



## The Use of Prescribed Fire for Maintaining open *Calluna* Heathlands in North Rhine-Westphalia, Germany

### Introduction

The Nature Reserve „Drover Heide“ is located only few kilometers south of the town of Düren (North Rhine Westphalia State [NRW], Germany) in the transition zone from the Eifel range to the Lower Rhein Plain. The reserve comprises almost 680 hectares (ha) of which 150 ha are open heathland and another 150 hectares are poor grassland, and it therefore contains valuable habitats for various highly endangered plants and animals depending on open landscapes. For that reason the reserve is embedded into the European conservation network Natura 2000 and because of its importance in different habitat types it is furthermore classified as a bird sanctuary. The area is famous for various rare species such as the Nightjar (*Caprimulgus europaeus*) with 35 breeding areas and the Woodlark (*Lullula arborea*) with six breeding areas, which are both highly restricted to open habitats.

The reserve had been extensively used as a military training area for more than a hundred years. To date the area is still Federal property and is administered by the Federal Real Estate Agency within the Federal Forest District „Wahner Heide“. Since the last 10 years all management activities have been coordinated and conducted by the Biological Station Düren, a local incorporated association. All issues with relevance to nature conservation are administered by the Landscape Board of Düren County. As a result of the military activities the reserve has been kept open for a long time period. Since the 1980s these activities were more and more declining and finally ceased to continue in 2005 completely. It was during that period of decreased military activity when the vast and continuous heathlands developed. As a contrast to the sandy soils of most other heathlands like the famous Lüneburg (Lunenburg) Heath, the Drover Heide is stocking on highly productive clay-loam. As a consequence heather (*Calluna vulgaris*) reaches a height of up to 1.5 m on these nutrient rich soils. In order to maintain the characteristics of this open landscape, management activities had to be intensified significantly over the past 20 years. Like in other similar heathlands of Central Europe over-aged heather and invasion of woody species can be identified as the main problems.

### Management activities in open habitats

Through intensive military activities, especially tank driving, the area was kept open also without any active management. On the contrary, it was often necessary to plant woody species for soil protection in order to avoid too strong devastation and dust clouds during the summer. To date almost the entire area is densely vegetated and patches with denuded soil as special habitats have vanished.

A large part of the poor grassland habitats is grazed seasonally by a local flock of around 300 sheep.

Several methods for the maintenance of the heathland are used in the reserve:

- Mowing: the possibility of mowing and disposal of the swath is only limited as the terrain must be relatively plane and free of woody vegetation to allow access of heavy machinery.
- Grazing: since 2005 a fenced area of almost 150 ha is regularly grazed by a flock of Scottish Highland Cattle and goats which resulted in a significant reduction of woody vegetation (mainly *Populus* spp. and *Betula* spp.).
- Mulching: in the case of strongly over-aged heather (older than 15 years) and a high proportion of woody vegetation, the only possible management was mulching up to the year 2007, which can be done at relatively low costs. All plant material is shredded and remains on site. However, if the layer of the mulched material is too thick, natural regeneration of the heather is hampered. Removal of the plant material is increasing costs significantly.
- Prescribed Burning: since early 2007 prescribed burning belongs to the suite of management activities in the reserve. Between January and March approximately 10 ha of over-aged and bush encroached heathland are burnt annually by a contractor.

## Preparation

Basically it must be said that all legal preconditions regarding the use of fire in NRW State have been tightened for the private sector as well as for communal areas. During the 1970s and 1980s it was very common in rural areas and forestry to burn agricultural residue, slopes, brushwood and stubble fields. Since the 1990s, however, it is now widely forbidden and special permission is required to burn lopping residue from orchards and hedges. This was also limiting forestry activities as burning brushwood on piles was allowed only under strict requirements during bark beetle calamities and wind throw. The legal framework for burning is given by the Landscape Law and the Pollutants Law of North Rhine Westphalia. Special permissions can only be granted by the municipal public order offices and the Landscape Board at county administration level.

Before the first prescribed burn the reserve in March 2007 fire as a management tool for the maintenance of open landscape was completely excluded by law in NRW. The only exception to this were actively used military training sites such as Sennelager near Paderborn.

Fire is perceived as a destructive element and a hazard to humans and nature by the general public, as can be observed every summer when the media report on arduous conflagrations and environmental destruction in southern Europe. The role of fire in ecosystems and its positive effects are often not recognised and although a wildfire problem such as in the Mediterranean is not existent in NRW, public opinion on fire is biased. Another limiting factor for the use of fire is its impact on recreation as burnt areas are generally perceived as unattractive.

On the other hand it was noted that regularly visitors were suggesting to use fire on the heathland because this was the traditional way of maintaining a productive heathland. Obviously the use of fire is known to many people in relation to shepherds and the improvement of pasture land.

