TRIAL AND DEVELOPMENT PROJECT

"SEMI-OPEN PASTURE LANDSCAPE HOELTIGBAUM"

1. INTRODUCTION

Dear readers,

low-intensity grazing systems over large areas are gaining more and more attention as an alternative concept for conservation management and land-utilisation in Germany. In the framework of conservation projects, compensatory measures or the rounding off of tenantry

land, grazing-systems are planned increasingly often, or are already established. In adjacent countries such as Denmark, Belgium and especially in the Netherlands, similar grazing-concepts have been successfully applied in nature conservation for years.

The approaches vary from concepts, concentrating on little to no human interference, following the idea of the "new wilderness", to management concepts which not only consider the demands of species-, biotope- and process-protection ("Prozessschutz"), but also include agricultural land-use and economic aspects.

The concept of "semi-open-pasture landscapes" represents the latter category. Great expectations have been placed in this concept, but does it really provide the key to solve the problems of species- and habitat-protection? Will the concept of "semi-open pasture landscape Hoeltigbaum" be successful? And which frame conditions have to be considered for livestock-husbandry in extensive grazing systems?

The trial and development project "semi-open pasture landscape Hoeltigbaum" is supported by the Federal Agency for Nature Conservation (Bundesamt für Naturschutz), cooperating with the regional states Hamburg and Schleswig-Holstein. For three years, they funded the model implementation of the concept of "semi-open-pasture-landscape" on a former military training site on the outskirts of Hamburg. The project goes hand-in-hand with scientific studies to document and assess the impacts of grazing on both nature conservation and economic factors. It's aim is to derive recommendations applicable to similar projects.

The brochure you have in hand is supposed to give an introduction to the concept of "semi-open-pasture-landscape" on the basis of our first experiences and results. The background of the project, it's aims and the grazing-management will be explained. The effects of grazing on habitats, vegetation structure and selected animal species are presented to the reader. Finally, the brochure lines out the future perspectives for the Hoeltigbaum area.

The results presented here may serve nature conservation authorities, non-governmental conservation groups, farmers, landscape-planning engineers and people involved in political decision-making. It may help those people to assess the demands which have to be met concerning basic conditions and implementation within the concept of "semi-open pasture landscapes". At the same time, the brochure is supposed to prompt further occupation within the field of "semi-open pasture landscapes" and to contribute to the recent discussion about new strategies in nature conservation.

2. Semi-open Pasture Landscapes

The Concept

The politically induced structural changes in agriculture as well as the decreasing sizes of military troops lead to abandoned, ecologically valuable open habitats, which are left un-utilised. From the point of view of species- and habitat-conservation, this is a problematic development, because the habitats in question are extremely important in terms of biological diversity. As an analysis of the red data books shows, many endangered species or species threatened by extinction are concentrated in low- to semi-intensively used agricultural areas. In addition, a considerable part of endangered native plant or animal species are found in former military training sites. The vegetation development starting after the sites have been abandoned usually includes the accumulation of litter, the increase of tall herbs and eventually bush encroachment. This does not offer a chance for many of the plants and animals in question to survive. This is due to changes in decisive habitat factors such as light conditions, temperature and food supply.

Traditionally applied methods of management and conservation are increasingly reaching their limits. Often, they do not yield the success expected, because of general environmental changes or because of problems met in implementing the methods. Furthermore, traditional methods often do not leave much space for natural dynamics in the development of habitats and species-communities. Furthermore, they are usually labour-intensive and cost-intensive. Due to reduced public spending and an increasing number of areas which have to be managed, the application of those measures will have to be restricted to selected areas in the long-term. Extensive low-intensity grazing can be considered as an alternative to conventional management measures. It is the most natural form of agricultural land-use and has been practised for thousands of years by large wild herbivores. Those grazing animals were natural elements of the landscape at that time, shaping all parts of the landscape including the forests.

Scientific studies in ancient wood-pastures, such as the "Borkener Paradies" in Lower Saxony or the "Bjergskov" in Denmark, have shown that grazed forests are of extraordinary importance for the conservation of species and habitats, and thus for the preservation of biological diversity.

Large-scale low-intensity grazing is the most natural form of land utilisation.

Figure 1: In the Danish nature reserve "Bjergskov", beeches develop short, compact shapes under the influence of grazing.

Figure 2: Danish forestry authorities have bred a kind of cattle by specific cross-breeding. Due to it's food preferences and its friendliness, the breed is particularly suitable for grazing in woodlands, which are also used for recreation.

Different kinds of grazing animals support a near natural diversity of habitat structures due to their different grazing preferences and browsing techniques. Apart from domestic animals such as cattle, horses, sheep, goats and pigs, wild animals like red deer or wild boar can be used in pasture land as well.

Low-intensity grazing supports the development of different habitats. In the process, vegetation development strongly depends on existing geomorphological conditions, soil-quality and hydrological conditions. Fixed boundaries of land utilisation disappear.

Depending on the environmental conditions and the composition of plant-species within an area, a tightly interlinked mosaic of a great variety of habitats can be formed, including open

habitats, woodland, shrubs and their respective transitional zones. Such a diverse landscape allows dynamic processes, but still forms a stable system.

Figure 3: Many native animal and plant species inhabit the transitional zones between wood habitats and open habitats.

The variety of habitats and landscape diversity are essential to groups of species, the local populations of which are threatened by changes of habitats or catastrophic events. The network of patchlike habitats in near natural extensive pasture landscapes allows the re-colonisation of habitats and thus the formation and maintenance of local plant and animal populations.

Figure 4: The Six-Spot Burnet (Zygaena filipendulae) occurs in small local populations in the area of the Hoeltigbaum. There is an exchange of individuums between the habitats of those populations.

The concept of "semi-open pasture landscapes" represents the most original and most natural way of land-utilisation: extensive, coherent parts of the landscape are grazed at low intensity throughout the year.

Grazing in Winter

The feeding behaviour of grazing animals during the winter period is particularly important for the development of habitats and the structural diversity of the landscape. Food supplies, which are rejected during the rest of the year, like areas of matted grass or stands of sedges (especially *Juncus effusus*) are grazed then. Trees and bushes are browsed as well, which effectively restrains shrub-encroachment.

Figure 5: During the autumn and winter period, cattle even browse the Soft Rush (Juncus effusus). The Juncus-populations are thus clearly thinned out and consequently die if they are flooded for a longer period.

The stocking-rate depends on the food-supply of a given grazing-site. To make sure that there is enough food throughout the year, the wintry food supply is taken for reference. Additional feeding is not intended and it only takes place for short periods in severe winters.

Calculating the stocking-rate according to the wintry food-supply leads to under-grazing in summer, which again results in a higher selectivity concerning the food intake of the animals. Thus a mosaic of patches, grazed at various intensities, develops, showing specific plant communities and structural qualities.

Expenses

The costs of grazing can be kept low if the animals are used for breeding and marketing. The grazing should be placed within the framework of an existing farm with mother-cow farming for meat production.

Given an appropriate management and suitable soil-conditions, all-year grazing provides decisive advantages in terms of business-management. Technical and financial efforts as well as the necessary input of labour are limited, because no stable-keeping and no

additional feeding is needed. Expenses for hay and for the cost of maintaining buildings as well as the amount of labour involved in feeding and mucking out are very low compared to stable-keeping. Any decrease in receipts, possibly caused by a lower weight-gain of the animals feeding on unfertilised conservation-sites, could presumably be compensated by taking advantage of agricultural government-premiums. Furthermore, the farmer gains a market advantage, because he can offer beef which is produced environmentally friendly and animal friendly.

All grazing projects produce a lot of costs at the beginning, when concepts have to be tested, installations have to be put up on the grazing-sites and herds have to be build up. Helping to balance those initial expenses, a clear reduction of costs compared to mechanical management measures is expected in the medium-term.

In the course of the "semi-open pasture landscape", land-utilisation can be controlled and variably applied. It can easily be combined with other forms of management such as an occasional regime of more intensive grazing or supplementary grazing by other herbivorous animals, as well as certain cultivation measures such as mowing or scrub removal.

The following aims are connected to the concept of "semi-open pasture landscapes":

Nature conservation objectives:

- Maintenance of open landscape elements, which provide habitats for many species of the European natural and cultural landscape. These include grasslands rich in species as well as dry grasslands and heathlands.
- Removing fixed boundaries between habitats in the compartmentalised landscape and developing broad transitional zones between wood-habitats and open habitats instead
- Creation of new pioneer habitats in wet as well as in dry areas
- Consideration of dynamic processes in terms of time as well as in terms of space according to the aims of process-protection ("Prozessschutz")

Business-management aims:

Integration of nature conservation oriented ways of agricultural management into existing farms to guarantee a long-term land-utilisation

Basic Conditions

For a successful implementation of "semi-open pasture landscapes" as a form of land utilisation that considers both the aims of nature-conservation and the interests of agriculture, certain demands concerning the basic conditions have to be fulfilled.

To rule out marginal effects, to guarantee sufficient habitat diversity and to suit the demands of business management, the **size of the grazing-site** must not fall below certain dimensions. The size of the herd - and thus of the grazing-site - constitutes a decisive factor in the viability of low-intensity mother-cow farming. To earn a positive income, the minimum number of cattle required is around 35 animals, this if the herd is integrated into an existing farm. The size of a grazing site thus has to cover at least 100 hectares even on fertile soils.

The kinds of habitats included in the grazing site are also important. There should be areas with mineral soils on which the animals can retreat in wet weather conditions. If the animals have to live on wet soils exclusively, health hazards are posed. Furthermore, the permanent disturbance of the vegetation layer on wet soils can lead to an unwelcome dispersion of the Soft Rush *Juncus effusus*. The result of this could be a change in competitive conditions soon followed by species impoverishment. In addition, in order to satisfy the year-long needs of the animals, the existence of seasonally changing food-supplies from different landscape elements throughout the grazing-site is recommendable.

The selection of a **suitable cattle breed** is an essential prerequisite for a winter grazing project. For example, the animals should be able to give birth without the help of a farmer or a veterinarian.

Furthermore, the animals should have an effective thermo-regulation and low energy requirements. They should be able to digest raw-fibrous fodder and should be endowed with a good health so that they will not suffer severe weight losses during the unfavourable weather- and feeding conditions in winter. Still, even robust cattle need possibilities for additional feeding during periods of extreme weather, for example when an icy layer exists atop a sheet of snow. In such cases, additional areas for harvesting hay or appropriate financial means as well as storage-facilities have to be available.

Figure 6: Scottish Highland cattle are considered a typical robust cattle breed. In their home country Scotland, they live in the open throughout the year.

The costs of **establishing a grazing system** depend on the size of the grazed area and the kind and number of animals employed. The initial investments should not be underestimated in the planning process.

Apart from building fences, drinking facilities which are protected from freezing usually have to be provided.

Figure 7: Cattle are capable of melting holes in thin layers of ice with their mouths and to slurp water from them. But in the course of this, the animals are in danger of breaking into the ice.

Furthermore, capturing facilities have to be installed to sort out the animals and to give them medical treatment. To carry out the necessary herd management, a temporary separation of at least one part of the grazing area has to be possible.

If the robustness of the animals still has to be increased by cross-breeding, an infrastructure is needed to care for the initial stock during the transitional phase.

