



Prescribed Burning of Coastal Heathlands in Western Norway: History and Present Day Experiences

Introduction

Anthropogenic heathlands constitute a part of the common cultural heritage of Europe. During thousands of years, regular controlled burning was essential for the maintenance of these cultural landscapes. The fires were an integrated part of the farming in the coastal zone where these heathlands mainly were found. Today large parts of the anthropogenic heathlands have disappeared, and so has the traditions of heathland burning. Where areas of this type of cultural landscape still exist, they need proper management to survive for the future. In order to safeguard this legacy of small scale European coastal farming, the most effective strategy is to encourage the use of traditional fire based heathland management. This is the best way to preserve the diversity of the landscape and to increase its productivity for sheep grazing.

Cultural heritage of Europe

The anthropogenic heathlands and moorlands of Western Europe are old cultural landscapes. Unlike alpine heaths, which are caused by climate, the anthropogenic heathlands are man-made and have been maintained by grazing and regular burning over thousands of years. They are mainly found along the coastal zone of the Atlantic Ocean from Portugal to Northern Norway, and in areas of similar climate (Figure 1).

In spite of the great variations of natural conditions over this large area, the population living here had to face many of the same ecological challenges. People therefore in the long run made similar environmental adaptations. In particular the heathland farming was done in the same manner. Because of this common type of land use practice, the remaining heathlands today represent a common cultural heritage of Europe (Haaland, 2002).

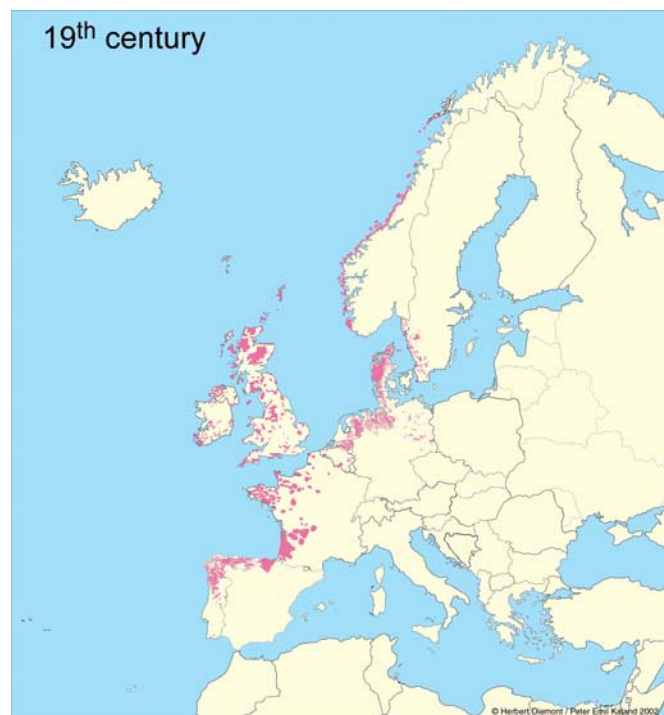


Figure 1. Map of major distribution of anthropogenic heathlands in Europe at the beginning of the 19th century. Source: HEATHCULT/The Heathland Centre.

Heathland farming started soon after the introduction of livestock husbandry to Western Europe. Even as far north as in Western Norway, the earliest datings of intentional heathland burning are about 5000 years old (Kaland, 1979, 1986). Gradually greater areas were cleared from shrubs and forests, in order to make heathland pastures for low intensity all-year-round grazing. This process went on during thousands of years until about 1800, when the heathlands obtained their greatest distribution area. At that time they were dominating the coastal landscapes of Western Europe. Since then, more than 80% of the heathlands has disappeared, and in several countries there are only remnants left. These old cultural landscapes are thus today also among the most threatened types of nature in Europe (Haaland, 2002).

The seven characteristics of anthropogenic heathlands

Throughout their entire distribution area, the anthropogenic heathlands of Europe share a set of common characteristics.

