

## Summary

# Characterization, expansion and restoration of Woodrush-beech forests

### Introduction

The object of the Knowledge Network for Restoration and Management of Nature (OBN) is to develop, distribute and utilize knowledge for the benefit of conservation site managers regarding the restoration of nature, Natura 2000, PAS, habitats and the development of new nature.

Within the framework of Natura 2000, rare species and vegetation types in the Netherlands are protected within a European perspective. The focus of the study summarized here is on the habitat type Woodrush-Beech forests (H9110) and on the forest type of the same name. Both make up part of the Woodrush-Beech forest landscape and are protected within the scope of Natura-2000.

The aim of the study is to characterize this type of forest and particularly to examine the possibilities of both enlarging the area and restoring the quality in the Netherlands. In doing so, a distinction was made between (1) the vegetation type (forest type) Woodrush-Beech forest (*Luzulo-Fagetum*), (2) the Woodrush-Beech landscape in which this forest type can be found, together with several other valuable vegetation types, plant species and fauna, and (3) the habitat type Woodrush-Beech forest (H9110).

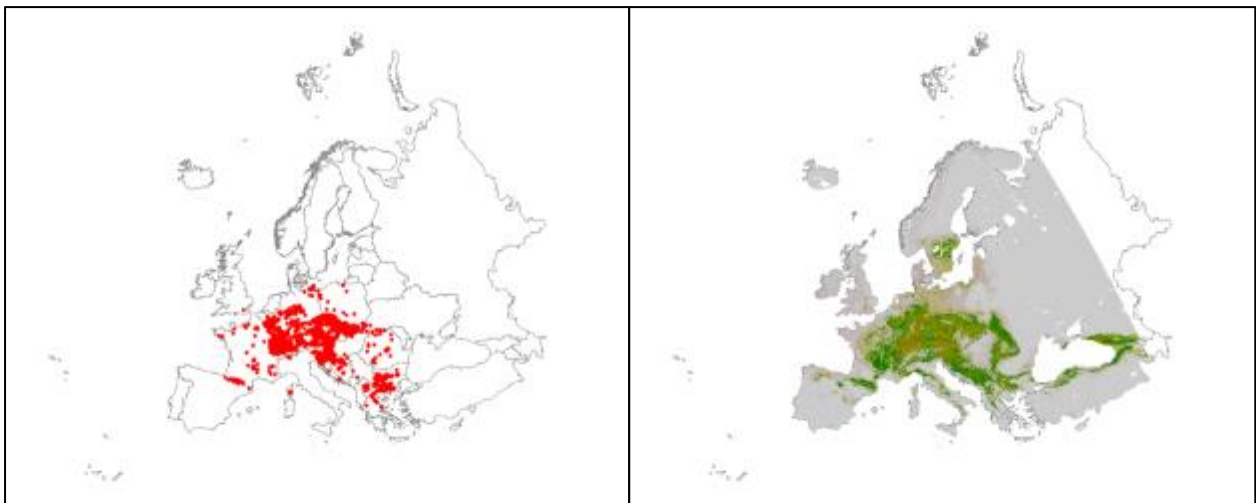
The results of the study are then translated into practical management measures for this habitat type and possibilities for improving quality. Two strategies to that end are described in this respect, namely fully spontaneous forest development and active management (periodical intervention).

## Characterization

The study first deals with the Woodrush-Beech forest as a forest type (*Luzulo-Fagetum*). This forest type is restricted to the south-eastern part of the province of Limburg in the Netherlands, but it is quite common in both adjacent regions abroad and in many other parts of Central Europe. Its distribution is mainly determined by climatic conditions and largely coincides with the transitional zone between a pronounced maritime and a continental climate. This transitional zone is defined by a difference between the average summer and winter temperatures of 15 to 20° C. The average yearly precipitation on a regional scale is also of importance, particularly where it concerns the lower threshold. The optimal level, however, appears to be between 800 to 1200 mm a year.

