Mons Kvamme, Peter Emil Kaland, Nils Georg Brekke

SAFEGUARDING THE HEATHLANDS OF EUROPE

Conservation and management of North European coastal heathlands

Case study: The Heathland Centre, Lygra, Western Norway

Education and Culture
Culture 2000

European Heritage Laboratories
HEATHGUARD

The Heathland Centre

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Conservation and management of North European coastal Heathlands
Case study: The Heathland Centre, Lygra, Western Norway

Conservation and management of North-West European upland Moorlands
Case study: Cairngorms National Park, Scotland

Conservation and management of Central European lowland Heathlands
Case study: Lüneburger Heide nature reserve, North-West Germany

Conservation and management of South-West European mountainous Heathlands
Case study: Peneda-Gerês National Park, Northern Portugal

Safeguarding the Heathlands of Europe
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safeguarding the heathlands of europe

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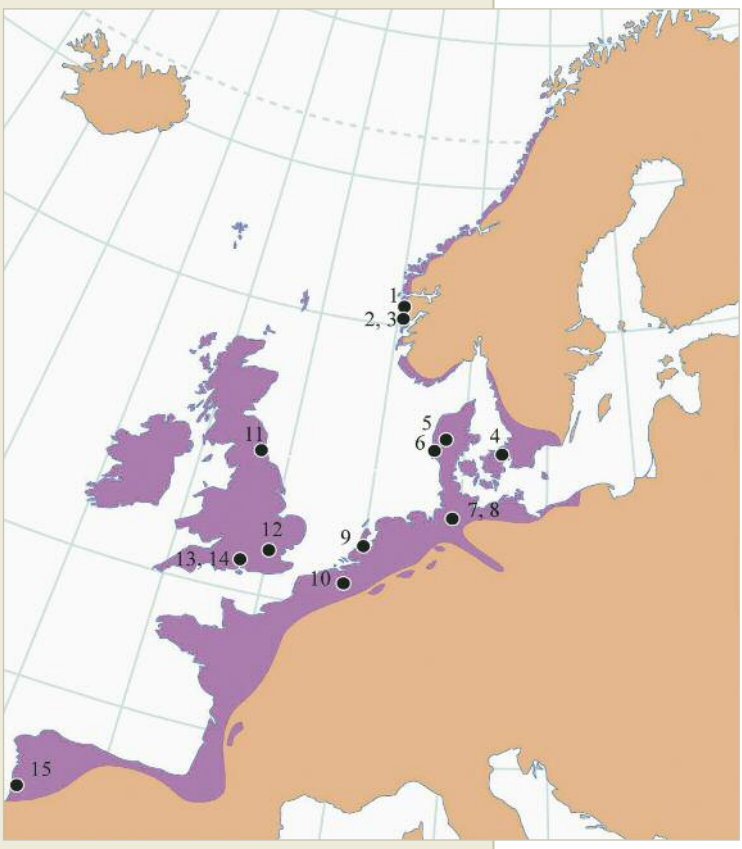
EGIL KORSNES

August at The Heathland Centre.



Heathland – The Atlantic Cultural Landscape of Europe

Network for the promotion, traditional management and cultural heritage

Participating institutions in The Heathcult Project:

1. The Heathland Centre, Lygra, Norway
2. University of Bergen, Norway
3. County Council of Hordaland, Norway
4. The National Forest and Nature Agency, Denmark
5. Herning Museum, Denmark
6. Skjern-Egvad Museum, Denmark
7. Landwirtschaftmuseum Lüneburger Heide, Germany
8. Alfred Toepfer Akademie für Naturschutz, Germany
9. Agricultural Research Department, The Netherlands
10. Institute for Nature Conservation, Belgium
11. European Economic Development Services Ltd., England
12. National Trust, England
13. New Forest Committee, England
14. Institute for Terrestrial Ecology, England
15. Instituto da Conservacao da Natureza (ICN), Portugal

For the location of the HEATHGUARD-participants see back cover.

Distribution map of the European heathlands, made by The Heathcult Project.

1 Introduction

"Safeguarding the Heathlands of Europe" (HEATHGUARD), is an EU-financed project within the "Culture 2000 Framework Programme in Support of Culture". Its aim is to compare heathland conservation methods and management practices in different regions of Europe, in order to develop recommendations for pan-European guidelines on heathland preservation.

The Atlantic heathlands are an important part of the common European heritage. Distributed from Portugal in the south to northern Norway in the north, they form a continuous belt of cultural landscapes throughout western Europe. Within this vast area, the strategies for making a living from the landscape resources have been more or less the same over innumerable generations. The homogeneity of the heathland farming methods across Europe has produced a landscape in which the similarities in land-use history and management traditions far outnumber any differences due to variations in geographical setting and cultural background.

Today, the economy of heathland farming is rapidly decreasing due to the development of modern agriculture. On the other hand, heathlands are receiving increasing attention as valuable areas for leisure, recreation and artistic inspiration for modern people living in urbanized areas. They also contribute considerably to our common European cultural history, and they are easily understood examples of sustainable subsistence based on natural resources.

These heathlands are valuable for the maintenance of important aspects of European biological diversity. This is partly due to the occurrence of species which have become specialized over a long timespan to live in this open landscape. In addition, some of the most interesting examples of ancient livestock breeds still surviving in Europe are found on the heathlands.

Despite the many values attached to heathland, it is today an endangered type of landscape. The relative importance of the different threats vary across Europe, but taken all together, about 80% of the European heathlands have disappeared over the last 150 years. Although these changes have been most rapid over the last 50 years, the development was foreseen much earlier, and the first conservation of heathlands took place in the early 20th century, e.g. in Germany. In other parts of Europe it is quite a new idea to establish protected areas of heathland.

It is important that heathlands are preserved in different parts of Europe. The variation in climate, geology and topography, imposes considerable variation in heathland biodiversity, and this cannot be safeguarded in one protected area alone. The many different cultural traditions, and diverse adaptations to local natural resources, are also impossible to preserve at any one location. To make sure that both the theoretical and practical knowledge behind this variety of land-use practices is passed on to future generations, it is important that suitable heathland areas are preserved in complementary regions throughout Europe.

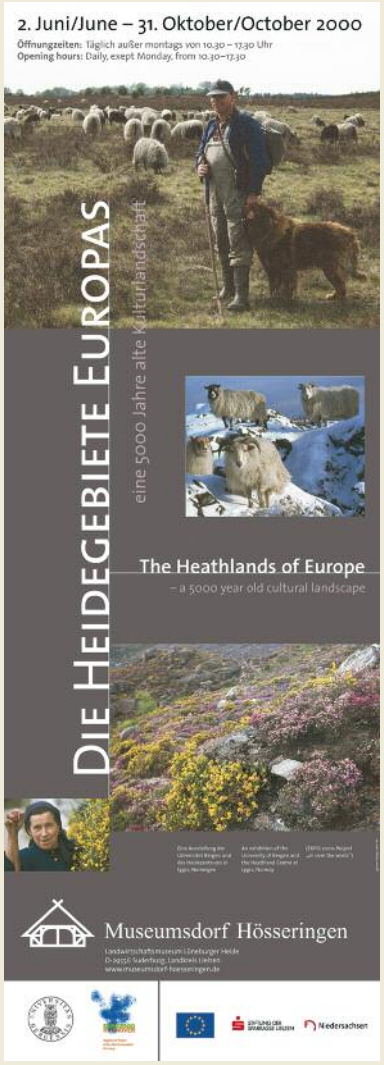
The variety of cultural traditions, management practices and uses of resources found within the heathlands has been mapped in an earlier EU-project called HEATHCULT, financed through the Raphael-programme. The results were communicated through a popular book (Haaland 2002), an internet site (www.nationaltrust.org.uk/heathlands), an exhibition at the World Exhibition in Hannover in 2000, and a mobile exhibition (Kaland, Kaland & Mellemstrand 2001).

The HEATHGUARD project builds on the experiences from HEATHCULT. HEATHCULT focused on visualizing, in a popular way, the most important aspects of heathland nature and culture all over Europe. HEATHGUARD will compare and exchange experiences of heathland management and preservation between complementary regions of Europe. This will be achieved by producing four standardized descriptive reports, one from each of the participating institutions. The present report is just such a report for The Heathland Centre, Western Norway. The other reports will be compiled by the Cairngorm National Park (Scotland), Lüneburger Heide (Germany) and Peneda-Geres National Park (Portugal).

The next step will be to analyse and evaluate the different conservation strategies and management methods applied in the four areas, as they are described in the individual reports. This work will be presented in a fifth report, where guidelines for the preservation of remaining heathland areas in Europe will also be developed.

HEATHGUARD has been financed by the Culture 2000 programme of the Europeaen Union. In addition generous economical contribution has been given by the Norwegian Directorate for Cultural Heritage and by Arts Council Norway. Without their support, it had not been possible to carry out this project.

The Heathcult book has so far been published in three different languages. Editions in four more languages are under preparation.



Exhibition poster from The Heathcult Project

PETER EMIL KALAND

Aerial photo of the Heathland Centre.

2 Definitions and identification of the area

The Heathland Centre is situated on the island of Lygra, approximately 40 km northwest of Bergen in Western Norway. Lygra belongs to the municipality of Lindås in the county of Hordaland. The exact location of the Centre is latitude 60°42′ N, longitude 5°60′ E.

The Heathland Centre covers an area of approximately 190 hectares, of which 24 hectares are cultivated infields, and the remainder is grazed outfields, mainly consisting of heathland but also with some grassland in special areas. The entire area is privately owned by five farms which are incorporated into the Centre.

The area has no legal protection under Norwegian nature or culture conservation laws. Preservation is based on long-term agreements with the owners, and in addition the area is reserved for heathland conservation in the regional plan of the Lindås municipality.

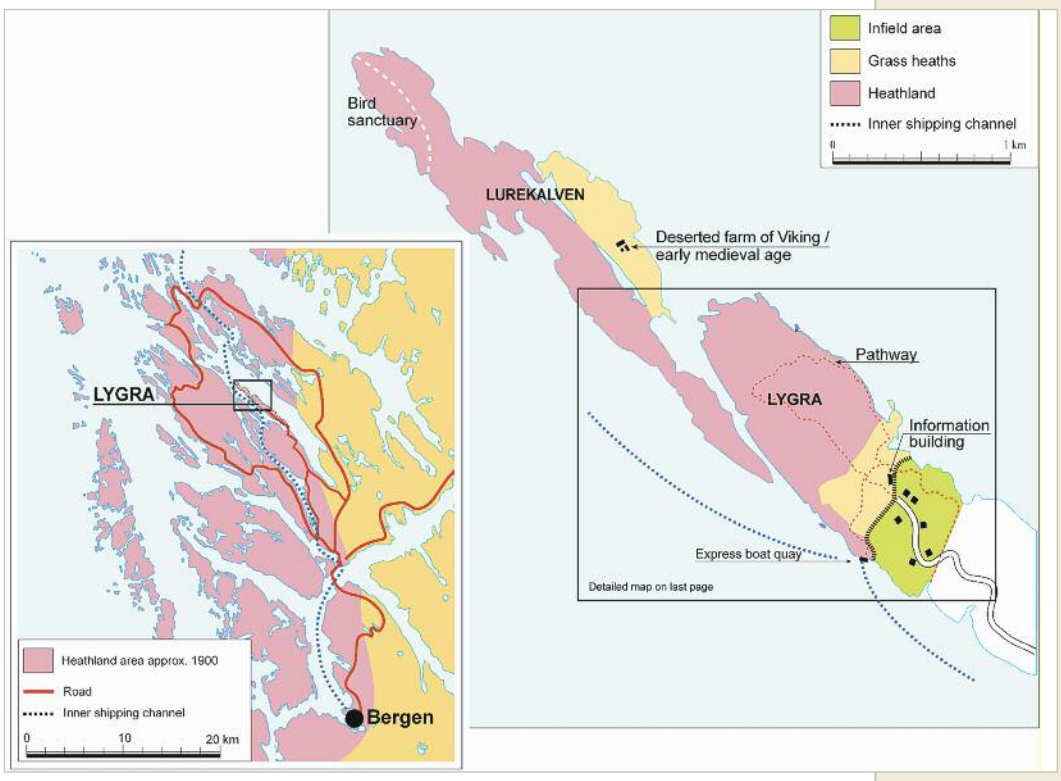
The conservation area of the Centre includes the northern part of the island of Lygra, Ytre Lygra, and a smaller island, Lurekalven, which today is uninhabited. The neighbouring buffer zones are: the southern part of the island, Indre Lygra, with approximately 240 hectares of cultivated infields, heathland and forest; the neighbouring island of Lurøy, with approximately 290 hectares of heathland and forest; and the fjord Lurefjorden of approximately 3000 hectares which surrounds Lygra.

The Heathland Centre is a foundation established by:

- The University of Bergen
- The County Council of Hordaland
- The municipality of Lindås
- The Council of municipalities in Nordhordland
- The Nordhordland Craft and Industry Union
- The farmers of Ytre Lygra who own the area

PETER EMIL KALAND

Landscape restoration at Lurekalven.



Location of the Heathland Centre compared to Bergen.

Illustration: Peter Emil Kaland

The foundation was established in 1998, and the Centre opened in 2000. The idea behind the Centre, and very much of the content, originates from a research project at the University of Bergen during the years 1971 – 1976, called the Lindås project. Among the many results from this project, three were of particular relevance for the development of the concept of The Heathland Centre:

- The man-made nature of the heathlands was appreciated much more than before (Kaland 1974).
- It became obvious for the scientists that this landscape was rapidly disappearing.
- It was shown, through a feasibility study, how a small area of heathland could be preserved by actively farming using traditional methods on a model farm (Ingvaldsen 1978).

Since the mid 1970s the leaders from the Lindås project had been looking for a suitable place where it would be possible to try out the ideas behind such a centre. Planning for a centre on Lygra began in about 1990 due to interest from the local population, the presence of well-preserved authentic heathland, and financial support from Hordaland County Council, the regional office for the Governmental Departement of Agriculture, and University of Bergen.

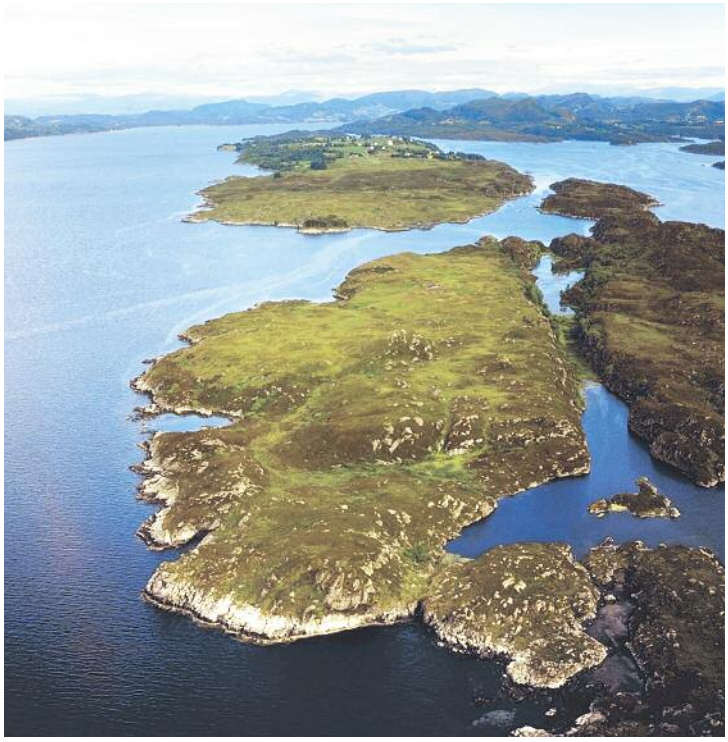
In 1994 Hordaland County Council decided to support and house the organization of the Heathland Centre as a development project for landscape conservation and tourism. In addition to the above mentioned partners, the project then also received support from the Lindås municipality, five different governmental ministries and several private sponsors. The project developed into the foundation which was established in 1998. In cooperation with the farmers, the foundation has restored the landscape and begun active management, restored 25 traditional buildings on their original location in the landscape and about 1,5 km of dry stone walls, constructed 4 km of paths to facilitate public access and outdoor life, and built a new visitors centre (The Information Building) with an exhibition, documentary film, classroom, and cafeteria.

PETER EMIL KALAND

Restoration of one of the boat houses.

Aerial photo of the eastern part of Lurekalven and the northern part of Lygra. The picture shows the flat character of the landscape. The thickest deposits of mineral soils are found here.

PETER EMIL KALAND



3 Description of the area as part of the Atlantic European heathland system

3.1 Natural conditions

Topography and soil

Lygra, as most of the islands along the west coast of Norway, belongs to what is defined as «the strandflat», the low-lying area west of the coastal mountains (Holtedahl 1960). The relief of the strandflat, in general, is relatively flat with few areas above 100 masl, at Lygra/Lurekalven the highest point is about 50 masl, and most areas are between 10 and 30 masl.

The geology is a part of the Bergen Arcs, which characterize the geology of most of Hordaland (Kolderup & Kolderup 1940). The bending of the arcs gives a southeast-northwest trending structure to the bedrock, and subsequently to the topography of Lygra and Lurekalven. The bedrock is dominated by metamorphic gneiss (Austrheim 1978) with a special composition of minerals such as biotite and iron oxides, which makes it highly susceptible to weathering processes. This has resulted in thick deposits of mineral soils, covering most of Lygra and the eastern part of Lurekalven.

Unlike the poor soils of glaciofluvial sandy deposits, the weathered soil on Lygra is relatively fertile and good for agriculture. It was therefore possible for the farmers here, as for farmers from other places with the same bedrock, to maintain much larger areas of cultivated fields compared with other coastal farms on this part of the coast. The soil is, however, not particularly rich in calcium, and heather therefore thrives on this soil in areas of low density grazing.

The bedrock and soil conditions on Lygra and Lurekalven are atypical for the coastal heathlands of western Norway. Most heathlands are found on slowly weathering acid bedrocks. Mineral soils are mainly restricted to the limited areas of Younger Dryas morainic deposits. This imposes limitations for the coastal agriculture in general, which must be based on small cultivated fields, intensively manured.

Climate

The climate on the coast of western Norway is oceanic, and strongly influenced by the Gulf Stream. The difference between summer and winter temperatures is smaller than further inland, resulting in mild winters but cool summers. In the heathland area of Hordaland the mean January temperature is about +0.5° C, whereas the mean summer temperature is about 14° C. The amount of precipitation varies between 1100 mm/yr on the outermost islands to about 2000 mm/yr on the inner edge of the heathland zone (Førland 1993). The amount of precipitation on Lygra is supposed to be 1500 mm/yr. The number of days with precipitation during a year is 220-230. Another aspect of the typical coastal climate is the wind, the number of days with strong wind is much higher than further inland, and periods with no wind are rare.

Due to the influence of the Gulf Stream, climatic boundaries along the west coast of Norway have a north-south rather than an east-west trend. There is a strong climatic gradient from the outermost islands on the coast eastwards, where the oceanic influence decreases. Traditionally, the essentially frost-free winters without lasting snow-cover could be experienced in a belt about 30 km eastwards from the westernmost islands. This was also the main distribution area of the heathlands. Today the zone of heathlands is much narrower, although the belt of land with mild winters has increased eastwards due to global warming over the last 15 years.

Due to the Gulf Stream the winters are mild along the west coast of Norway. The map shows the isotherm for mean January temperature of 0°C.

Ill. Peter Emil Kaland

3.2 Landscape development

The present landscape on the coast of western Norway is a result of several factors which have influenced the landscape over time. In addition to geology, the most important of them have been glaciation history, shoreline displacement, plant immigration, forest history, soil and bog development, and human impact. The most relevant to the heathlands have been forest history, bog development and human impact. The other factors will therefore only be briefly mentioned. This presentation is mainly based on Fægri 1944a, 1944b, 1954, Aarseth og Mangerud 1974, Kaland 1979, 1984, 1986, Kvamme 1982, Myking 1973, Waaler 1998 and Kaland & Vandvik 1998.

Glaciation history and shoreline displacement

The ice cover of the coastal zone of western Norway during the Quaternary glaciations was relatively thin compared to areas further east. Towards the end of the last glaciation, the westernmost islands were already ice-free by about 14,000 BP. During the slightly warmer Bølling/Allerød interglacial, the entire coast was deglaciated, but during the Younger Dryas cold period, the ice again covered most of the coastal areas of Hordaland and Sogn og Fjordane. However, in the northern and southern parts of western Norway, substantial ice-free areas existed during the Younger Dryas period.

Following the end of the Younger Dryas at about 10,300 BP, the ice retreated very quickly from the coastal zone of western Norway. Subsequently, within the heathland areas east of the Younger Dryas end morainic deposits, very few glacial deposits are found. In the heathlands outside (west of) the end moraines, deposits of glaciogenic origin are more frequent.

Due to the relatively thin ice cover, the postglacial isostatic land uplift was limited to about 30-40m during the Late Glacial and early Holocene periods. About 1500 years after deglaciation, land uplift became less than the eustatic sea rise, resulting in a transgression along most of the western Norwegian coast. During the period 8000-6000 BP, this transgression stabilized shorelines about 12-15 m above their present heights. Many Mesolithic dwelling sites have therefore been found in the heathland areas at this altitude. Since then, slow isostatic uplift has led to a gradual lowering of the shorelines down to their present levels, reached about 1000 years ago.

PETER EMIL KALAND

Remnants of the big forests at the coast can be found many places in the peat bog.

Forest history

The first postglacial pioneer vegetation consisted of a mixture of seashore vegetation and heath, dominated by dwarfbirch (*Betula nana*), crowberry (*Empetrum*) species and juniper (*Juniperus communis*). However, after only a few decades, this vegetation was replaced by birch (*Betula*) forest which completely covered the landscape. Another tree species which arrived locally very early was hazel (*Corylus avellana*). There has been speculation as to whether the early appearance of this species was related to the first Mesolithic immigrants. Although it has been documented that people were harvesting hazel nuts, it is much more difficult to prove that humans actually brought the trees with them.

The many thickets of hazel along the west coast probably presented an impediment to the immigrating pine (*Pinus sylvestris*), and the early Holocene pine forests were established later on the west coast than in the rest of the country. At about 8000 BP *Alnus* species arrived, and, in particular alder (*Alnus glutinosa*), came to dominate great areas on the coast. About 2000 years later oak (*Quercus*) species became more and more dominant on dry ground areas.

On the good soils of Lygra and Lurekalven, the mid-Holocene forest was totally dominated by oak, with alder mainly limited to the peat bogs, and birch to marginal and exposed locations. On sheltered sites, lime (*Tilia cordata*) was quite common. However, on the acid bedrock in most of Nordhordland, birch and pine dominated the dry ground together with some oak. Elm (*Ulmus glabra*), which was one of the dominant species in the broad-leaved forests of eastern Norway and southern Scandinavia at this time, was only sparsely present in the coastal zone.

