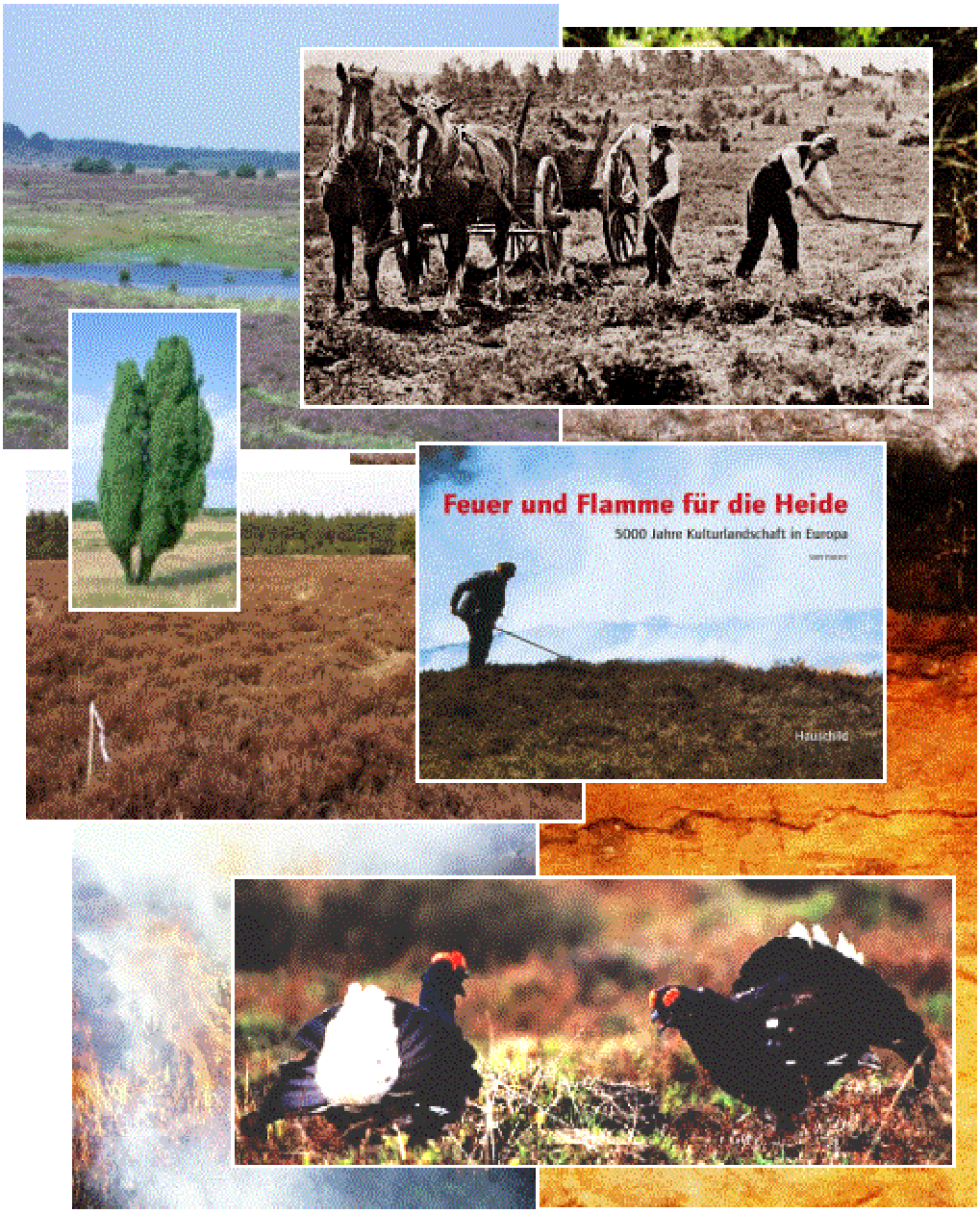
8th European Heathland Workshop

3rd to 11th July 2003

Camp Reinsehlen, Schneverdingen, Germany

Organised by the Alfred Toepfer Academy for Nature Conservation (NNA)



Abstracts of talks and posters.

Excursion guide.

Legend

1 Lüneburger Heide nature reserve

2 Bergen-Hohne Military training area

3 Nemitzer Heide

4 Kellerberge

5 Muskauer Heide

6 Polish heathlands

7 Tangersdorfer Heide

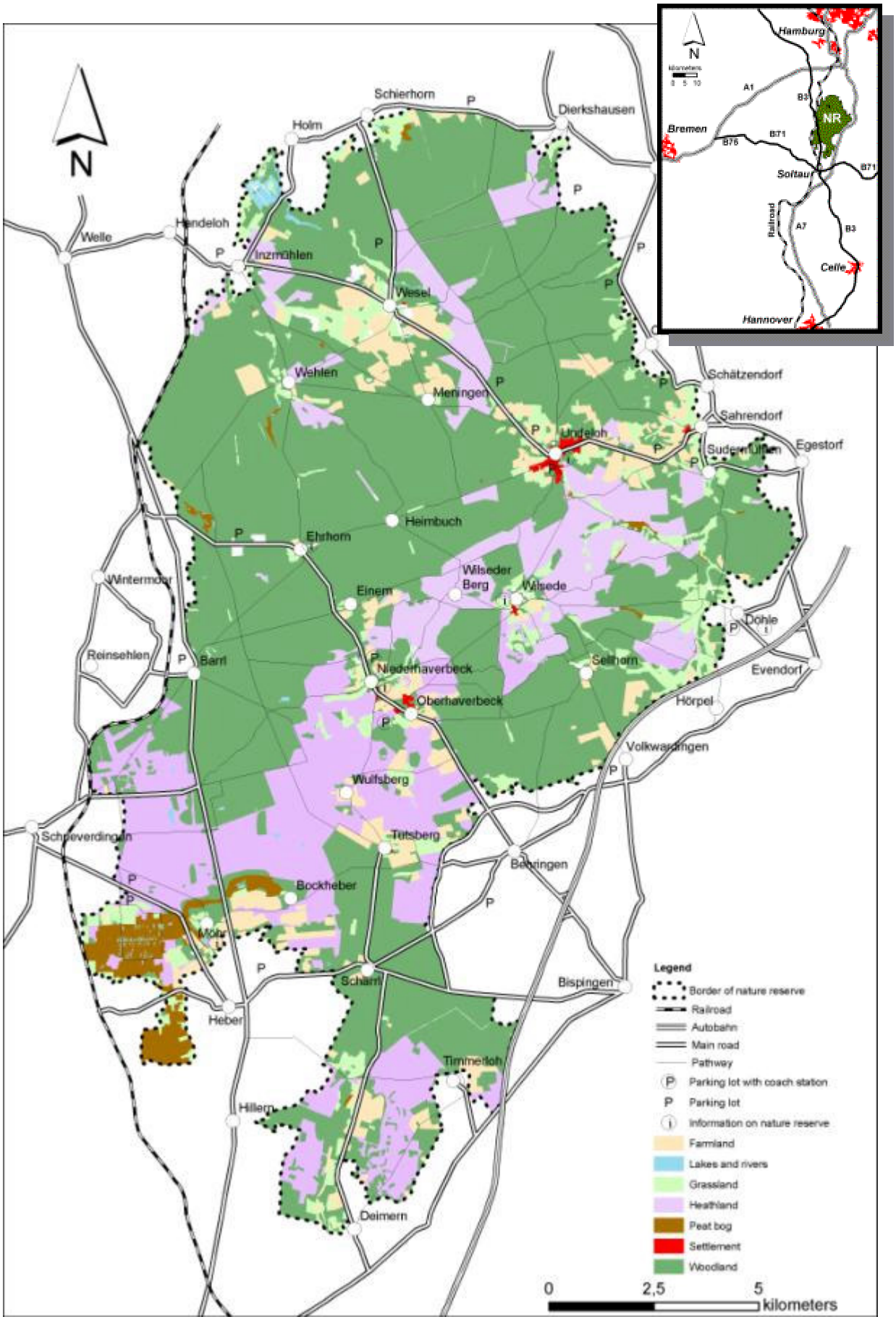


Figure 1: The Lüneburger Heide Nature Reserve

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Programme

Workshop

July 3rd (Thursday)

until 20.00 h	Arrival of participants at conference venue Camp Reinsehlen
20.00 h	Dinner
	Staying overnight at Hotel Camp Reinsehlen

July 4th (Friday)	**Excursion to the Lüneburger Heide nature reserve**
09.00 h	Coach-ride to Hof Tütsberg landscape management farmstead
	Guided walk to the village of Niederhaverbeck
	Coach-ride to the forest visitor centre Ehrhorn No. 1
	Management of heathland patches in forests
13.15 h	Lunch
14.30 h	Coach-ride to the village of Oberhaverbeck
	Trip to former Eickhof forest and Stadtberg hill with horse-drawn carriage
	Trip to the village of Oberhaverbeck with horse-drawn carriage
	Coach-ride to Camp Reinsehlen
	Coach-ride to Hof Möhr
19.00 h	Welcome by the Government of Lower Saxony at Hof Möhr with presentation of the German edition of the HEATHCULT book by Hauschild Verlag, Bremen
20.30 h	Barbecue at Hof Möhr
	Staying overnight at Hotel Camp Reinsehlen

July 5th (Saturday)	**Scientific programme (I)**
09.00 h - 09.30 h	Welcome/Introduction *Nigel Webb, Johannes Prüter*
	Part 1: Heathlands in Europe - History, conservation strategies and perspectives
09.30 h - 09.50 h	Protection of heathlands in Norway *Peter Emil Kaland*
09.50 h - 10.10 h	Transhumance and heathlands *Hilary Kirkpatrick*
10.10 h - 10.30 h	Heathlands on the Edges of the South Pennines – Examples of UK lowland heaths at their altitudinal limits? *Brian Davies & Sarah Ross*
10.30 h - 11.00 h	Coffee break

11.00 h - 11.20 h	The blessing of the commons *Herbert Diemont & Jan Jansen*
11.20 h - 12.00 h	*Discussion*
	Part 2: Heathland management
12.00 h - 12.20 h	Recent work and management of lowland heath in Scotland with reference to MOD (Ministry of Defence) sites *Lynne Farrell*
12.20 h – 12.40 h	Restoration and re-creation of lowland heathlands in the UK *Isabel Alonso*
12.40 h – 13.00 h	Nitrogen deposition and heathlands: consequences and management implications *Sally Power*
13.00 h – 14.30 h	Lunch
14.30 h - 14.50 h	Process-oriented heathland management *Michael Rode*
14.50 h - 15.10 h	Management of *Molinia caerulea*- Preliminary result from management experiments on Randbøl Hede, Jutland. *Rita Merete Buttenschøn*
15.10 h - 15.30 h	Former utilization, landscape changes and future protection at Kalvøya, Central Norway *Liv Nilsen*
15.30 h - 16.00 h	Coffee break
16.00 h - 17.30 h	*Open space / working groups*
18.00 h	Walk to the Hoepen, greenbelt recreation area of Schneverdingen Dinner in Sheep stable, possibility to present self-made European folklore Staying overnight at Hotel Camp Reinsehlen
July 6th (Sunday)	**Scientific programme (II) & Excursion to Bergen-Hohne military training area**
	Part 2: Heathland management (continued)
09.00 h - 09.20 h	Prescribed burning of heathlands in Germany *Tobias Keienburg, Johannes Prüter*
09.20 h - 09.40 h	Impact of different management practices on nutrient dynamics in heathland ecosystems (Lower Saxony, Germany) *Marion Sieber, Thomas Niemeyer, Silke Fottner*

Part 3: Floristic and faunistic aspects

09.40 h - 10.00 h	Changes in the vegetation of Randbøl Heath from 1954 to 1995 – and in the future. *Hans Jørgen Degn*
10.00 h -10.20 h	Expansion of Carex arenaria in coastal heathlands on the island of Hiddensee (Baltic Sea): facts and causes *Eva Remke*
10.20 h - 10.50 h	Coffee break
10.50 h - 11.10 h	Nightjars and disturbance *John Underhill-Day*
11.10 h - 11.30 h	*Gampsocleis glabra* in the heathlands of Northern Germany *Hans-Joachim Clausnitzer*
11.30 h - 13.00 h	*Final discussion*
13.00 h	Lunch
14.00 h - 15.00 h	Coach-ride to Bergen-Hohne military training area
15.00 h – 18.00 h	Guided tour through Bergen-Hohne military training area
18.00 h	Coach-ride to the city of Schneverdingen Visit of the Eine-Welt-Kirche (One-world-church) Coach-ride to Camp Reinsehlen
20.30 h	Dinner at Hotel Camp Reinsehlen Staying overnight at Hotel Camp Reinsehlen

Field trip

July 7th (Monday)	**Field trip to the Nemitzer Heide & the Kellerberge**
08.30 h - 10.30 h	Coach-ride to the Nemitzer Heide, near to the village of Nemitz
10.30 h - 12.30 h	Guided walk through the Nemitzer Heide
12.30 h - 14.00 h	Packed lunch, coach-ride to the city of Gardelegen
14.00 h - 18.00 h	Guided walk through heathlands near to Gardelegen (Kellerberge)
18.00 h - 19.00 h	Coach-ride to the city of Tangermünde/Elbe
20.00 h	Dinner at Hotel Schloss Tangermünde Staying overnight at Hotel Schloss Tangermünde/Hotel Schwarzer Adler

July 8th (Tuesday)	**Field trip to the Muskauer Heide**
08.00 h - 12.00 h	Coach-ride to the city of Bad Muskau
12.00 h - 13.00 h	Checking in at Hotel Krauschwitz, packed lunch
13.00 h - 18.30 h	Guided coach-ride through the Muskauer Heide military training area Guided walk through heathlands of the "Heide- and Teichlandschaft" (landscape of heathlands and ponds), presentation of grazing systems with elks, sheep and goats Visit of former mining landscapes Coach-ride to Hotel Krauschwitz

19.00 h	Dinner
20.30 h	Evening talk: "Polish heathlands" *Andrzej Nienartowicz*
	Staying overnight at Hotel Krauschwitz

July 9th (Wednesday)	**Field trip to Polish heathlands**
08.00 h - 09.00 h	Transfer to Poland
09.00 h - 16.30 h	Excursion to Western Polish heathlands near to the Neiße river, packed lunch
16.30 h - 19.00 h	Transfer to the city of Templin
19.00 h	Dinner at Hotel Templin
20.30 h	Evening talk:"Heathlands in Brandenburg" *Roland Lehmann*
	Staying overnight at Hotel Templin

July 10th (Thursday)	**Field trip to the Tangersdorfer Heide and return travel**
08.00 h - 13.30 h	Excursion to the Tangersdorfer Heide
13.30 h - 18.00 h	Packed lunch, coach-ride to the city of Lüneburg Individual departure or staying overnight in Lüneburg
18.30 h - 19.30 h	Coach-ride to Camp Reinsehlen Individual departure or staying overnight at Hotel Camp Reinsehlen

July 11th (Friday)	**Individual departure**
Morning	Individual departure from Lüneburg or Camp Reinsehlen

Abstracts of talks

Heathlands on the Edges of the South Pennines – Examples of UK lowland heaths at their altitudinal limits?

Brian Davies (English Nature) and Sarah Ross (PAA)

The South Pennines area of England is well known for their upland heath and blanket bog habitats. Rather less well known are the scattered more lowland heathland on the edges of the moorland.

These heathlands are dominated by heather, bilberry and often western gorse, giving them the characteristics of lowland heathland communities. They also form some of the most easterly areas of western gorse habitat within the UK.

This presentation discusses the potential importance of these largely unrecognised heaths at a UK and European level.

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The blessing of the commons

Herbert Diemont & Jan Jansen

It is widely accepted that common land inevitable becomes degraded, but under present conditions of decreasing needs for arable land, commons could become once more a blessing instead of a curse for Europe.

In these new commons private ownership is not a problem but might even be an advantage. The new commons provide common goods such as clean water and clean air and an attractive landscape. As it is expected that extensive husbandery is part of most common systems, farmers could produce very well these environmental goods including biodiversity. With respect to biodiversity it should be kept in mind that most biodiversity in Europe is related to agricultural practice.

Commons in the past where the outfields in agricultural systems. In the future these systems are thought to provide a more balanced mix of food production, availability of clean water and rural job opportunities.

The question is how? The accepted notion is that common goods such as land, water and air cannot be properly looked after and as soon the resource becomes scarce these lands or goods degrade by lack of a private owner who looks after the resource. A case in point is heathlands, where overgrazing resulted in large areas of drifting sands.