## Exchange of Information and Permissions

The first discussions on a possible use of controlled fire to maintain Calluna heathlands in the reserve were initiated already in 2002 by the Biological Station Düren. However, it almost took five years for the first burn to be implemented in the heathland after all. The basic step was to reach a consensus among the experts of the Landscape Board of Düren and the land owners who were represented by the Federal Forest Office Wahner Heide. The Federal Forest District Wahner Heide is responsible for the management of several other major real properties in Germany with also actively used military training areas among them. Every now and then there are accidental fires in these areas caused by the military training activities, but fire is also used intentionally to ensure permanent training activity. The main goal for fire use in these areas is not nature conservation, but it is seen as an instrument to keep the terrain open and reduce combustible material for safety reasons. This was the main reason why there was only little concern of the land owner towards the use of controlled fire. However, the legal administration of all nature reserves is within the responsibility of the County Landscape Board and that also accounts for „Drover Heide“. According to the Landscape Law and the General Rules for Conservation Areas it is generally forbidden to light fires in nature reserves. In so far it was mandatory to apply for a special permission with the local authorities. Prior to the first application of fire, the Biological Station Düren and the County Landscape Board decided to learn more on the effects and the ecology of fire use in the frame of a study tour to an actively used military training site in Belgium (Elsenborn). The participants visited several sites that were regularly burned to keep the area open. As the area is still used as a shooting range there is a great chance for accidental fires that are contained by control lines. Because of the high load of ammunition in the impact area there are no activities foreseen for fire suppression. In order to keep the uncontrolled fires from getting too intense and to keep the range open, annually vast areas are burnt in a controlled way by the responsible forest office and the military. A positive side effect from this is the maintenance of huge areas of *Nardus* grasslands, *Meum* pastures and *Calluna* heathlands that are unique in their vast extent.

The experience of such a breath taking landscape certainly helped the endeavor of introducing prescribed fire to the nature reserve and the ground for the regular use of fire was prepared.

After all, the consensus among all responsible experts was achieved that the application of controlled fire to maintain open Calluna heathlands and to restore over-aged and bush encroached heathlands is

reasonable and leading to the desired results. Prescribed Fire was then a third alternative in the management of heathland to mowing and mulching.

The selection of burning sites was conducted by the following criteria based on an agreement between the land owner and the County Landscape Board:

- Over-aged heathland with strong encroachment of woody vegetation (restoration measure urgently required). Terrain partially not appropriate for the use of heavy machinery due to the relief or the age of the vegetation. The heather is stocking on a loamy-clay with strong woody stems which limits the use of a rotary mower or a cutterbar. As the only alternatives remain the mulcher and prescribed fire.
- Burning plots should not be situated in close proximity to public hiking trails from a safety aspect and aesthetic reasons. During the first year of the trial it was preferred not to confront the general public with the black areas after the burning.
- Plots should be situated along old tank tracks which can serve as control lines

Another permission was required to be obtained from the neighbouring community of Vettweiß according to §7 of the Federal Pollutants Law. In addition police authorities and local fire brigades had to be involved in the planning process. Since the nature reserve is a former actively used military training site and in addition contains heavy loads of ammunition from WWII, it was also necessary to include an explosive ordnance disposal unit.

The general public was informed via the press media and a communal information print on the positive effects of controlled fire application and the first trial was announced.

In order to consider all financial aspects a cost estimate was required. As practical approaches were desired it was preferred to have payments based on a daily rate. There is an annual budget available for the maintenance measures in open landscapes which provides for an unbureaucratic way of acquiring the necessary financial means for the trial.

The local fire brigade was informed and it was required by the responsible authorities that a fire truck was present during the first operation. For the local firefighters themselves it was a very interesting experience and a good exercise since they also would have to respond in case of an accidental fire. Police authorities were informed, but were not present during the burning operation as no adverse effects on traffic were expected. It was likewise necessary to inform the nearby military air base Nörvenich about the burning operations as the open heathland is part of the training area for flight manoeuvres of fighter bombers and serves as bail out area in emergency situations.

### **Conclusions from the use of prescribed fire in the nature reserve**

The strongest influence on the success of a prescribed burning operation is the total dependence on the local weather conditions with the wind direction as the most important variable. The terrain in the nature reserve resembles more or less a long stretched hill with the consequence that with varying wind direction also the leeward effects of the burn plots is more pronounced. The situation is complicated by a forest belt surrounding the open core area and the patches of woody vegetation within. This is where the leeward effects play the most crucial role in determining if a plot can be burnt or not as the drying mechanisms for the heather fuels are rather unfavourable during the winter burn season. Especially after frosty nights it takes a lot more time to overcome the effects of rime due to shading effects in this highly productive heather stands that reach about 1.5 m in height. Consequently it is advisable to prepare more burn plots during the preparation phase than can be actually burnt on the day of the operations to be able to react on the current wind situation. This means it is of major importance to prepare burn plots on both West wind and East wind sides.

Generally the burning window during the winter burn period is very narrow. Usually operations will not start before 12:00 hrs after relative humidity has dropped below 50%, yet again after 16:00 hrs it becomes very difficult to light a fire because the relative humidity is rising too high. This means that there are only four hours per day available for the actual burning operation and it makes sense to prepare as much as possible prior to the burning operation in order not to shorten the burning window even more. Experience was showing that it is very efficient to prepare control lines of 4 to 6 m width around the burn plots with a mulcher.