Forest clearance and heathland development

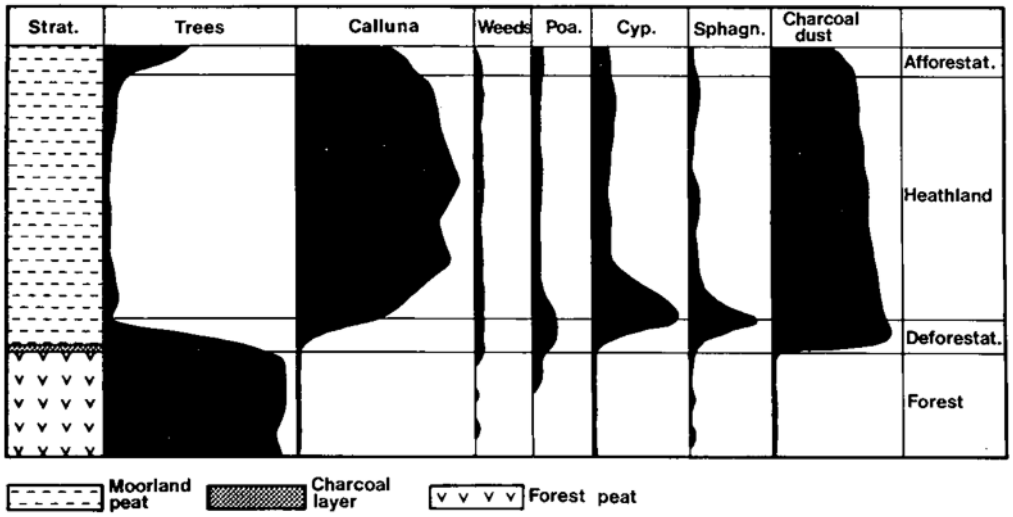
Up to about 5000 years ago, the entire west coast of Norway was completely forested except on the most extremely exposed locations. Heathlands dominated by heather (*Calluna vulgaris*) as we know them today did not exist. At about this time however, small-scale deforestation occurred, at first on small islands in the west. Quite soon the process spread, and gradually the forest disappeared over greater and greater areas. The process of deforestation lasted for more than 4000 years, the youngest dated deforestation in the heathland areas of Hordaland occurred about 800-900 years ago.

Closely related to the deforestation was the heathland development. A number of pollen diagrams have shown that the reduction in tree cover was immediately followed by the rapid spread of *Calluna*-dominated heath vegetation over the landscape. Another effect of deforestation was increased peat formation due to a change in the water balance of the landscape. When the trees disappeared, the evaporation surface was reduced and more water remained in the ground. This also stimulated the accumulation of raw humus in the soil and the development of blanket peat. These kinds of consequences are strikingly different from conditions in warmer parts of the world, where deforestation often causes problems of drought for the vegetation, and soil erosion.

Traces of the old forest can still easily be seen in many places in the peatbogs of western Norway. The

Deforestation peat profile. The upper limitation of forested peat is easily recognized.

PETER EMIL KALAND



Typical local pollen diagram from the coast of Hordaland.

Illustration by Peter Emil Kaland

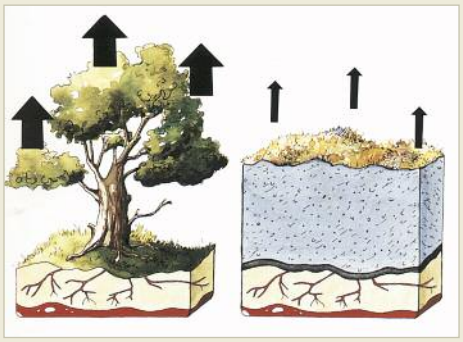
question of why the forest disappeared has therefore been discussed for many decades. For a long time it was thought that the main reasons for the deforestation were severe changes in climate at the Bronze Age/Iron Age transition, 2500 years ago. The most important argument for this was the assumption that deforestation was synchronous over most of the heathland area, and, of course, the vivid descriptions in the old Norse sagas of a catastrophic change in the climate at that time.

A lot of radiocarbon dated pollen diagrams have, however, shown that the deforestation in the heathland areas was metachronous. Within short distances there may be age differences of several thousand years, and, as mentioned above, it was more than 4000 years before the entire heathland area was deforested. This conflicts with a climatic explanation for the deforestation.

Many of the oldest dates of deforestation and heathland formation have been obtained close to areas with finds from Neolithic settlements. Together with the metachronous pattern of dates, this has led to the conclusion that the forest was intentionally removed by man to create heather-dominated grazing areas for their livestock. In the mild winter climate of the west coast of Norway, heathlands were particular valuable because they could be grazed throughout the year .

The conclusion that the heathlands were man-made has further been strengthened by finds of charcoal in peatbogs from intentional burning of the original forest vegetation. This has been found at the stratigraphical border between forest and heather peats. In addition, pollen analysis has revealed that the heather vegetation has been regularely managed by fire from its very first formation. This strengthens the conclusion that the heathland is a man-made landscape. The anthropogenic origin of the heathlands has also been shown elsewhere along the coast, e.g. in southwest Norway. (Prøsch-Danielsen & Simonsen 2000).

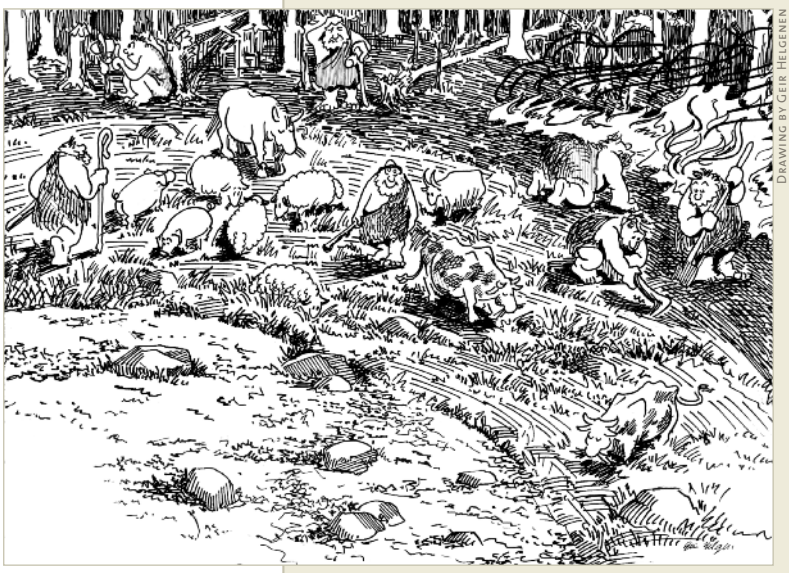
On Lygra, the history of heathland formation has followed the general pattern outlined above. However, due to extensive collection of peat for burning over a very long time, it is difficult to find source material to give a precise date for the deforestation. Archaeological finds related to farming activity go back to the late Neolithic, and at least parts of the island were probably deforested by that time (see 3.4).



When the forest was removed, the evaporation surface of the landscape was reduced. This caused increased peat formation.

Illustration by Peter Emil Kaland

Forest clearance of the coastal landscape started already during the Neolithic Stone Age.



Drawing by Geir Helgenen

Ludvig Lygre

Transport of cattle to Lurekalven by boat about 100 years ago.

On Lurekalven the record is much better, as less peat has been removed for burning purposes. This island was completely covered by forest with little human impact until about 750 AD. At this time people settled on Lurekalven and established a new farm. This process has been studied in great detail both archaeologically and by pollen analysis. The results have shown that when people settled here, they removed the forest from the entire island, not only from the area that was to become cultivated fields (see chap. 3.4). The settlers wanted to create a heathland farm without forest. The case on Lurekalven is a good illustration of how close the relationship could be between farming settlement, deforestation, and heathland formation.

The settlement on Lurekalven was abandoned after the Black Death, in the latter part of the 14th century. However, grazing has continued without interruption up until the present. Land re-allocation never took place on Lurekalven, and the island continued to be used in common between the farmers of Ytre Lygra. The traditional use of the island, as still was practised at the beginning of the 20th century, consisted of cattle grazing during the summer and sheep grazing during summer and winter. The heathlands on Lygra were used in a similar manner. After 1926, all cattle grazing was concentrated on Lygra, whereas more sheep were kept on Lurekalven. Although the overall grazing pressure on Lurekalven increased, the change led to a serious spread of bracken, in particular on the ancient fields of the Medieval farm site.

Retreat of the heathlands and recent development

The expansion period of the heathlands in Western Norway lasted for more than 4000 years, unto the Medieval period before the Black

LUDVIG LYGRE

People from Lygra, mostly women, rowed out to Lurekalven every day to milk the cows.

Death. At this time the heathlands had reached about the same extention as they had during the 18th and early 19th centuries. After the food crises and hunger catastrophies of the Napoleonic Wars, national authorities decided to modernize Norwegian agriculture, and after about 1850 these policies gradually affected the heathlands.

One part of the new initiative was a stronger focus on infield production. Thus, suitable heathlands were cultivated or transformed into grass-producing meadows. The introduction and development of new breeds of livestock with increased demands for fodder, in terms of both quantity and quality, made the heathlands less valuable as grazing areas. The act of land re-allocation passed in 1857 affected the heathlands. Before that the heathlands were used in common by the farmers. After the new law, each farmer got to own his part of the outfields. At the same time they were encouraged to modernize the use of the outfields, e.g. by tree planting. The more farmers that followed these suggestions, the more difficult it became for their neighbours to continue the traditional land-use and heathland management.

The most dramatic effect on landscape development probably came from the introduction of artificial fertilizers. These became commercially available between the wars, and led to a dramatic reduction in the use of the outfields. In the heathland areas the consequences was clearly felt from about 1950. In combination with higher economic demands for agricultural production, the increased use of artificial fertilizers caused the heathlands to lose their value for the farming economy. This led to a large reduction in heathland grazing, and hence re-forestation accelerated.

Due to the marginal situation of Lurekalven compared to modern farming practice, the grazing pressure gradually decreased after World War II. On many of the surrounding islands, the process of

Most heathland farms of western Norway have access to the sea. They have large areas of heathland outfields and relatively small cultivated infields.

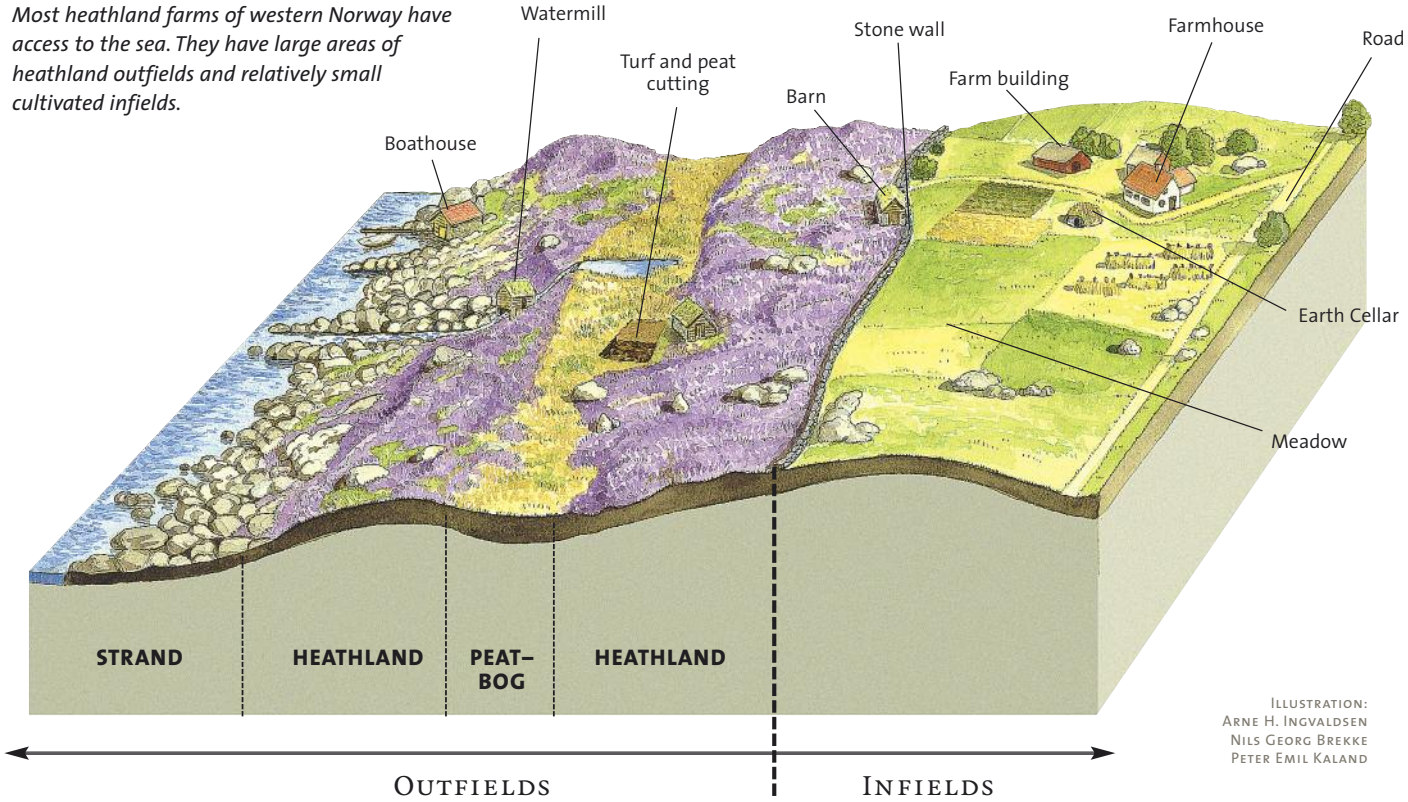
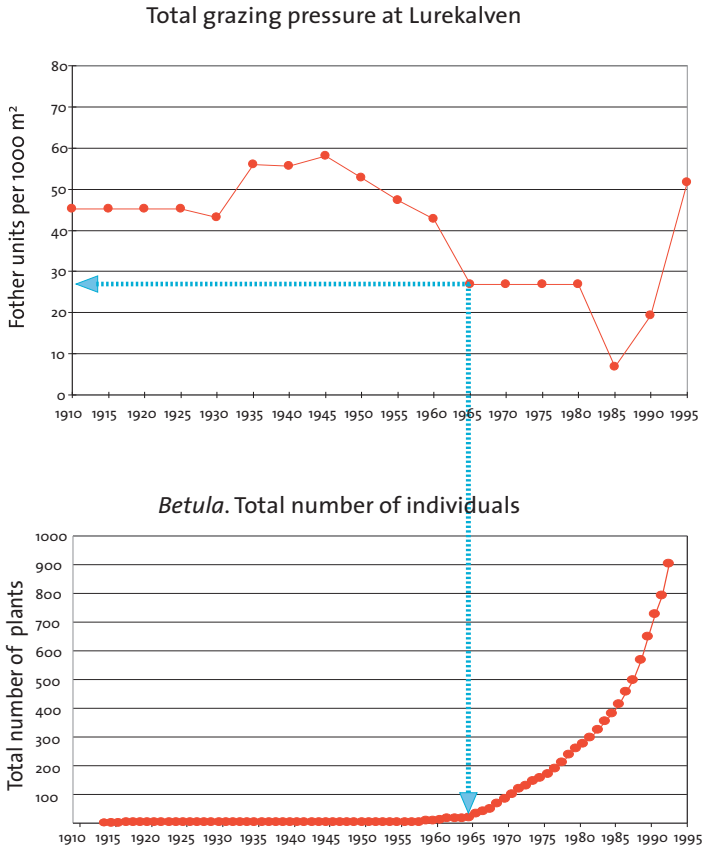


Illustration:
Arne H. Ingvaldsen
Nils Georg Brekke
Peter Emil Kaland

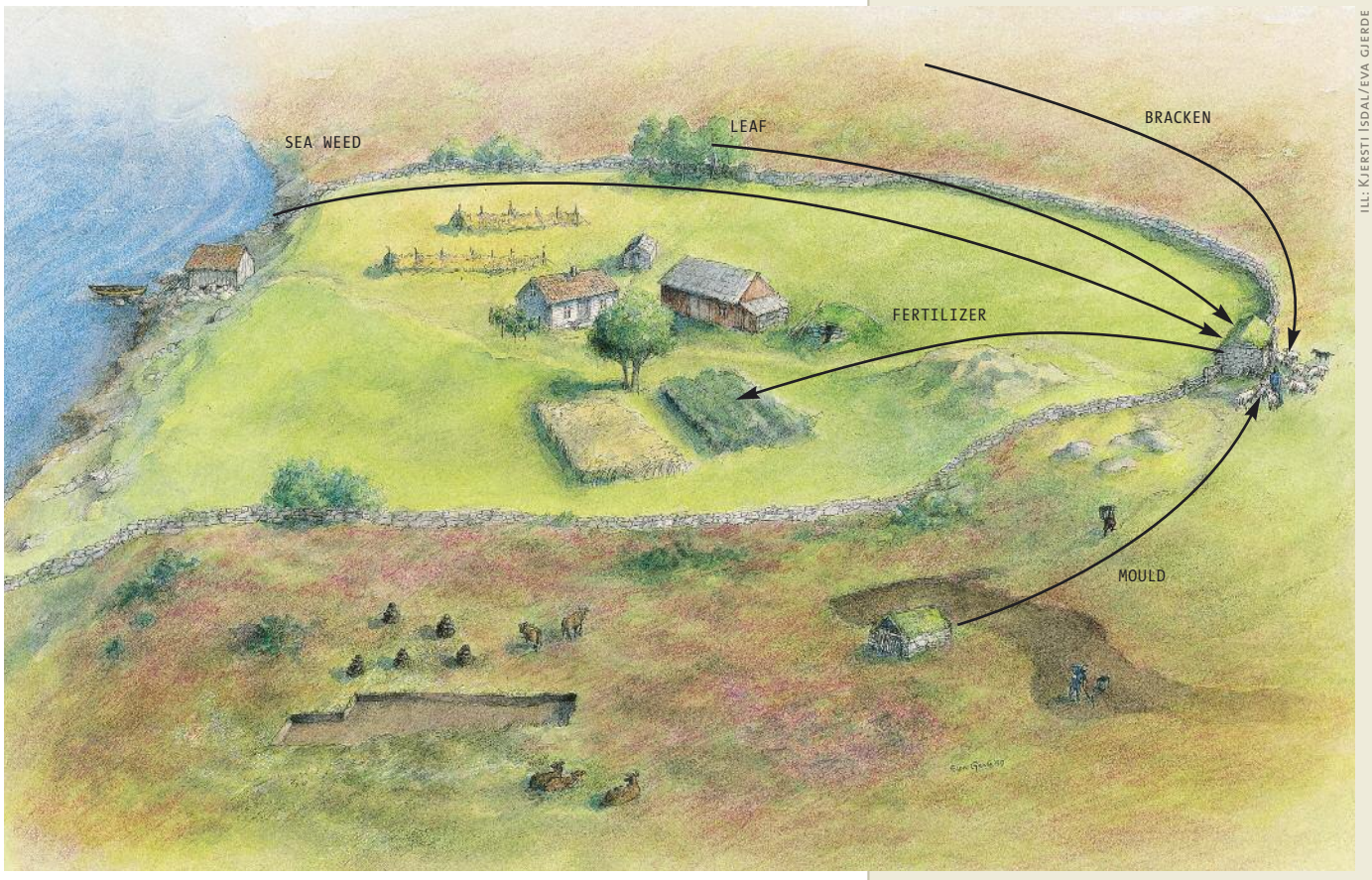


reforestation had already started by this time, as grazing had stopped completely. On Lurekalven, re-invasion by birch and pine did not occur before 1960. At this time winter grazing stopped, and summer grazing was greatly reduced, so that the total grazing pressure became less then 50% of what it had been a few years earlier. During the 1970s, grazing on Lurekalven stopped more or less completely. Reforestation continued up until the early 1990s, when much of the forest was removed and new management commenced with heather burning and all-year-round grazing by sheep.

On Lygra the heathlands were grazed by cattle and sheep unto 1960. After that time, the number of cattle was reduced, resulting in a similar spread of bracken to that described from Lurekalven. Active management by burning stopped about 1980, and the heathland grazing further decreased. Forest regrowth did not occur to the same degree as on Lurekalven, but some areas became covered by juniper thickets. In addition, some small areas were planted with spruce. In the early 1990s, active management with heather burning and all-year-round sheep grazing was taken up again in connection with the establishment of The Heathland Centre.

Relationship between the reduction in grazing pressure and beginning of reforestation at Lurekalven.

Illustration by Peter Emil Kaland



ILL: KJERSTI ISDAL/EVA GJERDE

Flow of nutrients on a traditional coastal farm.

3.3 Traditional Farming Systems

The typical heathland farms along the Norwegian coast shared a number of common characteristics. Some variation, due to differences in local conditions, may have occurred, but the basic management and working techniques were more or less the same on most farms. (The information in this chapter is partly based on Christensen 1976, Gjertsen 1975, Kaland, P.E 1979, 1986, Kaland S. 1979, Myking 1978, Mjåtvedt 1996.)

Size and organization

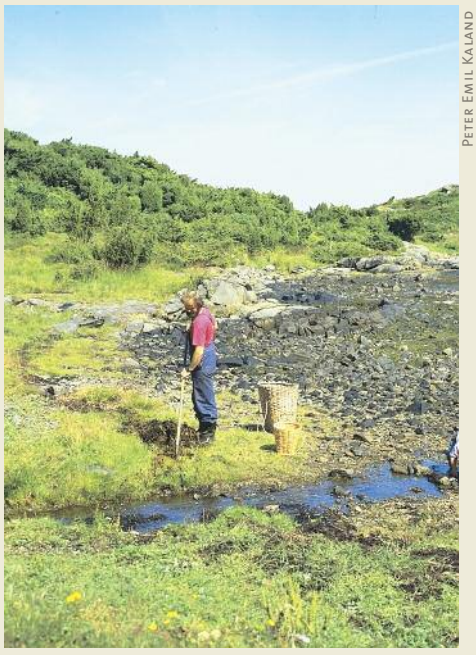
The size of the coastal farms was one of the striking differences compared with farms from most of the rest of the country. The heathland farms were small, in particular they had little arable soil. The small fields had to be cultivated every year, and therefore it was necessary to provide relatively higher amounts of nutrients to the fields than on bigger farms with space for crop rotation. The main crops of the fields were barley and oats, and after the Napoleonic Wars, potatoes also became common.

Another typical element of the heathland farms was the strong division between infields and outfields. The infields consisted of the cultivated fields and hay meadows for the production of winter fodder. The outfields consisted of grass and heathland for livestock grazing. Usually there was a boundary, often a stone wall, separating the two parts of the farm. The outfields comprised by far the biggest part of the farm, often ten times the size of the infields.

Flow of nutrients

In order to produce a steady supply of food from the cultivated fields, it was important to transfer sufficient quantities of nutrients from outside into the infield system. As long as commercial fertilizers were unavailable, the main source of nutrients was the outfields. One

Collecting of seaweed was important to provide sufficient nutrients for the fields.



PETER EMIL KALAND

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Collecting of dry, crumbled peat to use for bedding in the byre.

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Because of the mild winters on the coast, traditional breeds of livestock can graze outdoors in the heathlands.

method was to collect as much manure as possible from the livestock when they were grazing the outfields, and carry it to the infields. This was facilitated by building small summer byres where the livestock stayed during the night. These special byres were usually situated close to the outfield/infield border (see chap. 3.4).