But in the case of degradation of the land conversion of the commons to private land did not stop degradation. Depletion of nutrients by overgrazing was only replaced by overfertilization, degrading other common goods i.e. water, air, biodiversity and landscape, especially in the central part of West Europe.

Different from land resources, scarcity of these environmental goods cannot be solved by privatisation.To produce these environmental services we should use the once scarce but now abundant land resources. As said ,these new commons can become a blessing, as they can supply a better mix at the landscape level of food production, clean water, a nice landscape and jobs and contribute to a sustainable rural economy in the future.

Are land resources becoming more abundant? In the past common land became private land in response to a promise of better returns on invested capital and labour. In time, however, farm productivity increased to a point where only part of the land is needed for food production at present. Already 70 percent of the food come from only 30 percent of the land resources in the EU. As a result, the demand for land resources for food production decreases and this land can be used for environmental services and of course extensive farming. Environmental services also could trigger the development of other services. In this respect it is important to realise that Europe is heading for a service dominated economy, with some 65

percent of the labour force already in the service sector.

What about the costs? Costs will precede the benefits. One of the options is to use part of the agricultural subsidies in the EU as public venture capital. Especially in areas where land is already cheap and abandonment of land is a fact, it takes investments before green services can provide a return on investment and contributes to the rural economy. Some examples of financial mechanisms needed to match demand and supply of common goods will be discussed.

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Recent work and management of lowland heath in Scotland with reference to MOD (Ministry of Defense) heaths

Lynne Farrell

Sixteen areas were identified by the Defence Estates in their MOD Lowland Heathland Biodiversity Action Plan 2001-2005. The estimated extent of the heathland elements on these sites was about 5000 ha. The estimated total area of lowland heathland in Scotland is approximately 20000 ha, so the MOD sites are an important part of this habitat scattered throughout Scotland. The exact area and condition of the heathland is being investigated.

The status of the sites, that is whether they are designated as European Natura sites, or as SSSIs (Sites of Special Scientific Interest), and whether they have Management Plans and active Conservation Groups in place, has been checked. Several examples from the different parts of Scotland are given and one example of the work of an active Conservation Group in Fife, Eastern Scotland.

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Restoration and re-creation of lowland heathlands in the UK

Isabel Alonso

Lowland heathland in the UK is very important for nature conservation as it supports Red Data Book species of vascular plants and birds, all 12 species of amphibians and reptiles in the country and more than 50% of the British species of Odonata and Heteroptera. Many other species are either primarily associated with lowland heathland or have been recorded using this habitat.

Heathlands used to be part of the farming system and were managed mainly under extensive grazing. The nineteenth and twentieth centuries saw losses to urban development, conversion to arable and commercial softwood production. Nowadays a lack of appropriate management is the main threat to the remaining sites. Although they are very valuable for wildlife and public enjoyment, their economical value is small and their abandonment has led to the invasion of undesirable exotic species, or the overgrowth of some heathland species, such as bracken. Other threats to the maintenance of heathlands derive from their proximity to urban areas: they are used as rubbish-dumping areas, motorcycling areas or are burnt at any time of the year. Atmospheric deposition of nitrogen, nutrient enrichment and climatic change are threats that are difficult to quantify but are likely to have a significant and long-term effect on lowland heathlands.

The effort of many organisations has helped to halt last century's trend of heathland destruction and fragmentation in the UK. The last few years have seen the proliferation of projects whose aim is to restore or re-create the habitat and increase species populations. The most significant of these projects is funded by the national lottery (Heritage Lottery Fund) and is called "Tomorrow's Heathland Heritage". Its aim is to contribute over 70% of the national Biodiversity Action Plan target for maintenance and restoration of the habitat and more than 40% of the re-creation target.

The presentation focuses on some of the techniques used in the UK for lowland heathland restoration (bracken management, scrub removal, reintroduction of grazing) and re-creation (preparation of soils after cultivation, mining activities or commercial plantations, seeding, etc), some of the problems encountered, some solutions which have been tried out and lessons to learn for the future.

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Heathlands and nitrogen deposition - can management help?

Sally Power, Emma Green und Chris Barker

It is now widely recognised that elevated rates of atmospheric nitrogen deposition, associated with fossil fuel combustion and agriculture, have contributed to widespread changes in the structure and function of many semi-natural ecosystems. The typically low nutrient status of heathlands means that these ecosystems are relatively sensitive to perturbations of the nitrogen cycle. Recent research has demonstrated that elevated nitrogen inputs are responsible for changes in the growth, chemistry and phenology of *Calluna* and result in an accumulation of organic nitrogen stores within the heathland system. The different habitat management techniques employed on lowland heathland result in the removal of varying amounts of the above- and below-ground organic nitrogen stores within the system; the intensity of management thus has the potential to modify the impact of atmospheric nitrogen inputs on heathland systems.

Two experiments have been established at Thursley Common, a heathland National Nature Reserve in Surrey, aimed at establishing the role of management in a) influencing plant and microbial response to ongoing nitrogen inputs and b) accelerating ecosystem recovery following a reduction in N deposition. The first experiment involves nitrogen additions (0 or 30 kg ha^{-1} yr^{-1}) following four different habitat managements (low and high intensity mow, low and high temperature burn) in 1998. The second experiment involves the same four managements, also applied in 1998, to plots which had previously received N additions (0, 7.7 or 15.4 kg ha^{-1} yr^{-1}) over a seven year period from 1989. No further N additions have been made to these plots since 1996.

Early results indicated that plots which were managed most intensively had a lower absolute response to ongoing N additions, and that there were clear management differences in parameters such as *Calluna* growth, canopy cover and seedling invasion. Subsequently, differences between managements have reduced and effects of nitrogen addition have increased. For example, in 2002 shoot growth in N addition plots was approximately double that in the controls. Clear effects of nitrogen addition on the rate of litter decomposition and the soil microbial community were also apparent.

Ecosystem recovery following the cessation of nitrogen additions six years ago has been relatively slow. In 2002, *Calluna* canopy height and the percentage of flowering shoots were still significantly higher in plots which had formerly received additional N compared to controls. Differences between managements, although relatively large at first, have reduced over time. So far, there is only limited evidence that managements involving greater organic matter removal accelerate recovery from the earlier effects of N addition. However, it is clear that, even after management, ecosystem recovery may take many years, or even decades.

The implications of both nitrogen deposition and different forms of habitat management for nutrient cycling are currently under investigation. This may provide a key not only to understanding the mechanisms driving community change at many heathland sites, but also lead to management recommendations to assist in the conservation of heathland communities throughout Europe.

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Process-oriented heathland management

Michael Rode

Heathlands rank among semi-natural ecosystems. These types of ecosystems are characterized by human impact and by the ability to partial self-organization. Most of them are caused by historical forms of agriculture and became rare in the course of the last century because of dying out of historical working methods. The lack of human impact as well as an intensification of cultivation change structure and species composition resulting in other types of ecosystems. The alteration depends on kind and intensity of human impact and increases in time.

Today a. o. in northwest Germany, Denmark and The Netherlands most of the remaining heathlands are protected. Central measure of nature conservation in these heathlands is the periodical rejuvenation of the vegetation for initiating a time-limited succession. The frequency of tending interventions depends on the type of management: sod cutting, burning, mowing, grazing, removal of young trees.

However, these measures itself are unable to ensure a durable conservation of heathlands. They have to be combined with a management, which was oriented on the ecosystem-internal and anthropogeneous dynamic. The high biological diversity of heathland ecosystems originated from this dynamic, which results in a spatial mosaic of different phases of heathland development: areas with open soil, pioneer stages, stages of development, mature and degeneration stages, grass and shrub dominated areas.

An one-sided cultivation of heathland on wide areas with one phase of development causes low biodiversity. Therefore, heathland conservation management has to be aimed at the protection of all above-mentioned stages, not only in their sequence but also in their simultaneous existence within one heathland. This way allows the survival of species populations tied to one stage. If the preferred stage of development change to the next one with unfavourable conditions then the population is able to move to a neighboured place with good living conditions.

As in the most cases the pioneer stage of cyclic heathland succession is passed through in short time, the spatial relationship of the different stages of heathland development depends on the rate of succession and on the minimum area of pioneer stages given in the managed area. To guarantee a sufficient space in favour of pioneer stages a flexible, indicator regulated management is necessary.

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Management of *Molinia coerulea*
Preliminary result from management experiments on Randbøl Hede, Jutland.

Rita Merete Buttenschøn, Hans Jørgen Degn & Steffen Jørgensen

Introduction

In many parts of Denmark with annual precipitation exceeding 600 mm *Molinia coerulea* is expanding vigorously into dry to semi-moist heathland and thus displacing the former dwarf-shrub vegetation. This trend is analogous to the development seen on the Dutch and Northwest-German heathlands. The main reason for this development is believed to be an increasing deposition of ammonia and NO_x from the atmosphere, resulting in a marked change in competition between grasses and dwarf-shrubs due to higher nutrient availability in the heathland-ecosystem. The onset of this development in Denmark, however, has been delayed by a couple of decades. Whereas Denmark lies off the high nitrogen-deposition epicentre of heavy industrialised Europe, local emission from slurry in agriculture holdings, mainly piggeries, is increasingly contributing to airborne nitrogen deposition.

On wet heathlands and mires the disturbance of grazing may suffice to maintain the competitive balance between grasses and dwarf shrubs. But on drier soils it appears that traditional means of heathland management are insufficient to control the development. A main reason for this could be that seen over a management period, net-deposition from the atmosphere supersedes net-removal. Even though burning may remove some 100kg N/ha, the deposition over the period between burnings would be notably larger.

In order to find management procedures that could maintain or re-establish a substantial stand of dwarf shrub and that could be applied on the large-scale basis, a management experiment was set up on Randbøl Hede in Jutland in 1999.

Experimental set-up

The experiments were made on heathland on flat extra-glacial fluvial plain deposit, which is transversed by low dunes oriented West-East. On the plain of Randbøl Hede the ground water is in general close to soil surface. Before the start of the management experiments the vegetation was in general super-dominated by *Molinia coerulea*, but small amounts of *Calluna*-dominated vegetation remained on parts of the dunes, and a sedge-dwarf-shrub society was present in small amounts in the moister parts of the plain.

The experiment was set up with the following management treatments:

1. burning followed by peat-removal
2. peat-removal
3. harrowing two successive years
4. cattle grazing in summer every year
5. roto-cultivation
6. unmanaged reference
7. cutting
8. cutting followed by cattle grazing in summer every year
9. burning, ploughing and cropping with rye
10. burning followed by roto-cultivation
11. burning
12. burning followed by cattle grazing in summer every year

There were made three replicates of each treatment. Each experimental plot is 40 by 50m.

Soil

Before the start of the experiments soil-samples were taken from each plot covering the 0-10cm horizon. At sampling reference was made to the vegetation characteristics and the position in the basin-dune system. The following contents were determined:

- pH in 0.2 mol $CaCl_2$
- ppm P in 0.1 mol H_2SO_4
- ppm Ca in NH_4NO_3
- ppm K in NH_4NO_3
- pm C
- pm N
- ignition loss

A further sampling of soil is planned for 2003.

Vegetation

In 1999, 2000 and 2002 analysis was made on vascular plant cover in ten 1 by 1m analysis-plots placed at fixed intervals along a diagonal in each experimental plot. The method used is according with Braun-Blanquet's.
A further analysis is planned for 2003.

Results and discussion

Soil

The results of the soil testing are shown in table 1. The soil under the *Molinia* is more acidic than under the other vegetation types and the soil content of calcium, potassium, carbon, nitrogen and humus (ignition loss) is significantly larger in connection with the *Molinia*-dominated swards.

Table 1: Soil contents in relation to vegetation in 1999. "*"-marking implies significant differences.

Vegetation		pH	P ppm	Ca ppm	K ppm	C pm	N pm	ig.-loss %
Molinia coerulea	mean	3.31*	10.7	80*	43*	34*	1.4*	5.9*
	stdev	0.26	3.4	37	15	12	0.5	1.7
Deschampsia flexuosa	mean	3.5	11.7	48	31	26	1.1	4.8
	stdev	0.18	6.3	16	7	8	0.3	1.5
dwarf shrub (*Calluna vulgaris*)	mean	3.42	10.9	51	32	28	1.1	4.9
	stdev	0.21	2.8	16	8	6	0.1	0.9
mixed grass, sedge, dwarf shrub	mean	3.38	10.3	65*	31	25	1.1	5.1
	stdev	0.26	5.8	26	14	10	0.5	2.7

These results suggest that high levels of soil nutrient contents give a predisposition for *Molinia* colonisation and that the moister parts of the plain are colonised first. They do not, however, show whether the nutrient levels are rising, as a consequence of the colonisation or the colonisation is a consequence of nutrient deposition. The immediate effect of the management on the soil nutrient levels remains to be elucidated through the planned repeat-series of soil sampling and analyses.

Vegetation

The development in cover of *Molinia coerulea* from 1999 to 2002 is shown in figure 1. Peat removal appears to be the most efficient of the applied management methods, but the results must be seen in relation to the short duration of the experiment and the different degrees of vegetation cover decrease resulting from the applied method.

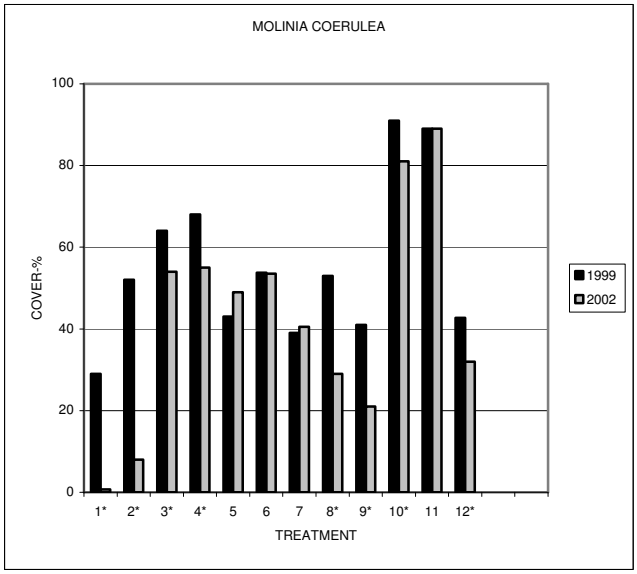

Figure 1: The cover of *Molinia coerulea* in 1999 and 2002. The cover is expressed as in percent. The numbers on the X-axis refer to the treatment, see above. The treatments marked with "*" resulted in a significant reduction in Molinia cover.

Another measurement of success would be the rate of increase in dwarf shrub cover resulting from the management. Figure 2 shown dwarf shrub cover in 1999 and 2002. There is no clear association between method or method combination and the resulting development in dwarf shrub cover. However, the re-colonisation of the peat-removed area appears to be by dwarf shrub rather than *Molinia*. Furthermore, there appears to be a link between increasing cover of dwarf shrubs and superficial soil treatments.

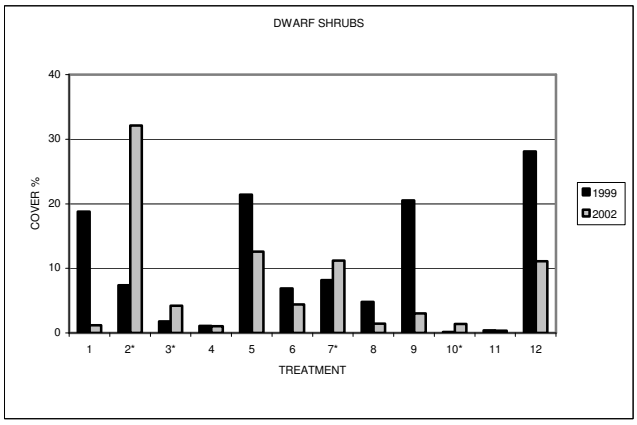

Figure 2: The cover of dwarf shrubs in 1999 and 2002. The cover is expressed as in percent. The numbers on the X-axis refer to the treatment, see above. The treatments marked with "*" resulted in a significant increase in dwarf shrub cover. The dwarf shrubs include *Calluna vulgaris, Empetrum nigrum*, *Erica tetralix*, *Genista anglica*, *Genista pilosa*, *Genista tinctoria*, *Salix repens* and *Vaccinium vitis-idaea*. *C. vulgaris* is the dominating dwarf shrub.

In an attempt to look into the disturbance of the management methods on the plant community has been ranked on the following scale:

reference	grazing	cutting	burning	harrowing	roto-cultivation	ploughing	peat re-moval
0	1	2	3	4	5	6	7

This has been transformed into a disturbance impact for each of the 12 treatments (figure 3).

