



## Field guide to the Holstein Habitat Corridors

Project partners of the d+t project:



Cover photos:

### **Fauna passage Kiebitzholm 2011**

*(photo: Nature Conservation Foundation Schleswig-Holstein, 2011)*

The fauna passage and the nearby otter underpass are to fulfil several tasks: Amongst fragmentation-sensitive species of forest and forest edges, species of heath and dry grassland as well as fens and water bodies have to be able to cross the motorway.

### **Natterjack toad, hazel dormouse & red deer**

*(photos: natterjack toad & hazel dormouse: Nature Conservation Foundation Schleswig-Holstein, red deer: Siegel)*

The species represent only a small section of biodiversity, but they represent many different types of requirement. While the natterjack toad colonizes pioneer habitats and needs adequate spawning grounds in reachable neighbourhood to sandy habitats, the hazel dormouse prefers species-rich and structured forests and the hedgerow landscape characteristic of Northern Germany. Populations of mentioned species are quite easy to manage because of local and regional habitat design. As for red deer which is active in a large area, social matters play a larger role than landscape-ecological matters.

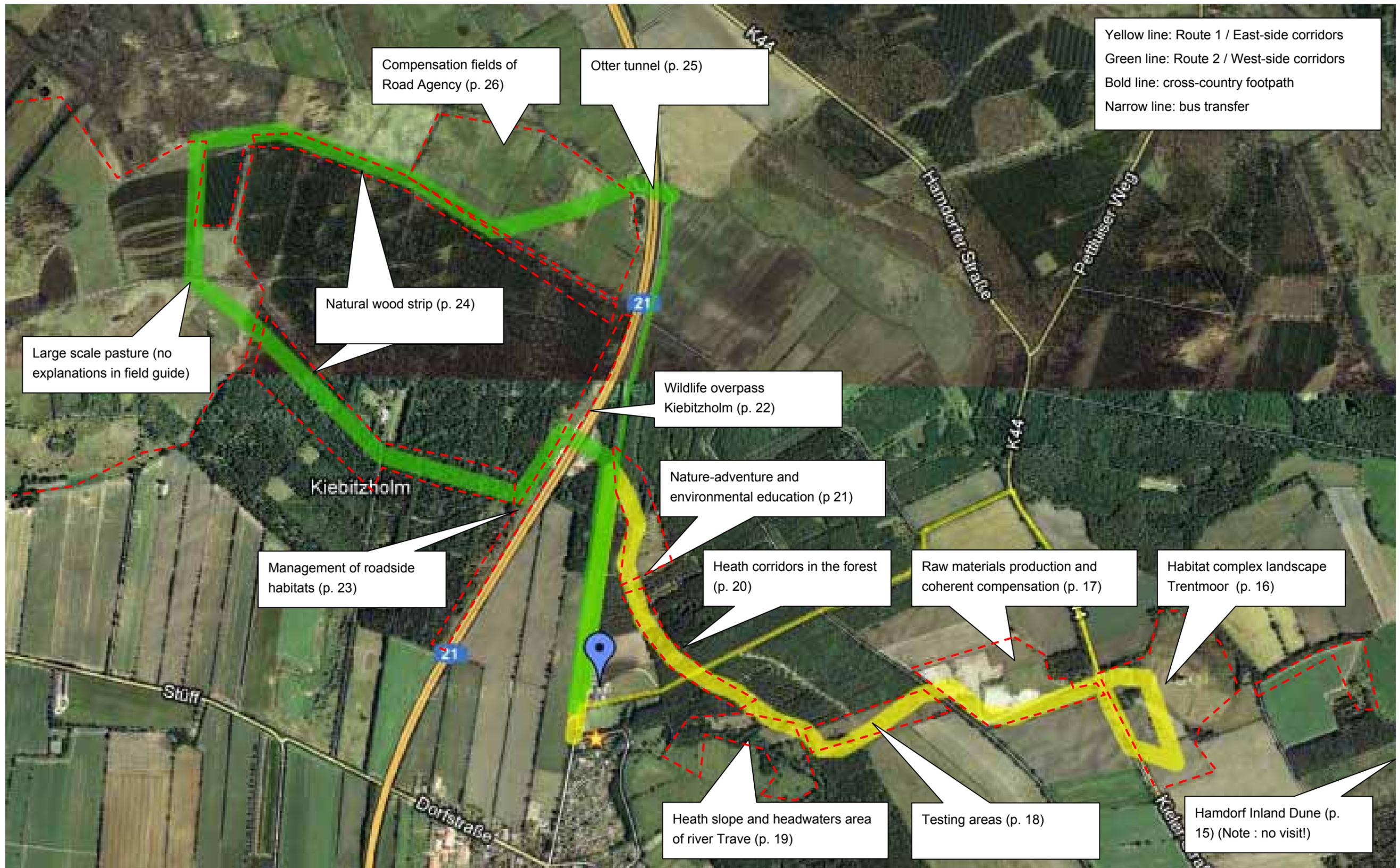
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November 2011

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## 1. Map of excursion and stations



## 2. Landscape ecological background

The excursion area is situated in the transition zone of the main natural areas “Östliches Hügelland” (Eastern hills as a young morainic landscape) and “Geest” (Northern German alluvial plains consisting of mainly sandy soil with scattered moorland inbetween). The climate is temperate warm and is characterized by west winds and regularly passing low-pressure-areas. The oceanic influence causes the annual temperature amplitude to be relatively low and humid weather conditions prevail. Average temperature in the winter is between 0°C and 5°C and in the summer around 15°C. Average annual precipitation (with large deviations in the different years) is 750 mm/a.



**Figure 1:** Section from the „Topographical Military Map of the Duchy of Holstein (1789-1996)“ of Gustav Adolf von Varendorf, land registry folio Bad Segeberg-Rickling (43) with the towns of Trügebötel (=Negerbötel) and Dal(l)dorf (this map is not orientated north) (red dot: location of fauna passage)

Still at the end of the 16<sup>th</sup> century, after former forest clearing periods, the excursion area had been to a large extent a forest-free heathland. It was surrounded by bog in the North and in the West. (see fig. 1).

As early as in the 19<sup>th</sup> century, the bog areas have been drained and the peat completely dug. Later, the areas were used as grassland and then as farmland. The topographic survey of Prussia of 1880 shows a thick hedgerow network on the sandy surfaces, which is still visible today as a network of deciduous trees in many places in the otherwise coniferous wood-dominated forest. In numerous places, sand and gravel pits have formed which were used and continuously enlarged till the 20<sup>th</sup> century. Not until the late 19<sup>th</sup> century, the re-forestation period has begun, which also concerned large parts of the heathland around Kiebitzholm. These areas are now situated west of the wildlife crossing and are the older commercial forests, while the areas east of the crossing have only been reforested extensively

in the 2<sup>nd</sup> half of the 20<sup>th</sup> century. A conifer forest has been created (first the spruce came, which previously not occurred in this area, then the Japanese larch, the Douglas fir and the Giant fir came). At the edges of the forest, the black cherry tree (*Prunus serotina*) has been introduced. Only in the past few years, beeches were planted and so a turn in the direction of acidophilous beech forest communities began, which are expected to be familiar with the prevailing living environment.

Comparing the Prussian topographic map of 1878 to the current maps of the land surveying office (TK\_25) you can see that in the late 19<sup>th</sup> century, there was only a big deciduous and mixed forest site (south of Negerbötel). Three sites of historic ancient woodland can be found in small areas of 2.5 km, 5 km and 6 km from the wildlife crossing.

History makes clear that the area ever was and still is in a dynamic change and that it is not only of great importance for animals but also for plants to have the ability to disperse. The motorway A 21 separates not only the local population systems and aggravates the negative effects of habitat isolation but also interferes with the colonization of new types of habitats. The flightless animal species as well as the plant species whose seeds are spread by animals (among them many types of forest and types of heath and neglected grassland) are affected.

### 3. Information on the fauna passage Kiebitzholm

#### 3.1. Introduction

The wildlife crossing Kiebitzholm has been built in the context of the further construction of the federal road B 404 to the motorway A21. It is an action necessary according to BNatSchG (Federal Nature Conservation Act) to prevent significant interference in the functioning of the ecosystem and is meant to help ensure the biodiversity.

The impulse for building the overpass were many wildlife collisions near Negernbötel as well as suggestions by huntsmen in the context of organization-cooperation. In order to enable animals to cross the road after having constructed new infrastructure and after having built wildlife fences it was necessary to build a wildlife crossing. During the planning stage of the crossing, multifunctionality has been taken into account, i.e. the crossing should be usable for forests as well as species of the open landscape and it should be wide enough for red deer to cross.

Due to the explanatory statement which was apparently unilateral focused on deer and the comparatively little knowledge about how much overpasses are of use for small animals (see judgment of 17 January 2007 of the VGH (Administrative Court)), the structure was controversial. In order to decide whether the overpass is sufficiently used by deer and other species in need of protection and to have a better planning and decision basis in the future, the Ecology Centre of the Christian-Albrechts-University of Kiel has been commissioned to examine whether or under what conditions the overpass is used by deer and whether it possibly helps plant species spread.