In addition, the farmers used to collect dried, crumbled peat from special sites. This was used as bedding in the byres, often together with dried straw, bracken, heather and seaweed. Sometimes minerogenic soil was added to this bedding mixture. In this way, the production of the infields was balanced by the availablity of resources and the number of livestock it was possible to graze in the outfields.

Another source of nutrients came from the sea. Nearly all heathland farms in western Norway had access to the sea, and seaweed, mussels and fish remains were used to fertilize the fields. In spring, when the fishing was good, if people had more fish than they could possibly eat, sell, or preserve, the surplus was ploughed directly into the fields to fertilize the soil. This was believed to give the potatoes a good start.

All-year-round grazing

In the mild winter climate on the west Norwegian coast, the ancient breeds of livestock have no problems surviving the winters outdoors. Traditionally, the small stock (sheep and goats) grazed outdoors throughout the year, whereas cattle and horses were taken indoors during the hardest winter months (December – March). This was very different from the farms further east and inland, where the snow conditions made it necessary to keep all livestock indoors for at least 6 months of the year. They therefore needed much more winter fodder than the heathland farmers.

In order to allow the livestock to graze outdoors during the winter, it had to be possible for the animals to find sufficient food. Grasslands have the best fodder value during summer, but they are of hardly any use during winter. Although heather *(Calluna vulgaris)* has a lower fodder value than grass, it retains the same value throughout the year due to its evergreen leaves. For farming based on all-year-round grazing, it was therefore essential to have large enough areas of heathland. The best overall production was achieved from well-managed outfields with a balanced mosaic of grass and heath. This gave the optimal production possible during summer, combined with sufficient fodder during winter.

Heathland management

In traditional heathland farming, it was important to get the best possible production from the heather plants. They should not be overgrazed, because then they would be too weak for winter grazing. On the other hand, if the heather plants were under-grazed, after some years their stems would become too coarse. The plant would gradually change to produce mainly wood, and thus lose its fodder value (mature-degenerative phase, Gimmingham 1972). Although, to a certain extent, this could be avoided by grazing, there would always be some areas where the heather started to get too coarse. To control this, regular burning was an important part of traditional heathland management.

It was important that the heather burning was conducted correctly, and at the right time of year. Therefore the farmers always burned their heathlands during the winter or early spring. With the right weather conditions, it was then possible to burn away most biomass above ground without destroying anything in the soil. The first shoots would start to sprout only a month or two after burning, and in less than six months the burnt surface would be green again.

It was usual to let the sheep graze on the newly burnt surface. They benefited from the new shoots rich in vitamins, and at the same

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Traditional heathland burning at Lurekalven.

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After burning the heather plant can sprout already the following summer.

time they eliminated all seedlings from trees, shrubs and other species which germinated on the burnt areas and could eventually have reduced the grazing quality of the heathlands.

The frequency of burning very much depended on the overall grazing pressure. In order to keep maximum production of young heather plants, a 10-year burning interval was recommended (Kvadsheim & Sundfør 1922). However, it was not usual to burn that often. It was also preferable to burn several small patches instead of large areas. This facilitated seed dispersal from the surrounding vegetation onto the newly burnt surface.

In addition to heather burning and grazing, the third management method was heather mowing mainly for collecting winter fodder. As much as one third of the winter fodder on the farms could be heather. Traditionally the heather was collected during the winter and early spring when the fodder was needed. It was normally mixed with hay and straw and some water added before it was given to the cattle.

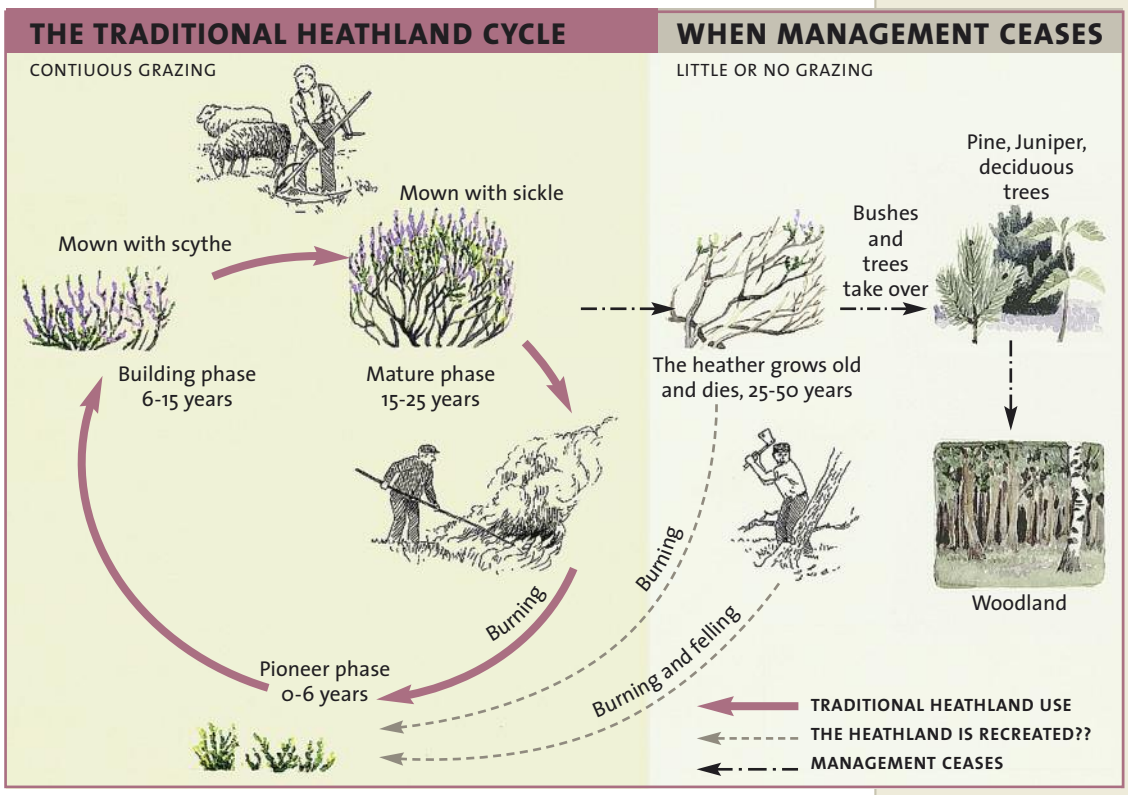

Illustration:
Peter Emil Kaland
ed Hazebroek

Peter Emil Kaland

Traditional heather mowing.

The ancient sheep breed

Traditional farming was based on a much greater variation in livestock breeds than today. Regional breeds of cattle, sheep, goats, pigs, etc. existed, and they were specialized to benefit from local ecological conditions. Most were smaller and produced less meat than modern breeds. On the other hand they were hardier, and were much more mobile. When the development of modern breeds started in the middle of the 19th century, the ancient sheep breed was the raw material which was partly interbred, and partly mixed with breeds from abroad. The result was more productive breeds, which gradually took over from the ancient breed which then more or less disappeared.

The ancient breed of sheep, which had been common along the coast of western Norway through centuries, has however survived on a small group of islands called Austevoll, south-west of Bergen (Løne 1976, 1991). In this fishing community they did not fancy modern breeds very much. In addition to the genetic diversity of the local breed, they also preserved the traditions of how to keep them and to work with them, knowledge which had disappeared from the rest of the coast.

Over thousands of years, this ancient breed became adapted to the climate of the west coast of Norway. The sheep became specialized to survive the winters on the heathlands, even when the ground was covered with snow and ice. In addition to heather and grass, they ate seaweed from the shore, or shrubs if available. If necessary, these animals could eat almost anything. They were also very hardy and resistant to both frost and sickness.

The rounding up of the sheep was a community activity. It took place twice a year, firstly in June to mark the lambs and cut/gather the wool, and secondly in September/October when the sheep were slaughtered. The outfields were used in common, even after land reallocation, and after the sheep were gathered, each farmer sorted out his own animals.

The animals are small, much smaller than modern breeds. They run very fast, climb like a goat, and can jump over a tall man without any difficulty. Both the rams and the ewes are horned, and they have very short tails, indicating that this a very primitive breed. Within a standard flock, all common colours of sheep are found, from white, grey and brown, to black. They have very strong flocking instincts, are fiercely protective of their lambs, and quickly flee from any possible kind of threat.

The wool has very special qualities: it is double, with a thick inner coat of more or less felted, lanolin-rich, fine wool, and an outer coat of long threads, which repels the rain. The animals shed their wool in late spring /early June. At the right time, it can be drawn off the ani-

Svein Haaland

The old Norse breed of sheep is very hardy and adaptable. The animals easily survive outdoors during winter on the coast of Norway.

Peter Emil Kaland

Rounding up of sheep in June. The green part of the slope has recently been burnt.

mals in one piece, giving the best quality wool. However, the wool is useless for modern spinning machines and cannot be used industrially, but it is wonderful for artists and other craftsmen.

The typical slaughter weight for a lamb is 8-10 kg. This is less than 50% of the weight which is expected from a modern lamb. The meat contains very little fat, and has an especially good taste because the animals have lived out in the heather throughout the year. Therefore, there has been a rapidly growing market for this meat over the last 10-15 years.

In the 1950s, the future of the ancient sheep on Austevoll became threatened. Because of the low slaughter weights, the farmers were badly paid for the meat, and they got nothing for the wool. They therefore started to introduce modern breeds to Austevoll, and the population of the original breed was reduced to about 1000 animals. Thanks to an initiative from the local agricultural officer, university experts and others became aware of the special qualities of this breed. The interest to secure it for the future started to grow, both in Austevoll and elsewhere on the coast. Today the winter population has grown to more than 20,000 animals of this special breed, spread out along the entire west coast of Norway. The meat has become very attractive and is sold as a special quality product.

Peat cutting

It was difficult for the local population to collect enough wood for fuel in the open landscape on the coast. Old stems and roots were taken from the peat bogs, and driftwood was collected from the seashore. In years with good fishing, they might also be able to buy some wood. However, this was not enough. The main source of fuel was dried peat. In the moist climate on the west coast, most farmers had no problems to find suitable peat bogs on their land.

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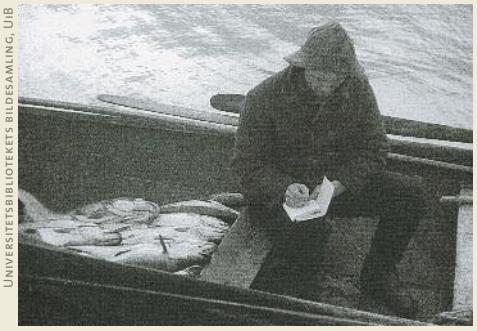
Turves of peat laid out to dry on the ground. Later the dried peat will be stored in the stone house.



A fisherman notes his catch of the day.

The peat was cut into rectangular turves and laid out to dry on the ground. The dry peat was stored in special houses, see chapter 3.4. The work in the peat bogs was a communal activity for everybody on the farms. It normally took place after the spring work on the fields was finished, and before the haymaking started. The heating value of the peat could vary substantially, the better decomposed the peat was, the higher its heating value. Good peat could have a heating value higher than dry wood.

The wettest peat bogs produced peat of the poorest quality because of their high content of un-rotted fibres. Blanket bogs covering the slopes were normally regarded as giving peat of much better quality. In some places, therefore, peat cutting has completely changed the land surface.

On Lygra electricity arrived about 80 years ago. Many people preferred the old type of heating, and peat cutting did not cease completely until after World War II. Even today evidence of peat cutting can readily be seen in many places in the outfields.

The combined farming/fishing economy

Most heathland farms in western Norway gained a living from both farming and fishing. This was possible because of the proximity of the sea, and because much of the livestock farming was based on all-year-round grazing, and therefore the coastal farmers did not need to spend so much time on the collection of winter fodder as the inland farmers (see above). Instead they could use their time for fishing. In this way, the system of all-year-round grazing made it possible to utilize the resources of both land and sea.

Fishing was important for two reasons: it was an extra source of food giving increased security, and made the population on the coast less vulnerable to agricultural failure; and it was the easiest (and often the only) way to achieve monetary incomes from the farms. There were two types of fishing industries in the districts around Lygra. One was herring fishing based on the use of big nets which were operated on a cooperative basis. Lygra was divided in three such cooperative groups. The other type of fishing industry was the delivery of fresh fish to the market in Bergen. The fish were supposed to be alive when they were sold. They were therefore stored in a wooden box with small holes, towed behind the boat. The entire operation of catching the fish, sailing/rowing into the town, selling, and travelling home, could easily take two days.

There was a distinct gender division concerning the work at sea and on the land. Normally women never took part in the fishing or worked at sea. The men did contribute to the heaviest work on the farm, such as the tilling of the fields, peat cutting, haymaking, etc, but the everyday work was done by the women and children. Their involvement in fishing could vary from generation to generation on the same farm. Some farmers rarely went to sea, while others were hardly ashore.

Fishermen arriving Bergen in order to sell their catch.

Peter Emil Kaland

Cultural layers from earlier settlements are often found below the cultivated fields of the present farms.

3.4 Cultural heritage, monuments and architecture

Cultural heritage

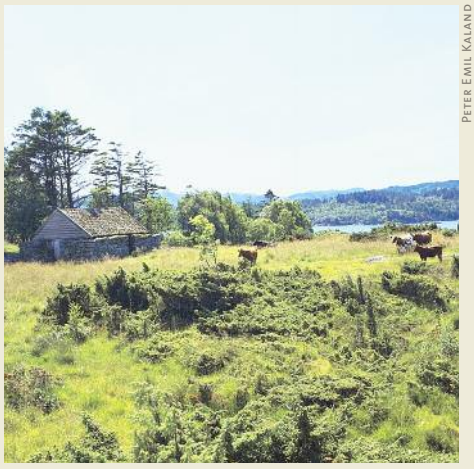
The man-made coastal heathlands are in themselves a cultural heritage of substantial age. In addition to their biological heritage, the landscape contains many physical traces of past human activities, both visible and invisible. The oldest remains of human occupation on Lygra cannot be seen on the surface today, as they are buried below the peat. These are the remains of dwelling places from the late Mesolithic/early Neolithic transition (7000-5000 years old). They are present at several locations on Lygra, but most are situated along the sound towards Lurekalven.

These kinds of archaeological finds are quite common in the coastal area of western Norway. They are normally found 10-20 m above the present sea level, and they reflect the living area of the fishing population at the time. People preferred to live close to the seashore, which, at the time, was situated higher than today (see chapter. 3.2). In particular, they stayed along the sounds between the islands and the streams going into the basin of Lurefjorden.

The oldest evidence for the agricultural settlements is more difficult to find because tilling and soil cultivation has caused disturbance over a long time period. Archaeological finds, dated to the late Neolithic and the early Bronze Age, indicate that agriculture occurred during these periods. Remnants of a Bronze Age cultural layer from a dwelling site also indicate that the forest, at least on central parts of Lygra, had been cleared away by this time.

Archaeological material from the Iron Age, in particular the younger Iron Age, is very rich on Lygra. Three relatively large burial mounds from the younger Iron Age are situated along the west coast just north of the infield/outfield boundary wall on Ytre Lygra. Similarly located on the east side, is a grave field of about 10 smaller burial mounds of the same age. None of these have been excavated, but the large barrows were plundered in ancient times and were inspected by people from Bergen Museum in the early 19th century. The dates are based on their findings (Fett 1965).

In addition to the remaining visible burial mounds, many mounds no longer exist, due to cultivation, road building, etc. Some were of considerable size. The many finds that have been collected through time demonstrate a rich and prosperous farming community during the Viking Age. In early Medieval times, Lygra became a part of the King's Manor and is recorded in the sagas. The King set up his «Ting» (court) here several times, and the place can still be pointed out according to local tradition.



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Much of the cultural heritage is related to the traditional land use activity and its influence on the landscape.

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Section through a charcoal pit from the outfields at Lygra.

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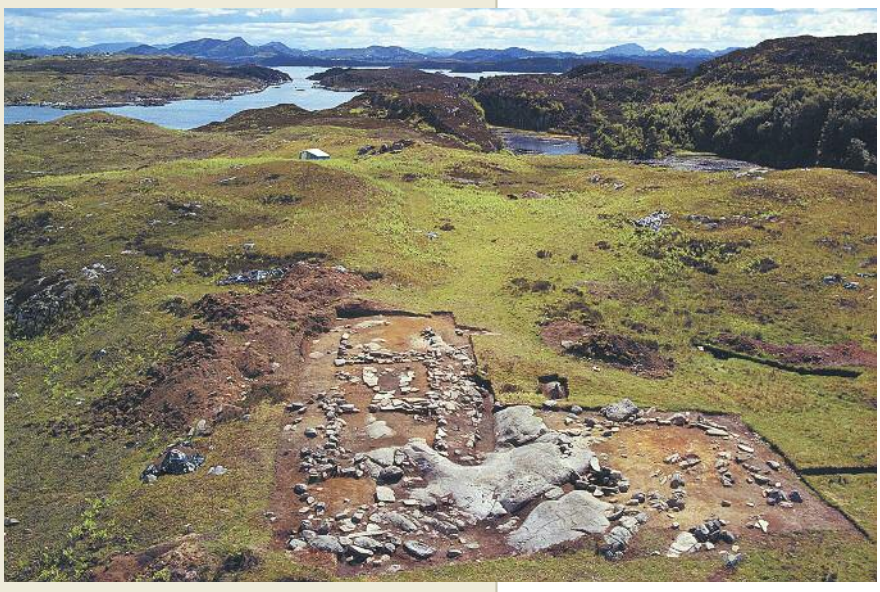
Section through one of the fossil fields at the deserted farm at Lurekalven. The black layer in the bottom is the remnants from the original soil surface before cultivating.

The house remains after the farm settlement at Lurekalven.



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In the outfields of Ytre Lygra more than 30 charcoal pits have been found with diameters of about 1-2 m. They are interpreted as vestiges of charcoal production for use in the local smithies. Two of them have been dated to the Viking Age. If this is a representative age, it is difficult to understand why they are situated here, and from where the raw materials (wood) originated. There is no reason to assume that forest was available on Lygra at this time, and the deforestation of Lurekalven had taken place about 200 years earlier.

The excavated deserted farm on Lurekalven

The main excavations on Lurekalven took place from 1975-1978 (Kaland S. 1979, 1987). They revealed the remains from two dwelling houses and one outbuilding which probably served as a byre and barn. One of the dwelling houses was a longhouse divided into four. This may have been a construction consisting of four small houses built together in one long row, similar to later traditions in the area.

The house remains are clearly visible today. The excavated areas are covered by heather, but as long as this is managed (grazed and mowed), the stone walls and fireplaces are easily recognizable. Because the houses are situated in an area of sandy soil with good drainage, no organic material has been preserved, and it is therefore impossible to decide with certainty how the houses were constructed. The lack of postholes and remnants of stone foundations do however indicate that at least parts of the houses were made from horizontal timbers. However, this building method may have been combined with vertical posts in part of the construction, as was quite common traditionally in such composite longhouses (Brekke 1992).

A lot of finds were found inside the two dwelling houses, all everyday tools of stone and iron, common in use in both the younger Iron Age and the early Medieval Age. Shards of ceramics from England, Germany and southern Scandinavia demonstrate that the economy of the farm was good enough to buy imported goods, probably in Bergen. One of the shards dates from the late 14th century, indicating that people on Lurekalven survived The Black Death (1349). The settlement continued for at least some decades afterwards.

Lurekalven is very well suited for the reconstruction of Medieval Age farming. It is an island, and detailed investigations have shown no traces of other settlements. Therefore the size of the farm can be determined precisely. Furthermore, there has been no settlement since the farm was abandoned. All traces of agricultural activity can therefore be related to the farm. Finally, the tax paid by the farm is known from written sources, and at Lurekalven it is possible to get an idea of what this really meant.

The archaeological excavations on Lurekalven were part of a broader interdisciplinary investigation of the island. The main focus was not only on the houses, but on the whole farm and how it had been run. It was possible to map the cultivated fields, and the stratigraphy of the cultivated soil was studied from numerous trenches. In this way the beginning of cultivation was dated to about 750 AD. As mentioned in chapter 3.2, this is contemporaneous with the deforestation of the entire island, and from the very beginning this was a heathland farm.

Another result of the study of the cultivated fields is that they were heavily manured all the time. In addition to the livestock dung, peat, and soil from the outfields were added in such quantities that

the soil thickness on average increased more than 2mm per year. The soil profiles of the cultivated fields on Lurekalven are of the same type as the profiles of «plaggenboden» in the coastal areas of Germany and Denmark, where a similar manuring system was used (see also chapter 3.3).

The total cultivated area of the farm was about 1 hectare, mainly producing barley and some oats. The total area of possible haymaking was about 7 hectares, and the rest was heathlands. Based on the production capacity of these vegetation types, and the estimated requirements of the Medieval Age breeds of livestock, the maximum number of stock which could have been kept on the farm has been calculated to be about 60 sheep and 15 cattle (S. Kaland 1979).

Local building traditions and restoration

In a cultural landscape such as the heathlands, cultural heritage is both related to archaeological sites and to numerous man-made physical structures of everyday life. These may be small buildings for different purposes, slope walls, fences, paths, etc. When the outfields are no longer in use, these structures lose their functions and start to deteriorate and decay together with vegetational degradation. For the present-day visitor, unfamiliar with their past use, it is often difficult to understand what kinds of activity they represent.

On Lygra, a selection of such structures, mainly different types of buildings and stone walls, have been restored in order to visualize the total functionality of the landscape. The boathouses are the easiest to understand. Rapid access to the sea was extremely important when living on an island such as Lygra, and therefore many farms had a double set of boats and boathouses, one on each side of the island. A total of 7 boathouses have been restored.

The boathouses were situated in natural bays, and the different farms used to have their boathouses together side by side, with the gables facing the sea. They could be made of stone or wood, if the latter, normally of a vertical post construction. In the gables they had a large opening, outside which was a slope covered by a frame of parallel aspen posts reaching down well into the sea even at low tide, so that it was easy to pull the boat in and out of the house under all weather conditions.

Another kind of small buildings are often found close to – or actually built into – the stone walls separating the infields from the outfields. They were used as a kind of summer byre to house the cattle during the nights when they were grazing close to the infields. The animals did not need to stay indoors at night, but this was a convenient

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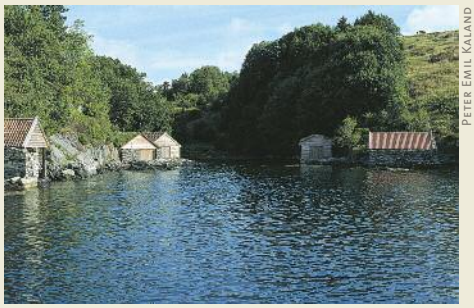
Small house for storing of crumbled peat.



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The activities related to the sea are an important part of the coastal cultural heritage.

EGIL KORSNES

Dried peat for burning, ready to be stored in one of the many houses for this purpose at Lygra.

PETER EMIL KALAND

Approximately 1.5 km of dry stone walls have been restored at Lygra.

method of collecting dung. These constructions were called «boundary wall byres» and were generally made of stone (see ill. p. 36). The door was in the outfield side of the building, and in the wall facing the infields was a small hole through which the manure could be shovelled. All farms had at least one such "boundary wall byre" because they badly needed as much nutrient-rich manure for their fields as possible.