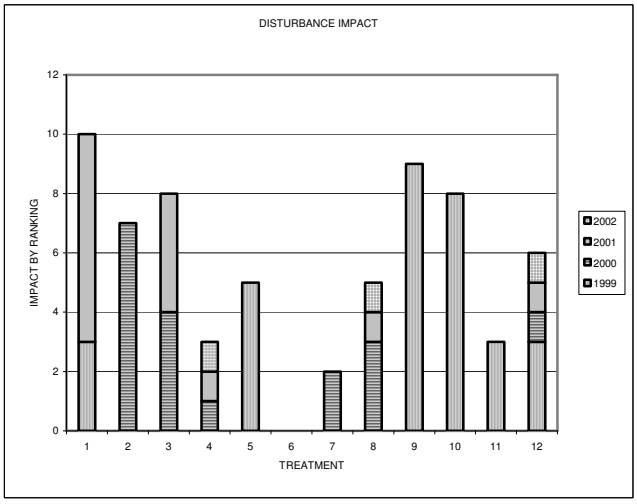

Figure 3: The total disturbance impact (Y-axis) of each of the 12 treatments (X-axis) as expressed through the disturbance ranking scale.

In figure 4 the disturbance impact has been ordinated against the development of *Molinia* cover for each treatment from 1999 to 2002, the latter cover shown as a percentage of the former.

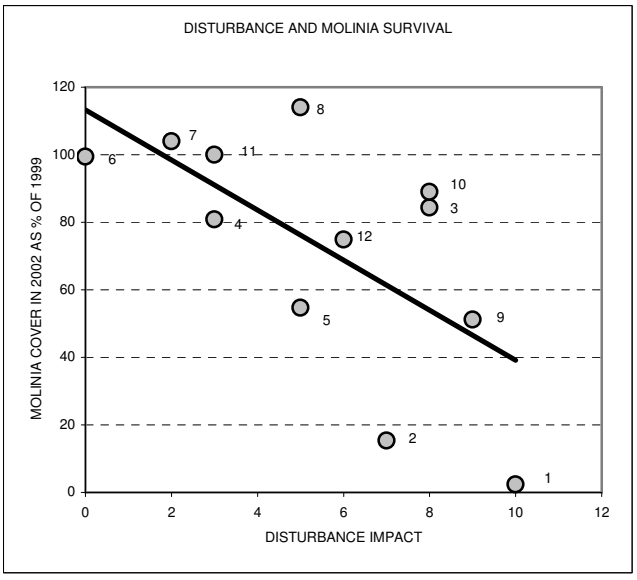

Figure 4: Ordination of the cover-ratio of *Molinia coerulea* 2002 to 1999 expressed as a percentage against the disturbance impact of the treatments. The numbers 1 to 12 refer to the 12 treatments. There is a linear connection between disturbance impact and *Molinia* cover reduction with 42% of the variation being explained by the interrelation and a correlation coefficient $r_{xy} = 0.64$.

Peat removal is seen to be more efficient than expected, grazing also, but not in the same degree. Whereas the efficiency of peat cutting lies with the high impact of disturbance, removal of nutrients and all plant matter, the relative efficiency of grazing is believed to be related to the annually repeated disturbance. All soil, cutting and burning treatments appear to be less efficient than predicted by the disturbance of the management methods.

This suggests that only very radical methods are efficient when a once and only management is carried out. Apparently even the more drastic soil treatments leave sufficient live Molinia fragment to enable a quick recolonisation of the treated plot. Repetition of even low disturbance methods, like grazing, seems to be more efficient than most of the high disturbance methods. Use of continuous low-disturbance methods (grazing and cut-

ting) may thus be an alternative or a supplement to efficient high disturbance methods involving peat removal. These early results, however, do need a further trial over a longer temporal scale.

When one looks at the second success criterion, dwarf shrub re-colonisation of the treated plots, there is no direct connection between the disturbance impact and the rate of re-colonisation. In connection with dwarf shrub re-colonisation three factors appear to be important: provision of suitable seedbeds, placement of seeds in the seedbeds and the rate of re-growth of Molinia under the given treatment. As mentioned previously peat removal and superficial soil treatment promote dwarf shrub re-colonisation. Whether repetition of low-disturbance methods may result in re-colonisation remains to be seen. Long-term cattle grazing on other parts of Randbøl Hede indicates that mosaic-dwarf shrub-grass-sedge vegetation will develop, but that Molinia remains as an important element in the vegetation.

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Former utilization, landscape changes and future protection at Kalvøya, Central Norway

Liv S. Nilsen

Kalvøya (approximately 7 km^2 land area) is an island northwest in Vikna, Central Norway. It is a part of Borgan and Frelsøy nature reserve, and belongs to the southern boreal zone and highly oceanic section. The mean precipitation is about 850 mm and the annual mean temperature is 6,0 °C; the mean January temperature is 0,5 °C. While the major rock type in Vikna is migmatitt, calcareous/siliceous slate and mica shists dominates at Kalvøya. The island was never inhabited, but until 1890s it was the summer-farm island of the Borgan community; later the island is used for grazing. The number of animals decreased in the 1960s and for a period of 20-30 years there was no grazing. For the last decade about 300 sheep have been at Kalvyøa in the summer season and for the last three years approximately 20 Norwegian traditional sheep have been grazing the whole year. The number of Norwegian traditional sheep is increasing. Heath has been burned, mostly for increasing the amount of grass and herb for the summer pasture and for increased cloudberry production.

A vegetation map of 1,5 km^2, shows that open heathland vegetation cover halves of the land area, damp heath is most common and rich heaths are also common. Mires cover 1/3, dominated by ombrotrophic hummock vegetation; rich fens are common. Deciduous forests cover about 5 % of the island, most of the area dominated by low-herb birch (*Betula pubescens*) woodlands; also *Populus tremula* and *Salix aurita* are common). Kalvøya has large areas of shallow marine and backwater systems and lakes. Decreased utilization has led to landscape changes even on the most outer coast areas, and at Kalvøya the invasion of shrubs and trees increases. In an intensively studied area of 1,2 km^2, using aerial photos and field registrations, the overgrowing situation is studied in detail: In 1961 2.7 % of the land was covered by forest; in 1981 3.3 %, and in 2001 7.3 %. The scrub covered areas also changed during the four decades: 0.2 %, 0.9 % and 4.2 % for 1961, 1981 and 2001, respectively. Trees of birch, *Populus tremula, Salix caprea and Sorbus aucuparia* were found to be more than 100 years of age (max 175 years); so some of the woodlands at Kalvøya are rather old. The forest is even mentioned in a land consolidation from 1830. The flora of Kalvøya (289 vascular species) is rich compared to other coastal areas of central Norway, including a large number of basophilous species.

A management plan is proposed for Kalvøya. The main aim is to keep the larger part of Kalvøya as an open coastal heathland for the future by clearing, grazing and burning. In addition some areas are proposed to be untouched; e.g. old woodlands including rare species, like the protected *Epiphogium aphyllum*. An old, traditionally used path from the farms (at Borgan) to the summer farm area at Kalvøya is proposed for restoration, as is also some of the houses of the summer farm.

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Prescribed burning of heathlands in Germany

Tobias Keienburg & Johannes Prüter

As pollen analyses show, fire has had an important effect on the development of many parts of the post glacial German landscape. Varied but similar fire using cultivation techniques were established during the last centuries, each adapted to local requirements. Some had Europe-wide effects (e.g. smoke layers of burning peat bogs).

The use of fire is forbidden in Germany by various legal acts (nature conservation act, waste act) now, but exemptions enable small-scale burning. The public awareness of prescribed burning is ambivalent; some administrative bodies think quite positive of burning, others are strictly against it. Being asked about their preference for varied management techniques in the Lüneburger Heide Nature Reserve, visitors didn't estimate prescribed burning as worse than, for example, the removal of raw humus.

Seven regions, in which prescribed burning is used, are presented. Three of them don't burn heathlands, but fallow land, vineyard or xerothermic slopes. Some of them are using fire not only as a means of nature conservation but also because of economic reasons, enhancing the initial small-scale research status to a larger-scale practical implementation. Further prescribed burning is done on varied areas throughout Germany and on military training areas.

Due to their nation-wide importance, ecological and economic investigations on the use of fire are supported in the Lüneburger Heide Nature Reserve and in the Diepholzer Moorniederung by the German Ministry of Education and Science (BMBF). With respect to the future change of landuse and abandonment of cultivated land, investigations with GIS show that large open areas will have to be managed to be kept open, possibly by prescribed burning.

The burning technique which is used in the Lüneburger Heide Nature Reserve is presented. Economic investigations show that prescribed burning (ca. 450 €/ha) is more expensive than, for example, grazing (ca. 170 €) or mowing (ca. 100 €).

The vegetational change after a wildfire in April 1996 is presented. In spite of the obvious positive effects of this fire, chances and risks of prescribed burning in winter or in summer are still controversly discussed.

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Impact of different management practices on the nutrient dynamics in heathland (Lower Saxony, Germany)

Thomas Niemeyer, Silke Fottner, Marion Sieber & Werner Härdtle

This study is part of a project supported by German Federal Ministry for Education and Science (BMBF), which examines the importance of different management practices (prescribed burning, sheep grazing, mowing and removing of raw humus by „schoppern“ and „plaggen“) for the conservation of heathland ecosystems in the nature reserve „Lüneburger Heide“. In addition the prescribed use of fire in the nature reserve „Diepholzer Moorniederung“ is investigated.

The aims of these management practices are both to prevent the establishment of tree saplings in dwarf shrub dominated ecosystems and to remove nutrients out of an ecosystem which is characterised by oligotrophic conditions. Especially the last point became more important during the last decades with regard to an increasing amount of nutrient input by atmospheric deposition in heathland ecosystems.

Our focus is to examine the nutrient balance (input by atmospheric deposition and sheep excrements; output by remove of biomass, raw humus and by percolating soil water) for the elements Ca, K, Mg, P and N and their variability with regard to the different management practices. Additionally the vegetation dynamic is investigated on permanent vegetation plots. The results are important for an assessment of these management practices in heathland ecosystems.

For a determination of the nutrient content in the soil and biomass samples were taken in different soil horizons with a volume of 100 cm^3 and in different compartments of the standing crop (Ericaceae, Poaceae, cryptogams) within 1 m^2 and 0,25 m^2 sample plots. The nutrient input (atmospheric input and input by sheep excrements) is sampled using deposition samplers (type „Münden 200“) and special collection bags, respectively. Nutrient losses by percolating soil water were determined using nylon porous cup soil water samplers and lysimeters. The nutrient output with removing a certain amount of biomass by different management practices is determined by comparing the remaining standing crop with that of the initial state within 1 m^2 and 0,25 m^2 sample plots.

In the lecture some (interim-) results concerning the nutrient flow of nitrogen, phosphorus and potassium after prescribed burning, grazing and mowing were presented.

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Changes in the vegetation of Randbøl Heath from 1954 to 1995 – and in the future

Hans Jørgen Degn

Vegetational changes were investigated on Randbøl Heath (8 km^2), Jutland. Different materials and methods were used: Areas left undisturbed since 1920, comparison of species lists from 1941 and 1992, continued registration of 3 plots (and 0) managed in different ways in 1937, distribution of dwarf shrub heath and grass heath 1954-1995 mapped from aerial photos, mapping of management 1954-1995, and photographic documentation on fixed locations established in 1957.

The different approaches support each other. The general trends are:

1. In 1954 dwarf shrubs (mostly *Calluna vulgaris*) covered 87 % of the total area compared to 77 % covered by grasses in 1995. A new finding is that *Molinia caerulea* has increased everywhere, not only in the humid habitats, but even on the top of the low inland dunes, and now covers nearly half of the area.
2. Management of 2.0 % of the area per year has not prevented this change.
3. Strong increase for trees and bushes.
4. Number of plant species in 1995 was nearly 1.5 times as high as in 1941. But the new species do not belong to the heathland, so the increase is no enrichment. Plant societies of the heathland proper have lost rare or typical species, especially those in low vegetation or on bare ground (e.g. annuals, lichens).

Since 1995 the deterioration has continued, partly due to a severe attack of the heather beetle *Lochmaea suturalis* in 2000-2001.

These trends are more or less typical for Danish heathlands in general, but in most places the conditions are not yet so grave.

Two major factors are decisive for the future development:

A. The deposition of nitrogen amounts to 22-24 kg N per ha per year. The critical load for dry heathlands of 10-15 kg N is substantially exceeded.
B. Effective control of *Molinia caerulea* is at best very expensive, and in rough terrain with dunes it is impossible with methods presently known.

If the present conditions are not changed, further expansion of *Molonia caerulea* will be expected. Pure stands of this species will soon cover so great a proportion of the heathland, that there is an imminent risk that even more heathland species will become extinct here. Some of them will possibly not be able to return due to insufficient dispersal capacity. If this situation should be avoided it is necessary in the very near future to reduce deposition of N as well as increase management of the vegetation.

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Expansion of *Carex arenaria* in coastal heathlands on the island of Hiddensee (Baltic Sea): facts and causes

Eva Remke

Though *Carex arenaria* (Sand sedge) occurs in different densities, the plant can be found in nearly every phytosociological taxon of coastal heathlands of Hiddensee. The existence and description of the *Caricetum arenariae* Steffen 1931, which consists of a species-poor, very dense vegetation of almost 100% *Carex arenaria*, is strongly discussed among phytosociologists. Its extension on Hiddensee has increased very rapidly during the last 15 years. It can develop out of nearly every sociological taxon but the most likely starting point is a community of the *Corynephoretea*. Circumstances which foster the occurrence and development of an almost monospecific *Carex arenaria* community are probably an increased organic content in the upper soil layer and geomorphologically less dynamic spaces than those in communities of the *Corynephoretea* or *Ammophiletea*. Nevertheless the nutrient supply remains suboptimal.

The sand sedge changes its environment, creates conditions that are favourable to itself and inhibits the invasion of other, mainly vascular plants. An invasion by trees (progressive succession of heathland) is hindered by the dense grass sward, consisting of both dead and living root and shoot material.

One possible reason for the expansion of the *Caricetum arenariae* in coastal heathlands on Hiddensee are the change of wild and domestic herbivore impact on the vegetation mosaic during the last decades. Furthermore, the development is supported by the decrease in geomorphological coastal processes due to increased coastal protection and management actions.

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Nightjars and Disturbance

Durwyn Liley, Giselle Murison & John Underhill-Day

Public access to southern heathlands can cause disturbance, pollution, erosion and an increase in wild fires. In the United kingdom increased access to heaths is proposed under government legislation.This study recorded the density of breeding nightjars against measures of human disturbance and the availability of foraging habitat on adjoining land on a number of heaths in Dorset, UK. It was found that nightjar densities were lower on more disturbed heaths and where nearby foraging habitat was restricted by built development. Further studies found that nightjars have poor breeding success, and that levels of disturbance are implicated in nest failure.

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Gampsocleis glabra in heathlands of Northern Germany.

Hans-Joachim Clausnitzer

Gampsocleis glabra has a southeastern European distribution, so the sites in northern Germany are at the northwest limit of its range. In former times, populations occurred at several localities within Germany, but all have become extinct except three. These remaining populations are completely isolated from the main distributional range.

There are two populations in Lower Saxony, one in Sachsen-Anhalt (all Germany), and one in the Netherlands. For one population in Lower Saxony, in the nature reserve Lüneburger Heide, the last individual – a single male - was recorded in 1991, despite continued further surveys.

Large scale afforestation is the main cause of the disappearance of most former populations. The surviving populations in Germany are restricted to large heathlands, which have been continuously open for at least 100 years. Neither food nor the singing places for the males seem to be limiting factors for the occurrence of this species. Instead, microclimatic conditions appear to be crucial, since the eggs lie two years in the soil before hatching. They appear to require a minimum temperature sum for development.

The females oviposit into places, where the ground is open, i.e. which neither have a thick litter layer nor a dense moss cover. However, most of the present heathland soils are covered by mosses, which probably reduce the soil temperature below a threshold necessary for egg development.

All heathlands, which still support populations of *Gampsocleis glabra* at the northwestern border of its distributional range (Netherlands, Lower Saxony and Sachsen-Anhalt), are frequently burned. Burning reduces isolating layers of litter and (mainly pleurocarpic) mosses, and allows therefore higher soil temperatures. Thus, frequent fires seem to be the most important factor to sustain viable populations of *Gampsocleis glabra*.

