and wild herbivores. Land use history includes grazing, mowing, cutting or pollarding trees, reed-cutting etc. Today it is hard to imagine just how much the grazing did influence the landscape and all habitats before the large-scale use of barbed wire started to change the pastoral activities.



Photo: Lauri Klein



Photo: Iiro Ikonen



Photo: Iiro Ikonen



Just a century ago free grazing was widespread in Estonia with shepherds or small children looking after the animals and most of the pastures were not fenced. Grazing used almost all the available land, only areas growing crops or hay were spared as well as sites planted recently with trees. In Estonia winter fodder is more important than in more southern countries, and therefore the use of grasslands for haymaking has been very widespread. Large areas were thus managed as hay-meadows that would only be grazed after harvesting.

The impact of pastoral activities was most pronounced in the coastal areas, especially in Western Estonia. As soon as the land was exposed by the land uplift, it was used for grazing. This created the coastal pastures where reed and bushes could not take hold – this habitat is therefore often not secondary in spite of being semi-natural. The floodplains were probably also pastures in the beginning but were later mostly used as hay-meadows. Thus the alluvial meadows were formed.

Forests were also used for hay-making and grazing, resulting in formation of wooded meadows and pastures. Grazing has also been instrumental in the formation of alvars, heaths and scrubs, and to some extent in the creation of open dunes with moving sand. Especially the over-grazing of the latter has been a continuous cause of concern for some time. In some places grazing was banned and dunes were planted with trees to stop the sand from moving.

A Brief Overview of the Land-use History

History of the land-use in Estonia has had a clear impact on the development of landscapes and habitat patterns. As glaciers retreated to the north, humans advanced with it. However the landscape "foot-prints" of the hunters and gatherers was small especially compared to the impact made by later human generations.

A significant change occurred with the Neolithic shift to pastoralism and the agriculture that advanced from the south, with the so-called culture of the battle axes. Further changes took place during the Bronze and Iron Ages, especially with the introduction of the scythe, which made haymaking on large areas possible. In medieval times, Estonia was conquered, by mostly German crusaders, and a feudal land-use system was forced upon the local peasants.

As the landlords hold title to most of the land and their estates used the most productive parts, the farmers were also forced to use only the very marginal parts of the lands. The decline of the feudal land-use systems in the 19th century Russian empire, that then also included Estonian land, allowed the more well-off farmers to purchase bigger farms. However, large parts of the land still remained in ownership of the landlords.

Considerable changes happened after the independence in 1918 and the subsequent land reform in 1920s. Farmers got access to the fields that previously had belonged to the large estates. This reduced the demand for hay from the distant woods, resulting in an overgrowth of the more remote wooded meadows. Some of the wooded meadows were converted into wooded pastures (mowing plus grazing was replaced by grazing only).

Barbed wire introduced a gradual shift into less 'total' grazing than before. This change however, was not as dramatic as the rapidly increased drainage activity that was also supported by the state. The impact of the soviet occupation as the result of WWII, and especially the so-called 'collectivization' in 1949, resulted in a subsequent concentration of agriculture which was even more dramatic.

Most of the wooded meadows were abandoned during the sixties. Large-scale drainage resulted in replacing former open ditches with underground pipes on 4/5 of the drained fields. To some extent, such large fields were also created by draining former wetlands. The use of open alluvial meadows continued, but tractors replaced the hand-mowing and horse-driven machines. The large kolkhoz herds of cattle differed significantly from the pre-war farm-herds but not so much from the herds owned by estates in the older days. More distant wet grasslands however, gradually fell out of use. Grazing and mowing also ceased on most of the islets. Intensification, concentration, mechanization and chemicalization of the agriculture resulted in a growing run-off of pollutants that peaked in the eighties.

Regaining of independence and the collapse of the communist system – followed by radical de-regulation of agriculture (including an unregulated import) resulted in a dramatic drop in agricultural production. The use of agro-chemicals and the related pollution also decreased. Many fields fell out of use and the amount of acreage decreased. The number of domestic animals also dropped quickly. Economic importance of semi-natural grasslands significantly decreased and their use became mostly unprofitable. Therefore all semi-natural grasslands started quickly to fall out of use.

The importance of protecting the remaining meadows and pastures was relatively quickly recognized by the Estonian nature conservation community, resulting in various actions to support the traditional management of these habitats.

After joining the EU, the main driver of change has been the Common Agricultural Policy (CAP). Part of the influence has been negative to HNV agriculture, as most of the money has gone to big and intensive agricultural producers. Efforts were made however, by the nature conservation professionals and NGOs already in a pre-accession process to secure support for sustainable use of meadows and pastures with CAP money. There have been several problems including those of eligibility for support, but since 2007 a special scheme for management of semi-natural habitats located within Natura 2000 has been in place. The results are mixed with clear success in some places and much more modest results in others but at least a quick loss of meadows and pastures has been halted. A slightly more detailed account is presented further below.

Loss of Biodiversity Due to Overgrowth – Why does it Matter?

The end of grazing and mowing triggers overgrowth of the sites leading to the disappearance of characteristic flora, including most of the orchids. Overgrowth of the short-grass communities leads to vanishing of typical nesting birds, especially the waders. Value of the area for migrating geese also decreases. Overgrowth of coastal meadows and dunes (including dune slacks and shallow lagoons) leads to vanishing of natterjack toad populations. Effects on biodiversity of invertebrates are also negative. To sum up – loss of grassland habitats and overgrowth of coastal habitats with tall vegetation can lead to severe loss of biodiversity and even to species extinctions.

The question thus rises - how can man-made effects on vegetation be of critical importance for so many species? Even though extensive agriculture – including pastoralism – has a history of several thousand years, and in some of the coastal regions of the Baltic Sea has indeed influenced nature ever since these coastal sites appeared from the sea, this time-scale is mostly far too short from an evolutionary point of view.

The species that, at present, are critically dependent on pastoral activities are mostly far older than the agriculture. The most feasible hypothesis to explain this apparent paradox has been independently developed by several authors, most clearly by Leif Andersson of Sweden and Franz Vera of the Netherlands. And the answer is indeed quite obvious: the large herbivores have grazed the land long before humans have domesticated them.

The keystone species in large parts of Europe were the wild horse and wild cattle, and both of these can also be found in archaeological and paleontological records of Estonia. These are the same species that, after they became extinct in the wild, represent a significant part of the domestic grazing animals used today. Thus, extensive grazing by domestic horse and cattle gradually replaced grazing by wild horse and auroch. Hence the same species that once had benefited from the grazing done by the wild horse and aurochs, continued to benefit from the free-roaming domestic animals of the same species.

Traditional agricultural activities influenced the landscapes in many ways. As a result of clearing the fields from the stones, stonewalls were erected along the field margins. Meadows and pastures were cleared from stones to a much lesser extent. Thus the traditional coastal landscape was created with relatively densely ditched small fields and sparsely ditched or totally unaltered large hay-meadows and pastures, and also thin woodlands used for haymaking or grazing.

In the coastal landscapes of Western Estonia historical borders between fields and meadows/pastures is often marked by a stone wall. The historic land-use has varied a lot but still, on several old maps, a landscape pattern similar to the present can be recognized.

The Working Group on Management of Coastal Lagoons and Wetlands (MLW) was established within the framework of HELCOM in 1993. WWF acted as the lead party and secretariat to MLW. At different stages EU (LIFE), Denmark (DANCEE) and Sweden (SEPA) financially supported the process. The main objective was the development of Integrated Coastal Zone Management (ICZM) plans for selected priority coastal wetland areas around the Baltic Sea. ICZM plans were developed for the Matsalu and Kaina Bay areas in Estonia. In both Estonian plans, management of the meadows and pastures in the coastal zone was a priority. At a later stage a decision was taken in Estonia to create a new, updated, plan covering both areas. This plan gave even higher attention to the management of meadow and pasture habitats in the coastal zone.

The shift into a more intensive and enclosed animal husbandry has left large areas without the grazing that has been present ever since the ice retreated. It is important to note that other herbivorous mammals still present are the Estonian wild fauna, like; elk (moose), roe deer, beaver and wild boar. These do not provide as sufficient grazing pressure as the horses and cattle. Any management of grassland habitats, and indeed most of the coastal ones as well as some wetlands and woodlands, must take this into account.

Management of Meadow and Pasture Habitats – a Brief Overview of the Experience Gained from the Last Twenty Years in Western Estonia

As noted before, the meadows and pastures are most prominently present in the Western Estonian lowlands. Furthermore, the coastal wetlands of Western Estonia are of a great importance to the East-Atlantic bird migration fly-way – and in these wetlands, the meadow and pasture habitats are critically important for many species both for migration and as nesting sites. It is therefore not surprising that in this part of Estonia, some pioneering activities were initiated and hence it is natural to give these a bit more attention. It must also be mentioned that by now, other parts of the country have followed the lead and similar activities have been performed elsewhere as well.

As it should be clear from the previous chapter, more or less all meadow and pasture habitats require grazing and/or mowing in order to secure their favorable conservation status. Understanding that the cessation of traditional use of these habitats is a major problem, has driven many projects and initiatives – both national and international – aimed at reversing these negative trends. Management planning was an important first step in this, as shown by the following example. The WWF Sweden got involved in management of coastal and semi-natural habitat conservation in Western Estonia early in the 1990s. First, focus was on the Matsalu nature reserve (now Matsalu National Park), the first Ramsar-listed wetland in Estonia. As a result of this co-operation between the WWF and local nature conservationists, one of the first plans to significantly influence nature conservation in Eastern Europe after the downfall of the communist system was formed.

The management plan for Matsalu wetland was ready in 1993 and endorsed by the minister of environment of Estonia in 1994. The plan gives an overview of the specific values of the area and the threats to these. The most valuable feature is the meadow and pasture complex that, to a large extent, also determines the status of the wetland as a bird area. The most important threat is the overgrowth of the meadows and pastures, and the main action against it – mowing and grazing contracts with the farmers. This was, at the time, a completely new approach for our region.

Planning alone however, does not improve the conservation status of the habitats. Examples of successful implementation luckily followed. To aid in the implementation of this plan, the Väinameri project was initiated by WWF Sweden and co-funded by SIDA. The project was aimed at conservation of meadows and pastures in the coastal zone (coastal meadows, alvars and others) in close cooperation with the local people. The key issue is securing appropriate grazing by model investments in cattle, sheep, fences etc. Investments in cattle largely focused on beef breeds since large-scale increase in dairy cattle numbers was (and still is) not possible under the current economic situation.

None of the above-mentioned projects would have achieved practical results without strong action based on local financing. Matsalu nature reserve employees started to look for additional financing necessary for the implementation of the plan immediately after the management plan was ready. Money for large-scale grazing and mowing has been made available by the Parliament since 1996. Tens of contracts were made and the area of semi-natural grasslands grazed or mown started to recover. The scheme established in 1996 was replaced by the new national system for all protected areas, or potential Natura 2000 sites, containing grassland habitats in 2001. Payment levels were adjusted and the overall budget increased. The number of contracts for meadow and pasture management in Matsalu wetland rose to three hundred.

The area of the mown alluvial meadows in Matsalu wetland rose from ca. five hundred hectares in 1995 to be more than two thousands in 2001. Wooded meadows returned from the brink of extinction. Over a thousand hectares of coastal pastures, alvars and juniper habitats started to be managed by grazing. Similar developments in other protected West-Estonian coastal sites followed, albeit at a more modest scale. Since 2007, the national support scheme has been replaced by an agri-environment sub-measure for semi-natural habitats in Natura 2000 sites, with some moderate further progress.

It must be noted, however, that even in a priority site like Matsalu National Park we still cannot claim that management has reached optimal levels and it is even more so regarding other West Estonian coastal wetlands. Though grazing pressure has increased it still is, in most cases, below optimal. In order to achieve an optimal grazing pressure, the number of animals used needs to increase even further. There is also very little mixed grazing, on most of the pastures there are only cattle, on some only sheep or horses. It is not clear if the agri-environmental scheme for the post-2014 period will be able to deliver better results.



The Experience This Far

In the present-day EU situation, the purely economic interest to graze or mow the valuable habitats is not sufficient, ear-marked payments for this are therefore necessary. Mostly these are paid as a part of agri-environmental schemes under CAP. There are also other possibilities, like the ones shown above. Meadow and pasture habitats have been relatively popular among LIFE projects in several member states, including Estonia. The latter however are more suitable for restoration and resuming of management, than for long-term conservation. It must also be noted that LIFE is a relatively small financial instrument as compared to more structural funds.

Grazing and/or mowing (and relevant financing) are thus an essential part of the management of the habitats in question. These same practices however, also pose a threat to some of the other species in the habitats. The very same birds that vanish from un-grazed/un-mown grasslands because of overgrowth can be killed by mowing tractors or their nests can be trampled by grazing animals. Therefore, conditions to avoid these negative side-effects are usually tied to the payments or can be even included into legal regimes of protected areas. In Estonia mowing is carried out mostly in July as a compromise between needs to secure mowing of large areas and to minimize nestling mortality. It must be noted that when thousands of hectares are managed a part of the area is always mown as late as in August. Late mowing is also considered to be favorable for most plants and invertebrates.

As for trampling of the nests by grazing animals, the debates of how serious the problem is are still going on and lot of variation due to different factors seems to be present. Later start of the grazing on sites with high density of nesting waders has been recommended but this is not always feasible. Apart from practical problems with the farmers, it can in some cases (if stocking rates are low) lead to insufficient grazing and hence to the deterioration of nesting conditions.

In general, late grazing should be recommended only if stocking rates are high. On one side the trampling tends to be a more serious problem with regards to high stocking rates, while on the other the side, high stocking rates can provide a sufficient grazing pressure, even with a late start of the season. In general, stocking rates about one animal per hectare are considered to be relatively safe for the birds. Choice of grazing animals is also of some importance. When grazing is used for managing important sites, supplementary feeding has to be avoided. It also goes without saying that management of semi-natural grasslands must be done without any chemical inputs.

Grazing nowadays also usually requires fences. Within the Väinameri project, an electric fence model around the most important demonstration coastal pasture was erected. It is an expensive but reliable type of fence that already has lasted for many years. Several LIFE projects have also included fencing. Mostly, electric fences are used and it is clear from the recent experience that investments in good fences are justified.

What of the future?

There is a strong need for further integration of biodiversity protection and other policies, most notably the CAP. Cooperation with the farmers must continue since, without the interest from them, the habitats and landscapes would be lost. We also need continued investment into better technological solutions for harvest and the use of meadow hay as well as better grazing of the semi-natural pastures. CAP has to become friendlier towards HNV-farming - it is still not clear if the reform process is going that way. Nature conservation authorities must also continue their monitoring, enforcement and environmental education activities.

Mowing also needs investments in the form of small machinery, from bush-cutters to big tractors. In the 1990s, farmers were not able to buy new tractors. Therefore, for example the Matsalu administration has made efforts to provide such equipment. By different projects, financed by Phare, LIFE, WWF and Ramsar Small Grants Fund, several new tractors with mowers and other equipment, not to mention many of the smaller items, have been procured. This has significantly contributed to our ability to manage the grasslands in co-operation with the farmers. At present the economic situation of the farmers has improved and they are mostly making the necessary investments themselves.

Photo: Iiro Ikonen



Habitats and Indicator Species

Various Types of Habitats

A large proportion of the Central Baltic vascular plants are closely tied to the agricultural landscape, for example in Sweden nearly half the country's approximately 2,000 species occur here and almost 70 % of them are now endangered. On arable lands the threats are particularly strong since the species here cannot sustain themselves without cultivation.

The managed areas, such as meadows, were formerly the main habitat in the open landscape, unlike today when it mostly consists of arable farmland. The farmers sometimes kept a few deciduous trees on these areas for shading, but completely open lands were also common. As mowing became more mechanized, the acreage managed by traditional means was drastically reduced and are today mostly carried out by communities or nonprofit groups. Unfortunately, this is often not enough to preserve the ancient flora since the grassland management in the past was more intense in the form of grazing and polarding. Another problem encountered in recent years is the nitrogen-rich deposition that benefits some species more than others.

Pastures were usually located in the outfields or in the lesser arable parts of the infields. Many species grow here that are also found on the hay meadows but mostly plant species favored by disturbance. The environment offers a rich flora as it contains everything from wet to dry areas and open to closed surfaces. An important habitat in meadows and pastures are old trees.

Roadsides and small habitats such as rock cairns are other areas that are also highly rich in species. Roadsides were once used as hay meadows and grazing land, and are important refuges for many plants and animals that lost their habitat when the fields were enlarged and ditches were covered. They also act as corridors that allowed many plants and animals to spread. Forests, field islets and rock cairns function in a similar way but many of them are now either removed or overgrown.

It is important to remember that even though the majority of the diversity is found in pastures and meadows, it is equally important for small habitats and areas in-between to be managed in order to maintain high species diversity in its entirety.



Which Species to Use?

One way to monitor and manage these habitats is by using indicator species. By observing these key species one can get a good view of how prosperous a particular meadow or pasture is and what resources are needed to address those at risk. Depending on the habitat and its location, certain groups of species might be better than others. With animals, it is primarily insects such as bees, bumble bees, butterflies and beetles that act as good indicators. Amphibians, reptiles, and birds are less common to use, as most of them don't have arable land as its main habitat, but there are exceptions.

Wood beetles thrive on dead or sun-exposed old trees that used to be common in old-growth forests but are now more common in pastures. These types of trees, often oak (*Quercus robur*) and beech (*Fagus sylvatica*), are rare and in many places protected. In all Central Baltic coastal areas there are a lot of red-listed species connected to these trees, it is important to do the utmost to preserve them. When clearing around an old oak it is important to do it in different phases since it might be damaging for a previous unexposed tree to get too much direct sunlight. Otherwise these trees should be kept as exposed as possible to attract beetles.

Various Habitats

Pastures were usually located in the outfields or in the sparser parts of the infields. Many of the species grow here that are also found on the hay meadows but mostly those plant species favored by disturbance. The environment offers a rich flora as it contains everything from wet to dry areas and open to closed surfaces. An important habitat in meadows and pastures are old trees; over 800 listed species are associated with old trees.

Roadsides and small habitats such as rock cairns are other areas that are also rich in species. Roadsides were once used as hay meadows and grazing land, and are important refuges for many plants and animals that lost their habitat when the fields were enlarged and ditches were covered. They also acted as corridors that allowed many plants and animals to spread. Forests, field islets and rock cairns function in a similar way but many of them are now either removed or overgrown. It is important to remember that even though the majority of the diversity is found in pastures and meadows, it is equally important for the small habitats and areas in-between to be managed in order to maintain high species diversity.

More information (in Swedish) about habitats:

<http://www.jordbruksverket.se/>
"Island pastures" - Leif Lindgren
<http://www.slu.se/cbm>



Other beetles, such as ground beetles and dung beetles, are also important indicator species for open areas such as pastures and coastal meadows. Ground beetles are sensitive to changes that affect soil and moist conditions and sun availability; thus it is necessary to maintain the areas as open as possible. Areas such as sand blots can also be arranged; they were an ordinary feature in the past but are easily overgrown if not maintained. They provide a good nesting place for not only beetles but also various species of wasps, the Sand Martin (*Riparia riparia*) and the Sand Lizard (*Lacerta agilis*). Furthermore, the grazing period should last longer and the livestock should be released to the pasture lands not sooner than in the middle of May. Anthelmintic should also not be used for longer than two weeks before they are allowed outside since it has a negative effect on the beetles.

Bumble bees and solitary bees are good indicators of the presence of flowering and give an estimate on the status of pastures or meadows. Some species demand a certain kind of material to be able to build a nest; it can be everything from barns, wooden fences, disturbed trees or soil and edge zones. These pollinators have faced a drastic decline in numbers due to habitat loss and changes in the agricultural regime. Other threats are the different viruses and mites that, in some places, have decimated populations by almost 30 %. To ensure a successful recovery, edge zones should be kept free from herbicides and the Goat Willow (*Salix caprea*) should be saved during spring time since its flowers are a good source for nectar.

Many species of butterflies and moths are very plant- and habitat-specific and are quickly affected by changes in the environment. This also means that they are very good indicators and, together with bumblebees, give a good picture of how healthy an area is. Butterflies are often dependent on warmth and prefer open areas such as hay meadows and pastures with some shading. When such an area is abandoned and is overgrown there's also often a notable decline in the numbers of butterflies. To ensure an increase in the various butterfly populations, specific areas need to be identified and managed. Depending on species, different methods might be needed, but in general the areas should be kept open and not mown until after flowering. Excessive grazing should also be avoided.

Orthoptera species are a group which is normally not too dependent on management but is negatively affected if an area is overgrown. They are often found on hay meadows, road ditches, pastures and semi-open grasslands. Some species also prefer dry and drained land while others prosper in moist areas like marshes or coastal meadows. The main focus in management should be on keeping the areas open but leaving some bushes which can be used for cover.

Vascular plants belong to the group that is by far the most numerous among the indicator species, but this also creates a problem since they often depend on a certain type of conditions. It is therefore difficult to generalize these all over Sweden, so they are instead divided into different regions. Vascular plants are also often the foundation for many of the agricultural landscapes and enable provide habitats for insects, mosses and lichens.

Vascular plants are also well documented and have for a long time been used as indicators for meadows and pastures. They are often easy to recognize and the traditional indicator species give a good estimation of the history of an area. Management concerning vascular plants is hard to generalize; grazing, mowing and clearing is necessary in many areas but might differ depending on where in the country it takes place.

Lichens are good indicators of grassland and meadows and many species are now endangered because of habitat loss. They have been used as indicators for high nature values and pollution in forests for a long time but are rather new as indicators for meadows and pastures, even though many have this as their main habitat. They are normally found on loose stones, cairns and bare land but some rare species are also bound to old barns and wood fences. Many of the red-listed lichens are often found together and are a good indicator of high nature values and grazed, calcareous rich soil. A good way to ensure a good

habitat for lichens is to keep cairns and stones free from bushes and trees as well as maintaining old farmland buildings.

Moss and fungi species also fill the norm with many mosses only growing in soil with a long history of disturbance. In these groups there are also examples of negative indicator species, species that benefit from reduced cultivation and grazing. Mosses are especially numerous in wet areas such as coastal meadows and marshes but they also benefit from trampled areas where the soil has been exposed. Some species only thrive on broadleaf trees located in a half opened environment and are sensitive to overgrowth. Management should involve continuous grazing or disturbance as well as keeping old pastures and meadows open.

Macro fungi are good indicators but difficult to monitor since they occur sporadically. There is a certain group of grassland fungi that often grows together in managed areas that indicate high nature values. They are often found on nutrient-deficient, open to half-open, semi natural grasslands as well as on pastures and mown meadows. Little research has been done regarding how to manage these areas but fruit bodies are often found on semi-natural grasslands that have a long history of mowing or grazing. Therefore these areas should be kept open and managed as traditionally as possible.

Birds are a group where most species are linked to the whole landscape and not separate habitats but there are some exceptions. Manure from livestock often gives a surplus of insects for some species of birds (such as the Motacillidae family and the Common Starling (*Sturnus vulgaris*) to catch, as well as undigested seeds. Rocks or cairns provide both good nesting grounds and lookouts for example the Northern Wheatear (*Oenanthe oenanthe*). Around 170 bird species are indirectly or directly connected to the agricultural landscape and there has been a steady decline in population size among these species.

Examples of successful restorations

The Rattle Grasshopper (*Psophus stridulus*) used to be a quite common in the Swedish countryside and existed in many parts of southern Sweden, Finland and Norway but is now classified as endangered in the Swedish and Finnish Red List (EN+VU). In Estonia the species is still quite abundant in West-Estonian dry grasslands and alvars. As grassland management decreased significantly over the past 30 years, so did the number of habitats with the *P. stridulus*. Throughout the 1900s, the numbers are believed to have decreased by almost 70 %. In addition to reduced management, the limited possibility for distribution is a major threat; there simply are not enough neighboring habitats to fly to.

To protect the Rattle Grasshopper a conservation program has been established where the goal is to reduce the main threats and get a viable population. The *P. stridulus* shares its habitat with several other endangered species that also will benefit from restoring habitats. There are many examples with positive results after areas have been restored or where grazing has been reintroduced. In the areas around Västra Götaland the development of *P. stridulus* has been closely monitored and several measures have been introduced. At Bräcke meadows hay management have been reintroduced which also has had a positive effect. At Kärr in Södermanland, several measures have been taken after a small population was found in 1996 where the fields were overgrown and poorly managed. The population recovered and in 2005, 268 males were found.

In Östergötland just over half of Sweden's population of *P. stridulus* are spread over 34 localities. To make sure that it reaches a stable population growth several initiatives are being taken within the county. The most important part when it comes to the preservation of *P. stridulus*, is to involve the landowners concerned and the public. With an increased understanding there may also be an increased involvement which is essential for the survival of the species. More information (in Swedish) can be found on: <http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6443-3.pdf>



Waxcaps are a group of fungi with strikingly colourful fruiting bodies. Currently, waxcap-grasslands are a declining habitat throughout Europe due to the agricultural intensification. Waxcaps thrive on nutrient poor pastures and meadows which are regularly grazed or mowed. Photo: Iiro Ikonen



The Rattle Grasshopper (*Psophus stridulus*), The Red Baron of dry meadows. Drawing: Ari Karhilahti

Examples of successful restorations

The Marsh Fritillary (*Euphydryas aurinia*), like *P. stridulus*, was hit hard by the decline of farmland but also due to changes that have occurred in the forest industry. In just 30 years there has been a large population decline in all of Western Europe and the species is currently classified as Vulnerable (VU) in Sweden. The butterfly prefers wet and damp areas, many of which disappeared when increasing numbers of unused meadows and pastures were replanted. There are still plenty of such areas on Öland where the butterfly also has its largest population. On the mainland *E. aurinia* has instead established itself along power line corridors and mineral-rich soils close to water.

E. aurinia uses the plant Devil's-bit Scabious (*Succisa pratensis*) to lay its eggs on and the plant must grow in very specific conditions for it to suffice as a host plant. This, along with habitats that must consist of unmanaged wet meadows, makes it very difficult to find potential areas for restoration. However, there have been successful restorations where shrubs and trees have been cleared away which have led to an increase in multiple locations. Protective enclosures have also been established to prevent the areas from being too heavily grazed.

After the *E. aurinia* was included in the EU's Habitats Directive, several Natura 2000 sites were established to protect the species. Many of these are found along power lines as well as hay meadows, pastures and marshes. The population has now recovered to the level it had before the decline during the 1990s, and an action plan has been established to increase the knowledge and awareness of the companies and agencies involved. The goal is to reduce fragmentation and create a persistent metapopulation. More information (in Swedish) can be found on:

<http://www.lansstyrelsen.se/kalmar/>



There might be several other factors behind the decrease in numbers, such as changes in wintering habitats, habitat loss or an earlier spring arrival due to climate change. However, studies show that after the heavy decline during the 1970–80s many populations have started to increase again and stabilize. One reason behind this might be that they have reached a new lower equilibrium level.

Further studies also indicate that today's populations are very sensitive to changes and future directives will have a strong impact on generations to come. One way to ensure continued success is to increase the amount of edge zones where studies show that many birds prosper. Additional practices could include increased fallow land, more bushes and solitary trees and a more varied grazing landscape ranging from lightly to intensely grazed and more herb-rich hay lands. The main focus should be on increasing the heterogeneity in the landscape both on a small and large scale.

Amphibians and reptiles are, like birds, nondependent on single habitats but are instead often dependent on a specific combination of them. In general, many species prefer open areas with different stages of overgrowth. Even so, this group has been severely affected by the agrarian revolution and most of the species in Sweden are now red-listed. Pastures and meadows connected to water are important habitats for both reptiles and amphibians and the fish-free waters provide a safe haven for their offspring. The rare European tree frog (*Hyla arborea*) is for example found on meadows dotted by trees and bushes. Smaller habitats such as sun-exposed cairns and rocks are also important for reptiles such as the Smooth snake (*Coronella austriaca*).



Indicator Species

Introduction to the Species Descriptions

The following chapter describes some of the most important indicator species for the Baltic area. Each example contains a general description of the species, its ecology and some guidelines to its management about how to best preserve each species and the habitat it belongs to. The species are classified into two separate categories according to their habitats: dry to mesic meadows ([green](#) section) and coastal meadows and lagoons ([blue](#) section). Within these categories the species are in an alphabetical order according to their Latin name.

The distribution of each species is presented in an associated map. The data for the maps have been compiled from various sources: the Swedish records are taken from Artportalen.se (<http://artportalen.se/>), the Finnish from “Kasviatlas” and from Metsähallitus internal database, the Estonian from “Atlas of the Estonian Flora” by Kukkk & Kull (2005). The maps do not distinguish short term temporal changes, and hence the reader is advised to treat maps as approximations and review the most up-to-date records from elsewhere.

In addition to the Latin name, the domestic name of each species is also given in all three languages. Next to each species name is its domestic name for each of the three countries along with the current red-list status. The most current red-list statuses are indicated with following acronyms: DD - Data Deficient, LC - Least Concern, NT - Near threatened, VU- Vulnerable, EN - Endangered, CR - Critically endangered, RE - Regionally extinct, EX -Extinct.



A cow at Jungfruskär. Photo: Eija Hagelberg

Species in dry to mesic meadows

Field Garlic - Nurmilaukka (LC) - Backlök (DD) - Rohulauk (LC) *Allium oleraceum*

Author: Tapio Saario

General information

The Field Garlic (*Allium oleraceum*) belongs to the genus *Allium*, notable for numerous cultivated species and varieties of onions and garlic. The Field Garlic is a bulbous perennial, usually 35 – 65 cm long. The slim leaves are at the base and first half of the stem. It flowers from July to August, after which the leaves wither. The sparse inflorescences, with drooping reddish brown flowers, contain reproductive bulbils. The bulbs are edible.

The Field Garlic does not usually seed. It reproduces mostly vegetatively by the bulbils or bulbs. The development of an individual plant begins in the autumn, when the offset bulb begins to develop roots, and then the bulb hibernates underground. The further development of the plant starts in the spring, when the scape and its leaves begin to grow. First, the buds develop between the young bulbils and are protected by them. Then the pedicels grow longer and the buds begin to stand out in different directions between the bulbils, in the late summer with less shade. Seed reproductions of the Field Garlic require favorable conditions, warm and not too dry summers, and preferably wasp pollination. In Finland, cold conditions in the autumn also hamper seed development.

Ecology

The Field Garlic is a European plant that has a southern distribution in Finland. It is quite common in the Åland Islands, fairly common in the southwestern part of Finland and common to rare in the rest of south Finland. The Field Garlic grows predominantly in southwestern Finland on semi-cultural biotopes like dry meadows, wooded pastures and mesic meadows. The vegetative reproduction of the Field Garlic strongly suggests prehistoric immigration and deliberate cultivation for nutrition. It is also an indicator species of prehistoric dwelling sites. It is found on fort hills, cairn cemeteries, mansions and churches founded near prehistoric sites and along ancient trading routes.

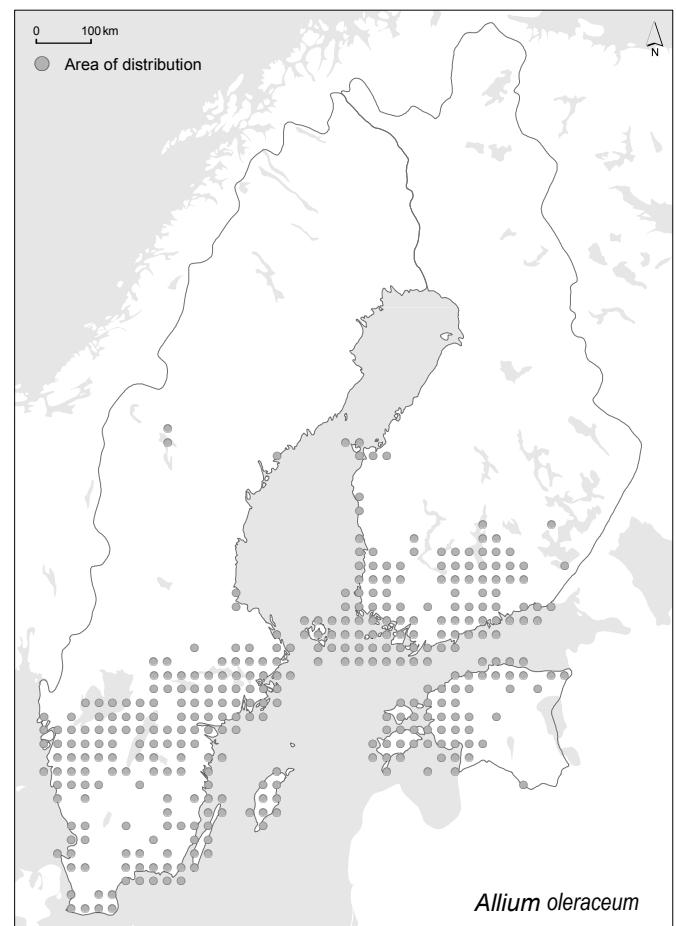
Management

The Field Garlic seems to be quite stable in more or less unchanged habitats, although annual changes in population sizes can be remarkable. Several populations have been destroyed because of overgrowth and changes in land use. The population size is often small, and the species does not seem to have a good capacity to spread from the original stand into the surroundings. The management of archaeological sites is taken care of by the National Board of Antiquities (in Finland), being usually annual mowing. The species is most likely safe there.