As full functionality may only be expected in a few years; this is for example the case when planted trees have reached a sealed foliage, for a start the monitoring regards a period within or shortly after the construction phase (2005 until 2008) and finally the year 2010. For the examination, representative species have been chosen which can be determined with relatively little effort.



Figure 2: Headlines, which reflect the initially controversial discussion concerning the construction of the wildlife crossing Kiebitzholm

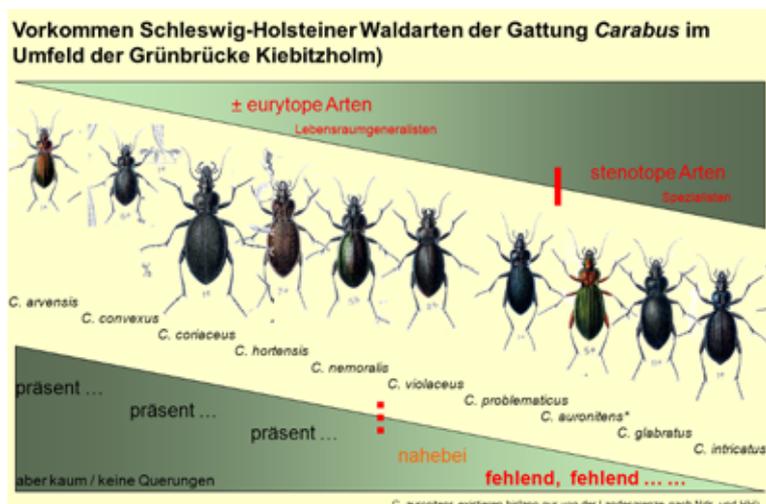


Figure 3: In the surroundings of the overpass, most eurytopic carabid beetle species can be found, while stenoeocious species are missing

### 3.2. The examined groups of species

Mediums-sized and large mammals cause traffic accidents and are isolated from each other over large areas by fenced and/or busy roads. The purpose of the overpass Kiebitzholm is to ensure deer crossing the roads as much as before and therefore it is examined whether these mammals use the crossing regularly.

Reptiles and amphibians which belong to the most fragmentation-sensitive group of small vertebrates are examined. Dormice are found in the wider but not yet in the very close surroundings of the overpass. Bats (among others *Myotis bechsteinii* is present) can possibly considerably benefit from the wildlife crossing. But they are not in the examination program because in the examination on the environmental impact assessment and the landscape conservation plan there are no references given about a sensitive population. Grasshoppers and carabid beetles which are mainly in need to spread and which can hardly cross the road are the representatives of the flightless invertebrates. Especially, forest species of flightless stenoecious carabid beetles are indispensable for the evaluation of the overpass. The flightless grasshoppers which live in the open landscape are of great significance. Finally, the vegetation is examined to decide whether the habitat quality is high enough. So vegetation surveys are necessary to be able to interpret the population of the different animal species but they also serve to evaluate whether maintenance and restoration of wildlife mobility supports plant dispersal.

### 3.3. Location of habitat network concepts and other crossing aids

The overpass Kiebitzholm is situated at a main connectivity axis of the statewide planned habitat system. This habitat and the Brandsau are bisected by the motorway 21. An extended flowing water culvert (with berm), the so-called otter underpass or otter tunnel, is to keep the German transport infrastructure network permeable at this very point. The overpass itself is a part of an axis with a high density of remaining dry habitats as well as forests in close position to each other.

From a supra-regional perspective, the wildlife crossing is situated in the Natura 2000 network (see Article 10 of the EU-Habitat-Directive) and in the area of one of the statewide last remaining habitat corridors suitable for large-scale ecosystem connectivity (see maps in NaBiv 17). The chosen axis is especially suitable for reconnecting red deer populations of Schleswig-Holstein (Meissner et al. 2010).

For these reasons, on the one hand particularly high requirements are imposed on the functionality of the structure, on the other hand the spatial situation confirms the decisions made on the construction of these costly crossing aids.



Figure 4: Location of the project area (orange) in the German Habitat Network (green and blue axes) and the Federal motorways in Schleswig-Holstein (red lines)



Figure 5: Location of the project area in the Habitat Network of the Land of SH (red circle: overpass)

### 3.4. Overview of road construction

**Length of the relevant planning section:** 8.6 km (4-lane cross-section with 2 additional hard shoulders, standard width total: 29.5 m)

**Number of bridge structures:** 5 (3 for traffic, 1 wildlife overpass, 1 otter tunnel)

**Traffic density on the motorway in the area of the overpass in 2008:** 12,500 cars per day (15% heavy goods vehicle traffic); traffic forecast for 2010 was approx. 36,500 cars per day (22% heavy goods vehicle traffic)

**Costs:** 26 million euros (of which 2.6 million euros for the overpass)

**Newly built-up area:** approx. 17 ha (asphalt consumption: 166,000 tons)

**Area for compensatory measures:** in the Brandsau plain tract (heathland restoration, construction of spawning grounds, buffer zones to the Brandsau) approx. 30 ha as well as approx. 38 further ha for the development of new forests

#### Data on the wildlife overpass:

Length: 35 m, width: 47 m combined with 18.2 km wildlife fences and partly amphibian fences; paths in the surrounding area have been shifted, parts of a neighbouring economic road have been deformed to a path, an area without hunting has been established. Wallows have been established for game, which can also be used as spawning grounds for amphibians.

**Completion of the overpass:** 2005, completion of adjacent ground work: 2008; Creation of exclosures and plantation of the boundary area: 2009

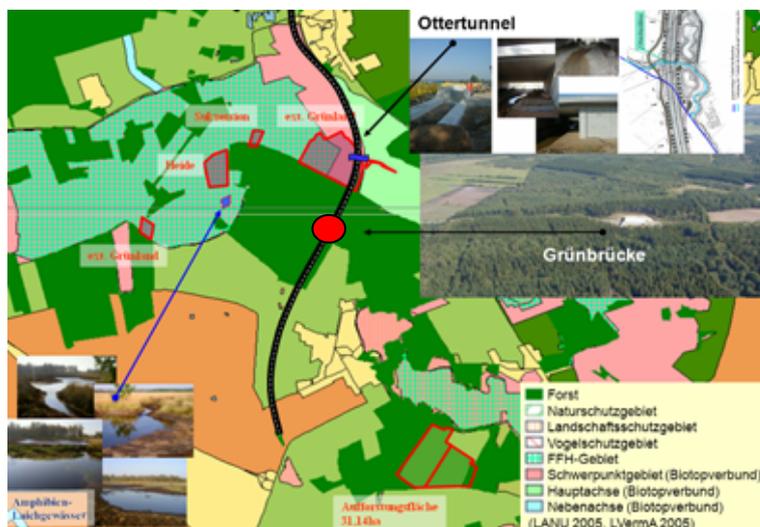
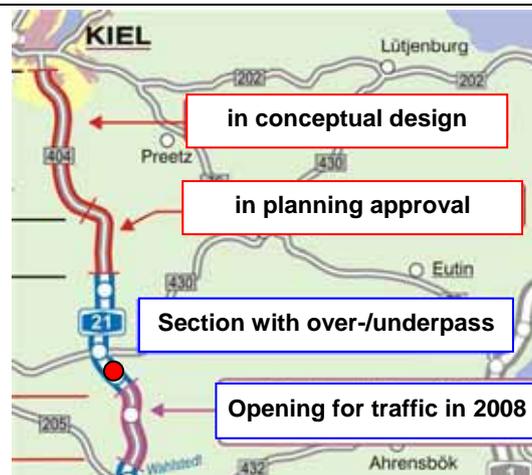


Figure 6: Location of prevention and compensation measures

### 3.5. Monitoring

The monitoring initiated by the Highway Management Services for Road Construction and Transport is charged with the task to clarify how much the construction of the wildlife overpass contributes to conserve the biodiversity and whether the benefit of the expenditure is efficient and what can be improved with the construction and expansion of future roads. In fact, the monitoring is very simple. It mainly aims at determining which species occur at the overpass in comparison to the spectrum of species in the surrounding area (direct observations including trace mapping, trace strips, automatic cameras, count distance and count surface, exclosures, man-made hiding places, pitfall traps as well as marking, capture and recapture and genetic analyses). Due to delays, fences and ground work could only be completed in 2008 and the plantation of the overpass as well as the sowing of the roadsides in the winter months of 2008/2009. In this respect, the monitoring results only refer to the construction phase and a short period after that. In 2010, the research was expanded and also applied to the otter tunnel. In the meantime, further measures have taken place to optimize the effectiveness (environmental design) in the framework of the Holstein Habitat Corridors.