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Abstracts of posters

Impacts of cutting and fertilisation in the dynamics of heathland in Spain

L. Calvo, E. Marcos, E. Luis & R. Tárrega

This study was carried out in the Cantabrian Mountains, Spain, where areas of *Calluna vulgaris* dominated heathlands still occurs and represents the most Southerner distributions of these types of heathlands. Traditionally, these areas had been used as pastures and associated to this, burning and cutting to provide pasture were used. This type of management has changed in the last decades and nowadays, patches characterised by *Calluna vulgaris* and other dwarf ericaceous such as *Erica tetralix* L. are scarce. In parallel records of nitrogen atmospheric deposition in mountain areas in Spain suggest an increase in the availability of this nutrient to the vegetation. The aims of this work are: 1. To investigate the successional trends in a community of heathland when it has been submitted to experimental cutting and nitrogen fertilization. Cutting has been proposed as an alternative to grazing, in areas where the later is not economically or socially viable. 2. To test the hypothesis that nitrogen fertilization may change the soil properties and the plant community composition and structure in succession process. Three areas in Cantabrian Mountains, Spain, were selected. The climatic conditions are characterised by a warm season with no (or less that two months) aridity period. Soils in all passes are podsols, although the underlying rocks are different. In all three passes, random patches of a significant extent with both *Calluna* and *Erica* were selected. In April 1998, 20 experimental plots (1x1m) were established in each of the three areas. The plots were assigned to one of five replicates of each of the following treatment:

1. no treatment (control, C-uF);
2. control and fertilization (control, C-F),
3. removal of *Calluna* and *Erica* (CE-uF),
4. removal of *Calluna* and *Erica* and fertilization (CE-F)

These plots were fixed to following the succession process. In the removal plots, all aboveground biomass of the shrub species were clipped at ground level. The removals were performed only at the start of experiment and the clipped material was removed from the plots. Nutrients were added early May during four consecutive years (1998-2002) as ammonium nitrate fertiliser. The fertiliser level (5.6 g m-2 yr-1 as weight of fertiliser) was chosen to be equivalent to twice the estimated current background pollution levels in this area. summary, in each Puerto there were five replicates plots for C, C-F, CE and CE-F, giving.

Pre-treatment measurements (soil characteristics, *Calluna* and *Erica* biomass and visual percentage of cover of each vascular species present), were made in order to establish the "baseline" characteristics of the vegetation and soils on the experimental sites, prior to the treatments being applied. After treatments the following measurements were also taken: The visual percentage of cover of each vascular species present was estimated 1 month after treatments and annually during four years (1998 to 2002); the maximum height per plot of the woody species more representative, *Calluna* and *Erica,* was measured on each plot 1 month after treatments and later annually during four years (1998 to 2002). The number of flowers

and the length of shoot grown per season were measured just once per year (in August) on five randomly selected shoots in the control, *Calluna* and *Erica* cut plots, both for *Calluna* and *Erica*, Soil characteristics. There is not significant effect of fertilization in the cover increase of *Calluna*. However, *Erica* presents a favorable effect of fertilization in the cover values. When both Ericaceous species were cut regeneration was slow for both species, although slightly better for *Erica*. Generally, after cutting without fertilization there are a dominance of woody species. However, cut and fertilized plots were dominated by perennial herbaceous species in all passes during the three years of study. Neither the number of flowers, nor the growths of the shoots in *Erica* were affected by any of the treatments or by time. The initial differences between the passes in soil characteristics remain after three years in the non-fertilized plots. However after fertilization the original differences in the fertilized plots disappear.

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Effects of fertilization and cutting on the C:N ratio of vegetation and soils of mountain heathlands in Spain

E. Marcos, L. Calvo, L. Valbuena & E. Luis

In the last few decades there has been increased deposition of atmospheric pollutants such as NO_2 throughout Europe, with levels between 200-400 $mol.ha^{-1}.yr^{-1}$ detected in Spain by 1988. Recent studies in NW Europe, records of nitrogen atmospheric deposition in mountain areas in Spain suggest an increase in the availability of this nutrient to the vegetation. One effect of increasing nitrogen deposition on heathland ecosystems could be the increase of the palatability of plant species. The carbon/nutrient balance hypothesis predicts a lower content of carbon-based secondary compounds (such as phenolics and tannins) in plants when nutrients inputs are increased. The aim of this work is to test the hypothesis that an increase in N supply decreasing foliar C:N ratio, favouring herbivores pressure, in *Calluna vulgaris* and *Erica tetralix* shoots and the variation of C:N ratio in the soil. A second aim was to study the variation on the foliar C:N ratio in the same species, when the other is removed by cutting.

The study was carried out in three mountain passes in northern Spain. Six 1-m^2 plots were established in April 1998 in each area. The plots were assigned to one of five replicates of each of the following treatments:

1. In two plots *Calluna* was cut by hand at ground level (C).
2. In two others *Erica* was cut likewise (E).
3. Two plots were not cut. One of each of the two-paired plots received an application of N-fertilizer (as ammonium nitrate), each year (early May) from 1998 until 2002. The fertilizer level was 5.6 g m^{-2} y-1 (as weight of fertilizer).

In each treatment the following measurements were taken:

1. Five shoots of *Calluna* and *Erica* were taken from separate plants in each plot to analyse total N and Carbon content during four years after treatment.
2. One soil sample was taken from each plot during four years after the treatments. In each sample carbon content and total nitrogen was determined.

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Profile of the Lüneburger Heide Nature Reserve

Introduction

Situated in north-western Germany between the cities of Hamburg, Lüneburg, Hannover and Bremen, the Lüneburger Heide Nature Reserve is Germany's second largest nature reserve. The total area of 23.400 ha comprises a fascinating and diverse landscape mosaic: from dry heathlands to wet brook valleys, from nutrient-poor peat bogs to more or less nutrient-rich arable lands, representing many habitats with various ecological functions. Therefore, since the German term „Heide" means only „heathland", the Lüneburger Heide Nature Reserve is much more than the name suggests.

The current distribution of habitats, which is given in table 1, is but one stage in a long and changing history of land use. The existence of dry heathlands is the result of a long agricultural tradition, called „Heidebauernwirtschaft" („traditional heathland farming"). For socio-economic and ecological reasons, this particular kind of heathland farming had been practised from about 1000 AD to about 1850 AD, when heathlands covered more than 80 % of the area of today's nature reserve. At the end of the 19th century, heathland farming ceased to be profitable for various reasons, leading to the afforestation of heathlands, mainly with pine trees.

Table 1: Habitats in the Lüneburger Heide Nature Reserve

woodland	13.700 ha (58,0 %)
heathland	3.100 ha (13,0 %)
former military training areas	3.100 ha (13,0 %)
arable land	2.000 ha (8,5 %)
grassland	740 ha (3,0 %)
peat bog	500 ha (2,0 %)
settlements, lakes and rivers etc.	300 ha (1,5 %)

Geology, climate and soil

Large parts of the north-western German landscape were formed by geological processes during the so-called „Saale ice age", more than 150.000 years ago. The ice layer, which reached into Dutch areas at its peak, left behind a mainly flat and sandy, partly hilly landscape, the so-called „Geest". The Lüneburger Heide Nature Reserve belongs to this flat Geest region. Due to the concentration of end moraines of the Saale ice age, the topography of the nature reserve is quite varied. The "Wilseder Berg" near to the village of Wilsede is the highest point in north-western Germany at an elevation of 169,2 m. During the last glacial period about 80.000 to 10.000 years ago, the so called "Weichsel ice age", the glaciers did not extend to the Lüneburger Heide area. Nevertheless erosion of the periglacial area led to further impoverishment of the soil. As a result, nutrient poor, sandy soil predominates today and leaching processes have led to the development of podzolic soil types. Brown earth and soils influenced by ground water are also found, although to a much lesser extent.

The local climate is influenced by the topography of the area with, for example, precipitation rates of about 822 mm per year (in the village of Wilsede) being higher than in the surrounding regions. The annual mean temperature (8,2 °C in the city of Buchholz) is also lower and there are more days with frost than in adjacent areas (approx. 81,9 days per year in the city of Buchholz).

The early centuries - traditional heathland farming

Not taking into account singular pre-historic settlements in the area of the Lüneburger Heide Nature Reserve 200.000 years ago, large-scale historical land use with the first notable expansions of heathlands began in 3000 BC to 500 BC. Widely distributed forests, dominated by oak trees, were burnt, grazed or cut down in order to establish arable land and cattle grazing. Thus heathlands were spread throughout north-western Germany.
However, this phase of heathland expansion ended by the time of the German migrations; woodlands reclaimed their former area and heathlands were pushed back.

Many years later, the heathland farming system began in earnest with the introduction of "intensive" cultivation of rye during the middle ages, around 1000 AD. In addition to rye, oat and buckwheat was also grown. In order to grow rye on the sandy soil, nutrients had to be transfered from the surrounding area (woodlands and initially small heathlands) to the small patches of arable land. This was achieved by transporting litter out of the woodland and raw humus out of the heathlands ("Plaggen") onto the arable land.
Later on, when heathlands were large enough to be grazed, farmers introduced the Grey Horned German Heathland Sheep ("Graue gehörnte Heidschnucke"), a very modest breed. Nutrient transfer could now be intensified by collecting the animals' faeces on litter, raw humus and mown heather, which was brought into the sheep sheds as bedding or winter fodder.

At the climax of this specific type of agricultural land use, the visual appearance of the landscape reflected the "infield/outfield" system, which was characteristic of all atlantic heathlands throughout Europe. Small patches of arable land ("infield") and grassland ("fields"), totalling approx. 10 % of the total area, were embedded in vast habitats, which served as sources of nutrients ("outfield"). This remaining 90% was common land, predominantly made up of heathlands, although with scattered patches of forests and peat bogs here and there. With increasing distance from the sheep sheds, the heathlands can be classified into areas being used for obtaining raw humus, those which provided cut heather and those which were grazed or burnt (see figure X for a schematic classification). The mown heather was used not only as bedding, but also as winter fodder,

for thatching roofs, building pathways, heating or for making household items such as brooms.

As a source of wool, meat and manure, keeping sheep was pivotal for the farming ecomomy. Grazing was practised throughout the whole year, but heather alone didn't provide sufficient nutrition in winter. Therefore the size of sheep flocks was limited by the need to feed the sheep with the limited supplies of available hay and rye straw. The currently widespread juniper tree was considered to be a weed and was therefore kept under tight control. Burning was practised to rejuvenate the heather, and bee keeping provided additional benefits in the form of both heather pollination and much desired honey.

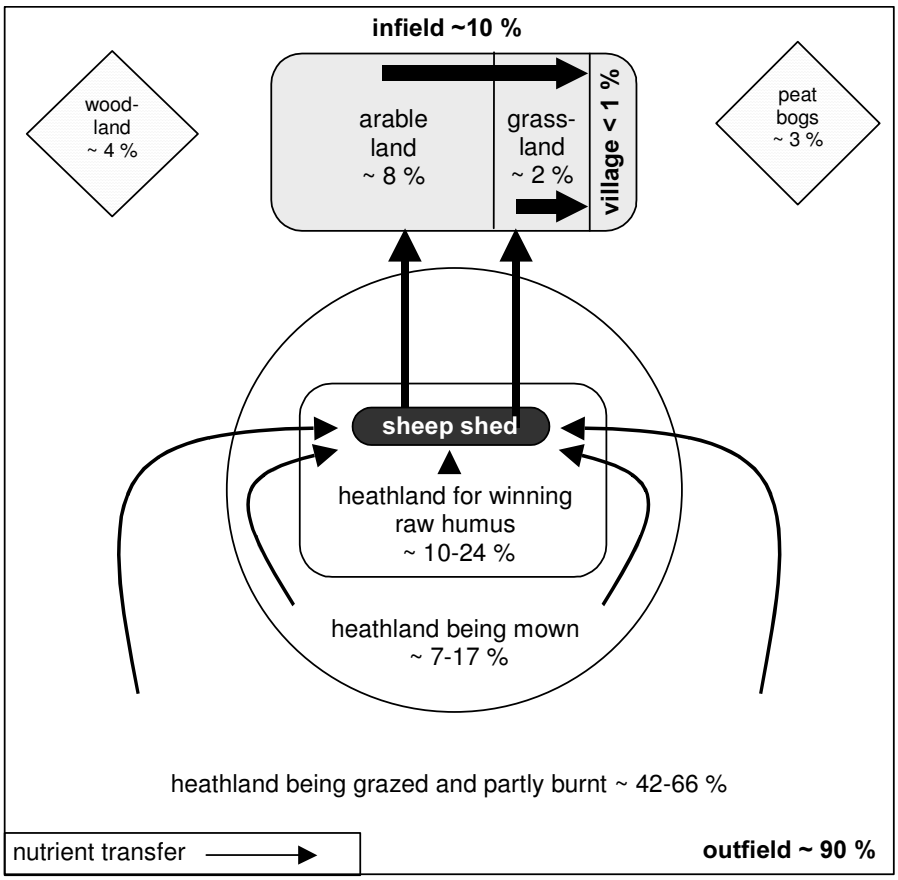


Figure 2: Schematic representation of the traditional infield/outfield system at the climax of the heathland farming phase in the middle of the 18th century

From today's point of view, it turned out that the described agricultural system was not sustainable, at least since the beginning of the 19th century. With the introduction of mineral fertilisers, refined sugar and the soft wool of Merino sheep from New Zealand, farmers were forced to intensify their grazing and nutrient removal to compensate for economic losses. Thus more and more areas were over-cultivated, leaving behind raw mineral soil, which was exposed to erosion. In some cases, erosion led to the development of moving sand dunes, which in one instance threatened to overrun a small village ("Ehrhorner Dünen").

The stabilisation of these sand dunes by afforestation with pine trees was only the beginning of large-scale afforestation. In the second half of the 19th century, large areas of the former heathlands were afforested. This afforestation was linked to a transfer of ownership: former common land was given to single farmsteads. Other reasons given for afforestation were the relative value over unproductive heathlands, the improvement of soil fertility, hydrological balance and local climate and also a lack of wood in Northern Germany.

"Verein Naturschutzpark" association

At the beginning of the 20th century only some thousand scattered hectares of the former vast heathlands remained in the area of today's nature reserve. When even these remaining areas were threatened with replacement by holiday villages (as was planned in the so-called "death valley" ["Totengrund"] near Wilsede) public opinion started to change from a negative to a positive attitude towards the heathlands. Small heathland patches were purchased in 1906 and 1907, but the point which marked the real development of the nature reserve was in 1909, when a newly formed nature conservation association, the "Verein Naturschutzpark (VNP)", decided to buy large areas of land, including heathlands, woods, peat bogs and arable land, in order to create a lowland nature conservation park in a similar way to U.S. American national parks. In 1913, the VNP consisted of about 16.000 members. At that time, around 30 km² of land was purchased, in order to manage this area to meet nature conservation objectives, using traditional forms of land use. In 1921 a law was passed which preserved more than 200 km², including the areas owned by VNP. In order to solve the conflict between nature conservation objectives and increasing numbers of tourists, VNP established a system of rangers ("Heidewacht") in 1924, that had worked until the Nazi regime began.

In addition to the land, many farmsteads and old buildings were bought and renovated. At first, these farmsteads were leased cheaply to willing farmers, who continued to employ traditional heathland farming practices, thus keeping alive the old infield/outfield system. But, for economic reasons, traditional farming was abandoned in about 1940.

World War II caused a severe decline of the number of VNP members down to about 2.000. Endowed with only the fees of these few members, the organisation was unable to continue with its heathland conservation for a number of years. The situation changed, however, when Dr h.c. Alfred Toepfer, a business man from Hamburg, became chairman of the association in 1953. In the thirty years during which he held this position, he spent about 50 million DM on projects linked to the Lüneburger Heide Nature Reserve. Much of the money has been used for renovating old buildings and especially for building twenty new sheep sheds and re-introducing twelve sheep flocks, each with about 350 ewes, to preserve and restore degenerate heathlands. From 1956 to 1983, about 628 ha of woodland was felled in order to re-establish heathlands.

The total area of the nature reserve was increased by a legal act in 1993, integrating more of the former military training areas into the reserve and resulting in a total area of 234 km².

Today - diverse habitat management

Landscape dynamics require flexible management concepts. When large areas of heathland declined as a result of heather beetle outbreaks and thick raw humus layers in the early 1980s and the heathlands were found to be quite species poor, a new conservation management concept was established. The number of sheep flocks was reduced to five or six and some heathlands were removed from the grazing regime and managed mechanically (particularly by mowing and mechanical removal of raw humus), leading to an intensified removal of biomass and nutrients. The use of small-scale prescribed burning for managing heathlands was also re-introduced in 1993.