As a prerequisite, the livestock owner needs to have the **necessary knowledge** about maternal-livestock-farming and has to have enough personnel at his hand to care for the animals. Even those animals living in a nearly wild fashion on huge grazing sites have to be regularly controlled. If the terrain is visually obscured, it is advisable to condition the animals to come to save time looking for them.

In marketing the animals, the farmer can usually gain higher proceeds than in conventional livestock farming because the meat can be labelled as an environmentally and animal

friendly product. Nevertheless, financial support by agricultural government premiums is still essential even in the production of eco-meat.

The establishment of extensive grazing systems usually means that the land will be used differently than it had been previously. If, for example, hiking trails or public areas are affected in the course of this, the project should be accompanied by intensive public relations work.

Legal handicaps have to be heeded. Grazing according to the concept of "semi-open pasture landscapes" is legally considered as proper agricultural land-use. Thus, the grazing animals underlie the current legal requirements for farming.

Figure 8: Calves have to be marked within seven days after birth.

According to nature conservation legislation, it is necessary to regulate the inclusion of legally protected biotopes beforehand. In most of the German regional states, special regulations are required, possibly followed by claims for compensation.

Many forestry authorities still object to the grazing of woodlands. In most cases, it is only allowed if combined with compensatory obligations. But more and more people realise that low-density grazing following the concept of "semi-open pasture landscapes" cannot be compared to the intensive previous form of forest utilisation which had led to the degradation of large woodland areas in Northern Germany up to the 19th century. As grazing of coppices or tree- and hedgerows shows, the function of those wood-habitats is always maintained under low-density grazing in a semi-open landscape rich in structures.

In Lower Saxony, woodland grazing with the purpose of establishing wood-pastures ("Hudewälder") is facilitated in the framework of special regulations by the state's forest legislation.

Aspects relevant for planning:

- dimension of grazing area
- landscape elements included in grazing area
- initial costs
- animal breeds
- livestock-farming
- public relations work

Legal aspects:

- obligatory marking of calves (§ 24 livestock trade law / "Viehverkehrsordnung")
- capturing of animals supposed to be slaughtered (up to now, shooting of livestock is not allowed or is only possible in the framework of case by case permissions)
- legal disposal of carcasses according to § 5 law on carcass disposal ("Tierkörperbeseitigungsgesetz")
- legally protected parts of a landscape and legally protected biotopes (§ 29 and § 30 of German Nature Conservation Law)

3. TRIAL AND DEVELOPMENT PROJECT "SEMI-OPEN PASTURE LANDSCAPE HOELTIGBAUM"

Associated Scientific Studies

At least for the north German lowlands, there is, up to now, no scientific following of "semi-open pasture landscapes", which could provide any long-term ecological and economic analysis. The Trial and Development Project "Semi-open Pasture Landscape Hoeltigbaum" was conceived to fill in this gap. The project works as a model for the development and testing of business management oriented management measures in extensive nature reserves.

In the framework of the scientific studies accompanying the project, the following parameters are being examined:

- feeding behaviour and fitness of the grazing animals *Figure 9*
- development of vegetation, soil morphology, landscape structure and zoologically relevant vegetation structure under the influence of grazing
- the population development of amphibians, birds, dragonflies, grasshoppers, spiders, stinging hymenopterans, night-flying lepidopterans and ground beetles *Figure 10, figure 11*

Figure 9: Selected grazing animals are equipped with a GPS reciever. Thus, detailed reports can be given about movements and activity patterns and about grazing sites and resting sites of the animals.

Figure 10: With the aid of live-catching light-traps and food baits, the existence of 274 species of night flying lepidopterans could be proved in the first three years of the study.

Figure 11: As an indicator species for the development of sites without or with poor vegetation, ground nesting fossorial wasps and wild bees are being examined.

The profitability in terms of business-management ensues from the following difference between proceeds and expenses:	
Proceeds:	**Expenses:**
• marketing of meet • mother-cow-, slaughter-, ox- and land-premiums according to European marketing-legislation • land-premiums for nature conservation by contracts	• human labour • technical equipment and vehicle expenditure • medical care / animal fodder • insurance premiums • slaughtering

The results of the associated scientific studies shall be used to develop strategies for the efficient implementation of alternative grazing systems applicable to other areas of Northern Germany. The comparison of the results with expenses in conventional livestock-farming and conventional conservation management, as well as the development of a business management model to analyse the economical potential of "semi-open pasture landscapes", is supposed to provide aid to decision making for farmers and conservation authorities in the planning process.

Implementation

Grazing started within the trial and development project "Semi-open Pasture Landscape Hoeltigbaum" in April 2002 on the former military training site "Hoeltigbaum" near Hamburg. The project area covers 220 hectares, which are divided into two grazing sites (40 and 180 hectares).

Cattle and sheep are applied as grazers due to their different browsing techniques.

The German Heath Sheep ("Heidschnucken") are owned by the nature conservation association "Verein Jordsand zum Schutze der Seevögel und der Natur e.V.". The breed is considered to be robust and undemanding.

Figure 12: "The worst of all kinds of sheep, with the blackish long hair of a shaggy spitz dog" feeds on "withered, wretched heather" throughout the year.

This is how Gerike describes the German Heath Scheep in 1804. Since then, the breed has been altered by specific breeding. The animals are taller and show twice as much weight as their predecessors. Their suitability for poor grasslands has remained.

The cattle belong to the Demeter (organic and anthroposophic) farm "Gut Wulfsdorf". It is aimed at establishing a robust mother cow herd. In the course of the project, Northern German red-on-white-ground cattle ("Rotbuntes Niederungsrind") are crossbred with

Galloways to elucidate the possibilities of building up a stock from an existing herd and to test if crossbreeds are suitable year-round grazing.

Figure 13: Crossbreeding the "red-on-white-ground" and "Galloway" cattle, the black colour and the absence of horns is dominantly passed on to the descendants.

Concerning the **equipment** on the grazing site, two wells and 12 kilometres of fence were set up, paid out of project funds. Sheds were built for the heath sheep, but the sheep only go there occasionally.

Figure 14: Cattle as well as sheep use trees and bushes as a protection against wind, precipitation and, most of all from the sun's rays.

The livestock owners erected a capturing-pen for the regular veterinary examinations and the capturing of animals.

Figure 15: The animals are treated against liver-flukes and other endo-parasites in spring. On this occasion, the cattle are weighed to document the weight gains and/or losses.

The livestock owners are in charge of **caring for the animals**. This can take some time if the animals cannot be spotted at once in the broken area. Since the cattle are not additionally fed and human contact is regular, but nevertheless not as close as with cattle in a cowshed, the crossbreeds born on the grazing site show an increasingly timid behaviour. During the winter months, cattle can usually be lured into the catching-pen with hay. But in summer, the herd may have to be driven by several people.

Figure 16: The heath sheep are conditioned to meet their caretakers and thus are lured quite easily. But capturing the herd is harder with the sheep as well.

The **stocking rate** is calculated according to the winter food supply. It can be calculated from the productivity of the vegetation and the extension of the grazing site. The soils on the Hoeltigbaum are predominantly a mixture of loam and sand, and in the soil-productivity-index reach an average of 32 points. Due to this classification, and considering the percentage of woodland area on the grazing site, a total stock of 100 LU (livestock-units = fully grown cattle) can be assumed under average weather conditions. For the first three years of grazing, the stocking-rate amounted to an average of 0,41 LU per hectare on the 180 hectares grazing site. Cattle composed eighty percent of the stock. The other part of the grazing site, covering 40 hectares, was grazed by an average of 0,28 LU per hectare. Due to the higher share of trees and bushes in this area, the percentage of heath sheep was adjusted to forty percent of the total stock.

Suckler-cow-farming according to the concept of "semi-open pasture landscapes" also requires **herd management measures**. The mating of cattle is controlled within the project, so that calves are not given birth to in a climatically unfavourable season. During the mating period in June/July, young female animals are separated from the mother-cow herd for about three months to prevent premature mating. The calves are weaned from their mothers in November/December. For the red-on-white-ground mother cows, the wintry grazing is still a strain if they have had a suckling calf the previous year and are already pregnant again at the start of winter. To rule out any damage to the animals they were additionally fed with hay for four weeks during each of the first winter periods.

The net product of livestock farming is achieved by marketing oxen. Apart from this, the farmer applies for suckler-cow-, slaughter-, oxen- and land-premiums (nature conservation by contracts and extensification premium according to European marketing law). The meat of the slaughtered animals is sold in the farmer's food shop as ecologically produced meat according to the European standard EWG 2029/91. The net weight of the first two and a half year old oxen reached an average of 255 kg. Marketing the heath sheep is done by selling them to other sheep farms. In the long term, the aim is to market the sheep meat as ecologically produced meat as well.

Life in the Open

In the Hoeltigbaum area, livestock farming follows traditional techniques. Instead of living in technically, highly equipped feeding or milking stables, the cattle – as well as the sheep – in the Hoeltigbaum area live in herds in the pasture. And because of the great structural diversity of the grazing areas and the low-intensity management, the animals can follow their natural patterns of behaviour.

The mother cows follow their instinct to segregate themselves from the herd and to retreat to coppices and bushes for protection while giving birth. For the first days after the calves are born, they hide them in areas of high vegetation while taking up food themselves. As a consequence, it is no easy task for the farmer to control the births and to mark the calves.

Figure 17: The young calves are hardly visible in the high standing vegetation.

The cattle live in a functioning extended family. As soon as the calves have reached a certain degree of maturity, they are looked after by two or three females – usually without calves - in a kind of "kindergarten" during the mothers' feeding periods.

An similar caring for the young is also observed among the heath sheep. But before that, the mother sheep and their lambs segregate themselves from the herd for several days. This is the time needed by a mother sheep and its lamb to establish a relationship via smell and voice which is necessary for their mutual identification.

Growing cattle show a specific social behaviour as well. Playful fighting for example mainly takes place between young bulls or oxen. The female animals apparently prefer to indulge in mutual personal hygiene. Furthermore, it seems that deeper relationships between the sexes can be found among cattle, too.

Figure 18: Measuring their power as well as playful mounting is an inherited behaviour of young oxen.

Figure 19: Mutual personal hygiene by licking of head and throat is mainly observed among female animals.

The daily routine of the animals is strongly correlated with light intensity. In the morning hours, the cattle first look for a place to drink via long cow trails. The following feeding- and

regurgitating-phases are interrupted depending on temperature, sun intensity and food supply for one to five hours. During the heat at mid-day or during their nightly resting periods, they stay in places protected by trees and bushes. In the course of this, their chosen place to sleep is always shifted each time by a few meters.

Figure 20: Seven days in the life of a cattle herd. The blue line marks the movements of the herd in the snow covered Hoeltigbaum area around the turn of the year 2002/2003. There are points of increased movement at small ponds and at a feeding-point in the north. There is a remarkably quick movement on New Years Eve (long distance in the middle of the area), when the animals covered a distance of nearly 800 meters between midnight and five minutes past midnight.

The Organisation Structure

The trial and development project "Semi-open Pasture Landscape Hoeltigbaum" is implemented in close cooperation between different institutions and authorities.