### 3.6. *Short assessment of previous results*

Both crossing aids are able to ensure necessary mobility of key species and of threatened species. Some of the animals accept the overpass perfectly. All resident hoofed animals (ungulates), these are fallow deer, deer and wild boar use the overpass intensely and the motorway is crossed without an accident. Even the sparsely migrating red deer uses the bridge as well as threatened amphibians, reptiles and insects. Some forest species with high requirements and a few other highly threatened and protection-deserving insect-, amphibian-, and reptile species of the surrounding heathland-biotopes could not yet be found at the overpass. In order to restore the habitat network which is essential for these species, the surroundings of the crossing aid have to be improved. The emphasis will be on a suitable substratum and on optimizing or rearranging donor and stepping stone biotopes.

If expensive but necessary structures like wildlife overpasses are supposed to make an effective contribution to ensure biodiversity, substratum management (which was hitherto neglected when building crossing aids), plantation, environmental design and hinterland connection play an essential role. Equally important is the correct positioning and where applicable complementary structures.

## 4. *Information on the development and testing project „Holstein Habitat Corridors“*

### 4.1. *Schleswig-Holstein – the gateway to Scandinavia*

Schleswig-Holstein is Central Europe's gateway to Scandinavia. This imposes obligations on the land government. A project of tremendous dimensions is pending, that is the Fehmarnbelt-Crossing and several motorway constructions and extensions, which will strengthen the function of Schleswig-Holstein as a traffic bridge to Scandinavia.

However, the land is not confined to its bridge-function in transport management, the requirements are much higher: It is expected that for many species there will be a northward shift of territories in consequence of the changing climate. First re-immigrations of flying species have been registered so far. At the same time, possibilities for spreading and territory shifts decrease rapidly. The main reason for this is the loss of areas valuable in nature conservation terms, which by now include former ordinary landscape elements of the cultural landscape. This happens especially when utilization of land is intensified for example for the production of renewable primary products for agri-gas plants, which takes place at the same time with the construction of dispersion barriers (see above mentioned roads). Hence, the requirements increase to preserve and restore the bridge function of Schleswig-Holstein also for species and habitats and to enable recolonization of existing habitats.

One of the key places to conserve the ecological bridge function of the whole *land* is on the northern edge of the metropolis of Hamburg between the motorway A7, A21 and the planned roadway of the A20. These roads are currently constructed and extended. Foresighted demands of local people affected and organizations have reached that the construction was followed by an ecological motivated moderation and compensation. This is how the first wildlife overpass of Schleswig-Holstein was built over the motorway A21. The plannings of the extension of the motorway A7 and the construction of the A20 finally took crossing aids into consideration from the beginning on. The result is five future overpasses over three different motorways in a single administrative district.

However, the crossing aids can not maintain or restore the ecological bridge function of the *Land* by its presence itself. Location, measurement and building of overpasses are – see example of Kiebitzholm – very good though and offer great potential to minimize the barrier effect of roads essentially. But without integrating crossing aids into a habitat which should reach far into the surrounding area, they will not develop full functionality. There is much to suggest that in comparison to road construction there are only low investments to be made, in order to provide the overpasses with an ecological hinterland connection

and this way take full advantage of their connectivity potential. But just as in road construction, it is necessary to make supra-local and supra-regional approaches.

What is missing in the "Land between the overpasses" in the district of Segeberg in the key place of Schleswig-Holstein is re-linking rapidly the most important habitat types and according species.

#### **4.2. Project partners**

The realization of a far-reaching regional connectivity programme which is spatially and in technical respects integrative is challenging. In order to meet different demands of the landscape and the society, larger project groups have to be involved. Schleswig-Holstein seems to agree about this fact. This shows at least the previous results of the development and testing project, which is sponsored by the Federal Agency for Nature Conservation since September 2008 until December 2009 within the framework of a preliminary study and since the middle of 2010 as major project.

The narrower project group consists meanwhile of the Nature Conservation Foundation (as the project management organization), the Schleswig-Holstein State Forests, the National Hunters' Association (and thus the regional community of hunters) and the Highway Management Services for Road Construction and Transport. The project is scientifically supported by the University of Kiel. Project communications and involvement of the regional public is done by the Wildlife Park Eekholt. The Nature Conservation Foundation is a statewide expert in the realization of large-scale and challenging nature conservation projects and with its statewide nearly 30,000 ha, it has the necessary land ownership. The largest land owner in the region is the state forest which pursues the revaluation in nature conservation terms of parts of its economic forests. Many parts of the measures of the connectivity programme can be realized on the land of the state forests, for instance the wildlife overpass Kiebitzholm is situated in the middle of the state forest areas. The Highway Management Services for Road Construction and Transport owns larger compensation areas which can be optimized or expanded for connectivity measures. The community of hunters as an association closely linked to land use is an important local partner. It supports the project essentially because of its convincing and positive attitude towards re-linking habitats for red deer and co. The National Hunters' Association as the community of hunters' umbrella organization accepts an important role with the presentation and the nationwide exchange of project ideas.

#### **4.3. Regional partners**

This narrower project group involves many other institutions, which accept different project tasks. The District of Segeberg fully supports that native species should be given more space for mobility and peoples' life quality should be improved right in front of the door-step. This is why the district supports and provides advice and offers their areas for the measures. Exemplary is the "Nature Conservation Fund Segeberg" fed from supplementary monies, which is operated on a trustee basis by the Nature Conservation Foundation.

This is how a large amount of financial means is available which is exemplarily applied in an integrative manner also beyond the project, in order to realize accompanying measures to meet the projects' targets. Furthermore, other institutions are involved, like regional nature conservation practitioners of the "Naturschutzring Segeberg e.V.", the district and local groups of the NABU (Nature and Biodiversity Conservation Union) and many more. The list of the regional partners will also be open for other institutions during the course of the project.

#### **4.4. Regional suitability**

The location of the project area in the heart of Schleswig-Holstein has several essential advantages:

##### **Bodies of water**

The possibilities for connecting species of water bodies are good and are at the same time of statewide importance. The section of Kiebitzholm and the otter underpass under the motorway A21 nearby the overpass are directly on the watershed between the North Sea catchment area (rivers Osterau and Stör which flow into the river Elbe) and the Baltic Sea catchment area (river Trave). Measures with regard to re-linking species of water bodies do not only have an impact on one single river basin system but are also of importance for recolonizing the whole central part of this federal state.

##### **Xerothermal, heath and bog biotopes**

The District of Segeberg is rich of sandy soils and moor. The share of bogs and former gravel mining areas and heath is quite high in comparison to the statewide average, although ecological high-quality areas are small and are a long distance away from each other.

##### **Forest network**

Schleswig-Holstein is the most sparsely wooded federal state and the particularly important historic ancient woodlands occur more rarely than elsewhere in Germany. As expected, according to the existing spot-checked results of a preliminary study, the existing forests have become poor of stenoeious wood species and species of low dispersal possibilities. However, the potential for re-connecting high value wood habitats in the project area is relatively high, because the Segeberger Forst (about 4,000 ha), the Ricklinger Forst (2,000 ha) and the Halloher Gehege (1,000 ha) form some of the largest connected woodlands in Schleswig-Holstein. The change of once large-area monotonous non-natural coniferous forests into deciduous mixed forests - being managed according to Forest Stewardship Council (FSC) criteria - has begun. And important missing habitat stepping stones of the forest-, heath- and water corridors can be created in the middle of these forests supplementally within the development and testing-project and which are especially beneficial for conserving biodiversity. At the places essential for successful connectivity (for example in the direct environment of wildlife overpasses), cross-functional natural wood strips are established in the economic forests, on which there will be no more forestal utilization. This hitherto unprecedented measure is meant to give forest species with most demanding requirements a permanent opportunity to cross the road safely.

#### **4.5. Components of measures**

Of course, well-established categories of measures are used in the development and testing project, which are not mentioned here in particular. As the measures are to be effective also after the project duration, and the project management organization can not hold long-term money, nature conserving revaluations have to be self-preservative. An example for a successful and also long-term self-supporting solution is an extensive pasture landscape. On these areas when having finished initial preparations of habitat components (ponds, brims,...) habitats for complex habitat residents are conserved by semi-wild cattle and horses pasturing. Thanks to EU-subsidies for grassland management at least management costs can be covered in the long-run.

What works in the grassland with the help of farm animals, can also be able in the free landscape with the help of wild animals. In many places in the project area, their locally high importance in respects of nature conservation as habitat-engineers and vectors becomes clear. Because of the action of fallow and red deer and wild boars, small-area and species-rich relict localities and stepping stones are preserved. As well as the transport of some red list species to the wildlife overpass is the result from zoochore transport. One goal of the project is to control the animals in habitat corridors in that direction that they ensure and increase biodiversity (for example in heath and bog), while they do not endanger economical or

conservation aims in another place. For re-linking pasture landscape, rangeland is established for farm animals.

In the floodplain area for example, the establishment of riparian strips, rewettings or ponds supports connectivity of amphibians and other species of water bodies.