The Field Garlic is also safe on numerous managed semi-natural biotopes, diminishing along with many other species because of the agricultural changes of the last century. The sites can be valuable nature conservation areas, or privately owned traditional rural biotopes, managed with the environmental support funding.



Photo: JC Schou, Biopix



Catsfoot - Kissankäpälä (NT) - Kattfot (DD) - Harilik
Kassikäpp (LC) *Antennaria dioica*
Author: Tapio Saario

General information

The Catsfoot (*Antennaria dioica*) is perennial herb, 5 – 20 cm long. It has a rosette of basal leaves, and smaller leaves spiraling up the stem. The flowers are arranged in 2 – 8 capitula, male flowers being usually white, female flowers pink. The Catsfoot is dioecious, but can also reproduce without fertilization. The colonies can thus be all-male, all-female or mixed. It flowers from May to July.

Ecology

All the other four species of the genus *Antennaria* are exclusively mountainous in the Nordic countries. The Catsfoot is common throughout the Nordic countries, except Iceland. World widely it is a European - North Asian species. The Catsfoot grows on open, dry and nutrient- poor soils, such as hillsides, dry meadows, pastures, rocks, eskers and coniferous forests. The species favors by limestone in the soil. Its distribution has diminished by the continuous overgrowth of open, dry habitats.

Management

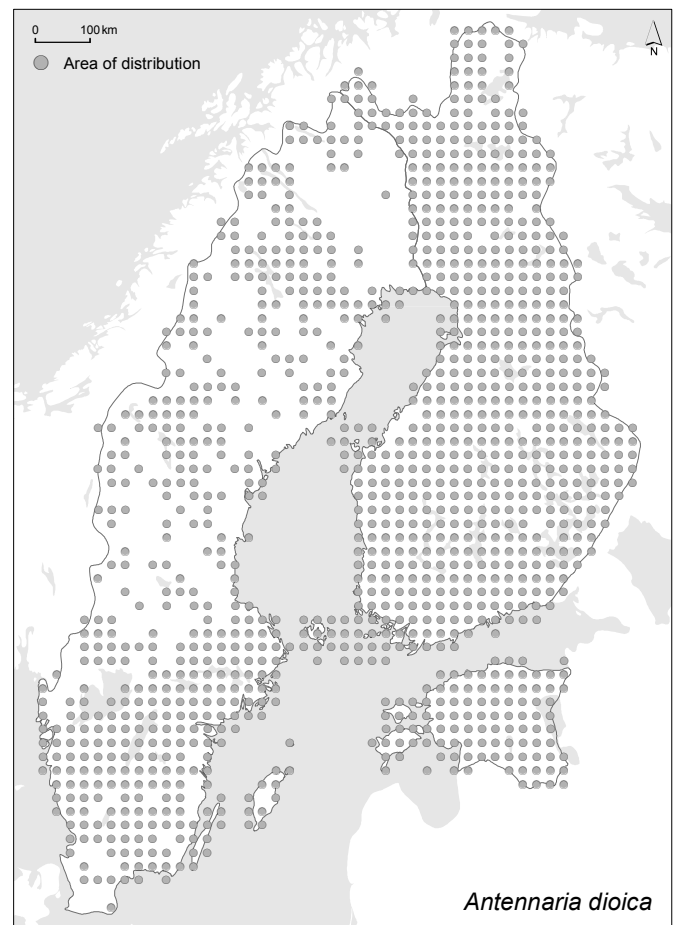
The Catsfoot is a noteworthy species of traditional rural biotopes, on which it has declined surprisingly fast. It therefore benefits from the management program of such biotopes.

An extreme example on the Catsfoot benefitting of artificially cleared environment is the Oripää airport, where the rivaling heather (*Calluna vulgaris*) is either mowed or trampled upon in the active use of the airport, for example the massive revival meeting in 2009 with tens of thousands of visitors. This Catsfoot population is probably the largest in Finland, with an estimated amount of millions of individual plants, which means that the plant benefits from erosion and trampling.

The Oripää airport is one of the five known places for the endangered (EN) moth *Gnorimoschema strelliciellum* in Finland, for which the Catsfoot is the host plant. *Gnorimoschema strelliciellum* can also be found on another small airport in Kiikala, and in the military area of Säköjärvi, where the military practices and artillery fire has kept the vegetation low and populations of the Catsfoot are large. Another threatened (EN) moth species in Kiikala airport and Säköjärvi, also feeding on the catsfoot, is *Levipalpus hepaticellus*.



Antennaria dioica. Photos: Iiro Ikonen, CEDTE



Field Wormwood - Ketomaruna (LC) - Fält- malört (NT)
- Pöldpuju (LC) *Artemisia campestris* (ssp. *campestris*)
Author: Tapio Saario

General information

The Field Wormwood (*Artemisia campestris*) is a perennial forb, with tough stems of 20 – 80 cm arising from a woody rhizome. Plants are leafy at the base. The leaves are first hairy, then usually balding. Flowers are inconspicuous, reddish or yellowish, and occur in spike- or panicle-like inflorescences. The plant is almost odourless.

Ecology

In Europe and central and northern Asia the Field Wormwood is widely spread and fairly common, in North America it is imported. In Finland the Field Wormwood is a native species in the south coast, Åland and the south-west archipelago, and favors open and dry, even warm and sunny habitats. It grows on dry meadows, sandy or gravelly shores and rocks and rock fringes. It flowers from July to September. The seed is primarily wind-dispersed, which helps the spreading especially on rural habitats with human activities like traffic. It is considered common from Scandia in the south up to Upland in the middle parts of Sweden and is especially found along the coastline.

Management

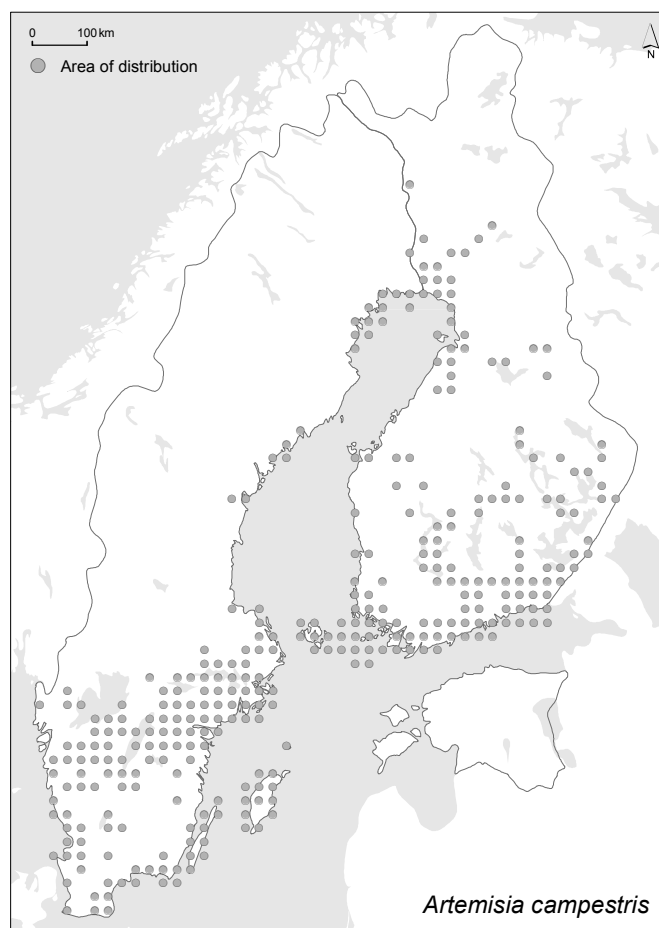
In the archipelago the Field Wormwood has even become somewhat more abundant over the last decades. It is, however, a key species because it is a food plant for various moths, for example the endangered (in Finland) *Coleophora caelebipennella* (EN), *Pelochrista huebneriana* (VU) and *Pelochrista infidiana* (EN). In the archipelago its habitats, dry and sandy meadows and shores, are threatened by overgrowth by juniper, heather and moss and lichen. The habitats are also vulnerable to erosion by trampling, construction or sand extraction. An invasive species, Japanese rose (*Rosa rugosa*), is also a threat, with its aggressive spread suffocating the original vegetation. The Field Wormwood clearly benefits from management of dry, sandy meadows and shores. Recommended methods are mechanic removal of juniper and young pines, mowing, and complete elimination of Japanese rose populations.

The Örö Natura 2000 -area (Kemiönsaari, Dragsfjärd in Finland) is a closed military area and its flora and fauna is extremely rich. In its detailed management plan, suggested treatment methods for the habitats of the Field Wormwood are the complete elimination of *Rugosa* rose, removal of young pine and bushes, artificial eroding and possibly burning. The Field Wormwood is also the host plant for *Coleophora caelebipennella* (EN in Finland) on the sandy shores of Vänö (Kemiönsaari, Dragsfjärd). In Vänö the open, dry habitats were almost completely overgrown by juniper, heather and mosses and lichen. Restoration actions are essential for the survival of many threatened butterfly species.

On archaeological, mainly Iron Age, sites the Field Wormwood benefits from the active management by the National Board of Antiquities. In southwest Finland the Field Wormwood also occurs on several inventoried traditional rural biotopes, both managed and unmanaged.



Artemisia campestris. Photo: Kimmo Härjämäki



**Brown-banded Carder Bee - Juhannuskimalainen (NT) -
Backhumla (DD) *Bombus humilis***
Author: Juho Paukkunen

General information

The Brown-banded Carder Bee (*Bombus humilis*) is a medium-sized bumblebee, queens of which are 16–20 mm long, workers 9–15 mm and males 10–14 mm. The coat of the thorax is reddish-brown on top, with usually pale yellow flanks. The light-brown abdomen has a dark-brown band basally and a somewhat striped effect, especially in the queens. The tongue (glossa) is relatively long, in queens ca. 11 mm and in workers and males ca. 8 mm. The species can be most easily mistaken with the Moss Carder Bee (*B. muscorum*) and the Common Carder Bee (*B. pascuorum*). These species however usually have black hairs in the sides of the thorax and/or in the base of the abdomen.

Ecology

The Brown-banded Carder Bee has a Eurasian distribution, which extends from Western Europe to China and Mongolia in the east. The northernmost records are from central Sweden, and southern populations are found from Mediterranean Europe, Iran and the Tibetan plateau of China.

In Finland, the species used to have a relatively wide distribution area extending from the south coast to North Karelia in the north. From the early 1970's onwards it started to decline and eventually survived only in Åland and the coastal area of SW Finland. Nowadays the species has a patchy distribution in the SW coast, where it can be locally common. Only a few inland populations have been found in recent years (Lohja and Somero). In 2008, a single queen was found from Liperi in North Karelia. This individual might have flown from Russian Karelia, where the species occurs in the Lake Onega area.

In Sweden, the Brown-banded Carder Bee is distributed from the south up to Dalarna and Västerbotten in the north. According to Holmström (2009) the species has declined strongly during the past years, especially in southern Sweden. After the year 2000 relatively few records have been made from Bohuslän, Dalarna, Scania and Uppland. The latest observation from Gotland is from the 1990's.

In Estonia, the Brown-banded Carder Bee has a wide distribution, but most of the records are from the south and from the island Saaremaa. It has been found recently (after year 2000) at least from Saaremaa, Põlva province and the sur-

roundings of Tartu. It belongs to the third category of protected animals, which includes species that are not in direct danger, but may decline severely and become threatened in the future. In Estonia, 10 % of habitats of the third category species must be taken under protection.

The main habitats of the Brown-banded Carder Bee in northern Europe are semi-natural grasslands and especially dry meadows. It has also been found from legume fields, sandy abandoned fields and gardens. Among the plants visited are clovers (*Trifolium*), knapweed (*Centaurea*), vetches (*Vicia*) and vetchlings (*Lathyrus*).

The flight season lasts from the beginning of May to the end of August. Queens emerge from hibernation in the spring and construct a nest usually on the ground surface under a grass tuft. It may rarely also use abandoned rodent nests under ground level as nesting sites. The size of the nest is relatively small; usually it consists of less than 100 workers. Males and new queens emerge from the nest in late summer, and the mated queens overwinter in sheltered places. The Field Cuckoo Bee (*Bombus campestris*) is known as a cleptoparasite of the Brown-banded Carder Bee.

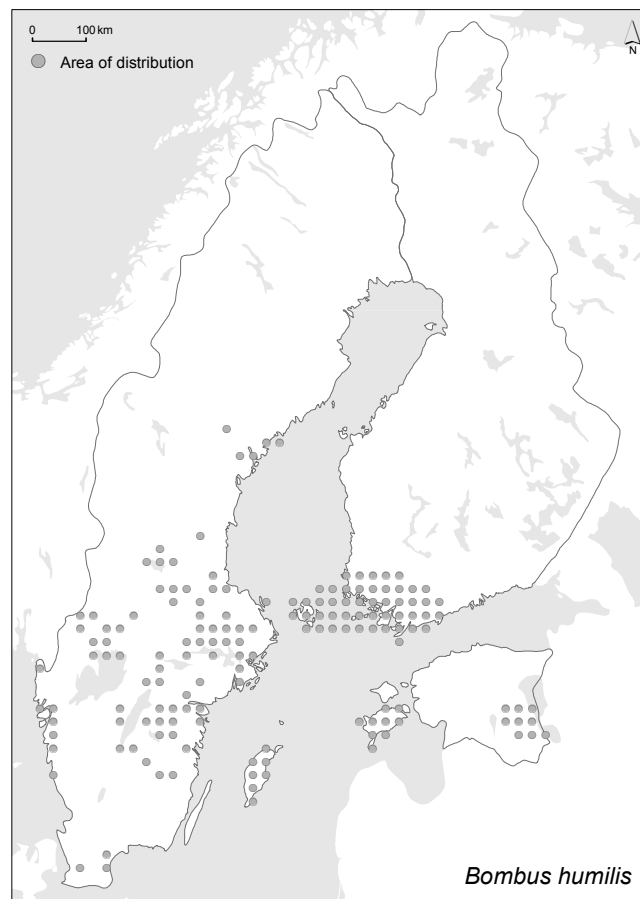
Management

The Brown-banded Carder Bee is threatened by habitat loss due to intensive farming and overgrowth of grasslands. It is especially sensitive to habitat changes in the northern part of its distribution, being near the edge of its latitudinal range. Also construction relating to housing, traffic, recreation etc. can locally threaten the species. In order to prevent overgrowth of grassland habitats and maintain floral richness, management by grazing or mowing is important. However, because the nests are usually constructed on the ground surface and are easily destroyed, mowing should be carried out in late summer, when the new queens and males have left their nests. Field verges, ditches and road edges can also offer suitable nesting sites if they are not managed, or if management takes place sufficiently late in the season.

Monitoring of bumblebee populations can be carried out by the line transect method or the study plot method. These methods have been widely used especially in the monitoring of Lepidoptera. The densities of bumblebees can be difficult to estimate with certainty, because bumblebees and bees in general tend to have a clumped distribution in the field. Thus mark-recapture observations may additionally be needed for reliable estimations of population sizes.



Bombus humilis. Photo: Pekka Malinen



Northern Moonwort - Pohjannoidanlukko (VU) - Nordlasbräken (VU) *Botrychium boreale*
Author: Anna Haapaniemi

General information

The entire shoot is 5–25 cm high. The sterile blade is shiny and of dark green colour, attached slightly above the middle of the plant. The pinnae of the blade are narrowly triangular and lacking any prominent stalks. The pinnae are composed of 2–3 irregularly shaped pointed segments and they are tightly arranged hence overlapping one another.

Ecology

The Northern Moonwort is an arctic circumpolar species also found from NE Asia and North America. In Finland the species is encountered from the Northern parts of the country (Lapland) and it is rare from the coastal areas and the archipelago of the SW Finland. In Sweden, the species is focused north from the province of Dalarna and has only sporadic occurrences south from the river Dalälven. There are no encounters of Northern Moonwort in Denmark, and in Norway they only occur north from Rogaland-Telemark. *B. boreale* prefers lime-rich soils and can be found from pastures, coastal (sandy) juniper meadows, fell heaths, and along river and stream banks.

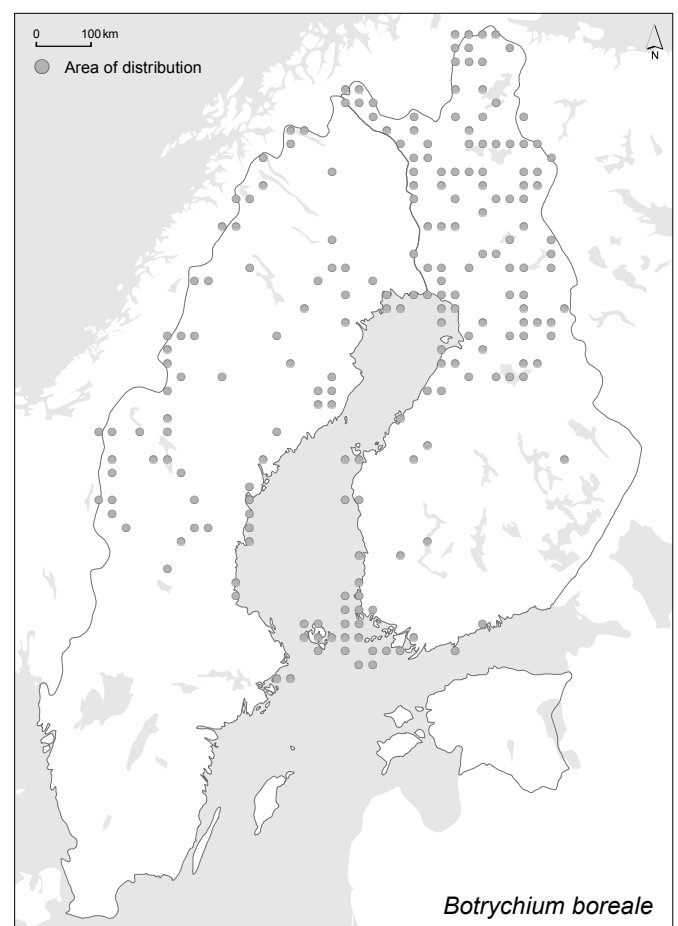
The juniper-heaths were regularly burnt in the Finnish archipelago in the old days clearing them from Juniper, Black crowberries (*Empetrum nigrum*), Common heather (*Calluna vulgaris*) and other dwarf bushes. The burnt space for a few decades invaded by herbs and grasses and a more productive pasture was formed for sheep and cattle. *B. boreale* was obviously favored by this treatment. Nowadays most heaths are left unmanaged and the dwarf shrubs are invading the whole heath, including patches with herbs and grasses. The dwarf shrubs like Black crowberries use chemical warfare to improve their competitive situation by exuding for example fenolic acids into the soil. This effect contributes towards herbs like Northern Moonwort disappearing from the site.

Management

The management of the species follows the general guidelines applied to all the moonworts. Northern Moonwort is similarly sensitive to competition from other species, and habitats can be preserved by reintroducing grazing and mowing methods. Reintroducing the burning of heaths at least in nature conservation areas would improve the situation. Artificial nitrate fertilization should be avoided. Surveying is recommended to be performed during so called “moonwort years” when due to warm spring rains there is a better chance of finding moonworts.



Botrychium boreale. Photo: Leif Lindgren, Metsähallitus



Lance-leaved Grape Fern - Suikeanoidanlukko (VU) - Topplasbräken (VU) - Süstjas vötme- hein (RE) *Botrychium lanceolatum*
Author: Leif Lindgren

General information

The genus *Botrychium* has a short subterranean stem with a shoot consisting of a sterile and a fertile blade. The shoot of the Lance-leaved Grape Fern (*Botrychium lanceolatum*) is 5–25 cm high. The sterile blade is inserted above the middle of the plant and is broadly triangular, pinnate and yellowish-green.

Ecology

The Lance-leaved Grape Fern has a circumboreal range from North America via Middle- and Northern Europe to Siberia. The European distribution is mainly concentrated to the Nordic countries, but the species is absent from Denmark. The species is widely distributed but rare and strongly declining in Finland. In Sweden it is scattered to rare south to Dalarna and Gästrikland, mainly on the coastland and the large river valleys.

The population in Finland has decreased since the 1970s. Almost 180 localities are known, most of them in northern Finland. The Lance-leaved Grape Fern has disappeared from more than 200 localities, while some 70 are uncertain. Since 2000 only four localities are known from southern Finland. The decrease has been rapid especially in central and eastern Finland, where successional stages of former slash and burn forest used to provide the species with suitable habitats.

The Lance-leaved Grape Fern is found on dry meadows, graminoid heaths, old pastures and lawns. Some of the dry meadows and the graminoid heaths have acid soils. Sometimes the species grows on the same site as Common Moonwort (*B. lunaria*), Northern Moonwort (*B. boreale*) and Camomile Grape Fern (*B. matricariifolium*). In southwestern Finland the Lance-leaved Grape Fern is favoured by calcareous soils, for instance shell deposit soils. The species is sometimes found on meadow-patches of crystalline limestone rocks and on wooded pastures. The Lance-leaved Grape Fern grows also on mesic low-nutrient meadows, scarce in nitrogen. It declines moderately immediately after the management has ceased, more severely after an intermediate period of time and disappears after a long time.

Most localities are scarce and casual. The sites consist typically of one or two specimens, seldom refound when the site is monitored. In a few cases the locality consists of tens of specimens. The monitoring is hampered by the annual variation in population size and the capricious disappearances and reappearances of the species. The spores may form a spore-bank for decades. Like other moonwort's, the Lance-leaved Grape Fern forms a symbiosis with fungi. In unfavourable conditions the species may hide within the soil for decades.

Sheep grazing was still so intense in the 1960s that the botanists in the southwestern archipelago of Finland had to crawl under the juniper-bushes to find *Botrychium* -species. All other places were so intensely grazed that the species could not be found or indentified. The Lance-leaved Grape Fern is clearly

favoured by moderately intense grazing with moderate intensity. Since the 1960s the species has strongly declined when the cattle farming almost ceased, which has led to overgrowth of open habitats.

Management

On the island of Jurmo, in Archipelago National Park in southwestern Finland the Lance-leaved grape fern is found under low-growing carpet-like juniper on shell deposit soil. During the last decades the population size has varied annually between 2 and 283 specimens. Most of the individuals are found under the carpet-like growing low juniper, contrary to Common Moonwort, found mainly on dry meadow patches between the juniper stands. A camp with volunteers was arranged in 2010 to clear the juniper.

The objective was to favor a number of plants and invertebrates typical of alvar-like dry calcareous meadows. 25 % of the juniper was to be spared to protect the Lance-leaved Grape Fern from grazing animals and drought. Before the camp in early July only one specimen of the Lance-leaved Grape Fern was found and demonstrated to the volunteers. The sporangium of the Lance-leaved Grape Fern ripens a bit later than Common Moonwort and Northern Moonwort. The ripe yellowish-brown sporangia are more conspicuous than the unripe green ones. During the camp the sporangia gradually ripened and more and more specimens of the Lance-leaved Grape Fern were found among the juniper, often in the centre of dying juniper-carpet.

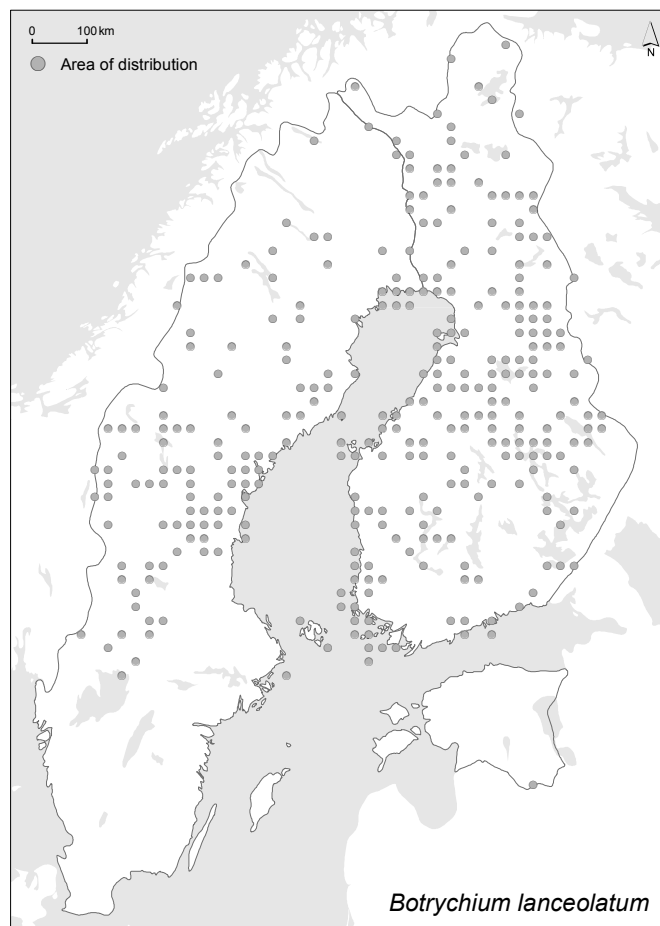
The stands of juniper with the Lance-leaved Grape Fern were left uncleared. The volunteers quickly became *Botrychium*-specialists and surprisingly found specimens of the Lance-leaved Grape Fern beneath the dense juniper removed or under the juniper planned to be removed.

Many of the smaller the Lance-leaved Grape Fern specimens had not been able to grow through the juniper-carpet, but were dwelling beneath it, in perpetual dusk. In this shady microhabitat of dead juniper needles nothing else was found except the odd specimen of Common Moonwort. At the end of the camp 283 specimens of the Lance-leaved Grape Fern were discovered, half of which were dwellers of the perpetual dusk. Next summer at least some specimens of the Lance-leaved Grape Fern were found on the spots from where juniper was cleared the previous summer.

The species seems to be sensitive to early grazing by sheep and the hiding among the juniper might be an adaptation to grazing. This hypothesis should however be confirmed by research. Experiments with slightly different kinds of management (grazing, clearing, burning) on open pastures should be made and monitored to achieve recommendations for optimal management.



Botrychium lanceolatum. Photo: Leif Lindgren, Metsähallitus



Common Moonwort - Ketonoidanlukko (NT) - Lasbräken (NT) - Kuu-vötmehin (NT) *Botrychium lunaria*
Author: Anna Haapaniemi

General information

The plant shares the same general structure of all moonworts: a short subterranean stem with a shoot consisting of a sterile blade and fertile stalk carrying the sporangia. In the Common Moonwort (*Botrychium lunaria*) the sterile blade is shiny, yellow-green and attached in the middle of the plant or slightly above. The pinnae lack a clear stalk thus seeming to be directly attached to the stalk of the sterile blade. The blade is 2–3 times as long as it is wide on a mature specimen. The entire shoot is 5–30 cm high with the fertile blade bearing the sporangia having a long stalk and reaching, as mature, well above the sterile blade.

Ecology

The Common Moonwort is the most common species of the moonworts, having a circumpolar distribution on the northern hemisphere, but it can also be encountered south of the equator. It is found abundantly over all the Nordic Countries, while in the Finnish Lapland it is relatively rare. However, the occurrence of the the Common Moonwort has recently declined similarly to the rest of the moonworts and *Botrychium* species are a focus of several teams working on threatened species.

The Common Moonwort favors dry and well-drained sandy meadows, mesic meadows, dune areas, coastal juniper- meadows, heaths, borders of rocky areas, and roadsides. It thrives on heavily grazed and beaten grounds and coastal areas. Like all moonworts, the Common Moonwort is capricious and the year-to-year occurrence of the plant is uncertain. With the aid of nourishment from mycorrhizal fungi it can remain underground for years before growing a shoot. This is to be taken into account when surveying its occurrence as well as the notion that in general moonworts are often quite difficult to find. A public campaign in Finland arranged by the Finnish Environmental Institute (SYKE) to report sightings of moonworts brought significant amount of new localities and new species from old already known locations. This indicates that moonworts might be somewhat under-identified.

Management

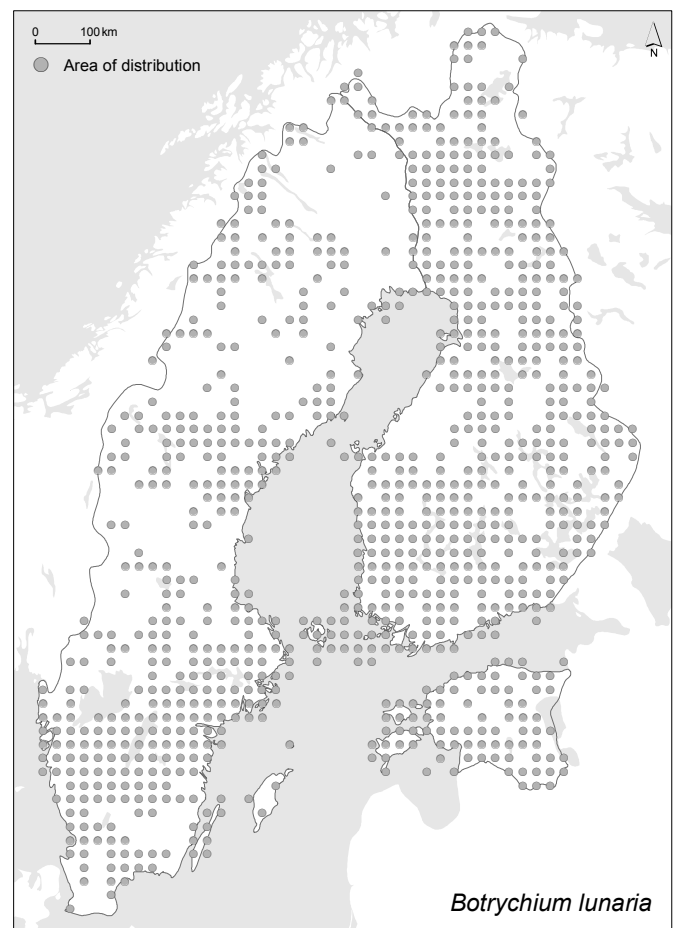
It is suspected that the reason for its decline is due to the overgrowing of open grounds as the practice of grazing and mowing meadows has become replaced by modern-style farming methods during the last decades. Due to their relatively small size, moonworts fail to compete with other larger plants for space and favorable lighting conditions. Also, early grass cutting can cause the specimens to be removed before the sporulation takes place thus inhibiting the completion of its reproduction cycle. Furthermore, it is suspected that artificial fertilization and nutritional supplements given to animals together with nitrous aerial pollution can have a detrimental impact to the growing conditions of moonworts. There is also some indication that the structure of fungal community in the soil could be an ele-

ment of importance in determining the overall biodiversity of grasslands with implications to conservational matters. Due to the long dependence of the subterranean plant of the mycorrhizal fungi, the fungal interaction could be of importance for the moonworts, but more research is needed to confirm this.

The survival of the *Botrychium* species depends on the active management of habitats or reintroduction of traditional grassland agriculture practices to generate occasional perturbations of the vegetation cover. Traditionally the common moonwort survived on intensively sheep-grazed dry meadows by growing under dense stands of juniper. The management should restore the type of open pioneer habitats suitable for moonworts to establish. In addition artificial fertilization should be avoided and mowing should be done in mid-July or later.



Botrychium lunaria. Photo: Iiro Ikonen



Camomile Grape Fern - Saunionoidanlukko (EN) - Rutlas-bräken (EN) - Haruline vötme-hein (EN)

Botrychium matricariifolium

Author: Anna Haapaniemi

General information

The fleshy shoot of the Camomile Grape Fern (*Botrychium matricariifolium*) is 5–20 cm high and is often thick and brownish-red from the bottom. The sterile blade is inserted slightly above the middle of the plant and is narrowly triangular, short-stalked, and gray-green coloured. However, the species is highly variable in shape and form and larger specimens can be confused with Lance-leaved Grape Fern (*B. lanceolatum*).