In 1995, a management plan for the total area of the nature reserve was drawn up. By comparing the current condition of the habitats and their future development potential, management objectives were assigned to every area in the nature reserve, taking into account socio-economic requirements and legal prescriptions.

As there is no uniform administration of the nature reserve responsible for developing and implementing management plans, a so called "steering group" has been created, bringing together everyone involved in managing the nature reserve: VNP, District Government, Municipalities, State Forestry Office and the NNA. Within the steering group, concepts for the further development of the nature reserve are discussed and a lot of problems can be solved.

Today, VNP manages 8.000 ha of its own land, consisting of about 6.000 ha heathland, 1.700 ha woodland, 260 ha arable land and 200 ha grassland. With financial help of 4.000 members, the state of Lower Saxony and the German Federal Republic, a staff of about 20 persons is involved in conservation management, facility management for more than 100 buildings and visitor information for about 3-4 million visitors per year.
Concerning heathland management, more than 2.500 ha were grazed by six sheep flocks in 2002, five of them being owned by VNP, one privately. More than 50 ha have been mown. The mown heather is being used as bio-filter or for thatching roofs. 12 ha were managed by prescribed burning. Raw humus has been removed from about 27 ha. On an area of more than 830 ha, saplings of predominantly pine trees and birch have also been removed.

As listed in table 1, the Lüneburger Heide Nature Reserve consists not only of heathlands, so other habitats require more or less management too.

A 240 ha ombrogenous *peat bog* still exists in the south-western corner of the nature reserve ("Pietzmoor"). Peat development began about 10.000 years ago. In undisturbed parts the height of the peat layer is now as much as 5 m. However, large parts have been used since the 16th century, leaving behind deep holes; these have been rewetted since about 1975.
Phreatophytic fens can be found in brook valleys. With most of these having been changed to grassland, today's management objective is to restore some of the former fens.

In addition, some very small, partly ombrogenous, partly phreatophytic bogs exist in sinks or on slopes. Some of these are also fed with springwater..

As mentioned above, most of the *woodland* dates back to the large-scale afforestation in the late 19th century. The forests consist mainly of pine tress and partly of spruce on better soil. It is intended that forests which are owned by the state of Lower Saxony (5.100 ha) or by VNP (1.700 ha), will be enriched by broad-leaved trees, especially beech. Silviculture of these forests is to be carried out in a natural way.
To a small extent, ancient woodlands still exist in the surroundings of former farmsteads, and are dominated by oaks and beeches. Historically, the fruits of the 150 to 260 year old trees were used for feeding cattle and pigs. As small patches in a fragmented landscape, these forests are very important for immobile or less mobile species.
To enable natural regeneration of the forests, intensive hunting of hoofed game (red and roe deer, wild boar) takes place in the woodlands.

Source areas with wet alder forests should be typical of the heathland *brooks and their valleys*. Normally, the brooks are characterized by coherent and sandy or gravelled stream beds, straight upper courses, high diversity of structure, lack of nutrients and a constantly low temperature. For various reasons (establishment of pastures, maintenance by machines, nutrient input, increasing depths because of higher flow velocities, deforestation, barriers for wandering animals, increasing temperature etc.), most of the brooks and their valleys are in a poor condition. To improve this situation, management objectives have been developed for brook valleys. Some brook sections have already been restored, and further sections may be restored in the course of implementation of the EU water framework directive.

Former military training areas
Immediately after World War II the British (and partly Canadian) army started to use areas within the nature reserve for military training, especially for tank driving exercises. Beginning with 5.000 ha at first, the training area was reduced to 3.000 ha in 1963, when the so-called Soltau-Lüneburg agreement, signed by the British army and the German government, came into effect guaranteeing year round exercises to the British army..
Military training led to large-scale soil compaction and destruction of vegetation, seed banks and soil profiles, leaving behind vast sandy areas, i.e. more than 50 % of the total area. To avoid erosion by wind or water, small coniferous plantations of mainly non-indigenous trees, and dams, were established. Water ponds were created to collect rain water and to stop gully erosion.
When it became obvious that the so called "red areas" would be vacated by the British army in 1994, a scientific commission was set in place. Based upon old maps, which characterized the red areas as former richly structured *Calluna* heathlands, a restoration plan for these was worked out, defining the following objectives and measures:

- Levelling the micro relief caused by tracks of the tanks.

- Sowing *Festuca filiformis* to stabilize the soil and to provide a suitable microclimate for the subsequent growth of heather plants.
- Developing semi-open *Calluna* dominated heathland on the largest part of the total area. Re-introducing *Calluna* seeds by spreading raw humus material or material from mown heathlands on a third of the total area.
- Removing the coniferous plantations except for the indigenous broad-leaved trees.
- Preserving areas covered with shifting sand.
- Removing some of the dams (about 100.000 m^3 of ground material).
- Leaving about 200 ha to natural succession.
- Creating woodland-heathland ecotones.
- Establishing a new system of pathways, balancing both visitor and nature conservation needs.

Many of the required measurements were realized by servicemen of the British army.

Ten years after the beginning of the restoration measures, the following preliminary effects can be observed:
Despite very dry summer periods after the initial sowing, *Festuca filiformis* built up a soil-fixing grass layer very rapidly. Even one year after spreading heather material, the first *Calluna* seedlings could be observed between the rows of grass. In some areas it took more than five years before the first *Calluna* seedlings were evident. Today, dense heather stands can already be found on favourable sites.
Pine and birch trees have started to grow with an undesired intensity, making it necessary to mow large areas. Invertebrates specialists of bare ground were the first species to re-colonise the area and invertebrate communities reflect the vegetation dynamics.
Several typical heathland/moorland bird species find suitable habitat conditions, at least at the edges of the red areas, today, e.g. common cranes, black grouse, curlews, nightjars and woodlarks.

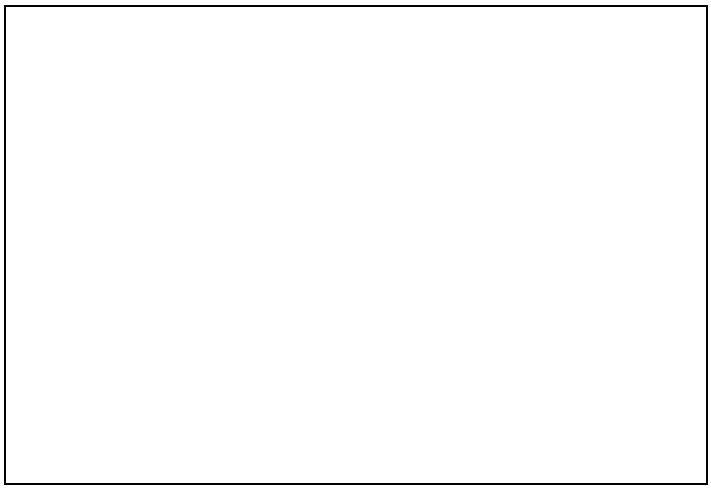


Figure 2: Military training grounds with islands of trees (ca. 1994/1995)

Hof Tütsberg - combining organic farming and landscape management

As was mentioned in table 1, about 2.000 ha within the nature reserve are managed as arable land and 740 ha are used as grassland. The principle crops are potatoes, rye, maize and rape. Some of the land (260 ha of arable and 220 ha of grassland), is cultivated by the landscape management farmstead at Hof Tütsberg, which is owned and led by the VNP. The farmstead was purchased by the VNP in 1928. In 1998, a contract was signed with the state of Lower Saxony, regulating the cultivation system. Among other things, VNP promised to do without synthetic pesticides and irrigation and to restrict fertiliser inputs to the level being removed by the crop. As a result of this practice, Lower Saxony provides appropriate compensation to the VNP. Hof Tütsberg switched to organic farming in 1999, according to the directives of the German "Bioland" association. These directives used to be more rigid than the directives of European Union.

Some of the objectives of Hof Tütsberg:

- Ecologically harmless cultivation of available farmland.
- Conserving heathlands, as determined by traditional and pre-industrial heathland farming.
- Conserving and supporting plant communities typical of sandy soil, especially segetal plants.

To achieve these objectives, 1.800 ewes are kept, in 5 flocks, grazing about 2.500 ha of heathlands. Goats have been added to some of the flocks in order to ensure intensive grazing of tree saplings, esp. pine trees. Grazing takes place throughout the year; sheep are led into the sheep sheds every night. Hay and silage are used as winter fodder. Sheep dung is collected on shed litter and is used for fertilizing the arable land, according to the concept of a closed management cycle.

Despite the sandy soil, cereal cropping is quite diverse. In addition to cultivation of rye and buckwheat, growing for seed is also practised: spelt, triticale, peas, vetches and incarnate clover are grown, according to the quality of soil. The yields per hectare are rather low; rye yields about 36 dt/ha, oats 33 dt/ha, these numbers are expected to fall to roughly 25 dt/ha and should then level out again.

Hof Tütsberg also aims at reviving farming methods that where used by traditional heathland farmers. This is done on approx. 5 ha close to Wilsede, Hof Tütsberg and Benninghöfen, demonstrating a specific crop rotation scheme: at first the field is ploughed and fertilised with raw humus from nearby heathlands. Then rye is grown for four successive years, followed by rough oats and buckwheat, each for one year. The field is then left fallow and is allowed to be grazed by sheep for another four years. After ten years, this kind of crop rotation is repeated. Hof Tütsberg tries to use old varieties of the crops that were grown in the 18th century. The material being used today has been obtained from regional seed banks.

Though this kind of traditional heathland farming isn't of economic value any more, it provides visitors with a lively and clear impression of a farming concept which led to the development of a once dominant landscape structure.

Thanks to national and EU agri-environmental programmes and, not least, to the concept of organic farming, Hof Tütsberg does quite well economically, thereby providing a good example of how to combine historical, ecological and economic interests.

NNA - education, research and public relations for nature conservation

The main tasks of the Alfred Toepfer Academy for Nature Conservation (NNA), which is a state institution under the administration of the Ministry of the Environment of Lower Saxony, are

- to organise seminars and conferences in the field of nature conservation and sustainable development for a wide range of target groups (e.g. nature conservation administration, honorary nature conservationists, planners, students, pupils, politicians, businessmen; a yearly programme can be found on www.nna.de),
- to initiate, coordinate and realize research projects on nature conservation topics, especially within the Lüneburger Heide Nature Reserve, and
- to promote the understanding of nature conservation and sustainability in the population.

To accomplish these tasks, NNA is divided into three departments: *Education and Communication*, *Research and Documentation*, *Administration*. The departments consist of totally 16 permanent employees plus a variable number of contract staff, being employed for specific, short term projects.

These tasks are not necessarily bound to the Lüneburger Heide Nature Reserve. But there are many facts that link NNA to the nature reserve:

- The buildings, which are used by NNA, are situated in the nature reserve or close to its borders. The Department for Education and Communication is located at Camp Reinsehlen, a former military training camp. Most of the 70 yearly seminars and conferences take place at Camp Reinsehlen. A hotel and a restaurant, which are run privately, care for the participants' accommodation and physical well-being. The Departments for Research and Education and Administration are located at Hof Möhr, a former heathland farmstead. A library and a small laboratory provide good resources for up-to-date research.
- The idea of establishing a nature conservation academy has been developed by Dr h.c. Alfred Toepfer, the former head of VNP, and some specialists in the field of nature conservation. Purchasing the farmstead Hof Möhr in 1977 and leasing it to the state of Lower Saxony for no money, Dr h.c. Toepfer made it possible that the academy was founded in 1981 as Northern German Nature Conservation Academy ("Norddeutsche Naturschutzakademie [NNA]"). In 1996 the academy was renamed to "Alfred Toepfer Akademie für Naturschutz", to honour the name of its patron.

- Much of the research, which is done or coordinated by NNA, concentrates on the Lüneburger Heide Nature Reserve. With heathlands, brook valleys, peat bogs, woodlands and Hof Tütsberg right before the front door, the nature reserve provides fascinating objects for research. Other research has been done, for example, in the valley of the Elbe river. Much of this research is done in co-operation with universities, such as Lüneburg or Hannover.
- NNA hosts the "Steering Group Lüneburger Heide Nature Reserve" (see above).

The academy's environmental education activities are organised by a Regional Environmental Education Centre ("Regionales Umweltblidungszentrum [RUZ]"), which is supported by Lower Saxony's Ministry for Education by delegating three part time teachers for a few hours per week. Most of the activities are aimed at kindergartens and schools. Guidelines and proposals for teachers concerning environmental education in different habitats are published in the series "Naturschutz im Unterricht".

Another publication series, the "NNA-Berichte", disseminates some of the knowledge gained by the organisation of scientific meetings.

A small visitor information centre at Hof Möhr has been opened on June 1st, 2003.

Hof Möhr

Camp Reinsehlen

Forest Visitor Centre Ehrhorn No. 1 - linking woodland and heathland development
In the small village of Ehrhorn, a forest visitor center opened in May 2000. It houses an exhibition that avoids the well-worn clichés so often encountered in exhibitions dealing with forest or nature. Instead of displaying the animals and plants of the forest, it presents the ways in which people dealt with the forest in historical times and the way in which they treat it now. Man has always made use of nature and has sometimes even exploited his natural environment to the point that he has deprived himself of the environment's ability to sustain him. The small village of Ehrhorn and its history are bound up in the history of the surrounding landscape and of the people living there, and it is this connection that the exhibit explores.

The visitor centre is run by the state owned Sellhorn forestry office, which was founded in the 1860s during the large-scale afforestation. Approx. 5.100 ha of forest are under the regime of the forestry office. These forests lie completely within the nature reserve, demanding a management which pays particular attention to nature conservation objectives. Its main aim is to integrate conservation, hunting, recreation and wood use.

The forestry office carries out intensive research in collaboration with the Lower Saxonian forestry planning office, the Lower Saxonian forestry experimental office and the University of Göttingen. Research is concentrated in three areas: ancient woodlands, natural forests and the dynamic development of pine plantations.