In the heath or gravel mining landscape, automatic initial maintenance, local removal of the upper layer of soil, the use of fire and also the introduction of pasturing improves the conservation status. The moor conservation will also be of great importance, whereas large-area and so expensive measures are financed by the moor conservation funds of Schleswig-Holstein. Smaller measures like removal of young wood and ditch backwatering and above all the establishment of stepping stone habitats between rewetting areas are financed by project means.

#### ***4.6. Transferability, exemplarity and importance***

A development and testing project has to be designed so that on the one side new nature conserving concepts are tested and evaluated. When having the results of the scientific monitoring at the end of the project, the project management organization has to give instructions on how to repeat the success in other regions. In this place, clear references have to be given, which of the previously untested measure types are responsible to what percentage for the success. For a selection of the most demanding target species it is expected to get very specific knowledge on the recolonisation process concerning density, size, quality and connectivity of stepping stones. Especially the presentation of importance of the mentioned measures in the frame of environmental design and hinterland connection and so interrelated with the crossing aids, will set an example.

On the other side, the project has to give transferable instructions on how the socioeconomic basics for the establishment of regional habitat corridors can be made. The constantly growing project alliance of the Holstein Habitat Corridors is on its best way to raise larger shares of investment money for the habitat corridors. A well-linked project coordination and scientific advice are the condition for this. The necessary finances can usually not be raised by the institutions itself on the whole. For this, corresponding support programmes or activities of the government are essential.

For successful realization, considerable support from the region is necessary. This is to be further supported and secured sustainably with the help of educational components.

The project area has further particularly good preconditions, amongst others in terms of land property; but is at the same time an area in which seemingly competing or even contradictory high developing requirements are imposed. It is a space between central federal developing axes, at the border of the Hamburg metropolitan region, with strong agricultural and forest usage interests, with high relaxation and experience demands of the public and now it has also the aim of integrating the "Holstein Habitat Corridors". The project is meant to act as a precedent and be an example for sustainably avoiding and compensating transport-related landscape changes.

#### ***4.7. Research***

In order to safeguard metapopulations of threatened species, to safeguard ecosystem functions of habitat creators (bioengineers) and vectors, to keep the adaptability of biocoenoses to habitat dynamics and changing climate and to save the functionality of conservation area systems despite transport infrastructure, nature conservation urgently needs practical knowledge and exemplary projects that efficiently re-linked ecosystems.

Connectivity measures with a special need for testing and monitoring of their effectiveness are:

- shaping of the fauna passages direct surrounding and establishment of a hinterland connectivity,

- balanced interplay of different, but complementary components of measures for reaching sufficient connectivity (dynamic mosaic-approach instead of static, constant and therefore impossible large-area connection of similar habitat types),
- ensure functionality of natural wood strips as components of habitat corridors,
- promotion of self-dynamic processes for reaching nature conservation aims and to ensure network function (amongst others optimization of habitat usage, i.e. mobility of habitat-shaping, large, wild herbivores as well as farm animals on rangeland) and
- the use of transport-accompanying areas (road margins) for re-linking habitats.

With the exception of the importance of transport-accompanying areas (e. g. Vermeulen 1995, Sayer & Schäfer 1995; summarised overview also in Rasmus et al. 2003), there are hitherto no direct, i.e. at best anecdotic research on the above mentioned measures.

Environmental design relating to crossing aids has been neglected so far. But it is probably the most important element to ensure functionality of crossing aids. There is no closer experience, there is only analogue conclusions possible from examinations on single components of measures, like colonization of newly established compensation habitats (e.g. contributions in Dröschmeister & Gruttke 1999, Tischew et al. 2004). Concerning direct importance of crossing aids, data is insufficient, especially on invertebrates (see Georgii et al. 2007, IENE 2009). Natural wood strips, as they were achieved in the project are a new development, experience on its potential success on this is missing.

The intended accompanying investigations are sketched in the following tables.

Nr.	Investigation components	Contents
1	Occurrence of species at destinations in the habitat corridor (e.g. at crossing aids/points)	How does coenosis change/extend and numbers of individuals at target areas because of the change/habitat design in the habitat corridor (before-and after investigations at target area, measure area and reference area; if applicable spatial distribution of well ascertainable indicator species) (Ability to overcome linear barriers dependant on the quality of donor habitats)
2	Occurrence of species in different types of biotope and measure areas in the natural wood strip	Representative before-and after investigations on measure- and reference areas, if applicable spatial distribution of well ascertainable indicator species; colonization of measure areas with different connectivity to donor habitats
3	Impacts of wild migrating, large herbivores in the habitat corridor (investigations of impacts on animals is optional)	The influence "ecosystem engineers" have on the vegetation and on small animals is to be clarified by investigating the change of „effective surface“ (e.g. browsing areas, wallows) in the space and by comparing investigation of coenoses (at influenced and reference areas). If applicable little exclosures are to be established on observing the vegetation development at test areas.
4	Importance of re-designed roadside habitats and wood edges for connectivity of habitats	Representative before- and after investigation on measure and reference areas
5	Overview investigation on the success of further measures (amongst others shape of river bank, pasture and heath management, rewetting)	Cursory before-and after investigations on measure- and reference areas, which in single example comprise the whole spectrum of the measurement types.
6	Permeability analyses for the evaluation of measures and habitat topology for the dispersal of flightless species	Field-mapping of selectec species beyond their reproduction habitats as well as at linear barriers dependant on the location of donor habitats; if applicable marking and recapture investigations.

Table 1: Processing of chosen indicators in the investigation components

Chosen indicators		Plants	Large mammals	Hazel dormouse	Breeding birds	Herpeto-fauna	Grasshoppers	Ground beetles	Butterflies
Investigation components									
1	Occurrence of species at target places in the habitat corridor (e.g. at crossing aids/points)	•	•	•		•	•	•	○
2	Occurrence of species in different types of biotope and measure areas in the natural wood strip	•	•	•	•	○	○	•	○
3	Impacts of wild migrating, large herbivores in the habitat corridor	•				w	w	w	w
4	Importance of re-designed roadside habitats and wood edges for connectivity of habitats	•		○		•	•	○	•
5	Overview investigation on the success of further measures (amongst others shape of river bank, pasture and heath management, rewetting)	•			○	•	•	•	•
6	Permeability analyses for the evaluation of measures and habitat topology for the dispersal of flightless species					•	•	•	

● Focus-investigation, ○ orienting, w = desirable (optional)

## 5. The excursion stations

### 5.1. Hamdorf Inland Dune

Please note, there is no stop here, but this is as a part of the natura2000 network an important core area in the Habitat Corridors.

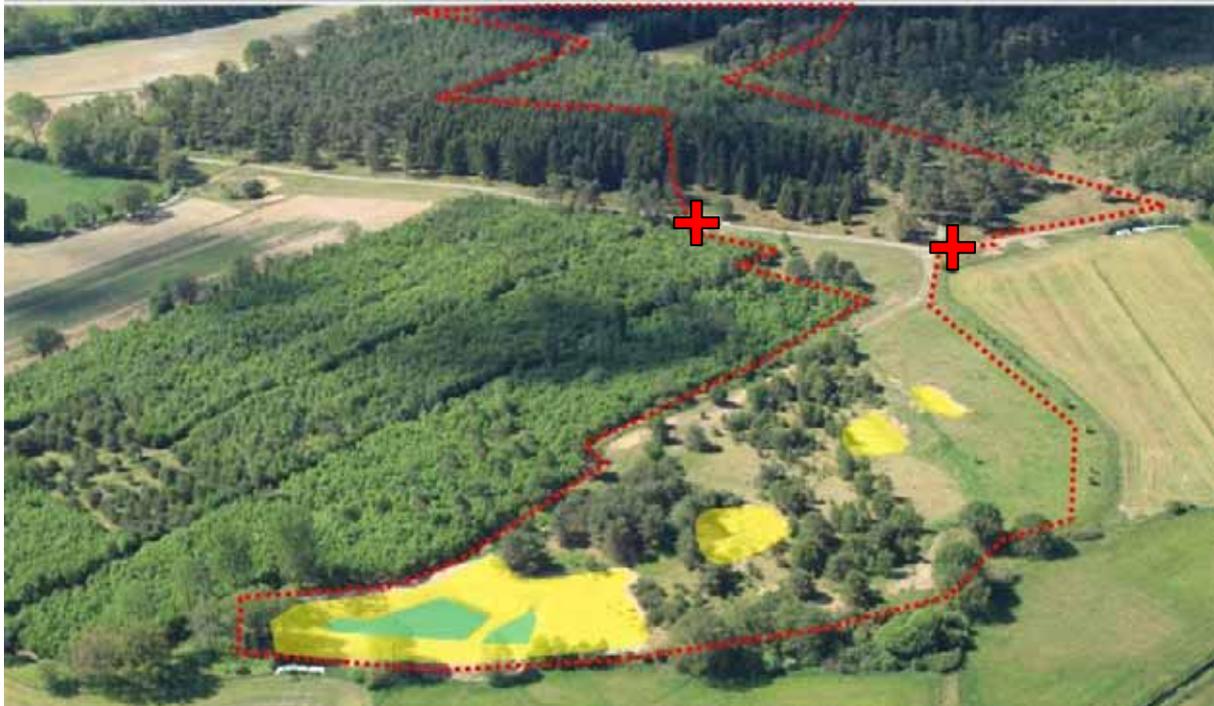


Figure 7: The conservation measures at the Hamdorf Inland Dune from a bird's eye view (dashed red line: borders of the pasture landscape, yellow: bare soil, blue: bodies of water, red crosses: Cattle-Grids; date of photo: 2011)

The Hamdorf inland dune is considered to be one of the best equipped areas with at least in recent times proven species of the habitat directive and other rare species. The Hamdorf inland dune can be effective as an important donor location in the connectivity concept when properly maintained and developed and above all connected. Re-colonization processes will be able to start from here.