The Local Authority of Siek ("Amt Siek") in Schleswig-Holstein and the Authorities for Environmental and Health Issues of the Free and Hanseatic Town Hamburg ("Behörde für Umwelt und Gesundheit der Freien und Hansestadt Hamburg") put **land** at the project's disposal.

Supporters of the main project carrying out the co-ordination with the livestock owners, the public relations work, and the organisation of infrastructure, are the Foundation for Nature Conservation Schleswig Holstein ("Stiftung Naturschutz Schleswig-Holstein"), the District of Storman ("Kreis Storman") and the Foundation for Nature Conservation Hamburg ("Stiftung Naturschutz Hamburg"). The Schleswig-Holstein Nature Conservation Foundation implements the project.

The **financing** of the main project was granted for a period of five years (15th of August 1999 to 30th of June 2004) by financial contributions of the Federal Agency for Nature Conservation ("Bundesamt für Naturschutz") out of funds from the Federal Ministry for Environment, Nature Conservation and Safety of Nuclear Power-Plants ("Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit"). The project is further supported by the Foundation for the Support of Northern Germany ("Förderungsfond Nord"); out of funds from the regional states Schleswig-Holstein and Hamburg; from the Authorities for Environmental and Health Issues of the Free and Hanseatic Town Hamburg; and out of funds from the Schleswig-Holstein Nature Conservation Foundation.

The Institute for Landscape Ecology and Nature Conservation of Lueneburg University ("Institut für Landschaftsökologie und Naturschutz der Universität Lüneburg") has been commissioned to carry out the **associated scientific studies**. Those studies took place in cooperation with the Kiel Institute for Landscape Ecology ("Kieler Institut für Landschaftsökologie") and are financed over a period of five years as well, until the 31st of January 2005, by the Federal Agency for Nature Conservation out of funds from the Federal Ministry for the Environment, Nature Conservation and Safety of Nuclear Power-Plants.

The people who work on the project receive **specialist support** by the Federal Agency for Nature Conservation, the Authority for Nature and Environment of Schleswig-Holstein ("Landesamt für Natur und Umwelt Schleswig-Holstein") and the Authorities for Environmental and Health Issues of the Free and Hanseatic Town Hamburg.

4. INTERIM BALANCE OF NATURE CONSERVATION

Initial Situation and Development of the Project Area Under the Influence of Military Use

The site of the trial and development project is located within the nature reserve "Hoeltigbaum", which covers 550 hectares in the north-east of Hamburg. The area is divided by the border separating the regional states Hamburg and Schleswig-Holstein. The landscape is formed by geomorphological elements dated from the ice-age, like sandy hills called "drumlins" with their narrow, parallel running valleys and their even plateaus. The soils are mainly composed of a mixture of loam and sand. Small patches of pure sand and drained mud swamp peat are scattered over the area. Throughout the mainly dry sites there are many permanent or temporary small ponds and waterways.

Following a former agricultural utilisation, the Hoeltigbaum was turned into a military training site of the German Federal Armed Forces in 1958. Military vehicles drove around the area leaving behind large patches of bare soil with characteristic pioneer communities of plants and animals.

Figure 21: Tank exercises and other vehicles kept the loamy-sandy slopes free from vegetaion.

Those areas excluded from vehicle exercises were used as low-intensity land without or with little fertilisation, for example for guarded sheep grazing. A spatially diverse mosaic of different habitats developed including various successional stages like bare soil, grasslands, fringe communities and some trees and bushes. The main part of that habitat complex was

poor in nutrients and was shaped by periodical disturbances thus providing space for the retreat and development of many endangered species.

The military utilisation of the Hoeltigbaum area was abandoned in 1995. Due to its nature conservation value and its high potential for development, the area has been turned into a nature reserve. The Schleswig-Holstein part was put under legal protection in 1997, the Hamburg part in 1998.

The abandonment of land-use led to a change in the scenery: protosoil patches without any plant cover were turned into grasslands and thus disappeared. Shrubs and coppices developed in different parts of the area. Since loamy sands are the predominant soil types, the productive force of the soil is strong enough to induce an accumulation of a high amount of biomass within a few years without further fertilisation. Pioneer species and less competitive, light-loving plants were deprived of their possibilities to develop. In the medium term, a loss of habitat diversity and characteristic species groups was to be expected.

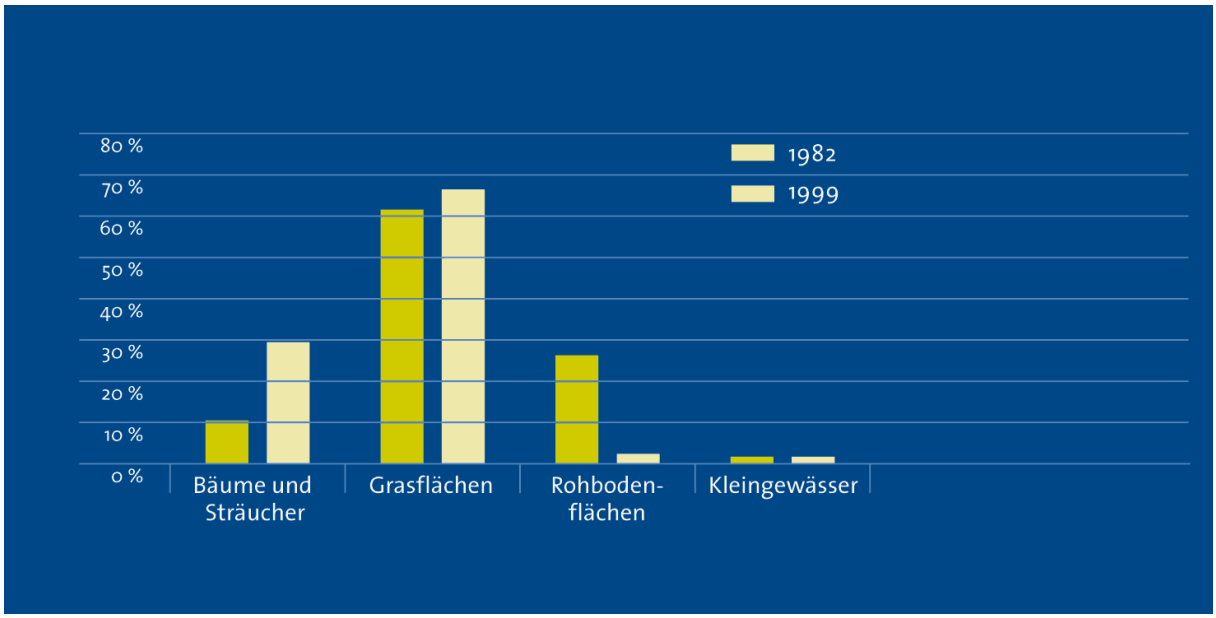

Diagram: Changes in structural patterns of the nature reserve Hoeltigbaum between the years 1982 and 1999 (Hamburg part of the area, square dimension about 40 hectares)

Based on those circumstances, a management scheme for the maintenance of the countryside was developed. A grazing system according to the concept of "semi-open pasture landscapes" should help to restore or maintain the historically and ecologically important landscape. To meet the demands of habitat continuity, this had to include large scale and long-term measures.

The Impact of Grazing on Landscape Development

Grazing has been practised for three years now in the Hoeltigbaum area and a clear impact has already been shown. Feeding and trampling of sheep and cattle has an effect on the development of different habitats as well as on the species composition and structural quality of vegetation. Those effects are increased by the individual differences in the grazing behaviour of different animals.

Depending on differences in the parameters of the site, different grazing intensities can be observed. In the preferentially grazed areas such as moist sites rich in nutrients, a low vegetation layer is formed. On other sites usually rejected by the animals or only grazed in times of food shortage, vegetation grows tall and is encroached by fringe species or shrubs.

Figure 22: Special food preferences and permanent migrating movement of sheep and cattle during their grazing lead to the establishment of feeding patterns in the vegetation layer.

The periodical use of habitats promotes dynamic processes: The extension and composition of plant communities are changed, vegetation development is suspended and small pioneer habitats are established. Thus a long-term survival is made possible for animal and plant species depending on early successional stages. At the same time, grazing provides a stable system of habitats due to the permanent restoration of different stages of development.

Pioneer Habitats

Pioneer habitats are extremely endangered within the complex mosaic of habitats in the Hoeltigbaum area. They were created by intensive disturbances during military exercises. Those habitats are characterised by the predominant absence of vegetation and thus the absence of competition.

Especially on dry sites, the microclimate is changed if the rate of vegetation cover decreases. Light intensity increases near the soil surface. Thermal insulation and radiation show an increased fluctuation and the soil is prone to quick and long-lasting drying out.

Species of low competitive capacity adapted to mechanical disturbances colonise such sites. If, in addition, the sites are poor in nutrients, they can provide habitats for plant and animal species whose primary habitats have been widely destroyed.

Pioneer habitats can only persist under recurrent soil disturbances. With the cessation of those disturbances, perennial tall growing species gain competitive advantages. A closed plant cover will then be re-established.

A similar development took place in the area of the Hoeltigbaum after the cessation of military utilisation. Pioneer habitats without vegetation can thus only be found as isolated, small patches today.

The succession processes which took place since the abandonment of the Hoeltigbaum area cannot be reversed by grazing. Cattle and sheep cannot substitute tanks. But they can slow down the development or even stop it in some places. Trampling with their hooves they produce little open patches of footprints on wet and dry sites.

Spots of dry, bare soil such as horizontal or vertical soil banks are of high functional importance for soil-breeding insects like wild bees or various groups of wasps. The occurrence of rare and endangered species in the Hoeltigbaum area will mainly depend upon the availability of bare soil patches as nesting sites maintained or created by the grazing animals. The species in question include the burrowing wasp species *Mimesa bicolor* and *Miscophus concolor*, the anthophorid bee *Anthophora aestivalis*, the *Nomada* species *Nomada fuscicornis* and *Nomada similis* and the halictid bee *Lassioglossum xanthopus*. Vegetation-free areas also fulfil a key function for the extraordinarily large nesting

aggregations of aculeate Hymenoptera, for example of the sand bee *Andrea vaga* or bees of the genus *Panurgus*, *Panurgus calcaratus and Panurgus banksianus*, which can be observed in the Hoeltigbaum area.

Dry pioneer habitats in the Hoeltigbaum area are of major importance for soil-breeding species of bees and wasps.

Patches of bare soil constitute important nesting sites for sand bees like **Andrena vaga**. *Thousands of them are nesting in appropriate areas in the Hœltigbaum area.*

Among the large nesting aggregations of wild bees and burrowing wasps, many parasitic aculeate Hymenoptera like the chrysidid wasp **Hedychrum nobile** *can be found as well.*

The nesting habitats often also fulfil the function of a mating place, where the freshly hatched females immediately met by waiting males.

The open soil areas are also important as hunting habitats. For instance, burrowing wasps of the genus Tachysphex *capture grasshopper larvae, and spider wasps as the depicted* **Anoplius viaticus** *hunt for spiders.*

While the creation of open soil patches requires a relatively high disturbance intensity on dry sites, wet soils are much easier laid bare by trampling. The seeds of various plant species are uncovered and are given the possibility to germinate in footprints on moist to wet pioneer habitats along small ponds or pools or on wet pasture.