Endangered Flowering Plants and Ferns of the Lüneburger Heide

Species (Latin)	Species (English)	Red Data Book
Agrimonia eupatoria	Agrimony	3
Agrimonia procera	Fragrant Agrimony	3
Alchemilla vulgaris	Lady's Mantle	3
Andromeda polifolia	Bog-rosemary	3
Antennaria dioica	**Mountain Everlasting**	**1**
Anthemis arvensis	Corn Chamomile	3
Arctostaphylos uva-ursi	**Bearberry**	**2**
Armenia elongata	**Thrift spp.**	**3**
Arnica montana	**Loepard's Bane**	**2**
Arnoseris minima	Lamb's Succory	2
Artemisia campestris	Field Wormwood	3
Blechnum spicant	Deer Fern	3
Botrychium lunaria	**Moonwort**	**1**
Calla palustris	**Bog Arum**	**3**
Caltha palustris	Marsh-marigold	3
Carduus nutans	Musk Thistle	3
Carex echinata	Star Sedge	3
Carex elata	Tufted-sedge	3
Carex elongata	Elongated Sedge	3
Carex ericetorum	Rare Spring-sedge	2
Carex lasiocarpa	Slender sedge	2
Carex panicea	Carnation Sedge	3
Carex pseudobrizoides		2
Carex vesicaria	Bladder-sedge	3
Carex viridula	Yellow-sedge	3
Carex vulpina	True Fox-sedge	3
Carum carvi	Caraway	3
Centaurium erythraea	**Common Centaury**	**3**
Chrysosplenium alterni-fol.	Alternate-leaved Golden-saxifage	3
Chrysosplenium opposi-tif.	Opposite-leaved Golden-saxifage	3
Cicendia filiformis	Yellow Centaury	1
Cicuta virosa	Cowbane	3
Circaea alpina	Alpine Enchanter's-nightshade	3
Corrigiola litoralis	Strapwort	3
Crepis tectorum	**Narrow-leaved Hawk's-beard**	**3**
Cuscuta epithymum	Dodder	2
Dactylorhiza maculata	Heath Spotted-orchid	3
Dactylorhiza majalis	Western Marsh-orchid	2
Dactylorhiza sphagni-cola		2
Dianthus deltoides	**Maiden Pink**	**3**
Digitaria sanguinalis	Large Crabgrass	3
Drosera intermedia	**Oblong-leaved Sundew**	**3**
Drosea rotundifolia	**Round-leaved Sundew**	**3**
Dryopteris cristata	**Crested Buckler-fern**	**2**

Species (Latin)	Species (English)	Red Data Book
Echium vulgare	Viper's-bugloss	3
Elatine hydropiper	Eight-stamened Water-wort	2
Eleocharis acicularis	Needle Spike-rush	3
Eleocharis multicaulis	Many-stalked Spike-rush	2
Eleocharis uniglumis	Slender Spike-rush	3
Euphrasia stricta	Eyebright spp.	3
Filago arvense	Cudweed spp.	2
Filago minima	Small Cudweed	3
Genista anglica	Petty Whin	2
Genista pilosa	Hairy Greenweed	3
Genista tinctoria	Dyer's Greenweed	2
Gentiana pneumonan-the	**Marsh Gentian**	**2**
Geum rivale	Water Avens	3
Gymnocarpium dryop-teris	Oak Fern	3
Helichrysum arenari-um	**Everlastingflower spp.**	**2**
Hottonia palustris	**Water-violet**	
Hypericum humifusum	Trailing St John's-wort	3
Hypercium pulchrum	Stender St John's-wort	3
Hypochoeris glabra	Smooth Cat's-ear	2
Ilex aquifolium	**Holly**	
Illecebrum verticillatum	Coral-necklace	2
Iris pseudacorus	**Yellow Iris**	
Juncus filiformis	Thread Rush	3
Juniperus communis	Common Juniper	3
Lathyrus linifolius	Bitter-vetch	2
Lilium bulbiferum croceum	**Orange Lily**	**2**
Linnaea borealis	**Twinflower**	**1**
Listera ovata	Common Twayblade	3
Lycopodiella inundata	Marsh Clubmoss	3
Lycopodium annotinum	Interrupted Clubmoss	2
Lycopodium clavatum	Stag's-horn Clubmoss	3
Lycopodium tristachyum	Clubmoss spp.	1
Lysimachia nemorum	Yellow Pimpernel	3
Lysimachia thyrsiflora	Tufted Loosestrife	3
Lythrum portula	Water-purslane	3
Menyanthes trifoliata	**Bogbean**	**2**
Monotropa hypopitys	Yellow Bird's-nest	2
Montia fontana	Blinks	3
Myosotis discolor	Changing Forget-me-not	3
Myosotis ramosissima	Early Forget-me-not	3
Myrica gale	Bog-myrtle	3
Myriophyllum alterniflo-rum	Alternate Water-milfoil	2
Narthecium ossifra-gum	**Bog Asphodel**	**3**
Nuphar lutea	**Yellow Water-lily**	

Species (Latin)	Species (English)	Red Data Book
Nymphaea alba	**White Water-lily**	**3**
Oenanthe fistulosa	Tubular Water-dropwort	3
Ophioglossum vulgatum	Adder's-tongue	2
Oreopteris limbosperma	Lemon-scented Fern	2
Osmunda regalis	**Royal Fern**	**3**
Paris quadrifolia	Herb Paris	3
Parnassia palustris	**Grass-of-Parnassus**	**1**
Pedicularis palustris	**Marsh Lousewort**	**1**
Pedicularis sylvatica	**Lousewort**	**2**
Petrorhagia prolifera		2
Phegopteris connectilis	Beech Fern	3
Pilularia globulifera	Pillwort	2
Platanthera bifolia	Lesser Butterfly-orchid	2
Polygala vulgaris *Polygonum bistorta*	Common Milkwort Common Bistrot	3 3
Potamageton compressus	Grass-wrack Pondweed	3
Potamageton gramineus	Various-leaved Pondweed	2
Potamageton obtusifolius	Blunt-leaved Pondweed	3
Potamageton polygonifolius	Bog Pondweed	3
Primula veris	**Cowslip**	**2**
Pyrola minor	Common Wintergreen	3
Radiola linoides	All-seed	2
Ranunculus bulbosus	Bulbous Buttercup	3
Ranunculus hederaceus	Ivy-leaved Crowfoot	2
Ranunculus penicillatus	Stream Water-crowfoot	3
Ranunculus trichophyllus	Thread-leaved Water-crowfoot	3
Raphanus raphanistrum	Radish	3
Rhinanthus angustifolius	Greater Yellow-rattle	3

Species (Latin)	Species (English)	Red Data Book
Rhynchospora alba	White Beak-sedge	3
Rhynchospora fusca	Brow Beak-sedge	2
Rosa subcollina	Dog-rose	3
Saxifraga granulata	Meadow Saxifage	2
Scirpus cesp. germanicus		3
Scirpus setaceus	Bristle clubrush	3
Scleranthus perennis	Perennial Knawel	3
Scorzonea hispanica	**Viper's-grass spp.**	**2**
Scorzonea humilis	Viper's-grass spp.	2
Senecio aquat. aquaticus	Marsh Ragwort	3
Silene vulgaris	Bladder Campion	3
Sparganuim natans	Least Bur-reed	2
Stachys arvensis	Field Woundwort	2
Succisa pratensis	Devil's-bit Scabious	3
Taraxacum nordstedtii	Dandelion spp.	3
Taxus baccata	**Yew**	**3**
Teucrium scorodonia	Wood Sage	3
Thalicrium flavum	Common Meadow-rue	3
Thelypteris palustris	Marsh Fern	3
Thymus pulegioides	Large Thyme	3
Thymus serpyllum	Breckland Thyme	2
Trifolium medium	Zigzag Clover	3
Triglochin palustre	Marsh Arrowgrass	2
Utricularia australis	Bladderwort	3
Utricularia minor	Lesser Badderwort	2
Vaccinium oxycoccus	Cranberry	3
Valeriana dioica	Marsh Valerian	3
Veronica montana	Wood Speedwell	3
Vicia lathyroides	Spring Vetch	3
Viola canina	Heath Dog-violet	3

Antennaria dioica = Priority species listed in Appendix 2 of the Fauna Flora Habitat Guideline of the EU.

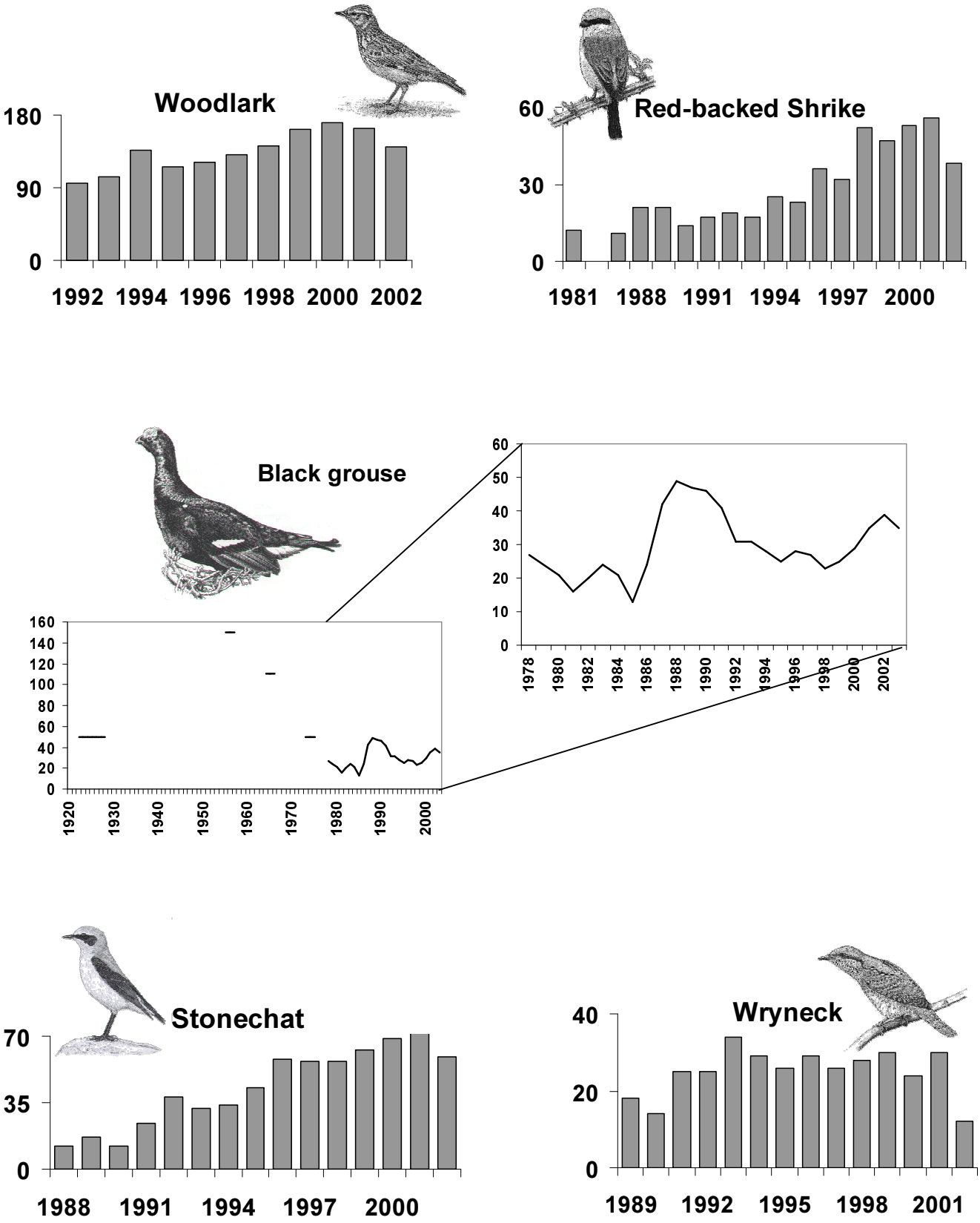
"Rote Liste" = Species that are listed as "endangered" in the State Niedersachsen. 0 = extinct, 1 = in danger of extinction, 2 = highly endangered, 3 = endangered, 4 = potentially endangered.

The Reptiles and Amphibians of the Lüneburger Heide nature reserve

Reptiles	
Latin names	**English names**
Anguis fragilis	Blind worm
Cornella austriaca	Smooth snake
Lacerta agilis	Sand Lizard
Lacerta vivipara	Viviparous Lizard
Natrix natrix	Ringed snake
Vipera berus	Adder, Common viper

Amphibians	
Bufo bufo	Common toad
Bufo calamita	Natterjack, Rush toad
Hyla aborea	Common tree frog
Pelobates fuscus	Common spadefoot
Rana arvalis	Moor frog
Rana dalmantina	Agile frog
Rana esculenta	Edible frog
Rana lessonae	Pool frog
Rana temporaria	Common grass frog
Salamandra salamandra	Fire salamander
Titurus cristatus	Wary newt
Titurus helveticus	Palmate newt
Titurus vulgaris	Smooth newt

Some rare bird species of the Lüneburger Heide nature reserve



Profile of the Bergen-Hohne Military Training Area

- Being the largest military training ground in Europe, Bergen-Hohne covers an area of about 284 km².

- First exercises already by the army of the Hannover kingdom in the 19th century.

- Considerably enlarged training grounds were established during the Nazi period in 1935; 24 villages were depopulated and destroyed, 3.650 inhabitants forced to resettle. Further enlargement to nowadays size until 1952.

- Several shooting ranges are used all year round by different NATO forces.

- Central parts (mainly heathlands, bogs, acid grassland and some nutrient poor fields) covering about 88 km² are registered as Special Protection areas (SPA) according to the EU Birds directive (e.g. Niedersachsens biggest sub population of Black Grouse, about 85 Ind.; ca.100 BP of Nightjar, ca. 100 BP of Woodlark).

- Management measures that aim at preserving open landscape especially on the shooting ranges are prescribed burning during winter, mowing and cutting of invading trees. In some parts grazing influence by deer living in the surrounding forests in high densities is obvious. Moreover uncontrolled fire due to shooting mainly in summer is a predominant factor influencing the heathland ecosystem.

Profile of the Nemitzer Heide Nature Reserve

The “Nemitzer Heide” is an isolated heathland, situated in Niedersachsens easternmost Landkreis “Lüchow-Dannenberg” on extended sandy plains within the broad Elbe valley. Dunes can be found in several locations.

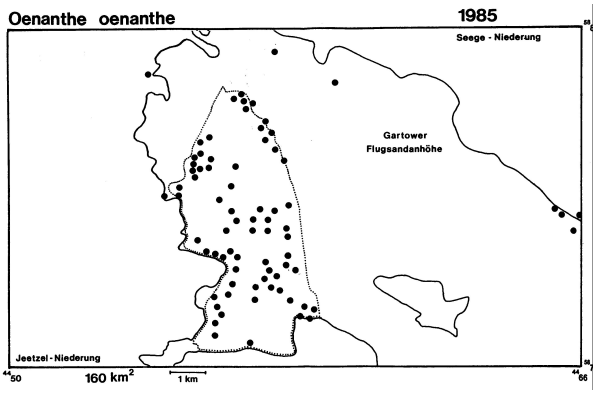
As in other parts of Niedersachsen during the summer of 1975 uncontrolled fire destroyed young Scotch Pine forests of about 18 km² in the Nemitz area. From that about 5 km² were not reafforestated afterwards so that sponatuously developed open heath and nutrient poor dry acid grassland persisted, here and there interrupted by spontanuously growing thin birch and pine stands.

A sheep shed was built and a sheep flock established in order to keep the heathland open and to provide an attraction for local tourism. Grazing is the main management measure until today.

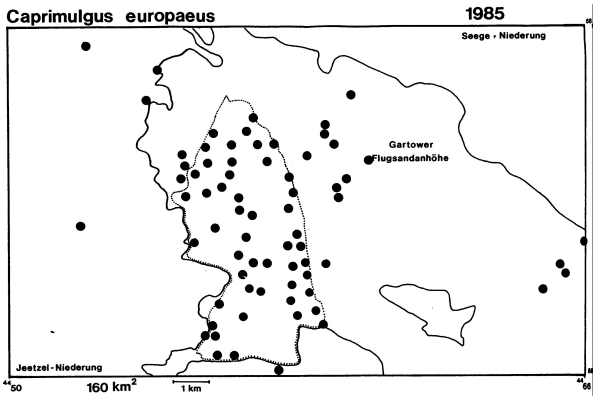
Considerable breeding populations of typical heathland birds developed spontaneously for a few years (fig. 1) including species with mainly continental eastern distribution such as Tawny pipit (*Anthus campestris*) and Hoopoe (*Upupa epops*). The local breeding populations of these “pioneer species” however decreased considerably since, in case of Tawny pipits down to 3 remaining BP in 2003.

Further characteristic species: Sand lizzard (*Lacerta agilis*), Schlingnatter (*Coronella austriaca*), Blauflüglige Ödlandschrecke (*Oedipoda caerulescens*), westliche Beißschrecke (*Platycleis albopunctata*)

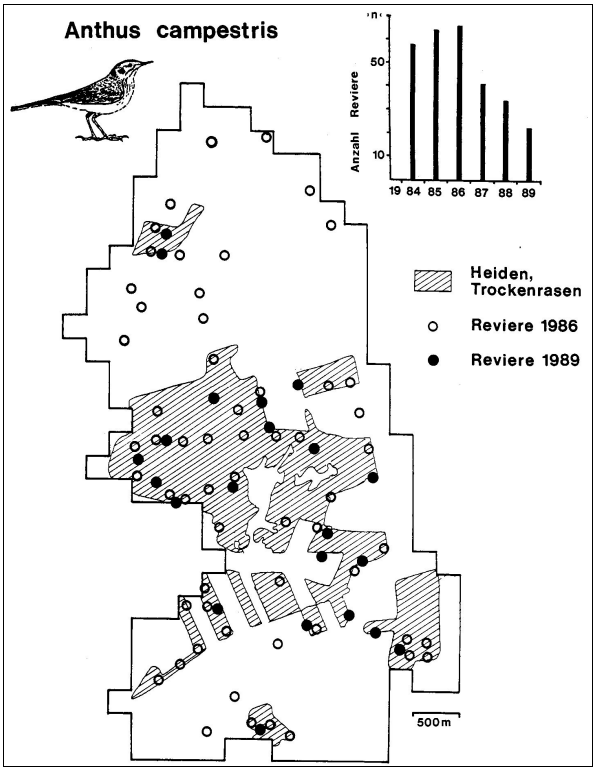
Today the “Nemitzer Heide” is a nature reserve and put on the official recommendation list for “Natura 2000” sites.



