Establishing dry grassland on dump sites for nature conservation development (Lusatian Lignite District) – a 14-years-documentation

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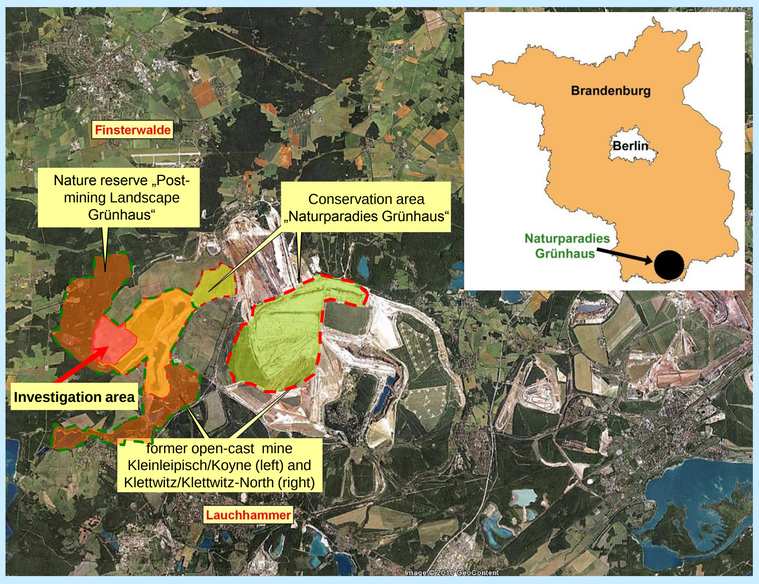
Background

Beginning in 1987 the former Institute for Landscape Research and Conservation, unit Finsterwalde (ILN) first ideas to design a nature reserve in the course of recultivation of a open-cast mine has been developed in co-operation with the Office of Territorial Planning Cottbus. In the early 1990s a project has started together with the Lausitzer Braunkohle AG and in consultation with local authorities of nature conservation and the State Office of Environment to create a model landscape for nature development. For this purpose, a 200 hectare area (Federal State Brandenburg, 13°42'16" - 13°43'43" E, 51°32'35 - 51°33'17" N) situated in the former open-cast mine Kleinleipisch was used. In the following time the area has been integrated into a network of ecological priority sites. Since 2003, it is part of the “Naturparadies Grünhaus”, a conservation area owned by the NABU Foundation for National Natural Heritage, and designated as nature reserve in 2006.

Investigation Area

The investigation area is located appr. 8 km south of the town Finsterwalde. Within the study area coal-bearing (0.8 %) dump sand (ojb-(x)ss (pq)) predominantly occur, which is characterized by a high content of sulfur and extreme low pH values (pH 2.8 to 3.3). Without any manipulation succession pass a long-term (>50 years) vegetation-free stage on such sites. In order to minimize wind erosion loads into neighboring residential areas, it was necessary to reduce this period to a minimum. In addition, effects of initiated vegetation development on colonization processes should be observed.



Investigation area on an arial image (the general map shows its position in the Federal State Brandenburg).

Methods

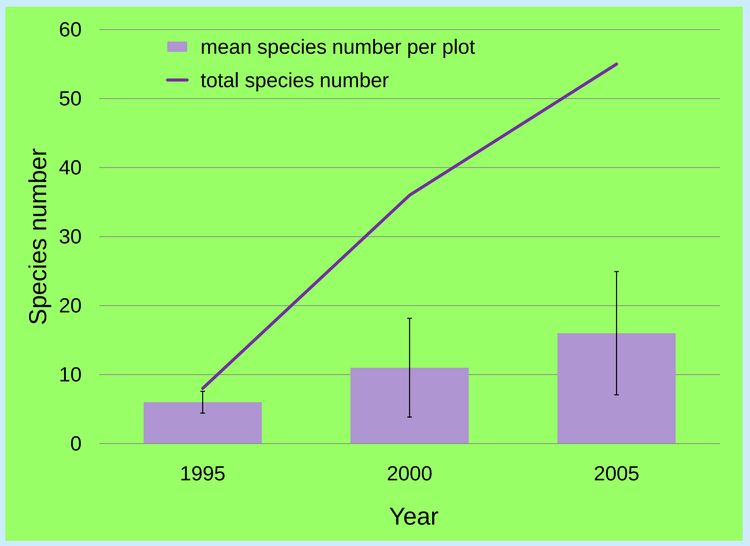
In 1991/92 a grass mixture consisting of 60% sheep fescue (*Festuca filiformis, F. brevipila*), 30% *F. rubra* and 10% *Agrostis capillaris* following shallow amelioration with lime marl (25 to 100 dt CaO ha^{-1}) was used on a total area of 120 ha. Seed density was 6 $g*m^{-2}$.