In order to ensure and enhance the value in terms of nature conservation, a co-operation treaty on the development of about 13 ha of communal land has been closed between the area owner (Municipality of Negernbötel) and the Nature Conservation Foundation:

- 1) **Conversion of existing non-natural coniferous forests on former inland dunes** for the benefit of nutrient-poor open grassland. Therefore the necessary forest conversion permission (forest is protected by law and must not be converted into open land!) has been obtained.
- 2) **Redevelopment and establishment of special habitat components** for species and communities of dry grassland and ponds in early stages of succession.
- 3) **Integration of rural roads** (especially used by farmers) for the enlargement of the pasture landscape and for overcoming small barriers (by cattle-grids).
- 4) **Establishment of a pasture landscape**, grazing only during the winter months, use of robust cattle, integration of open landscape and wood areas (pasturing management is done by the Nature Conservation Foundation).
- 5) **Provision of pasturing area for local recreation purposes** by the installation of information signs and numerous flap gates and an adaptation of the pasture to the existing ways.

## 5.2. Habitat complex landscape Trentmoor

The areas in the “habitat complex landscape Trentmoor” which have been in partly intensive agricultural utilization up to 2010, were restructured into an moderately used conservation site adapted to the natura2000 targets. As the potential is high (experts have proved remainders of priority species only a few years ago) and recolonization with rare species seems possible because of the location, further conservation measures were realized.

Neighbouring an existing land parcel owned by the Nature Conservation Foundation two more land parcels have been bought with the financial means of the Nature Conservation Fund of Segeberg (a fund filled with compensatory money). Together with the neighbouring species’ conservation field - its special usage system as well is financed by the Nature Conservation Fund Segeberg - there is a total area of 10 ha maintained in nature conservation terms since the Habitat Corridor project has begun. Altogether, measure targets to be mentioned are:

- conservation of rare segetal flora: adapted field management for the conservation of the lamb succory and others
- Strengthening of donor populations e.g. natterjack toad (*Bufo calamita*) and grasshopper (*Omocestus haemorrhoidalis*)
- For ensuring the area quality: grazing with robust cattle especially for structuring of the moor margins, for the maintenance of dry grassland and spawning waters; in this particular case, the cattle could have a negative influence on wildlife, as traditional deer crossing is affected.

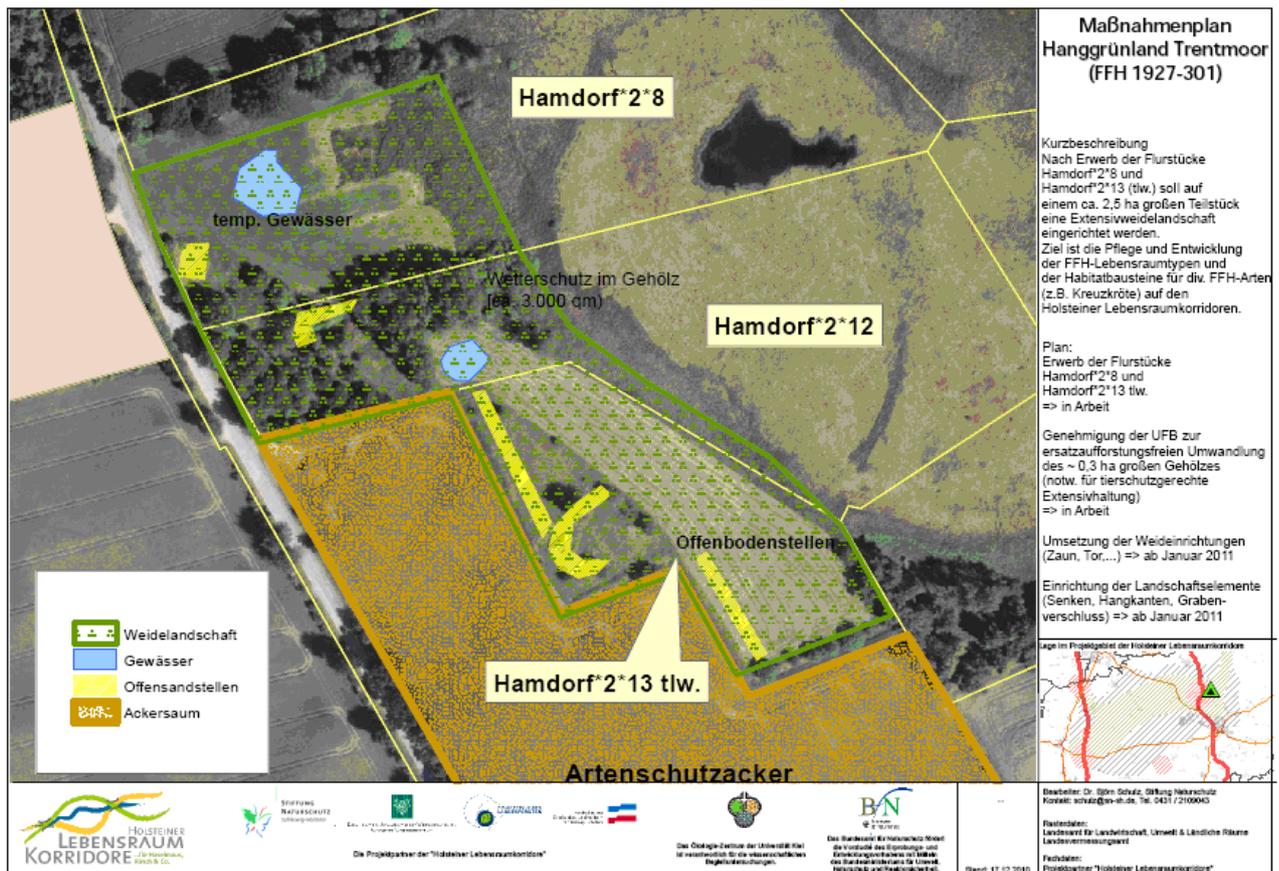
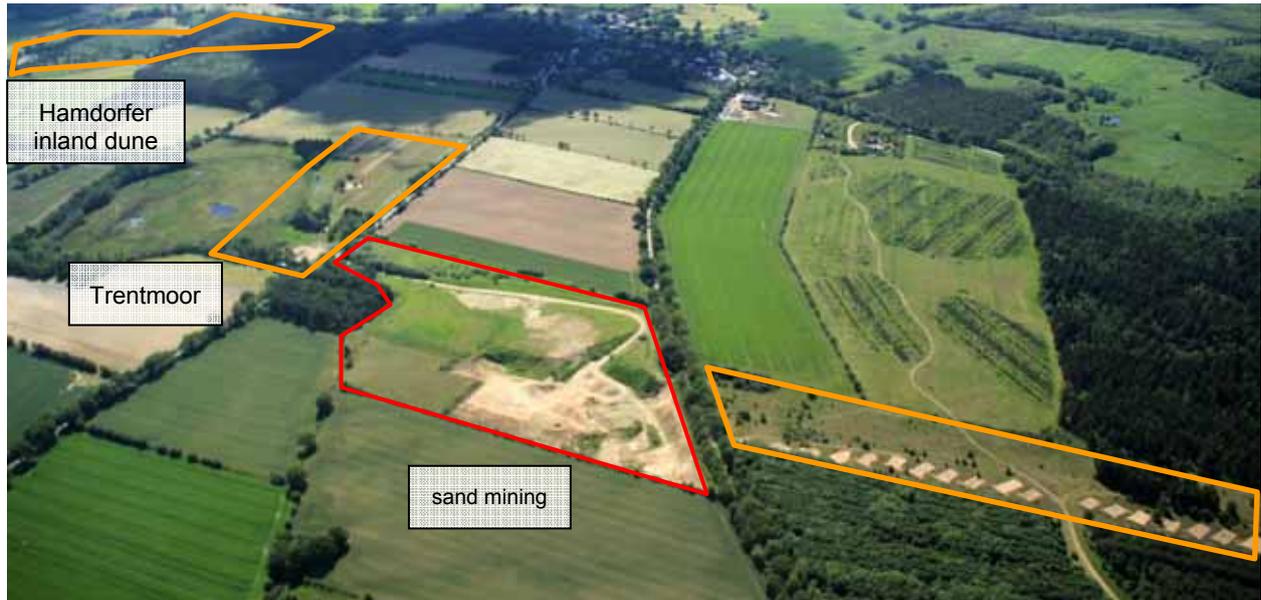


Figure 8: Measure planning at the Trentmoor

### 5.3. Raw materials production and coherent compensation



**Figure 9:** The sand mining area is due to its location and potential development an essential component of the habitat network (date of photo: 2011)

The sand area which is currently being mined, is to serve as example of how in the framework of upcoming mining permissions, nature conservation targets can be effectively realized at an early stage. The target is to maintain and develop the gravel pit in terms of nature conservation, but not to disturb the mining process. Therefore, the Nature Conservation Foundation was negotiating with the gravel-mining company and the UNB as the permission authority for the renewal of the mining permission. After mining the gravel pit will be redesigned into a conservation site and be transferred into the ownership of the Nature Conservation Foundation.