Within its climatically defined area, the forest type *Luzulo-Fagetum* can be found on various geological formations. The soils are characterized by a good moisture holding capacity (a loamy texture and/or with some stagnation) and are moderately acidic to acidic (optimal pH of the top soil is 4, low base saturation) and moderately nutrient-poor. The humus form is mud-like (moderately poor and acidic) Within the southeast part of the province of Limburg and the adjacent regions abroad, most notably in Belgium, the forest type is virtually restricted to a substrate that - in a European perspective - is very atypical: flint eluvium, covered by a layer of loess of varying depth.

In German literature, the soil types that are suitable for *Luzulo-Fagetum* are largely categorized under the broad range of "Braunerde". French literature refers to these as "sols brun acides et podzoliques". These soil types are more or less limited to areas with an oceanic climate or a climate that has characteristics of both an oceanic and a continental climate. These soils are replaced by more distinct podzols in a pronounced continental climate (Northeast-Europe) or by "chernozemic soils" (black soil; Southeast-Europe).



**Figure 1:** Actual (left) and potential (right) distribution area of the *Luzulo-Fagetum*, estimated by the computer program Maxent based on 8490 relevés with *Fagus sylvatica* (cover > 50%) and *Luzula luzuloides* (present).

The Woodrush-Beech forests of Limburg are virtually restricted to altitudes higher than 180 m above sea level and can be interpreted as a link in the gradient from the (beech) forests on acidic, nutrient-poor soils in the lowlands (*Deschampsio-Fagetum*) towards the typical, montane form of the *Luzulo-Fagetum* that grows in the Central European mountain ranges between 500 and 900 meters above sea level. Based on their species composition, the Woodrush-Beech forests of Zuid-Limburg can be classified as the sub-montane form of the *Luzulo-Fagetum* association. The study also touches on the species composition and its relation to some other forest types.

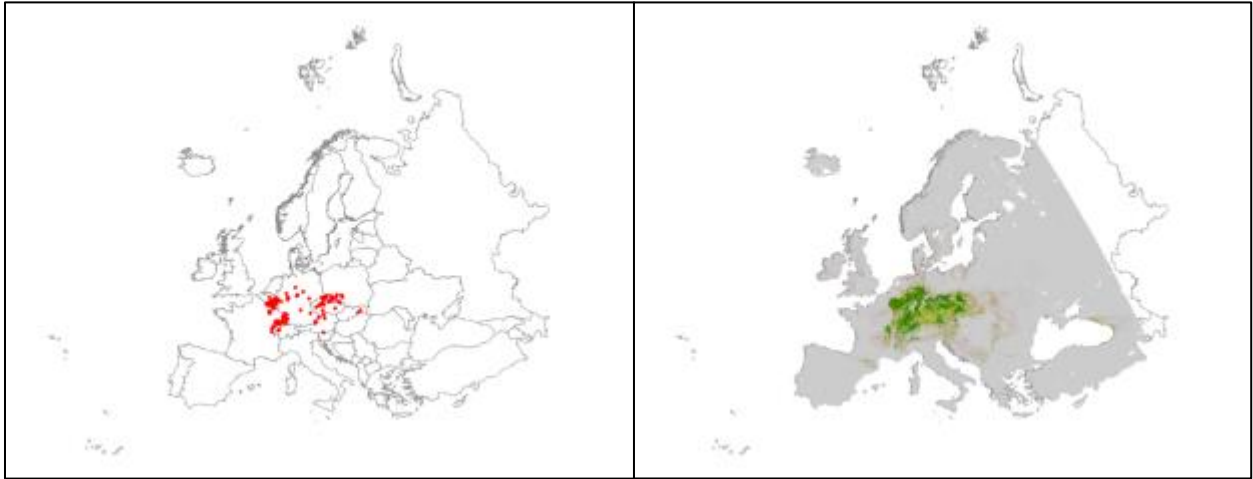


Figure 2: Actual (left) and potential (right) distribution area of the *Luzulo-Quercetum*, estimated by the computer program Maxent based on 384 relevés with either *Quercus robur* or *Q. petraea* (cover > 50%), and *Luzula luzuloides* (present).