Ecology

The Camomile Grape Fern is a native European and North-American fern that has also been encountered in few localities in Eastern-Asia and South-America (Patagonia). In the last few decades the species has become rare over its entire distribution area. In Sweden the species is also generally rare and encountered from its main distribution area in Scania but can be found up to the Norrbotten region.

In Finland the occurrence is focused in the archipelago area of the SW Finland and on the southern coastal region. Some new sites have recently been encountered from Uusimaa region, while the northernmost known occurrence from Hyrynsalmi was last confirmed 1978, and since, the species is likely to have regressed to more southern latitudes. The overall drastic decline of the species in Finland has resulted in changing the species status from vulnerable to endangered. The species can be found on dry and heavily grazed meadows and sandy grounds, sometimes on rocky meadows close to the sea. The plant can be regarded as a pioneer species and the Camomile Grape Fern prefers to co-habit on sandy mounts together with Mouse-ear Hawkweed (*Pilosella officinarum*), sites, which are particularly prone to drastic changes in environmental conditions. Both species gain part of their nourishment from an association with mycorrhizal fungi, which in case of the Camomile Grape Fern allows it to remain underground during unfavorably dry growing seasons. For this reason the species is capricious in occurrence and for example the amounts of rain falling during the early spring can impact whether the plant will produce a shoot or remain underground.

On the other hand, a research study performed by Muller (1993) on this particular moonwort species contested the general view that moonworts are capricious: instead the matter could be a manifestation of low population intensity on a genus with a lifespan including a long underground phase (ca. 10 yrs) and only a short (avg. 2 yrs) “adult” frond-producing stage. This arrangement could give an artificial appearance of capriciousness.

Management

The decline of the species is most likely a result of the same reasons that apply to other moonworts: overgrowth of grazing lands, change in farming practices and forestation. However, due to its particular affinity to claim disturbed habitats as a pioneer plant, its management might be more challenging than

other moonworts as the suitable growth sites are naturally more ephemeral in character. In order to ascertain that the plant stock remains viable, sites at an early succession stage should be forming at the same rate as the previous disappear. To facilitate this, it is still necessary to do more tests to better understand the preferences of the species and to find the most effective management method.



Botrychium matricariifolium. Photo:JC Schou, Biopix



Blue Sedge - Vahasara (LC) - Slankstarr (DD) - Vesihaljas
tarn (LC) *Carex flacca*
Author: Anna Haapaniemi

General information

The Blue Sedge (*Carex flacca*) is medium-sized sedge of 20–50 cm in height growing in tussocks. The 3–6 mm wide flat leaves are shorter than the stem, while the supporting leaf reaches to the top of the plant. The leaves are composed of a blade, being the free part of the leaf, and a sheath which wraps around the culm. All the leaves and the stalk have a bluish-green glaucous hue. In *Carex*'s the culm is usually solid and more or less 3-angled, distinguishing them from grasses, and many, like the Blue sedge, have an erect and simple culm without any branches. The spikes have a long stem giving them gradually droopier appearance as the spike matures. In the Blue Sedge the staminate and pistillate flowers are in separate spikes with each plant carrying 1–3 staminate spikes and 2–4 pistillate ones. The shape of the utricle covering the fruit of the plant is used to identify between various *Carex* plants. The Blue Sedge has a roundish fruit with a very short beak.

Ecology

The species can be found from diverse habitats. It is known to tolerate occasional flooding and to have a preference to lime rich soils. The Blue Sedge is native to grasslands, sand dunes, moist meadows and marches of Europe and North Africa. The species has also spread to North America. In Nordic countries it can be encountered from the coastal regions of Norway and from entire Denmark. In Sweden the species is common in some southern coastal regions in Scania and on the islands of Öland and Gotland while the occurrence is patchier in the central Sweden lake region and in Uppland. In Finland the species is most common in Åland archipelago, where it can especially be found on lime rich grove soils commonly together with blue moor-grass (*Sesleria uliginosa*). In mainland Finland no recent sites of occurrence are known, and from the archipelago of Finland proper only one recent find is known with the Blue Sedge.

Management

The Blue Sedge is highly sensitive to competition pressure from other species. Studies performed in Jungfruskär, Åland by Lindgren (2001) show how different management methods affect the abundance of Blue Sedges. In 1980 the wooded meadow was heavily thinned out of bushes and growing stock and regular mowing practices and spring raking were introduced, both increasing the general diversity in the area. In 1988-89 an intensified grazing with beef cattle and sheep was introduced, and it appears that it is this practice that has resulted in significant growth in the number of Blue Sedges. It is suggested that the mowing method should be combined with raking to promote the competition sensitive and rare meadow species like the blue sedge. Also, emphasis should be placed to meticulous spring raking to remove all the excess litter from the managed site. The species can be used as an indicator of well-managed mesic meadows as it swiftly disappears if the habitat is left unmanaged and becomes overgrown.



Carex flacca. Photo:JC Schou, Biopix



True Fox-sedge - Ketunsara (EN) – Rävstarr (DD) - Rebastarn (LC) *Carex vulpina*
Author: Anna Haapaniemi

General information

The species grows in tussocks and is slightly taller than the False Fox-sedge (*Carex otrubae*) reaching up to 30–80 cm. The leaves are almost the same length as the culm, 5–10 mm broad and bright green in color. Also, contrary to the False Fox-sedge the culm has a concave side. The plant forms several dark brown spikes with dense flower arrangement. The pistillate and staminate flowers co-occur in the same spike where the staminate ones exist on the lower portions of the spike. The lowermost leaf of the spike is either very short or missing (cf. *C. otrubae*). The utricles are matt.

Ecology

The species occupies the same type of wet, sometimes shaded habitat such as ditch margins, moist meadows and other marshy ground as the False Fox-sedge. It is known for preferring nutrient-rich acidic soils with humus rather than lime-rich soils. The main distribution area of *C. vulpina* is in Europe from Iberia to Ural Mountains although some isolated occurrences have been encountered in Asia. A more detailed distribution of the species is partly uncertain due to difficulties of distinguishing between the True Fox-sedge and the False Fox-sedge. In general the True Fox-sedge is more eastern and more northern of the species.

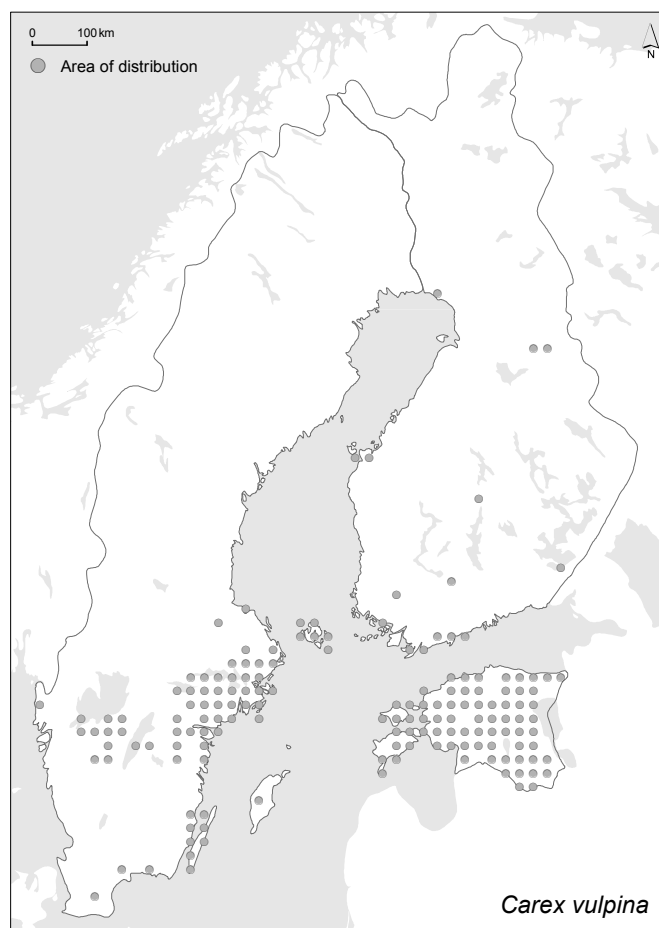
In the Nordic countries the main distribution area is in Uppland in Sweden. The species has a scattered distribution around the Swedish lake region and in coastal areas of Scania, and in Denmark it is found in the eastern parts of land areas. In Finland the species is rare on the Åland islands. The sites in the mainland are sparse with one in SW Finland (Pöytyä) and quite recently from an island off Helsinki. Occasionally the species is known of spreading with traffic and being associated with previous human settlement.

Management

This is an endangered species, and for example in Finland the species is in immediate danger of disappearing. The reasons for its decline are not well understood, but it is suspected that they are similar to those of Blue Sedges: overgrowth due to lesser grazing, but also construction of under drainage systems. In Finland, the overgrowing of river banks with various bushes in 1980s and the intensive expansion and overtaking of meadow-sweet (*Filipendula ulmaria*) are thought to have been responsible of the decline.



Carex vulpina. Photo: JC Schou, Biopix



**Carlina Thistle - Lännenkurho (LC) – Spatistel (DD) - Hari-
lik keelikurohi (VU) *Carlina vulgaris***
Author: Erik Andersson

General information

The Carlina Thistle (*Carlina vulgaris*) is a 10–30 centimeters high biennial herb. The stem is red-like and woolly with a few flowers at the end. The flowers are yellow and consist of two to five globe-like baskets that are two to four centimeters wide and are androgynous. The leaves are knife-like with notched edges and stiff bristles. The outer scales of the carline thistle are quite jagged and 10–20 millimeters long. The inner scales are yellow and expanded during dry weather. The fruit is hairy and has a feathery end that falls off quite soon after dispersal.

Ecology

In Sweden the Carlina Thistle is common on open, dry to mesic, loam. It grows on dry slopes, pastures, forest edges and along road ditches. It can also be found on rocky grounds and shore heaths. In Sweden the carline thistle is normally found on calcareous rich soil from Scandia in the south to Gästrikland in the north. In Estonia species is common in calcareous meadows and alvars of west-coast islands. It is considered common in the southern areas and less common in the north. In Finland the plant is rare and can be found in the south-western parts of the country. The most recent findings are from the Åland islands and just a few from the Finnish mainland.

Management

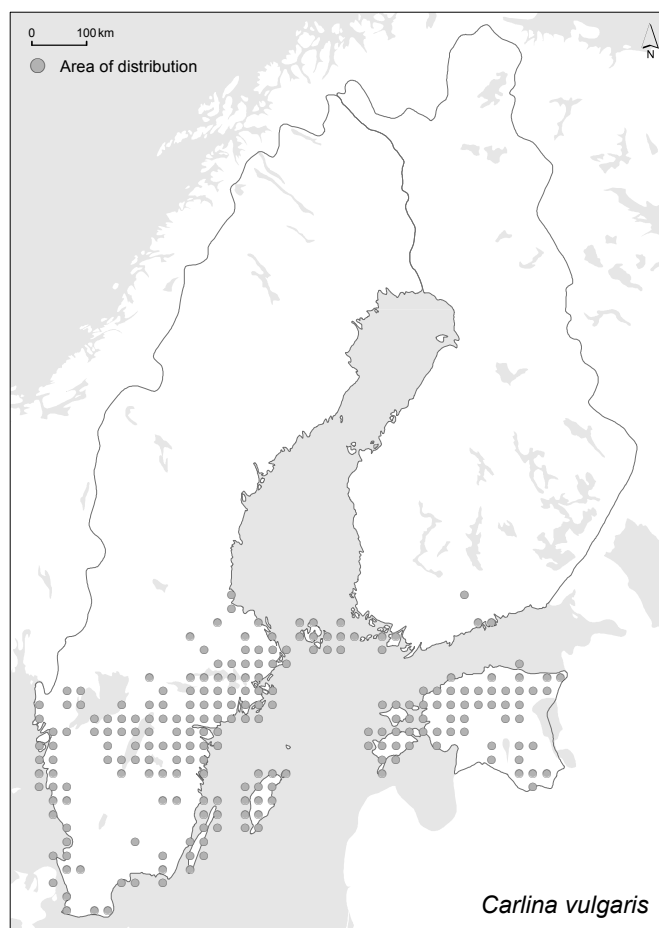
As in the case with several other plants connected to the dry slopes and pastures the carline thistle has decreased in numbers due to overgrowth. This is a result of the decrease in cultivation management and increase in nitrogen fallout. An increase in hay management and an opening of overgrown pastures is needed to ensure an increase in the population. The species is favored by grazing but not necessarily by mowing. When the site is left unmanaged for a longer period of time, the numbers of species are decreasing moderately at first, but rapidly on an intermediate period of time and will be extinct after a longer period of time.



Carlina vulgaris. Photo: Leif Lindgren, Metsähallitus



Carlina vulgaris (overwintered). Photo: Iiro Ikonen



Elder Flowered Orchid - Seljakämmekä (NT) - Adam och Eva (DD) - Leeder Sörmkäpp (RE) *Dactylorhiza sambucina*
Author: Leif Lindgren

General information

The Elder Flowered Orchid (*Dactylorhiza sambucina*) is 20–30 cm high. The stem is sturdy with only lower leaves. The three or four leaves are 5–19 cm, oblanceolate, obtuse and spotless. The Elder Flowered Orchid flowers in May and June and has two colour forms, a purple one and a light yellow one. The purple flowers have a yellow freckled area in the centre of the labellum. Intermediate colour forms occur, but they are rather sparse.

Ecology

The Elder Flowered Orchid is a European species that is rare and declining in Finland, fairly rare on the east coast and in the eastern archipelago of Sweden but rare on the mainland and extinct in Estonia. The Elder Flowered Orchid grows preferably on calcareous meadows and pastures. The characteristic biotopes are open dry grassland, mostly calcareous dry meadows and semi-natural deciduous forest with a thin layer of trees, i.e. wooded meadows, wooded pastures or forest pastures. In many places these open or forested grasslands and pastures are nowadays left unmanaged. The species favours limestone but does not demand it. It is found also on slightly acidic soils. When the site is left unmanaged the species numbers increase moderately at first, even more after an intermediate period of time, but are decline rapidly after a longer period of time.

The Elder Flowered Orchid is pollinated by bumblebees and supposedly other insects too. The flowers contain no nectar, so the bumble-bee gains nothing when visiting the flowers. The colour dimorphism might have evolved to cheat the pollinators. After visiting the inflorescences of one or two yellow coloured elder flowered orchids the bumble-bee has learned that no nectar can be found in them. It therefore tries the purple coloured form and might pollinate some before it realizes that these also lack nectar. The purple colour form dominates in Finland. Here only every 5th or 10th specimen is yellow (on Jungfruskär). On the mainland of Sweden both colour forms are equally common and further westwards in Norway only the yellow colour form is found.

The seeds of the Elder Flowered Orchid are dispersed by the wind. The seeds ripen (in Finland) in mid- or late July. The forming of seeds seems to be scarce or irregular.



Dactylorhiza sambucina. Photo: Iiro Ikonen, CEDTE

Management

The population of the Elder Flowered Orchid on the island of Jungfruskär in the Archipelago National park in Finland has been monitored since the 1980s. The traditional land use included spring raking on the wooded meadows in late April and early May and haymaking in July. After that the wooded meadows and the other meadows and pastures were grazed by cows, horses and sheep.

The population seems to fluctuate on a long-term basis. The increase from the beginning of the management in 1980 to the year 1995 is obvious. After that the fairly large annual variation has some regular patterns, but its causes are unknown. The increase seems to peak some 10–14 years after the beginning of management. On Jungfruskär the management in the 1980s and 1990s mostly involved cattle grazing and the clearing of trees and bushes. The data reveals that a considerable number of new sites have been colonized during the monitoring period. This certainly is a success for effective long term management.

As only fertile individuals have been monitored, dormant periods may explain a significant part of the annual variation. The time from germination of the seed to blooming is generally long in orchids. This may explain the delay of almost ten years, between the beginning of the management period (roughly 1980–84) to the observed positive response of the Elder Flowered Orchid population in 1993–95.

On open meadows the annual variation differs from that of the whole population, with no clear increase in numbers in the period 2009–11. The species is on its northernmost range sensitive to frost during the flowering period. Individuals with frost-bitten blackened inflorescences (61 % of the local population) have been observed on open meadows in May 1999. The most abundant populations of the Elder Flowered Orchid are found on wooded meadows on Jungfruskär. On wooded meadows and wooded pastures the Elder Flowered Orchid seems to colonize newly restored (from 1990 and onwards) wooded meadows with a delay of 10–20 years. The development on wooded meadows and wooded pastures is fairly positive compared to that on open meadows.

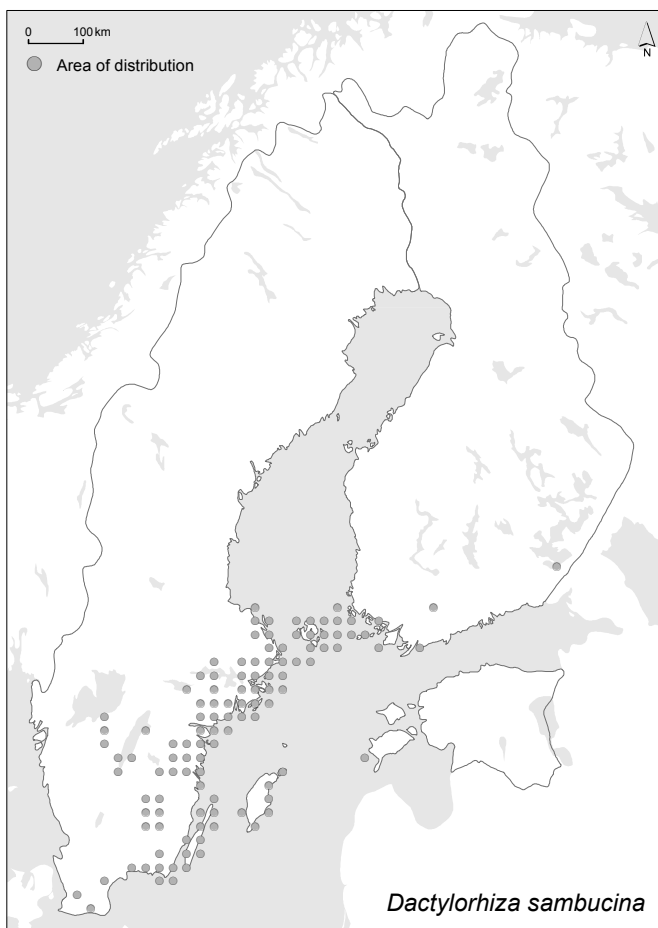
Forest pastures are defined as grazed forest. They are not - contrary to wooded pastures – restored by thinning out the tree- and bush layers. The cattle is just allowed to graze the otherwise unmanaged forest.

Grazing alone can in moderately overgrown sites maintain the population of elder flowered orchids and maybe even increase it. On non-managed areas the declining and disappearing population may be fairly abundant for years. This development must be taken into consideration when deciding on management policy. Otherwise the temporary abundance peak as part of the natural variation may lead to wrong conclusions.

It is well known that early grazing with sheep is disastrous to orchids. This was demonstrated in Jungfruskär when an area was grazed by sheep in late may and early June 2010. The number of fertile individuals was reduced from about 150 in 2009 to less than 20 in 2010. Only 84 specimens were found in 2011.

In 2009 and 2011 the same area was grazed by beef cattle, not by sheep. The recovery of the population will take more than a year. The Elder Flowered Orchid probably also benefits from late mowing, because the seeds are not shed until in early July, at least not every year.

The population of the Elder Flowered Orchid on Jungfruskär could be a metapopulation. This implies that there should be ample areas of suitable biotopes available. Every favourable spot will not be used by the species simultaneously, but it is vital for the long term stability of the metapopulation and its possibilities to expand that there are enough available biotopes for the species to colonize.



Maiden Pink - Ketoneilikka (NT) - Backnejlika (DD) -
Nurmelk (LC) *Dianthus deltoides*
Author: Anna Haapaniemi

General information

The Maiden Pink (*Dianthus deltoides*) is a perennial plant growing in loose turfs with its flower heads reaching to 10–20 cm in height. The slender green to blue-green stems are covered with fine hairs and often form branches. The leaves are short and very narrow and positioned sparsely in pairs along the stem. The flowers arise from elongated trumpet-like calyxes and are generally purple in colour with some white spotting. Light pink and white variants can also be encountered occasionally. The flower head consists of total 5 pedals roughly triangular in shape (lat. *deltoides*) with toothed brims. They are either singular or in a fan-shaped arrangement of a couple of flower heads.

Ecology

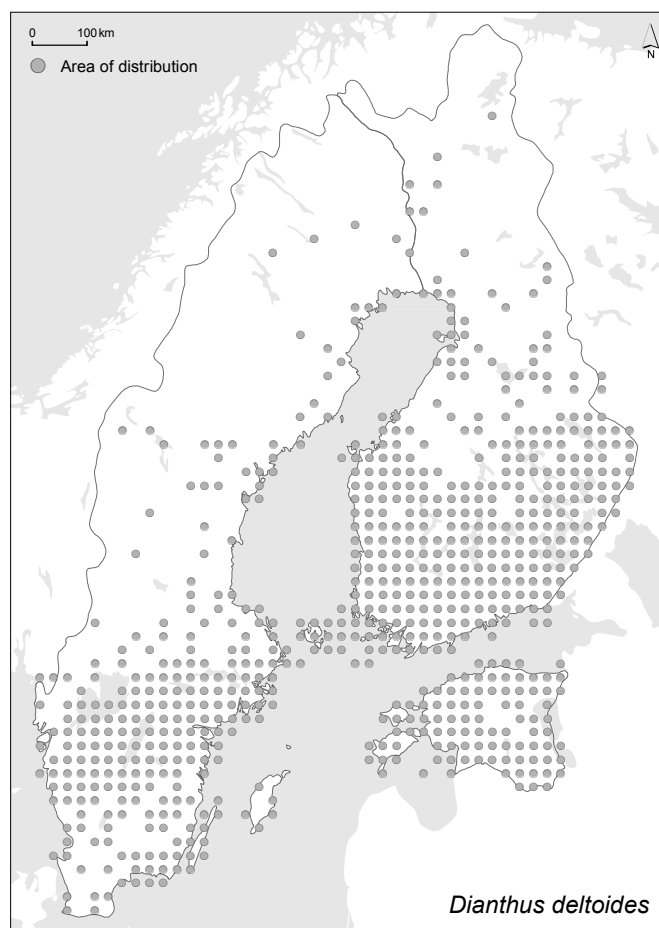
The distribution area of the species covers the whole of temperate Europe reaching all the way to the southern parts of the Siberia. In Finland, the species can be found in most of the country, but it is only fairly common in the south up to a borderline connecting Vaasa-Jyväskylä-Joensuu. In Sweden, the plant is common from Scania up to Medelpad after which it becomes gradually rarer. The species thrives in sunny and open places, sandy to heavy soils. It is encountered on meadows, roadsides and rocky and sandy slopes. In rich soils the plant can be found in the proximity of rocky areas where it can thrive without the competition from other plant.

Management

The Maiden Pink has declined all over Europe. It is associated with traditional agricultural methods and suffers from overgrowth by failing to compete for growing space with other more sizable plants. Also, it seems that fragmented distribution pattern might pose a threat to the pollination process of the species causing the plant to produce only infertile seeds (see Jennersten 1988). Maiden Pink reproduces via its rooting system, but generally produces plenty of seeds with their fertility reliant on the pollination of butterflies. Butterflies, contrary to other insects, are able to distinguish the shades of red and they can reach deep into the calyx of the plant. Any soil turning or digging operation can result in re-appearance of Maiden Pinks which have remained abundant in the seed bank. Re-introducing grazing and mowing practices are the most proficient way to create suitable habitats for the Maiden Pink.



Dianthus deltoides. Photo: Kimmo Härjämäki



Marsh Fritillary - Punakeltaverkkoperhonen (EN)
-Väddnätfjäril (VU) - Teelehe-mosaiklib-likas (DD)
Euphydryas aurinia
Author: Kari Nupponen

Directive Species (Annex II)

General information

The Marsh Fritillary (*Euphydryas aurinia*) is a medium-sized butterfly with a wing-span of 33–42 mm. Females are on average larger than males. Wings are mottled, orange-red with paler yellowish patches. Black veins and cross-lines form a net-like pattern. The underside of wings is more uniform and yellowish-orange. An arc of black spots at a broad orange-red post-discal band of hind-wings is characteristic for the species.

Ecology

The Marsh Fritillary is distributed all over Europe, excluding the arctic regions, Norway, Iceland and the Mediterranean islands. Outside Europe, its range spans Asia Minor and eastward across temperate Asia to South Yakutia, Transbaikalia, northern Mongolia and Korea. The species is local and declining in the whole of Western Europe, and even extinct in The Netherlands and Belgium.

In the Central Baltic area the Marsh Fritillary is rare and local, occurring as isolated metapopulations. The species has drastically declined in the past decades, and vanished from many of its historical sites. The Marsh Fritillary is listed in appendix II of the European Union habitat and species directive, which means that special protected areas have to be assigned.

The habitats of the Marsh Fritillary in the Central Baltic area are semi-permanent meadows and transient clear-cuts in the forest. The species tends to prefer young to old clear-cuts, apparently because the vegetation has become too high in the latter. In mainland Sweden, most of the remaining populations are restricted to wider powerline clearings. On Öland and the Saaremaa islands, it also occurs in wet fallow pastures. In the Central Palaearctic region, and generally at high altitudes, the species is mesoxerophilous, inhabiting various kinds of dry meadows. The species is univoltine. The flight period of the adults extends from late May to late June in North Europe. The main host of the larvae is the Devil's-bit Scabious (*Succisa pratensis*). In Central Europe, a few other plants such as Scabiosa, Lonicera, Gentiana and Primula are seldom used as larval hosts as well. The species hibernates at the larval stage. The caterpillars live gregariously in webs on leaves of the host plant.

The adults are rather mobile. Lifetime movements are on average higher for males than females. It is not unusual that movements of individuals exceed 10 km. Some females can cross distances of several kilometres. In a network of habitat patches, sites with high density of larval host plant are more likely to become inhabited than the others, while highly isolated patches are less likely to be occupied. Parasitoid attacks, principally by the wasp *Cotesia bigneilli*, are rather common among colonies of the Marsh Fritillary, increasing fluctuations in butterfly populations.

Management

The major threats to the Marsh Fritillary are habitat destruction caused by development and agricultural improvement, inappropriate management of sites including abandonment of grazing and increasing fragmentation and isolation of habitat patches. The species depends especially on extensive farming systems, and appropriate habitat management of unimproved grasslands. Increased isolation of habitat patches due to overgrowth, often results in genetic drift and possibly inbreeding. Therefore it is important to support gene flow by expanding the networks of habitat patches with creation of new patches, and restoring of both remaining and former habitats. Short distances to the nearest colonies buffer against declines. Moreover, small-size and too intensive grazing of habitats have been observed to increase the rate of decline and amount of extinctions. Small populations are also more vulnerable to extinctions caused by natural fluctuations, related to e.g. parasites or exceptional weather.

Continuing presence of semi-permanent meadows is essential for the survival of the Marsh Fritillary. Habitat restoration and re-creation will be necessary in many networks with insufficient habitat area. A combination of mowing and grazing are considered to be a good practice for managing wet, unimproved grasslands. Potential habitats may be restored through cutting twice a year until suitable conditions are reached. In general, a long period of light grazing is better than short periods of heavy grazing.





Euphydryas aurinia. Photo: Pekka Malinen

During heavy grazing, the butterfly colony may become almost extinct due to the nearly complete consumption of the larval host plant and larval groups. Too high grazing pressure almost destroyed a large population in Southern Karelia Korvenkylä meadow in 1996, because the host plant *Succisa pratensis* was eaten. Usually, as in Korvenkylä meadow, the colony will quickly recover when the grazing pressure is lowered. However, the intensity of management should be adjusted by continuous monitoring of the target species. Periodic burning may be useful in maintaining a suitable habitat on some sites and restoration management of sites. Burning on sites should be carried out in rotation, so that only a part of each site is burnt each year. Care should be taken in rank sites, and bracken areas avoided. The main breeding areas on a site should be identified and avoided.

Monitoring of the species and estimation of population sizes are easiest during the period of fresh winter nests in early autumn. Line-transect counts of adults may also be performed, as well as mark-release-recapture procedures especially for studying the mobility of adult individuals. Particular emphasis for future conservation work should be placed on correlating changes in butterfly abundance to the detailed vegetation structure of the site..

Dropwort - Sikoangervo (LC) - Brudbröd (LC) - Angerpist (LC) *Filipendula vulgaris*
Author: Tapio Saario

General information

Dropwort (*Filipendula vulgaris*) and Meadowsweet (*Filipendula ulmaria*) are the two wild species in Finland of the genus *Filipendula*. The Dropwort is a perennial herb which has finely-cut basal leaves, and an erect stem 20–50 cm tall. It blooms from June to August. The tiny, white, odourless, five-petalled flowers appear in dense inflorescences. Some of the roots are tuber-like and starchy.

Ecology

The Dropwort grows in Europe and north and central Asia. In Finland it is distinctively southwestern. It grows predominantly in southwestern Finland on semi-cultural biotopes like dry meadows, wooded pastures and mesic meadows. It is an archaephyte, its occurrences coincide with Iron Age remains. It is an old medicinal herb and the starchy roots are edible. Charred remnants have been found inside the graves in excavations the Dropwort does not spread easily to new habitats, but on the other hand single individuals, as well as entire populations, can be very long-lived. It has not been found on inhabited sites that are younger than the 14th century. This suggests that it has been deliberately cultivated, most likely as reserve food. When the interest for its use ceased at the end of the Iron Age, the Dropwort ceased to be spread.

The Dropwort is a calciphile. It favours open, dry and warm habitats (unlike Meadowsweet), like dry meadows, meadow slopes and rocky slopes.

Management

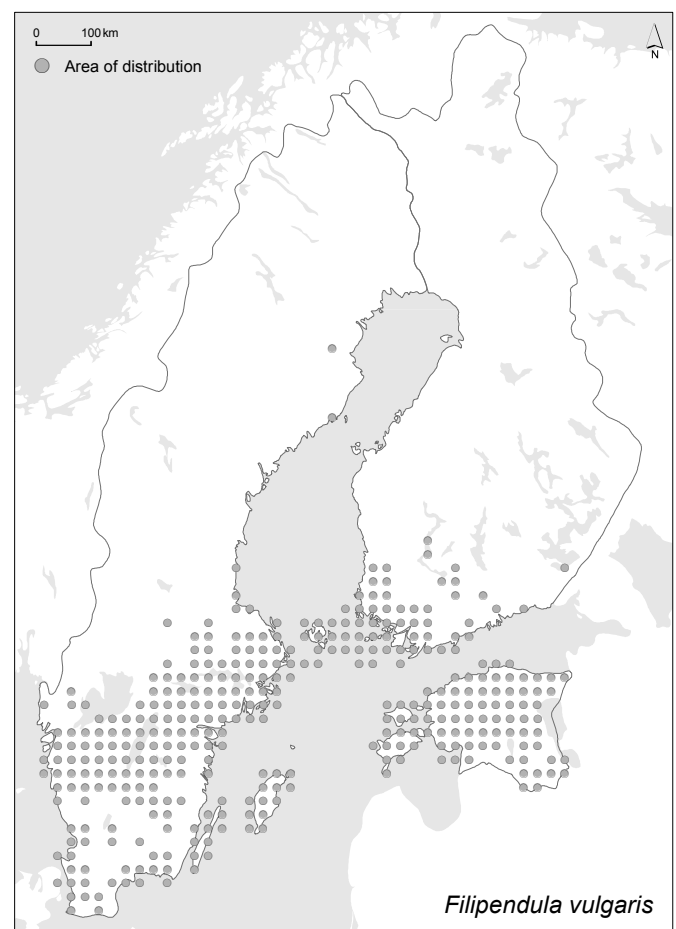
The Dropwort is an indicator species of grasslands and pastures as well as of pre-historic human culture. The Dropwort has survived on habitats where it once was introduced by man and that have remained open since. On archaeological sites it is often found slightly further from the actual human habitation, where the soil would have been too nitrogenous for it.

Archaeological sites are maintained by the National Board of Antiquities (Museovirasto in Finland). From the Dropwort point-of-view, these sites vary a lot; there are monumental fort hills, like the Vanhalinna in Lieto, where site management includes landscape development, basic restoration, site management (forest thinning, removal of young trees and overgrowth and continual care) and site-use planning. Cairn cemeteries, like Huttalanmäki in Piikkiö, are usually maintained by keeping the site open and park-like with long-term forest management. On smaller sites, overgrowth is a threat, even to the Dropwort, since management and maintenance are not possible everywhere.