Also scattered around the heathlands were peathouses, in which dried peat for fuel was stored. They were normally situated on the edges of good peat bogs, and were simple stone constructions. In the moist climate of the west coast of Norway, it was important to store the peat indoors as soon as it had dried during the summer. Normally the peat was transportet home during the autumn or in the winter when it was needed. Closer to the infields, the farms had their storehouses for the crumbled peat used for animal bedding. They were similar to the peathouses, but smaller. A total of ten heathland stone buildings of the different types described above have been restored on Lygra, but there are still ruins of several more dotted around the landscape.

Irrespective of the building materials or construction principles used for the rest of the building, the roof was always carried on a wooden frame. This was sometimes covered by slates, but usually the roof was covered with turf. Such turf roofs were constructed in a special way. The wooden frame was covered by some simple boards, to stabilize the roof and to give it the necessary physical strength. To make it waterproof, the boards were covered by seven layers of birch bark. This was then covered by the turf to keep the bark layers in place. The roof was held down by stones, and in exposed areas covered by a net, to prevent the wind from blowing the turf away. The roof was bordered by a log on the lower edge, fastened to the wooded frame in a special way to prevent the covering layers from sliding off the roof.

Typical farmstead of a traditional coastal farm, with clusters of small houses partly built of stone.

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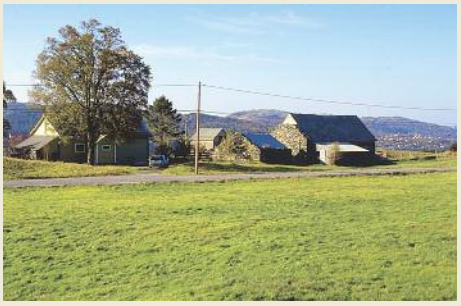


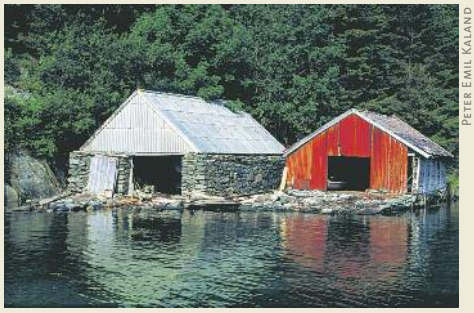
In addition to the buildings, about 1,5 km of dry stone walls have been restored. The most important wall was that between the infields and outfields, but the property boundaries between the farms were also made of stone. They were about 1.5-1.8 m high, and normally consisted of a double set of stone walls with gravel and small stones in between. This type of wall needed to be maintained every spring, because the weather (particularly the frost) altered the positions of some of the stones. During the last 50 years, other fencing materials have taken over, and most stone walls have fallen down and are lying in ruins because they are no longer needed. The knowledge of their construction and repair is about to disappear, but when built properly, the walls greatly enhance the beauty of the landscape.

In the infield area, four dwellings, three barns/byres and one smithy, all from the old cluster settlement, still exist, but none of them are in their original locations (see chapter 3.6). The owners of the dwellings have received economic support for restoring the outsides to their traditional appearance. The three barns have been totally renovated (one of them had fallen down after a storm). They have all been constructed according to ancient construction principles using vertical posts (Brekke 1992).

A special tradition in this area was to build a protection wall of stone on the most exposed end of a building. This was not part of the construction, but an independent addition to the house, made up like a dry stone wall (Brekke 1975). One of the restored barns has such a wall, and the new Information Building also shows this principle. This can also be seen on other buildings on Lygra, even on houses which are still inhabited.

Another typical stone construction of the farmsteads is the potato cellar. This a small circular stone building, covered by turf. There is a small door on the side, and storage conditions for potatoes inside these constructions are excellent. Unfortunately none are extant at The Heathland Centre, but they are frequent elsewhere on Lygra.

The use of stone for construction purposes is of course a very old tradition. Many of the stone buildings are however not that old. In the beginning of the 19th century there was a public campaign to encourage the farmers on the coast to use more stone as building material. Much of the stone architecture seen today is therefore from that period.



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Restoring of boat houses and the surrounding landscape at Lygra.

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Traditional dwelling house with protection stone wall in one of the ends.

KRISTINE EKELUND

The flower rich meadows give rich contributions to the biodiversity of the coastal landscape.

INGER ELISABETH MÅREN

Cross-leaved Heath (Erica tetralix) visited by a honey bie. Because they flower earlier than Calluna, the honey from the Erica species can be produced by itself as a speciality.

3.5 Biodiversity

Vegetation and flora

The vegetation of the northern part of Lygra and Lurekalven is dominated by heather *(Calluna vulgaris)*. Central parts of Lygra consist of cultivated infield areas and some forest (mostly reforested meadows), and the southern part of Lygra is former heathland which has been completely reforested during the last 60 years. The forests on Lygra today are dominated by birch *(Betula pubescens)*, but other frequent tree species are aspen *(Populus tremula)*, oak *(Quercus robur)*, hazel *(Corylus avellana)*, elm *(Ulmus glabra)*, lime *(Tilia cordata)*, rowan *(Sorbus aucuparia)*, pine *(Pinus sylvatica)* and planted spruce *(Picea abies)*. Some parts of Lurekalven were also reforested by the same type of vegetation, but most has been removed during the landscape restoration since 1992 (see chapters 3.2 and 6.4). This chapter will focus on the biodiversity of the heathland areas, mainly found at The Heathland Centre.

Phytogeographically, the heathlands of Lygra and Lurekalven belong to the boreo-nemoral zone (Moen 1999). They can be followed north to Stad (northwestern Norway). The islands are situated in the inner part of the traditional open heathland zone. For this reason the most frost sensitive species are not found here, e.g *Erica cineria* which has its eastern limit on the islands just west of Lygra. A few kilometres further to the east, pine forest of southern-boreal type takes over (Øvstedal 1985, Moen 1999).

In areas of well-managed heathland, three types can be separated depending on soil moisture and slope inclination. The highest frequency of herbs and grasses is found in the dry heath, In the wet heath

(and on peat bogs) *Erica tetralix* and *Scirpus* species dominate together with *Calluna*. On northeast exposed slopes, species such as *Blechnum spicant* and *Cornus suecica* are common, together with the usual heather vegetation. On Lurekalven there are many gullies with wet fens in the bottom, covered by thickets of *Salix* shrubs.

In areas of good soil, grasslands are common. However, most of the grassland areas are overgrown by bracken *(Pteridium aquilinum)*. Bracken has also spread into some of the heather areas (see chapter 6.4). On grasslands and on badly managed heathlands, thickets of juniper *(Juniperus communis)* can dominate, but most of this has been removed during landscape restoration (see chap. 6.4).

Norwegian Institute of Nature Research (NINA) has during several years worked with mapping the biodiversity at The Heathland Centre. Although this project is not finished yet, some prelimnary conclusions can be drawn, and the following has been written by them:
The island contains a rich variety of habitat types more or less affected by different management regimes, such as grazing, fire and logging. Seven main EUNIS habitat types *(http://eunis.eea.eu.int/habitats.jsp)* are represented.

The seashore contains Marine habitats (A) such as A1 Littoral rock and other hard substrata, A2 Littoral sediments (mainly coarse material) and Coastal habitats (B) including B3 Rock cliffs, ledges and shores. One lake can be classified to the category C1.2 Permanent mesotrophic lakes, ponds or pools.

The major part of the island is covered by managed heathland, shrub, mires and grassland. Mire, bog and fen habitats (D) are evenly distributed in recessions and on gentle slopes and consist of D1.1 Raised bogs, D2.2 Poor fens and D2.3 Transition mires and quaking bogs. The managed heathlands belong to the EUNIS type F4 Temperate heathland and both F4.1 Wet heathland and F.2 Dry heaths are common. All different growth phases after fire are represented such as the pioneer phase, building phase, mature phase and degenerating phase (Gimmingham 1972). Small patches of Mesic grassland (E2) occur within the heathland. Small woodland sites remains after intensive forest logging. Some can be classified to G3 Coniferous woodland and other to G4 Mixed deciduous and coniferous woodland.

The large variation in habitat types should imply a high floristic diversity. However, the bedrocks and the sediments on the island are rather poor in nutrients, and the diversity is at a medium level. Approximately 200 vascular plants are recorded within the different habitat types, in addition to several bryophytes and lichens. The plant communities are characterised by oceanic species that requires high winter temperatures and a long growing season such a as *Juncus squarrosus, Carex binervis, Hypochoeris radicata* and *Hypericum pulchrum*, while *thermophilous* species adapted to high summer temperatures are rear. However, species such as *Tilia cordata, Corylus avellana, Primula vulgaris* and *Sanicula europaea* are found on microclimatic favourable sites. A few species are rear on the western coast of Norway due to their limits in geographical distribution, such as *Moneses uniflora* and *Agrimonia eupatoria* (Fremstad et al.1991).

The oldest *Calluna*-heath has the lowest floristically diversity, mainly characterised by heather, a dense moss layer and a few graminoids. The highest diversity is found in the late pioneer phase, building phase and transition sites to grassland, where flowering plants such as *Lotus corniculatus, Potentilla erecta, Antennaria dioica* and *Polygala sephyllifolia* are more common (Aarrestad & Vandvik 2000).

Only one Norwegian red-listed plant species (DN 1999) is recorded from the island. The moss *Leptodontium flexifolium* was found on sandy, newly burnt peat soil, and the occurrence represents the northern limit of its distribution in Europe (Aarrestad & Vandvik 1997).

Peter Emil Kaland

Revegetation the first year after burning. This phase is important for the presence of many plants and animals in the heathlands.

Inger Elisabeth Måren

Bird's-foot-treefoil (Lotus corniculatus) is common in the heathlands the first years after burning.

Inger Elisabeth Måren

The Heath Milkworth (Polygala serpyllifolia) is typical for the coastal heathlands.

Peter Emil Kaland

The best biodiversity is found in well managed heathlands.

Jon Skartveit

Butterflies from Lygra. Above: Lycaena phlaeas. Below: Callophrys rubi. Right: Saturnia paronia.

Jon Skartveit

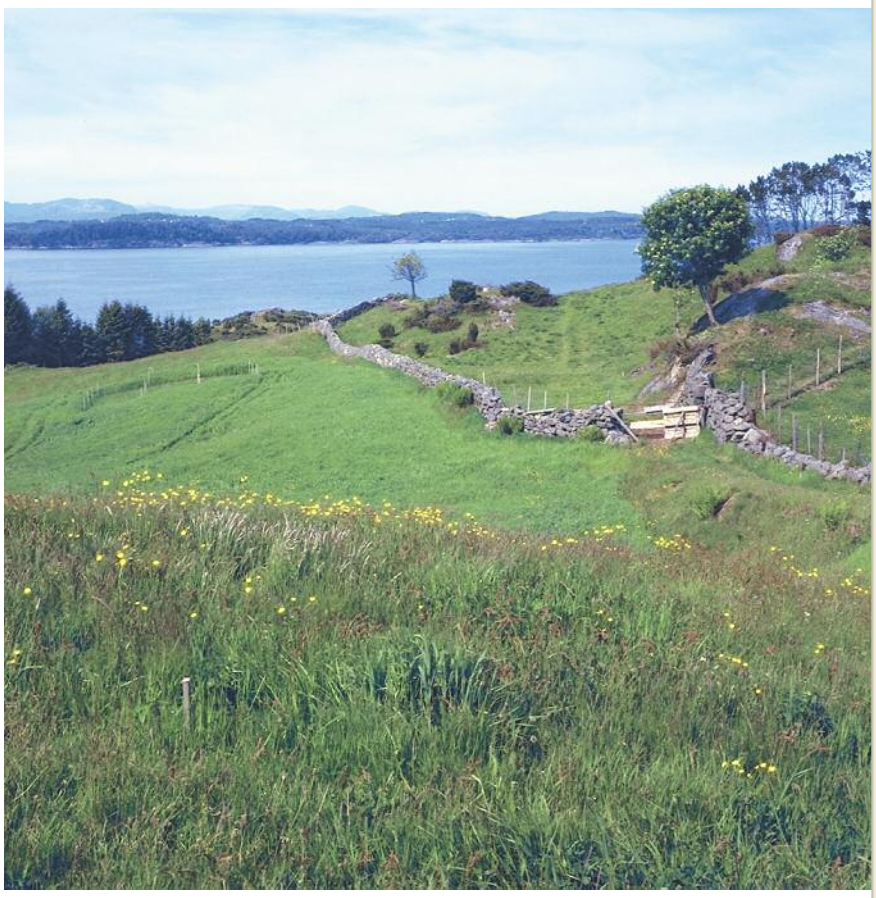
Fauna

Ongoing studies carried out by the Norwegian Institute of Nature Research have shown a relative high diversity of bird species on the islands Lurekalven, Lurøyni and Lygra with 63 observed species. The diversity is highest on Lygra due to a wider range of managed habitat types. The red listed white-tailed eagle *Haliaeetus albicilla* (DC - conservation dependent), visits the islands regularly.

However it was not found nesting in the analysed area. The red listed species corncrake *Crex crex* (E - endangered) was observed on Lygra in the 1990ies. The introduction of chopper forage harvester might be a contributing factor for the disappearing of this species from the island. The most interesting part of the bird fauna is the dense population of whitethroat *Sylvia communis*, and the fact that skylark *Alauda arvensis* is more common in managed coastal heathlands than in modern agricultural landscape.

Jon Skartveit

Peter Emil Kaland



The many border zones in the landscape between areas of different land use, offer good habitats for many plants and animals.

Bjarne B. L. Andersen

The Lapwing is a popular messenger of the spring at Lygra.

Inger Elisabeth Måren

The Adder (Vipera berus) is a typical species for the heathlands of western Norway.

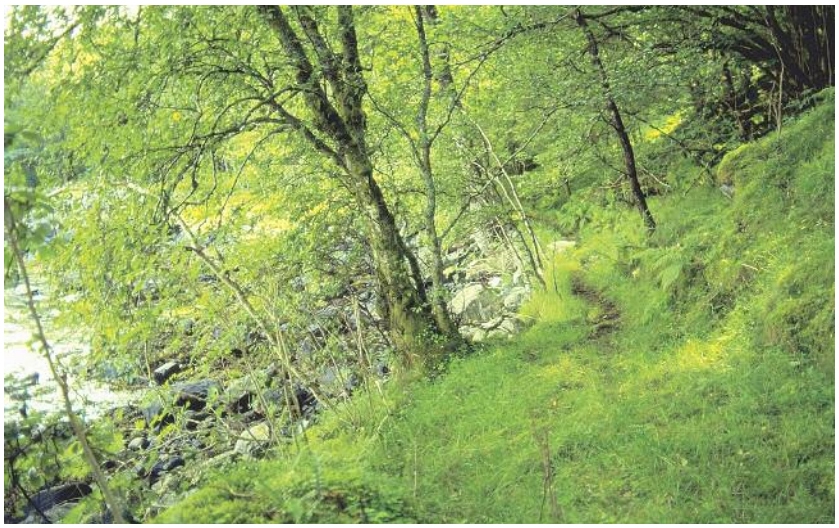
An investigation of beetles Coleoptera using pitfall traps on heathland, grassland and woodland has so far shown 180 species, of this 31 species of ground beetles *Carabidae*, 81 species of short wings *Staphylinidae* and 68 species from 18 other families. These data have not yet been treated; however it looks like the diversity is highest on the grasslands.

Main conclusion

The relative high diversity on Lurekalven is probably caused by the management regime with regularly burning and grazing by sheep, contributing to the maintenance of a variety of habitat types.

Below: Dragonflies are common in wet areas on Lurekalven. On the picture, a specimen of Aeschna juncea is resting on a birch.

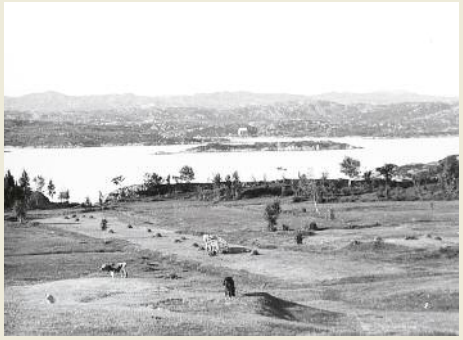
Peter Emil Kaland



Jon Skartveit

Small areas at Lygra close to the seashore still have broad leaved forests.

LUDVIG LYGRE



Spring work on Ytre Lygra, about 1910.

LUDVIG LYGRE

Two of the farms at Ytre Lygra, about 1910. The houses have just been removed from the old clustered farmstead, and are still there today.

Infield areas (green/yellow) and outfields (blue) at Lygra in 1876.

3.6 Population and settlements

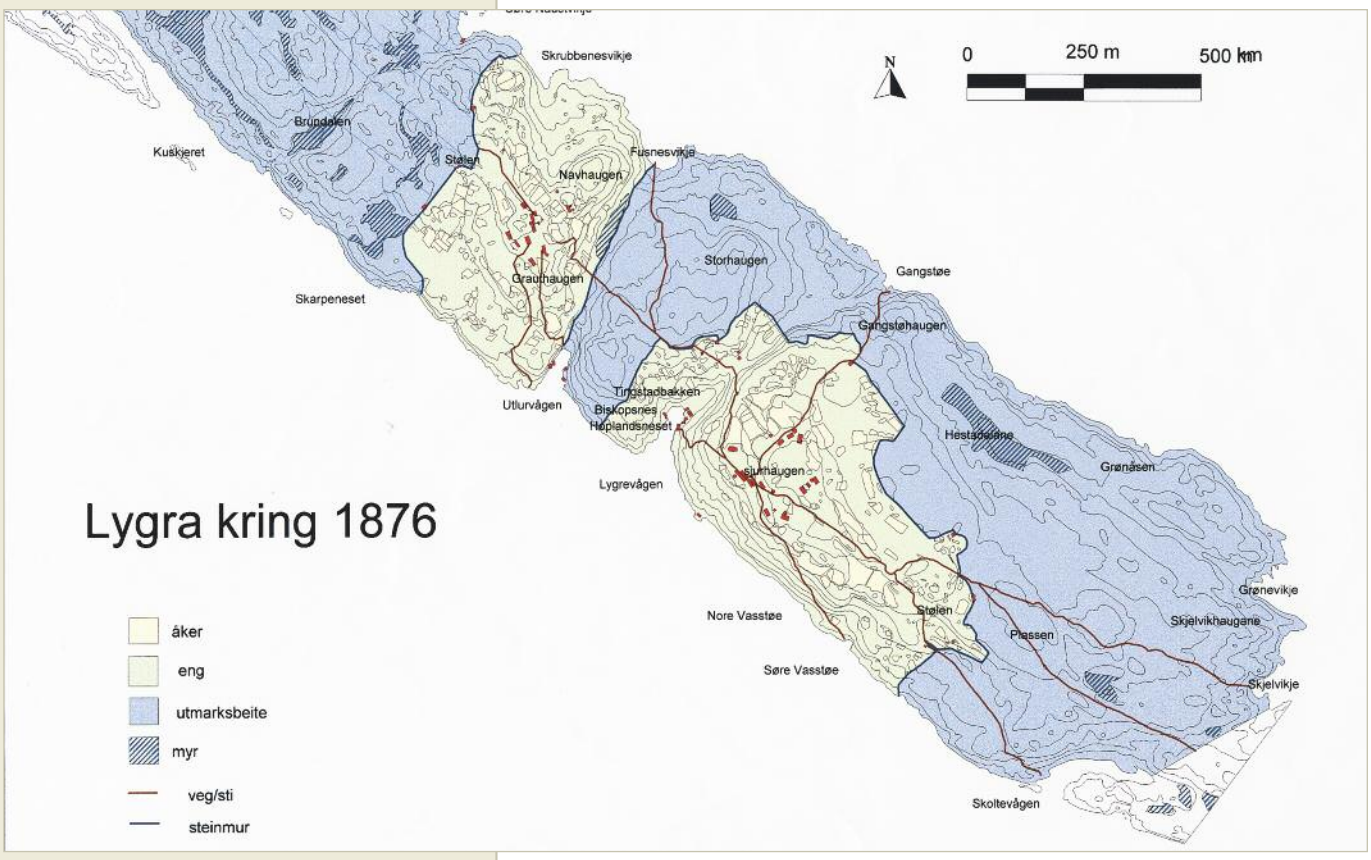
The traditional settlements of Lygra were divided into two named farming communities, Indre Lygra and Ytre Lygra. Ytre Lygra consisted of five farms and Indre Lygra of twelve. Nearly all the buildings belonging to the different farms were situated in two clusters, one in each community. The reason for this was the old and very complicated system of ownership of the land, where each field or meadow had many owners. This made it impossible to put up a new building outside the limited common settlement area.

The great change in this pattern came with the act of land re-allocation of 1857. If the owner of one of the farms wanted, the whole farming community was mapped by specialists and all the owners acquired an area of land equivalent to the many pieces he had in his possession from before. In most cases the farmers demolished their houses and rebuilt them on their new land. Today, on Ytre Lygra, the old communal farmstead (see map) is completely empty, and only the road passes through the old settlement ground. But, as mentioned above, a total of 8 houses still exist which originally were a part of the farming community.