For the vegetation survey the method of Braun-Blanquet was used. Sampling was made on five plots, each 25 m² in size. Pitfall traps, used to analyze the epigeic spider community and its development, were filled with formaldehyde and exposed, two at each site, on four representative sites between April and October.

Investigation area in 1992 shortly after amelioration.

Results

Within the first years a sparse grass cover has developed mainly composed of *Festuca filiformis* and *F. brevipila.* Only a few pioneer species (*Salsola kali, Sisymbrium altissimum, Corispermum leptopterum*) are found.



Development of species number (herb layer, excluding woody species).

In subsequent years, the density of grass cover increased (mean soil coverage in 2005: >55%) and other vascular plants migrated. However, only *Trifolium arvense* and *Conyza canadensis* spread significantly and reached a constancy of more than 50% on control plots within the first years. In 2000, 36 species of vascular plants (excluding woody species) were detected (mean species number per plot: 11 ± 7). This number increased to 55 species (mean species number per plot: 16 ± 9) until 2005.

Development of species composition and species abundance over the whole period until 2005.

	1995	2000	2005
Shrub layer			
Cytisus scoparius	.	2	4
Herb layer			
Festuca trachyphylla	2	4	3
Festuca filiformis	2	2	2
Agrostis capillaris	+	+	+
Salsola kali	2	.	.
Sisymbrium altissimum	2	.	.
Conyza canadensis	+	+	+
Corispermum leptopterum	2	r	r
Cerastium semidecandrum	1	1	1
Trifolium arvense	.	2	2
Helichrysum arenarium	.	+	1
Hypochoeris radicata	.	+	+
Taraxacum sp.	.	+	r
Senecio vernalis	.	+	+
Erigeron acris	.	r	+
Hieracium pilosella	.	r	+
Corynephorus canescens	.	r	r
Epilobium angustifolium	.	r	r
Filago minima	.	+	+
Medicago lupulina	.	+	1
Arenaria serpyllifolia	.	.	+
Jasione montana	.	.	r
Rumex acetosella	.	.	+

Constancy: < 25% | 25 bis 50% | 50-75% | > 75%

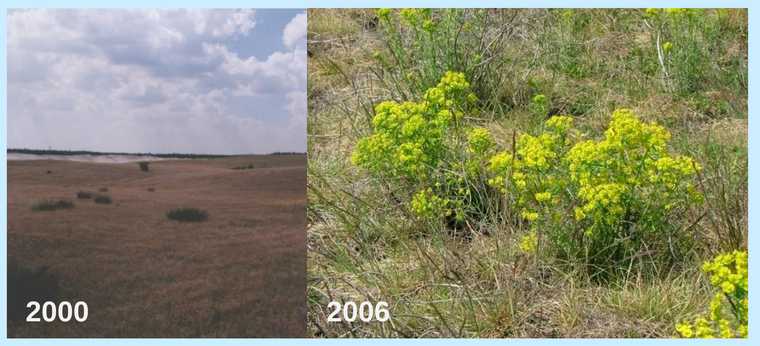
Additionally only in 2000 / 2005 on a single plot each year: *Achillea millefolium* 1/1, *Agrostis stolonifera* 1/+, *Bromus erectus* r/+, *Cerastium holosteoides* +/+, *Dianthus carthusianorum* r/1, *Echium vulgare* +/+, *Filago arvensis* r/r, *Hieracium pilloselloides* r/r, *Leontodon taraxacoides* r/r, *Melilotus alba* r/r, *Phalaris arundinacea* r/r, *Phragmites australis* r/r, *Trifolium dubium* +/+,*Trifolium medium* 1/1, *Trifolium pratense* r/r, *Tussilago farfara* r/+, *Vicia tetrasperma* 1/1, *Avenella flexuosa* r/r, *Hieracium* sp. r/r

only in 2005 on a single plot: *Ajuga genevensis* 1, *Calamagrostis epigejos* 1, *Cirsium vulgare* r, *Crepis tectorum* +, *Daucus carota* r, *Cytisus scoparius* 1, *Spergula morisonii* +, *Thymus serpyllum* 1, *Gypsophila fastigiata* +, *Armeria maritima* r, *Centaurea stoebe* ssp. *australis* r, *Veronica vernalis* r, *Taraxacum elegantius* r, *Poa compressa* +, *Melilotus officinalis* r, *Festuca rubra* +, *Euphorbia cyparissias* r

Braun-Blanquet scale:
r sparse /single individuum; + sparse/ abundance <1%; 1 1-5 %; 2 5-25 %; 3 25-50 %; 4 50-75 %; 5 75-100 %