- They are open habitats. Traditionally the farmers could leave small copses of trees or shrubs for the grazing animals to seek shelter during bad weather. Shrub-browsing could also provide beneficial nutrients for the winter grazing animals. However, these copses were kept strictly under control by regular burning of the surrounding areas.
- They are dominated by dwarf-shrubs. In most of Europe, *Calluna vulgaris* is the most important species. But in the southern part, different species of *Erica* and dwarf species of broom and gorse are as important. Similarly, *Empetrum nigrum* occurs abundantly in the coastal heathlands of Northern Norway.
- They were used for all-year-round grazing. The distribution of anthropogenic heathlands is confined to areas of oceanic or sub-oceanic climates that permit winter grazing. In Scandinavia this includes the westernmost coasts of Norway and Sweden and most of Denmark.
- They were managed by regular burning. This was done in order to optimize the fodder production of the heather plants, and to prevent invasion of shrubs and trees into the pastures.
- They belonged to farmers practising strictly different productions of infields (cultivating) and outfields (grazing). The anthropogenic heathlands were not part of a slash-and-burn cultivating system.
- All over Europe, except Britain, there are traditions of heather mowing. This was mainly done for the purpose of winter fodder collection.
- Heathland soil has been used in different ways to improve the soil nutrient content of the cultivated infields.

Traditional coastal farming of Western Norway

The west coast of Norway has an oceanic climate, implying mild winters with little or no snow. Under these conditions, the traditional breeds of smallstock and even young cattle had no problem to survive the winters outdoor (Figure 2). They needed however food, and for that reason the farmers maintained large areas of *Calluna*-dominated heathlands. Different from grasses and herbs that lose their fodder value when withering in the autumn, the evergreen heather plants keep their fodder value unchanged during the year.



Figure 2. Traditional winter grazing in the heathlands outside Bergen. Photo: P.E. Kaland.

The possibility of all-year-round grazing made the techniques and the methods of coastal farming to be very much specialized on heathland pasture management. In the rest of the country, where the livestock had to be fed indoors half-the-year, the farmers had to spend a greater part of their time on winter fodder collection. Due to the practice of heathland farming, the need of winter fodder at the coastal farms was strongly reduced.

Unlike heathlands in most of continental Europe, the coastal heathlands of Norway are maritime landscapes (Figure 3). The resources of the sea were readily available, and e.g. seaweed, shell and fish remains were used as supplement to the manure in order to enhance the nutrient content of the cultivated soil. Because of the heathland based land use system, the farmers had time to go fishing as well, leaving much of the daily work at the farm for the women. Fish was of course important to the diet, but also of commercial interest. This was particular the case in Northern-Norway, where the famous stockfish was produced from the cod, without adding salt, by outdoor drying during the spring months (Alsaker and Herje, 1999).



Figure 3. Anthropogenic heathlands along the coasts of Western Norway are also maritime landscapes. Photo: Svein Haaland.

The economy varied among the heathland farms at the coasts of Western Norway; in the outermost part farming was a supplement to fishing, in the inner part fishing was a supplement to farming. Because of the mixed subsistence with stable supply of food, people could live well on small farms. This specialized system of utilizing the natural resources allowed for a higher population density at the coast than in any other rural areas in the world at similar latitudes.

Heathland management and the importance of burning

The individual plants of *Calluna vulgaris* undergo structural changes during their life span (Gimingham, 1972). If the plant is growing undisturbed (without management), the production of wood will increase with age, and consequently the fodder value will decrease. In order to avoid this shrub development of the heather plants, the farmers used to put the heathlands at fire at regular intervals. The frequency of these fires depended of the grazing pressure, in particular during the winters. If this was high, the lignification of the heather plants proceeded slowly and the needed fire frequency was low. With a low grazing pressure, it was necessary with a higher frequency of fires.

In order to avoid damage of the soil structure and the seed bank stored here, the burning always was done in late winter or early spring, in periods of nice weather. Some slow wind was beneficial, but of course not too strong. The farmers always were burning in the wind direction, and let the fire stop against different natural limitations, like the sea, water courses or bare rock formations (Figure 4).



Figure 4. Heathland fire to be stopped by the sea. Photo: Svein Nord.

The fire had a three-fold effect on the vegetation. Firstly, most of the biomass of the old, woody heather community burned off, including young specimens of trees and shrubs. Secondly, the heather plants would start to regenerate, normally already after a few months both from the roots and from the seed bank in the soil. Thirdly, many of the seeds embodied in the soil from grass- and herb species started to germinate after fire. Due to this, grasses and herbs dominated the vegetation of newly burned areas the first years after fire. Gradually the *Calluna* plants regained their dominance.