A variety of opinions on the (both actual and potential) tree species composition of the Woodrush-Beech are described in international literature. A broad definition of the forest type is recognized in the Netherlands and Flanders, in which young phases of forest development dominated by oak and/or birch are also included. This is relevant because the share of beech trees is strikingly small in most of the Woodrush-Beech forests of Limburg. Moreover, the floristic composition of the sections of forest where beech does dominate is relatively low.

The study also examines the various valuable aspects of the landscape in which the Woodrush-Beech forests are found. This concerns both valuable vegetation types that are replacing the *Luzulo-Fagetum* as well as a number of characteristic species (groups) of which the presence is not necessarily limited to the forest vegetation. Important (competing/replacement) vegetation types include felled areas (including pioneer forest with wild shoots of goat willow *Salix caprea* and elderberry *Sambucus racemose*), bramble thickets, forest edges, barren grasslands (currently no longer present) and dry heathlands.



**Photograph 1:** Characteristic pale inflorescence of the White wood-rush (*Luzula luzuloides*).

The most important species groups studied here include brambles, hawkweeds, mosses and butterflies. Which species are present (or were present as far as known) is indicated for each of the species groups, in addition to any relationship between these species and vegetation- and substrate types and/or patterns. In addition, the study also focusses attention on three rare mammal species that do not have a specific connection with Woodrush-Beech forests, but of which it is known that these forests mark the border of their European habitat. The study examines the manner in which these species use the forest landscape and the extent to which their biotope can be (actively) secured and possibly expanded. These species are Hazel dormouse, Wild cat and Greater mouse-eared bat.

Finally, the study examines the habitat type Woodrush-Beech forest (H9110) and thereby examines the policy framework of Natura-2000 in which the protection of this forest type and related nature values are secured. Possibilities for quality improvement and expansion are also discussed. The starting-point in this respect is a gross list of "conditions for improvement and expansion" (see below). These conditions are subsequently translated into concrete recommendations for management.



**Photograph 2:** Large population of Whorled Solomon's-seal (*Polygonatum verticillatum*) in the Kerperbos.

The conditions described below apply to both the existing Woodrush-Beech forests (improvement) as well as to not (yet) qualifying areas within the landscape (expansion). They are:

- buffering of older core forests against undesired influences, such as fertilizers blowing in and wild shoots of coniferous trees and American oak;
- adequate spatial arranging of old core forests and actively managed forest sections in relation to adjoining ecosystems such as plateau heathlands and felled areas;
- room for the spontaneous development of dead wood and root balls for the benefit of species;
- enough spots with a favorable light climate on the forest floor to stimulate varied undergrowth;
- room for species with 'rich' litter for the benefit of forest species in the undergrowth, paying particular attention to old forest plants;



- room for special brambles (*Rubus*) and hawkweeds (*Hieracium*) that are found on the border and/or in developmental stages in the forests;
- restoration of the butterfly fauna of the Woodrush-Beech landscape, in which the focus is on the forest community itself for moths, and on suitable mosaics with borders and open sections for butterflies;
- room for forest borders and the accompanying bramble bushes for special species such as Hazel dormouse (*Muscardinus avellanarius*) and the Yellow-necked mouse (*Apodemus flavicollis*), but also more common small mammals as a source of food for the Wild cat (*Felis silvestris*);
- the presence of forest sections with little undergrowth and high, old beeches as a hunting ground for bats, particularly the Greater mouse-eared bat (*Myotis myotis*).
- Providing room for the spontaneous establishment of woody pioneer species, such as Goat willow (*Salix caprea*), Red elderberry (*Sambucus racemosa*), Silver birch (*Betula pendula*) and Rowan (*Sorbus aucuparia*);
- Making optimal use of the seed bank for characteristic species that is still present.