This gravel-mining area serves not only as an essential connecting element between two already secured areas on the heath and dry grassland corridors. It can be an important donor location for rare species in the mining process of more or less coincidentally emerging landscape elements. For example, the largest larval habitats of the six-spot burnet moth in the closer surroundings have been proven here.

In the extremely wet year 2011 (since May), numerous small-sized depression have had sufficient time with water, so that natterjack toad populations “exploded”. Co-operation between the operator and the project partners is meant to ensure these qualities also during the process and of course during the time after the process.



**Figure 10:** Population explosion of the natterjack toad in areas of the gravel mining area, which has been slightly overflowed for several months.

## 5.4. Testing areas

The approx. 3.8 hectare-sized private-owned land parcel Hamdorf \*6\*6 was leased by the project for development and testing means. The contract between the owner and Stiftung Naturschutz allows the irreversible development of this parcel into an conservation site. Thus, a further essential component on the corridor of dry grassland and heath habitats types is protected.

Due to the small area size and the not (yet) permanently assured access to the area, no cost-intensive investment, such as fencing with following pasturing should be made. Because the abandonment of the field more and more threatened the small populations of typical heath species, the following low-cost and also effective simple management measures was realized:

- reactivation of the seedbank by topsoil removal and topsoil perturbation (“sod plugging”)
- transfer of grass cutting biomass from species-rich sites



**Figure 61:** The sod plugging areas on Hamdorf\*6\*6 serve as a multiple testing object, e.g. in what way seed banks can be reactivated by simple soil perturbation or whether they are adequate places for germination for zoochore seed transport (date of photo: 2011).

The sod plugging creates hitherto completely missing open sand habitats, which depending on effect intensity of disturbances and depending on the seed-transport, need more or less time to become green. We hope that in the future a mosaic of open sand areas and plant communities will develop, which range from very early (e.g. grey hairgrass fields) to very late



**Figure 72:** At the area secured by the developing and testing project, transfer trials of grass cuttings of a project co-ordinated by the DVL took place.

stadiums (e.g. loose shrubbery) of heath succession. On some of the 18 sod plugging areas, seeding trials with grass cuttings from species-rich dry grassland in the wider surroundings will take place.

### 5.5. Heath slope and headwaters area of river Trave

The heath slope near Negernbötel is a central donor and target area dependant on management, which has to be integrated into the habitat corridor axis. As for the neighbouring fen, a sustainable, the target-biocoenosis supporting land use has to be achieved. At the steep south-facing areas, facing to the headwaters area of the Faule Trave, rare species have been proved (e.g. the moth species pigmy footman (*Eilema pygmaeola*) which was considered to be extinct in Schleswig-Holstein until their rediscovery. Increasing shrub encroachment threatens the ability for the slopes to serve as habitat for neglected grassland and heath communities.



Figure 83: Hoofed animals as a precondition to guarantee biocoenoses conservation

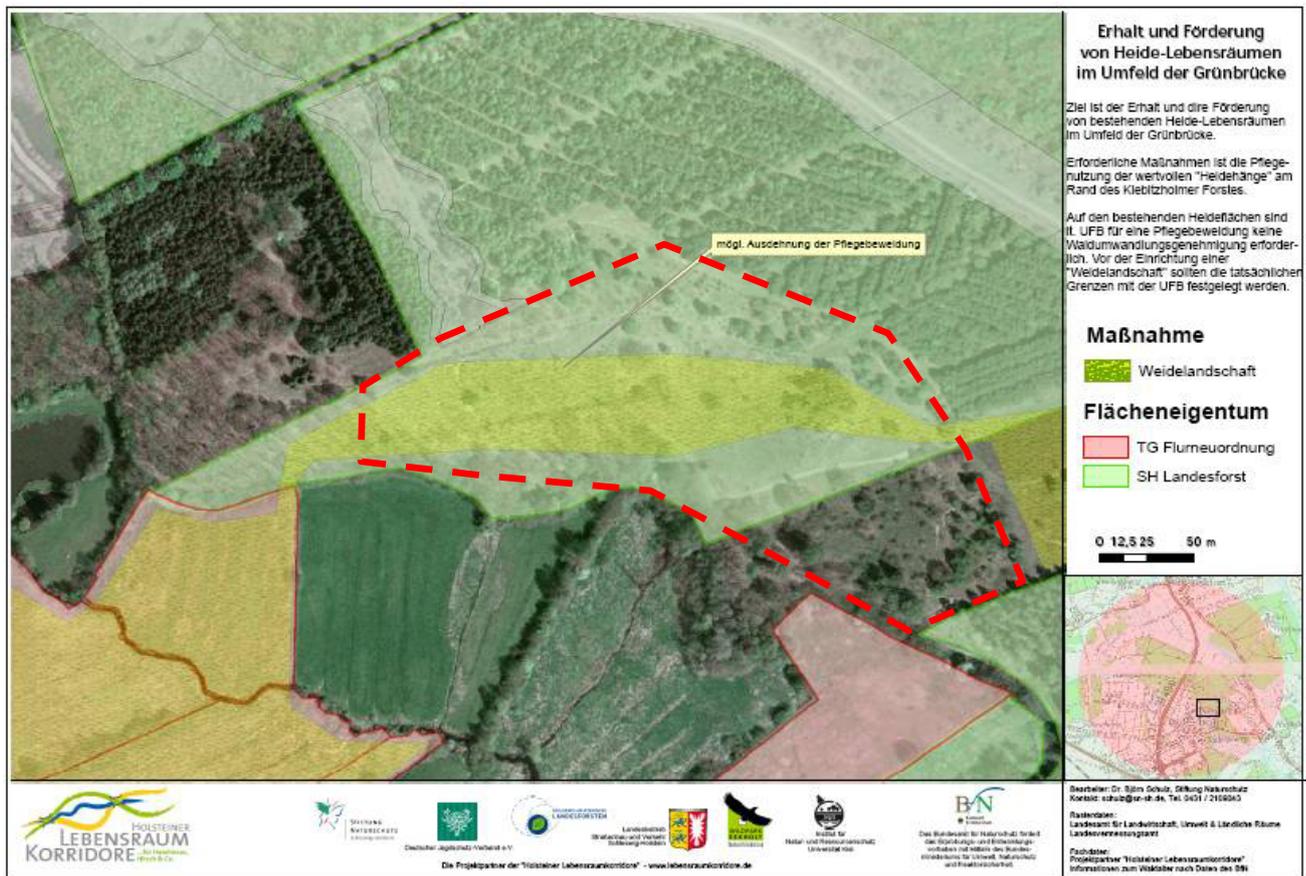
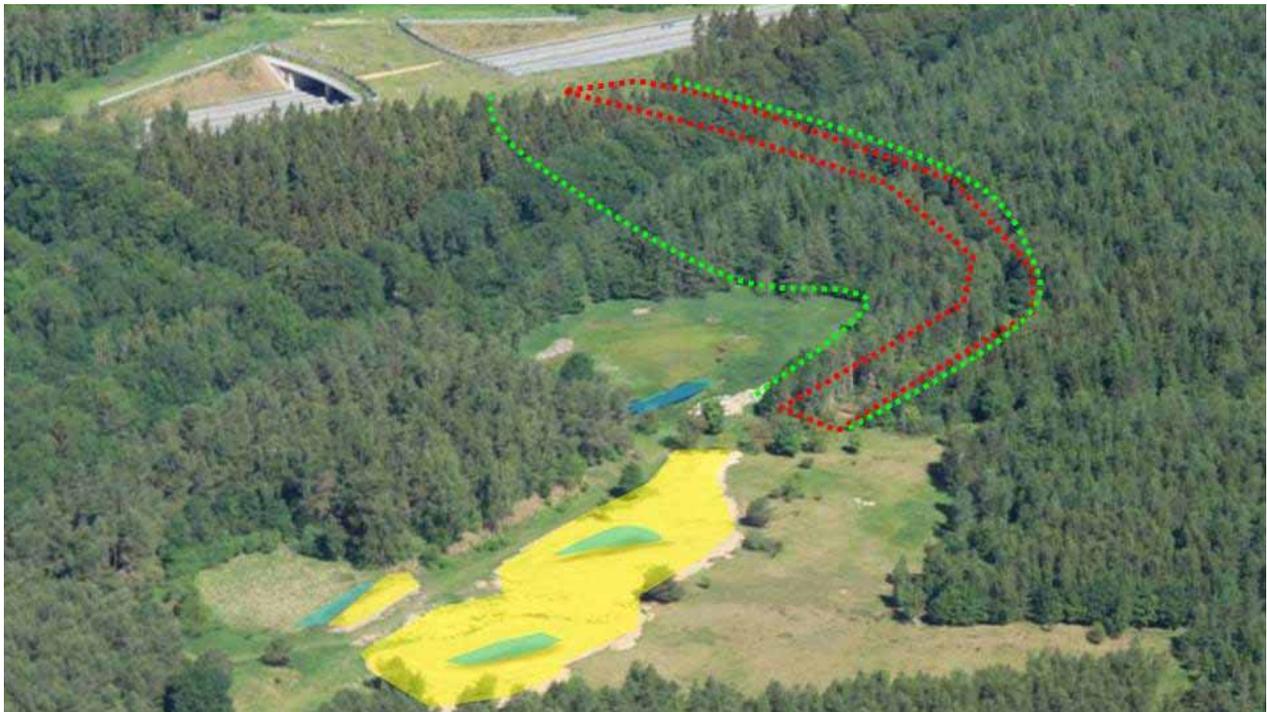