The farmers normally burned several limited areas instead of making one big fire. In this manner they obtained a patchy structure of the vegetation (Figure 5). Some areas became dominated by grasses, some by young heather and others by old heather. In some restricted areas they also permitted small copses of shrubs to survive, in particular willows, as an extra nutritious supplement for the livestock during the winters. The mosaic pattern was dynamic, and it gave the highest fodder value of the pastures over the year.



Figure 5. The farmers always burned in a mosaic in order to achieve optimal fodder production throughout the year. Photo: P.E. Kaland.

In addition to the all-year-round grazing and the regular burning, the heathlands were also managed by mowing. Heather mowing was done in order to collect extra winter fodder for the cattle. The mowing took place during the winter and early spring, and the heather was given fresh to the cattle. As much as one third of the winter fodder for the animals could be heather collected in this way.

Traditional heathland management can be summarized in a cyclic manner (Figure 6). Until about 100 years ago all coastal farmers followed the cycle seen to the left in the figure. Even 50 years ago, still many farmers were actively utilizing the heathlands. But during the next 20 years nearly everybody ceased, and the result is seen to the right in the figure. The earlier open landscape became increasingly overgrown by shrubs and trees, and this process is still accelerating today.

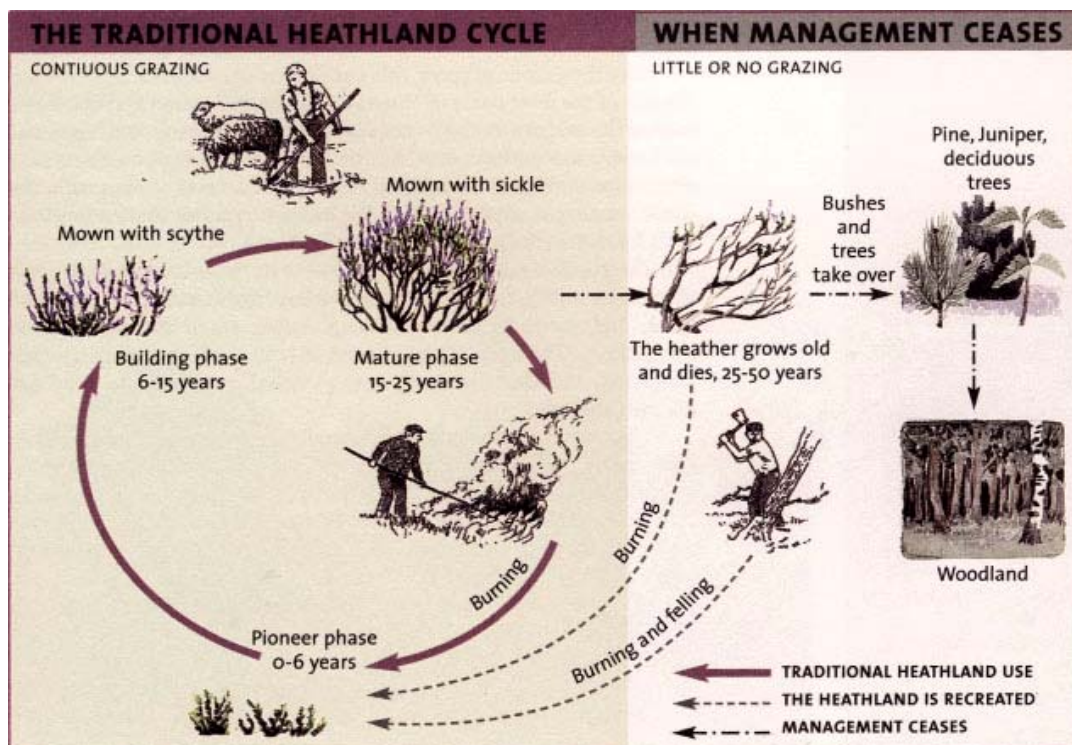


Figure 6. Traditional farming maintained the heathlands in a cyclical management as seen to the left in the figure. When farming was reduced, the successions started as shown in the right part. Ill.: P.E. Kaland and Kjersti Isdal.