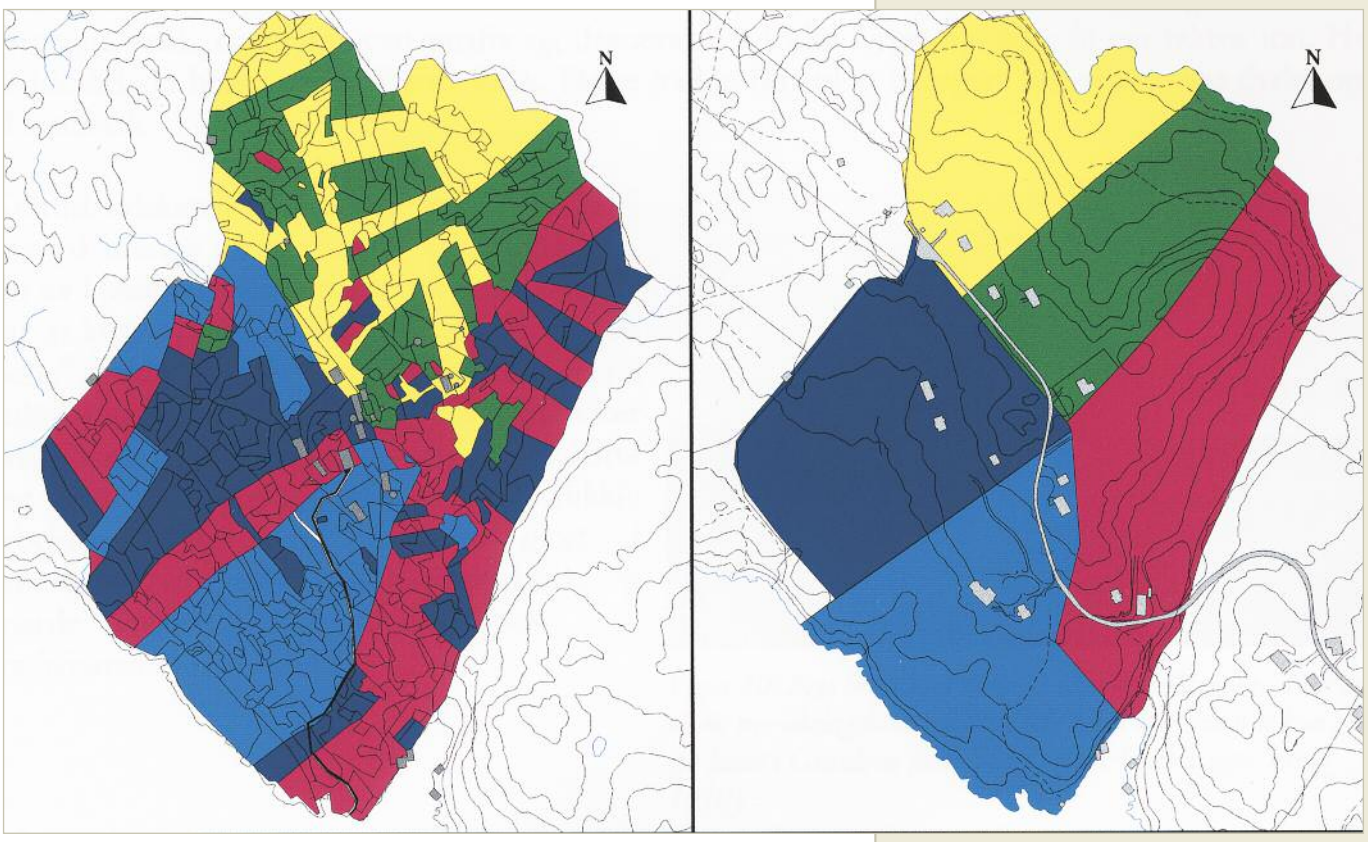
Today seven people live on two of the farms at the Heathland Centre. The total population of Lygra is about 50. However, during holidays and weekends the number strongly increases as many families then stay here. This reflects the fact that only a couple of generations ago, many more people than today were living on Lygra. In 1900 the population at Lygra was about 120 (Isdal 1998).

Lygra was traditionally a place of high population density. This was related to the good farming facilities and the fact that the island had a very strategic location for travelling by boat. The distance to good fishing places was short, and it was easy to get to most places of importance in the district which could be reached from the sea. The main sailing route to Bergen passed the island, and as long as sea transport was the most important way of travelling, Lygra was a cen-

KALAND/ISDAL



Infield land properies of the five farmers at Ytre Lygra before and after the land allocation.



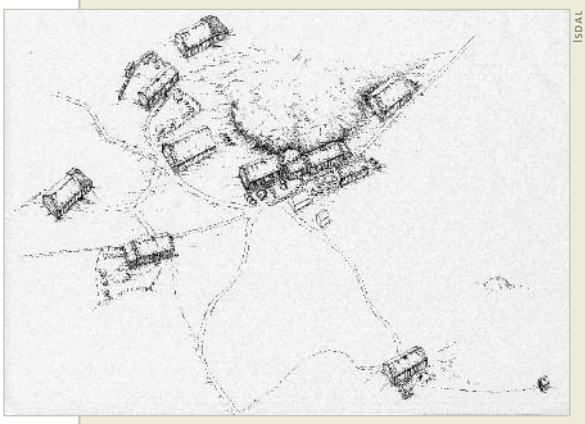
KALAND/ISDAL

tral place in this part of western Norway. There has been a church since Medieval times (the present church is the fourth), and there was a dairy by the main harbour, and also a small shop.

The de-population of Lygra fits into a general pattern along the coast of western Norway, caused by the decreased economy in farming and increased specialization both within farming and fishing. People had to decide to be either a farmer or a fisherman. The traditional combined subsistence became more and more difficult. More and more people found themselves jobs in the towns or at industrial concerns in the district, such as the oil refinery at Mongstad. The subsequent effect is that more and more farms have become holiday houses. This is the case with three of the five farms on Ytre Lygra. It is also typical that those who want to continue farming, have to use the production areas from many neighbouring farms in order to survive.

The de-population of Lygra has also been related to changes in transportation from the sea to the land. Over generations, Lygra was a central place of easy access, but today it is situated far from the main transport routes. However, during the last five years, development has started to change. A small number of people have moved to Lygra, partly because of the establishment of the Heathland Centre. Although conventional farming is still decreasing, it gives some hope for continued economic activity on Lygra in the future.

The old clustered farmstead at Ytre Lygra before the land allocation.



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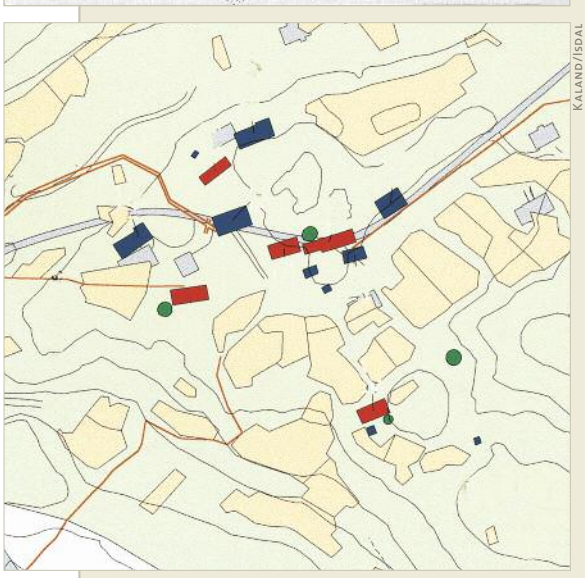


KALAND/ISDAL

LUDVIG LYGRE

Landscape picture from 1910. The clustered farmstead at Indre Lygra was situated behind the church, which is still in use.

4 Current objectives for conserving heathlands

Heathlands as cultural landscapes

Conserving heathlands is a novel idea in Norway. Far into the 20th century they were regarded as being some of the poorest and most barren types of landscapes present in our nature. They were useless for modern, intensive agricultural production, and they received little attention from scientists, humanists, or artists. During the 19th century national romantic movement (which was very strong in Norway), the heathlands elsewhere in Europe received great attention from the artists, but in Norway it was the mountains, the waterfalls, and the fjords which were their focus. Very few paintings were made of the heathlands.

As the natural conditions for agriculture are very limited in Norway (only 3 % of the land surface is possible to cultivate), traditional farming was also based upon all kinds of vegetation and other types of available natural resources. These had to be utilized in a varied and sustainable manner. In this way a diversity of cultural landscapes developed all over the country, including the heathlands. All such types of modified nature were the results of how innumerable generations of highly skilled farmers had used their land in order to survive.

The ancient ways of land use have gradually disappeared over the last 60-100 years. In response to this, nature has changed and many of the semi-natural cultural landscapes have disappeared. To the inexperienced eye, most of the remaining landscapes are perceived just as nature. However, today more and more people are starting to realize the cultural and historical origins of many of their most familiar types of landscapes.

In the heathlands the effect of former land use can easily be seen in the present landscape.

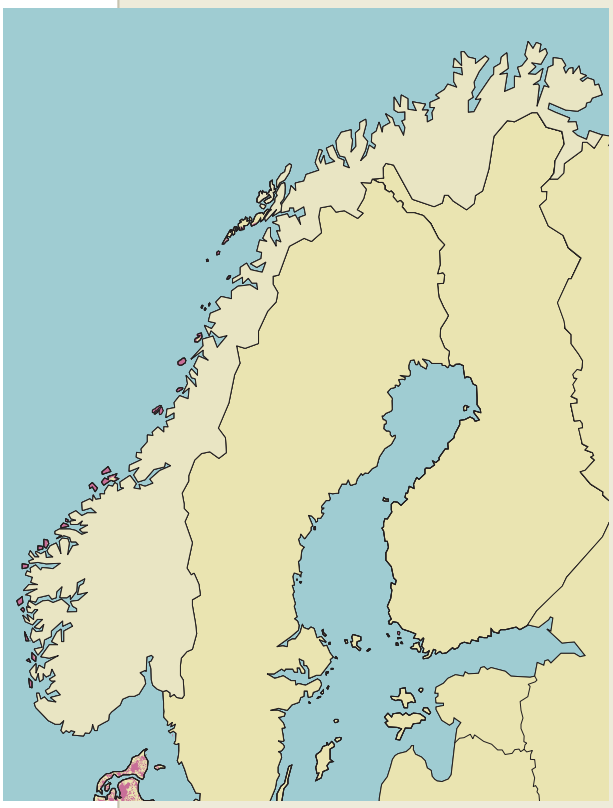
Peter Emil Kaland

The heathlands are very good examples of how a type of landscape today is understood differently from only a few decades ago. Then there were many heathland areas around the coast, and they were regarded as part of the harsh natural conditions from which coastal populations had to make their living. Today the heathlands are rapidly disappearing (see chapter 5), and it is obvious that they are not as natural as earlier believed. A completely new understanding of their history and ecology has developed from a number of research projects during the last 30-40 years (e.g. the Lindås project).

Norwegian obligations and cultural identity

Norway has special obligations regarding heathland conservation. Of the total north-south extent of the European heathlands (about 3600km), one third (about 1200km) is found along the Norwegian westcoast. Furthermore, the northerly outposts of this large common European cultural landscape are found here. Finally, the practical knowledge of heathland farming has up to present day survived much more as a living tradition in Norway than in more industrialized areas of Europe. It is therefore still possible for researchers and conservationists to achieve a very authentic landscape management when they cooperate with skilled and experienced farmers.

In Norway, heathland heritage is part of the coastal culture. It is the land-based supplement to the large and varied maritime history of the coast. Unlike national monuments and outstanding, high prestigious architecture, the heathlands represent the history of the everyday life of ordinary people. The knowledge about this landscape, with its vegetation, archaeology and vernacular buildings is as relevant as fishery history and boat building traditions are, for the understanding of traditional coastal subsistence and local history. Today people living on the coast are becoming increasingly aware of this, and they realize the importance of the heathlands for their feelings of identity.



Distribution map of Calluna dominated heathlands in Norway. (Source: Peter Emil Kaland)

Træna is the northernmost place in Europe were heathland burning in the past has been documentet with certainty.

School children participating in traditional farm work at The Heathland Centre.

KRISTINE EKELUND

Biodiversity and education

In addition to being an important part of coastal cultural heritage, the heathlands are important for biodiversity. The total diversity is high, although the number of vascular plants seen alone may be lower than in some other types of cultural landscape. This is however very much dependent on proper management. Some of the most oceanic species in our flora are connected to open habitats, like *Erica purpurea*, *Scilla verna* and *Gentiana pneumonanthe*. Many other species as well are disappearing from the coastal landscape as traditional farming methods ceases, like *Arnica montana* or *Leucanthemum vulgare*. As described elsewhere in this report, there were many causes for why The Heathland Centre was situated at Lygra and Lurekalven. Although the occurrence of threatened species was not the main reason for this location, these islands have proven to have a relative high biological diversity, as can be seen from chapter 3.5.

In well-managed heathlands there will be a mosaic pattern of vegetation, caused by the different ages of the heather plants and the variable vegetation found in the different phases. At a larger landscape scale, there are many boundary zones between heathland and grassland, peat bogs, fertilized and cultivated areas, transitions to copses of shrubs, etc. In addition, the many stone walls found in the open landscape are special zones in themselves. All this creates a large variety of habitats for smaller organisms such as insects, beetles, and also birds. Thus it has been proven that when the total biodiversity is measured, the heathlands have a very high score, and that many of the species found here are completely dependent on these types of habitat. It has been recorded that when open heathlands become overgrown by forest, specialist species tend to be replaced by species without any particular affinity (Grimsby 2000, Sæbø 2000).

Heathlands are cultural landscapes of high educational value. Their heritage, ecology and management are readily understood, and they are very useful for teaching purposes (see chap. 6.6). In addition, they are well suited for explaining the overall qualities of cultural landscapes, both for students and the general public. The beauty of the scenery and the atmosphere in the landscape make a deep impression on most visitors. This has something to do with the composite experience of nature and cultural heritage, aesthetics and authenticity. It is not always possible to combine aesthetic concerns with authentic methods of management, e.g heather burning. However, for most visitors it is the total landscape experience that matters and which makes strong impressions.

Tourism

Traditional cultural landscapes, such as the heathlands, have a great potential for the development of tourism. In Norway today, these are not the kind of attractions which are promoted to the tourists. The fjords, wilderness, and the Vikings are marketed – as they can be seen at the great museums. The potential of the Viking legacy as it can be seen out in the landscape, has yet to be discovered by most tourist organizations. However, during the last couple of years, some hotels have started to realize that when the traditional, open landscapes are replaced by forest, they are no longer so attractive for the tourists. This may indicate the start of a changing attitude.

In spite of this, a number of foreign visitors have found their way to The Heathland Centre. What they appreciate is the possibility of combining experiencing nature with learning something about the heritage. Within the tourist industry, the market is growing for this type of attraction. Tourists are not satisfied with pure entertainment, and they tend to look for something more enlightening. The challenge is to keep the landscapes and the farmers alive unto the potential of the old cultural landscapes for this kind of tourism (geotourism) is discovered and becomes better developed here in Norway.

Peter Emil Kaland

For the visitors, the small buildings in the heathlands can tell a lot about former exploitation of the resources in this landscape. The wooden fence is to prevent sheep from overgrazing the turf covered roof.

Ancient livestock breeds and their products

In many types of cultural landscapes, different breeds of domestic animals have developed over long time. They are specialists in utilizing the local conditions, and they have been the basic for modern stock breeding. Today there is an increasing understanding between scientists that these elderly breeds are not sufficiently preserved only as frozen embryos. They need to be kept alive in their original environment, in order to serve as a living gene bank.

Unfortunately, many of the traditional breeds which earlier existed along the coast, today are extinct. One outstanding exception is however the old Norse sheep breed, which is described in chapter 3.3 and 6.4. The last populations of this breed were safeguarded in the 1950's, mainly in Austevoll south-west of Bergen. During the last 20-30 years, the awareness of the many qualities of this type of sheep has increased. This has created a new interest for the special way of sheep-farming related to the breed, and it is no longer threatened of extinction. On the contrary, it has turned out to be very popular, and the market for its tasty and lean meat is still growing. This animal is closely related to the heathlands, and the quality of their products is not the same when they have grazed on other types of pasture.

Other types of special husbandry also have a potential in the heathlands. Earlier, goats were common on the coast, in particular in the northern part of western Norway. In the community of Selje, the last populations are found of an ancient, outwintered goat breed. Keeping goats for milk production on the heathlands can not compete with flocks elsewhere, but a new type of goat farming, with the wool of the goat as the main product, (Kasjmir-goat) has proved promising also on heathland pastures (Aalen 2003).

The old west Norwegian breed of cattle, the "*Raudkolle*" has become rare today (only 250 individuals left). In many ways it is in the same position as the Austevoll breed of sheep was 50 years ago. Raudkolle thrive very well in the heathlands, and, kept for meat production, animals of this breed can more or less be outwintered. The quality of the meat is very good, and in the future it may turn out to be a similar success to that of the old breed of sheep. In

«Raudkolle», one of the old breeds of west Norwegian cattle.

Peter Emil Kaland

Peter Emil Kaland

Boundary wall byre at The Heathland Centre before restoration (see page 24). These buildings were extremely important to the traditional farming economy.

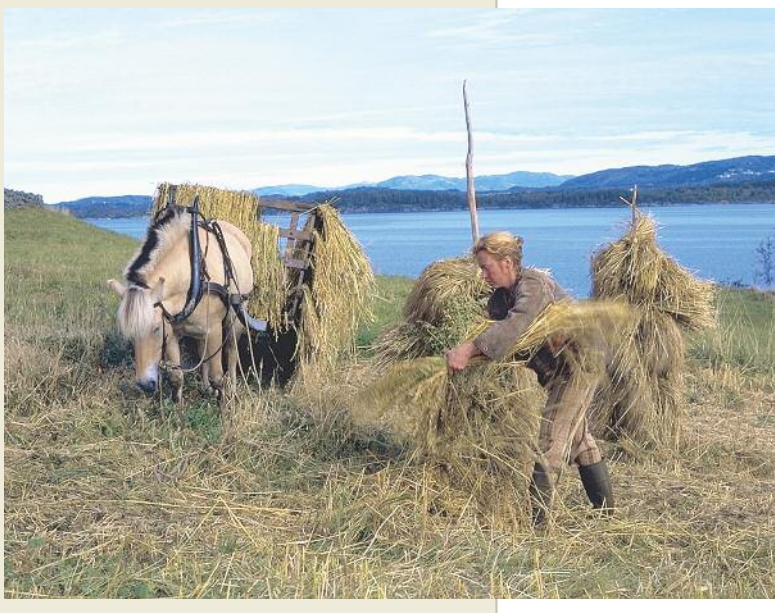
later years, some farmers in coastal Western-Norway have imported Scottish Highland cattle. This breed survive the winters on the Norwegian heathlands very well, and they produce a high quality meat.

A traditional product from the heathlands is the honey. The special *Calluna* honey from western Norway is famous for its high quality. The beekeepers are today very worried because the good production areas are reduced every year. At The Heathland Centre, a local beekeeper comes with his hives late in July and collects them in September. The honey produced in these hives is marketed as exclusive *Calluna* honey from Lygra which has turned out to be a very popular product.

Ecological sustainability and credibility

As all traditional cultural landscapes, the heathlands have developed from a method of food production which was totally based on the sustainable use of local resources. This type of food production has today been replaced by more efficient production methods, mainly based on imported cereals and a high consumption of energy and fossil fuels. This has given us cheap food and enough food, but more and more of it is produced from smaller and smaller areas. The question now is how ecologically sustainable this is, and how wise it is to give up the old production methods and the knowledge related to them. As most meat production in Norway today is based on feeding the animals with essential imported cereals, we have become one of the countries of highest cereal consumption per capita in the world. At the same time, worldwide cereal production is decreasing, and over-consumption of cereals increases every year. By encouraging and stimulating farmers to increase the "uneconomic" food production of the heathlands and similar types of cultural landscapes, our cereal import could easily be reduced, and our ethical and ecological credibility increased.

Arne Årseth



Cereal harvest in traditional manner at The Heathland Centre.

EGIL KORSNES

Early invation of pine trees in the heathlands at Lygra before landscape restoration had started.

5 THREATS TO HEATHLANDS

Reduced land use

Several different processes today threaten the heathlands of western Norway. The most widespread and common threat is natural reforestation due to the reduced utilization of the outfields. This process has been evident on the islands around Lygra for the last 4-5 decades. Also further west, in the outermost parts of the heathland area, reforestation is today rapidly progressing. The regrowth develops in three phases: first the heather plants become coarse and reach the degenerative phase (Gimmingham 1972); secondly the juniper sprouts up and becomes more and more dominant in the vegetation; and finally birch, rowan and pine proliferate and kill off the heather. During a 40-50 year period, an open landscape can be completely transformed into forest. As mentioned in chapter 6.4, it can be documented that with climatic conditions similar to those on Lygra, a grazing pressure of at least 1 sheep and its offspring per hectare throughout the year is needed to keep the landscape open.

Another threat, related to reduced land use, is the spread of bracken *(Pteridium aquilinum)*. This is not so common in western Norway, but in places with soil conditions similar to those found at Lygra, it is a serious problem. This fern species has a very aggressive vegetative propagation by a widespread system of rhizomes. It thrives in the deep soils of Lygra and Lurekalven. The animals normally do not eat it, but in areas grazed by cattle, it is more or less controlled through physical damage from the animals. Earlier it was also mown and dried for use in animal bedding in the byres (see chapters 3.2 and 3.3). When areas are only grazed by sheep, or are ungrazed, bracken can become completely dominant in the vegetation, particularly on good soils (see also 6.4 and 6.6). It may completely depress grass production and also, to a certain extent, reduce the productivity of the heather.

KRISTINE EKELUND

"Brackenfield" at Lygra.

LUDVIG LYGRE

PETER EMIL KALAND

Top: Inner part of Ytre Lygra in 1910.
Below: the same view today.

Right page, top: Heathlands of Fonnes farm, Austrheim, 1971.
Right page, bottom: Same view today.

Changed land use

Another threat is related to alternative types of land use. For a long time the farmers were advised by agricultural authorities to plant trees, mainly spruce *(Picea abies)* on their heathland, which was subsidised by the state. The encouragement to plant trees on the coast started more than 100 years ago, when *Pinus mugo* was planted. This is a forest limit species from the Alps which was used because it was generally thought that Norwegian trees could not survive the coastal climate. At the beginning of the 20th century, spruce gradually took over as the most planted tree species. On Lygra and the surrounding islands, a lot of spruce was planted in the 1950s and 1960s. Today they have started to regenerate naturally by seed, although spruce is not a native plant of western Norway. Within the area belonging to The Heathland Centre, all plantings of spruce have been removed except one which is kept for educational purposes.

Where the soil and landscape conditions are favourable, much heathland has been cultivated for the modern production of silage or other crops. At The Heathland Centre only a small part of the «inner pastures» of the outfields has been treated in this way. However, this has been quite common on flat areas elsewhere. The biggest heathland area in Norway, at Jæren in southwest Norway, has more or less disappeared for this reason.

Nitrogen and beetles

The third type of threat to the heathlands is related to the nitrogen content of the soil. If this becomes too high, the heather plant is weakened and may die, whereas grasses and other fast-growing species are boosted and become dominant in the vegetation. By adding nitrogen-rich manure, heathlands can be transformed into highly productive grasslands. This was of particular interest in areas of summer grazing. When artificial fertilizers became commercially available, many of the best outfield grazing areas in the district were treated in this way, including some parts of the inner pastures of the outfields on Ytre Lygra. When outfield grazing started to be less economic in the 1980s, areas treated in this manner proved to be particularly vulnerable to overgrowth by juniper, due to the absence of burning over a long period (see chapter 6.4).

PETER EMIL KALAND

PETER EMIL KALAND

KULTURLANDSKAPSSENTERET, HORDALAND FYLKESKOMMUNE

Because of reduced outfield grazing, juniper is invading the heathlands.

The soil may also accumulate nitrogen from air pollution. Huge amounts of nitrogen oxides are released into the atmosphere by the combustion of fossil fuels, and some of it is washed out by the rainfall and deposited on the ground. If this deposition becomes higher than about 15 kg per hectare per year (de Smidt 1995), it starts to become a serious threat to the heather plants. The nitrogen deposition along the coast south of Bergen is about at this critical value, but it gradually decreases further north. So far, the heathlands on Lygra and the surrounding area do not seem to be influenced by this threat. However, in some areas close to the oil refinery at Mongstad, there are indications of damaged heathland from nitrogen deposition.

There is also the threat of an explosion of heather beetle attack related to nitrogen deposition. This beetle is present on Lygra. Its reproduction is influenced by the nitrogen content of the plants, and if this becomes too great, the beetles multiply in such numbers that great areas of heathland may be killed. This has not been the case in areas around Lygra, but a few examples of heather death further south along the coast may have been caused by the beetle (Hansen 1991, Taksdal 1997). A few episodes of heather death have occurred in the district during recent years but not on Lygra or Lurekalven. They have all been in areas of old and unmanaged heather which have probably become weak and sensitive to frost in the spring.