In the management of traditional rural biotopes, the Dropwort is not a target species, but it benefits from grazing and other measures that restrict overgrowth.



Filipendula vulgaris. Photo: Iiro Ikonen



White Spot - Oliivineikkayökkönen (NT) - Ol- ivbrunt nejlikfly (NT) - Oliiv-nelgiöölane (DD) *Hadena albimacula*
Author: Kari Nupponen

General information

The White Spot (*Hadena albimacula*) is a medium-sized noctuid moth, with wingspan of 28–37 mm. It is a characteristic species and easy to separate from other northern European species of the genus by the olive brown ground colour, distinct pattern and a white medial spot on the forewings. The species shows only minor external variation, primarily in the tone of forewing colour. A southern European *Hadena magnolii* has olive brown forewings too, but it differs from the White Spot by more dense and indistinct pattern and absence of medial spot of the forewings. Two other European noctuids, the Cameo (*Polymixis gemmea*) and *Lamprosticta culta* also resemble the White Spot to some extent. The former occurs in the Baltic Sea region as well, but the moth is autumnal. Species of the genus *Hadena* are readily separated from those of *Polymixis* by hairy eyes and a very long ovipositor of a female.

Ecology

The White Spot is a Ponto-Mediterranean species. The range of the species spans the whole of Europe, excluding northern half of Scandinavia, arctic and taiga zones of Russia, Iceland and most of the British Islands. In the south the species occurs in the western half of the Maghreb area, and in the east the range extends to the high mountains of Central Asia and northwestern Himalayas. Recently, an extremely isolated population was discovered in the high mountains of Yemen, southwestern part of the Arabian Peninsula.

The White Spot appears in the whole Central Baltic area. In Finland the species is rather rare and local, and the majority of its known localities lie at southern coastal areas. The inland populations are dominantly declining, and several of those have vanished during the last decades. In Sweden the White Spot occurs in the southern half of the country, northward up to Dalarna. As in Finland, the inland populations are also declining in Sweden. However, the species is still locally common in the eastern coastal area and especially on Gotland.

In Estonia and Latvia the White Spot is widely distributed and rather common, with the richest populations in coastal regions and on the islands of Saaremaa and Hiiumaa. The species is nearly threatened in England and many areas in Central Europe.

The White Spot inhabits open rocky grasslands and shrubby slopes, often on calcareous ground. At the northern limit of its range in Scandinavia the species occurs in sandy ridges, dry meadows and rocky coastal localities, but also in man-made sun-exposed environments, like gravel-pits and small airports. In Eastern Europe the species inhabits various kinds of steppes, and in the southern part of the range it often occurs at higher zones of large mountain systems. The species hibernates at pupal stage.

The flight period of the adults extends from mid-June to late July. In northern Europe the species is principally univoltine. The moths of the occasional second generation have been observed in August. The moths are nocturnal and willingly visit flowers for feeding, in particular on Caryophyllaceae. The larvae feed on the flowers and seed-capsules of catchflies and campions (*Silene spp.*), in Northern Europe on the Nottingham Catchfly (*S. nutans*), rarely also on the Bladder Campion (*S. cucubalus*) and the White Campion (*S. latifolia*).

Management

The main threats for the White Spot in northern Europe are the overgrowing of open xerothermic areas, grazing by sheep and mowing in the middle part of the summer, the first one leading to loss of suitable habitats and the other two causing an acute decline of the host plant. For example, on Gotland the species suffers from heavy grazing, and the area of suitable habitats has considerably reduced. Such management can be fatal for populations of the White Spot, and therefore a sufficient amount of spots should remain untouched yearly in critical areas. Anthropogenic pressures in certain areas may cause loss of suitable habitats as well, especially in localities attractive for tourists like beaches and dry meadows around sights.

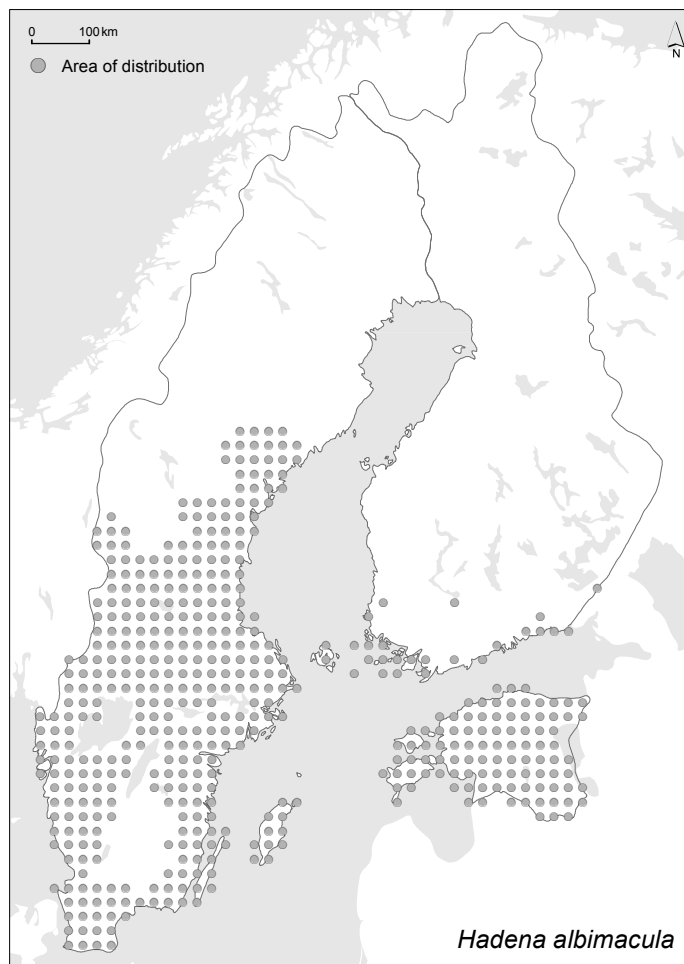
Restoration of sun-exposed environments is a key action in conservation of the White Spot in northern Europe. The aim is to increase the density of high-quality habitats for the moth. If there remain populations in the adjacent areas, the species may colonize new localities rather quickly. In a recent monitoring in Hamina, southeastern Finland the White Spot re-colonized a restored habitat four years after the larval host plant was sowed into the area. However, in most cases a man-made re-establishment of the Nottingham Catchfly in the restored locality is required for successful colonization of the moth.

There are no conservation projects known to us which were strictly directed to the White Spot. In England the species is included in the UK Government's Biodiversity Action Plan to protect threatened moths, but so far the concrete actions concern conservation of valuable habitats rather than any single species. However, in most cases the White Spot benefits from general conservation and restoration of sun-exposed environments as well, even though it is not chosen a target species.

Monitoring of the White Spot appears to be somewhat problematic. The species can be detected by using artificial light, looking for feeding moths on flowers or searching for caterpillars on the host plants. The latter may be the only one giving reliable results. Improvement and standardization of monitoring methods for the White Spot are highly desirable to obtain comparable results.



Hadena albimacula. Photo: Chris Manley



**Irish Fleabane - Rantahirvenjuuri (LC) - Krissla (VU) -
Pajuvaak (LC) *Inula salicina***
Author: Anna Haapaniemi

General information

The Irish Fleabane (*Inula salicina*) is a perennial plant that grows 20–80 cm high. The most striking feature of the Irish Fleabane is its bright yellow flowers sitting on half-sphere shaped involucre. The flower head is 2.5–4 cm across and is formed in tongue-like ray-florets surrounding the smaller tubular disk florets. The stem is of reddish brown in colour and has a fairly slender posture. Each stem usually bears a single flower. The stalk-less and narrow lanceolate leaves are positioned fairly closely with their undersides covered with fine brownish hair. The leaves bear an appearance to willow braches giving it the scientific name salicina.

Ecology

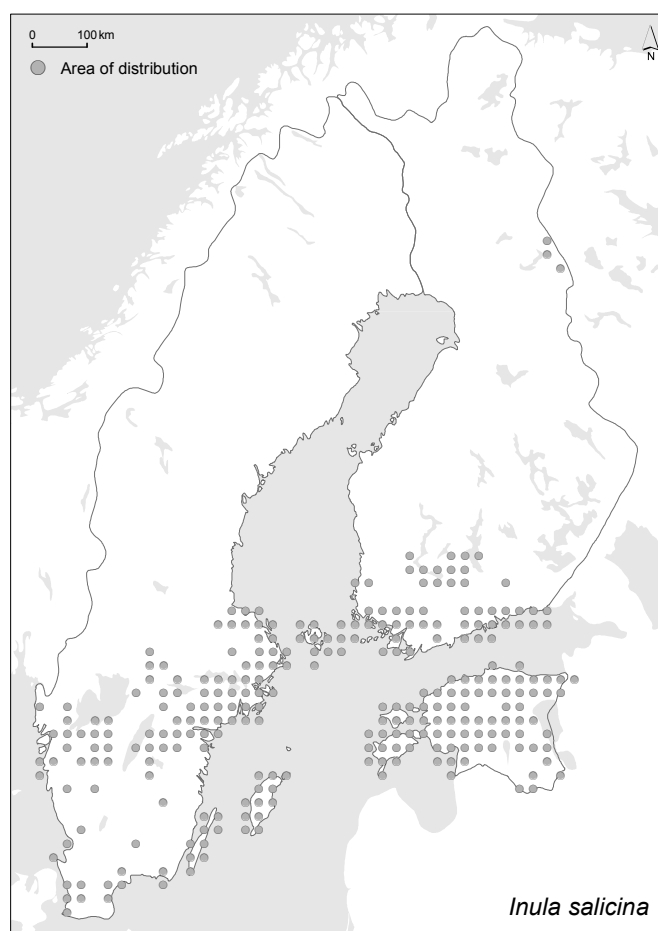
Irish fleabane is found especially in lime-rich soils and prefers dry and sunny meadows. In Sweden the plant can be found from the south to the middle of the country, but it is most common on the islands of Gotland and Öland. In Finland it mainly grows in the SW of the country across the archipelago, the coast of the Gulf of Finland and inland in the Häme region. The species favours meadows and pastures in the southwest part of Finland, but becomes a plant typical of coastal meadows in the archipelago of the Finnish Gulf, from the peninsula of Hanko eastwards. The Irish Fleabane is host plant for several monophagous moth species like *Oidaematophorus lithodactylus*, *O. vafradactylus*, *Ebulea crocealis* and *Epiblema obscurana*.

Management

The Irish fleabane is highly sensitive to competition. A surveillance site in Ireland showed how an establishment of a hydroelectric station reduced seasonal changes in the lake level, which were vital to the success of the plant by reducing competition from flood-intolerant species. It has been suggested that particularly due to the small seed size, the Irish Fleabane might be more dependent on open gaps with low competition. The species is favoured by late mowing. When the site is left unmanaged the species numbers increase moderately at first, more rapidly during an intermediate period of time, but decline quickly after a longer period of time.



Inula salicina. Photo: Iiro Ikonen



**Purple-edged Copper - Ketokultasiipi (NT) - Violettkantad
guldvinge (NT) - Puna-kuldtiib (DD)**

Lycaena hippothoe

Author: Kari Nupponen

General information

The Purple-edged Copper (*Lycaena hippothoe*) is a rather small butterfly, with wingspan of 27–34 mm. Like most species in the family Lycaenidae, the species is sexually dimorphic. The upper sides of wings are gleaming flame-red with dark margins and a purple sheen in males, while those of females are dominantly dark-brown with purplish-orange marginal bands and dull orange forewings. The species is relatively easy to separate from its North European relatives by the ash-grey underside of hind wings with characteristic pattern.

Ecology

The Purple-edged Copper is a Transpalearctic species. The range spans the temperate forest zone of Europe, extending over the taiga zone to Siberia, northern Mongolia and Amur region to the Pacific coast and Sakhalin. In southern and Western Europe the species occurs sporadically at high altitudes in the mountain ranges. It is absent from the arctic regions of Russia, the British Isles, Iceland, lowlands of southern Europe and most of the Iberian Peninsula. In the Balkans the Purple-edged Copper is replaced by its sister species the Balkan Copper (*L. candens*).

In the Central Baltic area the Purple-edged Copper is widely distributed. The species has somewhat declined during the last decades, due to overgrowing of meadows, but it is still rather common. Surprisingly, the species has not been discovered on Gotland.

In northern Europe, the Purple-edged Copper is dominantly a mesohygrophilous species inhabiting humid forest meadows. It also occurs in dry meadows, especially at the northern limit of its range. The species seems to prefer small habitat patches. The main flight period of adults extends from mid-June to mid-July. Single individuals can be observed in early June and late July. In Northern Europe the species is principally univoltine. Individuals of the occasional second generation have been observed in late August. In northern Europe, the main host of the larvae is the Common Sorrel (*Rumex acetosa*). At high altitudes the larvae also feed on the Alpine Bistort (*Bistorta vivipara*), and in the East Palearctic region the species is oligophagous on Polygonaceae. The species hibernates at larval stage.

The Purple-edged Copper males show aggressive territorial behaviour. The individuals use a combination of perching and patrolling in defending territories. In warm and calm weather, perch phases are more frequently interrupted by patrol flights. Generally, residents are particularly successful in defending their territories, leading to a residence time of up to four weeks

within one territory. Old and already worn males loose fights against competitors much more frequently than fresh ones. Territories are preferably located within patches of flowering nectar plants, of which the most important are the Alpine Bistort and the Meadow Buttercup. Defending nectar sources is an uncommon territorial system in butterflies, and its evolution is attributed to the widely dispersed occurrence of receptive females, which concentrate at rich nectar sources. A reduced availability to nectar sources is detected to constrain realized fecundity in females, which explains their behaviour of gathering at good feeding sites.

Management

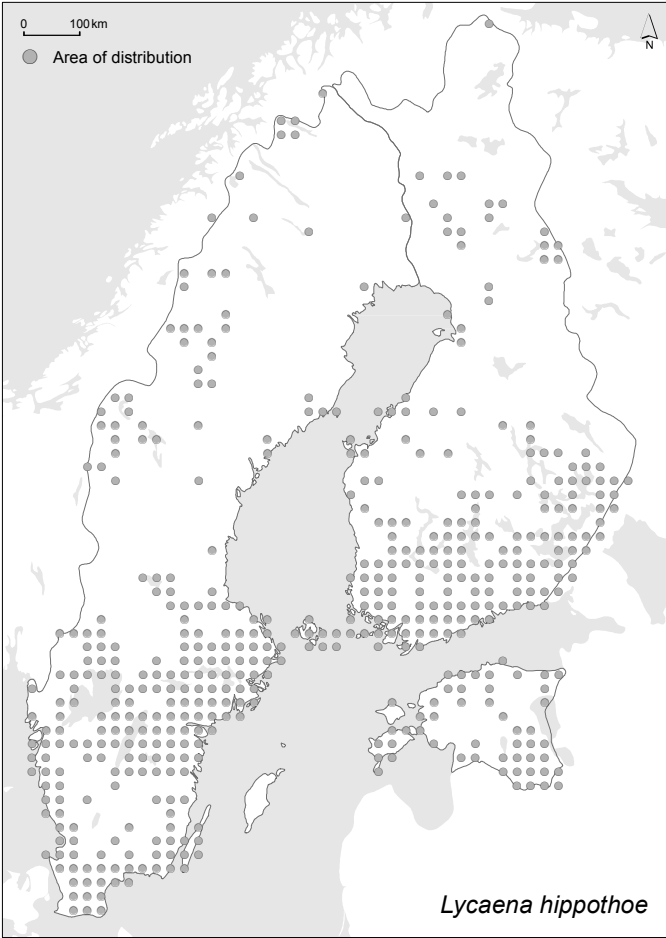
The main threat for the Purple-edged Copper in Europe is the decrease and fragmentation of high-quality habitats. The isolation of colonies is increased due to a dramatic loss of traditionally managed semi-natural grasslands throughout Europe. Moreover, modern agricultural techniques with a high mowing frequency lead to a reduction of nectar sources, which makes moving between habitats more complicated. These factors are supposed to be significant for regional declines in this sedentary species. The Purple-edged Copper is most abundant in old pastures. However, the species colonizes restored habitats very slowly. Even five years of restorative grazing in mesic grasslands is insufficient for the colonization of the species in restored sites.

Management in semi-natural grasslands should be carried out periodically and by various intensity, to ensure that the diversity of patches remain sufficient for target species. Heavy grazing in the entire restoration area usually results in temporary decrease of both the quality of the habitat and the diversity. Temporary loss of host and nectar plants due to unrequited management methods is exceptionally harmful for specialized butterflies like the Purple-edged Copper and easily leads to its disappearance from the locality.

Line-transect count is a useful method for monitoring the occurrence and changes in abundance of the Purple-edged Copper. To obtain reliable and comparable results, transects should be standardized and observed regularly for several years. Mark-release-recapture procedures can be used to estimate population sizes and the mobility of individuals.



Lycaena hippothoe. Photo: Pekka Malinen



Crested Cow-wheat - Tähkämaitikka (VU) - Korskovall (NT) - Harjakas härghlein (NT) *Melampyrum cristatum*
Author: Leif Lindgren

General information

The Crested Cow-wheat (*Melampyrum cristatum*) is a 15-40 cm high semi-parasitic herb. The inflorescence is 3 cm high and cross-shaped if seen from above. The supporting leaves of the inflorescence are sharply dentate and brownish purple. The corolla is purple with a yellow lower lip. The form *M. c. f. alutaceum* is devoid of antocyan and the supporting leaves of the inflorescence and the corolla are pale yellow. The species blooms in July and August.

Ecology

The Crested Cow-wheat is a semi-parasite like other species of the genus *Melampyrum*. In Central Europe the species is known to parasitize on many trees such as oak and hazel and on many different species of herbs, but not on graminids. The Crested Cow-wheat belongs to a group of species, characteristic for forested steppes- with a continental euro-siberian range. In Europe the species avoids the Atlantic coast. It occurs in the southern part of the Nordic countries and western Estonia.

In Finland and Sweden, the Crested Cow-wheat is a species typical for the archipelago. It favours calcareous soils in warm dry habitats like dry meadows, wooded meadows and wooded pastures. It often grows in association with species typical to calcareous dry meadows like Bloody Craneshill (*Geranium sanguineum*), Dropwort (*Filipendula vulgaris*), Common agrimony (*Agrimonia eupatoria*), Wild Basil (*Satureja vulgaris*), Wild Marjoram (*Origanum vulgare*), Hairy St. John's-wort (*Hypericum hirsutum*), and Swallow-wort (*Vincetoxicum hirsutinaria*).

The species is clearly favoured by grazing and mowing and sensitive to overgrowth of tall herbs and grasses, bushes and saplings of trees. When the site is left unmanaged the species numbers increase moderately at first, but decline in an intermediate period of time and disappear after a longer period of time.

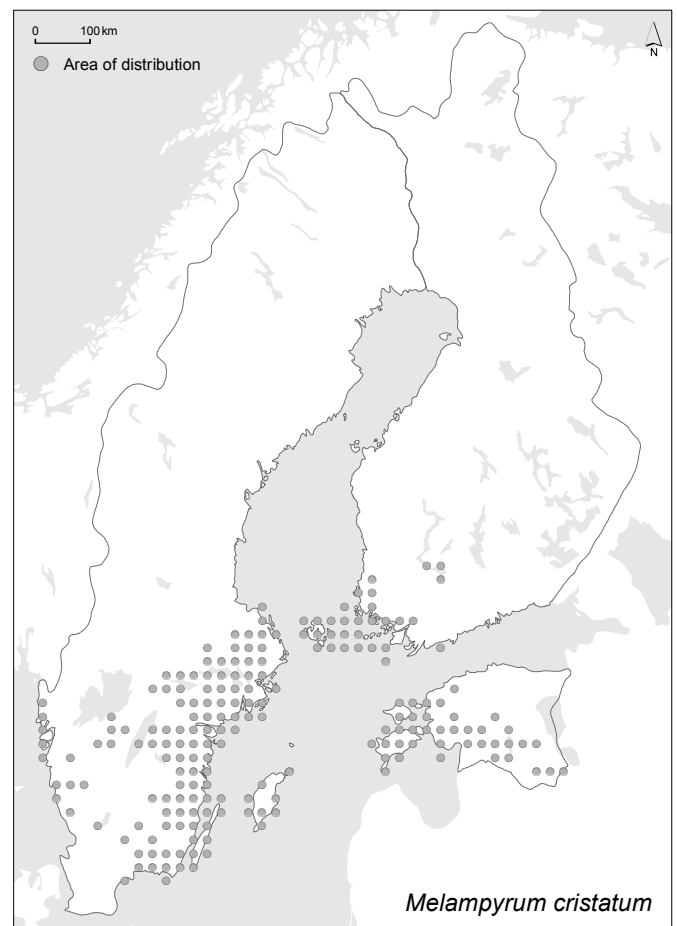
Management

The Crested Cow-wheat has rapidly declined during the last decades. The decline is a consequence of overgrowing of meadows and pastures after the traditional cattle husbandry has been abandoned.

The annual fluctuation of local populations is considerable. In the Archipelago National Park in Finland the number of specimens may be from two up to ten times more abundant than the previous year. The reason for this variation in numbers is not fully understood. Sheep grazing early in the season and with great intensity is clearly disastrous for the population. On such sites the specimens of the Crested Cow-wheat are found on places out of reach for the sheep, like under thorny roses or between stones. Early mowing is also harmful for the species. Grazing should be done with cattle, preferably a bit later in the season. Sheep should be avoided. Mowing should not take place until the end of July or in August.



Melampyrum cristatum. Photo: Leif Lindgren



Glanville Fritillary - Täpläverkkoperhonen (EN) - Ängsnät-fjäril (NT) - Nömme-tähnivörkliblikas (Dd)

Melitaea cinxia

Author: Marko Nieminen

General information

The Glanville Fritillary (*Melitaea cinxia*) is a middle-sized butterfly with a wing-span typically between 33–46 mm. Males are somewhat smaller than females. The upper sides of the wings have an orange-brown groundbase-colour with transversal black bands of variable width. The underside of the hind wings has a wide creamy- or yellowish-white and orange-brown bands bordered with narrow black lines. In the innermost whitish band there are angular spots close to the base. The black spots in each wing cell of the outer orange-brown band on both sides of hind wings are characteristic to the species. In the Central Baltic area it is most easily confused with the Heath Fritillary (*M. athalia*), but these lack the characteristic black spots.

Ecology

The Glanville Fritillary is a widespread species in the Palaearctic region spanning from the Atlas Mountains, Spain, France and England in the west to Amur in the east. Since the last Ice Age, most of the Central Baltic region has been colonized by individuals from the Ural Mountains and Siberia. The Glanville Fritillary is relatively widespread in the Central Baltic area and is often locally abundant but also strictly restricted to particularly suitable sites. Habitats are typically sun-exposed dry meadows with low vegetation and spots of bare rock, sand or gravel. A good example is the Estonian and Swedish alvars. The amounts of suitable habitats have been decreasing for many decades throughout the Central Baltic area, mainly due to over-growing after cessation of traditional grazing and mowing. Because of that, the Glanville Fritillary has been declining for many decades at least in Finland and Sweden.

The Glanville Fritillary is univoltine in the Central Baltic area, mainly flying in June and early July. Timing of the flight period varies considerably depending on accumulation of the temperature sum and weather conditions. They lay eggs primarily on two larval host plants, which are the Ribwort Plantain (*Plantago lanceolata*) and the Spiked Speedwell (*Veronica spicata*). Other Plantago or Veronica species are very rarely used for egg-laying, most often the Sea Plantain (*P. maritima*). Eggs are laid in clusters of typically 100–200 eggs on the undersides of leaves close to the ground.

Larvae hatch within 2–3 weeks and live gregariously until the last instar. Survival rate of larvae is increased with increasing group size. They spin a communal web on plants where they spend nights, shed their skins and escape from bad weather. They repeatedly bask in tight groups in sunshine to speed up their development. Larval groups regularly consume their host plants completely and they have to find a new host within some dm distance from the original plant. Half-grown larvae spin a very dense nest for overwintering in late August or early September. Final instar larvae may move at least 20 m away from their last web when they spread around to feed solitarily until pupation within tussocks and litter in May.

Egg-clusters can be totally consumed by lacewings and coccinellids, and larval groups by predatory bugs. Larvae are attacked by two specialist parasitoid wasp species. *Cotesia melitaeorum* has 2–3 generations within one generation of the Glanville Fritillary and it may even cause local extinctions. *Hyposoter horticola* is a larger species, which causes relatively uniform death rate of approx. 20–30 % in practically all populations of the Glanville Fritillary. Pupae are also parasitized, mainly by chalcidoid wasps.

The butterflies are fairly mobile within a couple of kilometres distances. Many males stay in their natal habitat patch, whereas most females leave after they have laid at least one egg-cluster. Emigration increases with a low density of conspecifics, a low nectar supply, small habitat patch area and with open areas adjacent to patches. Immigration increases with habitat patch area and abundance of nectar sources. Individuals moved at considerably low rates through unsuitable habitat in a cage experiment. Recently, molecular variation in the phosphoglucose isomerase gene has been linked to flight physiology and distances moved at the landscape level.

Management

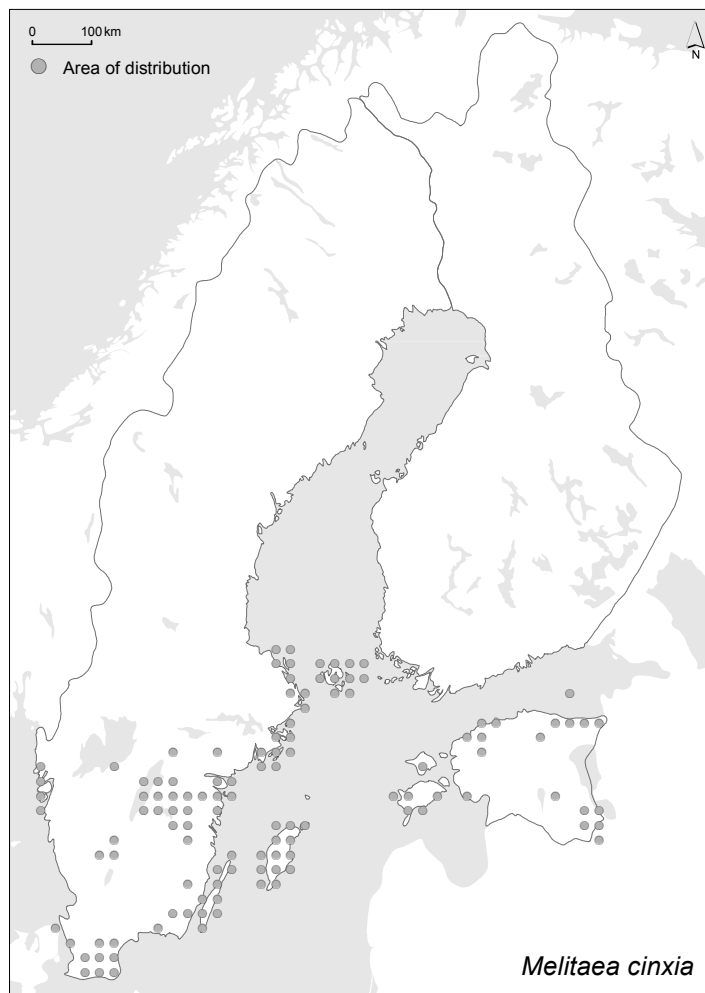
Increasing habitat fragmentation, i.e. decreasing amount of habitat, decreasing size of habitat patches and increasing isolation, is the main threat for the Glanville Fritillary in the Central Baltic area. Fragmentation increases due to overgrowing of meadows and habitat destruction. Small populations are particularly vulnerable to extinctions caused by random variations in population size and structure and inbreeding depression. Yearly monitoring of all populations of the Glanville Fritillary has been going on in Åland since 1993. Monitoring is relatively easy during the period of fresh winter nests in early autumn.

Locally, populations may be seriously affected by too high grazing pressure, which leads to larval groups becoming destroyed by grazing animals and to a lack of nectar plants. In The Netherlands, heavy grazing during hibernation has been found extremely harmful. Grazing is probably harmful also during the pupal period, and therefore grazing should not be conducted throughout the whole habitat patch in one year.

These effects can be magnified due to particular weather factors, which affect populations negatively (environmental stochasticity). Droughts, especially during the time of egg-hatching and in combination with high grazing pressure, cause local extinctions. Heavy rain showers can destroy groups of eggs or small larvae in a regional scale.



Melitaea cinxia. Photo: Marjo Saastamoinen



Clouded Apollo - Pikkuapollo (VU) - Mnemosynefjäril
(EN) - Mustlaik-apollo (LC) *Parnassius mnemosyne*
Author: Iiro Ikonen

Directive Species (Annex IV)

General information

The Clouded Apollo (*Parnassius mnemosyne*) is a protected day butterfly belonging to the species of strict protection listed in Appendix IVa of the Habitat Directive and mentioned in Bern convention. The species is a protected day butterfly belonging to the species of strict protection listed in the Appendix IVa of the Habitat Directive and mentioned in Bern convention.

The Clouded Apollo is a habitat specialist of traditionally managed semi-natural grasslands and has declined throughout whole Europe. Its larva is monophagous, usually on a spring-flowering plant of *Corydalis sp.*, the occurrence of which highly restricts its occurrence. In Nordic countries the species has suffered from intensification of agriculture, loss of semi-natural grasslands and especially the ceasing of cattle grazing in natural pastures.

Ecology

The species has been on the decline for the last hundred years on almost all of its ranges in Europe. In Finland, the Clouded Apollo is presently found on the Åland Islands, on the Southwest coast, and the islands between these two areas, but it also occurs in two places in the interior, Rekijoki and Halikonjoki -river valleys. Prior to agricultural intensification during early 1900s the butterfly also inhabited wide areas of the inland river valleys. During recent decades it has vanished from most of its previous approx. 30 recorded sites in the inland of Southern Finland. In Sweden it has also been declining and is currently encountered in three regions; in Blekinge coastal areas, in Roslagen coastal areas and in the delta area of the Indal River. In Norrtälje municipality 22 out of 24 previous populations have become extinct. In the Southeastern parts of Estonia the Clouded Apollo has even expanded territory while some Saaremaa populations (*P. mnemosyne osiliensis*) have been extinct.

The foodplant of the caterpillars of the Clouded Apollo are *Corydalis* species, usually in the Northern Europe the solid-tubered *Corydalis* (*Corydalis solida*), in Sweden Medelpad and Jämtland *Corydalis intermedia* and in Belkinge mostly *Corydalis pumila*. Later during summer *Corydalis* sites are usually grown over by higher vegetation such as *Filipendula ulmaria*, *Rubus idaeus* and other higher plants which push out other smaller vegetation species, thus leaving more space for *Corydalis* spring growth. The Clouded Apollo species is univoltine, the larve diapausing and hibernating within the egg shell. The larval period starts in April and lasts about 5–6 weeks in nature. The pupal period lasts 2 weeks in nature and pupae are placed usually 5–10 cm above ground surface in dry and airy conditions. The female butterfly will mate during the first day of life and start egg-laying on the fourth day.

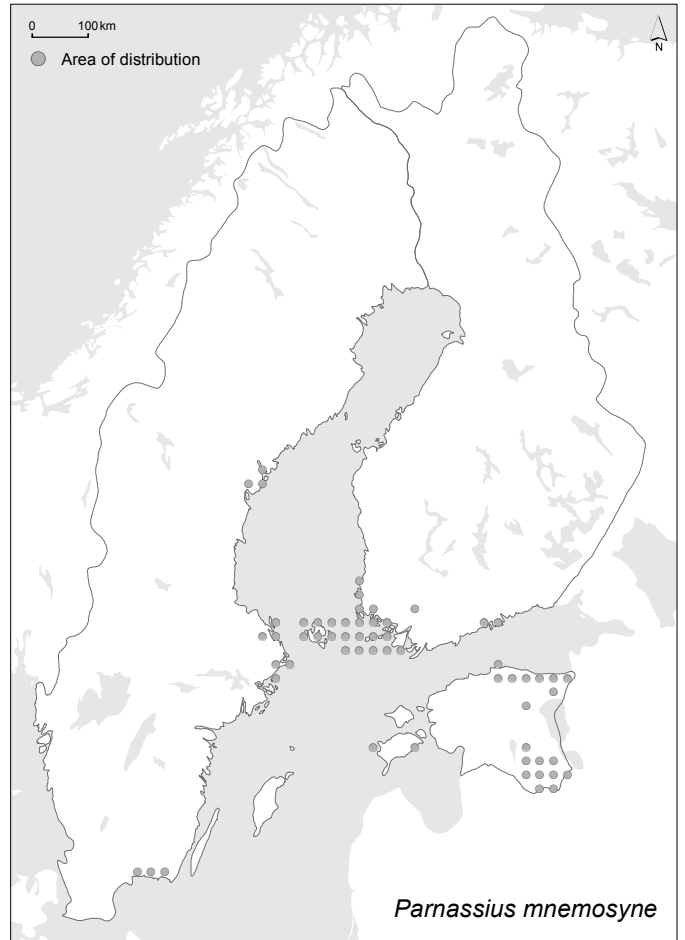
The peak of the flight is reached during the first weeks of flight. The flight period in Southern Finland river valleys lasts one month, in Southern Finnish conditions from late May to late June. The species flies only during sunny weather, as the name Apollo (god of the sun) indicates. Host plants of larvae have already disappeared from the ground surface when the butterflies lay or drop their eggs in grass or litter in June. However, the Clouded Apollo does not lay eggs at random but it is able to identify the habitats of the *Corydalis* from the chemical stimuli of the tuber or seeds. Several studies have indicated that the species favours a mosaic-like meadow-forest structure: open, moist patches of grassland and more shady, grove-like forest edges. It favours sunny and shady environments rich in nectar plants. The female butterflies seem to favour resting in higher vegetation.