Heathland history of Western Norway

After the last glaciation the coasts of Western Norway were colonized by trees, and at mid-Holocene the coastal landscapes were totally forested. The main forest trees were pine, oak, alder and birch (Fægri 1940, 1944; Kaland, 1984, 1986; Paus and Moe, 1996). By the study of many local pollen diagrams from peat deposits of the historically known cultural landscape, we have obtained a good understanding of how the coastal forests were transformed into open heathlands.

These studies have revealed that this fundamental change of the vegetation followed a certain pattern. Within limited areas the forest disappeared rapidly and was replaced immediately by Calluna-dominated heathlands. On a local scale this was a total deforestation. The vegetation composition of the subsequently developing heath was obviously influenced by grazing livestock, indicating that the local deforestations were related to farming (Kaland 1979, 1986). In addition, in all diagrams there are high content of microscopic charcoal particles, not only at the level of deforestation, but also in all later peat layers. This documents that regular heathland burning was an integrated farming technique already at the time of the first deforestations early in the Neolithic.

In order to understand the formation of the heathlands, it is important to realize that this was not a synchronous process along the coast. There may be great local variations in the age of deforestation,

even between two neighboring islands or from one farm to another (Kaland, 1986). This demonstrates the anthropogenic nature of the coastal heathlands, they are man-made landscapes.

The oldest dates of heathland burning from Western Norway are about 5000 years old (Kaland, 1986). From the data available today, it seems likely that the earliest heathlands developed at about this time on the westernmost parts of the coast, mainly on islands and similar localities easy to restrict. This method of land use was however rapidly taken up by people elsewhere along the coast, and gradually wider areas were deforested.

By comparing the pollen analysis with archaeological data, three different driving forces behind the deforestation are revealed. In Western Norway, the real change to a farming economy took place in the Late Neolithic period (Bakka and Kaland, 1971; Myhre, 2004; Hjelle et al., 2006), and during this process the first proper expansion of heathlands can be seen in many pollen diagrams (Kaland, 1986). In the agricultural favourable areas of Jæren in the southern parts of Western Norway, the major expansion of heathlands took place immediately afterwards during the subsequent Bronze Age (Prøsch-Danielsen and Simonsen, 2001).

Further north along the coast, e.g. in the poorer agricultural areas west of Bergen, the major expansion period of the heathlands came later, during the earlier part of the Iron Age, when better tools for the forest clearances became readily available. From this time period we also have proper documentation of the relationship between heathland formation and permanent farm settlements (Kaland, 1979; Kaland, 1986; Kvamme, 1982).

The heathland expansion culminated during the 12th and 13th century. At this time the coastal landscape was dominated by heathlands from the southernmost parts of Norway to Lofoten in the north. In Western Norway the heathland zone could be as broad as 40 km and in some areas even more. Further north the zone was narrower because the stronger climatic gradients from west to east made restrictions for the possibility of winter grazing. But on the outermost islands of Lofoten, the winters are as mild as in Western Norway.

The distribution area of heathlands remained unchanged during the next 600 years. It is no evidence for substantial overgrowing and reforestation of West Norwegian heathlands during this time, not even after the demographic and agricultural crisis from 1350, when more than 50% of the population died and many farms were deserted. It has been shown that large farms often took over the land belonging to the smaller farms as additional pasture-land (Myking, 1973), and in this way the landscape remained open.

The processes of deforestation and heathland burning are often criticized to be destructive to the nature and causing erosion. In the oceanic climate of Western Norway, the opposite is true. The rate of peat growth and soil formation has increased after the deforestation due to changes in the soil water balance, and this is not harmed by properly done burning (Kaland, 1986). The coastal heathlands are cultural landscapes that many places have remained stable for thousands of years. This had not been the case unless the farming techniques involved had been sustainable and not destructive to the landscape.

Heathland development after the industrial revolution

During the 19th century, great changes took place in European economy, settlement pattern and food production. Farming methods were made more efficient and new and bigger breeds of livestock were introduced. Because of these changes heathlands came under pressure and gradually they started to disappear over large areas.

In Norway the changes started later, and for a long time coastal farming was little affected by the new development. The knowledge of the old land use methods, e.g. the heather burning, therefore survived as a living tradition much longer in Norway compared to many other heathland areas in Europe. However, gradually the ancient livestock breeds were replaced by modern ones, and little by little the heathlands lost their economic importance for the farmers. But until about 1950, large areas of authentic heathlands still were intact in Western Norway.