All the threats described here are related to the development of changing economical demands, and their influence on modern agricultural practices. Traditional small-scale coastal farming had two competitive advantages: the great heathland areas which were utilized for all-year-round grazing and nutrient collection for the infields; and the possibility of combining farming with fishing (see chapter 3.4). This made it possible to make a living based on a mixed economy. With the specialization of work after World War II (see also chapter 3.6), the typical combined subsistence of the coastal farmers became more and more difficult. At the same time, the availability of cheap artificial fertilizers provided the nutrients both for the infields and elsewhere. There was a demand for an increased economical efficiancy from the farming, and thus modern stock breeds, which could not survive outdoors all winter but were more productive, took over from the ancient traditional breeds. In the end there was no longer any need for the heathlands within the framework of modern farming economy. Today, this is the major threat for the heathlands and similar types of outfield cultural landscapes.

6 Conservation and management

6.1 Development of ownership and legislation

Ownership

On Lygra there are a total of 17 farms, organized as two "named communities", *Indre* and *Ytre Lygra*. These are old settlements, and in the Medieval Age they were the highest taxpayers in the region. They also belonged to the Medieval Age King's Manor at Seim.

The areas included in The Heathland Centre are privately owned by the five farms on Ytre Lygra. They were run in a traditional way until the 1970s. During the 1980s, production was reduced on four of the five farms, as they were too small to be economically viable for intensive modern farming.

From 1990 these five farms were involved in the planning of The Heathland Centre, which opened to re-activate ecological farming, conserving the heathlands by the use of traditional land-use methods and sustainable heritage management of landscape and buildings. From 1995 agreements with the farmers were signed, regulating their farming methods, heritage management, and public access.

Legislation – general background

In Norway there is no legislation relating specifically to heathlands. However, conservation authorities in Norway have, for the last 20 years, been aware of the special problems related to the conservation of heathlands as well as other types of ancient cultural landscapes. During the "Campaign of the Council of Europe on the cultural landscapes" in the 1980s, the Norwegian Ministry of the Environment was already focused on the importance of this type of nature for biodiversity and cultural heritage.

In the early 1990s the same Ministry initiated a comprehensive mapping and registration of existing valuable cultural landscapes throughout the country, in cooperation with the Ministry of Agriculture and the Directorates for Nature Management and Cultural Heritage. This resulted in a list of 104 areas of special valuable cultural landscapes all over the country (DN 1994). At the same time, a proposal was made for a protection plan for heathlands along the west coast of Norway, based on botanical values, by the Norwegian Institute for Nature Research (Fremstad et al. 1991). In both evaluations, the heathland areas on Lygra and Lurekalven were given top scores at a national level.

It was quickly realized that the existing legislation for nature conservation was inadequate for the preservation of ancient cultural landscapes. The law mainly protects an area from physical and other types of disturbance, in order to safeguard vulnerable species and their contribution to biodiversity. The focus has very much been on protecting the wilderness, the unused nature, with little or no interference from man. Nature has therefore been "left to itself", with limited options for recommended human interaction. Many areas are even closed to public access during part of the year in consideration of special types of wildlife. Very often this causes conflicts with the local rural population.

The values of cultural landscapes are, however, dependent on human interference with nature, like the old types of land use which today are uneconomic in terms of modern farming. Protection is therefore impossible without a management plan, which in most cases involves extra cost. In addition, most valuable cultural landscapes are privately owned, whereas national parks or nature reserves are usually established in areas owned by the state.

Similarly the legislation for conservation of cultural heritage has limited options for the protection of cultural landscapes. The law

mainly focuses on the protection of monuments and individual sites, and only in exceptional situations is open for application at the landscape level. The most spectacular monuments, such as many of the stave churches, are popular tourist attractions. However, the income generated in this way normally does not cover the costs of maintenance. Many other monuments and objects of conservation are either hidden away for their protection (such as rock carvings), or they become a problem for the owner because he cannot use his land in the way he would prefer.

Most of the valuable cultural landscapes on the 1994 registration list were related to agricultural activity. It was decided to make public grants available (mainly from the budgets of the Ministry of Agriculture) to farmers to cover extra costs for actively taking care of the cultural landscapes on their farm (STILK). During the past 10 years this has been the main source of support for conserving cultural landscapes in general. This system had three major weaknesses: the first was that it did not cover the need for support in areas belonging to farms where agriculture had already been greatly reduced or had ceased altogether; the second was that these grants were mainly given for small investments (improvements, restoration, etc.) and little went to cover yearly running costs related to the management of cultural landscapes; and thirdly, the areas in question had no legal conservation status. Originally it was the intention that the 104 areas on the 1994 list should be given a legal status similar to that of protected areas, but due to the unclear situation relating to both economy and legislation, this was never followed up. The result is that, in most cases, they only have the protection given them by municipality plans (mainly as agricultural areas), which can be changed by local political authorities.

From 2004 the subsidies available for managing cultural landscapes, together with several other earlier support systems for special or difficult farming, have been reorganized and restructured. They are now all allocated for environmental caretaking of agriculture. Grants can be applied for both at a regional (county) and a municipality level. Due to a severe reduction in small-scale farming over the past 10 years (to which most valuable cultural landscapes are related), it is now possible to support the management of special areas where ordinary farming has ceased.

However, the problem of giving valuable cultural landscapes of national or international relevance and interest a legal protection status is still unsolved, with very few exceptions. Within the present economic framework for the above mentioned subsidies, this task can not be expected to be handled by local authorities alone. Economic support for continuous land-use management and necessary legal conservation status can only be secured by interaction with governmental authorities.

In the long run it may also become problematical that conserving and managing cultural landscapes to such a degree is based on agricultural subsidies. This type of economical support tends to be decreasing both in Norway and internationally. The special values of the cultural landscape are by definition either environmental, related to cultural heritage, or a combination. But they are more or less dependent on a certain type of (often old-fashioned) agricultural activity. This makes the ancient cultural landscapes to meeting-places of multidisciplinary interest. Already there are different opinions about who is going to foot the bill. In the future the disagreements may increase if not better coordination of means and priorities is carried out between the different disciplines involved (see also Heiberg 2000).

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The Heathland Centre has been concerned to develop further the traditional aesthetic qualities of the landscape at Ytre Lygra.

6.2 Concepts, strategies and management planning

As described in chapter 5, the traditional competitive advantages of the coastal farms are of little economical value within the framework of modern farming (see also chapter 3.3). Most of the production is now based on the infields, which on most farms are very small compared to those of other and better agricultural areas. With increasing demands for efficiency in food production, it becomes less and less economical to run the small coastal farms. During the last 20 years, more and more farmers have therefore found themselves other types of work, whereas those who really want to continue farming have to harvest the infields from several farms to maintain a living.

In spite of this development, many people living on the west coast of Norway still possess knowledge on how to manage the heathlands authentically, and how to utilize the landscape. Although this knowledge is no longer applied, it has been a living tradition until recent times. This is in great contrast to more industrialized areas of western Europe, where these traditions disappeared generations ago, and can only be gathered from written resources.

In the late 1980s, only one farm on Ytre Lygra was run according to modern standards, but the infields of all the farms were harvested, either by this farm or other farmers on Lygra. The special situation was that the old generation of farmers had carried on using the heathlands until the early 1980s. Therefore both the heathlands on Ytre Lygra and Lurekalven, and the traditional knowledge of how the landscape was managed, were much better preserved here than on most other farms in the district, where utilization had stopped 20 years earlier.

As described in chapter 2, the idea of making a conservation area for heathlands, based on the traditional farming techniques, was

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The Information building where interpretation and most other activities are organized.

developed in the Lindås project (1971-1976). When Lygra was selected as a suitable place to put this idea into practice, it was partly because of the well preserved heathlands, but mainly because the farmers and landowners here showed interest in taking part in such a project. In addition, much information was available about the islands from different research projects and local sources.

However, it was obvious that if the farmers involved themselves in managing the landscape in the traditional manner, it was necessary to find a method of creating some economic compensation for their effort. The strategy has therefore been to develop the area for public access, where landscape conservation and agricultural activity is combined with education, interpretation, outdoor life and tourism. The idea has been that the income from these activities, combined with public grants usually available for this type of undertakings, should provide sufficient income to the farmers involved and cover the costs of preserving the landscape by traditional management. The aim of The Heathland Centre is thus very close to the original French definition of an eco-museum.

The concept is based on a close cooperation between the local farmers and landowners on Ytre Lygra, and the local and regional authorities involved in the foundation. The farmers are responsible for running their farms, including the heather outfields, in accordance with a plan developed in cooperation between them and experts from relevant authorities (university, agricultural authorities, cultural heritage authority, etc., see also chapters 6.3-6.5). They are also an important part of the foundation, where they have 2 of the 8 seats on the board.

To coordinate activities, take care of visitors, teaching, etc., the foundation has a staff at Lygra, located in the newly-built Information building. There is an exhibition, a room for teaching and meetings, a small theatre for showing documentary films, and a small cafeteria. The staff and local farmers are supposed to cooperate closely so that the many goals for the foundation are achieved as much as possible.

The intention of The Heathland Centre is to preserve the heathlands on Lygra and Lurekalven as authentically as possible, and to show how dependent they are on active land use and management. As discussed above, this is very difficult to achieve by means of conventional strategies and legislation for nature or cultural conservation.

The concept of The Heathland Centre is to focus on the totality of the landscape as a result of the farmers' activity. This is a new and alternative way of thinking about conservation of nature and cultural heritage. Therefore, from the very beginning, the local farmers and land-owners were involved in the process, and it was decided to base the conservation of the heathlands on long-term legal agreements with them.

The conservation of the landscape is supposed to be beneficial to the owners and local population, and not to be a burden and a problem. Traditional farming can be seen in many places at museums, but on Lygra it is a part of the landscape conservation and the total heritage management. The intention is not only to preserve biodiversity and cultural heritage, but also to facilitate research, education, outdoor-life, and tourism, and thus stimulate local economic development. This type of landscape conservation represents a way of thinking which so far has been little tried out in Norway (Heiberg 2000).

6.3 Responsibilities

The overall responsibility for the activities and the development of The Heathland Centre lies with the board of the foundation. In addition to two representatives from the local farms, the five institutions involved are:

- The University of Bergen
- Hordaland County Council
- Lindås Municipality
- The Council of municipalities in Nordhordland
- The Nordhordland Craft and Industry Union

Each farm is responsible for the management of their property, in accordance with the agreements and the overall management plan for the area. As will be described in 6.4, the heathland management is organized in a cooperative way, so the farms mainly differ in the way that they use their infield areas. All farming activity is furthermore performed in dialogue with, and under guidance from, the County Department of Agriculture and the district veterinary authorities.

Scientific responsibility for the landscape management and conservation lies with the Botanical Institute, University of Bergen, and the County Department of the Environment.

The responsible institutions for the ancient monuments and prehistorical sites, are the Department of Archaeology at Bergen University Museum, and the County Council Department of Cultural Heritage. They are also responsible for restored buildings and all other objects of cultural heritage.

6.4 Management measures

This section describes the management of the outfield areas, dominated by heathlands. The outline of the infield management on the separate farms is described in 6.5. The goal for the management of the heathland area is to show how this landscape looked at the time when it was of economic importance to the farming economy and was actively used in a sustainable manner. This does not mean that all the work is done exactly the same way as in the past (e.g. with respect to tools, clothes, etc), but the ecological effect of the management on the vegetation and the landscape is meant to be as authentic as possible.

The outfields on Ytre Lygra involved in The Heathland Centre are divided into three: Lurekalven (a separate island, of 92,5 ha), Tangane (the northern part of Lygra, 37,5 ha) and the inner pastures (the area closest to the infields, 36 ha, see map chapter 2). The first two are dominated by heathland, whereas the last is about 60% heather and the rest is a mixture of vegetation types, with much more grassland. In earlier times, the inner pastures of Ytre Lygra were divided into five by fences, due to differences in land use between the farms, but today most of the fences have been removed. Tangane and Lurekalven have always been used in common by the five farms, and therefore have not been fenced.

The work on the heathlands is done cooperatively between the farmers, staff from the foundation, and volunteers from the local community and the different institutions involved.

Sheep grazing

The main reason why the coastal farmers preferred to have open heathland landscapes, was their potential for year-round grazing. Authentic heathland management has therefore to be based on grazing activity. At The Heathland Centre this is achieved by grazing sheep. As described above, heathland grazing on Lygra ceased about 1980. In 1992, 50 individuals of the old Norse breed of sheep (see chapter 3.3) were brought from Austevoll, and released on Lurekalven. Soon after, a smaller flock also started to graze on Lygra.

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Half year old rams. They have to be removed from the flock the first autumn to avoid inbreeding. Most of them are slaughtered.

It was more than 100 years since this breed had disappeared from Lygra. Old pictures from about 1910 show clearly that by that time, the farmers on Lygra had changed to more modern breeds. However, it was regarded to be most correct to use the old Austevoll breed, because this type of sheep has been so closely related to the heathlands over a very long time, and has only survived up to modern times in this type of landscape. It is also the hardiest breed of sheep in Norway and specialists in finding sufficient food from the heathlands during winter, even on snow-covered ground.

The sheep are the joint property of the five farms. This is organized through "Ytre Lygra Villsaulag", which is an independent unit, covering all costs related to the keeping of the sheep and the distribution of the surplus between the farms. They also organize all the work with the sheep. This is mainly concentrated into two periods during the year. In early/mid June, the sheep are rounded up to earmark the newborn lambs and to shear the wool from the adults. In October the flocks are again rounded up so that animals to be slaughtered can be separated. This is in accordance with the traditions from Austevoll. At both gatherings, all animals are vaccinated against intestinal parasites. This is necessary because they live in the same area all the year.
The meat production is mainly based on lambs. About 20 lambs are, however, kept over the winter for replacement of weak and old adults. It is important that all male lambs are taken away from the flock to avoid inbreeding, as these animals become fertile during the first autumn they are alive. The female lambs which are going to be integrated into the flock are also taken away and grazed on a separate pasture until the mating season is over. It is not healthy for them to be pregnant the first winter they are alive.

As this breed consists of small, hardy, fast running and high jumping animals, they are not easy to catch. Popularly speaking they are therefore called «wildsheep», although this is strictly misleading concerning their ownership. Traditionally the gatherings of sheep were done as common community work. Today, school classes are invited to participate at the roundups at The Heathland Centre, in order to get enough people. Normally about 30 pupils and 8-10 adults take part in the work. This could, however, easily be done by 2 experienced dogs.

According to veterinary regulations, the animals must be inspected once a week throughout the year. It is also necessary for the animals to be able to seek shelter under extreme weather conditions, either in copses of shrub and woodland, or in special buildings. On Lygra this is solved by leaving the doors of the restored peathouses (see chapter 3.4) open. Over the past 12 years, the sheep have not been observed using the buildings during winter. However, the animals sometimes seek shelter here from the heat during summer. In accordance with traditions, the animals are not given extra fodder during the winter, and several test roundups have shown that they are in perfect condition both in January and February, as well as at the roundup in June.

In order to achieve the best possible management of the heathlands from the grazing activity, it is important to find a level of grazing pressure which is optimal both with regard to the vegetation but also with regard to the welfare of the animals. If the number of sheep is too high, overgrazing may destroy the heather, and the risk of animal sickness increases. If the grazing pressure is too low, the heather will degenerate, lose fodder value, and inevitably be overgrown by shrubs and trees (see p. 14). Over recent years, the size of the winter flocks has been stabilized at about 75-80 adult animals on Lurekalven, and 40-45 on Tangane. In addition, about 20 female lambs have been kept on the inner parts of the outfields. On Lurekalven about one tenth of the area is excluded from grazing. This has given the following numbers for grazing pressure:

	Average no. of adults	Productive areal	Ad./ha	Ha/ad.
Lurekalven	77,5	83	0,93	1,07
Tangane, Lygra	42,5	37 ha	1,15	0,87

Wool shearing of the adult animals is done in June. The wool will loosen by itself, and if this has started, the wool can easily be removed by hand. This gives a better quality of the wool.

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Rounding up sheep at Lurekalven by the help of school classes.

If the number of animals is increased, slaughtered weights tend to decrease, and the problems of intestinal parasites increase during the summer, in spite of the vaccination program. Under the climatic conditions of western Norway, it is thus our experience that an animal density of about one adult per hectare during the winter on actively managed heathlands is optimal. A higher density of animals in our area is limited by summer grazing possibilities. The areas with the most prolific amounts of grass and herbs have been heavily invaded by bracken (see page 37), which greatly reduces the quality of the area for summer grazing.

The sheep density numbers given above are seen as optimal from an animal health-care point of view. From a heathland management point of view, however, the effect of this level of sheep grazing is not sufficient to keep the heather at the optimal production stage. Although some areas tend to be grazed very strongly, most of the heather is not grazed enough. A better, and probably more even, effect of the grazing could be achieved from grazing the sheep with other types of stock, such as goats or cattle of the ancient, hardy breeds. This would also accord better with the traditional grazing of the heathlands. So far, it has not been possible to do this at The Heathland Centre due to economical restraints and other reasons. However, plans exist to improve this in the future.

On Lurekalven, the relationship between reduced grazing and reforestation has been documented and is illustrated on page 14 (chapter 3.2), which shows the variation in grazing pressure on Lurekalven since 1910. The new forest on Lurekalven started to spread after 1960, when winter grazing ceased, and the total grazing pressure was reduced from about 450 fodder units(f.u.)/ha/yr to below 300 f.u./ha/yr. The number of sheep grazing on Lurekalven today corresponds to a level of about 280 f.u./ha/yr (calculation methods: Kaland, S. 1979, Løne, T. 1976). This is not enough to keep the forest at bay. During most of the time since 1910, the grazing pressure has been at a level of 450 f.u./ha/yr or higher. To reach that level, the number of sheep on Lurekalven would have to increase by at least 40 winter grazing adults. Until the summer grazing quality has been improved, this can not be done for the sake of the animals' welfare.

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All animals are checked and weighed at each gathering, as a part of the research programme going on at The Heathland Centre.

The sheep on Lygra and Lurekalven are continuously controlled through an ongoing research program (see chapter 6.6). This research has shown that the sheep (particularly the lambs) on Lygra have a significantly lower value of vitamin B12 in their blood compared to standard values (Øpstad, S. pers. med). This is a serious problem, as this deficiency reduces their growth and their resistance to sickness. To compensate, the lambs are given slowly dissolving mineral tablets at the June roundup.

In the flock on Lurekalven no similar deficiency has been observed. This difference can not be explained by geological features or by the main vegetation patterns. However, vitamin B12 is directly related to cobalt, which appears unevenly in the vegetation. Some species, e.g. *Salix* shrubs, are known to be rich in cobalt. On Tangane there are few *Salix* shrubs in the vegetation, whereas on Lurekalven there are plenty due to the occurrence of many gullies (see chapter 3.5). Although no scientific conclusions can yet be drawn, these results may be relevant to heathland management in other areas.

Stock kept throughout the year on the outfields will always be exposed to attack from predators, if present. In general, the loss of young or adult animals is very low. Compared with agricultural statistics, the loss of our marked animals is much lower than average values for sheep grazing on outfields. However, in some years, the number of new lambs has been lower than expected when rounded up in June. As no dead lambs have been found, the most probable explanation is attack from predators. Sea eagles are frequent in the area, but so far we have no proof that they have taken lambs. The raven is another common bird in the area, which can attack newly-born lambs. However, they are unable to carry away the dead body. The most probable candidate is the common fox. Some years they are seen frequently, and after a successful year of fox hunting, the number of lambs increases the next spring.

Management heather burning at Lygra.

Svein Nord

Burning and mowing

So far it has not been possible to develop a grazing regime that can manage the heathlands adequately by itself. For their maintenance it is essential that there are other methods of management as well, the traditional method being burning. This accords with farming traditions both on Lygra and on the coast in general (see chapter 3.3).

The purpose of the burning is five-fold:

- to eliminate as many as possible of the coarse, woody Calluna stems;
- to kill small plants of tree or shrub species which try to establish themselves in the heather;
- to stimulate the growth of new, fresh Calluna shoots from the old roots;
- to facilitate seed germination of new Calluna plants from the seedbank in the soil;
- to facilitate seed germination of other fodder plants (grasses, herbs) from the seedbank in the soil.

Regular burning was begun again on Lygra in 1992, the same year as sheep grazing was resumed. It was then 15 years since the last fire, and in most of the area the heather plants were older. In order to create a mosaic in the vegetation, most fires have been kept to a limited size (about 2-3 hectares). There is still much left to be burnt where the heather plants are very old (30 years +).

Burning always takes place between early January and late April. In theory it could be carried out in the late autumn as well, but in practice the humid climate of western Norway excludes this. The challenge is to find the optimal weather conditions for the fire. In particular, when the heather is old with coarse stems, it is best for it to be as dry as possible when the vegetation is lit. This must be balanced against the danger of a subterranean humus fire. This could last for days (or even weeks) and destroy not only the soil structure, but also the roots, the seedbank, and all other soil organisms.

In addition to dry conditions, successful heather burning is dependent on good planning. This involves deciding on what to burn, where to start the fire, and where and how to stop it. The latter is, of course, very important. Situated on islands, the fires can often be directed towards the sea, but topographical features (e.g. peat bogs) are also useful places to stop the fire. Long-shafted aluminium spades have proved to be effective tools for this work (easy to carry, effective in use). Normally 6-8 persons are sufficient to control a well-planned heather burning.

It is very important to take into consideration the wind when planning heather burning. Some wind is good, but it must not be too strong. It is also important to calculate that a fire of a certain intensity creates its own wind. A fast moving fire due to strong wind is difficult to control. Some experts recommend burning against the wind. This has been tried without any significant improved effect on the vegetation. This way of burning was not traditional used, and in addition, it takes a much longer time and is therefore much more expensive. The best effect is achieved by establishing a continuous fire front which is driven forwards by a slow wind.

If the heather is tall and invaded by shrubs, it may be difficult to control the fire. Then it is useful to make a fire break - a 3-5 metre-broad zone where the vegetation is cut down to a minimum (or burned off against the wind) is sufficient. The intensity of the flames will be so much reduced here that the fire is easy to stop. If possible, it can also be useful to soak the fire breaks with water before the burning.

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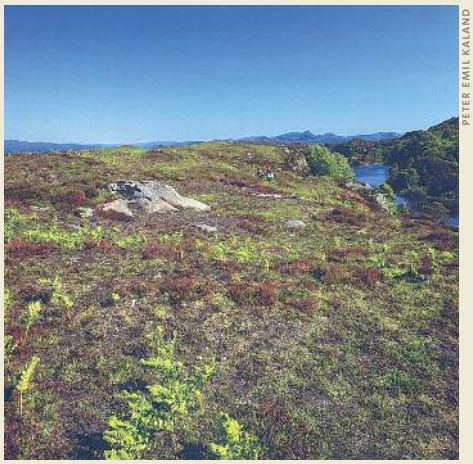
Heather burning at Lurekalven.



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The burnt area one year later.

Peter Emil Kaland

Early spring at the northern end of Lygra one year after burning.