Wheatear



Nightjar



Tawny pipit

Figure 1: Distribution of breeding birds about a decade after the fire burnt parts of the Nemitz Scotch Pine stands
- dotted line: burnt area with heath, acid grassland and young reafforestations
- "Heiden, Trockenrasen": heathland, nutrient-poor grassland, "Reviere": territories
(Reference: *Neuschulz, F. (1991): Spontane Ansiedlung seltener Kleinvogelarten in neu entstandenem Lebensraum. Seevögel 12: 75-78.*)

Profile of the Kellerberge Nature Reserve

- Northernmost part of the large “Colbitz-Letzlinger Heide”, that is mainly used as military training ground until today.

- Situated on nutrient poor sediments from the last but one ice age (Saale-Eiszeit) with sandy top layers locally concentrated to dunes of considerable size.

- The whole region has been mostly covered by woodlands during the past centuries; in parts of the area heathlands are known already from the 19th century, presumably mainly due to forest fires and intensive wood pasture.

- “Kellerberge” were used by cavalry forces already during the 19th century; military airport during Nazi period; training ground (without shooting) for the Russian troops at Gardelegen between 1945 and 1991.

- Since then heathlands and arid grasslands of about 450 ha have been conserved, 110 ha of which are protected as a nature reserve and recommended as “Natura 2000” site.

- Management measures: Sheep grazing (Heidschnucken), mowing, turf stripping, tree cutting, prescribed burning.

- Great effort to promote tourism; e.g. public festival on the occasion of flowering heather.

Profile of the Lausitz-Niederschlesische Heide

The northern part of the Lusatian area is dominated by Pleistocene sediments from the "Saale"-ice age period; hilly moraine areas ("Muskauer Faltenbogen") occur as well as broad valleys built by melting ice water ("Breslau-Magdeburger Urstromtal"). Dune systems are characteristic for the northern parts of these sandy lowlands.
Comparative continental features in climate; yearly precipitaion of about 600 – 700 mm; most rainfall during summer.

Oberlausitz military training area ("Muskauer Heide")

- Most extent heathland area of the region.
- Evidence of a free living and reproducing wolf population in Germany since about 5 years

Brown coal opencast mining

- Mainly in the North of the Lusatian area important clay and brown coal layers from the Tertiary period were found. They formed the basis for industries in the region since the early 19th century.
- Huge opencast mining areas had severe influence on the groundwater system of the whole region.

UNESCO biosphere reserve "Upper Lusatia Heath and Pond Landscape"

- One of Germany's vastest pond regions
- Local residents have made economic use of the ponds for centuries (mainly carp breeding), creating numerous such bodies of water embedded in a harmonious landscape of dune forests, moist meadows, cultivated fields, floodplains and heath areas; outstanding rich in rare and endangered plant and animal species, e.g. Germany's biggest otter population
- UNESCO biosphere reserve founded in 1994; from a total of 26.000 ha 4 % are core areas without direct human influence; the management zone cover about 44 % of the total area, zone for development and regeneration of about 52 %.
- On the former tank shooting range "Dauban" as part of the reserve a project within a federal research program is conducted in order to develop suitable strategies for to regenerate heathlands or to keep former heathlands open. In a fenced area 3 elks, some goats and sheep are kept together since autumn 2001 in order to graze/influence vegetation at different height levels. The effects of grazing on microrelief, vegetation and fauna are investigated.

Federal Nature Conservation Project "Carp ponds Niederspree-Hammerstadt"

- Nature reserve of about 1.550 ha since 1998;
- Federal funded project since 1997 to support especially regeneration measures in wet habitats, old forest stands and nutrient poor dry vegetation types.

Polish heathlands

Andrzej Nienartowicz & Mieczyslaw Kunz

According to Matuszkiewicz (1984) heathlands occurring on the Polish territory belong to two main types of plant communities. They are:
1 – Atlantic communities of wet heathlands from the class *Oxycocco-Sphagnetea*, the order *Sphagno-Ericetalia* and the alliance *Ericion tetralicis*, and
2 – dry heathlands from the class *Nardo-Callunetea* and the order *Calluno-Ulicetalia.*

Communities of the first type occur on the peaty and gley-podzol soils in ground depressions with considerable fluctuation of the ground water level in the annual cycle. Floristically they are characterised by a substantial share of species with the Atlantic type of range and lack of continental-boreal species, and insignificant share of peat-forming species of tufty peat mosses.

Wet heathlands are represented in Poland by one association *Ericetum tetralicis* with the dominating *Erica tetralix*, recorded fairly frequently along the South-Baltic seacoasts, and also seldom in the West of Wielkopolska (Great Poland) and Lower Silesia. The association reaches in Poland its absolute eastern range of occurrence and is distinctively floristically impoverished as compared with typical West-European forms.

The second type of heathlands is constituted by communities dominated by the heather *Calluna vulgaris* and only sparsely scattered individuals of juniper and undergrowth of birch and pine. They occur on poor acid podzols that developed from loose sands or slightly clayey sands in the maritime climate. In Poland there have not been ever any doubts concerning anthropogenic character of those heathlands, which develop only after cutting coniferous or mixed forests and considerably intensify the podzolization process of soils. Our communities from the order *Calluno-Ulicetalia* are floristically very impoverished, as most of their characteristic species do not reach the western border of Poland. All occurring here types of heathlands from this group should be interpreted as non-typical borderland forms of various syntaxa.

Having in prospect the whole range of the order *Calluno-Ulicetalia* one can distinguish in Poland three main associations representing three different alliances:

Calluno-Genistetum – sub-Atlantic inland heathlands. They are exclusively anthropogenic communities of dry heathlands, developing on poor sandy soils as degenerative phases of pine and mixed forests. Locally they occur in several regions of north-western, western and central Poland in thin forest stands, on clearings, along fire-control lines and along unsurfaced amid-forest roads). Vast and more typically developed phytocenoses are known mainly from Western Pomerania, Bory Tucholskie (Tuchola Forest), Bory Dolnoslaskie (Lower-Silesia Forests) and other extensive forest areas on sandy grounds.

Salici-Empetrum nigri – crowberry maritime heathlands. Boreal-Atlantic heathland with the dominating *Empetrum nigrum* and some share of *Salix arenaria*. This community occurs in Poland only along the Baltic coast and at least partially has natural character. The factor inhibiting succession towards forest communities are very strong winds. Moreover *Salici-Empetretum nigri* is an anthropogenic vicarious community of the maritime crowberry forest.

Arctostaphyllo-Callunetum – subcontinental bearberry heathlands of the boreal-continental type of range, characterised by some share of *Arctostaphylos uva-ursi* as a sub-dominant and other continental psammophytes. Range of this association is not yet known in details. Probably its centre lies in Baltic countries and areas of Belorussia. In Poland *Arctostaphylo-Callunetum* occurs quite often in north-eastern and eastern parts. Its stands are known from e.g. surroundings of Torun and big forest complexes: Puszcza Kampinoska, Piska, Kurpiowska, Bialowieska, Knyszynska and Augustowska.

Recently in Poland among inland heathlands, besides above-mentioned associations, the association *Pohlio-Callunetum* was distinguished which belongs to the distinct order *Pohlio-Callunion*, and among maritime heathlands the association *Carici arenariae-Empetretum nigri*, *Vaccinio uliginosi-Empetretum nigri* and the community *Empetrum nigrum-Vaccinium vitis-idaea.* The table 1 presents a list of syntaxonomical units within the class *Oxycocco-Sphagnetea* and *Nardo-Callunetea* which was applied for elaboration of “The distribution atlas of plant communities in Poland”. The association *Calluno-Nardetum stricte* dominated by the heather *Calluna vulgaris*, representing the order *Nardetalia*, occurs in the plateau and prealps levels, mainly in Beskidy in places highly or even excessively grazed by sheep and cattle, and constitutes the last stage of vegetation degradation.

Table 1: Syntaxonomical units within classes comprising Polish heathlands (*)

OXYCOCCO-SPHAGNETEA Br.-Bl. & R. Tx. 1943			
	Sphagno-Ericetalia Br.-Bl. 1948 em Moore. (1964)1968		
		Ericion tetralicis Schwick. 1933	
*			*Ericetum tetralicis* R. Tx. 1937
	Sphagnetalia magellanici (Pawł. 1928) Moore (1964) 1968		
		Sphagnion magellanici Kästner & Flössner 1933 em. Dierss. 1975	
			Erico-Sphagnetum medii (Schwick. 1933) Moore 1968
			Sphagnetum magellanici (Malc. 1929) Kästner & Flössner 1933 (=*Sphagnetum medio-rubelli*)
			Association *Eriophorum vaginatum-Sphagnum recurvum* Hueck 1928 pro ass.
			Eriophoro-Trichophoretum caespitosi (Zlatn. 1928, Rudoph & all. 1928) Rübel 1933 em. Dierssen 1975
			Pino mugo-Sphagnetum Kästn.& Flössn. 1933 em. Neuh. 1969 corr. Dierssen 1975
			Ledo-Spliagnetum magellanici Sukopp 1959 em. Neuhäusl 1969
		Oxycocco-Empetrion hermaphroditi (Nordh. 1936) R. Tx. 1937	
			Empetro-Trichophoretum austriaci (Zlatn. 1928) Jenik 1961 em. Mat. 1974
NARDO-CALLUNETEA Prsg 1949			
	Nardetalia Prag 1949		
		Nardion Br.-Bl. 1926 em. Oberd. 1959	
			Hieracio (vulgati)-Nardetum Kornaś 1955 n.n. em. Balcerk. 1984
			Hieracio (alpini)-Nardetum Szafer & all. 1923 em. Balcerk. 1984
			Carici (rigidae)-Nardetum (Zlatn. 1928) Jenik 1961
		Violion caninae Schwick. 1944 (= *Nardo-Galion saxatilis* Prsg 1949)	
			Polygalo-Nardetum Prsg 1953
			Nardo-Juncetum squarrosi Nordh. 1920 Bük. 1942
			Calluno-Nardetum strictae Hrync. 1959
	Calluno-Ulicetalia (Quant. 1935) R. Tx. 1937		
		Calluno-Genistion Duving. 1944	
*			*Calluno-Genistetum* R. Tx. 1937
		Pohlio-Callunion Shimwell 1973 emend. Brzeg 1981	
*			*Pohlio-Callunetum* Shimwell 1973 emend. Brzeg 1981
			Association *Hypnum jutlandicum* Balcerk. & Brzeg 1978
			Sieglingio-Agrostietum Brzeg 1981
		Calluno-Arctostaphylion R. Tx. & Prsg 1949	
*			*Arctostaphylo-Callunetum* R. Tx. & Prsg 1940 (=*Cladonio-Callunetum* Juraszek 1928)
			Scabioso canescentis-Genistetum Balcerk. & Brzeg 1993
		Empetrion nigri Böcher 1943	
*			*Salici-Empetrum nigri* R.Tx. 1955
*			*Carici arenariae-Empetretum nigri* R.Tx. & Kawamura 1975 em. Barendregt 1982
*			*Vaccinio uliginosi-Empetretum nigri* R. Markowski 1997
*			Community *Empetrum nigrum-Vaccinium vitis-idaea*

Location of main heathland complexes in Poland (Fig. 1) is following:

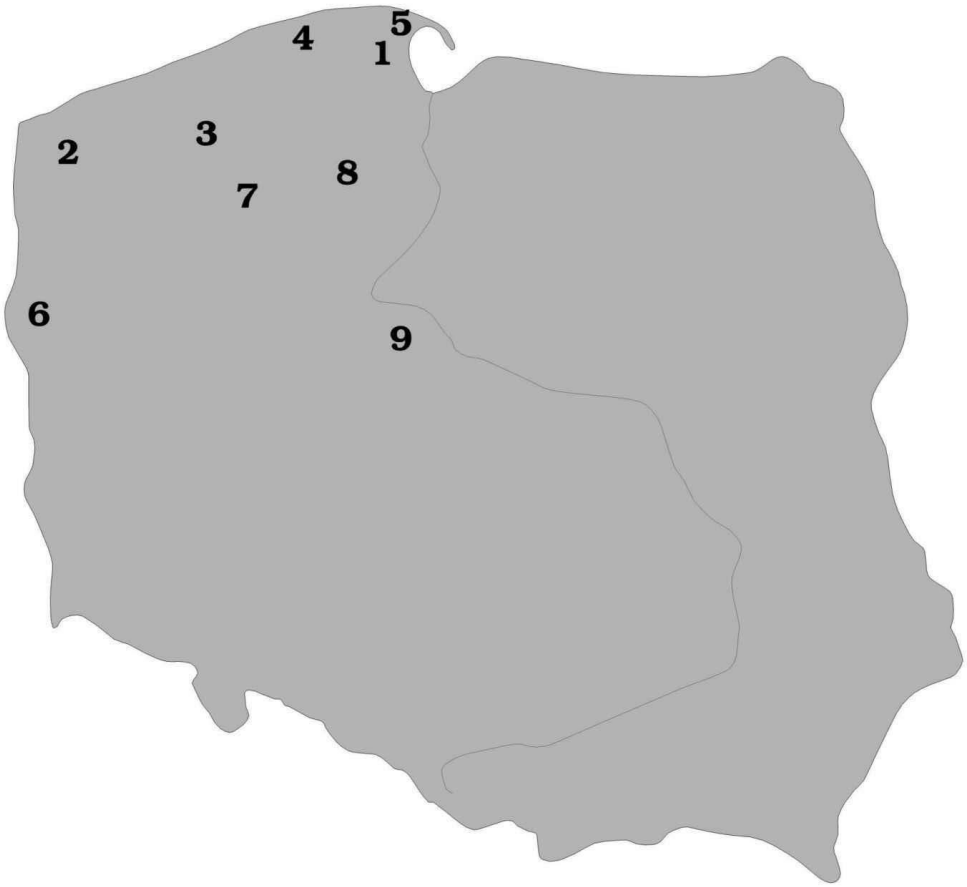


Figure 1: Location of main heathland complexes in Poland

Wet heathlands:

1. Bielawskie Bloto near Puck, close to the Baltic coast. It is the easternmost wet heathland with *Erica tetralix.* In the complex of peatbogs and heathlands three reserves are located there: „Bielawa" – created in 1999 of 680.21 ha area, the reserve with *Myrica gale* (33.0 ha) and the reserve with *Rubus chamaemorus* (8.4 ha). During last years progressive deterioration of this peatbog and heathland was observed. The reason behind the degradation of the heathland were drainage, peat-mining and frequent fires.
2. Sowno heathland – the nature reserve in the vicinity of Goleniow and Szczecin. The reserve was created in 1977 and its area amounts to 26.0 ha. Among the species *Erica tetralix* and *Carex pulicaris* occur.
3. The nature reserve Nowe Wicko (4.49ha) established in 1984; the locality of *Myrica gale* on the south-easterly range border.

Dry maritime heathlands:

4. Heathlands in the Slowinski National Park, which constitutes the UNESCO Biosphere Reserve.
5. Heathlands in the vicinity of Jastrzebia Gora and Wladyslawowo. Small areas of heathlands with *Empetrum nigrum.*

Dry inland heathlands:

6. Cedynskie Heathlands – the nature reserve established in 1985, 71.61 ha. It is situated closed to the Odra in the Cedynski Landscape Park. Several interesting xerothermic species occur there.
7. Heathlands in the vicinity of Szczecinek and Borne Sulinowo. It is a large area of the former firing grounds by the soviet army. Previous heathlands so called „Teufel Heide". Till the end of the Second World War it served as German firing ground, e.g. training ground „Afrika Korps" by the Marshal E. Rommel. The terrain is highly contaminated by petroleum derivative compounds.
8. Bory Tucholskie – Tuchola Forest (germ. Tucheler Heide) – one of the biggest pine forest complexes in Poland. In several places former heathlands had been afforested. At present the association *Pineto-Callunetum* occurs in those places. Heathlands occur along fire-control lines (e.g. in the vicinity of the National Park "Bory Tucholskie – Tuchola Forest"), along mid-forest roads and on abandoned plough-lands. A large complex of heathlands exists next to the archaeological reserve in Odry.
9. Surroundings of Torun – heathlands with *Calluna vulgaris* and *Arctostaphyllos uva-ursi* and xerothermic species, e.g. *Pulsatilla patens*, *Stipa joannis.* South of the town the artillery firing ground is located and hence frequent fires of heathlands occur caused by missile explosions. Along the town border degradation of heathlands is observed due to illegal refuse dumps. In the northern part of the town the district "Wrzosy - Heaths" is located. After the Second World War a residential district was created on the heathlands.