Figure 94: The "heath slopes (red interrupted line) at the Faule Trave" are (still) non-woodland areas owned by the State Forest and private owners and accommodate important target species of heath habitats.

### 5.6. Heath corridors in the forest

In the “intensively used” forests around the Kiebitzholm overpass, numerous open landscape patches are imbedded for several reasons (e.g. historic sites, old gravel mines or adventure areas of the local kindergarten). These clearings and the surrounding wood areas are often species-rich habitats (as a relict of a former landscape-characteristic heath landscape), on the other side they are necessary for re-linking remaining neglected grassland with the heaths and with the overpass. The areas of neglected grassland are not yet completely connected to each other. Often there are narrow bars of conifer woods between the separated heath parts. These barriers are to be eliminated, without disturbing the forest network and forest function too much. The dimensioning necessary for a successful open landscape connection and the (negative and positive) effects of such open landscape aisles in the forest is still quite controversial. An intensive scientific supervision will make things clear.



**Figure 105:** The location of an forest aisle (red dotted: firstly realized forest aisle, spring 2011, green dotted: area of forest conversion applied and approved, after having made an agreement with the forest authorities in 2012) and other habit designs (blue: construction and optimization of waters, yellow: construction of open sand areas) in the direct east surroundings of the wildlife overpass (date of photo: 2011) (Annotation: most recent plans will lead to much wider heathland corridors)

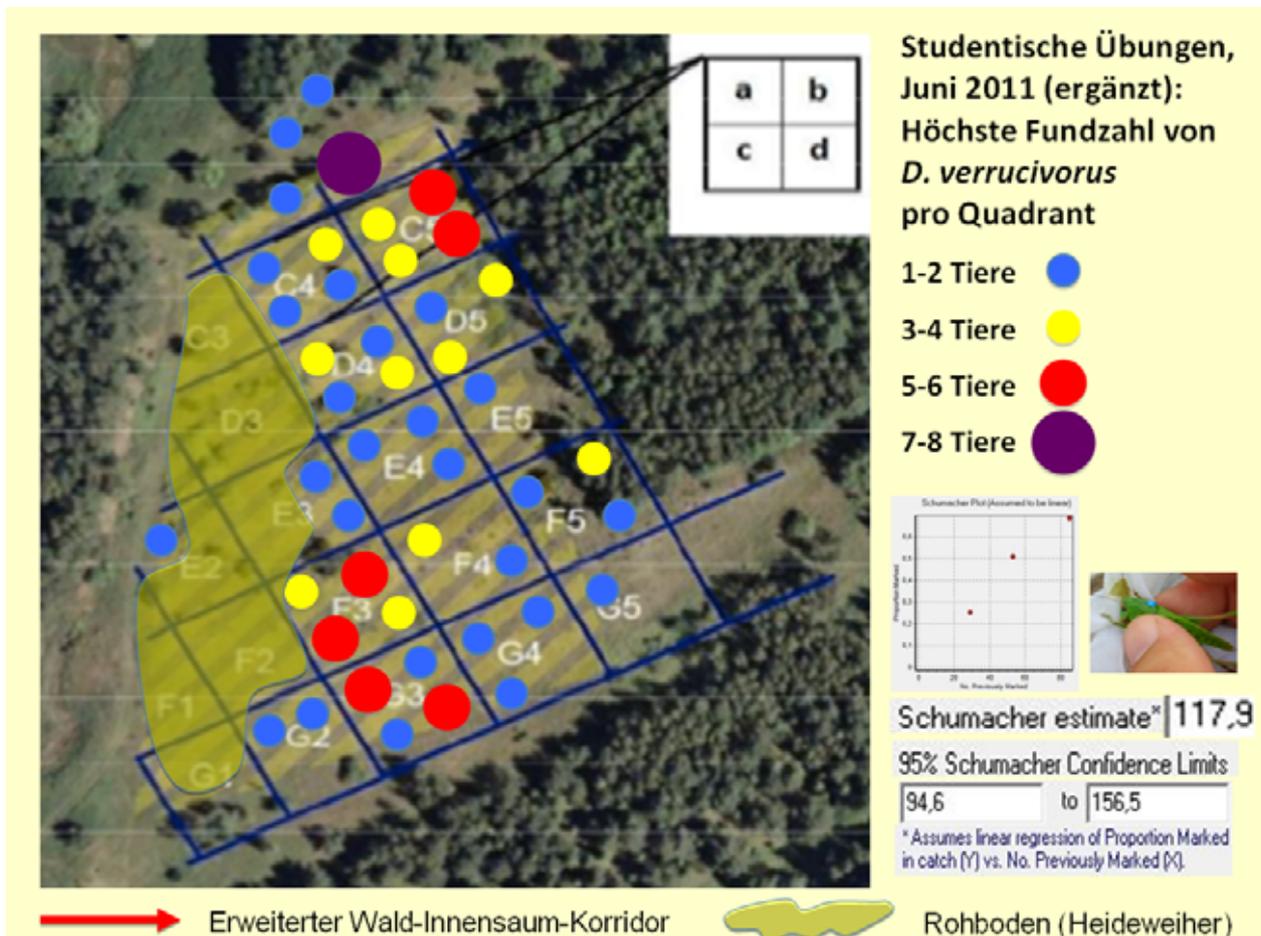
However, for sure is that the isolated open landscape, as relicts that are hardly influenced by neighbouring effects or intensification of use, of a former large-area open landscape in the productive forest, are of high importance for the total diversity of species in the region. They are not only stepping stones but also donor biotopes for several species (e.g. wart-biters). At the same time, these areas are favoured local recreation areas and thus by the project are used intensively for environmental education purposes.

### 5.7. Nature-adventure and environmental education

Kids are addresses to help the project as being a natural scientists assisting with the monitoring of target species. For this purpose, a field guide for children and teachers has been developed. At this special site practical university courses take part as well. This way, e.g. dispersion maps of species of indicator plants and animals (see below) were created.



Figure 116: The children of the Negernbötel day-care centre use project sites as an adventure and education area, they assist the project as researching colleagues



## 5.8. Wildlife overpass Kiebitzholm



Figure 138: The wildlife overpass Kiebitzholm (date of photo: 2011)

### **Main topics**

- Substrate management (-diversity)
- Plantation and maintenance
- Monitor-installations
- Stepping stone biotopes and hinterland connection
- Fences (incl. browsing-protection)

Further explaining information see section 3.1.

An intensive reconstruction of habitats on the fauna passage is planned for end 2012. Then eutrophic soil is to be removed and oligotrophic sand will be accumulated. Shrubs planted on the south slopes will be transferred to the north slopes. This will help those species to reach and successfully cross the fauna passage that have problems to get through high vegetation.

### 5.9. Management of roadside habitats

The direct surroundings of the fauna passage is of special importance as species, that have reached here must be lead onto the fauna passage, so that successful recolonisation can take part. Here the only place for heathland corridors on the west side of the fauna passage is in the narrow lane between the road pavement and the wood edge. As in the past *Prunus serotina* dominated here and thus worked out as a barrier for species of dry grassland, this shrubs including their roots and the surrounding topsoil were removed towards the wood edge.