After the Second World War, large efforts were made to modernize farming in Norway and make it more efficient. At the same time extensive programs of tree planting in the coastal areas were

intensified. The effect of all this was that traditional use of the heathlands nearly totally ceased. Only a few farmers were still burning, and during the 1970s the last ones gave up. Because of the high fodder demands of the modern sheep breeds, heathlands were not used even for summer grazing, instead the coastal farmers transported their sheep to summer pastures in the mountains.

Overgrowing and reforestation

The consequence of leaving the heathlands unused has always been overgrowing by shrubs and trees. This process started to increase over large areas due to the changes in agricultural policy in the 1950s, and from the late 1970s it has accelerated. The most aggressive shrub species is *Juniperus communis* that even used to be present in moderately grazed heathlands of low burning frequencies. If the grazing pressure is too low or ceases completely, the juniper takes over in a few years and causes difficulties for the heather plants to survive. In wet or badly drained areas, different species of willows may become a problem as well.

The most common invading tree species are birch, pine and sometimes rowan. In particular in areas of short distance to existing forests, these trees can develop copses and thickets within a few years if heathland management suddenly stops. The kinds of forests that develop today due to overgrowing are totally different from those forests that were cleared away by the farmers in the past (Figures 7 and 8).



Figure 7. Authentically managed heathlands on the coast of Western Norway, photographed in 1971. Farming ceased in 1975. Photo: P.E. Kaland.

The large scale overgrowing of the heathlands going on today has serious consequences for the coastal landscape:

- The outfields lose their potential for grazing and food production.
- The value of the landscape for outdoor life and recreation is strongly reduced because it becomes difficult to move around in these overgrown areas. In addition the views and the highly appreciated experience of open land is disappearing.
- The biodiversity is reduced both in the overgrown habitats and in the region, as many of the species adapted to live in the heathlands has no other places to go (Grimsby, 2000; Nilsen, 2004; Kvamme et al., 2004).

- The heritage of the landscape disappears. The heathlands are man-made and have been maintained for generations by the coastal farmers, and they are thus a part of the coastal heritage. In addition comes the physical, cultural remains spread out in this landscape. When they are overgrown by trees they become invisible and over time they risk to be destroyed by the roots.
- The ancient breeds of livestock adapted to take benefit of the heathland environment are disappearing.
- The knowledge about traditional farming techniques based on natural resources disappear. This includes prescribed burning as well as competence on handling the ancient breeds of livestock.
- The landscape becomes more inflammable. Old, woody heather combined with thickets of juniper, pine and birch imply a great increase of the fuel load production compared to traditionally managed heathlands. Because of the high content of resin and etheric oils in the pine and juniper, these kinds of vegetation behave like fire bombs if they start to burn uncontrolled on a warm and windy summer day. During the later years there have been several severe fires in overgrown cultural landscapes due to this development.



Figure 8. Exactly the same view as figure 7, photographed in 2005. Photo: P.E. Kaland.

Overgrowing and tree planting are the major threats to the remaining heathlands today. But manuring, cultivating and building activities are locally taking their tolls, and for the moment the development of windmills for electricity production along the coast is a great issue. In south-western parts of Norway, increased deposition of airborne nitrogen on the ground may cause problems to the heathlands in the future.

Safeguarding of heathlands: The Heathland Centre

In the 1960ies it was mainly the botanists who were alarmed by the overgrowing. In the 1970ies the environmentalists started to be worried, and in the 1980s a majority of the farmers realized that this could be a problem. In the 1990s the agricultural and environmental authorities began to map valuable cultural landscapes and to try out different economical systems to support grazing in such areas. However, this has not been sufficient to reduce the overgrowing, and still (2009) there is no plan for safeguarding heathlands in Norway, although this has been proposed for more than 20 years (Steinnes, 1988; Fremstad et al., 1991).

In 2000 The Heathland Centre opened at Lygra, located on two small islands 40 km northwest of Bergen. This is a research and interpretation centre for coastal heathlands. In cooperation with the local farmers, about 150 hectares of authentic heathlands are managed in traditional manner. This includes prescribed burning and all-year-round grazing by the traditional breed of outwintered sheep that was reintroduced to the area 17 years ago. The intention is also to keep other breeds of cows and goats that we know traditionally were used in the heathlands (Figure 9).