Management

One of the key rules of management of the Clouded Apollo site is avoiding overgrowth of suitable traditional rural biotope-habitats and preserving the mosaic structure of the landscapes including *Corydalis* and nectar plant areas. In Halikonjoki river valley, corridors between two subpopulations were cleared by the riverside, which significantly increased proportionate movement of Clouded Apollo into these corridors compared with uncleared area, as well as the conditions for growth of *Corydalis*. Narrow patches of the mature forest do not significantly hamper the dispersal of the Clouded Apollo but wider patches can cause a problem. It has been observed that the species usually moves between habitats situated close to each other within a radius of less than 2 km. It has been observed that recolonization of the restored habitats located at a distance >5 km from existing Clouded Apollo metapopulations is in most cases unlikely because of the restricted dispersal capacity of the butterfly. Combining the right kind of management of traditional rural biotopes and forest habitats would be of crucial importance to the remaining Clouded Apollo -sites.

When restoring traditional biotopes and planning pasture rotation, one should avoid the possibility of the species being eaten up or trampled down.

Increasing awareness of people and increasing cooperation with farmers and landowners are key issues. Usually landowners and farmers are retaining a mosaic landscape with the help of A-E programmes or other financial incentives. The species has previously been more abundant and possible areas where it could be reintroduced could be looked for throughout the whole Central Baltic area. In Finland one reintroduction has been successful in Porvoo (from 20 individuals in 2000 to 1,000 in 2011) and new attempts were made in 2012 when female individuals were reintroduced in southern part of Rekijokilaakso river valley and Paimionjoki river valley. The source population is a site of >10,000 adults in the Northern part of Rekijokilaakso river valley. This very large and stable population allows the use of this metapopulation as a source population for the reintroductions, with the permission of authorities.



Parnassius mnemosyne. Photos: liro Ikonen

Dwarf Milkwort - Katkeralinnunruoho (VU) - Rosettjungfrulin (DD) - Möru vahulill (LC) *Polygala amarella*
Author: Leif Lindgren

General information

The Dwarf Milkwort (*Polygala amarella*) is a small 5–15 cm tall herb with intense blue flowers. The inflorescence is a dense thyrsum with 10–25 flowers. Not many herbs in our wild flora have such deep blue coloured flowers as the Dwarf Milkwort. White flowered colour forms exist, but are rarely seen. In southern Finland the Dwarf Milkwort starts blooming in mid-May and blooms a bit more than a month. It is best detected for monitoring purposes from beginning of June to about the 10th of June. All the specimens bloom at that time and the taller herbs have not yet closed the field layer.

The Dwarf Milkwort is a European species. In Sweden most localities are on the east coast and in the Stockholm archipelago and on the islands of Gotland and Öland. In Estonia the Dwarf Milkwort is common.

Ecology

The Dwarf Milkwort grows on low, calcareous, mesic or slightly moist meadows with nitrogen poor soils. The species is also found in secondary habitats, like ditches gravel pits and other places where the mineral soil has been exposed. The Dwarf Milkwort demands calcareous soils. It belongs to the *Sesleria*- or the *Molinia caerulea* -type of mesic herb-rich meadows, characterized by a long continuous tradition of mowing and grazing. Typical species of the same habitat are Blue Moon Grass (*Sesleria caerulea*), Bird's-eye Primrose (*Primula farinosa*), Blue Sedge (*Carex flacca*), Northern Gentian (*Gentianella amarella*), and Fragrant Orchid (*Gymnadenia conopsea*). When the site is left unmanaged the species numbers are decreasing moderately at first, but rapidly during an intermediate period of time, disappearing after a longer period of time.

The Milkwort acts as a host plant to a monophage butterfly, *Hypercallia citrinalis* (EN in Finland). The caterpillars of this beautiful red and yellow coloured butterfly live in the inflorescence and reveal their presence by sewing nearby inflorescences together.

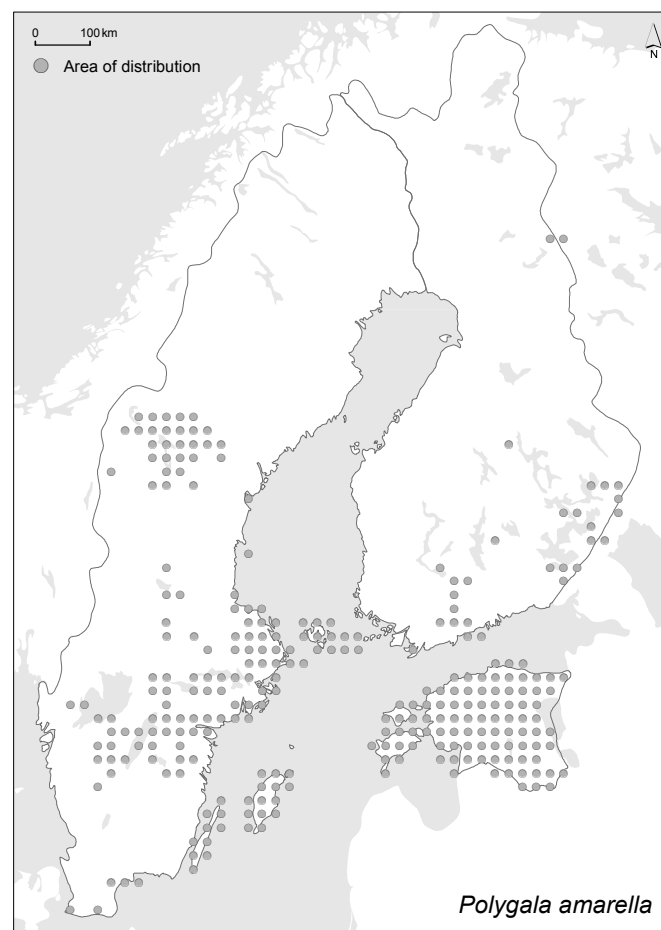
Management

The Dwarf Milkwort has been monitored during the period 1980–2011 on Jungfruskär in Archipelago National Park in Finland. The Dwarf Milkwort was abundant here in the 1920–1930s, but was absent when the management restarted in 1980 after a period of overgrowth from the 1950s and onwards. The Dwarf Milkwort was thought to be lost but reappeared mysteriously in 1988. Either sterile specimens had been overseen or the Dwarf Milkwort has a seed bank. The species has responded very positively to the management of the wooded meadows. The management included clearing of excess trees and shrubs from the overgrowth period and non-recurring management, including spring-raking in April–May, mowing in July and

grazing with cattle and occasionally sheep after the haymaking. Pollarding has been done somewhat irregularly. From 9 specimens at the beginning of 1988 the increase was modest at first, but rapid from 1995 and onwards. The numbers of the Dwarf Milkwort were 5000 in the late 1990s and passed 10 000 specimens in 2004.

The Dwarf Milkwort is sensitive to the accumulation of litter, especially of old aspen leaves that quickly cover small-sized plants. Inadequate funding meant that the spring raking was abandoned for a couple of years on a small wooded meadow, although the mowing continued as before. Consequently the Dwarf Milkwort disappeared from the site. However, the species reappeared on the same site after a three-year period of spring raking.

In January 2005 the water level in the Baltic was for just a few days exceptionally high, more than one meter above the normal level. This alone was enough to eradicate three populations of Dwarf Milkwort on Jungfruskär. The Dwarf Milkwort is favoured by spring-raking and mowing. These disturbances seem to be more important than grazing alone.





Polygala amarella. Photo: Leif Lindgren

Lesser Clubmoss - Mähkä (DD) - Dvärglummer (DD) -
Koldjas selaginell (EN) *Selaginella selaginoides*
Author: Anna Haapaniemi

General information

The Lesser Clubmoss (*Selaginella selaginoides*) is a perennial herb with slender, prostrate dichotomously-branched stems. Although the species is superficially similar to mosses, it has true roots and vascular tissue. It can be distinguished from mosses by its generally taller stature and dimorphic leaves of fertile stems.

Ecology

The Lesser Clubmoss is a circumboreal species extending sporadically across Eurasia with its largest centers of distribution in Canada and western Eurasia. The distribution is focused to the northernmost regions and mountainous areas. In Finland the Lesser Clubmoss is encountered in the middle parts of the country and on rare occasions on the islands in the south-west. In Sweden the species is distributed across almost the whole country. It is common in the middle but rare in the northern and southern parts. It can be found in most parts of Estonia but overall the species is considered endangered.

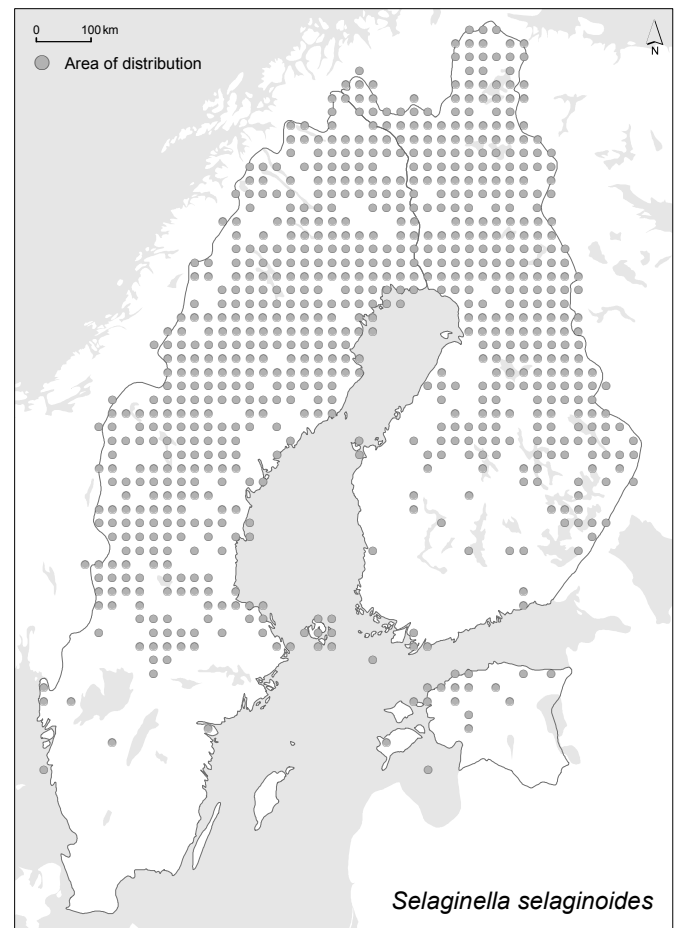
The lesser clubmoss prefers open, moist, calcareous soil such as spring marshes, beaches, meadows and pastures. In sub-fossil pollen stratigraphy the Lesser Clubmoss is known as a cryophyte that indicates severe cold conditions in periglacial tundra together with Dwarf Birch (*Betula nana*) and Mountain Aven (*Dryas octopetala*).

Management

The Lesser Clubmoss is favoured by mowing and grazing. When a site is left unmanaged the numbers first decrease rapidly and will become extinct after a longer period of time if nothing is done. It requires a cool and stable environment and is threatened by anything that alters the moisture content of the soil. Since the Lesser Clubmoss normally grows in small, isolated populations inbreeding depression might occur. Focus should therefore not only be on managing existing habitats but to also secure suitable new habitats which it might settle on.



Selaginella selaginoides. Photo: Leif Lindgren



Blue Moor Grass - Lupikka (NT) - Älväxing (DD) - Harilik lubikas (DD) *Sesleria uliginosa*
Author: Erik Andersson

General information

The Blue Moor Grass (*Sesleria uliginosa*) is a perennial grass of the Poaceae family. It is a middle-sized, between 15–50 centimetres high, grass that grows in dense tussocks. The tussocks are surrounded at the base by layers of old leaf sheaths and grows over time into large rings. The straws, which usually have two short straw leaves, can grow up to a half a meter high but are normally much shorter. The leaves are a couple of millimetres wide with a sharp end, the upper side of the leaf is gray-green and the underside is pure green. The blue moor grass flowers during May to June and the small grains are flattened with three to five flowers. The Blue Moor Grass is a very characteristic grass that is easy to recognize among other species thanks to the blue-violet puff and the gray-green leaf sides.

Ecology

The Blue Moor Grass grows on low, calcareous, mesic or slightly moist meadows with nitrogen poor soils. It characterizes the *Sesleria*- or the *Molinia caerulea* -type of mesic herb-rich meadows, with a long continuous tradition of mowing and grazing. Typical species of the same habitat are Dwarf Milkwort (*Polygala amarella*), Bird's-eye Primrose (*Primula farinosa*), Blue Sedge (*Carex flacca*), Northern Gentian (*Gentianella amarella*) and Fragrant Orchid (*Gymnadenia conopsea*). The Blue Moor grass is common in Sweden on grazed wet pastures, hay meadows, beach meadows and along marsh edges.

It can also be found in enclosed pastures and wooded areas but this is probably a remnant from times when the area was more open. The Blue Moor Grass can be found on the island of Öland and Gotland as well as the north and eastern parts of Uppland. In Finland the blue moor grass is found on the Åland islands and on only two sites in Finland proper. The species is very characteristic in West-Estonian calcareous meadows.

Management

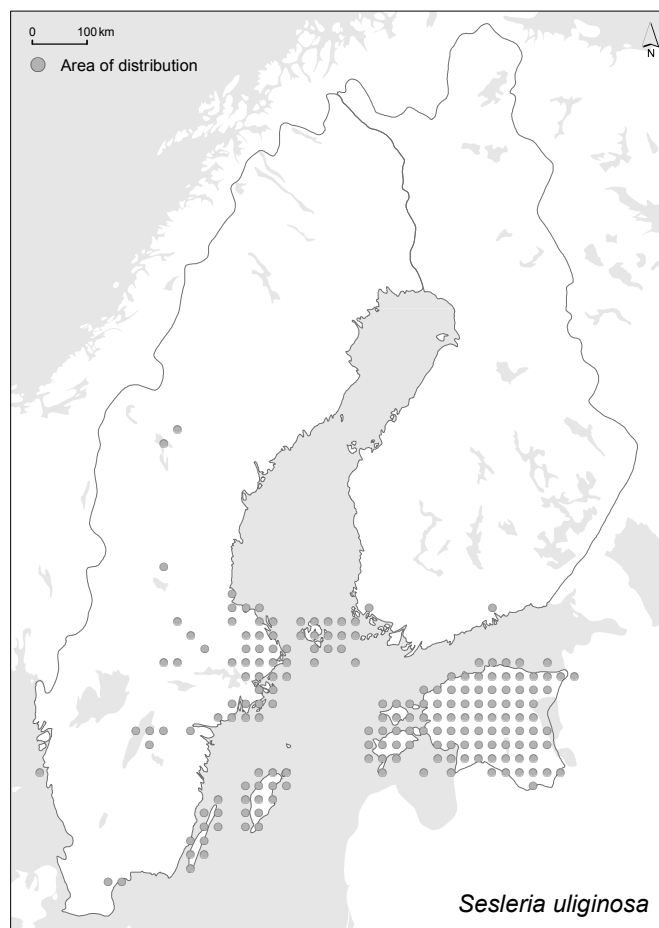
There has been a drastic decrease in the central parts of Uppland believed to be because of the overgrowth of moist meadows. As with most species linked to pastures and meadows a reinsertion of management of these habitats is needed. The species is favoured by mowing and to some extent by grazing. When the site is left unmanaged the species numbers increase rapidly at first, no change is noted during an intermediate period of time, but the species will decrease rapidly after a longer period of time.



Sesleria uliginosa. Photo: N Sloth, Biopix



Sesleria uliginosa meadow in Åland. Photo: Kimmo Härjämäki



Rattle Grasshopper - Palosirkka (VU) - Trumgräshoppa (EN) *Psophus stridulus*

Author: Marko Nieminen

General information

The Rattle Grasshopper (*Psophus stridulus*) is a relatively large species. The usual body length of males is 20–25 mm and of females 31–40 mm. Males are dark grey to black, but females are lighter with greyish, brownish or reddish colours. The most striking feature is the widely bright-red colouration of hind wings visible at flight. Females are brachypterous and therefore unable to fly any notable distances, but the red colouration on wings is still visible. Males are also readily identified by the rattling flight sound, which they almost always produce when flying. An adult Rattle Grasshopper can only be confused with the very rare Speckled Grasshopper (*Bryodemella tuberculata*), which has a smaller area with lighter rose-red colouration on its hind wings than does the Rattle Grasshopper, and the hind wings are more transparent.

Ecology

The range of the Rattle Grasshopper spans from the Pyrenees in Western Europe to Mongolia and Korea. In the Central Baltic area, their microhabitats are slopes of various sizes (from high esker slopes to dune areas, railroad embankments and roadsides) usually exposed to south-southwest. They depend on hot and sunny conditions, and require sparsely vegetated and short-turfed soil of sand or refined pebbles for egg laying.

The Rattle Grasshopper apparently has a two-year life cycle throughout Finland, but mainly annual life cycle in Sweden. Eggs are laid in clusters of approx. 20 eggs, which overwinter twice and start to develop in late May to late June in this area. There are four larval instars until maturation. The adult stage occurs from mid-July to late September. The sex ratio is strongly biased: the numbers of females are typically 20–30 % of the numbers of males. The Rattle Grasshopper is polyphagous feeding on many grass and herb species. They are, nevertheless, selective to some degree, as several plant species are not accepted during rearing.

The purpose of the rattling flight sound is not known, as females do not apparently respond to it. However, it probably is a display for females, and it has been suggested that the sound stimulates pheromone excretion in females.

An average individual is very sedentary, which is more or less self-evident for females as they do not fly. Buchweitz (1993) found a maximum dispersal distance of 81 m for females (309 individuals marked), and 700 m for males (451 individuals marked) in southern Germany. Weibart & Fischer (2006) found a maximum dispersal distance of 185 m for females (349 individuals marked), and 476 m for males (633 individuals marked) in Switzerland. Moreover, both larvae and adult females are clustered even within habitat patches, probably in the most suitable (hottest) microhabitats. Small larvae move actively and the dispersal may be mainly performed at that developmental stage.

The sedentary habits of the species strongly restrict its capability to colonize suitable habitats even at a distance of several hundreds of meters. Therefore, local extinctions are nowadays hardly ever compensated for by colonizations in the Central Baltic area. That makes every remaining population very important for the long-term survival of the species.

Management

The greatest threat to the Rattle Grasshopper is habitat loss caused by succession: overgrowth of early successional stages due to the lack of processes enhancing openness, such as forest fires, as well as re-vegetation of grazed areas. Because of habitat loss the species has rapidly decreased both in Finland and Sweden. Its occupancy has decreased by 70 % since 1950 in Sweden with 100 known locations left. There are 25 locations from the 2000's in Finland. No reliable information on distribution and distributional changes is available from Estonia and Latvia.

Conservation of the remaining populations with appropriate habitat management is currently the most urgent requirement. Open and hot microhabitats have to exist. It is preferable that a fair amount of bare ground (sand) is exposed at habitat patches.

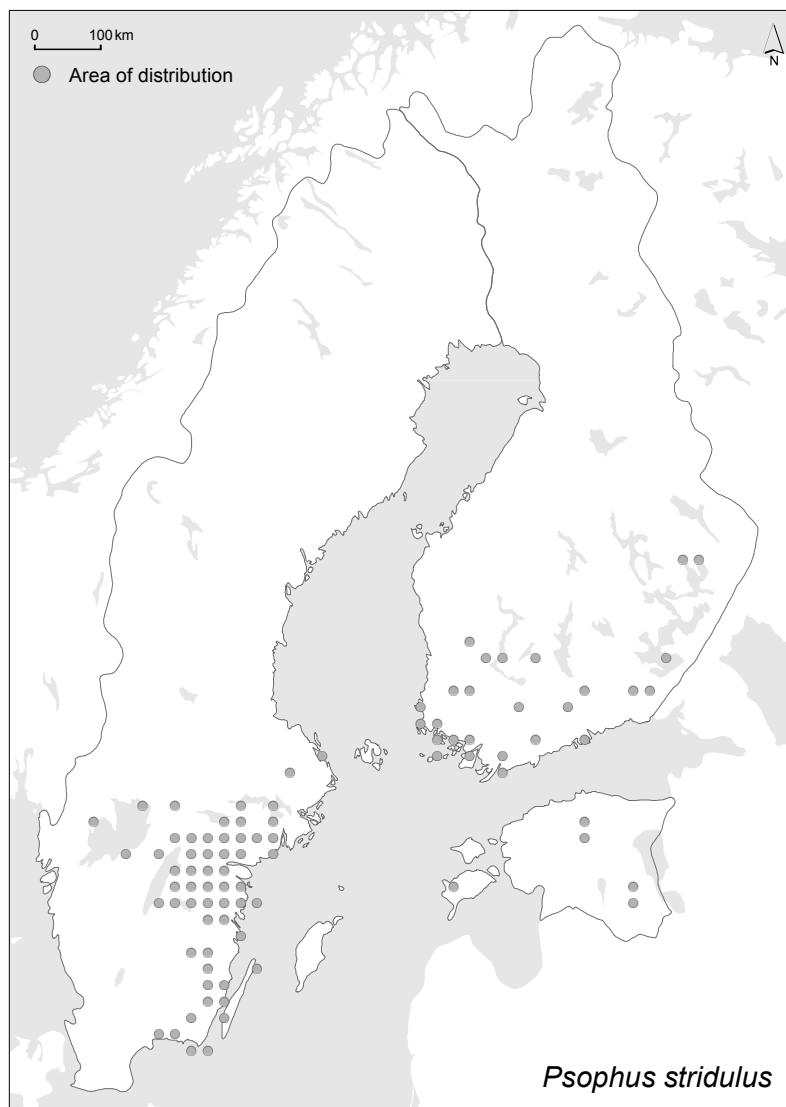
Burning is probably the best management method, because it creates openness very efficiently and sooty surfaces are very hot during the summer. The best time for burning is springtime before the larvae start to hatch to avoid killing them. Another option is to burn in late autumn after the adults have died. However, soot has the strongest warming effect after burning in springtime. Other useful management methods include grazing and mowing. Grazing has been found effective in Sweden, but too heavy grazing pressure must be avoided. Mowing may not be enough in itself in a longer term, but removing of scrub and tree seedlings, and probably also lower vegetation, is needed. Patchy burning at several-year intervals combined with mowing in other years might be a usable management strategy. It is extremely important not to manipulate the whole area of a habitat patch at the same time (year) to avoid e.g. removing too much of the food plants and increasing mortality.

Another urgent need is to restore currently unsuitable but previously suitable habitat patches, especially if they are located close to surviving populations. "Close" means within the dispersal distance, which is some hundreds of meters. However, restoration is highly desirable on sites further away from currently occupied habitat patches, too. Larger high-quality sites should especially be restored and individuals of the Rattle Grasshopper transferred there. Due to the very restricted colonization ability, it will not reach suitable areas further away from the current populations by itself, so re-introductions are crucial for reversing the declining trend and for the long-term survival of the species.

Population sizes of the Rattle Grasshopper can be monitored with various methods. The fastest method is fixed line transects through the habitat, preferably with marking of individuals at the same time. Another fast method is fixed counts, in which one thoroughly covers a fixed area in a fixed time. The most time-consuming but also the most accurate method is mark-release-recapture within the entire habitat patch.



Psophus stridulus. Photo: Pekka Sundell



Wild Thyme - Kangasajuruoho (NT) - Bactimjan (DD) -
Nömm-liivatee (LC) *Thymus serpyllum*
Author: Iiro Ikonen

General information

The Wild Thyme (*Thymus serpyllum*) belongs to the family Lamiales. It is a low, usually prostrate subshrub growing to 2 cm tall with creeping stems up to 10 cm long, with oval evergreen leaves 3–8 mm long. The strongly scented flowers emerge in Central Baltic region between June - August and are either lilac, pink-purple, magenta, or a rare white, all are 4–6 mm long and produced in clusters. The hardy plant produces odours ranging from heavily herbal to lightly lemon, depending on the plant.

Ecology

The Wild Thyme prefers dry habitats such as eskers, dry meadows, rocky meadows, road verges, calcareous meadows and coastal sandy meadows. The species is partly diclinous, having stamens and pistils in different flowers, some individuals are monoclinal. The plant produces 1–4 seeds/flower and has a seed bank. The dispersal unit of the Wild Thyme is a hispid spiky corolla that can attach to the fur of cattles. In studies by A. Eriksson, the Wild Thyme populations were found on ant-turfs, which may indicate dispersal by ants.

Management

Occurrence of the Wild Thyme on site indicates that grazing pressure is not too low and not too stark for seed production. The species has declined because of lack of disturbances such as ceasing of forest fires and overgrowth. Thus the creation of replacing environments is nowadays important as well including active management of sand and gravel pits and road verges. The species benefits from forest fires on eskers and reasonable disturbance in the form of grazing and trampling. Sheep do not prefer this species.

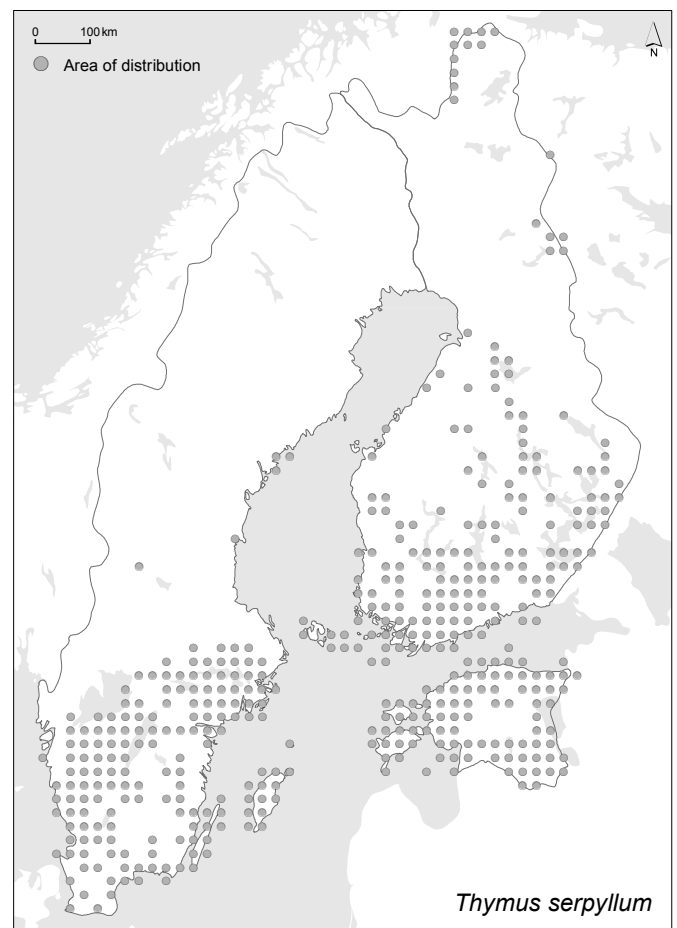
Management and plantation experiments have taken place in Finland on eskers of Hyyppärä and Komio and in Archipelago (Örö island). Ericsson (1998) emphasized that the species is found in managed habitats with long and continuous grazing regime. “The results indicate that the distribution range of the Wild Thyme has been influenced by human activities, both for the dispersal phase and for the maintenance of established populations, and that this influence may reach back to the Iron Age. Because of the poor establishment in undisturbed and more fertile habitats, and the exclusive appearances in managed sites, long continuous management by grazing and haymaking is obviously important for the maintenance of this species”. Ericsson stressed that in historical times these populations were possibly connected with each other in a metapopulation system, but nowadays, due to habitat fragmentation and changes in farming systems, they are most likely isolated (Ericsson 1998). The species is an important nectar plant for insects and a host plant for many rare insects as well, including bluewings Large Blue (*Phengaris arion*) and Eastern Baton Blue (*Pseudophilotes vicrama*).



Large Blue (*Phengaris arion*) on *Thymus serpyllum*. Photo: Iiro Ikonen



Thymus serpyllum. Photo: Iiro Ikonen



Species in coastal meadows and lagoons

False Fox-sedge - Revonsara (VU) - Blankstarr (DD) - Tihe tarn (DD) *Carex otrubae* (syn. *Cuprina*)

Author: Anna Haapaniemi

General information

The species is fairly similar to the True Fox-sedge (*Carex vulpina*) and they can easily be confused with each others. The False Fox-sedge (*Carex otrubae*) is slightly smaller, 30–75 cm high. The leaves are light green in colour but otherwise similar. The culm is different in shape and instead of a concave side, it has a convex side. Also, the lower most leaf of the spike is clearly a distinctive feature and sometimes almost the length of the spike. The plant forms several yellow brown spikes with somewhat less dense in flower arrangement than the True Fox-sedge and the utricles are shiny.

Ecology

The species can be found on wet, sometimes shaded, places on heavy soils, marches, ponds, ditch margins and coastal meadow areas. In Nordic countries the species closely follows the distribution area of the True Fox-sedge with the difference of spreading onto the west facing coastal margins, and hence it has been found all the way up from the Norwegian coasts. It is likely that the species has disappeared altogether from the mainland Finland and from Jungfruskär in Houtskär and found currently only on the Åland islands. The Finnish sites on Åland are on moist coastal meadows and on the margins of field ditches.

Management

The particular reasons for the decline of the species are not fully understood, but it is suspected that overgrowing is the main factor. Thus, the management quite possibly follows similar guidelines as for other sedge species. The mowing and grazing of coastal meadows is imperative to keep them from being overgrown with reeds. In recent years the numbers has increased in Sweden, probably due to a diminishing grazing pressure.



Carex otrubae. Photo: JC Schou, Biopix

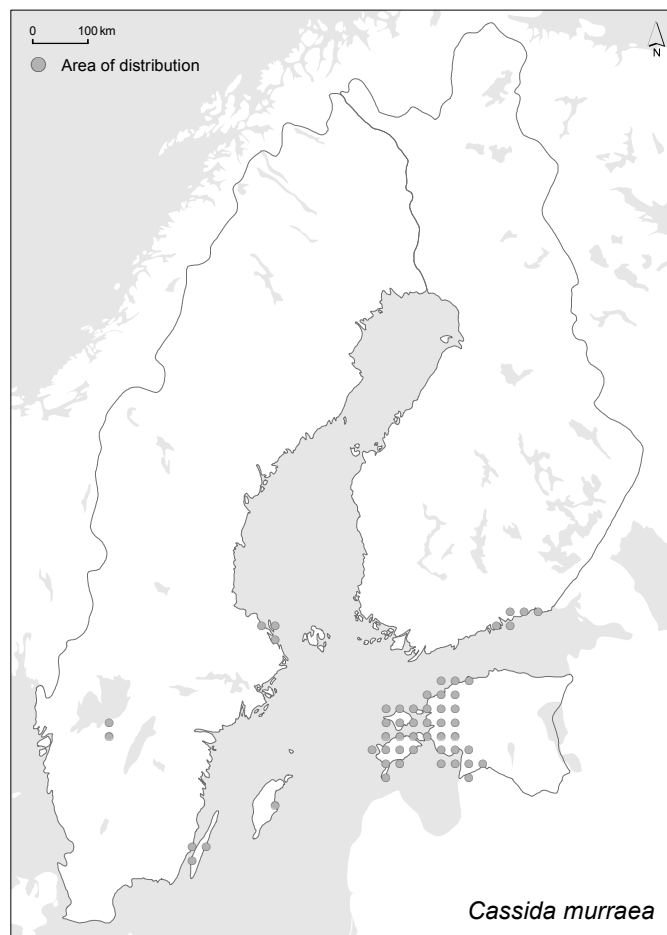


Fleabane Tortoise Beetle - Mörökilpikuoriainen (VU) - Svartbent sköldbagge (NT) *Cassida murraea*
Author: Ilpo Mannerkoski

General information

Tortoise beetles are flat and broad, oval or nearly round leaf beetles (family *Chrysomelidae*). The half round pronotum wholly covers the head which is visible only from below. They can retract their antennae and legs very tight beneath their body when disturbed. Most *Cassida* species, 22 species recorded from Fennoscandia and Baltia, are green or yellow-green by colour. Both larvae and adult beetles are usually seen on their herbaceous food plants. The spiny larvae have, at the tip of their abdomen, a forked appendage on which it carries its frass and exuviae as camouflage. The larvae thus look like small heaps of rubbish on the leaf.