*Figure 24: The highly endangered Ivy-Leafed Crowfoot (*Ranunculus hederaceus*) grows in extensive layers in the marginal area of a small pond nurtured by spring water. Providing low competitive capacity, this species only occurred after grazing had started. It is dependent on open, sunny patches of soil in spring areas. Those patches are created by trampling of the herbivores.*

*Figure 25: At first, the Bristle Club Rush (*Isolepis setacea*) was only found in one site in a lane with alternating humidity. The little plant has since colonised many sites along the banks of water bodies kept open by cattle but not too intensively trampled.*

Water Purslane (*Peplis portula*), a highly endangered plant species in the region of Hamburg and Schleswig-Holstein, could initially only be found at the banks of very few water habitats. Since then, it has colonised the banks of virtually every pond or pool in large numbers.

Figure 23 a-c: The highly endangered weevil Nanophyes globulosus *depends on stands of Water Purslane located above water level (top figure). It's larvae develop in the seed capsules 2 mm in size (figure in the middle). The beetle, which only measures 1.7 mm, can be detected by characteristic feeding patterns on the leaves of the plants (bottom figure).*

This rare plant serves as the habitat of two monophagous weevil species which are major rarities of the cultural landscape. The two species *Nanophyes globulosus* and *Pelenomus olssoni* count as highly endangered in reference to Germany and as threatened by extinction in reference to Schleswig-Holstein. The most important populations of those species within Northern Germany are found in the Hoeltigbaum area.

Small Ponds and Watercourses

About 40 small bodies of water can be found in surface depressions, hollows and valleys of the Hoeltigbaum area. Most of them have temporary water levels depending on precipitation. Depending on weather conditions, the number of ponds and pools strongly varies over the years. Only four ponds cover an area of 500 to 1000 m^2 and hold water throughout the year at levels of 60 centimetres.

Most of the waterbodies have been reshaped due to military exercising, thus remaining in an early successional stage. Even several years after the military exercises had ceeded, pioneer stages with poor vegetation, sparse flooded grasslands, small reeds and stands of sedges were still the dominant vegetation of the ponds and pools, predominantly poor in nutrients. Only those stretches of water excluded from military use showed advanced successional stages. Willows and alder scrubs have now developed on some stretches of banks.

Figure 26: Small ponds are usually endangered of swift silting due to the establishment of vegetation stands and litter. Grazing stops that development.

The development of ecologically valuable bodies of water on pasture landscapes is of particular significance, because the grazing animals have free access to banks and water for **drinking and grazing**.

The juxtaposition of plants with different nutrient requirements is, of course, influenced by the nutrient conditions, but the decisive factors are frequency and manner of soil disturbances.

Figure 27: The nutrient input caused by the animals is put into vegetation growth and, according to the type of waterbody, is removed again when the plants are grazed during the drying out periods.

The browsing of Flote-Grass reeds and stands of rushes and sedges as well as the trampling of banks since has led to the development of a heterogeneous plant cover rich in structures with singular patches of exposed soil. Species of dwarf sedges accommodated to pioneer habitats, herbs with low competitive capacity as the Marsh Speedwell (*Veronica scutellata*) or Water-Starwort species can exist in those areas.

The **attractiveness of a stretch of water** for the grazing animals mainly depends on the respective water level. Both dried-out pools and very deep bodies of water are of no interest. Shallow waters are preferentially visited. In the course of grazing, cattle usually follow the shoreline, which recedes towards the middle of the waterbody during the period of drying out in summer. In more deeply located areas, plants can thus develop more or less undisturbed up to their ripening stage, whereas an increased occurrence of pioneer species is shown at the banks and outer areas of the ponds.

Most of the small ponds and watercourses have clear water and accommodate a diverse vegetation of submerged plants composed of Bryophytina-mosses, Water-Starwort or small reed species such as the endangered Orange Foxtail (*Alopecurus aequalis*).

In some places, plants indicating a rich nutrient supply such as the Fine-Leaved Water Dropwort (*Oenanthe aquatica*), Flote-Grass (*Glyceria fluitans*) and Common Duckweed (*Lemna minor*) have managed to spread. But at the same time, species indicating poor sites are extending their stands in the same areas. Water Purslane (*Peplis portula*), Bristle Club-Rush (*Isolepis setacea*) or Marsh Cinquefoil (*Potentilla palustris*), which can only persist in progressing succession on sites of poor nutrient conditions, profit from the reoccurring disturbances.

According to the predominant site conditions, formerly similar types of watered areas develop quite differently under the influence of grazing. Both the diversity of the singular ponds or pools and the overall diversity of bodies of water increased. No other habitat in the area accommodates a comparably high variety of particularly specialised and endangered **animal species** as the small bodies of water.

Among the dragonflies, ground beetles, aquatic beetles and weevils observed, 9 dragonfly species and 37 species of beetles were recorded in the German Red Data Books.

NAME OF SPECIES	FAMILY	RED DATA BOOK	
Beetles		Germany	Schleswig-Holstein
Agonum versutum	ground beetle	2	3
Agonum viridicupreum	ground beetle	3	1
Anthracus consputus	ground beetle	3	3
Blethisa multipunctatus	ground beetle	2	2
Chlaenius nigricornis	ground beetle	V	3
Chlaenius tristis	ground beetle	2	1
Pterostichus gracilis	ground beetle	3	3
Hygrobia tarda	aquatic beetle	3	1
Agabus labiatus	water beetle	2	2
Hydroporus rufifrons	water beetle	2	1

Rhantus bistriatus	water beetle	3	R
Berosus signaticollis	aquatic beetle	-	1
Bagous lutulosus	weevil	3	1
*Nanophyes globulus**	weevil	2	1
Pelenomus olssoni	weevil	2	1

Dragonflies			
Aeschna juncea	Common Hawker	3	3
Coenagrion lululatum	(no English name available)	2	2
Ischnura pumilio	Scarce Blue-Tailed Damselfly	3	3
Lestes barbarus	Shy Emerald Damselfly	2	R
Sympetrum striolatum	Common Darter	-	2

*) Exclusive: The only known population in Schleswig-Holstein and Hamburg north of the Elbe river.

Due to fact that many ponds and pools do not permanently bear water, the abundance of dragonflies in the Hoeltigbaum area highly deviates from one year to the other. However, it is exactly the shallow and quickly warming waters in particular that are colonised by endangered habitat specialists. Among them are thermophilous species of southern dispersal such as the Common Darter (*Sympetrum striolatum*) or pioneer species such as the Scarce Blue-Tailed Damselfly (*Ischnura pumilio*) and the Shy Emerald Damselfly (*Lestes barbarus*). They are adapted to the drying-up by their developmental biology and they profit from the scarce aquatic vegetation of early successional stages.

Figure 28: The endangered Scarce Blue-Tailed Damselfly (Ishnura pumilio) colonises bodies of water with poor nutrient conditions and sparse vegetation composed of small reeds. The establishment of tall reeds is prevented by the periodical drying-up and by grazing of aquatic vegetation.

Figure 29: The Shy Emerald Damselfly (Lestes barbatus) is highly endangered in Germany. It mainly lives near mesotrophic bodies of water which dry up in summer, characterised by sparse small reeds and thin flooded grasslands.

*Figure 30: Species with a fast larva development are excellently adapted to drying-up bodies of water. The development of the larvae of the Spotted Darter (*Sympetrum flaveolum*) is additionally accelerated by rising water temperatures.*

Among the group of aquatic or water beetles, 68 species live in the different types of water areas. In several pools, extremely rare species with high ecological requirements concerning the quality of water can be found. The water beetles *Agabus labiatus* and *Hydroporus rufifrons* are characteristic species for temporary bodies of water poor in nutrients in moist heaths and flooded areas.

Figure 31: The formerly widely spread weevil Hydroporus rufifrons *is threatened by extinction in Northern Germany. One of its last populations lives in the Hoeltigbaum area.*

The breeding waters are characterised by sparse *Eleocharis*-reeds and a dense, submerged vegetation of Water-Starwort, Water Purslane and the moss *Drepanocladus aduncus*.

Figure 32: The aquatic beetle species Hygrobia tarda *was presumed missing in the area of Schleswig-Holstein for about a hundred Years. Not until 1996 was it rediscovered. The photo depicts the larva.*

Grazed banks give rise to habitat structures, suiting the ecological requirements of a variety of **ground beetles** in terms of moistness, shading and substrate qualities. Both the muddy clay banks and the densely grown rush-reed areas are colonised by specific, often endangered species, partly with high abundance.

Many ground beetles living on water-banks show adaptations to a periodical drying-up of bodies of water. Among those adaptations are the flying capability of adult animals and the toleration of flooding by their larvae. A remarkable variety of species could be proved up to now: over 60 species of ground beetles live on the water-banks and thus compose the ground beetle community with the greatest number of species in the Hoeltigbaum area. Many of the species are recorded in the Red Data Books, for example the species *Blethisa multipunctata*, which lives in flooded grasslands and small reeds. Other species like *Agonum versutum* or *Anthracus consputus* occur in the transitional zones between densely grown, half-shady stretches of banks.

Figure 33: The ground beetle Agonum viridicuperum *was presumed missing for the area of Schleswig-Holstein and Hamburg since 1890. Now it has been detected in the Hœltigbaum area and in two other sites in Schleswig-Holstein.*

Figure 34: The ground beetle Agonum sexpunctatum*, a rare species of open sunny banks, occurs in very large populations.*

*Figure 35: Females of the nation-wide endangered Short-Winged Conehead (*Conoceohalus dorsalis*) lay their eggs into the stems of rushes. Even though a large share of the rushes is browsed by cattle in winter, the Short-Winged Conehead reaches high densities in rush-reeds.*

The banks of small stretches of water also accommodate several species of **spiders** adapted to humid, open habitats. Some of them are counted as endangered either in the area of Schleswig-Holstein or in Germany. The wolf spiders *Pardosa paludicola* and *Arctosa leopardus* were found in each of the three years of research and reached relatively high densities.