**Figures 1-4.** (1) Typical succession of *Betula* spp. in *Calluna vulgaris* heather in Drover Heide Nature Reserve; (2) High-intensity prescribe fire (2007); (3) Success of prescribed burning is revealed by high mortality of birches and poplars, and (4) by healthy regeneration of heath. Photos: R. Mause.

The greatest success of the fire application was the reduction of upcoming woody vegetation. Almost 100% of young birches did not survive the prescribed burning operations because the high flame temperatures exceeded the lethal point of the trees by damaging the xylem in a way that caused the total desiccation of the plants. At a later stage fungi and other infections established in the fire scars and caused further damage to surviving trees, leading to the final kill-off. This is besides the natural regeneration of *Calluna* seen as pivotal for the permanent preservation of open landscapes, as mechanical treatment by far do not have such resounding success. Young *Betula* and *Populus* trees are reacting with strong resprouting after being cut back with motor chain saws and make a second treatment necessary within short time. Also the remaining stumps of the thin trees can easily destroy even tractor tires which causes problems to subsequent treatments for the maintenance of the heathland. On the other hand one has to consider that dense patches of young trees do not allow the development of an understorey or layer of herbal vegetation and hence carry only very low fuel loads and it is therefore very important start timely with the treatments. However, from a bird protection point of view a complete removal of the woody vegetation is also not desired.

During the winter burn season (October-February) only a few days are suitable for efficient prescribed burning operations. Since the heather is reaching a maximum height of 1.5 m it takes some time until the fuels are dry enough after precipitation events. This requires a relatively low organizational preparation phase prior to the burning operations, but experience shows that one day is usually enough to have everything in place.

## Results

From 2007 onwards between 6-10 ha of heathland were burnt annually with accompanying ecological assessments through permanent plots for floristic studies and different animal groups such as Arachnidae, Carabidae and birds.

## Vegetation

The results of the floristic assessment exceeded by far all expectations. Vegetative as well as generative regeneration of *Calluna* was abundant all over the area as already in the summer following the prescribed burning operations the flowering of *Calluna* was area-wide. Of major importance is the fact that the burn plots showed a significant increase in biodiversity. Generally Atlantic heathlands are rather poor in species composition. Prior to the burning operations the heathland was comprised of over-aged monocultural stands of *Calluna vulgaris*. After the fire, however, various species of the initial phase of a heathland and species of mat grass swards respectively were germinating on the burn plots such as *Nardus stricta*, *Molinia caerulea*, *Danthonia decumbens*, *Polygala vulgaris*, *Carex pilulifera*, *Agrostis vinealis* and others.

The burn plots are located within the fenced paddock, which leads to a revival of the traditional management form of fire and grazing. The burn plots are extremely attractive for the grazing animals.

Another aspect of major importance is the results for the reduction and repression of woody vegetation. Mortality among young *Betula* trees was almost 100% after the burns, especially after the optimal burn conditions in March 2007 where the temperature remained relatively warm (6.0°C) for several days and the relative humidity allowed for excellent drying of the fuels. Consequently, the resulting temperatures of the backing and flanking fires exceeded the lethal point for almost all young trees and bushes. Some trees were resprouting relatively quickly after the fire, but could not survive the summer period and the browsing pressure of the cattle and goats. Also rabbits who feed on the young shoots have a certain influence on the post-fire mortality, but it is difficult to quantify.

## Arachnids and Carabid beetles

Both groups are being monitored in altogether five ground traps since June 2006 which fortunately includes one vegetation period prior to the first burn. The traps are examined every 2 weeks and there is already a tendency to be observed that especially rare thermophilous species were benefiting from the prescribed burning operation. For example several thermophilous Arachnid species that are typical for heathlands were counted on site after the burn: *Agroeca proxima*, *Callilepis nocturna*, *Xerolycosa nemoralis*, and *Micaria silesiaca*. Thus, the burnt area can be considered a substitute habitat for the patches of denuded soil that were created by intensive tank driving.

## Birds

It is particularly remarkable that both nightjar and woodlark established breeding territories immediately after the burning operations. This helped to confirm the preferences of these ground breeding species that are described in the literature. Both species deserve special attendance in the reserve as they belong to the very rare breeding birds in NRW and need a special management concept.

## Perception

The reaction of the local population to the use of prescribed fire is astonishingly indifferent. Although smoke development was significant during the burning operations nobody called the fire service or police. Most likely this is due to comprehensive information campaigns prior to the prescribed burns.

During the second burn a group of approximately 30 hikers were watching the operation from safe distance. Unfortunately it was not possible to conduct interviews on how they perceived this treatment. When presented on subsequent guided excursions to the reserve the burn plots were generally perceived as unusual by the visitors. It was not until the ecological processes and context were

explained that most people were showing comprehension, others, however, disagreed with the approach as they are promoting “free development” and generally object human interference with nature, i.e. all kind of management. From a nature conservation point of view, however, the management concept in the nature reserve is undisputed and there are clear rules from the FFH directive. Also the political representatives of the communities and the County consider the heathland and open landscape of the nature reserve as an important recreation area and this leaves no room for free development.

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### **Reference**

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