The Fleabane Tortoise Beetle is a 6–8 mm long beetle. Usually it is easily identified by its colour. Its upper side is brownish-red or orange-red and it has small black spots on the elytra. Along the suture of elytra it has a black stripe. The legs and antennae are wholly black. The ventral side is also black. It is, however, important to keep in mind that after hatching young adults of this species are also green with black markings. They have the final colour just after hibernation.



Ecology

The Fleabane Tortoise Beetle is usually living in moist areas, most often shore meadows, but it can also live in more dry habitats. In Finland, it occurs only on the sea coast near the shoreline. It lives mainly on *Inula* species, like the Irish Fleabane (*Inula salicina*). It is also known to live on *Pulicaria* spp., *Carpesium* spp. and Mints (*Mentha* spp.). The adult beetles fly in late May and early June looking for food plants. They are good fliers and are able to find isolated patches of food plants. This is the only period when the species can spread out to new areas. The beetles are eating holes to the leaves or top shoots of food plants in that time. They never gnaw the margins of the leaves like many moth larvae living on the same plants. In June, the females stick their eggs in small holes gnawed by them to the stems and cover them with a layer of secretion.

The larvae are often eating winding galleries in the leaves but especially when bigger they also eat holes through the leaves. There are big differences in the phenology of single specimens, so adult beetles and larvae of different ages can often be found on the plants at the same time. The light-green larvae grow up to a length of 7 mm. The larvae probably go to the ground for pupation. The new generation hatches mostly in July. After that the young, green-coloured beetles eat some weeks on the plants before hibernating in the ground among plant debris.

In Finland, the Fleabane Tortoise Beetle is a rare species living only in very restricted areas on the islands and coast of eastern Gulf of Finland. The food plant however has much wider distribution in southern Finland. In Sweden, the Fleabane Tortoise Beetle has a scattered distribution and is nowadays known from three separate areas: Öland, one location near the lake Vänern in Västra Götaland and a small area in the coastal Uppland. There are also old records from Scania and Gotland. It is also known from all Baltic Countries and from the surroundings of St. Petersburg in Russia. The general distribution is Asiatic European extending from Great Britain and southern part of North-Europe to south-eastern Europe, Caucasus, Central Asia, Siberia, Mongolia, western China and Japan.

Management

The habitats for the Fleabane Tortoise Beetle are often threatened by overgrowth after grazing and mowing has ceased. Construction and mechanical wear related to the summer cottages and other leisure time use of seashores are also important threat factors for the species. Populations are usually small and isolated and disappear easily. In Finland, it is a species under strict protection according to annex of the Nature Conservation Decree.

The conservation and management of any species must be based on exact information on its occurrence. The mapping and monitoring of the Fleabane Tortoise Beetle is possible from the beginning of June to August. In areas where *Cassida ferruginea*, which makes similar markings in leaves, is living the adult beetles are seen. In areas without *C. ferruginea* the occurrence



Cassia murraea. Photo: Peter Orchard

can be confirmed by the feeding markings alone, and July is probably the best time for that kind of survey. The adult beetles are easily seen in June, but in August the young green adults are more difficult to find. A sweep net is usable in finding the adult beetles.

Most important in the management of the habitat is to make sure that the food plant has good growing conditions. Continuing or restarting grazing is the best means of management in many areas, but too intensive grazing should be avoided. The grazing must be light and irregular and it should not be started too early in the spring. Some populations of the Fleabane Tortoise Beetle have disappeared after too intensive grazing. At least in Finland most occurrences are small and may not be suitable for grazing. There is no practical experience available on the influence of mowing to the Fleabane Tortoise Beetle.

Fourleaf Mare's-tail - Nelilehtivesikuusi (EN) - Ishavshästsvans (CR) - Neljalehine kuuskhein (..) *Hippuris tetraphylla*
Author: Erik Andersson

Directive Species (Annexes II, IV)

General information

The Fourleaf Mare's-tail (*Hippuris tetraphylla*) is a perennial aquatic plant which grows in an upright position to a height of 15–40 cm. The stalk usually becomes a couple of decimetres high and is covered with rims of four to five leaves. The leaves are blunt and three to five millimetres wide. The flowers grow on the axillary and are quite inconspicuous. The plant is often confused with *H. x lanceolata*, which is a hybrid between the Fourleaf Mare's-tail and the more common Common Mare's Tail (*H. vulgaris*).

Ecology

The Fourleaf Mare's-tail grows on soft bottoms and prefers a sheltered environment in brackish water. On all the sites where it has been found in Sweden there have been flat beaches with a swift rise of land. The four locations where it has been found are believed to exist due to seeds drifting from the Finnish population where it also is more common. It can be found all along the Finnish coast with a distinct concentration peak in the Uleåborg area. The species in Finland is clearly favoured by mowing and grazing, especially in the southern part of its distribution, where the land upheaval is moderate. The sites of the Fourleaf Mare's-tail are often threatened by overgrowing by reeds. The Fourleaf Mare's-tail can also be found on along the shores of Alaska, Canada, Russia and northern Europe.

Management

The Fourleaf Mare's-tail is a weakly competitive species and achieves optimal growing conditions when it grows in very loose substrate. According to Ericsson 2006, the Swedish population wasn't declining and since there were no apparent threats to be found no actions were taken. However if the population in both Sweden and Finland starts to decline there might be need for ex-situ cultivation or preservation so the populations need to be closely monitored. The waters of the Baltic Sea also need to be improved in order to optimize the growing conditions for the Fourleaf Mare's-tail.



Hippuris tetraphylla. Photo: A Neumann, Biopix



Directive Species (Annex V)

General information

The Medicinal Leech (*Hirudo medicinalis*) has two thin dorsal red stripes on dark, brownish or greenish background. The ventral side is darkly pigmented with white and grey markings. Adults are 10–15 cm in length and 1–1.5 cm in width. Both the anterior and posterior ends of the body bear a sucker, which is used for adhesion. The Horse Leech (*Haemopsis sanguisuga*) is another large leech species and common in the Central Baltic area. It can be confused with the Medicinal Leech, but it lacks jaws and does not suck blood; it consumes small invertebrates at the bottom of bodies of water.

The Medicinal Leech has a variety of sense organs including touch receptors, light organs, vibration receptors and chemoreceptors distributed along the body. There are five pairs of dorsal eyes on the anterior part of the body. Sense organs aid the Medicinal Leech to detect host vertebrates. In a pool the leech swims towards warm parts of a vertebrate body. Sweat, warmth and water movement actions of host animals cause the leech to swim closer and attach itself. In contrast to most other leeches recorded in Finland the Medicinal Leech is less photonegative, i.e. it may be seen swimming at daytime.

The Medicinal Leech is hermaphrodite, i.e. it has male and female reproductive organs. Only sexual reproduction is recorded. In copulation one partner acts as male and another as female. Possibly, in head to tail position reciprocal fertilization can also take place, i.e. both partners act as male and female at the same time. Fertilized eggs are laid into cocoons which are deposited into wet or humid shore soil close to waterline.

Ecology

In Finland, the Medicinal Leech occupies stagnant water-bodies such as pools and lakes where at least some vegetation, especially *Nuphar*, *Nymphaea* and *Typha* species, as well as water mosses, are present. These provide underwater shelter for the leech waiting for its prey.

The Medicinal Leech is a native of several countries in South and Central Europe, as well as South and East Asia. It was post-glacially distributed northwards up to the countries around the Baltic Sea basin. Perhaps it can make even long dispersal jumps

when attached to the host animal. But, abiotic factors such as floods may have aided in its dispersal as well. Because the species has had widespread medical use during hundreds of years, its northward dispersal has also been aided by man.

The Medicinal Leech was previously present in an area from southern to central parts of Finland up to the city of Kuopio. In the late 1800s and early 1900' it was widely used for medical purposes and it was introduced into new ponds. In the 1800s the Medicinal Leech was recorded in at least 33 ponds mostly in Satakunta and Häme. In the middle of 1900s it still belonged to the list of products sold in Finnish apothecaries, when approximately 65,000 specimens were annually used for medical purposes in Finland. From the early 1900s populations started to decline because suitable wetlands were drained and grazing on shores diminished. There were only two localities known in Åland and one on the southern coast in the 1980s. Currently, the species is recorded in a few separate ponds on the Åland Islands, in southwestern Finland and in southern Häme.

Management

Over-collecting for medical purposes is unlikely to be a threat today, even though it may have had local impact on the Medicinal Leech populations in the past. More significant issues nowadays are the conversion of grazed wetlands to arable cultivation, decreasing numbers of natural drinking sites for cattle, pollution of suitable water-bodies, more intense land use such as filling up wet habitats and pools, increased drainage lowering water level locally, and fewer host species.

Needs and methods for conservation still have to be worked out. At present, the conservation of known populations and their habitats may be preferred. Construction of pools with a shallow shore would create suitable habitats for the Medicinal Leech, and also for amphibians, which serve as prey animals for the leech. Reintroductions to sites where the species has occurred could be considered as well. New populations should be searched for and studied in detail to determine their current status.

Populations should be monitored in order to meet possible future threats. There are various ways to monitor the species. One can choose 3-5 sites by the pool and use a waternet with a fixed number of sweeps from the bottom material and among submerged vegetation per site and per visit. Moreover, one can provide a small piece of fresh and bloody meat at the end of a string tied to a stick and move the lure back and forth in shore-water for a couple of minutes. One may also walk bare-footed a given time in shore-water and count the leeches revealed.



Hirudo medicinalis. Photo: Juhani Terhivuo



Yellow-spotted Whiteface - Täplälampikorento (DD) - Citronfläckad kärrtrollslända (DD) Suur-rabakiil (DD)
Leucorrhinia pectoralis
Author: Marko Nieminen

Directive Species (Annexes II, IV)

General information

The Yellow-spotted Whiteface (*Leucorrhinia pectoralis*) is a middle-sized dragonfly species with wingspan of approx. 65–70 mm. *Leucorrhinia* species have a whitish forehead (frons) which separates them from other dragonflies. Males are mottled black, red and orange-yellow, whereas females have black base-colour with strong yellow patterns. Matured Yellow-spotted Whiteface males (and often also old females) can usually be distinguished from other *Leucorrhinia* species by the lemon-yellow dot on the upper side of the 7th segment of abdomen. However, the dot is quite pale in pre-mature individuals and young mature females, and then the species can only be distinguished by details of genital area. It is most easily confused with the Ruby Whiteface (*L. rubicunda*).

Ecology

The range of the Yellow-spotted Whiteface spans from Central Europe to Ukraine, southern Russia and Kazakhstan including southern Fennoscandia. A notable amount of the European population occurs in southern Finland and southern Sweden. It has been spreading towards the north and also become more common in the Central Baltic area in recent decades, except perhaps in Estonia where it is considered declining. The Yellow-spotted Whiteface is listed in appendices II and IV of the European Union habitat and species directive, but is not threatened nor nearly threatened within the Central Baltic area. However, the listing in appendix IV means that it is forbidden to deteriorate or destruct the breeding sites or resting places of the Yellow-spotted Whiteface.

The species is selective with regard to breeding waters, even though the preferred habitat types apparently vary regionally. Larvae even tolerate quite acidic water. In Finland it lives in lush lakes, ponds, bays of the Baltic and even ditches, and is often found in more open patches with abundant aquatic vegetation within reed-beds. In Sweden, it breeds in ponds with abundant vegetation, mire ponds, small lakes and delta areas, as well as in bays with dense vegetation of larger lakes. The majority of populations inhabit naturally eutrophic lakes and oxbow lakes in Latvia, even though dystrophic water-bodies including lakes and ponds in raised bogs and mires are quite often used.

The breeding sites are at mid-successional stage, i.e. areas of both open water surface for egg-laying and dense aquatic vegetation for larvae to hide within are required. Visual habitat recognition by the Yellow-spotted Whiteface is based on the pattern of polarized light and on structural properties. It has been shown experimentally that structural features of the habitat, such as emergent vegetation, are important for the choice of breeding habitat.

In the Central Baltic area, the main flight period starts around mid-June and lasts until mid-July, but there is a lot of variation depending on the yearly temperature sum and weather conditions. After maturation, males take over and defend a small territory at a breeding place. They sit and wait, usually on vertical plant parts, for females to arrive for mating, which starts at flight and continues within vegetation approx. 15–25 minutes. After mating, females almost immediately start to lay eggs by dipping their abdomen into water from free flight.

Management

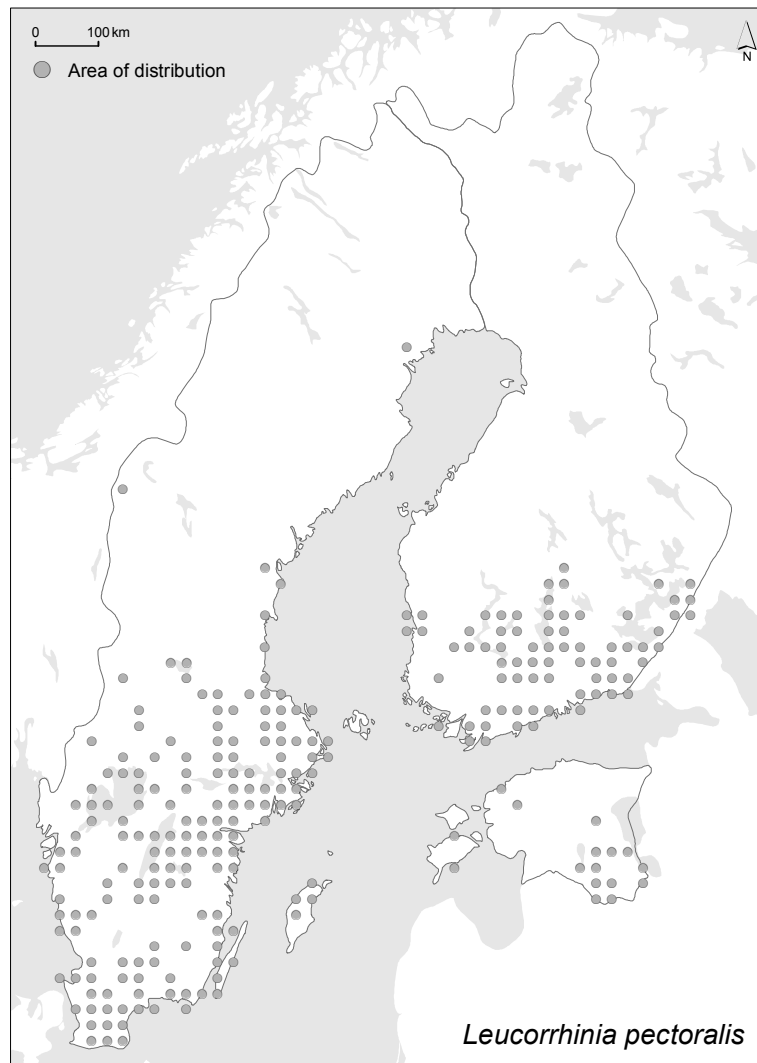
Stray individuals are every now and then found several kilometres from known breeding sites, which is in concert with observed colonisations of restored and relatively isolated ponds. Based on studies for several years it has been suggested that the regional occurrence is based on meta-population dynamics, i.e. extinctions of local populations and (re-)colonisation of empty habitats.

Possible threats for some populations in the Central Baltic area include increased shading of small breeding sites by surrounding trees, overgrowing of ponds previously used for drinking sites by cattle or for watering plants, too dense vegetation due to eutrophication of water-bodies, stocking ponds with fish which feed on larvae and decrease oxygen levels, pesticides and fertilizers spread for agricultural purposes, changing land-use (e.g. infilling of ponds, recreational renovations of water-bodies) and pollution in urban areas, and rapid changes in water-levels.

It may be necessary to perform habitat management in some sites, e.g. by dredging or mowing. Experience in habitat management comes from Central Europe where the species is under threat. Some successful restoration projects have been performed there. A formerly drained mire was restored by damming in Germany and the Yellow-spotted Whiteface colonised that site within a few years. Rotational management of breeding ponds promoted local populations in Switzerland. A habitat management project aiming at habitat restoration of Yellow-spotted Whiteface sites has recently been started in Estonia. At least one monitoring programme has been carried out in Schleswig-Holstein, Germany. Monitoring is easiest during the flight season, when adults can be counted using different methods.



Leucorrhinia pectoralis. Photo: Petro Pynnönen



**Adder's-tongue - Harilik maokeel (DD) - Orm-tunga (DD) -
Käärmeenkieli (LC) *Ophioglossum vulgatum***
Authors: Tapio Saario & Erik Andersson

General information

The Adder's-tongue (*Ophioglossum vulgatum*) is a small plant of the *Ophioglossaceae* family. The stem reaches 30 centimetres at the most and it consists of a single egg-shaped green leaf and an upper upright sporangium. The sporangium has 10–40 yellow-green sporangia and a sterile end. It flowers between June and August. The Adder's-tongues are easy to recognize but hard to find due to its size and if the sporangium hasn't developed it is easy to mistake it for a Common Plantain (*Plantago major*).

Ecology

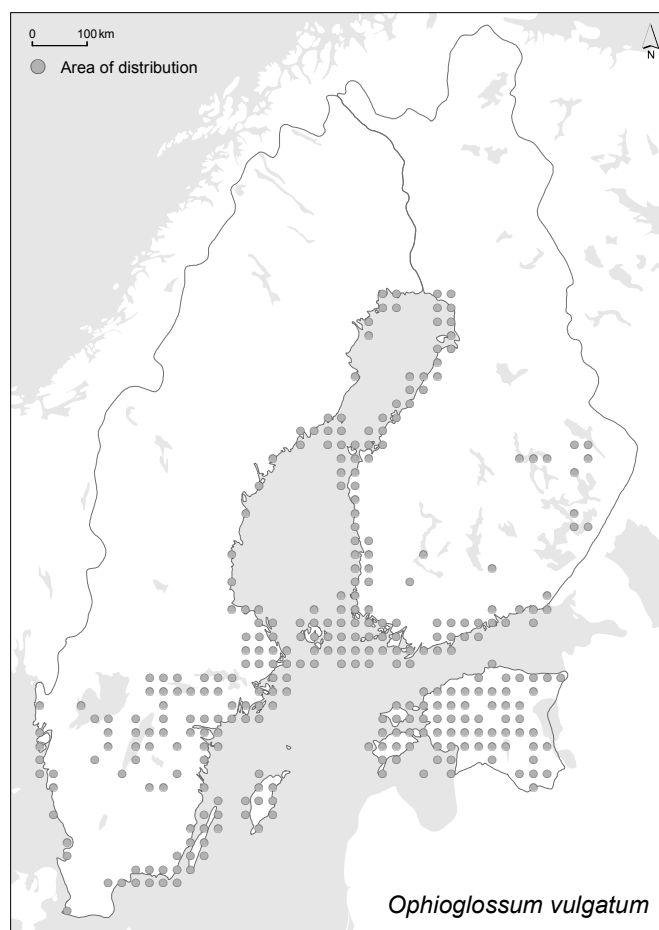
The characteristic environments for the Adder's-tongue are coastal meadows and meadows with low vegetation. It is also found on along the supralittoral zones with hay meadows, calcareous rich moist meadows and along wet areas in pastures. It also seems to survive well in overgrown pastures by growing under dense gatherings of Meadowsweet (*Filipendula ulmaria* L.). In Sweden the plant can be found along the east coast up to the county of Hälsingland with strong inland populations in Uppland and the areas around Lake Vättern. Most Finnish sites are located on coastal meadows. Only on the Åland islands is the species found on the supralittoral zones with calcareous meadows as well. In Finland it is also found along the coast with a concentration in the south western part.

Management

In Finland the Adder's-tongue is almost exclusively a seashore species, where occurrences in Sweden and central Europe are quite common in the inland areas. The main reason behind the decline of the Adder's-tongue is mainly because of the overgrowth of shore meadows. In the south-west Finnish archipelago, the Adder's-tongue seems to in some places, to have increased somewhat during the last century. This is probably due to the abandonment of grazing and subsequent eutrophication. This indicates that intensive grazing would have an impact on the Adder's-tongue populations, which prefer nutritious and moist conditions. The ideal management practices for it seem thus to be low exploitation, very little grazing and moderate mowing.



Ophioglossum vulgatum. Photo: Leif Lindgren



**Marsh Lousewort (Red Rattle) - Luhtakuusio (LC) -
Käärspira (DD) - Soo-kuuskjalg (NT) *Pedicularis palustris*
Author: Anna Haapaniemi**

General information

The Marsh Lousewort (*Pedicularis palustris*) is a fairly large biennial plant growing to a height of 20–80 cm. The stem is often reddish and forms branches. The leaves are positioned upright and in an alternate fashion along the stem and they also form a basal rosette. The leaves are pinnate, or feather shaped, and the middle rib of the leaf is two mm wide and flattened. The flower has two lips of equal length which form a cylindrical shape with the lower lip consisting of three lobes and the upper having a sharply convex tip. The flower is purplish-red in colour with the upper lip having a more intense shade. Sometimes yellow or white variants can occur. The calyx is hairy with two leaf-like lobes.

Ecology

The Marsh Lousewort belongs to a fairly new genus originating from the Himalayas from where it has spread to Europe and to the rest of the Northern hemisphere after the last ice-age. It used to be common in natural wetlands in different regions of Europe, but is today endangered in many places across Europe.

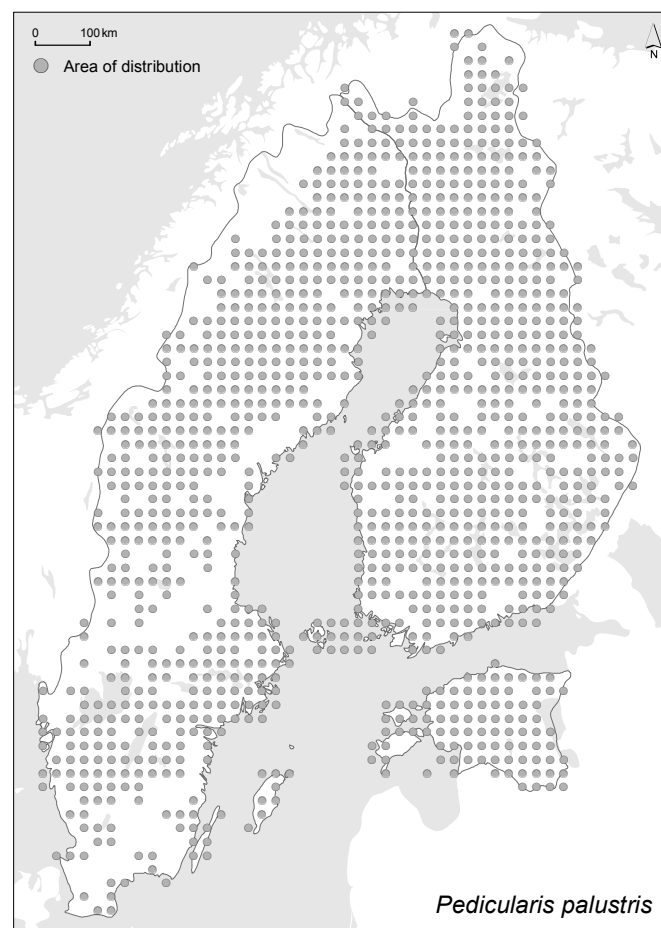
Only in the Nordic countries is the species still quite common in many places with large undisturbed areas. In Finland and Sweden, although common, the plant is rarely abundant. It is known for several variants (*P.p. ssp. palustris*; *P.p. ssp. opsiantha*; *P.p. ssp. borealis*) habiting slightly different regions. The Marsh Lousewort grows on nutrient-poor wetlands e.g. on shores and flood-influenced meadows, lake shores, riversides, moist meadows, fens, boggy margins and rich swamps. Marsh Lousewort is a hemi-parasitic plant using extra nutrition from other close-by plants. The species has largely disappeared from the coastal meadows of southern Finland, for instance from all sites in the Archipelago National Park, were it grew in more than ten localities in the beginning of the 20th century.

The Marsh Lousewort suffers from habitat loss due to both the abandonment and the intensification of land use during the last few decades. The species is a short-lived biennial and semelparous plant with only a short-term persistent seed bank, and thus the persistence of the species entirely relies on regular seed production. Also, Marsh Lousewort is heavily dependent on pollinators because of its low auto-fertility. The plant can only be pollinated by the most powerful insects and is therefore heavily reliant on bumble-bees. Bumble-bees are known to be attracted by high flower densities, indifferent as to whether the flowers are of the same or co-flowering species. Hence, low densities of flowers in small and fragmented populations without the other species flowering around it can have detrimental effects.

Management

When growing on seashore sites the Marsh Lousewort, similar to many other seashore species, seems to be negatively influenced by grazing, perhaps suffering directly from grazing and trampling. They may also suffer indirectly through altered salinity in the soil resulting from trampling by cattle and compression of the soil. However, regardless of the negative influence of the grazing, seedling establishment is only possible when small gaps are present in the vegetation. Therefore, management plans should include either moderate grazing or mowing and haymaking, which would reduce the amount of competition for light and would lead to suitable conditions for germination and establishment.

A single incidence has been recorded where a suitable habitat has been created by lowering the water table of a lake in combination with a human deposition of sandy material. Genetic processes are another aspect to be considered when planning future conservation efforts for the species. A high amount of genetic differentiation has been detected between different populations of Marsh Lousewort. This variation can be lost if management of the remaining populations is only concentrated on the large populations, letting the smaller ones decline. One measure to prevent this is to use artificial gene flow while the main efforts should focus on restoring populations regardless of their size. When the site is left unmanaged the species numbers increase moderately at first, but decline somewhat on an intermediate period of time and rapidly after a longer period of time.





Pedicularis palustris. Photo: JC Schou, Biopix

Bird's-eye Primrose - Jauhoesikko (EN) - Maj-viva (VU) - Pääsusilm (NT) *Primula farinosa*
Author: Erik Andersson

General information

The Bird's-eye Primrose (*Primula farinosa*) is a perennial herb of the *Primulaceae* family. It has a basal rosette of leaves and violet flowers located at the top in rounded clusters with around 20 flowers. The leaves are green and tongue-like with a smooth topside and a white powdery underside. The stem is normally 5–25 centimetres high but on alvar-soil it may sometimes be a bit shorter. The Bird's-eye Primrose flowers in May to June with red to pale violet flowers and the flowers are heterostylous, meaning that they have either long or short epipetalous. The crown has a wide skirt with a yellow mouth. The crown spout is about half as long as the skirt's diameter.

The Bird's-eye Primrose can be confused with the northern relative Scandinavian Primrose (*P. scandinavica*) but the later has fewer flowers and the epipetalous are of equal length. This takes time though and it will take a lot of patience to ensure a steady and stable population.

Ecology

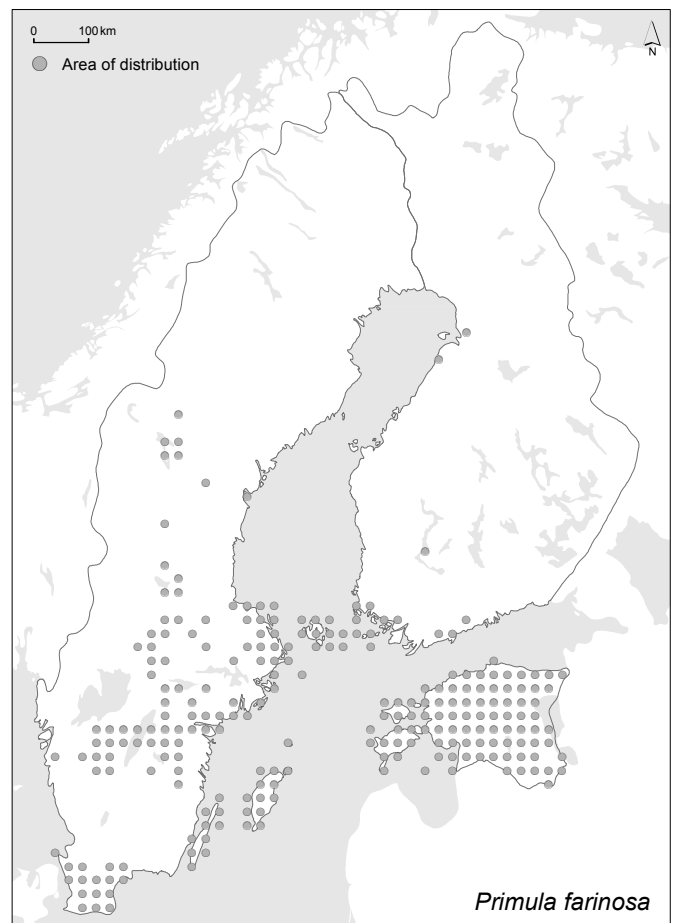
The Bird's-eye Primrose prefers calcareous rich soil and used to be quite common on wet and mesic meadows, in fens and on beach meadows, but does not grow on coastal meadows. In Sweden it is considered common on the island of Öland and Gotland but it can also be found along the coast of the mainland and some parts of the county of Jämtland. In Finland it can be found in small numbers on the islands surrounding Åland.

Management

The Bird's-eye Primrose has decreased heavily in numbers due to overgrowth of the important wet meadow habitants in the inland areas. A study made in Great Britain shows that the main reason behind the decline is due to loss of habitat through drainage, fertilization, re-sowing and overstocking. Slotte (2003) did a study where he found that in areas where grass cutting had been reintroduced, the Bird's-eye Primrose started to increase in small numbers.



Primula farinosa. Photos: Iiro Ikonen



**Common Glasswort - Suolayrtti (EN) - Glasört (DD) - Hari-
lik soolarohi (LC) *Salicornia europaea***
Author: Anna Haapaniemi

General information

The Common Glasswort (*Salicornia europaea*) is a small, up to 5–20 cm tall, succulent herb. The plant is mostly composed of a green to reddish stem with its leaves reduced to small scales making the plant appear leafless. The erect photosynthetic stems are composed of short cylindrical internodes that branch off from a horizontal main stem. The reddish colour may be more emphasised towards autumn. The flowers of *Salicornia* are characteristically embedded into the fleshy tissue of the stem. Distinctive feature of the Common Glasswort is the central of the three flowers being distinctively larger than the two laterals. However, the species also exhibits a significant amount of variation in its outward appearance due to differences in growing sites and in annual changes in weather.

Ecology

The genus *Salicornia* has spread globally except for Australia and South America, and in Europe much of the distribution can be attributed to the Common Glasswort occurring around most of the European coastline, where it is the first colonizer of open tidal flats and often forms extensive monocultures. The species of the genus *Salicornia* are so called halophytes, which tolerate high levels of salinity and are thus associated with saline, brackish or alkaline substrates. The habitats are mostly established on unconsolidated sediments ranging from clay to sand and occasionally on gravel in case it co-occurs with a finer mixture. The substrates are often sludgy or muddy coastal flats. The plant has created a resistance to alternating levels of salinity by producing three types of seeds which differ in size. The largest tolerate the highest level of salinity and they germinate at the very beginning of the growing season; the smaller ones form the seed bank of the species asserting that species can recover after unfavourable growing condition. However, it seems that a continuous seed production is needed as the seed bank does not preserve well beyond a year's time limit.

In Finland the occurrence of *Salicornia* has been especially connected to the existence of dry salt soils strongly related to the aridity of the summer season. Hence, its descriptive aridity index (de Matonne index) appears to be the most determining factor of *Salicornia*'s distribution in Finland limiting it to the very coastal rims of the country, the Åland archipelago, the archipelago of Finland Proper and the Bay of Bothnia. However, the emphasis of the distribution on the western coastal region of the Åland islands and the Gulf of Bothnia is likely a result of post-glacial rebound, which has relatively recently exposed swaths of land from sea; from the Gulf of Finland, where this process is in lesser effect, no records of *Salicornia* exist although aridity index would predict suitable conditions.