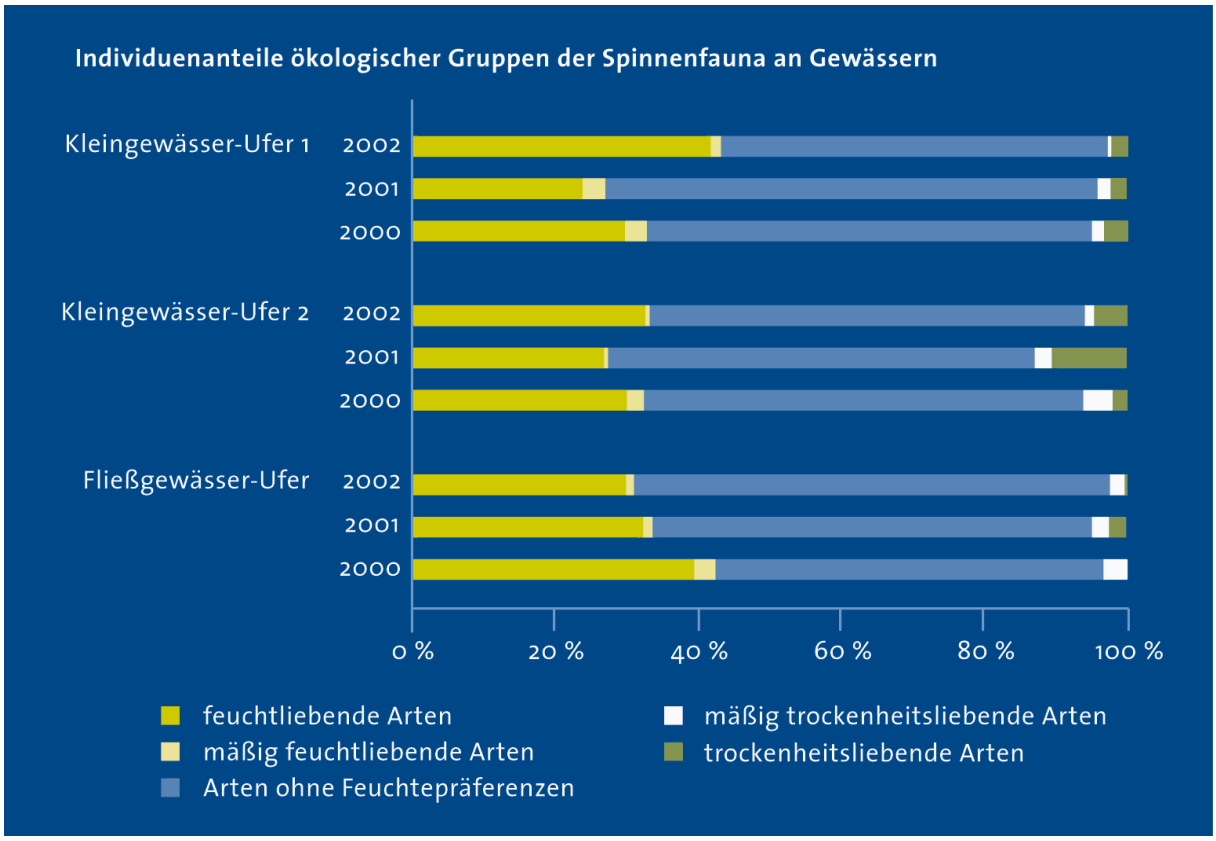

Diagram: Abundance of ecological groups of Spider in water-habitats (percentage of total number of individuums)

Amphibians were able to reproduce in about 35 bodies of water throughout the project area. Their occurrence is concentrated in ten larger shallow waters each covering an area of up to 1000 square metres and bearing water for a sufficient period during the summer months. Concerning the other bodies of water, the abundance of spawn and the actual reproductive success vary greatly from year to year. However, those spawning grounds are still very important to the overall stand of amphibians.

The stands of all of the five species of amphibians in the Hoeltigbaum area have clearly been increasing since grazing started. The species in question are the Crested Newt (*Triturus cristatus*), the Smooth Newt (*Triturus vulgaris*), the Common Toad (*Bufo bufo*), the Common Frog (*Rana temporaria*) and the Moor Frog (*Rana arvalis*). The increase of the repoducing population can be recorded by counting the number of spawn clutches of Common and Moor Frogs ("Brown Frogs").

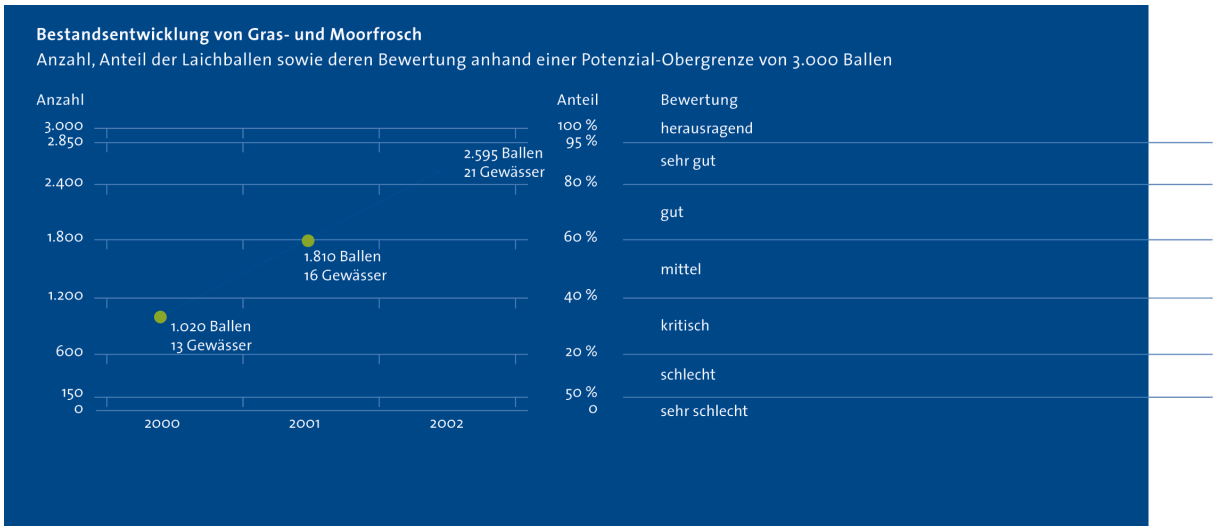

Diagram: Development of Common Frog and Moor Frog stands. Total number and percentage of spawn clutches and their assessment according to an upper limit of capacity of 3.000 bales.

According to the theoretically derived upper capacity limit of 3000 spawn clutches throughout 35 optimally developed and colonised spawning grounds. The spawning stand of "Brown Frogs" has risen from a critical level at the start of the grazing project towards a very good level within only two years. The excellent development of the stands becomes obvious with thousands of young frogs and toads to be found throughout the entire grazed summer habitat including wood habitats, fringe communities and poor grasslands.

*Figure 36: The endangered **Crested Newt** (*Triturus cristatus*) first only reproduced in five bodies of water. After two years it had already reproduced in 13 spawning grounds, and in the year 2002 several thousands of young newts were counted.*

Apart from favourable weather conditions, the development of amphibians is traced down to the impact of grazing on the structural qualities of the entire grazed area and of ponds and pools in particular. Concerning the Common Frog and Moor Frog, a further increase of stands is hardly possible any more. But the habitat complex provides the potential for the immigration of further amphibian species such as Edible Frog (*Rana esculenta*), Common Tree Frog (*Hyla arborea*) and Common Spadefoot (*Pelobates fuscus*).

In the course of the positive development of amphibian populations, the Grass Snake (*Natrix natrix*) spread throughout the Hoeltigbaum area as well. The occurrence of the second specie of **reptiles**, the Common Lizard (*Lancerta vivipara*), rather reflects the development of the entire terrestrial summer habitat. Both species have extended their colonies to the entire pasture land and are clearly encountered more frequently than at the start of the grazing project.

*Figure 37: Both grown up and juvenile **Grass Snakes** can be observed sun-bathing on banks or hunting in the waters.*

Flowing Waters

Over a stretch of about 500 metres, the grazing area is cut through by a temporary, straightened waterway called the Wandse. The spring of the Wandse was built over several

years ago. The water was deviated so that the stream is now only supplied by precipitation water from the adjacent areas. As a rule it dries up from May on.

Before grazing started, tall grown vegetation of ruderal plants and perennial herbs and a dense layer of litter were typical throughout the banks and lowland areas. Along the moderately steep, 50 to 100 cm high embankments riparian species and reed species were found. Lowland areas accommodated fallow stands of moist pasture with Tufted Hair Grass (*Deschampsia caespitosa*) or Soft Rush (*Juncus effusus*). Higher areas were dominated by dry ruderal communities including Creeping Thistle (*Cirsium arvense*), Common Nettle (*Urtica dioica*) and Bush-Grass (*Calamagrostis epigejos*).

Cattle show clear preferences to stay and to graze in humid areas, whereas the sheep would rather graze on dry sites. The stream Wandse is used for drinking and in the dry season as a cow-trail. During the grazing project, the small stream overflowed its banks repeatedly. Near fords and trampled bank stretches, plunge pools developed and a few shallow hollows were flooded. As a consequence of grazing, the stream has clearly become more rich in structures, meandering minutely and at various speeds of flow in different depths of water.

Several plant species characterising wet meadow communities such as Meadowsweet (*Filipendula ulmaria*), Large Bird's-Foot-Trefoil (*Lotus uliginosus*), Common Water Forget-Me-Not (*Myosotis palustris*), Sneezewort (*Achillea ptarmica*) and Lesser Spearwort (*Ranunculus flammula*) have spread along the banks. Browsing and trampling by the animals led to a reduction of litter and to a heterogeneous development of vegetation. The share of herbs increased throughout the ruderal communities. During the second year, the thistle stands have clearly been reduced as well.

Figure 38: At the time of spring 2000, the long-term research site on the Wandse flats shows a high density of litter.

Figure 39: Already in spring 2002, the effect of browsing and grazing is clearly visible: Dead Bush-Grass and Tufted Hair-Grass litter has been removed to a great extend.

Figure 40: In periods of low water levels, as in autumn 2002, thinned-out banks rich in structures are exposed.

The soil insect fauna reacts to the changed habitat conditions. The species composition of **ground beetles** shifted, presumably caused primarily by the removal of litter and the increased richness of structures. The shift was to the advantage of an increasing number of typical wet meadow species and water-bank species. The typical water-bank species *Agonum marginatum*, *Argonum versutum* and *Anthracus consputus* could be proved for the first time during the third year of grazing.

Dry Oligotrophic Grasslands and Heaths

After the cessation of soil disturbances by military vehicles, Small-Hair-Gras-communities developed in large parts of the loamy-sandy pioneer sites. Those plant communities represent an early stage in the development of ologotrophic grasslands composed of usually rare and endangered species with low competitive capacity. They depend on regular soil disturbances to prevent the immigration of species with higher competitive capacities.

Figure 41: Remnants of the Smaal-Hair-Grass communities can still be found on the sides or atop dry, sandy slopes throughout the area. Due to intensive disturbances by tanks and the dry soil poor in nutrients, only a thin layer of humus could develop on those sites.

According to the respective soil conditions, dry oligotrophic grasslands are shaped by the Early Hair-Grass (*Aira preacox*), The Silver Hair-Grass (*Aira caryophyllea*) or dominant stands of the Mouse-Ear-Hawkweed (*Hieracium pilosella*). Annual, early flowering herbs like the Small Cudweed (*Filago minima*) or the Common Bird's Foot (*Ornithopus perpusillus*), as well

as annual grass species such as the Squirrel-Tail Fescue (*Vulpia bromoides*) are also typical for those communities. The wealth of blossoms on those dry oligotrophic grasslands represents an important basis for the nutrition of many insect species.

Low-intensity grazing cannot totally stop the successional process on dry oligotrophic grasslands. In some places, the extensive Cudweed communities are invaded by species of trampling-resistant communities or moderate grasslands. On the other hand, stands of the Mouse-Ear-Hawkweed (*Hieracium pilosella*) are extending on other sites. Species of Small-Hair-Grass communities also colonise the repeatedly trampled edges of cow-trails. Starting from there, they spread into the adjacent grasslands. In this way, grazing maintains existing dry oligotrophic grasslands and creates new habitats, thus securing the present populations of oligotrophic grassland species including endangered species in the area.