Figure 14: Management of roadside habitats, here transfer of stands of *Prunus serotina* into open sand



Figure 15: The roadside habitats before (above) and after (below) the transfer of the *Prunus serotina* stand into open sand

### 5.10. *Natural wood strip*

Open landscape biotopes as well as forest biotopes are optimized in terms of nature conservation in this project. Here we present the development and conservation of natural wood strips. Further information on the concept of protected wood strips in productive forests can be sent in an separate script (contact Dr. Reck).



**Figure 19:** The "natural wood strips" (light green rimmed; total size 17 ha) run right across the forestal sections and land parcel boundaries. They were taken completely out of utilization after the reconstruction phase which will last until 2012. The minimum width of the strips is 40 m, the location depends on the location of the overpass and especially on existing ecologically high-quality areas.

Natural wood strips are (at least) 40 m wide wood strips, which are permanently excluded from forestal use. The natural wood strips are to ensure that more old trees and non-use areas are created when forestall use is diclaimed. These strips should be aligned that way that existing old-wood patches are connected. Here a real network of long and narrow old wood patches is present, because there are ancient hedgerow lines in this re-afforestation. The special thing about these natural wood strips introduced here is that they are "tailored" especially for nature conservation requirements disregarding forestal unit boundaries. Furthermore, the natural wood strip leads directly to the wildlife overpass so that stenoecous and wood species of low dispersial ability will find their way to the crossing aid and over it.

### 5.11. Otter tunnel

Topics to be discussed on the otter tunnel are:

- Dimensioning (also regarding location at a main axis of the state-wide habitat network concepts)
- Waterside construction
- Substrate development
- Entrance design
- Environmental design

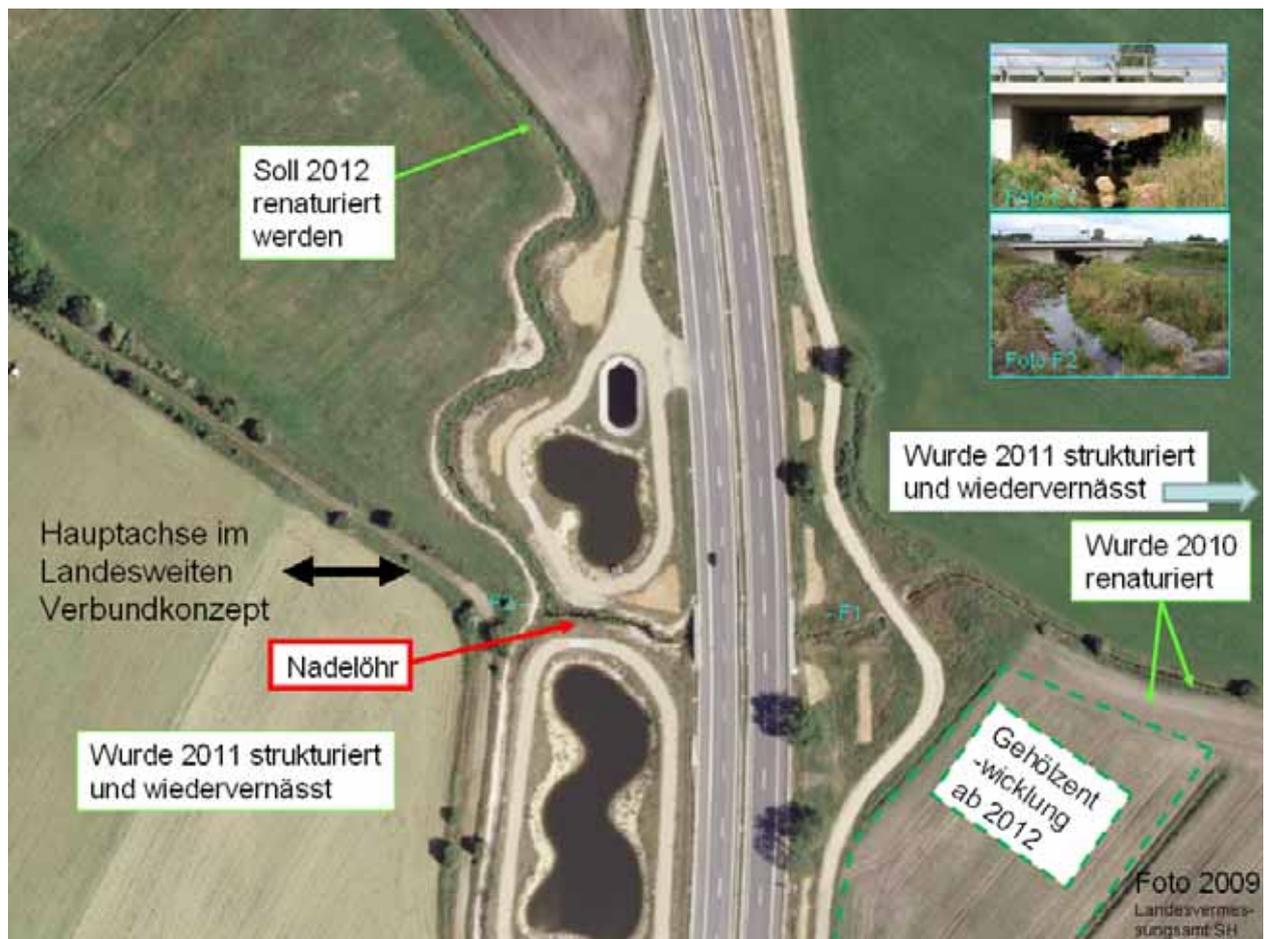


Figure 160: The otter tunnel and its direct surroundings

## 5.12. Compensation fields of Road Agency



Figure 21: The compensation areas of the LBV-SH (road agency) after further nature conservation optimization by the Habitat Corridor Project (uninterrupted red line; large picture: status in 2011, small picture: status under intensive agricultural use before it became a compensation area), the sand strip created at the edges of the forest is well-recognisable, which will serve as dispersion axis for dry grassland species (interrupted red line). This management of roadside habitats was also necessary because the black cherry (*P. serotina*) had reached high dominance and thus acted as a barrier to xerothermophilous species.

The so-called "Brandsau-meadow" (Brandsau-Weide) or "silt-meadow" (Lehmwiesen) used to be a field (on raised bog). Today it is extensively used as grassland. This compensation area of the LBV-SH should serve as an important donor site for amongst others little-mobile amphibian and reptile species, for it is located directly west of the otter underpass. Therefore, it was needed to be further optimized by project measures. In order to achieve this, the former hydrological conditions were recreated by ditch backwatering, drainage deregulation and small water bodies were established as well as strongly levelled surfaces were reversed. These measures took place taking into consideration the development targets defined in the planning agreement.

East of the motorway A21, the raised bog soil is furthermore intensively agriculturally used. Although hydrological measures (WRRL) have been carried out at the Brandsau and in an approx. 10 m wide waterside strip, further stepping stones should be developed in the direct crossing surroundings.

Even though on both side of the otter tunnel more or less high-value habitats have been established, the structural measures in the direct surroundings of the otter tunnel seem to have a negative influence on the crossing frequency of species.

## **6. Contact persons, staff and thanks**

### **Project partners as well as local contact persons:**

Highway Management Services for Road Construction and Transport Schleswig-Holstein (branch office IZ): Volker Seifert

Schleswig-Holstein State Forests: Thomas Jacobi, Ulrik Steffen and Christiane Herty

Landesjagdverband Schleswig-Holstein: Marcus Börner

Wildlife Park Eekholt: Ute Kröger and Jan Hellwig

Ecology Centre of the Christian-Albrechts-University of Kiel: Dr. Heinrich Reck, Kerrin Müller, Henning Nissen

Nature Conservation Foundation Schleswig-Holstein: Dr. Björn Schulz, Christian Lange

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### **Sponsors with project managers:**

BfN – Marita Böttcher

### **Thanks:**

For the excellent support with the researches and the installation of the experiments sets-ups, we would like to thank the Highway Management Services for Road Construction and Transport, Department Landscape Conservation of the branch office Itzehoe (responsible: V. Seifert). The forestry Hamdorf (responsible: Herbert Borchert and Thomas Jacobi and in the meantime Heide Anders-Schnippkoweit) has supported us any time. The Landesamt für Natur und Umwelt (responsible: Arne Drews) has supported us with data and providing us with a necessary catching permission for small animals. We would like to express our special thank to Prof. Dr. Günther B. Hartl (University Kiel) for the possibility to use the gene-laboratory of the Zoologisches Institut and to Volker Seifert for the aerial photos.

For the co-operation with inventory we would like to thank Dr. Leonid Rasran, Henning Nissen, Tim Wiemers, Christian Gaharau, Sina Ehlers, Meike Jaworski, Hauke Hinsch and Sebastian Schulze as well as numerous other students, who were supervised by the colleagues as well as by Prof. Dr. Ulrich Irmeler and Dr. Daniel Hoffmann.