In Sweden the Common Glasswort can be found especially along the west coast, while the occurrences on the eastern coast are patchy and rare.

Management

The Common Glasswort is declining in many areas and it is suspected that one reason for this is the general eutrofication of the Baltic Sea which also affects the terrestrial coastal regions. This is quite possibly a contributing factor to the overgrowing of the coastal regions, while the main reason for overgrowth most likely lies in the general change of farming, particularly in decline of grazing and mowing practices. The Common Glasswort is rapidly outcompeted by perennials, especially by reeds, in undisturbed areas and will eventually be overgrown. Hence, the species survives almost solely on ephemeral and disturbance-generated patches.

Methods of disturbance can vary and for conservation purposes new habitats can also be generated by artificially maintained patches. Commonly, livestock both disturb the vegetation cover and break the soil surface keeping the tall competitive plant species at bay, thus facilitating the survival of the population, while along the Baltic Sea coast for example increase of winters with no sea-ice cover can have a negative influence by promoting overgrowth of coastal meadows.

The species cannot survive conditions in which the soil becomes waterlogged for longer periods of time, and for example in Hailuoto (Isonmatala) in the Bay of Bothnia high water levels might have been the reason for losing its large population, especially when the remaining stock at the site was above the water level at the time of the deluge.

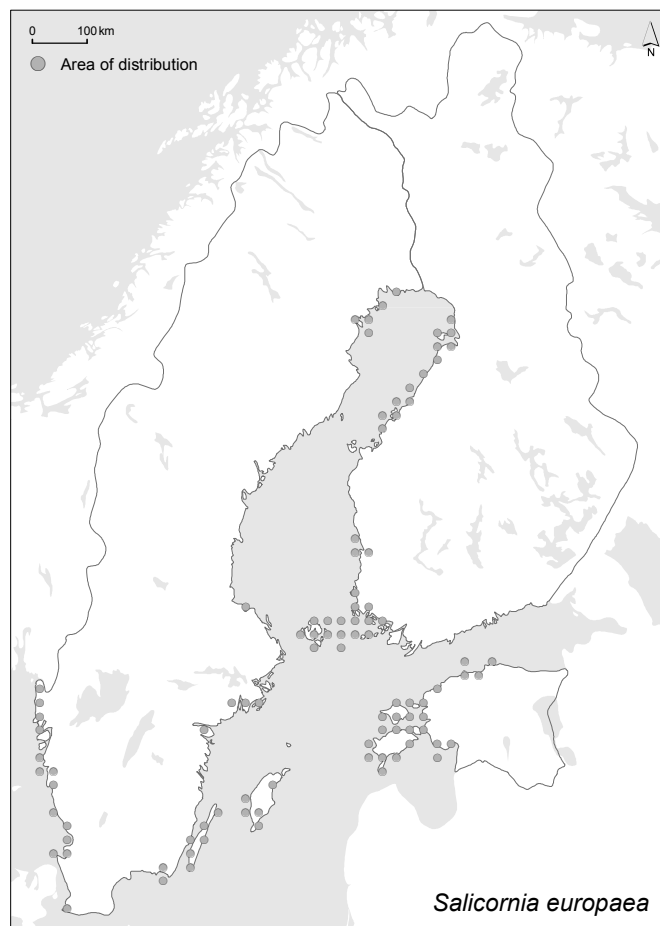
The influence of rotting plant material to the survival success of the Common Glasswort appears to give opposing views: according to Piirainen (1989) change in mowing practices has meant that the hay is often left on to the ground to rot, and it is suspected that this has a negative influence on the survival of the species. However, when spring flooding washes up debris onto the marsh areas, the decomposing material kills the vegetation below it creating new bare patches for *Salicornia*. This difference in views may be merely a result of different habitats with other influencing factors. General climate change factors can also influence the occurrence of the Common glasswort with the decline in salinity due to increased rainfall.

In Finland the Common Glasswort is also a host plant to two threatened butterfly species, Glasswort Case-bearer (*Coleophora salicorniae*) (EN) and Sea-aster Groundling (*Scrobipalpa salinella*) (CR), both being entirely reliant on *Salicornia* due to their monophagous larval stage, which also requires fairly extensive stocks of *Salicornia* for its survival.

An experiment in Kökar, in the Åland archipelago, has given good results in restoring the habitats of the Common Glasswort for butterfly conservation purposes. Six patches of an area of 2 x 10 m previously known for having stands of the Common Glasswort was scraped free of vegetation with a bulldozer. In the following year one of the patches had its entire area covered with a tall, dense and vigorous *Salicornia* -population. The clearing should be done either early in spring or optionally late in the autumn.



Salicornia europaea. Photo: Leif Lindgren, Metsähallitus



Brookweed - Suolapunka (EN) - Bunge (DD) - Lihtrand-
pung (EN) *Samolus valerandi* L.

Author: Erik Andersson & Anna Haapaniemi

General information

The Brookweed (*Samolus valerandi*) is a perennial, bare herb with a distinctive light green colour. The stem is between two to forty centimetres high. The dull green leaves are partly distributed along the stem and partly gathered as a gray-green basal rosette. The Brookweed usually flowers around July to August and the flowers are located in a protracted sparse cluster. They have short stems which often have small bracts. The crown is white, bell shaped and surrounded by round tabs and is a bit longer than the feed. The capsule is round, enclosed by the feed and has small black seeds.

Ecology

The species has a wide distribution pattern in the northern hemisphere, and in addition to Europe, the Brookweed can be found from North America and Asia. In Finland, the records of the species extend up to the ice-sheet retreat of the last Ice-Age. Currently, the distribution is limited to two separate regions, one on the island of Åland and the other on the mainland coastal rim between Helsinki and Hamina. On mainland Finland ca. 50 sites of Brookweed occurrence have been known, of which only ten are left. In Sweden, the Brookweed can almost exclusively be found along the calcareous beaches along the Baltic Sea, but also in the western parts of Scania. The species has experienced a rapid decline during the last couple of decades. The reason for this decline is the general eutrofication of the Baltic Sea and its shorelines and the recent cessation of the formerly common practise of grazing on shores. Common feature for the remaining populations is the abundance of bare soil, lack of Common Reed (*Phragmites australis*), and occasional disturbance of the soil surface. The disturbance can be generated by water level fluctuations, ice scouring, or erosion by the grazing animals. The species thrives on wet and sheltered locations with fine sediment deposition and scarcity of organic matter, occasionally the Brookweed can be found growing under water as well. The species is halophytic, and the pH of the surface soil should preferably be over 6.0 and the availability of nutrients, phosphorus and nitrogen, sparse.

Management

In order to preserve Brookweed in the Baltic Sea region it is of paramount importance to arrange the management of the remaining populations. Currently, the remaining sites are too small to survive without management activities in the current trend of habitat degradation. Focusing on preventing the eutrofication of the Baltic Sea region is the most important measure in preserving the Brookweed. The nutrients from the sea accumulate especially onto the most sheltered shores which will be rapidly overgrown. Especially, the plant would benefit from cattle grazing, which would keep the vegetation low and prevent the shores from being overgrown by Common Reed. The footprints of cattle also disturb the soil surface producing open patches suitable for seedling to emerge. Alternatively, the sites



Samolus valerandi.
Photo: JC Schou,
Biopix

can be managed by mowing the stands of Common Reed and by removing organic material which drifts to the shores, covers the habitat patches and alters the acidity of the soil. In Sweden, there seems to be a positive trend regarding the number of Brookweeds found along the coast of Uppland, similar trend has also been observed in Finland. This might be because of better wintering conditions due to a slightly milder climate but also because of better coverage of the flora during later years. When a site is left unmanaged the species numbers increases at first, but then decreases moderately during an intermediate period of time and rapidly after a longer period of time.



Strawberry Clover - Rakkoapila (NT) - Smul- tronklöver (DD) - Randristik (LC) *Trifolium fragiferum*
Author: Anna Haapaniemi

General information

The Strawberry Clover (*Trifolium fragiferum*) is a 10–30 cm tall perennial with a low creeping stem posture. Typical to all clovers the leaves are trifoliate. The flower head is spherical and composed of small individual flowers shaped as dense spikes of a light red colour. The plant closely resembles white clover (*T. repens*), but the flower heads are somewhat smaller and the corollas have a stronger red tint. The most distinctive feature is the round, sparsely hairy fruit head that resembles an unripe strawberry (lat. *fragiferum* (pl.) = wild strawberries). These light and airy structures carry the seedpods inside and can travel efficiently with wind and waves.

Ecology

The Strawberry Clover is native to Europe and the northern fringe of Africa with some sparse occurrences in Asia. In the Nordic countries the Strawberry Clover is found in the southernmost coastal regions. In Finland the main distribution areas of the species is in the Åland archipelago with few sites in the archipelago of Finland Proper. In Sweden the species is common in southern coastal regions all the way up to Uppland latitudes.

The Strawberry Clover is only moderately sensitive to soil salinity, and can occasionally be found co-habiting with *Salicornia*. The species prefers open grounds and nutritious soils found in coastal meadows. Although the plant tolerates salt, it does not demand it.

Management

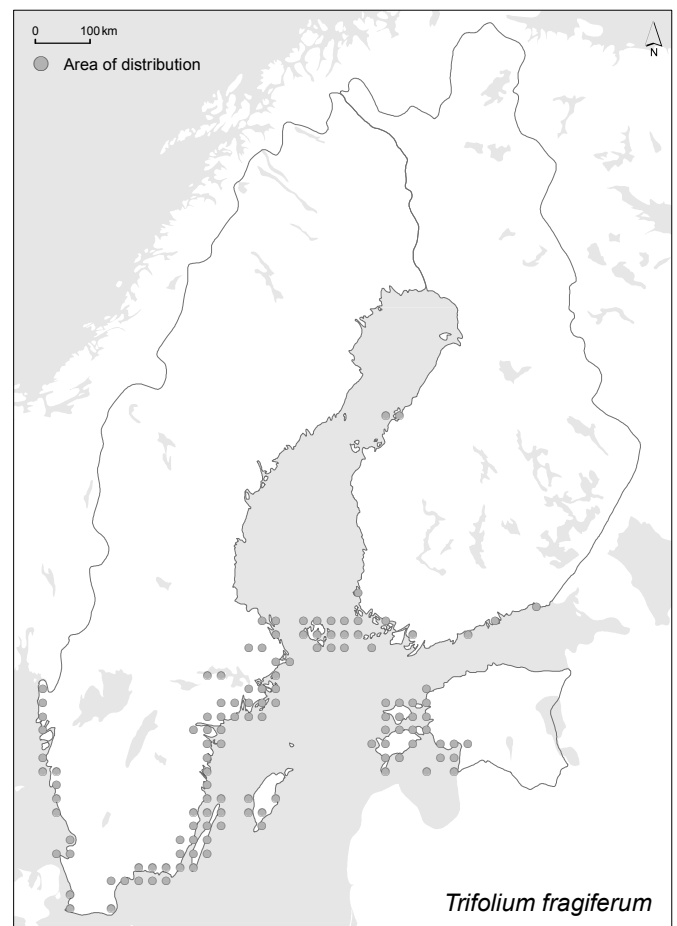
In Finland the decline of the species began in 1960s due to change in farming methods, but also due to increased building pressure on coastal regions. The species is heavily dependent on grazing as it fails to compete with taller grasses, and can disappear almost completely if this practice is not continued on a regular basis. The Strawberry Clover is especially sensitive to overgrowth with reeds. It is favoured by both grazing and mowing. When the site is left unmanaged the species numbers decrease rapidly at first, and continue its rapid decrease also during an intermediate period of time and will become extinct after a longer period of time.



Trifolium fragiferum. Photo: JC Schou, Biopix



Trifolium fragiferum later stage. Photo: Anna Haapaniemi



References

General books & web resources:

- Anderberg A. A. & Anderberg A.-L. (n.d.). Den virtuella floran [WWW] Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/welcome.html> [referenced 15.8.2012].
- eBiodiversity (n.d.). Web interface for the taxa found in Estonia [WWW]. Available from: <http://elurikkus.ut.ee/index.php?lang=eng> [referenced 15.8.2012].
- Ekstam U. & Forshed N. (1992). Om hävden upphör: kärnväxter som indikatorarter i ängs- och hagmarker. Naturvårdsverket. Skötsel av naturtyper. Värnamo: Naturvårdsverket, 135 pp.
- Fauna Europaea (n.d.). Database of the scientific names and distribution of all living multicellular European land and fresh-water animals [WWW]. Available from: <http://www.faunaeur.org/> [referenced 15.8.2012].
- Gorbunov P. (2001). The Butterflies of Russia: classification, genitalia, keys for identification (Lepidoptera: Hesperoidea and Papilionoidea). Ekaterinburg, 320 pp.
- Gärdenfors U. (eds.) (2010). Rödlistade arter i Sverige 2010. Uppsala: ArtDatabanken, Sveriges Lantbruksuniversitet, 590 pp.
- Haeggström C.-A. & Haeggström E. (2008). Ålands flora. Mariehamn: Ålandstryckeriet, 436 pp.
- Hultén E. (1971). Atlas över växternas utbredning i Norden. Stockholm: Generalstabens litografiska anstalts förlag, 531 pp.
- IUCN (2011). The IUCN Red List of Threatened Species [WWW]. Available from: <http://www.iucnredlist.org> [referenced 15.08.2012].
- Jacobson A. (2012). Plant communities of high nature value grasslands. Farmland Biodiversity Conference: Quo vadis, farmland biodiversity?, November 2012. Tartu [WWW]. Available from: http://pmk.agri.ee/pkt/index.php?valik=20&keel=1&template=mak_sisu.html [referenced 3.1.2013].
- Jalas J. & Suominen J. (eds.) (1972). *Altas Florae Europaeae*. Distribution of vascular plants in Europe. 1. Pteridiophyta. Helsinki: The committee for mapping the flora of Europe & Societas Biologica Fennica Vanamo, 121 pp.
- Lindgren L. (2000). Island pastures. Helsinki: Metsähallitus & Edita, 203 pp.
- Jonsell L. (ed.) (2010). Upplands flora. Uppsala: SBF-förlaget, 896 pp.
- Mossberg B., Stenberg L. & Ericsson S. (1992). Den Nya Nordiska Floran. Stockholm: Wahlström & Widstrand, 696 pp.
- Naturegate (2012). Web interface for species identification [WWW]. Available from: <http://www.luontoportti.com/suomi/en/> [referenced 15.8.2012].
- Rassi P., Hyvärinen E., Juslén A. & Mannerkoski I. (eds.) (2010). The 2010 red list of Finnish species. Helsinki: Ympäristöministeriö & Suomen ympäristökeskus, 685 pp.
- Rautiainen V.-P. & Laine U. (1989). Varsinais-Suomen uhanalaiset kasvit. Turku: Varsinais-Suomen seutukaavaliitto, 111 pp.
- Ryttäri T. & Kettunen T. (eds.) (1997). Uhanalaiset kasvimme. Helsinki: Suomen ympäristökeskus & Kirjayhtymä, 335 pp.

Allium oleraceum, Antennaria dioica, Filipendula vulgaris, Artemisia campestris:

- From S. (ed.) (2005). Paahdeympäristöjen ekologia ja uhanalaiset lajit. Helsinki: Suomen ympäristökeskus. Suomen ympäristö 774, 86 pp.
- Härjämäki K. & Pakkanen T. (2007). Maatalousalueiden luonnon monimuotoisuuden yleissuunnitelma, Perniö. Lounais-Suomen ympäristökeskuksen raportteja 4. Helsinki: Edita Prima Oy, 104 pp.
- Itämies J. (2009). Scrobipalpa strelichellum-kartoituksia Oripään lentokentällä, 2 pp.
- Itämies J. (2010). Perinnebiotooppien perhosinventoinnin tulokset. Vakka-Suomen arvokkaat maisemat ja muinaisjäännökset – hanke 2010, 17 pp.
- Kemppainen R. & Lehtomaa L. (2008). Varsinais-Suomen perinnebiotooppien hoito-ohjelma. Lounais-Suomen ympäristökeskuksen raportteja 15, 148 pp.
- Lehtomaa L. (2000). Varsinais-Suomen perinnemaisemat. Alueelliset ympäristöjulkaisut 160. Turku: Lounais-Suomen ympäristökeskus, 429 pp.
- Lindgren L. (2010). Kemiönsaaren kunnan Öron luonnonhoitosuunnitelma. Metsähallitus, Etelä-Suomen luontopalvelut, 131 pp.
- Lindgren L. (1998). Lenholmin luonnonsuojelu- ja lehtojensuojelun hoito- ja käyttösuunnitelma. Metsähallitus, luonnonsuojelu. Luonnonsuojelujulkaisuja B44, 136 pp.
- Majuri P. (2010). Mynämäen Mietoisten Saaren kartanon kasvillisuus. Koneen säätiö.
- Muller S. (2002). Diversity of management practices required to ensure conservation of rare and locally threatened plant species in grasslands: a case study at a regional scale (Lorraine, France). *Biodiversity and Conservation* 11, 1173–1184.
- von Numers M. (2003). Florans förändring under ett drygt halvsekel i Skärgårdshavets nationalparks samarbetsområde. Vanda: Forsstyrelsen. Naturskyddspublicationer A 142, 51 pp.
- Nupponen K., Nieminen M. & Sundell P.-R. (2007). Kiikalan Hyppäränharjun ja lentokentän paahdealueiden perhosselvitykset 2005-2006. *Faunatica*, 33 pp.
- Nupponen K., Nieminen M. & Sundell P.-R. (2006). Säkyänharjun uhanalaiset perhoset: väliraportti III. *Faunatica*, 57 pp.
- Oja J. & Oja S. (2008). Oripään lentokenttäalueen kissankäpäläselvitys. *Suomen Luontotieto* 77, 8 pp.
- From S. (ed.) (2005). Paahdeympäristöjen ekologia ja uhanalaiset lajit. Helsinki: Suomen ympäristökeskus. Suomen ympäristö 774, 86 pp.
- Seppälä S.-L. (2006). Perinnemaisemien yhteys varhaiseen asutus- ja maankäyttöhistoriaan. Helsinki: Ympäristöministeriö. Suomen ympäristö 1, 112 pp.
- Silkkilä O. & Koskinen A. (1990). Lounais-Suomen kulttuurikasvistoa: eräiden kartanoiden, kirkkojen, pappiloiden ja virkatalojen kasvistosta. Turku: Turun maakuntamuseo. Raportteja (Turun maakuntamuseo) 12, 64 pp.
- Sundell P.-R. (2004). Vänön uhanalaisperhosten esiselvitys. Raportti Perhostensuojelutoimikunnalle, 12 pp.
- Suominen J. & Hämet-Ahti L. (1993). Kasvistomme muinaistulokkaita: tulkintaa ja perusteluja. Helsinki: Luonnontieteellinen keskusmuseo, Kasvimuseo. *Norrlinia* 4, 90 pp.
- Tiitinen T. (ed.) (1999). Hiidenkias ja tulikukka: opas arkeologisen kulttuuriperinnön hoitoon. Jyväskylä: Museovirasto, muinaisjäännösten hoitoyksikkö, 135 pp.
- Åström H. & Hægström C.-A. (2004). Generative reproduction in *Allium oleraceum* (Alliaceae). *Annales Botanici Fennici* 41, 1-14.

Bombus humilis:

- Amiet F. (1996). Hymenoptera Apidae, 1. Teil. Allgemeiner Teil, Gattungsschlüssel, Die Gattungen Apis, Bombus und Psithyrus. Insecta Helvetica Fauna 12, 1-98.
- eBiodiversity. (2011). *Bombus humilis* [WWW]. Available from: http://elurikkus.ut.ee/prmt.php?lang=eng&redgr_id=3 [referenced 29.11.2011].
- Goulson D., Hanley M. E., Darvill B., Ellis J. S. & Knight M. E. (2005). Causes of rarity in bumblebees. *Biological Conservation* 122, 1-8.
- Holmström G. (2009). Humlor – alla Sveriges arter. Stockholm: Brutus Östlings bokförlag Symposion, 159 pp.
- Luig J. (2011). (personal communication) Chief treasurer, Natural History Museum, University of Tartu. E-mail. [Referenced 2011-11-12].
- Löken A. (1973). Studies on Scandinavian bumblebees (Hymenoptera, Apidae). *Norsk Entomologisk Tidsskrift* 20, 1-218.
- Medler J. T. (1962). Morphometric studies on bumblebees. *Annals of the Entomological Society of America* 55, 212-218.
- Pekkarinen A. (1979). Morphometric, colour and enzyme variation in bumblebees (Hymenoptera, Apidae, Bombus) in Fennoscandia and Denmark. *Acta Zoologica Fennica* 158, 1-60.
- Pekkarinen A. & Teräs I. (1977). Suomen kimalaisista ja loiskimalaisista. *Luonnon Tutkija* 81, 1-24.
- Pekkarinen A. & Teräs I. (1987). Observations on *Bombus humilis* (Hymenoptera; Apidae) in Finland. *Notulae Entomologicae* 67, 208-209.
- Pekkarinen A., Teräs I., Viramo J. & Paatela J. (1981). Distribution of bumblebees (Hymenoptera, Apidae: Bombus and Psithyrus) in eastern Fennoscandia. *Notulae Entomologicae* 61, 71-89.
- Rasmont P. & Iserbyt I. (2010). Atlas of the European Bees: genus *Bombus* [WWW]. STEP Project, Atlas Hymenoptera, Mons, Gembloux. Available from: <http://www.zoologie.umh.ac.be/hymenoptera/page.asp?ID=169> [referenced 25.11.2011].
- Soon V. (2011). (personal communication) PhD student, Faculty of Science and Technology, University of Tartu. E-mail. [referenced 6.11.2011].
- Söderman G. & Leinonen R. (2003). Suomen mesipistiäiset ja niiden uhanalaisuus. Helsinki: Tremex Press Oy, 420 pp.
- Teräs I. (1983). Estimation of bumblebee densities (*Bombus*: Hymenoptera, Apidae). *Acta Entomologica Fennica* 42, 103-113.
- Westrich P. (1990). Die Wildbienen Baden-Württembergs, 2nd ed. Stuttgart: Ulmer-Verlag, 432-972.
- Wikipedia (2011). Brown-banded Carder Bee [WWW]. Available from: http://en.wikipedia.org/wiki/Brown-banded_carder_bee [referenced 25.11.2011].
- Williams P. (2011). *Bombus*, bumblebees of the world [WWW]. Natural History Museum, London. Available from: <http://www.nhm.ac.uk/research-curation/research/projects/bombus/index.html> [referenced 25.11.2011].

Botrychium boreale:

- Ljung, T. (1996). *Botrychium boreale* – nordläsbräken [WWW]. ArtDatabanken, Sveriges lantbruksuniversitet. Available from: http://www.artfakta.se/Artfaktablad/Botrychium_Boreale_164.pdf [referenced 16.8.2012]
- Rautiainen V-P. & Laine U. (1989). Varsinais-Suomen uhanalaiset kasvit. Turku: Varsinais-Suomen seutukaavaliitto, 111 pp.
- Riis-Nielsen T., Söchting U., Johansson M. & Nielsen P. (1991). Hedeplejebogen. De danske heders historie, pleje og udforskning. Miljöministeriet, Skov- og Naturstyrelsen, 248 pp.
- Tuomikoski R. (1958). *Botrychium boreale* Milde – Pohjan noidanlukkko, In Jalas, J. (ed.): Suuri kasvikirja I. Otava: Keuruu, 851 pp.

Botrychium lanceolatum:

- Eisto K. (1994). Lehtonoidanlukon (*Botrychium virginianum*) esiintyminen ja suojelutarve Oulun ja Lapin lääneissä. *Aquilo Ser. Botanica* 33, 17-29.
- Hakalisto S. (1987). Pohjois-Karjalan uhanalaiset putkilokasvit. Joensuun yliopisto, Matemaattis-luonnontieteellisen tiedekunnan raporttisarja 18, 1-136.
- Hakila R. & Kalinainen P. (1984). Satakunnan uhanalaiset kasvit. Satakunnan seutukaavaliiton julkaisuja A 147, 1-65.
- Jäkäläniemi A. & Ulvinen T. (1992). Kainuun uhanalaiset kasvit. Kainuun Liiton julkaisu B 7, 1-279, liitteet 1-3. Kajaani.
- Koskinen S. & Lampolahti J. (1989). Suikeanoidanlukkko ja rantaputki voimissaan Merikarvian Ourassa. *Lutukka* 5, 70-72.
- Knuutinen J. (1995). Rautalammin uhanalaiset putkilokasvit. Jyväskylän yliopiston museon julkaisuja 4, 1-85.
- Mikkola R. (1981). Neljän noidanlukkolajin, *Botrychium*, kasvupaikka Orivedellä. *Talvikki* 5, 30-31.
- Rautiainen V-P. & Laine U. (1989). Varsinais-Suomen uhanalaiset kasvit. Turku: Varsinais-Suomen seutukaavaliitto, 111 pp.
- Øllgaard B. & Tind K. (1993). Scandinavian ferns. A natural history of the ferns, clubmosses, quillworts and horsetails of Denmark, Norway and Sweden. Copenhagen: Rhodos, 317 pp.

Botrychium lunaria:

- Eriksen, M., Björke K.E. & Dhillon S.S. (2002). Mycorrhizal plants of traditionally managed boreal grasslands in Norway. *Mycorrhiza* 12, 117-123.
- Huovinen H. (2008). Laidunnuksen ja niiton vaikutus ketonoidanlukon (*Botrychium lunaria*) kokoon ja lisääntymiseen. Unpublished thesis (MSc), University of Jyväskylä, Department of Biological and Environmental Science.
- Härjämäki K. (2006). Logokasvin tarina: salaperäiset noidanlukot [WWW]. Varsinais-Suomen perinnemaisemayhdistys ry. Available from: <http://www.vsperrinnemaisemat.net/noita.htm> [referenced 15.8.2012].
- Kalliovirta M. (2004). New records of *Botrychium* species in Finland during the rainy summer 2004. *Lutukka* 20(4), 103-104.
- Muller S. (1999). Plant communities and conservation of *Botrychium*-rich grasslands in the Bitcherland (Northern Vosges Biosphere Reserve, France). *Biodiversity and Conservation* 8, 1519-1532.

Botrychium matricariifolium:

Muller S. (1993). Population dynamics in *Botrychium matricariifolium* in Bicherland (Northern Vosges Mountains, France). *Belgian Journal of Botany* 126(1), 13-19.

Carex flacca:

Hämät-Ahti L., Suominen J., Ulvinen T. & Uotila P. (1998). *Retkeilykasvio*. Helsinki: Luonnontieteellinen keskusmuseo, Kasvimuseo, 656 pp.

Lindgren L. (2001). Perinnebiotooppien kasvien ja kasvillisuuden seuranta Saaristomeren kansallispuistossa. *Metsähallituksen luonnonsuojelujulkaisuja A 127*, 228 pp.

Mohlenbrock R.H. (1999). *The illustrated Flora of Illinois. Sedges: Carex*. Carbondale: Southern Illinois University Press, 328 pp.

Carex otrubae:

Foley M.J.Y. (2006). Epitypification of *Carex vulpina* L. (Cyperaceae). *Watsonia* 26, 27-30.

Hämät-Ahti L., Suominen J., Ulvinen T. & Uotila P. (1998). *Retkeilykasvio*. Helsinki: Luonnontieteellinen keskusmuseo, Kasvimuseo, 656 pp.

Lampinen R. & Lahti T. (2011). *Kasviatlas 2010 [WWW]*. Helsinki: Helsingin Yliopisto, Luonnontieteellinen keskusmuseo, Kasvimuseo. Available from: <http://www.luomus.fi/kasviatlas> [referenced 15.8.2012].

Carex vulpina:

Foley M.J.Y. (2006). Epitypification of *Carex vulpina* L. (Cyperaceae). *Watsonia* 26, 27-30.

Hämät-Ahti L., Suominen J., Ulvinen T. & Uotila P. (1998). *Retkeilykasvio*. Helsinki: Luonnontieteellinen keskusmuseo, Kasvimuseo, 656 pp.

Nyysönen T. (1994). Uhanalaisen ketunsaran (*Carex vulpina*) inventointi ja hoito Pöytyän Juvalla

Turku: Varsinais-Suomen luonnonsuojelupiiri ry, 9 pp.

Rautiainen V.-P. (1990). Selvitys uhanalaisen kasvilajin suojele ja hoitosuunnitelmaa varten. Ketunsara (*Carex vulpina* L.) Pöytyällä (Turun ja Porin lääni). Turun yliopiston kasvimuseo, 22 pp.

Carlina vulgaris:

Anderberg A. A. & Anderberg A.-L. (2012). Spätistel [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/di/astera/carli/carlvul.html> [referenced 2.3.2012].

Naturegate. (2012). Carline Thistle [WWW]. Available from: <http://www.luontoportti.com/suomi/en/kukkakasvit/carline-thistle> [referenced 2.3.2012].

Cassida murraea:

Bukejs A., Telnov D. & Barševskis A. (2009). Review of Cassidinae (Coleoptera: Chrysomelidae) of the Fauna of Latvia. *Latvijas Entomologs* 47, 27-57.

Gärdenfors U., Aagaard K., Biström O. & Hollmer M. (2002). Hundraelva nordiska evertebrater. Handling för övervakning av rödlistade småkryp. Nord 2002,3. Nordiska Ministerrådet och ArtDatabanken, 288 pp.

Mohr K. H. (1966). Chrysomelidae. In Freude H., Harde K.W. & Lohse F.A. (eds.). *Die Käfer Mitteleuropas. Band 9*. Krefeld: Goecke & Evers Verlag, 299 pp.

Naturvårdsverket (2007). Åtgärdsprogram för hotade insekter på krisslor. Naturvårdsverket och Länsstyrelsen i Uppsala län, manuscript, 77 pp.

Silfverberg H. (2010). *Enumeratio renovata Coleopterorum Fennoscandiae, Daniae et Baltiae*. *Sahlbergia* 16, 1-144.

Silfverberg H. & Gärdenfors U. (2001). *Cassida murraea* – svartbent sköldbagge [WWW]. Artdatabanken, Sveriges Lantbruksuniversitet. Available from: www.artfakta.se/Artfaktabladd/Cassida_Murraea_100556.pdf [referenced 15.8.2012]. Rev. eds. (2005) Ljungberg H. & Lennartsson 2005; (2012) Wanntorp H.-E.

Dactylorhiza sambucina:

Lindgren L. (2001). Monitoring plants and vegetation on semi-natural biotopes in the Southwestern Archipelago National Park. *Metsähallituksen luonnonsuojelujulkaisuja A127*, 1-228.

Dianthus deltooides:

Hämät-Ahti L., Suominen J., Ulvinen T. & Uotila P. (1998). *Retkeilykasvio*. Helsinki: Luonnontieteellinen keskusmuseo, Kasvimuseo, 656 pp.

Jennersten O. (1988). Pollination in *Dianthus deltooides* (Caryophyllaceae): Effects of habitat fragmentation on visitation and seed set. *Conservation Biology* 2, 359-366.

Mäkinen Y., Laine U. & Kalela A. (1994). *Pohjolan kasvit 1*. Helsinki: Tammi, 491 pp.

Naturegate. (2009). Ketoneilikka (*Dianthus deltooides*). Luonnonkukkien päivän teemalaji [WWW]. Available from: <http://www.luontoportti.com/suomi/fi/kukkakasvit/ketoneilikka> [referenced 15.8.2012].

Euphydryas aurinia:

Barnett L. K. & Warren M. S. (1995). Species action plan. Marsh fritillary (*Eurodryas aurinia*). *Butterfly Conservation*, 29 pp.

Betzholtz P.-E., Ehrig A., Lindeborg M. & Dinnetz P. (2007). Food plant density, patch isolation and vegetation height determine occurrence in a Swedish metapopulation of the marsh fritillary *Euphydryas aurinia* (Rottemburg, 1775) (Lepidoptera, Nymphalidae). *Journal of Insect Conservation* 11, 343-350.

Bulman C. R. (2001). Conservation biology of tile marsh fritillary butterfly (*Euphydryas aurinia*). Unpublished thesis (PhD), University of Leeds, School of Biology, Centre for Biodiversity and Conservation, 168 pp.

eBiodiversity. (2011). *Euphydryas aurinia* [WWW]. Available from: http://elurikkus.ut.ee/prmt.php?lang=eng&redgr_id=3 [referenced 29.11.2011].