The colonisation of such sites by terricolous invertebrates is influenced by extreme microclimatic conditions such as strongly varying soil and air temperatures in summer and temporarily extremely low soil and air humidity. Those habitats are inhabited by a highly adapted community of ground beetles. Concerning the population development of specific species, a positive tendency can be observed since the start of grazing. Even endangered graund beetles of the genus *Amara*, among them *Amara praetermissa* and *Amara equestris*, and various species of the genus *Calathus* form large populations. In areas already colonised by birches before the start of grazing and thus showing more even microclimatic conditions, the share of species adapted to warmth and dryness compared to less specialised species is much smaller.

*Figure 42: The Common Tiger Beetle (*Cicindela campestris*) lives throughout the Hoeltigbaum area in large populations.*

SELECTION OF NIGHT-FLYING LEPIDOPTERANS PROVED IN THE AREA			
Species name	**English name**	**Habitat**	**Vulnerability status Schleswig-Holstein Red Data Book**
Aetheria bicolorata	(no Engl. name available)	Lactuca, Leontodon	3
Apamea furva	(no Engl. name available)	Grass species Festuca rubra, F. ovina	3
Calamia tridens	Burren Green	Grass species Festuca, Agrostis	3
Mesoligia literosa	Rosy Minor	Grass species Festuca, Agrostis	V

The sparse, lacunar oligotrophic grasslands are also of particular significance for xerophylic species of **spiders**. The clubionid spider *Cheiracanthium virescens* and several endangered species belonging to the groups of wolf-spiders and gnaphosid spiders have been found. Typical wolf-spiders such as *Alopecosa cuneata* and *Xerolycosa miniata* occur in high densities on some sites.

Among the 274 species of **night-flying lepidopterans**, several rare and endangered species are found in the oligotrophic grasslands. The Burren Green (*Calamia tridens*), the Rosy Minor (*Mesoligia literosa*) and the species *Apamea furva* carry out their larval development on grass species in dry oligotrophic grasslands. The lepidopterans thereby prefer particularly dry standing, solitary tussocks of the Red Fescue (*Festuca rubra*) or very sparse grasslands.

Figure 43: Caterpillars of the species Aetheria bicolorata *develop in the blossoms of smally ellow composite flowers (Asteraceae), for example the genus* Lactuca*, feeding first on the flower heads, later on leaves and stems as well.*

The thermophilous Stripe-Winged Grasshopper (*Stenobothrus lineatus*) is a representative species of dry oligotrophic grasslands. Formerly widely spread in Northern Germany, its occurrence has decreased to about 30, mainly isolated populations due to the decrease of heaths and dry oligotrophic grasslands. At the beginning of the project, only a remnant population very poor in numbers existed in the Hoeltigbaum area, too. However, as the mosaic of oligotrophic grasslands further provides suitable habitats for the Stripe-Winged Grasshopper again, a further extension of this species is to be expected.

*Figure 44: After three years of grazing, the Stripe-Winged Grasshopper (*Stenobothrus lineatus*) has colonised several sites in the Hoeltigbaum area.*

For **wild bees** and various families of **wasps**, the dry oligotrophic grasslands are an optimal feeding habitat because of their wealth of blossoms. Furthermore, the stinging Hymenoptera can find nesting grounds in those sparse habitats or in adjacent pioneer ones. For typical species of wild bees, favourable possibilities of development can be expected.

Species of **dwarf shrub heaths** are scattered throughout loamier sites of the grasslands, for example the Common Heather (*Calluna vulgaris*), the Petty Whin (*Genista anglica*), the Dyer's Greenweed (*Genista tinctoria*) and the Hairy Greenweed (*Genista pilosa*).

Figure 45: Clay heaths ("Lehmheiden") or grassland heaths ("Grasheiden") represented a typical type of vegetation in Schleswig-Holstein at the beginning of the 20th century. They developed from grazing and were later pushed back by arable lands and affforestation.

As an effect of grazing, the Common Heather (*Calluna vulgaris*) is spreading because its seeds, depending on raw soil for germination, now find germinating grounds in the footprints of the grazing animals. The plants also profit from the browsing of the German Heath Sheep. The flowering is thus limited, but the scrubs do not over-age and stay vital.

Figure 46: The Common Heather germinates in the footprints of herbivores.

*Figure 47: Even though the Common Heather (*Calluna vulgaris*) only occurs in small stands in the Hoeltigbaum area, it is accompanied by characteristic heath species. The bee of the genus* Colletes*, Colletes sucinctus, exclusively uses the heather for collecting pollen and nests in nearby patches of bare soil.*

The thorny Petty Whin (*Genista anglica*) is rejected by the animals. The species, in the meantime endangered throughout Germany, profits indirectly from grazing, as other more competitive species threatening to overgrow it are browsed. At the same time, this species germinates in footprints as well and shows a clear tendency to extend.

Poor Grasslands

Almost seventy percent of the Hoeltigbaum area is colonised by poor grasslands. They were either already developed during the phase of military land use or extended as following stages from small pioneer sites. Throughout Central Europe, extensive stands of poor grassland are almost exclusively found on military training sites, where they form richly flowering habitats accommodating a great share of endangered species.

*Figure 48: The **Red Fescue** (*Festuca rubra*) and the **Common Bent** (*Agrostis capillaris*) make up for a considerable share of the poor grassland vegetation. Flowering aspects of herbaceous plants have been rather moderate up to now.*

The vegetation in the Hoeltigbaum area is still shaped by the fallow phase inserted between military land use and grazing. During that time, dead plant material accumulated until a thick layer of litter covered the ground. Only few seeds were able to germinate in those conditions, and the vegetation, poor in species already, was further impoverished.

The matted grasslands changed in the course of grazing. A considerable share of litter has been eaten or crushed by cattle and sheep trampling. Plants with low competitive capacity could germinate in the newly developed open areas. The number of species within the stands has clearly increased.

Among those species are perennial herbs and low-growing species difficult to browse. Species of ground level vegetation such as the Harebell (*Campanula rotundifolia*), the Heath Bedstraw (*Galium harcynicum*), the Trailing Tormentil (*Potentilla anglica*) and the Common Speedwell (*Veronica officinalis*) spread to surrounding areas by creeping shoots and conquer sites at greater distances with their seeds.

Figure 49: The reduction of litter makes it possible for the ***Harebell*** *(*Campanula rotundifolia*) to spread largely by wind-sperad seeds and underground creeping shoots. As it is a plant germinating in light, this species is characteristic for low-intensity, poor grasslands or early fallow stages.*

*Figure 50: The **Deptford Pink** (*Dianthus armeria*) was presumed missing in the area of Hamburg and is threatened by extinction in the area of Schleswig-Holstein. It has now been rediscovered on a slope of poor grassland and its stand is spreading in footprints of the grazing animals.*

In areas where grasses still show a covering rate of over ninety percent, dominances have clearly changed. While the Red Fescue (*Festuca rubra*) was predominant on most sites, it has now been driven out by the Common Bent (*Agrostis capillaris*) in more humid, preferentially grazed areas. The Bent regenerates more easily under grazing and is clearly more palatable for the herbivores. Thus the animals create their own grazing sites. However, on the dryer elevations of the area grazed only in periods of food shortage in winter, the Red Fescue is still dominant.

Throughout the wide grasslands in the Hoeltigbaum area, ground nesting **birds** such as the Sky Lark (*Alauda arvensis*), the Tree Pipit (*Anthus trivialis*) or the Meadow Pipit (*Anthus pratensis*) build their nests. The developments of their respective breeding populations vary. The number of breeding pairs of Sky-Larks has hardly changed over the last three years. The population of Tree-Pipits, however, has decreased. After only three years of observation, it cannot be assessed if grazing had an influence on this. The increase of breeding pairs of the

Meadow Pipit in an area predominantly frequented by the grazing animals speaks against the loss of nests by trampling of cattle and sheep, for example.

*Figure 51: An effective camouflage on the one hand and an impressive singing ability on the other hand characterise the **Sky Lark** (*Alauda arvensis*) during the breeding season.*

Spiders also show a great number of both species and individuums throughout the grasslands. Among those, the xerophilous species have increased since the start of grazing. This development probably mirrors the thinning out of grasslands as an effect of grazing. In oligotrophic grasslands not entirely open any more, the share of specialist species has decreased.

*Figure 52: Tall-growing structures within grasslands are essential to web-building spiders such as the **Wasp Like Spider** (*Argiope bruennichi*).*

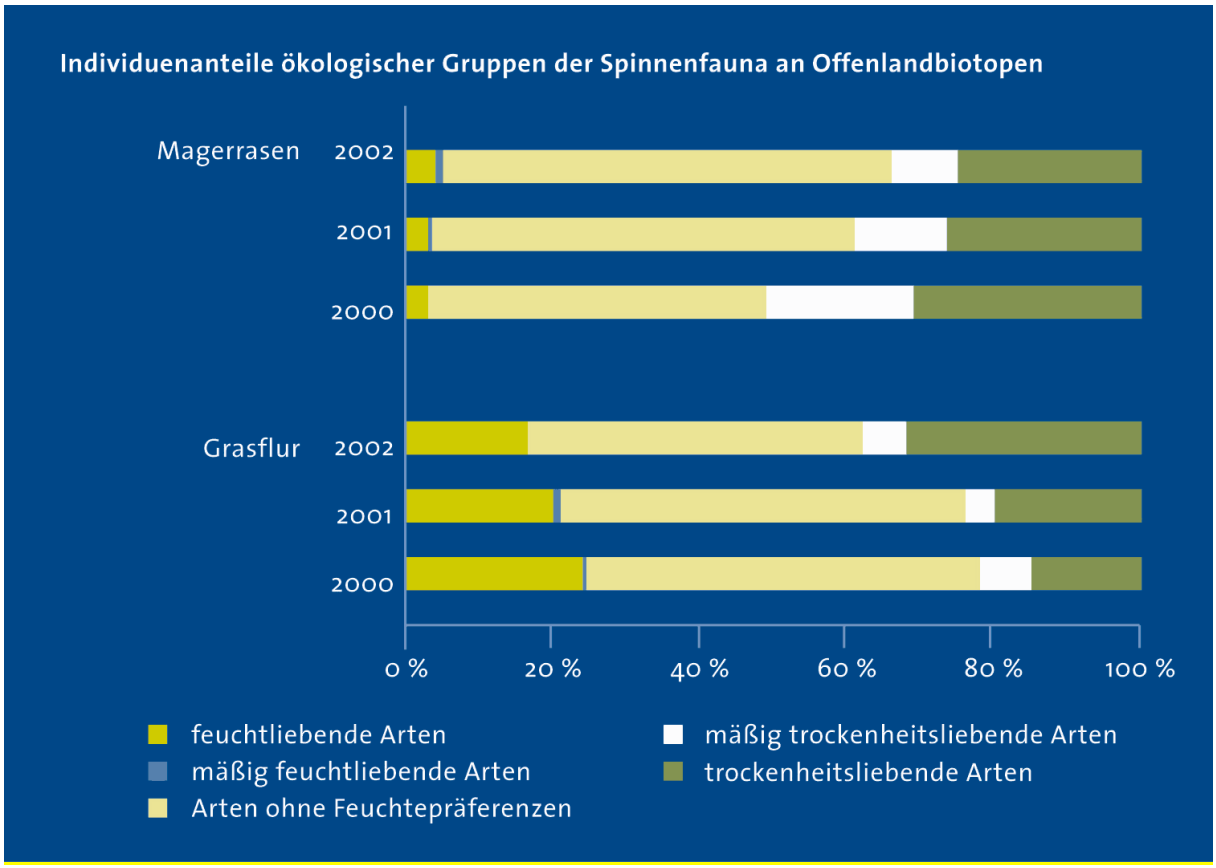

Diagram: Abundance of ecological groups of spider species in open habitats (percentage of total number of individuums)

Due to low grazing pressure, tall-growing perennial herbs can establish themselves within the grasslands as well. This close interlinking of different structural types of vegetation supports the development of favourable microclimatic conditions. The sparse vegetation of oligotrophic grasslands leads to high solar irradiation. At the same time, shrubs or stands of tall perennial herbs form a protection against the wind. Species with high temperature requirements such as butterflies, burnets and various species of beetles profit from such conditions. Ground-living insects like ground beetles (*Carabidae*) or leaf beetles (*Chrysomelidae*) can move well in the sparse vegetation. At the same time, the perennial herbs with their rich food supply are easily available.