Dryness and weather conditions influence the regeneration of the vegetation after burning. A fast-moving fire gives incomplete combustion. Too high temperatures may cause soil damage and subsequent erosion. However, the experience from The Heathland Centre is that vegetational regeneration is influenced as much by the conditions of the heather plants before burning. It is impossible to get rid of the coarse stems from old heather plants (mature or degenerative phase, Gimmingham 1972) by controlled burning. Parts will always remain for 3-5 years before they disappear. (In earlier days they were collected and used as kindling).

The major problem with heather in mature/degenerative phase is, however, that the soil surface is covered by a thick layer of mosses which is very difficult to get rid of by controlled fire. Although they will be more or less killed off by the fire, the mosses cause a serious delay to germination from the seedbank in the soil. In addition, the older the heather plants are at burning, the weaker the regenerative power of their roots.

Traditionally the heather plants were burnt before they reached the mature phase. Regeneration then occurs much faster, and under good conditions, most of the burnt stems disappear together with litter and the thin moss layer. Regeneration starts after only 1-2 months, and after 6 months the burnt surface may be green again from a mixture of heather seedlings, grasses and young herbs germinating from the soil seedbank. In addition, roots sprout abundantly from the bases of the old plants.

If grazing animals are excluded from the newly burnt areas, unwanted species (such as birch seedlings) may establish themselves and influence the succession after the fire. If the sheep have free access, they seem to be attracted to the newly burnt areas. Their grazing activity contributes to the development of a robust and grazing-tolerant vegetation. It is also probably healthy for the sheep, but this has not been scientifically tested.

The experiences from 12 years of regular burning at The Heathland Centre is that both food production and biodiversity are best preserved if the heather is burnt before it reaches the mature phase. What this equals in number of years is dependent on the grazing pressure. With the present grazing pressure on Lygra and Lurekalven, the optimal burning frequency seems to be about 15 years, which is in accordance with the authentic management regime. This implies that about 8-9 hectares should be burnt every year.

Heather mowing is mainly carried out as part of the educational program at The Heathland Centre. It is done using short-shafted scythes in the traditional manner. The ecological effect of mowing is very much the same as the burning, in preventing the heather plants from getting old and keeping them at an optimal stage of food production. The heather plant should be in the building phase, and tolerates mowing about every third year.

Combating the juniper

One of the most problematic invaders in old heather is juniper (*Juniperus communis*). If the plant is very young, or the sheep are starving, they will eat it, but normally it is ignored by the sheep if it manages to get established. Juniper is very sensitive to burning, so in frequently burnt areas it is not a problem. But on unmanaged heathlands, it may develop into extensive thickets causing major problems for grazing animals and their owners.

It is very difficult to burn large juniper thickets in a controlled manner. In any case, the fire will leave behind the trunks and branches as large skeletons. A better strategy is to cut them by chain saw, leave them to dry for some time and then burn them. If this is done in a dry period, much more of the wood will burn away and the roots will more or less be killed off at the same time. It is important that the areas are grazed afterwards, to minimize new sprouting from stems surviving the fire. All remaining litter from the stems must be removed as they may be dangerous to sheep and cattle.

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When outfield grazing is reduced or cease, aggressive juniper invation can make them completely inaccessible.

Bracken controll

Bracken (*Pteridium aquilinum*) is a great problem on parts of the heathland both on Lygra and Lurekalven. This is due to the bedrock and good soil quality. Generally in western Norway this plant is not a problem in heathland areas on acid bedrock. As described in chapters 3.2 and 3.3, in earlier times it was collected and used as bedding in the byres. The really rapid expansion of bracken occurred when cattle grazing on the outfields was reduced, and replaced with only sheep grazing.

Today bracken covers large areas of the outfields with the best soils, where the potential vegetation includes much grassland. The bracken problem thus reduces the quality of the summer grazing. Furthermore, when already present, it is favoured by heather burning. Until large-scale means of combating the bracken are found, it will continue to increase its domination of the vegetation.

As will be described in chapter 6.6, a 5-year project monitoring small-scale strategies to combat the bracken has taken place since 1997. This has shown that cutting the bracken fronds twice every summer for 5 years has the same effect as spraying with available specific herbicides (Ekelund 2002, Ekelund & Måren 2003). For the moment, staff and farmers are looking for methods to put the results of this research project into action on a large scale (Måren et al. in press).

Regularly repeated cutting of bracken will in a few years have the same effect as spraying. Enthusiastic school children has been of great help in this work.

KRISTINE EKELUND

KRISTINE EKELUND

KRISTINE EKELUND

Management of the inner pastures

As described above, the inner parts of the outfields have a more diverse land-use history than the rest of the outfields. This is mainly because much of this area, for the last 50 years in particular, has been used for summer grazing of cattle. Parts of the area have been fertilized to transform heathland into more productive grassland (about 10 ha). This is still done today using artificial fertilizers.

During the period of reduced farming in the 1980s, the utilization of this area was reduced, and it was then aggressively invaded by bracken. This is a typical succession on this kind of land. However, most of the juniper has now been removed (see above). Some of the area has also been taken over by bracken. When bracken first manages to establish a strong colony, cattle grazing does not help reduce it, as long as the animals can find sufficient food elsewhere.

For about seven years, the inner parts of the outfields (totally about 36 ha) have served as summer grazing for 25-30 young cattle and 10 modern sheep. In addition, about 20 6-month-old sheep of the old Norse breed have grazed here during the winter. This grazing pattern, in particular during the summer, is very concentrated on the fertilized areas. The rest of the area is hardly grazed, and shows signs of deterioration. If the fertilizing had been reduced, probably the grazing would be more evenly distributed.

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Aerial view of The Heathland Centre with the infield area of the five farms in front.

6.5 Integration of land use systems

The philosophy of The Heathland Centre is to show how the landscape can be conserved by active farming. The work and experiences with the outfield heathlands are described in chapter 6.4. It is important to show that the management is not an isolated endeavour, but related to active farming on the infield area. The whole concept of the conservation is based on the existence of a living farming community on Lygra. Two different systems are being tried out today, and a third is planned.

The cultural historical farm

This farm is supposed to be run in the same manner as it was in about 1940. The infields consist of about 3 hectares of meadow, 1.2 hectares of pastures, and 0.2 hectares of cultivated fields. The grass from the meadow is dried to produce hay, the fields are used for potatoes, cereals (barley and oats), and turnips. No artificial fertilizers are used, only the dung from the byres and seaweed are spread on the fields. No commercial fodder is used. Most work is done by hand or horse, but there is a small tractor available for the heaviest operations.

The livestock consists of 2 cows and 2 heifers of the cattle breed typical of western Norway at the time, 1 horse, 10 sheep of a semi-modern breed, 2 pigs, and 20 hens of different origins. The breed of cattle, called «Raudkolle», is very rare today (only 250 individuals left), and is a joint conservation project with the Agricultural Museum of Norway.

Earlier, the meadows had a high diversity of flowering plants because they were managed with little fertilizer and always mown late in the summer (mid-July). This regime was replaced by modern farming some years before the start of The Heathland Centre. The modern method of cultivating the meadows introduced high quantities of nitrogen-rich fertilizer to the soils, and the old flora disappeared. One of the objectives of the management today is to see how far it is possi-

ble to restore the old meadow flora by traditional management, and how long this will take.

It is, of course, impossible to gain a living from this type of farming by itself. Expenses are defined as part of the running costs of The Heathland Centre. The owner, who lives and works on the farm, makes his living by also developing the farm for tourism and doing different jobs for the foundation.

The reason for running a farm like this is to show how farming was practised at the time when the heathlands were still in active use and of economic importance. This is the only credible way in which to demonstrate the important link between agricultural land-use and the landscape.

The modern farm

In addition to traditional farming, modern farming is also shown. This is done not only to demonstrate the fast development of farming over the past 60 years, but also to give visitors an experience of how modern food production differs from the subsistence farming of earlier generations in this landscape. The difference in production methods between the cultural historical farm and the modern farm is many times greater than the difference between the traditional farm (as in 1940) and the Medieval Age farm on Lurekalven (of approximately 1340), though in only a tenth of the time.

The modern farm harvests about 15 hectares of highly productive grass fields using modern methods. Farming is based on modern technology, with applied artificial fertilizers and the use of commercial fodder in addition to silage. Until recently, milk and meat were produced, based on 15 milking cows and 10-15 young cattle. The present developments in agricultural subsidies make it difficult for a family to make a living from a farm of this size.

Modern ecological (organic) farming

One of the farms is planning to begin modern ecological (organic) farming. Today it is run in a modern way by a neighbour. This will be changed to modern organic production when he has retired and the future economy of The Heathland Centre permitted. This will supplement the cultural historical farm, which in itself is ecologically run. Modern organic farming is, however, done completely differently, and this will be demonstrated.

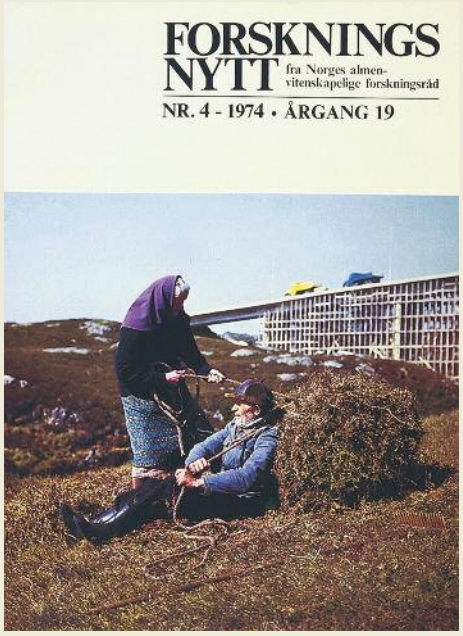
6.6 Research, education and interpretation

Research

As briefly mentioned in chapter 2, The Heathland Centre is based, to a large extent, on the data and the new understanding of the heathlands which came out of the Lindås project at the University of Bergen (1971-1976). This was the broadest interdisciplinary research project on cultural landscapes ever carried out in Norway. It was financed by the Norwegian Research Council and the University of Bergen. The project included different subjects such as biological diversity and ecology, landscape development, archaeology and the history of land use and settlement, local building traditions and vernacular architecture, subsistence history, sociology, etc. Since the results of this project were published (Lindåsprosjektet 1-31), all later serious research on heathlands in Norway have discussed their results in relation to these findings.

Throughout the planning and development of The Heathland Centre it has been the intention that this should be a place for further research, in addition to all other activities. Therefore all work in the landscape and the restoration of buildings have been properly documented, and many interviews have been recorded with representatives

One of the survey publications from Lindåsprosjektet.



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Documentation of ancient farming technics which today have disappeared.

from the old generation of the local population. The scientific working group behind the Centre was also involved in a national project called "The Agricultural Landscape" (1991-1995) financed by the Norwegian Research Council. Part of the research took place on Lygra and Lurekalven, working out the relationship between grazing pressure and reforestation. Several scientific theses have been written from the area (e.g. Kvamme 1982, Lystad 1997, Waaler 1998, Isdal 1998), and at least two doctoral theses are in progress, involving substantial material from The Heathland Centre.

Without being a research institution in itself, it is important for the foundation to organize and facilitate research projects from academic institutions. Some of the current projects are listed below.
The Heathland Centre is the only place in Norway where long-term field research on outfield grazing of the old Norse breed of sheep is being carried out, in cooperation with the Norwegian Crop Research Institute and the Norwegian Institute of Veterinary Research. (Øpstad et al. 1998, Lystad 1997, Hovstad & Øpstad 2000). Some of the findings have been discussed above (chapter 6.4)

In cooperation with the Departement of Biology, University of Bergen, different methods of controlling bracken invasion have been tested on numerous permanent plots. The long-term effect on the heathland and grassland vegetation of different herbicides with a special effect on bracken (Asulam and Gratil) have been compared with the effects of different mechanical treatments (Ekeland 2002, Ekelend & Måren 2003, Måren et al. in press).

The ecological effects of sheep grazing and controlled burning are being studied in cooperation with the Norwegian Institute for Nature Research and the Biological Institute at the University of Bergen (Aarrestad & Vandvik 1997, 2000).

The Norwegian Institute for Nature Research also has its own project mapping in detail the biodiversity of Lurekalven (see chapter 3.5). This is one of the few places along the coast of Norway where such mapping has been done.

Bergen University Museum and the Biological Institute at the University of Bergen are currently working with the archaeology and vegetation history of Lygra and Lurekalven to improve our understanding of the old settlement and the land-use history of the area (Kaland, S. 1979, Kvamme 1982, Kaland & Vandvik 1998, Waaler 1998).

Education

Lygra and Lurekalven have been used for University teaching since the late 1980s. From the very beginning of the planning of The Heathland Centre, educational possibilities for the Centre had a high priority. Early on, a working group of scientists and teachers from all types of schools, started to work out educational programs for different levels of teaching.

The remit of one of the staff members is to work with school classes, who come from both local areas and Bergen. Special activity sheets for pupils have been produced to cover a wide range of topics that are relevant to a school day on Lygra. In addition, an interdisciplinary book about the heathlands, aimed at teachers, is under production by the group of scientists. Courses for teachers have also turned out to be popular. In addition to their interest in this type of landscape in itself, they are interested in heathlands as a good teaching example of how natural processes and human activity influence the cultural landscape.

As described earlier, the pupils are involved in several working processes. They help with the heather mowing, and also take part in the battle against the bracken. Pupils and students are indispensable for the sheep roundup, and there is special cooperation between some schools with respect to this work. Sometimes pupils also take an active part in particularly work-demanding operations on the cultural historical farm.

Interpretation and communication

The Heathland Centre is organized to have open public access. People are free to move around in the landscape whenever they like, and this is facilitated by the 4 km network of paths. Special places have been established for outdoor life, and three public floating quays make it easy to approach and disembark from small boats. Many people take advantage of this, and use the place for touring and recreational purposes. In this way the landscape communicates directly with the visitors through their experience of just being there.

Guided tours in the landscape are organized from the Information Building. They are particularly popular for the many groups visiting the Centre. Written

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Students studying the history of reforestation at Lurekalven.

RITA FLØHOLM

School children take part in the traditional heathland management as a part of the teaching programme.

PETER EMIL KALAND

Part of the exhibition of the Information building, showing some of the products from the heathlands.

information is sold to those who prefer to walk around by themselves to study the landscape and read about it. There is also an exhibition which provides visitors with further information about the heathlands, and which tries to put their experiences on Lygra into a broader perspective. The visitors are also offered the chance to see a documentary films about traditional heathland management. One of these films was produced during the Lindås project (Sandberg 1974).

In addition to the direct communication taking place on Lygra, the staff and experts behind the Centre have written many articles in newspapers, magazines and scientific journals about the heathlands and the work on Lygra. This has generated a lot of curiosity and interest in the subject all along the coast. Many people have come to Lygra to experience The Heathland Centre, but in addition, members of both the staff and the expert group have been asked to give innumerable lectures and presentation about the project. Today the focus on the use of the coastal heathlands in Norway is much greater than it was 10 years ago, and there is no doubt that The Heathland Centre has stimulated and provided important contributions to this increased interest.

6.7 Economy of conservation and management

Many of the strongest arguments for safeguarding heathlands in Norway are related to biodiversity, ecology, and cultural heritage. In spite of this, very little resources are today allocated to conservation and management of heathlands or similar types of ancient cultural landscapes from the environmental or the cultural historical authorities. Agricultural subsidies are mainly given for modern production, but through the STILK-grants (see chapter 6.1) some resources have been made available, mainly for restoration purposes. The reorganization of the agricultural subsidies this year should make it easier to get support to cover the yearly running costs of maintenance and management of heathlands and similar vegetation types, that are no longer of economic interest to modern farming.

A rough idea of the costs of heathland management can be made from our experiences at The Heathland Centre. They are mainly related to four working operations: sheep roundup and other field work with the sheep (shearing, marking etc); weekly sheep inspections; heather burning; and other physical management (combating bracken, controlling juniper, maintenance of walls, fences, etc).

Basis of calculations	Numbers of work hours pr year
Sheep roundup:	
Running:	
Lurekalven: 25 persons for 4 hours	100
Lygra: 25 persons for 2 hours	50
Fieldwork with sheep:	
Lurekalven: 10 persons for 8 hours	80
Lygra: 10 persons for 5 hours	50
Total hours of one roundup:	280
Total hours of 2 roundups:	**560**
Weekly sheep inspections:	
4 hours each week	
Total hours of sheep inspections:	**208**
Heather burning:	
7 persons spend 4 hours on burning 3 ha	
9 ha need to be burned each year	
Total hours of yearly burning: 7x4x3	**84**
Other management:	
20 ha densely overgrown by bracken:	
Management:	
6 hours/ha twice in summer	240
40 ha moderately overgrown by bracken:	
Management:	
3 hours/ha twice in summer	240
Other management: 1 hour/ha	120
Total hours of other management:	**600**
Grand total:	**1452**

Based on the standard hourly rate for agricultural work, and a total production area of 120 hectares for the sheep, this gives a total cost of 1815 NOK per hectare per year. The figures for the different operations are:

Sheep roundup: 700 NOK per hectare per year
Sheep inspection: 260 NOK per hectare per year
Heather burning: 105 NOK per hectare per year
Other management: 750 NOK per hectare per year
(150 NOK per hectare per year without bracken control).

In the last figure the control of bracken is included (600 NOK per hectare per year) although this is not yet in force on a large scale (see chapter 6.4). Within a time period of 5 years this figure can thus be greatly reduced.

The main economic activity related to the heathlands today is the products from the old Norse breed of sheep. The price of the meat may vary, depending on the quality and how the farmers prefer to sell it. Based on an animal density of one sheep per hectare during the winter (see chapter 6.4) and one lamb per sheep, it is possible to obtain about 400 NOK per hectare. This is for members of the interest organisation (Norsk Villsaulag) by standard sales through the abbatoirs. In addition comes income from other products like wool, skin and horns, which may give one hundred NOK per hectare. Farmers with a total sale exceeding 30 000 NOK can apply for public grants to outfield grazing, heathland management and production based on the old Norse breed. These may give a maximum of 684 NOK per hectare. In Hordaland the total gross income from heathland grazing with the old Norse breed of sheep may thus end up with about 1150 – 1200 NOK per hectare.

From these numbers it is easy to see that if all work related to the heathland management by sheep grazing was paid for by standard rates, the costs excluding the bracken combating would more or less be equal to the income. As described earlier, most of the work is done cooperatively between the farmers involved in Lygra Villsaulag, members of staff from the foundation and volunteers who participate in their spare time. In this way it is possible for the farmers to keep a nett income from the sheep production.

By making small adjustments, the income from the meat production of the old Norse sheep could be increased. Today the high quality meat from this breed is discriminated against by the abattoirs, as the breed is much smaller than the modern sheep. If the payment for this meat increased, which would mainly be covered by the market price, the economy of heathland conservation could be improved considerably.

Another method of obtaining income from the heathlands is from honey production. None of the farmers on Lygra keep bees, but other beekepers use the area for their hives. Both production and prizes vary, but from their experience, the average income for a good year may be about 200 NOK per hectare per year.

The Heathland Centre has so far received a yearly support of 1,800,000 NOK, mainly from Hordaland County Council but also from Lindås municipality. This money is supposed to cover staff expenses for administration and educational purposes etc, to secure a reasonable income for the farmers involved including the costs of the cultural historical farm, and to cover the costs of management and maintenance of the landscape and buildings. In addition, the foundation has some income from tourism. However, the expenses incurred in establishing the Centre as a new kind of tourist attraction in an area with a weak tradition of tourism in general, have so far more or less outweighed the income. At the same time farming subsidies in general have been reduced. The Centre has therefore been totally dependent on private sponsors in order to survive these first years.

Guided walks in the landscape is an important part of the interpretation at The Heathland Centre.

PETER EMIL KALAND

7 Visions and perspectives

Perspectives on the safeguarding of heathlands

The *Calluna*-dominated heathlands along the west-coast of Norway are today disappearing faster than any other habitat types of comparable distribution in this country. This is mainly due to the great changes in farming methods during the last 50 years. Strong reduction in the exploitation of the outfield production areas has subsequently caused dramatic changes in the landscape. This is today most readily seen by the rapid expansion of shrubs and forests into the former open areas.

If the present development continues at its current speed, there will be very little heathlands left in Norway within a few decades. As they are important to many different subjects, like cultural history, regional identity, biodiversity, low intensity food production, recreation and outdoor life, this will be a serious loss to Norwegian nature. In spite of this fact, there is no governmental decision or strategy to safeguard some areas of heathlands in Norway for the future.

The lack of organized protection plans can partly be explained by the widespread distribution and until recently common occurrences of heathlands all along the coast. In addition they were considered to be caused by the harsh coastal climate. The understanding of heathlands as man-made and dynamic cultural landscapes is relatively new. It has mainly developed from research during the last 30 years. The landscape changes of today are underlining the findings from this research. Heathlands can only be maintained by moderate land use or management.

Heathland conservation has also suffered from the general difficulties in implemention of a scientific satisfactory policy for protection of valuable cultural landscapes in Norway. This has to be based upon interdisciplinary knowledge, it must involve cooperation between different heritage conservation authorities and include several governmental ministries. In addition it may be slightly more expensive in some cases than other types of nature conservation. After more than ten years of discussion, general agreement about how to organize this, has not yet been achieved.

The vision of The Heathland Centre

The Heathland Centre has been established in order to meet some of these challenges. In cooperation with local farmers, an area of open heathlands is safeguarded for the future. The landscape is preserved as authentically as possible by using traditional land use methods. Old buildings and other visible constructions related to the former subsistence have been restored in their original place. In this way it is possible to demonstrate and disseminate the knowledge about how earlier generations through thousands of years have utilized the resources of the coastal landscape.

The idea came from research groups at the University of Bergen, and it has been carried through in cooperation with regional and local authorities, and with the local farmers and landowners at Ytre Lygra. They have been involved in the process from the beginning, and without their interest and positive response, it would never have been possible to realize the centre at Lygra. The total area is privately owned, and it has no legal protection under the Norwegian nature or culture conservation laws. Preservation is therefore based on active farming, regulated by long-term legal agreements with the owners.

The heathlands at Lygra are not unique today. That will however be the case within short time, if the landscape changes in the surrounding areas continue at their present speed. The centre has been situated on Lygra, because the islands are representative for the traditional coastal landscape in this part of the country. Many of the qualities related to the heathlands are readily seen and easily understood here.

The deterioration of the heathlands looks innocent in the beginning, but suddenly it changes into rapid reforestation, which is a hard job to stop.

By passing the knowledge of heathland management further to new generations, The Heathland Centre wants to raise the awareness of the value of the coastal landscape.

RITA FIØHOLM

The intention of The Heathland Centre is not only conservational. It is also educational. It is important that the heritage of the coastal landscape is passed on to future generations. To develop a teaching program for all school levels has therefore been given the highest priority. Many of the lessons to be learned from the heathlands are based on living organisms and practical ecology. They are reflections of the natural conditions and the land use history of the coastal farmers. This is difficult to understand from theory alone. It has to be experienced in a living landscape.

In addition to the landscape conservation, it has been important to make The Heathland Centre as available as possible for the general public. The whole area is made accessible by walking paths and by boat. The processes and the qualities of the landscape can in this way be experienced directly by the visitors, in combination with outdoor life. Further knowledge can be achieved by participating on guided tours in the landscape or from the Information building with its exhibition, film and booklets.