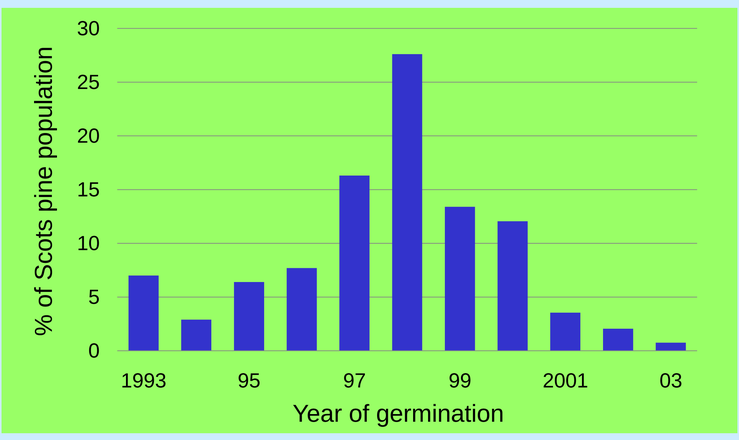
Within 8 years after sowing a dry grassland has developed with a distinct layer of mosses and lichens which reached in 2005 a mean soil coverage of 16% (characteristic species e.g. *Polytrichum piliferum, Cladonia rei, Peltigera didactyla)*. In 2005 the proportion of bare soil was 35%.

Investigation area in 1992 shortly after amelioration.



Succession of woody species

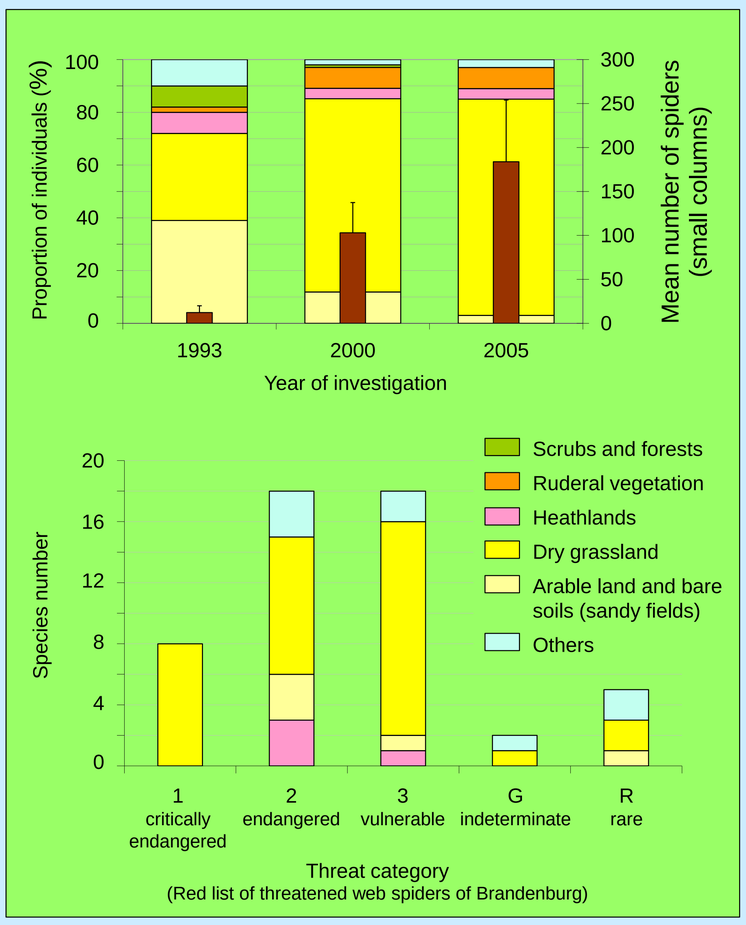
A study of the age structure of pine regeneration (sample number: n = 145) in 2004 showed that, beginning in 1993, the number of successfully germinated seedlings of Scots pine (*Pinus sylvestris*) increased. After a peak in 1998 the annual number of germinating pines decreased rapidly due to decreased bare soil portions and increased dry conditions during vegetation period in the subsequent years. Additionally, only *Cytisus scoparius was* observed more frequently. In 2005 the mean soil coverage of shrub layer was 13 %.



Age structure of Scots pine (*Pinus sylvestris*) as a result of a survey made in 2004.

Epigeic community

According to the development of the vegetation the community of epigeic spiders has changed from a species-poor community dominated by field and bare soil inhabiting species to a typical community of dry grassland vegetation within 8 years. Afterwards, a clear increase of species and individuals is observed until 2005. Finally, approximately 80% of all epigeic spider species recorded in 2005 prefer dry grassland vegetation. In 2005 about 67% of all catched individuals belonged to threatened species. A total number of 51 threatened species was known from the whole study area.



Habitat preference of all observed spider species seperated by years (above) and habitat preference of Red list species (below).