Figure 9. Aerial view of The Heathland Centre at the northern part of Lygra and the neighbouring island Lurekalven. Photo: P.E. Kaland.

Since the preparation work started in 1992, different parts of the heathlands have been burned every year. The area is organized for outdoor life and the centre has an educational program for school classes of all ages. Different courses are given about sustainable land use methods of the coastal landscape, including prescribed burning. The idea and development of The Heathland Centre have received a lot of attention during the last ten years. This publicity and the activity at the centre itself has been essential in order to increase the understanding of the values of coastal heathlands, and to raise public awareness of the problems related to rapidly overgrowing landscapes.

New life to old landscapes

During the last twenty years, the coastal population has become increasingly worried for the dramatic vegetation changes in their environment. At the same time, nobody can afford to live as they did 100 years ago. However, many people try to revitalize aspects of the traditional heathland farming in combination with modern professions. In particular it is great interest in the reintroduction of "Ancient Norse Breed of Outwintered Sheep", in common speaking called wild-sheep.

This breed was the traditional type of sheep that was common along the coasts of Scandinavia for hundreds and probably thousands of years. It was the sheep of the Vikings, and they brought it to the islands in the North-Atlantic. Even today descendents from this breed are found e.g. on Island, Shetland, the Orkneys and Outer Hebrides. However, in Norway modern breeds with higher yields gradually replaced the older ones from about 1850 and later. Finally the ancient breed was only left in a small island society southwest of Bergen called Austevoll. For different reasons the people living here took care of this elderly type of sheep, and they also continued the traditions of how to handle these animals (Løne, 1991). Because they were hardier and shyer compared to the modern breeds, they were often called wild-sheep. But they did always belong to the local farmers.

During thousands of years, this breed has developed together with the coastal heathlands. The animals are perfectly adapted to live outdoor at the west coast of Norway, and they are specialists to survive the winters on the heathlands, even when the ground is covered with snow (Figure 10). In addition to heather, they eat grass and herbs in the summer, they eat seaweed and during the winter they also eat trees and shrubs if available (willows in particular). With access to heather they do not need any extra supply of fodder to survive the winter. Compared to modern breeds they are much smaller and are running much faster, and they jump over a tall man without any difficulties. They are very hardy and resistant to both frost and sickness.



Figure 10. The animals of “Ancient Norse Breed of Outwintered Sheep” are experts of surviving the winters on the coastal heathlands, even when the ground is covered by snow. Photo: Anne Magnussen.

Due to the demands for higher farming efficiency of the time, the wild-sheep at Austevoll started to be endangered in the 1950s. However, some of the farmers and local agricultural authorities were fully aware that these animals possessed many valuable properties that had been lost in modern breeds. They therefore started a conscious work to safeguard the breed. They succeeded, and when the knowledge about the qualities of these sheep was spread along the coast, the interest of reintroducing the breed from Austevoll to other areas started to grow. In particular during the last 20 years it has been a rapid increase in the number of wild-sheep. Today about 30,000 sheep of the old breed are kept outdoor during the winters, and they are spread along the entire west coast. They constitute about 3% of the total number of sheep in Norway (Figure 11).

The popularity of the wild-sheep is mainly due to three reasons. Firstly it is an easy way to produce food in the outfields without too much labour. Secondly the wild-sheep are clever to keep the landscape open, and thirdly the meat is better paid than the meat from modern breeds. The wild-sheep meat has got a very good reputation in the restaurant-branch due to its taste, structure and lower content of fat. The wool has on the other hand got a bad reputation because the modern spinning machines cannot treat it. However, it is nothing wrong with the wool, it is the machines that are not constructed for this kind of wool. When it is treated by hand it gives the most wonderful results, which are very well paid for (Vangen et al., 2007). The same is the case for the fleeces. Very few are living from wild-sheep farming alone, but this is a nice extra income for hundreds of families living on farms that today have become too small to be run economically within the framework of modern agricultural policy.