The heathlands are the results of a long tradition of knowledge about how to survive from local resources on the coast. Therefore, one of the main visions behind The Heathland Centre is awareness raising. The landscape itself and the knowledge related to it have to be presented in such a way that it has a high degree of transfer value. The importance of history and former land use for the conditions of the present landscape is supposed to be obvious to most visitors. When they leave, they have got a new understanding of the dynamic character of this kind of cultural landscapes. Many people have also got a new perspective on the ecology of the coast and the importance of sustainable food production.

The most important message to the visitors at The Heathland Centre is that heathlands essentially are man-made landscapes and thus a part of our common cultural heritage, as well as a part of our general environmental concerne. During innumerable generations, people on the coast were dependent on them in order to survive. This is not the case any more, but for many they are still an important part of their identity. A majority of the Norwegians are however ignorant of this knowledge. Proper distribution of information about these questions is probably the most urgent challenge for The Heathland Centre, in order to ensure a democratic political treatment of the future of this cultural heritage.

8 Concluding assessments and recommendations

Present situation for heathland conservation in Norway

Landscape conservation will always be a matter of politics. When it comes to cultural landscapes such as the heathlands, both agricultural politics and environmental politics are involved, including cultural heritage management. However, Norwegian environmental policy has unto now mainly been concerned with the conservation of mountain wilderness and so-called 'undisturbed nature'. The initiatives from the late 1980s on cultural landscapes have not been properly followed up, as seen from the unsettled situation of the 104 areas on the list of DN (see chapter 6.1). Many of the most endangered types of vegetation in Norway today are related to ancient cultural landscapes which have no economic value in modern farming (Fremstad & Moen 2001). With few exceptions, hardly any valuable vegetation types of this kind have legal protection for the future.

Along the west-coast of Norway, there are no national parks and only a limited number of protected areas. None of them have been preserved to safeguard the heathlands. From 2005 the coastal islands of Vega (north of Trøndelag) will be included in the UNESCO World Heritage List, but they contain only smaller areas of heathlands. In some nature conservation areas (e.g. heath-covered peat bogs), traditional management has even been prohibited. The result has been that the vegetation which were to be preserved, has disappeared. The Heathland Centre is thus a true pioneering project, as it is the first time that heathlands *per se* have been conserved in Norway.

As heathland conservation is dependent on active management, conventional protection in accordance with the legislation on nature conservation has turned out not necessarily to be the best way of safeguarding them. An alternative is to use the section on cultural environmental protection in the legislation of cultural heritage conserva-

Heathland safeguarding involves culture- and nature heritage conservation, landscape management and traditional farming. This has so far been difficult to implement within the frames of the ordinary conservation laws.

Peter Emil Kaland

tion. At present this is applied to another group of islands north of Trøndelag (not Vega). This includes a specific management plan for the heathlands.

In privately owned areas, the Lygra model, including legal long-term agreements with the owners, is an alternative. The good thing about this model is that the farmers are directly involved and responsible for the landscape conservation. This has worked out very well in practice. It is however important that this kind of agreements are given a firm economic basis.

Over the last 10 years, major economic contributions to safeguard cultural landscapes have come from special agricultural subsidies. From 2005 it is possible to apply for grants specifically for heathland management. Although this hopefully will prove beneficial for heathland conservation, agricultural budgets in general are not increasing at present.

Special agricultural subsidies encourage interested and active farmers to preserve heathlands where they are living. However, the areas supported in this way will not necessarily receive any legal conservation status for the future. Therefore these subsidies are not enough on their own to ensure the protection of a representative selection of heathland areas along the coast. This can only be achieved from making a scientifically based conservation plan, and by closer integration and cooperation between the environmental and agricultural policies.

In Norway today there is a running discussion on the magnitude of the agricultural subsidies and how they shall be spent. Whereas farmers' organizations want to use them on effective food production, a growing section of the general public want them to be used to provide pleasant and varied landscapes. There is an increasing demand for open landscapes with high aesthetic qualities, to use for leisure and recreational purposes. This is exactly what heathland conservation is providing. In particular, the tourist industry is interested in this. If these new trends are incorporated into the agricultural policy, it will be easier to drum up political support for maintaining the subsidies at a sufficient level for the small-scale farming found along the coast.

Experiences from The Heathland Centre

The experiences from The Heathland Centre have demonstrated that it is possible to stop the present deterioration and reforestation of the coastal landscape. By combining ecological knowledge, traditional management methods and modern technology, the open heathlands can be restored. After more than ten years of practical fieldwork, it is also possible to conclude that the authentically farming methods based on all-year-round grazing and regularly, prescribed burning, are indispensable in order to manage the heathlands in a sustainable manner.

During the 15 years since the earliest start of the project, it has been a steadily increasing interest for the work, the ecological knowledge and the experiences from The Heathland Centre. In particular people from marginal areas for agriculture along the coast, where modern farming is not economic compatible, have started to see the potential of the heathlands and their traditional management methods. They want to maintain this landscape as a source of alternative and sustainable food production, local identity and tourist development.

The interest from schools and other educational institutions has been considerable. The heathlands have a great pedagogical potential within many different subjects, and the facilities at The Heathland Centre has shown to be useful at all levels. The history and processes of the heathlands are easy to understand, and they provide a good background for the understanding of other parts of the coastal culture or other types of cultural landscapes.

The Heathland Centre has turned out to be a very popular area for outdoor life, both for the local people from the area and for the urban population living in Bergen. The number of foreign tourists coming to

Geir Goosen

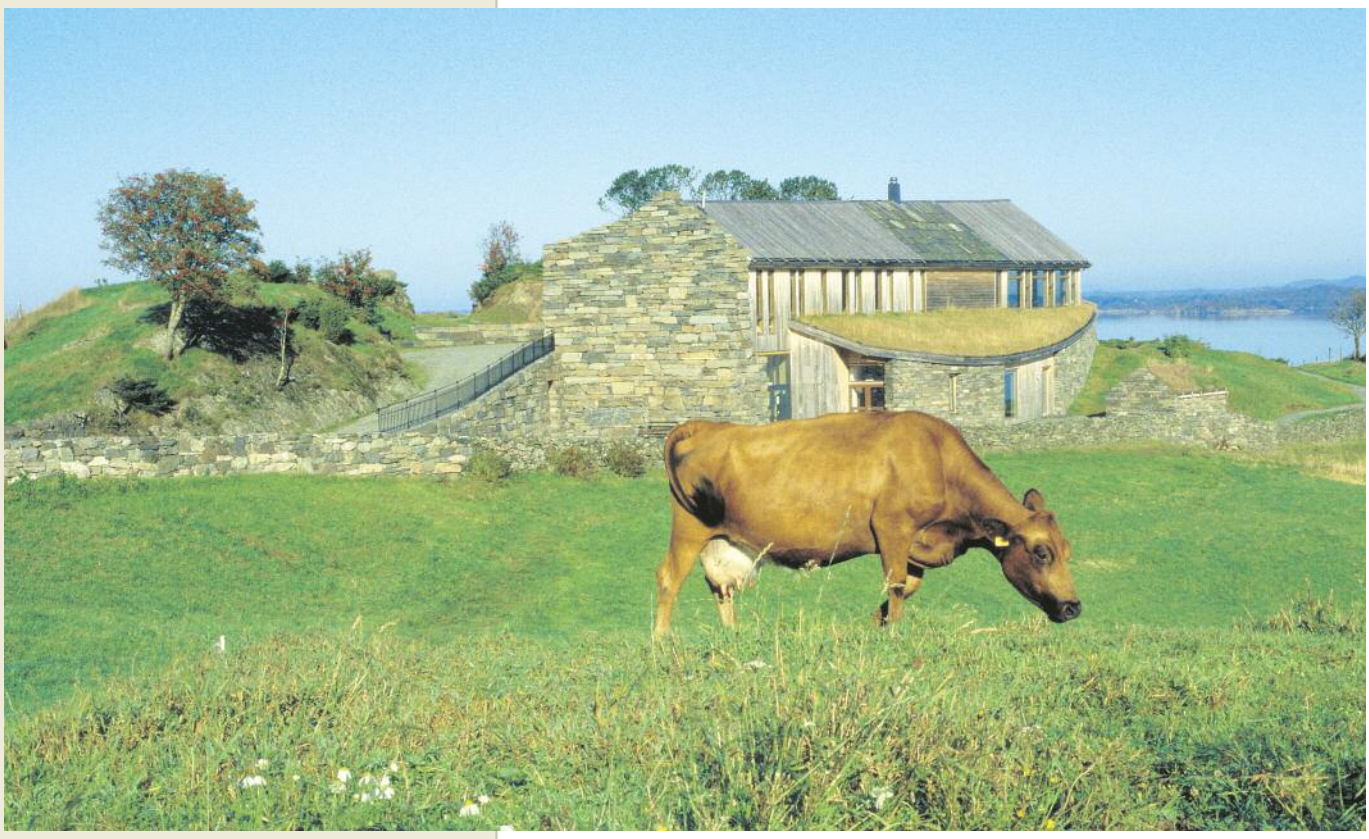
The Heathland Centre is a pioneering project, and it is the first time that heathlands per se *have been conserved in Norway.*

the centre is increasing, but is still lower than other comparable attractions. This is partly because it is a new destination with limited resources for advertising, but it also reflects that this is a new type of tourism (geotourism) in Norway.

The kind of landscape conservation represented by the Heathland Centre has never been tried in Norway before. It maintains a high professional standard both at national and international levels. This was seen in 2001 when the Centre received the "Melina Mercouri prize for conserving cultural landscapes" from UNESCO. If this high standard is to continue in the future, the financial incitements for heathland conservation have to be improved. For the moment, the overall reduction in support of small-scale farming during the later years, has caused serious problems for the economy of the farmers, both at Lygra and in many other coastal communities.

Peter Emil Kaland

The heathlands and the old Norse breed of sheep are closely linked together. The market for the products from this breed is today rapidly increasing.



PETER EMIL KALAND

"Raudkolle" is one of the traditinal breeds from western Norway, which today is about to disappear. It is important to preserve them as a living genebank for the future.

Recommendations

The major objective of heathland conservation in Norway comes from the breadth of their interdisciplinary values and the cross-sectorial interests related to these landscapes. It is also of vital importance that the practical landscape management is maintained in more than one place. People, who know how to handle these landscapes, are needed in several areas along the coast.

With the present agricultural development, only a tiny part of the remaining heathlands can realistically be preserved for the future, although much has already disappeared and most of the remaining areas are threatened. The question now is how to make sure that at least some heathland areas are secured for the future, and how this can be financed.

Because of the large variation of heathlands along the coast of Norway, different areas must be preserved if a representative selection of the variation of biodiversity and heritage present in these landscapes is to be secured for the future. The coast may be divided into four sections (Fremstad et al. 1991): the southwest Jæren area; the western area; the northwest area; and the northern area. To capture the large variation in landscapes, it will be necessary to preserve a minimum of 2-3 areas within each section.

The selection of areas has to be done in cooperation between the Directorate for Nature Management, the Directorate for Cultural Heritage, The Ministry of Agriculture and the Ministry of Environment. The protection of any heathland area has to be accompanied by a management plan, including a system of responsible quality control.

As most people are still unaware of the many qualities and the current situation for the coastal heathlands, it is a strong need for more and better distributed information about these questions, both among farmers, public authorities and in the schools. With small adjustments, the educational program for The Heathland Centre can be incorporated into the pedagogical plans for environmental teaching in the schools.

In particular among the coastal population, a stronger focus on awareness raising is important. For them this is not only a question of landscape conservation, but mainly about local cultural heritage and identity. If heathlands are going to be maintained outside a few protected sites, people living here must see a value and feel an ownership to this type of landscape.

Another important targeting group for more information is the tourist interests and organizations. They have always had the advantage that their attractions have been surrounded by well managed cultural landscapes. This is about to change today. In order to avoid a further deterioration of the situation, it will be beneficial for the tourist industry to involve themselves in maintaining the landscape qualities. This is the main perspective of the new trend of geotourism. By giving these aspects more attention, and by focusing stronger on this in the marketing of destinations, tourism can provide important contributions to the safeguarding of traditional cultural landscapes like the heathlands. In addition, the tourist business is important for the promotion of local food products e.g. from the heathlands.

The Heathland Centre is based on research and documentation of traditional land use methods. It is also organized to facilitate research activity (see chap. 6.6). In order to improve the possibility of responsible heathland safeguarding in the future, it is necessary to stimulate more research on the coastal landscape. The environment is probably changing faster here then anywhere else in this country. This opens both for monitoring as well as for more experimental work. One of the challenges in the future will be to make adjustments of the traditional management methods in accordance with the new environmental situations. This has to be done in a way that gives optimal yield both in terms of landscape management and farming economy. Some of these questions are addressed at The Heathland Centre at the moment, and similarly at the coast of Trøndelag (Nilsen 2004). However, it is important to open a much broader front of investigations all along the coast, in order to give the future safeguarding of the heathlands the knowledge platform which is needed.

Proper heathland management is dependent on extensive grazing. Through several millenia, this has been done by breeds of goat, sheep and cattle, which over time have been adapted to the coastal environment. Many of those are extinct today, but the breeds which still survive, constitute an irreplacable living genebank for the future development of sustainable coastal farming. It is therefore important to find means for stimulating farming production based on these breeds.

Heathland safeguarding will cost, but much can be achieved by a better coordination of available grants for cultural heritage, agriculture, landscape and environmental conservation. This is now partly tried out within the framework of a new type of regional environmental programs for the farmers. A better system for promotion of the products from heathlands and similar types of ancient cultural landscapes, could also contribute to reduce the conservation costs. In addition, heathland farming would take greate advantage from smaller adjustments in existing agricultural regulations, which today are made for controlling modern and highly intensive food production.

The type of small-scale, low-intensity land use, which is needed to maintain heathlands, cannot compete directly with the demands of economical efficiency in modern farming. However, from other parts of Norway with marginal conditions for modern agriculture (e.g. in Valdres), farmers have shown good economic results from taking up again more extensive land use methods (Thuv 2002). Their production volume has become smaller, but they have increased their income without extra subsidies. This kind of farming strategy, in combination with a scientifically based conservation plan, is probably one of the best things to do in order to safeguard some of the Norwegian heathlands for the future.

Peter Emil Kaland

The small buildings in the outfields are important to understand the former exploitation of the heathland.

9 Summary

Heathlands are present in most European countries facing the Atlantic, and they constitute a common cultural landscape unique for Europe. Safeguarding the Heathlands of Europe (HEATHGUARD) has been a one year European Heritage Laboratories project financed by the EU Commission Culture 2000 Framework Programme in Support of Culture. The object of the project has been to compare conservation methods and landscape management practice of heathlands in different regions of Europe. Project leader has been The Heathland Centre, Lygra, Hordaland in Norway.

The present report is the Norwegian contribution to this project. It contains descriptions of the West-Norwegian heathlands with special focus on the conditions at The Heathland Centre. The coastal heathlands of Western Norway are essentially man-made. They have a long development history, starting already during the Neolithic. The major expansion took however place during the Iron Age. They have been used by man from the very beginning. In Western Norway the heathlands are dependent of the management they received from the traditional farming methods, based on all-year-round grazing and regular, controlled burning.

Most coastal heathlands in Norway are maritime cultural landscapes. The proximity to the sea offered the option to combine heathland farming with fishing. This was a very common combination of existences, which made it possible to survive on small farms. Because of the good security for sufficient food supplies from this type of mixed subsistence, it gave way to a very high population density along the west-coast of Norway.

The heathlands are an essential,but often overlooked,part of the cultural heritage and identity at the coast. In addition Norway has an international responsibility for their safeguarding, as about one third of the extent of this European cultural landscape is found here, including its northernmost outposts. The heathlands represent irreplacable contributions to the Norwegian biodiversity. They are important for the survival of ancient livestock breeds, adapted to the condition at the coast, as a living genebank for the future.

Due to the intensification of the agricultural production methods during the last 50 years, the heathlands have lost most of their importance to modern farming economy. The exploitation has therefore been strongly reduced, and today there are only remnants left of the earlier widespread heathland grazing activity. Similarly, the traditional heather burning has ceased nearly completely along most of the coast.

As a result of the reduction in traditional land use practise, the heathlands today are rapidly disappearing. Shrubs and forests take over the earlier open landscapes. Even on the outermost islands towards the ocean is this process now proceeding. Widespread, governmental subsidized tree planting during 100 years has accelerated this development even more. In addition has easily accessible heathland areas, by surface fertilizing and cultivating, been changed into fields for intensive production of grass and crops. If the present development continues, most heathlands in Western Norway will be history within a few decades.

Due to the current landscapes changes, heathlands today are about to be among the most endangered types of vegetation in Norway (Fremstad & Moen 2001). Public authorities have however not yet been able to agree upon a conservation strategy or protection plan to safeguard a representative selection of Norwegian heathlands. The Heathland Centre has been developed to make sure that at least one area of open heathlands is safeguarded for future generations. It is so far the only place where heathlands *per se* have been conserved in Norway.

The Heathland Centre is situated on the islands of Lygra and Lurekalven, about 40 km northwest of Bergen. It covers an area of 190 hectares of which about 160 hectares are heathlands. The land is privately owned and has no legal protection from the Norwegian laws for nature or culture conservation. The conservation is based on active farming by traditional land use methods, regulated by long-term legal agreements with the owners. At the same time the area is organized for education, research, outdoor life and interpretation for the general public and tourists.

The development work has taken 15 years and has shown that by combining ecological thinking, traditional land use methods and modern technology, it is fully possible to stop the present deterioration and reforestation of the coastal landscape. Proper heathland management is dependent on all-year-round grazing. At The Heathland Centre the old Norse breed of sheep is used, but other ancient breeds of sheep or even cattle are able to utilize the heathlands as well. In order to keep the landscape open, the experience is that a grazing pressure is needed equivalent to one adult sheep through the whole year pr.ha. In addition comes a few rams, and the lambs during the summer. Heather burning is also important. This has to be done during winter or early spring, and the optimal results are achieved if repeated about every 15. year on the same place.

The Heathland Centre obtains increasing attention from coastal farmers all over the country. Similarly, conservationists and researchers from all over the European heathland area come to study the results at Lygra. The interest from the schools has been great, and an educational program adjusted to all levels has been made.

The visitors in general enjoy very much the possibility to combine outdoor life with landscape interpretation offered them at The Heathland Centre. The national tourist operators are also interested, but so far it has been obvious that this kind of landscape based tourism (geotourism) is not yet fully developed in Norway. Visitors from abroad are however very exited over the experiences and information presented to them at the Centre.

Safeguarding of Norwegian heathlands for the future has to be based on the following main points:

- Agreement by public authorities upon a scientifically based conservation plan for heathlands.
- Improved incitements to encourage low-intensity farming related to valuable cultural landscapes.
- Preservation of the ancient breeds of coastal livestock, as living genebank for the future.
- Facilitate the possibility of trading with the quality products from this kind of farming.
- Stimulate a broad front of interdisciplinary heathland research all along the coast.
- Increased focus on knowledge dissemination about heathlands to all groups.

This is not mainly a question of money. As much it is about adjusting of existing regulations which today are aiming to stimulate industrial agriculture. Very much can also be obtained by more cooperation between the different ministries and better coordination of existing grants and programs of subsidies. And it is about knowledge. Most politicians are today unaware of the special qualities and the possibilities of the heathlands. This is a problem if the future of this cultural heritage is to be decided in a democratic manner.

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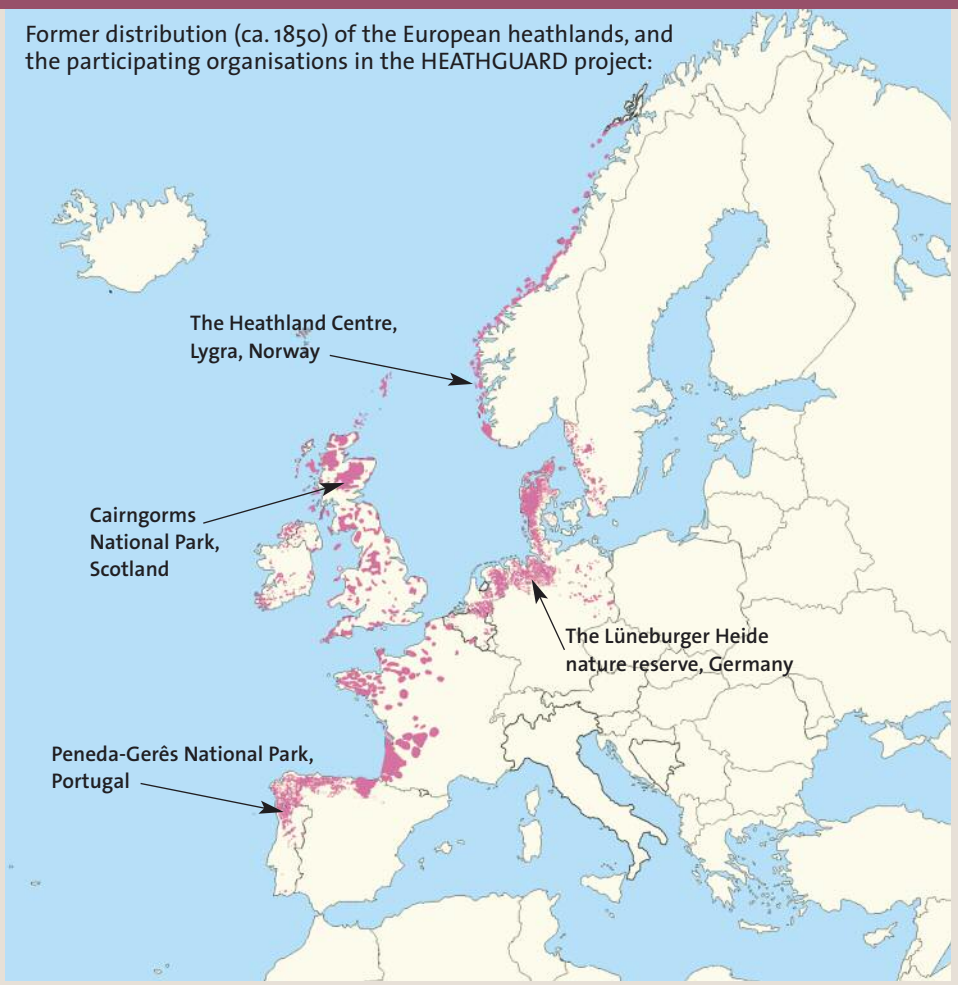

Heathlands are present in most European countries facing the Atlantic, and they constitute a common cultural landscape unique for Europe. Safeguarding the Heathlands of Europe (HEATHGUARD), has been a one year European Heritage Laboratories project financed by the EU Commission Culture 2000 Framework Programme in Support of Culture. The object of the project has been to compare conservation methods and landscape management practice of heathlands in different regions of Europe.

In four reports, one from each partner, descriptions are given of landscape development, traditional land use systems and the importance of heathlands to regional heritage, identity and biodiversity. In a fifth report the experiences of the partners from heathland conservation and management are compared and evaluated, in order to propose recommendations for the future preservation of the remnents from this common European cultural heritage.