*Figure 53: The larvae of the **Six-Spot Burnet** (*Zygaena filipendulae*) develop within the pulvinate stands of the **Common Bird's Foot Trefoil** (*Lotus corniculatus*). The caterpillars retreat to solid stems of tall perennial herbs or tall-growing grass plants for pupation. The adult insects live in richly flowering fringe communities and especially on the **Creeping Thistle** (*Cirsium arvense*).*

An example of the colonisation of toghtly interlinked vegetation structures is given by two species of weevils, *Rhinocyllus conicus* and *Larinus turbinatus*, which are continentally dispersed and very rare in the area of Germany. They only colonise poorly growing thistle stands on warm sites. If the surrounding vegetation becomes too dense, or if a layer of litter is developed, the thistle stands are not colonised. Thistle stands on fallow land rich in nutrients won't be colonised either.

Shrubs and Wooded Areas

Since the cessation of military exercises, many young woods and shrubs have colonised the area. In particular, wind-dispersing plants germinating on bare soil such as birches (*Betula pendula*), willows (*Salix caprea*) and alders (*Alnus glutinosa*) profit from the bare soils free of vegetation. But also hawthorns (*Crataegus spec.*), oaks (*Quercus robur*) and blackthorns (*Prunus spinosa*) are slowly spreading.

Figure 54: Since the cessation of military use, pioneer woods have spread over large parts of the area.

The trees and bushes predominantly develop as single plants or form small groups. The height of the trees grown after the abandonment of military land use usually stayed below five metres in the year 2002. Old groups of trees, hedges on mounds or tree rows only cover about 10 % of the project area.

Trees and shrubs change eventually as an effect of grazing. Mainly, two factors intervene in the structure of wood habitats: The behaviour of the cattle suiting its own well-being and direct browsing.

Figure 55: Cattle often rub against birches or young oaks., which can be broken down in the process. For higher trees, branches and twigs below the shoulder height of the animals are broken off. Above all, dense birch stands are thinned out by this.

Trees exceeding three metres in height are not interfered with by grazing. However, low trees or shrubs can be severely damaged by browsing. According to their specific defence capacities or due to the feeding preferences of cattle and sheep, different species of woody plants are concerned in various ways.

Figure 56: German Heath Sheep selectively browse leaves and twigs. They are thus capable of feeding on thorny bushes as well.

Figure 57: Cattle rip off whole twigs or harvest leaves by pulling twigs through their mouths. They are thus less specific than sheep in their effects.

A regressive development of stands is primarily expected among oaks, willows and poplars. They are more heavily browsed, broken down and their stands decreased.

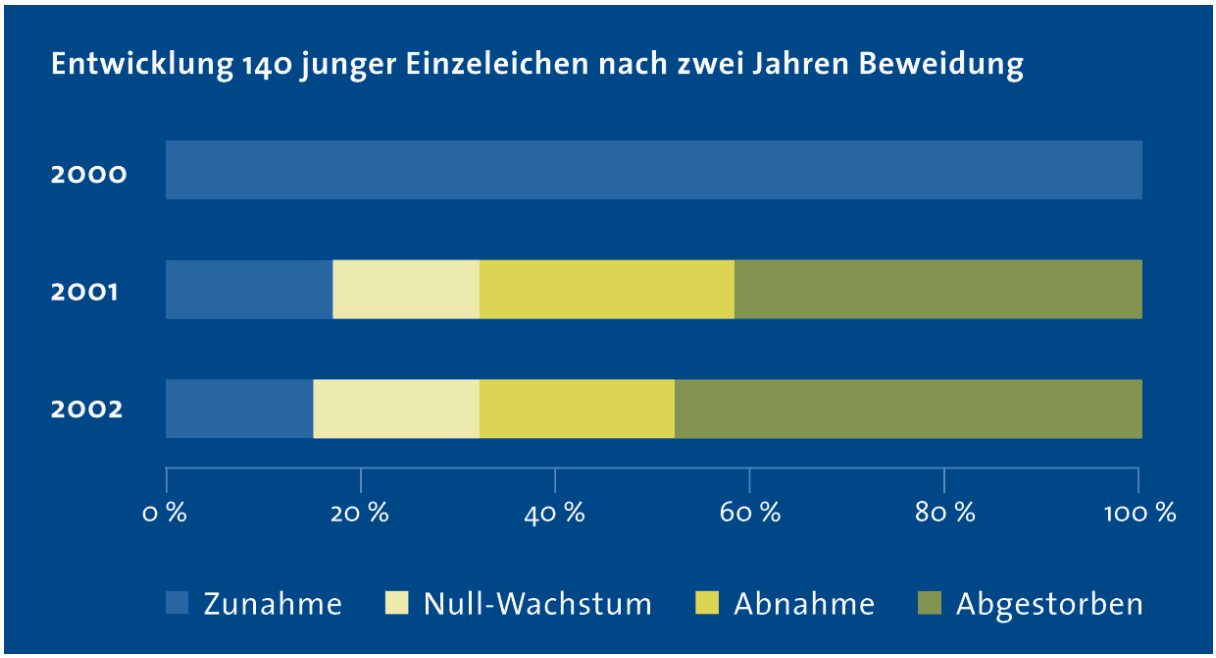

Diagram: Development of 140 solitary oaks after two years of grazing. By examining a representative choice of 140 young solitary oaks with heights from 50 to 300 centimetres, their development under the grazing pressure of cattle and sheep could be documented.

Further remarkable is the almost entire repression of Raspberry stands (*Rubus idaeus*). Bramble stands (*Rubus fruticosus agg.*), on the contrary, remained but experienced severe changes of growth.

Among hawthornes and roses as well as among birches, few plants are really entirely destroyed, but many show broken down stems or twigs as an effect of grazing.

Figure 58: Birches are only browsed irrelevantly because of bitter substances in their leaves. A higher chance of browsing exists in the winter months.

The saplings of oaks and Hornbeam (*Carpinus betulus*) also react to browsing by developing low and sturdy shapes. Those species thus suffer few losses among saplings, and will presumably grow up slowly but steadily until they escape the browsing horizon of the herbivores. Regarding competition with other species, those plants are even rather supported by grazing.

Saplings of birches, hawthorns, roses, poplars and willows showed higher losses than oaks within the first two years of grazing. Essential for the growing-up rate is the number of saplings, the respective site with its actual food supply and how easily accessible the saplings are for the grazers.

According to first results, it is to be expected that the extension of trees and shrubs can be stopped to a great extent. Apart from birches and single oaks and hornbeams, which were able to grow protected by thorny bushes or reacted to browsing by a compact sturdy growth, most saplings of woody plants are browsed. According to the associated scientific studies, newly emerging birches are either severely damaged within the first three years of their existence or develop a low sturdy shape as well. In the long term, only few trees or shrubs will be able to renewably establish themselves in the area.

Figure 59: Especially the German Heath Sheep nibble at the bark of softwoods (mainly willows and alders) or peel it off entirely in winter.

Figure 60: Oaks with long shoots, growing quickly and without disturbances, can only be found on the sites of fringes now, where they are protected by brambles and blackthorns.

In the complete stand of an alder wood, browsing of the herbivores induced a thinning-out of the herb- and shrub layer, already leading to a clear increase in the range of species of the ground beetle community. Apart from typical wood species such as *Abax parallelipipidus*, *Pterostichus oblongopunctatus* and the endangered *Harpalus laevipes*, species of shady to semi-shady, moist habitats such as *Platynus assimilis* and *Patrobus atrorufus* colonise the area in relatively large populations.

Figure 61: Due to the thinning-out of lower vegetation layers in the alder swamp forest, species requiring open moist sites are able to spread, for example the endangered **Chlaenius nigricornis**.

Old parallel tree rows mounds, formerly accompanying a road ("REDDER") or usual tree rows already show a typical wood community of ground beetles. Various species of the genus *Carabus*, among them the endangered *Carabus convexus*, can be observed there.

Stands of Bedstraw (*Galium*) in warm, light woods or shrubs are used by caterpillars of the **moth species** Ruddy Carpet (*Catarhoe rubidata*) and Royal Mantle (*Catarhoe cuculata*), both highly endangered in the area of Schleswig-Holstein. The adult moths live on trees and shrubs. In the Hoeltigbaum aerea, they predominantly feed on Common Bedstraw (*Galium mollugo*) within the swamp forests. The browsing and trampling prevent a matting of vegetation on those sites in such a way that caterpillars benefit by grazing.

The flowing transitions between open habitats and wood habitats, rarely found in the clearly compartmentalised cultural landscape, are of great importance for a multitude of animal species. Characteristically colonising wood margins and fringes or open landscapes respectively, they can find additional resources there. Those can be nesting grounds in dead wooden structures, feeding passages of boring beetles or additional food supplies.

Figure 62: Many soil-nesting fossorial wasps of open habitats such as the depicted Mellinus arvensis *are can be frequently seen on shrubs, particularly on oak leaves. There they take a rest or drink honeydew excreted by plant lice.*

Wood habitats and fringes are further significant due to their specific microclimatic situation and effect. Forming a protection against the wind, those stands of trees and bushes perform

a positive effect on thermophilous and xerophilous animal species in adjacent open habitats. Dense growth leads to a favourably warm climate within fringes. Browsing by the animals supports those site conditions, because many fringe composing species with creeping root-shoots react to browsing by a dense, partly stunted growth.

Habitat Complexes

The outstanding quality of large scale, low intensity pasture landscapes is the development of a mosaic of grass stands, herb stands and wooded areas continuously merging into each other without separating structures.

The particular importance of this interlinking of habitats results from the offer of different resources and qualities within a small spatial range. They are essential to animal species inhabiting different habitats in the course of their development, which could thus be seen as inhabitants of biotope complexes.

Among those inhabitants of biotope complexes are the obligatory habitat changing species, which have to migrate according to seasonal changes or according to developmental stages. Examples are given by amphibians, reptiles or various species of insects such as dragonflies, all with widely differing requirements to habitats concerning larvae and adult animals.

However, different habitat requirements concerning food intake and reproduction can also exist within one stage of development. Furthermore, there are insect species among the inhabitants of biotope complexes with only a small range of action. They depend on a direct spatial interlinking of the partial habitats they need.