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Profile of the visited Polish Areas

Polish forest district Chocianów

- moist forest and bog regeneration

Polish forest district Przemków

- conservation program for heathland ecosystems on former military training sites

Zurawie Bagno Nature Reserve

Heathlands in Brandenburg: History – Importance – Management

Roland Lehmann

The heathlands in Brandenburg are part of a heathland area which has a discontinuous distribution from Northwest-Germany to the Southeast of South-Brandenburg and Poland. GRAEBNER (1924) states that the heathlands of Brandenburg are only an enclave. Our heathlands are almost completely situated in the old-glacial (Saale ice age) landscapes of South-Brandenburg on poor sandy soils with calcium deficiency. In the young-glacial (Weichsel ice age) landscapes of North-Brandenburg heathlands were rare in the past. Heathlands in Brandenburg exist under specificl climatic conditions which are different from those in Northwest-Germany. Especially the heathlands of Southeast-Brandenburg are near the edge of the natural distribution range of lowland heathlands. Surprisingly, studies on heathlands in Brandenburg have no tradition - in contrast to the long tradition of cultivation and investigation of heathlands in Northwest-Germany. Therefore, our knowledge of the heathlands of Brandenburg rather is poor.

1. Historical development of heathlands in Brandenburg

The historical distribution of heathlands in Brandenburg is more or less unknown, But it is possible to give a rough overview for the last 200 years, because we know the history of agriculture in Brandenburg (KLEMM et al 1998). Probably, 200 years ago wide parts of South-Brandenburg have temporarily been heathlands. We have two reasons for this assumption:

- The soils of South-Brandenburg were so poor that cropping was nearly impossible.
- Large continuous woodlands got lost through wood cutting and wood pasture so that most woodlands looked like semi-open parklands.

I think it is possible to point out several periods of heathland development in Brandenburg:

period	causes
1800-1830 **decline of heathland**	▪ beginning of the Prussian land reform; ▪ removal of the tree-crop-rotation and introduction of the modern fruit-crop-rotation; ▪ it became possible to grow crops also on poor soils, especially potatoes; ▪ separation of forest and pasture; ▪ afforestation of fragmentary and poor woodland and heathland
1830-1870 **increase of heathland**	▪ increase of sheep breeding; ▪ Berlin became an European centre of textile industry, the need for wool increased rapidly; ▪ sheep in this time were the most numerous animal in agriculture
1870-1900 **decline of heathland**	▪ break down of sheep breeding in Germany caused by cheap wool imports from Australia and South Africa;
1900-1991 **increase of heathland**	▪ installation of more and more military training areas;especially after Word War II many training areas were installed by the Russian army; ▪ in this period, Brandenburg had the highest proportion of military training areas in Germany (7 % of the land surface)

2. Current Status

Since 1992, most of the large Russian military training areas have been designated as nature reserves, out of which 35 with a total of 69.000 ha are nominated to be designated as Special Protected Areas according to the EU Habitats Directive.

The largest sites:

Nominated FFH area	size
Wittstock-Ruppiner Heide	9.348 ha (active military training area)
Heidehof-Golmberg	8.708 ha
Lieberoser Endmoräne	8.266 ha
Kleine Schorfheide	8.200 ha
Forst Zinna-Keilberg	7.096 ha
Forsthaus Prösa	3.801 ha
Reicherskreuzer Heide	3.081 ha

The most important natural habitat types (EU Habitat Directive) in former military training areas:

NATURA 2000 Code	habitat type	total area in Brandenburg (in ha)	within former military training areas(%)
4030	Dry heaths (all types)	15.000	80-90
2310	Dry sand heath with *Calluna* and *Genista* (continental dunes)	2.000	95
2330	Open grassland with *Coryneporus* and *Agrostis* of continental dunes	5.000	95
7140	Transition mires and quaking bogs	1.750	40
9190	Old acidophilous oak woods with *Quercus robur* on sandy plains	9.500	15

3. Importance of heathlands

In the period from 1945 to 1992 it was impossible to investigate our large heathland areas. 1991 was the starting point of heathland research. Main emphasis was put on zoological research. Unfortunately, botanical investigations are the exception. The results of zoological research revealed the high importance of this habitat types for many threatened animal species:

Camprimulgus europaeus **European Nightjar** Germany: 3.100 to 4.400 bp
Brandenburg: 1.000 to 1.200 bp
95% in former military training areas

Nearly a third of the German population is breeding in the former military training areas of Brandenburg (BAUER et al. 2002, DEUTSCHMANN 2001).

Upupa epops **Hoopoe** Germany: 310 to 460 bp
Brandenburg: 125 to 200 bp
70% in former military training areas

Nearly a third of the German population is breeding in the former military training areas of Brandenburg (BAUER et al. 2002, FIDDICKE 2001 MÄDLOW & MAYR 1996, ROBEL & RYSLAVY 1996).

***Lullula arborea* Woodlark**
Germany: 25,000 to 45,000 Bp
Brandenburg: 12,000 to 18,000 Bp
40% in former military training areas
(BAUER et al. 2002, RYSLAVY 2001, SPITZ 2001)

***Lacerta viridis* (Eastern Green Lizard)**

Germany: occurrence in two separated areas in Brandenburg and in a small area in Bavaria
Brandenburg: the two sites in East-Brandenburg are the northern-most of the distribution range;
they are situated in the former military training areas Lieberoser and Reicherskreuzer Heide
(PETERS 1970)

***Dyscia fagaria* (Lepidoptera, Geometridae)**

Germany: all records are from sandy heathland in the glacial formed landscapes of North Germany
Brandenburg: 12 sites, out of it 10 in former military training areas
It is one of the most threatened species in central Europe (TRUSCH et al 1996).

***Bichroma famula* (Lepidoptera, Geometridae)**

Germany: recent records only in federal state of Rheinland-Pfalz
Brandenburg: extinct since 60 years, rediscovery 1996 in the former military training area Jüterbog-West;
It is the northern-most site of its distribution range (RÖDEL et al. 1997)

Many of the threatened species occurring in our heathlands are thermophilous. Our heathland areas are xerothermal islands in the landscape.

4. Threats to heathlands

From 1992 to 2000, the area of open sandy heathlands in the former Russian military training areas of Brandenburg declined by 60% (LEHMANN 2000). Most of them turned into initial pine and birch forests. The most important reason for uncontrolled succession is the high contamination of the sites by weapons and ammunition. 90% of our heathland is contaminated. Since it is forbidden to enter these areas, management is almost impossible. The full clearance of weapons and ammunition is too expensive. The costs for clearing one hectar are between 27.000 and 71.000 €. Actually, the maintenance of heathland is only possible on non-contaminated areas, comprising 10% of the total heathland area of Brandenburg. The habitats of many threatened heathland species are increasingly threatened by succession. These are species, for which Brandenburg has a responsibility at the national or even European scale.

5. Possibilities for heathland management

Besides military training, the traditional use of heathland is sheep breeding. In the present time sheep breeding is not possible without high public subsidies. But there is the high risk of cancellation of subsidies due to the financial crisis of the state. A better method is the use of mown heath material for the filter industry. There is a company in Brandenburg producing bio-filters and needing *Calluna* material as a suspender for specific bacteria which are able to

avoid offensive smell. Unfortunately, heathlands with an uncertain military contamination status cannot be mown. Therefore, the company in Brandenburg buys the heather material in Scotland, Denmark and the Netherlands, and our own heathland is overgrown by successional forests. In general, the maintenance of our heathland by sound use or management would be possible without any subsidies.

Burning of heathlands

Heathland burning as an important maintenance measure has a long tradition in West-Europe. In Brandenburg it may also be an interesting additional measure, but again, burning in contaminated areas is impossible. It is even forbidden to make fire fighting operations in such areas. (And this is very pleasant.) Unfortunately, the state forestry administration is strictly against the use of fire as a management tool. Brandenburg is the state with the highest danger of forest fire in Germany. Unfortunately, our administrative bodies are not familiar with modern fire management. A better situation is to be found in heathlands managed by the federal forestry administration, being responsible for military training areas of the German Forces including the former East-German Forces and being fairly experienced with fire management.

Since two years first and limited attempts with heathland burning in areas managed by the federal forestry administration in south-eastern Brandenburg have been realized together with Prof. Goldammer from the Global Fire Monitoring Centre. We hope that this is the beginning for more acceptance of prescribed burning as a tool of heathland management in Brandenburg.

6. Do we have a chance?

Will the heathlands in Brandenburg be disappeared by succession in a few years or will we be able to maintain parts of the heathlands by using it for the filter industry and for sheep breeding? What is possible? There are tree considerations:

1. Separation from contaminated and not contaminated areas

Military training areas are categorized as being contaminated with weapons in their whole cover. This is not correct. Nobody knows exactly where weapons are present and where not. There are also large areas without any weapons. This areas should be detected. Heathland management is possible there. We have to separate the former military training areas in parts with weapon-contamination and such without any contamination. This step has not been done until now. The contaminated areas need not be cleared at once. But they have to be marked. This way, enormous costs for clearing weapons can be avoided. The contaminated areas will be changed by natural succession, and a patchwork of open landscapes with grasslands and heathlands on one hand and groups of trees or small forests on the other hand will be created.

2. Reducing the costs for detection

It is also possible to reduce the costs for detection of weapons and ammunitions by means of a new technique. The manual detection can be replaced by aerial detection. A very low flying aeroplane with special metal detectors is able to find metal in the soil with a high precision. With a very exact GPS and a special software it is possible to draw up a map of metal contamination. In comparison to manual detection this method has two advantages: It is cheaper and quicker.

3. Use of explosion-protected tractors for mowing

To avoid a residual risk it is possible to protect a tractor driver against explosions during mowing. The driver in his cabin can be endangered from the bottom by explosion and by splinters destroying the windscreen. Such a tractor with bullet proof material and with an armour shield has been tested. The equipment can be installed at each normal tractor if needed, which was, for example, done with a John Deer (LEHMANN 2002).

In the past three years we were working on managing the technical preconditions for heather mowing in spite of contamination. We found a company which needs heather material, we found a company performing a modern and cheap method for aerial detection and we found a company which has developed explosion-protected tractors for mowing. They are all in Brandenburg. It is possible to maintain the heathlands by adapted land use without any public subsidies. But for detection of ammunition and weapons we still need the financial support of our administration.

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Profile of the Tangersdorfer Heide Nature Reserve

The core area "Kleine Schorfheide-Havel Nature Reserve"

With a size of 7.350 ha the Kleine Schorfheide-Havel Nature Reserve is one of the largest nature reserves in the state of Brandenburg. An area of more than 712 ha has been declared as absolutely protected, i.e. no landuse is permitted any more. In combination with the Himmelpforter Heide, the Kleine Schorfheide-Havel makes up the core area of the "Uckermark Lakes" region, which is supported by the German Federal Republic for being an area of nation-wide importance. This core area has a total size of 8.815 ha.

The area reaches from south of the city of Fürstenberg to the surroundings of the city of Zehdenick. It is about 18 km long and between 4 and 7 km wide. Up to 6.000 ha have been used for military purposes by the former CIS (Commonwealth of Independent States). The central part of this training area, the so called Tangersdorfer Heide, has a size of 3.500 ha. It was predominantly used as shooting range for tanks.

The former CIS real estate has been transferred to an association, the "Brandenburgische Boden Gesellschaft" in 1994, which has taken responsibility for privatizing these areas. Up to now, about 1.700 ha have been sold, mainly in the surroundings of the cities of Tornow and Vogelsang.

The "Feldberg-Uckermärkische Seenlandschaft" association, which is responsible for implementing the above mentioned nation-wide nature conservation programme, is trying to purchase approx. 2.500 ha of land with help of the World Wildlife Found (WWF).

Climate

Being influenced by both the more atlantic Mecklenburgian and the more continental continental Brandenburgian climate, average yearly rate of precipitation is between 620 mm (city-of Himmelpfort) and 550 mm (city of Vogelsang).

With average yearly maximum temperature of 31,9° C and average yearly minimum temperature of -18,1° C, the difference between temperature in summer and winter is obviously quite high. The vegetational season is relatively short.

Geology

The core area is predominantly determined by pleistoscenic outwash plains, being situated in front of the end moraines of the Weichsel ice age ("Pomeranian stadium") in the northeast. From there, melted snow and ice has washed out some glaciofluvial gullies. The Havel, the Woblitz and the "Templiner Wasser" are the best known rivers dating back to the Weichsel ice age. The river valleys are very boggy, sometimes they are accompanied by sandy soils ("Talsande"). Further geological formations like calcareous glacial marl or marly sand only occur on the fringes of the area.

Flora & vegetation

More than two thirds of the core area are covered by woodlands and younger and older forests. Open landscape can be found on 2.900 ha of land.

Nearly 69 % of the open landscape and 72 % of the river and lakes habitats can be considered as habitat types according to the Habitats directive. In the woodlands, their share is about 30 %.

The stable populations of the following species are of extraordinary significance:

Carex lepidocarpa
Cinclidium stygnum
Drosera langifolia
Helodium blandowii
Liparis loeselii
Paludella squarrosa
Potamogeton praelongus

Table 1: Distribution of the habitat types in the core area Kleine Schorfheide-Havel

Habitat type	Total area (ha)	Share of area (%)
Woodlands, forests, brushwood & bushes	**5.847,6**	**66,3**
Boggy and wet woods and bushes	500,1	5,7
Deciduous woodland	505,8	5,7
Coniferous woodland	29,2	0,3
"Halbforste" (mixture of forests and woodlands)	320,1	3,6
Deciduous and coniferous forests	3.842,4	43,6
Brushwood and bushes, rows of trees, groups of trees, avenues	41,1	0,5
Young woods and pioneer brushwood	597,8	6,8
Woody swamps	11,1	0,1
Open water areas	**185,2**	**2,1**
Vegetation of rivers and lakes	**217,0**	**2,5**
Lakes and rivers with floating plants	149,8	1,7
Reeds	67,2	0,8
Open landscape	**2.523,9**	**28,6**
Reeds (partly with sedges), vegetation of sources and brooks	277,4	3,2
Wet meadows, land with grass seeds, flood grassland, muddy river shores	222,5	2,5
Oligotrophic and xerophytic grassland (incl. heathlands)	1.700,5	19,3
Ruderal areas	233,6	2,6
Farm lands, areas with segetal plants, fallow land	88,8	1,0
Other habitat types	**41,4**	**0,5**
Sum	***8.815,1***	***100***

Fauna

In the course of making up a management plan for the area, a lot of species have been investigated. They give evidence of the extraordinary importance of this area for nature conservation. Table 2 provides an overview of endangered species, both according to regional and nation-wide Red Data Books and to Annex II of the Habitats directive.

The population of beavers should especially be mentioned. By building dams the 20 settlements have caused an area of water of a size of 120 ha to be dammed up.

Table 2: Species of the core area Kleine Schorfheide-Havel Nature Reserve being listed in German Red Data Books and Annex II of the Habitats directive

Group	Red Data Book Brandenburg			Red Data Book Germany			Annex II Habitats directive	Target species	Umbrella species
	1	2	3	1	2	3			
Mammals	3	1	6	1	1	5	2	2	2
Birds	14	17	24	6	10	14	25	53	29
Amphibians/reptils	4	6	7	2	5	5	3	15	10
Fish	(1)	3	2(2)		4(1)	4(2)	2(2)	3	3(1)
Diurnal butterflies	2	10	4		4	11	1	3	18
Nocturnal butterflies	9	12	44	2	13	32		(2)	(16)
Carabid beetles	1		2		5	9		22	1
Short-winged beetles	4	1	1	1		2		9	2
Araneae spiders	3	7	16	1	7	23		66	6
Grasshoppers	1	2	5		3	7		23	5
Xylobiontic beetles	2	14	72	13	54	86	1	13	14
Dragonflies	1	2	9	2	13	5	1	26	15
Molluscs	5	2	14	8	9	14	2	55	46
Caddis flies	2	1	3		1	3		2	

Further species of more than regional interest are as following:

Lutra lutra
Botaurus stellaris
Ciconia nigra
Falco peregrinus
Porzana parva
Cornella austriaca
Rhodeus sericeus amarus
Nehalinnia specinosa
Psophus stridulus
Lycaena dispar
Osmoderma eremita

According to the management plan, which was made up in the course of the nation-wide nature conservation programme, the following objectives are pursued:

- Preservation and development of water quality, structures and natural biocoenosis of lakes and rivers
- Stabilization of hydrological balance to preserve intact peat bogs
- Successive change of pine forests to deciduous forests
- Preservation of open sandy areas, dominated by *Corynephorus canescens*, and *Calluna* heathlands by goat and sheep grazing, mowing and prescribed burning
- Preparation of areas for visitors by removing remainders of ammunition

Imprint:
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July 2003