The heathlands were also grazed by other animals. The last remnants of a special breed of outwintered meat-goats do still exist on a few places. They were more widespread earlier, but much of their history is still unknown. Today they are endangered, but efforts are taken to safeguard them for the future. We do not know about a special coastal cow. However, two different breeds of cows do still exist that are exclusively for Western Norway. They were widely used in the heathlands earlier, but today they are mainly kept in other parts of Western Norway. This is partly due to limitations given by the veterinary regulations that are made for the modern breeds. The hardiness of the old breeds

seems to be forgotten by the authorities. However, hardy breeds of cattle have been introduced in the coastal heathlands during the later years, e.g. the “Scottish Highland Cattle” has proved to be successful.



Figure 11. The animals of “Ancient Norse Breed of Outwintered Sheep” are small but hardy, they run very fast, the meat is excellent and the wool gives wonderful products when treated by hand. Photo: P.E. Kaland.

The most numerous livestock in the heathlands today are the honeybees. Heather honey is famous for its taste, high quality and healthiness. Many beekeepers therefore transport their hives out in the heathlands from July to September in order to secure this valuable product. They are however worried for the present decrease in production areas because of the ongoing overgrowing of the heathlands.

Although traditional heathland farming totally has vanished today, it is an increasing interest to revitalize some of the methods that has proven to be successful in the past. As shown in these examples, this is mainly related to niche products of high qualities. The demand for clean food, produced in an ecological sustainable manner and of high quality, is rapidly increasing. Consumers are also getting more concerned about the environmental consequences of food production, and the associations of the wild-sheep farmers are utilizing this in their advertisements: “Buy one kg of wild-sheep lamb meat, and you have preserved one decare of heathlands”.

Burning for the future

During the last 10-15 years the interest of heathland burning has started to increase. This is mainly due to the growing popularity of the wild-sheep along the coast. The animals are yielding their best if they are kept on properly managed heathlands, and therefore the farmers want to take up again the old tradition of prescribed burning.

In many farms or villages they know that heathland burning has been done earlier. What is remembered today is however only the stories about the accidents, which in most cases have been wildfires caused by carelessness during the summer. People are therefore convinced that burning is impossible, or very difficult at their place. That their ancestors three generations ago were burning every winter as a part of their farming, has been forgotten today.

The renewed interest of heathland burning is also coming from others than the wild-sheep owners. Private persons and organisations involved in nature conservation and outdoor life activities are getting worried for the increasing overgrowth of the landscape and environmental and agricultural public authorities have now started to understand that prescribed burning will be necessary in order to

safeguard different types of nature and habitats for the future. It has however been a long way to go for many conservationists to realize that the only way to preserve nature types like heathlands is to burn them at regular intervals.

The competence we possess at The Heathland Centre are based on 30-40 years of experience from heathland burning. We learned the techniques of this farming method in the late 1960ies and the 1970ies from the last farmers in the region who still were burning their heathlands in authentically manner (Figure 11). Since then we have been practising this in different areas, and since 1992 we also have been burning at Lygra and Lurekalven in order to restore the cultural landscape of The Heathland Centre as authentic as possible (Figure 13). We try to develop and improve the method by combining the lessons we learned from the old farmers and our own experiences with the present research results from heathland ecology (Kaland, 1999; Kvamme et al., 2004).



Figure 12. Authentically heathland burning by Mandus Fondenes in 1971. Photo: P.E. Kaland.

In addition to the courses we give at The Heathland Centre, we often have been asked to come to local communities to explain the benefits and the techniques of controlled heathland burning. The audiences at these gathering are farmers, landscape managers, people from the local fire brigades and general public of interest. If possible we always go out and burn off an area in addition to the theoretical part. Often we cooperate with other experts informing about wild-sheep farming and product development (Figure 14). At such occasions we may attract more than 100 participants. In this way we have left numerous black footprints behind along the entire coast, and we know that the activity of heathland burning today is much more frequent than it was ten years ago.