*Figure 63: The Red Banded Sand Wasp (*Ammophila sabulosa*) installs/builds its nests in open sand aeras. As food supply for the larvae, it preferentially carries moth caterpillars into the nests, hunted in adjacent stands of heather or shrubs.*

Figure 64: The hoverfly Xanthogramma pedissequum *is a highly specialised inhabitant of biotope complexes. In the course of its development, it needs totally different but closely neighbouring habitats. Its larvae inhabit the underground tunnel complexes of field ants of the genus* Lasius. *There it feeds on root lice kept by the ants for harvesting their sugary excretions. The adult hoverfly lives in sunny, richly flowering wood margins, stands of perennial herbs and wind-protected oligotrophic grasslands instead.*

*Figure 65: The Orange Underwing (*Archiearis parthenisa*), endangered in the area of Schleswig-Holstein, is an example for inhabitants of habitat complexes in the margins of wooded areas. the caterpillars live on birches, whereas the adult lepidopterans are depending on associated willow stands where they suck the catkins of willows.*

Single elements of any habitat complex should not be viewed in isolation. Its value only follows from the availability of various resources and qualities adjacent in terms of time and space.

The mosaic of open landscape and wooded areas is the habitat of the Tree Pipit (*Anthus trivialis*). It uses trees and shrubs as singing points and open grasslands as feeding grounds. The population density thereby decreases with increasing distance from closed coppices or woods. The population density of the Sky Lark (*Alauda arvensis*), preferring open areas with low vegetation, shows the opposite pattern.

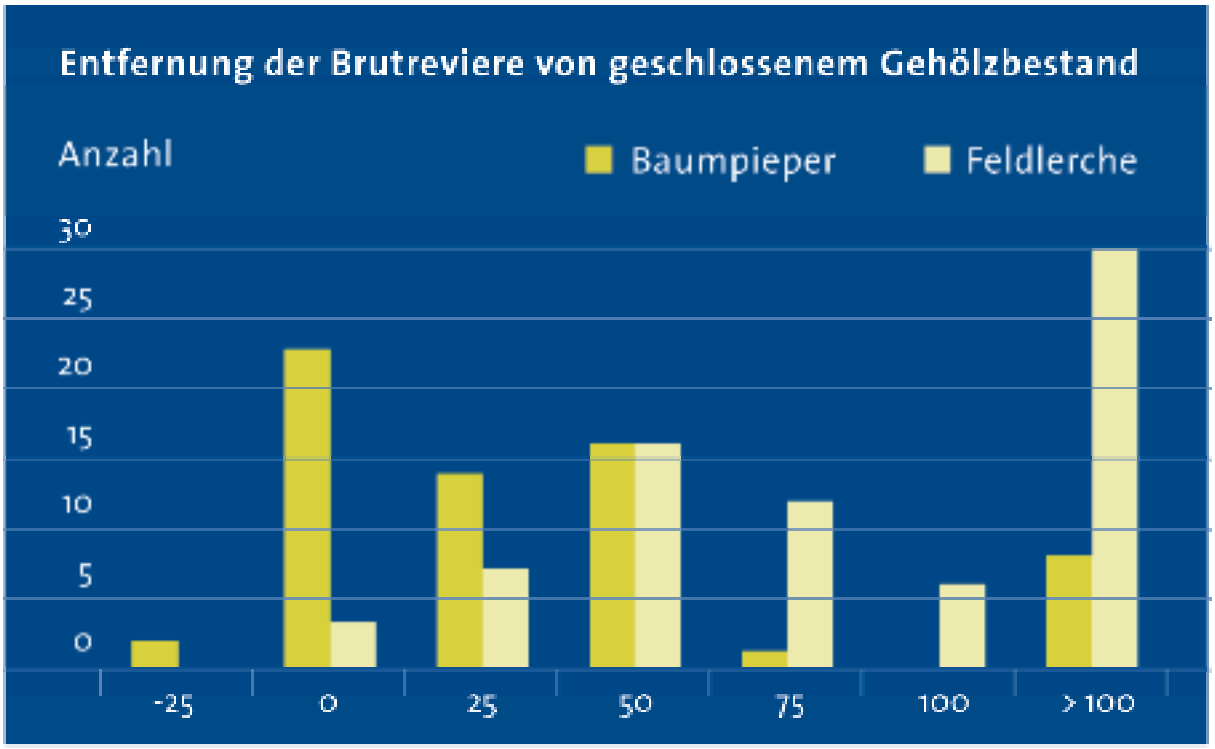

Diagram: Distance between breeding territories and closed coppices or woods

Dominant plant stands

Some plant species are able to spread out by underground creeping shoots and are thus capable to establish colonies out of a single plant (polycormones). Where they are of particularly strong growth, they develop dense dominating stands, which only accommodate very few other species.

*Figure 66: The **Bush Grass** (Calamagrostis epigejos) grows in dominating stands in parts of the Hoeltigbaum area, allowing only very few other plant species to grow there. Grazing clearly thins out those stands and new plant species immigrate. Especially on moist sites, preferentially grazed by the animals, the number of species within the Bush Grass stands has clearly increased.*

Figure 67: The dominating stands of ***Bracken*** *(*Pteridium aquilinum*) show similar developments. The stands are not repressed, but they become more sparse and more rich in species.*

Figure 68: The ***Japanese Knotweed*** *(*Fallopia japonica*) is browsed entirely. In its formerly dense stands, nitrophytic plants spread out, possibly driving out the* Fallopia *because they are less palatable.*

5. FIRST ASSESSMENTS AND FUTURE PERSPECTIVES

The outlined developments in the Hoeltigbaum project area are based on a grazing period of only three years, which was preceded by several years of fallow land. Nevertheless, positive

developments towards the establishment of a "semi-open pasture landscape" can already be presented.

Just in the first year, litter accumulated during the phase of fallow land was clearly reduced. Possibilities for the development of species of low competitive capacity and light-requiring species majorly improved in many places. Species of poor grassland communities are slowly spreading out, and increasingly more parts of the grazing area are characterised by their long periods of flowering during the summer months. Due to grazing, endangered pioneer species can find suitable niches again and will probably be able to remain in the area in the long term as well. Relict stands of clay-heaths ("Lehmheiden"), extremely rare throughout Germany, are increasing in small areas. The silting-up of small ponds and pools is hindered or permanently prevented, too. Along many stretches of banks, a sparse but diverse vegetation, including many Red Data Book species, replaced dense, flooded grasslands or tall reeds poor in species. Formerly dense stands of Soft Rush are starting to be thinned out.

Predominantly during the winter months, trees and shrubs are increasingly browsed and bark is bitten off to various degrees. According to results up to now, damage among new saplings is done by an amount that will probably maintain the present rate between open habitats and wood habitats.

Many animal species have found improved living conditions along with the positive development of vegetation structures. The thinning-out of grasslands due to grazing causes light conditions to improve and microclimatic conditions are changed. These developments support species diversity and population developments within animal communities. Particularly important for the development of a stable community is the simultaneous existence of the various habitats, especially concerning highly specialised inhabitants of habitat complexes.

Statements regarding the overall dynamical development of the area, would clearly require much more time of research. In addition, not even tendencies of those complex processes can yet be derived after three years of grazing.

An evaluation of the business management data at the end of the project will show if the economic aims of grazing can be reached. The grazing animals showed a satisfactory growth of meat over the period of two to three years. Because of the sustainable production of food without health hazards marketed as European standard "eco-meat", higher proceeds can be

gained than in conventional livestock farming. If usual forms of government support are made use of, the prospects are good for a profitable application of grazing.

In the framework of the associated scientific studies, the development of habitats and of plant and animal communities will be observed up to the year 2004. On the basis of present results it can be presumed that

- grasslands will lean in the long term under the impact of grazing and species with low competitive capacity will spread out .
- relict heaths will regenerate and spread out
- small pioneer habitats will be created by the trampling of grazing animals. This should guarantee the continuation of specialised, low-competitive species throughout the area.
- grazing around small ponds and pools will support aquatic and semi-aquatic plant and animal communities and stands of the Soft Rush will further be thinned out.
- habitat conditions for the potential immigration and extension of further, presently missing, typical species such as Thyme and the Common Spadefoot will be created.
- the appearance of the landscape will change according to the alterning structures of woods, coppices and shrubs and will approach the looks of parkland in the long term.
- the herbivore breeds (Galloway and German Heath Sheep) will, in the selected stocking rate, slow down and presumably even stop the extension of woods and shrubs.

- the semi-open character of the landscape with its fluid transitions between grasslands and woods or shrubs will be maintained.

Overall, the present results in the Hoeltigbaum area indicate that the nature conservation and business management aims striven for on the former military training site can well be achieved by implementing the concept of "semi-open pasture landscapes".

By first estimations, the concept of "semi-open pasture landscapes" appears to be a promising approach to managing extensive parts of landscapes considering both nature conservation and business management aspects.

The Schleswig-Holstein Nature Conservation Foundation

The Schleswig-Holstein Nature Conservation Foundation ("Stiftung Naturschutz Schleswig-Holstein") was founded as a foundation of public law by the regional state Schleswig-Holstein and was grounded in the state's Nature Conservation Law ("Landesnaturschutzgesetz") in 1978. The target of the foundation is to secure endangered areas worthy of protection for nature conservation aims. Besides the long-term leasing of land, purchasing land is the most important instrument – and often the only possibility - to maintain biological diversity and the beauty of landscapes.

The wealth of the foundation's 250 nature conservation projects varies from managing a small patch of dry grassland covering two hectares near the town Grossenaspe to re-wetting a large lowland area covering 660 hectares near the town Lunden. About half of the areas, around 10.000 hectares, are "pure nature" and develop without human interference. The remaining half is leased to farmers who manage and develop the valuable habitats by low-intensity farming.

Extensive pasture landscapes appear to be particularly well-suited to create diverse biotope structures and richly varying landscapes. Thus establishing a network not only for rare species of plants and animals, but also for people looking for recreation and the pleasure of nature. In cooperation with its partners, the Nature Conservation Foundation has created several of these "wild pastures".

The Federal Agency for Nature Conservation

The Federal Agency for Nature Conservation ("Bundesamt für Naturschutz") represents the central scientific authority for nature conservation and landscape management in Germany. It is among the responsibilities of the German Federal Ministry for the Environment ("Bundesumweltministerium"). The headquarters of the Federal Agency for Nature Conservation are located in Bonn with branches in Leipzig and on the island of Vilm near Rügen.

The central tasks of the Agency include scientific advisory in politics, scientific following of major nature conservation projects ("Naturschutzgrossprojekten"), trial and development projects ("Erprobungs- und Entwicklungsvorhaben", "E+E-Vorhaben") and research projects as well as providing overall information concerning nature conservation. Furthermore, the Federal Agency for Nature Conservation sanctions the import and export of legally protected animals and plants.

The Trial and Development Projects of the Federal Agency for Nature Conservation are supposed to contribute to the maintenance of biological diversity. In this context, projects combining aspects of nature conservation and land use are of particular importance. As projects supported by the Federal Government, trial and development projects have the following aims:

- realisation of promising nature conservation ideas
- implementation of important results from research into practise
- testing of new and improved applications of already existing methods
- working up of cumulative experiences to derive generally applicable recommendations

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