- Eliasson C. U. (2007). Leuphydryas aurinia – väddnätfjäril [WWW]. ArtDatabanken, Sveriges Lantbruksuniversitet. Available from: http://www.artfakta.se/Artfaktablad/Euphydryas_Aurinia_100942.pdf [referenced 29.11.2012].
- Eliasson C. U. & Björklund J.-O. (2009). Åtgärdsprogram för väddnätfjäril med bilaga för kärrantennmal, ängsväddantennmal och rosenmott. Naturvårdsverket, Rapport 5920, 79 pp.
- Hahtela T., Saarinen K., Ojalainen P. & Aarnio H. (2011). Butterflies of Britain and Europe. A photographic guide. London: A & C Black Publishers Ltd, 384 pp.
- Hula V., Konvicka M., Pavlicko A. & Zdenek F. (2004). Marsh Fritillary (*Euphydryas aurinia*) in the Czech Republic: monitoring, metapopulation structure, and conservation of an endangered butterfly. *Entomologica Fennica* 15, 231-241.
- Lvovsky A. L., Bogdanov P. V. & Morzun D. V. (2008). Nymphalidae. In Sinev S.Y. (ed.) Catalogue of the Lepidoptera of Russia. St. Petersburg - Moscow: KMK Scientific Press, 425 pp.
- Saarinen K., Jantunen J. & Valtonen A. (2005). Resumed forest grazing restored a population of *Euphydryas aurinia* (Lepidoptera: Nymphalidae) in SE Finland. *European Journal of Entomology* 102, 683-690.
- Seppänen E. J. (1970). Suurperhostoukkien ravintokasvit. Suomen eläimet - Animalia Fennica 14. Porvoo-Helsinki: WSOY, 179 pp.
- Sigaard P., Pertoldi C., Madsen A. B., Søgaard B. & Loeschcke V. (2008). Patterns of genetic variation in isolated Danish populations of the endangered butterfly *Euphydryas aurinia*. *Biological Journal of the Linnean Society* 95, 677-687.
- Smee M., Smyth W., Tunmore M., Ffrench-Constant R. & Hodgson D. (2011). Butterflies on the brink: habitat requirements for declining populations of the marsh fritillary (*Euphydryas aurinia*) in SW England. *Journal of Insect Conservation* 15, 153-163.
- van Swaay C. A. M. (1990). An assessment of the changes in butterfly abundance in the Netherlands during the twentieth century. *Biological Conservation* 52, 287-302.
- Wahlberg N., Klemetti T. & Hanski I. (2002). Dynamic populations in a dynamic landscape: the metapopulation structure of the marsh fritillary butterfly. *Ecography* 25, 224-232.
- Zimmermann K., Fric Z., Jiskra P., Kopeckova M., Vlasanek P., Zapletal M. & Konvicka M. (2011). Mark-recapture on large spatial scale reveals long distance dispersal in the Marsh Fritillary, *Euphydryas aurinia*. *Ecological Entomology* 36, 499-510.

Hadena albimacula:

- Barker A., Fuller M. & Shreever B. (2000). Butterfly Conservation, South-Central England. Regional Action Plan: Dorset. Butterfly Conservation, 199 pp.
- Eliasson C. U. (2011). *Hadena albimacula* - olivbrunt nejlikfly [WWW]. ArtDatabanken, Sveriges Lantbruksuniversitet. Available from: http://www.artfakta.se/Artfaktablad/Hadena_Albimacula_216165.pdf [referenced 24.11.2011].
- Hacker H. (1996). Revision der Gattung *Hadena* Schrank, 1802 (Lepidoptera: Noctuidae). *Esperiana* 5, 7-775.
- Hacker H., Ronkay L. & Hreblay M. (2002). Noctuidae Europaeae. Vol. 4. Hadeninae I. Sorø: Entomological Press, 419 pp.
- Hyönteistietokanta. (2011). Insect database [WWW]. Available from: <http://www.fmnh.helsinki.fi/insects/main/EntDatabase.html> [referenced 15.11.2012].
- Hulden L., Albrecht A., Itämies J., Malinen P. & Wettenhovi J. (2000). Suomen suurperhosatlas. (Atlas of Finnish Macrolepidoptera). Helsinki: Suomen perhostutkijain seura ry, 328pp.
- Nieminen M., Nupponen K. & Sundell P. (2011). Haminan Meltin suljetun kaatopaikan kunnostuksen vaikutukset hyönteislajistoon. Seuranta vuosina 2006–2010. Espoo: Faunatica Oy.
- Nupponen K. & Fibiger M. (2002). Contribution to the knowledge of the fauna of Bombyces, Sphinges and Noctuidae of the Southern Ural Mountains, with description of a new *Dichagyris* (Lepidoptera: Lasiocampidae, Endromidae, Saturniidae, Sphingidae, Notodontidae, Noctuidae, Pantheidae, Lymantriidae, Nolidae, Arctiidae). *Phegea* 30, 121-185.
- Seppänen E. J. (1970). Suurperhostoukkien ravintokasvit. Suomen eläimet - Animalia Fennica 14. Porvoo/Helsinki: WSOY, 179 pp.

Hippuris tetraphylla:

- Ericsson S. (2006). Åtgärdsprogram för bevarande av ishävshästsvans (*Hippuris tetraphylla*). Stockholm: Naturvårdsverket, 21 pp.
- Ericsson S. (2004). Ishävshästsvans *Hippuris tetraphylla* vid Kronören – nu och framtiden. *Natur i Norr* 23, 23–28.
- Anderberg A. A. & Anderberg A.-L. (2012). Ishävshästsvans [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/di/hippurida/hippu/hipptet.html> [referenced 1.3.2012].
- Naturvårdsverket. (2003). 1960 Ishävshästsvans [WWW]. Available from: http://www.naturvardsverket.se/upload/04_arbete_med_naturvard/n2000_art_naturtyp/karlvaxt2.pdf [referenced 2.3.2012].

Hirudo medicinalis:

- Lassila K. (1998). Juotikkaat kirurgiassa. In Heliövaara, K. (ed.): Suomen Luonto. Selkärangattomat eläimet. Porvoo: Weilin & Göös, 294 pp.
- Levander K. M. (1907). Verijuotikkaan levenemisestä Suomessa. *Luonnon Ystävä* 11, 180-181.
- Levander K. M. (1909). Lisätietoja verijuotikkaan levenemiseen. *Luonnon Ystävä* 13, 50.
- Lingdell P.-E., Engbom E. & Gärdenfors U. (2002). *Hirudo medicinalis*. In: Gärdenfors, U., Aagaard, K., Biström, O. & Holmer, M. (eds.) Hundraelva nordiska evertebrater. Laholm: Trydells Tryckeri, 46-47.
- Mann K. H. (1962). Leeches (Hirudinea) their Structure, Physiology, Ecology and Embryology. New York: Pergamon Press, 201 pp.
- Mannerkoski I. & Terhivuo J. (2010). Nivelmadot, Annelids, Annelida. In: Rassi, P., Hyvärinen, E., Juslén, A., Mannerkoski, I. (eds.) The Red list of Finnish species 2010. Ympäristöministeriö & Suomen ympäristökeskus, Helsinki. 344-345.
- Merilä J. & Sterner M. (2002). Medicinal Leeches (*Hirudo medicinalis*) attacking and killing adult amphibians. *Annales Zoologici Fennici* 39, 343-346.
- Miller S. A. & Harley J. P. (1999). Zoology. London: McGraw-Hill Companies, International edition, 592 pp.
- Nuorteva P. (1957). Juotikkaat. In: Nuorteva, P. (ed.) Suomen eläinkuvasto. Matelijat, Sammakkoeläimet, Kalat, Selkärangattomat. Porvoo: WSOY, 585-588.

- Pechenik J. A. (1996). *Biology of the Invertebrates*. Boston: McGraw-Hill Companies, 3rd Edition, 576 pp.
- Rassi P., Alanen A., Kempainen E., Vickholm M. & Väisänen R. (1985). *Hirudo medicinalis* L. *Komiteanmietintö* 43, 178.
- Terhivuo J. (1992). Juotikkaat. Verijuotikas (*Hirudo medicinalis*). In Koivisto I., Karivalo L., Laine L. J., Neuvonen V., Poutanen T., Sarvala M., Terhivuo J. (eds.): *Maaillman uhanalaiset eläimet*. Suomi. Vantaa: Weilin & Göös, 248-250.
- Timm T. (1999). *A Guide to the Estonian Annelida*. Tallinn: Estonian Academy Publishers, 199 pp.

***Inula salicina*:**

- Pinkka. (2012). *Inula salicina* [WWW]. Available from: http://pinkka.helsinki.fi/virtuaalikasvio/plant.php?id=28035&image_id=&viewnames=true [referenced 16.8.2012]
- Naturegate. (2012). *Inula salicina* [WWW]. Available from: <http://www.luontoportti.com/suomi/fi/kukkakasvit/rantahirvenjuuri> [referenced 16.8.2012]
- Anderberg A. A. & Anderberg A.-L. (2012). *Krissla* [WWW]. Den virtuella floran. Naturhistoriska riskmuseet. Available from: <http://linnaeus.nrm.se/flora/di/astera/inula/inulsal.html> [referenced 16-8-2012]
- National Botanic Gardens Glasnevin. (2007). Plant conservation at the National Botanic Gardes, Irish Fleabane *Inula salicina* [WWW]. Available from: <http://www.botanicgardens.ie/conservation/inula.htm> [referenced 16.8.2012]

***Leucorrhinia pectoralis*:**

- SYKE. (2011). Täplälampikorento. Citronfläckad kärrtrollslända. *Leucorrhinia pectoralis* [WWW] Lajien ja luontotyypin esittelyt, Suomen ympäristökeskus. <http://www.ymparisto.fi/download.asp?contentid=119735&lan=fi> [referenced 21.11.2011].
- Bernáth B., Szedenics G., Wildermuth H. & Horváth G. (2002). How can dragonflies discern bright and dark waters from a distance? The degree of polarisation of reflected light as a possible cue for dragonfly habitat selection. *Freshwater Biology* 47: 1707-1719.
- Bönsel A. (2006). Schnelle und individuenreiche Besiedlung eines revitalisierten Waldmoors durch *Leucorrhinia pectoralis* (Odonata: Libellulidae). *Libellula* 25, 151-157.
- Brauner O. (2006). Einjährige Entwicklung von *Leucorrhinia pectoralis* und *Brachytron pratense* in einem Kleingewässer Nordostbrandenburgs (Odonata: Libellulidae, Aeshnidae). *Libellula* 25, 61-75.
- Dreyer W. (1988). Zur Ökologie der Hochmoorlibellen. *Bonner Zool. Beitr.* 39, 147-152.
- Environmental Board. (2011). Securing *Leucorrhinia pectoralis* and *Pelobates fuscus* in the northern distribution area in Estonia and Denmark [WWW]. Available from: http://www.keskkonnaamet.ee/public/galleries/dragonlife/Inception_Report_2010.pdf [referenced 16.08.2012]
- Flenner I. (2007). Forest lakes affected by forestry - how resilient are dragonfly communities to logging in Central Sweden? Unpublished thesis (MSc). School of Business and Engineering, Halmstad University, Sweden, 16 pp.
- Flenner I. & Sahlén G. (2008). Dragonfly community re-organisation in boreal forest lakes: rapid species turnover driven by climate change? *Insect Conservation and Diversity* 1, 169-179.
- Haacks M. & Peschel R. (2007). Die rezente Verbreitung von *Aeshna viridis* und *Leucorrhinia pectoralis* in Schleswig-Holstein - Ergebnisse einer vierjährigen Untersuchung (Odonata: Aeshnidae, Libellulidae). *Libellula* 26, 41-57.
- Harabiš F. & Dolný A. (2011). Human altered ecosystems: suitable habitats as well as ecological traps for dragonflies (Odonata): the matter of scale. *J. Insect Conserv.* 16(1), 121-130.
- Kalniņš M. (2007). Protected Aquatic Insects of Latvia – *Leucorrhinia pectoralis* (CHARPENTIER, 1825) (Odonata: Libellulidae). *Latvijas entomologs* 44, 26-32.
- Karjalainen S. (2010). *Suomen sudenkorennot*. 2nd ed. Helsinki: Tammi, 239 pp.
- Bjelke U. (2011). *Leucorrhinia pectoralis* - Citronfläckad kärrtrollslända [WWW]. Available from: http://www.naturvardsverket.se/upload/04_arbete_med_naturvard/vagledning/arter/vl-ryggradslosa_djur/vl_citronflackad_karrtrollslanda.pdf [referenced 18-11-2011]
- Suomen Sudenkorentoseura (2011). Korentowiki. Täplälampikorento [WWW]. Available from <http://www.sudenkorento.fi/kwiki/T%C3%A4pl%C3%A4lampikorento> [referenced 18.11.2011]
- Termaat T., Kalkman V. J. & Bouwman J. H. (2010). Changes in the range of dragonflies in the Netherlands and the possible role of temperature change. In: Ott, J. (ed.) *Monitoring Climatic Change with Dragonflies*. *BioRisk* 5, 155-173.
- Theuerkauf J. & Rouys S. (2001). Habitats of Odonata in the Białowieża Forest and its surroundings (Poland). *Fragmenta faunistica* 44, 33-39.
- Wildermuth H. (1992). Habitate und Habitatwahl der Grossen Moosjungfer (*Leucorrhinia pectoralis*) Chap 1825 (Odonata, Libellulidae). *Zeitschrift für Oekologie und Naturschutz* 1, 3-22.
- Wildermuth H. (2010). Monitoring the effects of conservation actions in agricultural and urbanized landscapes – also useful for assessing climate change? In: Ott, J. (ed.) *Monitoring Climatic Change with Dragonflies*. *BioRisk* 5, 175-192.
- Wildermuth H. (2011). Artenschutzblatt. *Leucorrhinia pectoralis* (Charpentier 1825) – Libellulidae. Grosse Moosjungfer [WWW]. Available from: http://www.cscf.ch/files/content/sites/cscf/files/shared/documents/Leucorrhinia_pectoralis_D.pdf [referenced 21.11.2012].

***Lycaena hippothoe*:**

- Eliasson C. U. (2007). *Lycaena hippothoe* - violettkantad guldvinge [WWW]. ArtDatabanken, Sveriges Lantbruksuniversitet. Available from: http://www.artfakta.se/Artfaktablad/Lycaena_Hippothoe_102923.pdf [referenced 24.11.2011]
- Fischer K. & Fiedler K. (2001a) Resource-based territoriality in the butterfly *Lycaena hippothoe* and environmentally induced behavioural shifts. *Animal Behaviour* 61, 723-732.
- Fischer K. & Fiedler K. (2001b). Effects of adult feeding and temperature regime on fecundity and longevity in the butterfly *Lycaena hippothoe* (Lycaenidae). *Journal of the Lepidopterists' Society* 54, 91-95.
- Franzen M. & Ranius T. (2004). Occurrence patterns of butterflies (Rhopalocera) in semi-natural pastures in southeastern Sweden. *Journal of Nature Conservation* 12, 121-135.
- Hahtela T., Saarinen K., Ojalainen P. & Aarnio H. (2011). *Butterflies of Britain and Europe. A photographic guide*. London: A & C Black Publishers Ltd, 384 pp.

- Jennersten O. (1984). Flower visitation and pollination efficiency of some North European butterflies. *Oecologia* 63, 80-89.
- Kivinen S. (2005). Regional distribution and biodiversity perspectives of Finnish grasslands. *Fennia* 183, 37-56.
- Pöyry J., Lindgren S., Salminen J. & Kuussaari M. (2005). Responses of butterfly and moth species to restored cattle grazing in semi-natural grasslands. *Biological Conservation* 122, 465-478.
- Seppänen E. J. (1970). Suurperhostoukkien ravintokasvit. Suomen eläimet - Animalia Fennica 14. Porvoo-Helsinki: WSOY, 179 pp.

Melampyrum cristatum:

- Laine U. (1980) *Melampyrum cristatum* L. Tähkämaitikka, In: Jalas J. (ed.): Suuri Kasvikirja III. Keuruu, 944 pp.

Melitaea cinxia:

- Eliasson C. U. (2007). *Melitaea cinxia* – ängsnätjäril [WWW]. ArtDatabanken, Sveriges Lantbruksuniversitet. Available from: http://www.artfakta.se/Artfaktablad/Melitaea_Cinxia_102922.pdf [Referenced 24.11.2011]
- Hanski I. (1999). *Metapopulation Ecology*. New York: Oxford University Press, 328 pp.
- Hanski I., Kuussaari M. & Nieminen M. (1994). Metapopulation structure and migration in the butterfly *Melitaea cinxia*. *Ecology* 75, 747-762.
- Hanski I., Pöyry J., Pakkala T. & Kuussaari M. (1995). Multiple equilibria in metapopulation dynamics. *Nature* 377, 618-621.
- Kuussaari M. (1998). Biology of the Glanville fritillary butterfly (*Melitaea cinxia*). PhD-thesis, University of Helsinki.
- Kuussaari M., Nieminen M., Pöyry J. & Hanski I. (1995). Täpläverkkoperhosen (*Melitaea cinxia*) elinkiertö ja esiintyminen Suomessa. *Baptria* 20, 167-180.
- Kuussaari M., Nieminen M. & Hanski, I. (1996). An experimental study of migration in the butterfly *Melitaea cinxia*. *Journal of Animal Ecology* 65, 791-801.
- Kuussaari M., van Nouhuys S., Hellmann J. & Singer, M. (2004). Larval biology of checkerspot. In: Ehrlich, P. R. & Hanski, I. (eds.) *On the Wings of Checkerspot: A model system for Population Biology*. Oxford: Oxford University Press, 138-160.
- Lei G. & Hanski, I. (1997). Metapopulation structure of *Cotesia melitaeorum*, a specialist parasitoid of the butterfly *Melitaea cinxia*. *Oikos* 78, 91-100.
- Lei G., Vikberg V., Nieminen M., Kuussaari M. & Hanski, I. (1997). The parasitoid complex attacking Finnish populations of the Glanville fritillary *Melitaea cinxia* (Lep: Nymphalidae), an endangered butterfly. *Journal of Natural History* 31, 635-648.
- Nieminen, M., Singer, M. C., Fortelius, W., Schöps, K. & Hanski, I. (2001). Experimental confirmation that inbreeding depression increases extinction risk in butterfly populations. *The American Naturalist* 157, 237-244.
- Nieminen, M., Suomi, J., van Nouhuys, S., Sauri, P. & Riekkola, M-L. (2003). Effect of iridoid glycoside content on oviposition host plant choice and parasitism in a specialist herbivore. *Journal of Chemical Ecology* 29, 823-844.
- Nieminen, M., Siljander, M., Hanski, I. (2004). Structure and dynamics of *Melitaea cinxia* metapopulations. In: Ehrlich, P. R., Hanski, I. (eds.) *On the Wings of Checkerspot: A model system for Population Biology*. Oxford: Oxford University Press, 63-91.
- Niitepöld, K., Smith, A. D., Osborne, J. L., Reynolds, D. R., Carreck, N. L., Martin, A. P., Marden, J. H., Ovaskainen, O. & Hanski, I. (2009). Flight metabolic rate and Pgi genotype influence butterfly dispersal rate in the field. *Ecology* 90, 2223-2232.
- van Noordwijk C. G. E. (2011a). Using life-history analyses to improve restoration management. *Proc. Neth. Entomol. Soc. Meet.* 22, 75-85.
- van Noordwijk T. (2011b). (personal communication) Stichting Bargerveen / Afdeling Dierecologie, Radboud Universiteit Nijmegen The Netherlands. Email. [9.11.2011].
- Norberg, U., Enfäll, K. & Leimar, O. (2002). Habitat exploration in butterflies – an outdoor cage experiment. *Evolutionary Ecology* 16, 1-14.
- van Nouhuys, S., Singer, M. C. & Nieminen, M. (2003). Spatial and temporal patterns of caterpillar performance and the suitability of two host plant species. *Ecological Entomology* 28, 193-202.
- Reudler Talsma, J. H., Biere, A., Harvey, J. A. & van Nouhuys, S. (2008). Oviposition Cues for a Specialist Butterfly – Plant Chemistry and Size. *Journal of Chemical Ecology* 34, 1202-1212.
- Saccheri, I. J., Kuussaari, M., Kankare, M., Vikman, P., Fortelius, W. & Hanski, I. (1998). Inbreeding and extinction in a butterfly metapopulation. *Nature* 392, 491-494.
- Wahlberg, N. & Saccheri, I. (2007). The effects of Pleistocene glaciations on the phylogeography of *Melitaea cinxia* (Lepidoptera: Nymphalidae). *European Journal of Entomology* 104, 675-684.

Ophioglossum vulgatum:

- Anderberg A. A. & Anderberg A.-L. (2012). Ormtunga [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/orm/ophioglossa/ophio/ophivul.html> [referenced 6.3.2012].
- Muller S. (2000). Assessing occurrence of *Ophioglossum vulgatum* L. and other Ophioglossaceae in European forests. Significance for nature conservation. *Biodiversity and Conservation* 9: 673-681.
- Muller S. (2002). Diversity of management practices required to ensure conservation of rare and locally threatened plant species in grasslands: a case study at a regional scale (Lorraine, France). *Biodiversity and Conservation* 11: 1173-1184.

Parnassius mnemosyne:

- Bergström M. (2008). Årsredovisning 2007. Norrtälje Naturvårdsstiftelse, 32 pp.
- Franzen M. & Imby L. (2008). Åtgärdsprogram för mnemosynejäril 2008-2012 (*Parnassius mnemosyne*). Naturvårdsverket, 44 pp.
- Hulden L., Albrecht A., Itämies J., Malinen P. & Wettenhovi J. (2000). Suomen suurperhostatlas. (Atlas of Finnish Macrolepidoptera). Helsinki: Suomen perhostutkijain seura ry, 328pp.
- Kuussaari M. & Juslen A. (2010). SYKE 2010: ACTION A.4: *Parnassius mnemosyne* reintroduction plan in LIFE –application.
- Ovaskainen O. Luoto M., Ikonen I., Rekola H., Evgeniy M. & Kuussaari M. (2008). An Empirical Test of a Diffusion Model: Predicting Clouded Apollo

Movements in a Novel Environment. *American Naturalist* 171:5, 610-619.

Viidalepp J. (2000). Mustlaik-apollo (*Parnassius mnemosyne*) Eestis [*Parnassius mnemosyne* Linnaeus, 1758 in Estonia]. Tallinn-Tartu. TA Kirjastus.

Pedicularis palustris:

Jutila H. (1999). Effect of grazing on the vegetation of shore meadows along the Bothnian Sea, Finland. *Plant Ecology* 140, 77-88. Karrenberg S. & Jensen K. (2000). Effects of pollination and pollen source on the seed set of *Pedicularis palustris*. *Folia Geobotanica* 35, 191-202.

Mäkinen Y., Laine U. & Kalela A. (1994). Pohjolan kasvit. Tammi, Helsinki, 491pp.

Schmidt & Jensen (2000). Genetic structure and AFLP variation of remnant populations in the rare plant *Pedicularis palustris* (Schphulariaceae) and its relation to population size and reproductive components. *American Journal of Botany* 87(5), 678-689.

Polygala amarella:

Eklund O. (1924). Botaniska notiser från Ab, Korpo. *Medd.Soc. F. Fl. Fenn.* 48,12-19.

Eklund O. (1958). Die Gefäßpflanzenflora beiderseits Skiftet im Schärenarchipel Südwestfinlands. *Bidr. känned. Finl. Natur och Folk.* 101, 1-342.

Kukkonen I. (1980). *Polygala amarella* Cranz. – Katkeralinnunruoho. In Jalas, J. (ed.), *Suuri kasvikirja III.* Keuruu, 944 pp.

Primula farinosa:

Anderberg A. A. & Anderberg A.-L. (2011). Majviva [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/di/primula/primu/primfar.html> [referenced 4.3.2012].

Hambler D. J. & Dixon J. M. (2003). *Primula farinosa*. *Journal of Ecology*, 91, 694–705.

Naturegate. (2012). *Primula farinosa* [WWW]. Available from: <http://www.luontoportti.com/suomi/sv/kukkakasvit/majviva> [referenced 4.3.2012].

Slotte H. (2007). Majviva och älvväxing på slättermark. (The decline of *Primula farinosa* and *Sesleria uliginosa* in semi-natural meadow). *Uppsala. Svensk Bot- Tidskr.* 101, 277-280.

Psophus stridulus:

Buchweitz M. (1993). Zur Ökologie der Rotflügeligen Schnarrschrecke (*Psophus stridulus* L. 1758) unter besonderer Berücksichtigung der Mobilität, Populationsstruktur und Habitatwahl. *Articulata* 8, 39-62.

Bönsel A. (2004). Ethological and morphological adaptations of *Psophus stridulus* L. 1758 (Caelifera: Acrididae) to habitat islands. *Beiträge zur Entomologie* 54, 241-253.

Bönsel A. & Runze M. (2000). Ein Habitat der Rotflügeligen Schnarrschrecke (*Psophus stridulus* L. 1758) im nordöstlichen Polen. *Articulata* 15, 49-62.

Karjalainen S. (2009). Suomen heinäsiirkat ja hepokatit. Tammi. 207 pp.

Kindvall O. (2011). Åtgärdsprogram för trumgräshoppa 2011–2015 (*Psophus stridulus*). Rapport 6443, Naturvårdsverket, Stockholm.

Kolb K.-H. & Fischer K. (1994). Populationsgröße und Habitatnutzung der Rotflügeligen Schnarrschrecke (*Psophus stridulus*, Insecta: Saltatoria) im NSG "Steinberg und Wein-Berg"/ Bayerische Rhön. *Articulata* 9, 25-36.

Piirainen T. (2011). Havaintoja palosirkan (*Psophus stridulus*) elintavoista. *Diamina* 2011, 24-28.

Saarinen K., Jantunen J., Kallio E. & Albrecht A. (2005). Siirtoistutus paljasti palosirkan kaksivuotisen kehityksen. *Luonnon Tutkija* 19, 98-107.

Väisänen R., Somerma P., Kuussaari M. & Nieminen M. (1991). *Bryodema turberculata* and *Psophus stridulus* in southwestern Finland (Saltatoria, Acrididae). *Entomologica Fennica* 2, 27-32.

Weibart M. & Fischer K. (2006). Populationsstruktur, Dispersionsverhalten und Habitatpräferenzen der Rotflügeligen Schnarrschrecke (*Psophus stridulus* L.) in der Fränkischen Schweiz. *Articulata* 21, 169-182.

Salicornia europaea:

Davy A. J., Bishop G. F. & Costa C. S. B. (2001). *Salicornia* L. (*Salicornia pusilla* J. Woods, *S. ramosissima* J. Woods, *S. europaea* L., *S. obscura* P.W. Ball & Tutin, *S. nitens* P.W. Ball & Tutin, *S. fragilis* P.W. Ball & Tutin and *S. dolichostachya* Moss). *Journal of Ecology* 89, 681-707.

Ellison A.M. (1987). Effects of competition, disturbance, and herbivory on *Salicornia europaea*. *Ecology* 68(3), 576-586.

Egan T. P. & Ungar I. A. (2000). Mortality of the salt marsh species *Salicornia europaea* and *Atriplex prostrata* (Chenopodiaceae) in response to inundation. *Ohio Journal of Science* 100(2), 24-27.

Hakala A. (2011). Muuttuva selkämeri. Ilmastonmuutos Selkämeren alueella. Pyhäjärvi-instituutin julkaisuja B(19), 107 pp.

Merilä E. (2005). Koirantakkua ja karupäitä. Luonnon monimuotoisuuden yleissuunnitelma Hailuodon maatalousympäristölle. Pohjois-Pohjanmaan ympäristökeskuksen moniste 29, 93 pp.

Piirainen M. (1989). Suolayrtti (*Salicornia europaea*) muuntelusta, kasvupaikoista ja levinneisyydestä Suomessa. *Lutukka* 4, 103-108.

Ryttäri T. (1994). Suolayrtti ja kilokit. Piikit eivät suojaa ihmiseltä. In Vuokko S. (ed.), *Kasvit I.* Weilin+Göös Oy, 128 pp.

Ungar I. (1987). Population characteristics, growth, and survival of the halophyte *Salicornia europaea*. *Ecology* 68(3), 569-575.

Östman M. (2001). Glasörten – hotad särpling på strandängen. *Finlands Natur* 5, 30-31.

Anderberg A. A. & Anderberg A.-L. (2011). Glasört [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from:

<http://linnaeus.nrm.se/flora/di/chenopodia/salic/salieur.html> [referenced 22.8.2012]

Valtioneuvosto. (2011). *Salicornia europaea* [WWW]. Available from: <http://www.valtioneuvosto.fi/ajankohtaista/tiedotteet/tiedote/fi.jsp?oid=313661&c=0&toid=2213&moid=2208> [referenced 22.8.2012]

Samolus valerandi L.:

Anderberg A. A. & Anderberg A.-L. (2011). Bunge. [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/di/astera/carli/carlvul.html> [referenced 2.3.2012].

Aspelund P. (2006). Suomen uhanalaisia lajeja: Suolapunka (*Samolus valerandi L.*) Manner-Suomessa. Suomen ympäristö 803, 55 pp.

Selaginella selaginoides:

Heidel B. & Handley J. (2006). *Selaginella selaginoides (L.) Beauv. ex Mart. & Schrank (club spikemoss): A Technical Conservation Assessment.* [Online]. USDA Forest Service, Rocky Mountain Region, Species Conservation Project.

Mäkinen Y., Laine U. & Kalela A. (1994). Pohjolan kasvit 1. Tammi, Helsinki, 491pp.

Sesleria uliginosa:

Anderberg A. A. & Anderberg A.-L. (2012). *Sesleria uliginosa* [WWW]. Den virtuella floran. Naturhistoriska riksmuseet. Available from: <http://linnaeus.nrm.se/flora/mono/poa/sesle/sesluli.html> [referenced 1.3.2012]

Thymus serpyllum:

Eriksson Å. (1998). Regional distribution of *Thymus serpyllum*: management history and dispersal limitation. *Ecography* 21: 35-43.

Rosqvist G. (2003). INDIKATORARTER- metodutveckling för nationell övervakning av biologisk mångfald i ängs- och betesmarker. Naturcentrum AB, 92 pp.

Ryttäri T. & Tainio E. (2010). Öron kangasajuruoho- ja kasvillisuus seurannat - pikayhteenveto vuosien 2004-2010 seurannoista.

Kittamaa S., Ryttäri T., Ajosenpää T., Aapala K., Hallman E., Lehesvirta T. & Tukia H. (2009). Harjumetsien paahdeympäristöt - nykytila ja hoito. Suomen ympäristö 25/2009, 88 pp.

Salminen J. (2007). Paahdeympäristöjen hyönteiseuranta. Metsähallituksen luonnonsuojelujulkaisuja A 172. Available from: <http://julkaisut.metsa.fi/julkaisut/pdf/luo/a172.pdf> [referenced 22.8.2012]

Trifolium fragiferum:

Naturegate. (2012). *Trifolium fragiferum* [WWW]. Available from: <http://www.luontoportti.com/suomi/en/kukkakasvit/strawberry-clover> [referenced 16.8.2012]

Mäkinen Y., Laine U. & Kalela A. (1994). Pohjolan kasvit. Tammi, Helsinki, 491 pp.

Suominen L. & Hämet-Ahti J. (1993). Kasvistomme muinaistulokkaat: tulkintaa ja perusteluja. *Norrinia* 4, 3-5. Kasvimuseo, Helsinki.

Erik Andersson (edit.)

Indicator Species

An important tool when preserving the cultural landscape

The now-scattered occurrence of many plant and insect species is mainly an indication of the once-extensive network of traditional landscapes. As recently as half a century ago, there were large areas of grazed forest, landscapes were more open and seeds spread quickly in open environments and trampled areas with hay transports and extensively wandering animals. Nowadays a large proportion of the threatened species in our countries are species with extinction debt that are typical of traditional landscapes. This publication presents indicator and flagship species of traditional landscapes in our coastal areas and coastal lagoons. Indicator species occurring in traditional landscapes are a measure of the level of management and the 'health' of the areas.

The aim of the Natureship project and this publication is to promote co-operation in order to enhance exchange of information and best guideline practices of management, restoration and monitoring of traditional rural biotopes and coastal areas between Finland, Sweden and Estonia.



ENVIRONMENTAL BOARD



METSÄHALLITUS



Ehkiväino, liikenne- ja ympäristökeskus
Närings-, trafik- och miljöcentralen
Centre for Economic Development, Transport and the Environment



CENTRAL BALTIC
INTERREG IV A
PROGRAMME
2007-2013



EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
INVESTING IN YOUR FUTURE