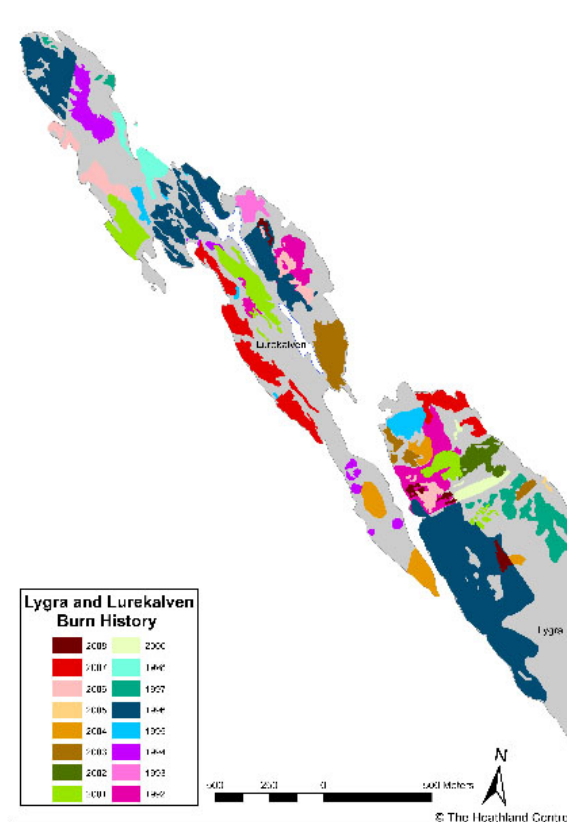


Figure 13. History of heathland burning at The Heathland Centre 1992 – 2008. III: The Heathland Centre.



Figure 14. Modern farmers learning the ancient farming technique of heathland burning in 2005. Photo: Aslaug Aalen.

Traditional heathland burning was primarily management fire in order to maintain the quality of the heathland pastures. Today we have to face the problem that most burning is more or less restoration fires. The heather plants may be 40-50 years old with woody, coarse stems that burn incompletely.

Underneath such old heather a thick layer of mosses develops on the ground. This is normally not possible to burn properly away by fires in early spring. Regeneration from the roots of old heather plants develop slower than from younger plants and the moss layer obstruct the seed germination. To come around these problems we have started to burn later in the spring so the vegetation can be as dry as possible without risking soil combustion. But after 15 April it is not legal to make fires in the outfields of Western Norway.

A major problem of Norwegian heathlands is the juniper (*Juniperus communis*). It grows like a weed and has taken the position that brooms and gorse have in the continental and British heathlands. In Norway we have no wild growing gorse, and brooms are only found in the heathlands of the southernmost tip of the country. Juniper has very hard and long lasting wood and was earlier used for many purposes. Today it is only growing wild. In areas of tall growing juniper, the fire has to be planned very carefully because they burn fiercely when first ignited. Still, the "skeletons" of the junipers have to be removed manually afterwards. The good thing with the juniper is that it is killed after burning, compared to brooms and gorses that are favoured by burning.

Due to the accelerating reforestation during the last 50 years, the dispersal pressure of seeds from trees into the heathlands has increased, and many species, e.g. birch, readily germinate on newly burned ground. It is therefore a risk of undesired vegetational successions after fire. We have observed that the sheep love to stay in the recently burned areas, and they effectively remove all sprouting trees and most other invasive plants to the heathlands. Due to this experience we always recommend livestock grazing in combination with heathland burning, even if the purpose of the fire is pure management, e.g. for outdoor life.

Another issue we strongly recommend to everybody who plans to start heathland burning is to have a good relationship with the fire authorities and the local fire brigades. They always need to be informed about planned heathland burning, because people who don't know that this is done under controlled conditions will observe the fire. In general fire authorities have little knowledge about heathland burning, and in many districts they are very sceptical to this practice. We therefore try to inform them as good as we can, and to convince them that this kind of controlled burning is beneficial compared to great uncontrolled wildfires during the summer.

Prescribed burning is essential to proper heathland management. This has been of great importance in the past, but it may prove to be as important for future food production. Traditional cultural landscapes like the heathlands, developed and were maintained over long time as a consequence of food production based on natural resources. The ancient breeds of livestock were specialists of utilizing the conditions of these landscapes. Many of the properties of these ancient breeds were lost during the development of modern types of livestock for the industrial farming. Today many arguments are calling for a revision of the agricultural policy, and in this work it will be necessary to utilize the ecological experience of the past farming methods. Of particular importance is the caretaking of ancient breeds of livestock and their genetic resources, and to safeguard the landscapes where they are adapted to survive. The story of wild-sheep reintroduction and heathland restoration along the coast of Norway, is a good example of how future food production can be developed by the combination of landscape heritage and the diversity of traditional breeds of livestock.

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