### Improvement strategies

The presence of the habitat in itself is no indication of the quality, as major differences can be found within the habitat type depending upon the spot and these differences are directly related to the age of the stand, its floristic composition and the presence of specific other vegetation communities and relating fauna. It can be said in general that well-developed examples of the Woodrush-Beech forest vegetation also have nature values of the highest level, but that is not the case by definition. Particularly in forest areas that have developed spontaneously further to a coppicing situation and that are located on shallow flint eluvium, it is not uncommon to find interesting and often relatively species-rich, yet beech-poor young stages of the Woodrush-Beech vegetation. These generally concern transitions from (secondary) oak *Quercus* forests (also described as *Luzulo-Quercetum* in foreign literature) with an abundance of Beech to a further developed, typical *Luzulo-Fagetum* vegetation. Examples of vegetations that are ranked as the habitat type Woodrush-Beech with a relatively low nature value generally concern even-aged and uniform mono-cultures of broad-leaved trees (mainly pedunculate oak) that were planted following World War II.



**Photograph 3:** Dry heathland on shallow flint-eluvium in the Onderste bos.

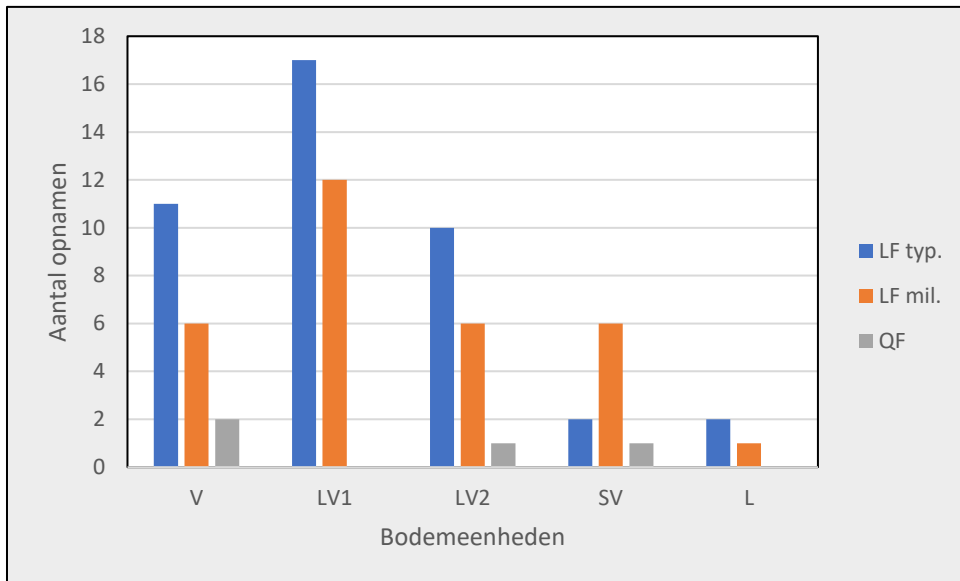
With respect to aspiring after the quality improvement of the habitat type, there are essentially two strategies at our disposal: (1) enhancing the quality of the habitat type itself, which in actual practice means transforming the current mono-cultures and (2) by allowing, whether temporarily or not, the development of other communities with high nature values within the existing forest landscape (including felled areas, heaths, forest borders). The existing surface area of the habitat type is not reduced in either case and there may be no loss of quality.

The quality improvement can be achieved via two strategies:

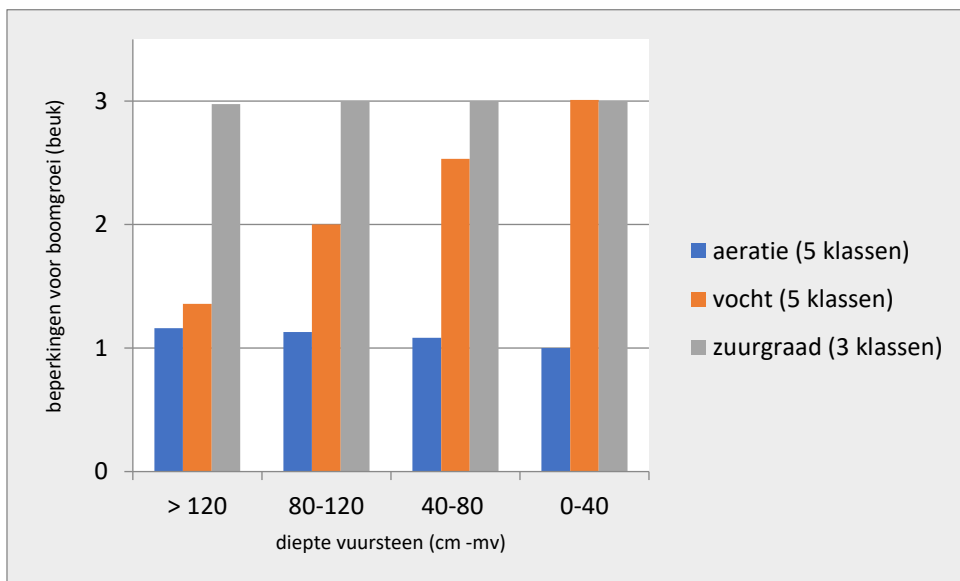
- Focusing fully on spontaneous forest development and, if necessary;
- Periodical intervention with an aim to secure the desired nature values within the Woodrush-Beech landscape, including other valuable species groups.

As both strategies are important for developing and strengthening the desired aspects concerning nature quality, there should be ample opportunity for both. It is important in both cases that full use is made of the soil gradient and that both the actively managed forests or forest sections as well as those intended for spontaneous development are sufficiently robust. It is proposed that at least one section in each of the two most important forest complexes with Woodrush-Beech in Zuid-Limburg (the Vijlen plateau and the Onderste-/Bovenste Bos complex) be reserved for spontaneous development for an indefinite period of time (without intervention).

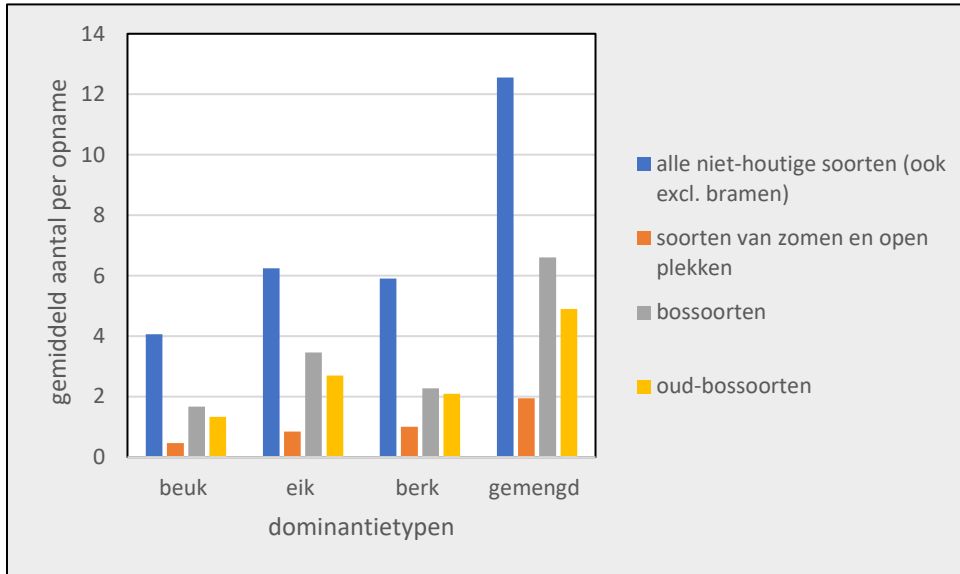
In addition to the conditions formulated above, there are also a few uncertainties and obscurities of a somewhat more generic nature. There is presently a tendency towards the development towards a warmer, more moderate and wetter climate (with higher (winter) temperatures, a more limited annual temperature range and a higher annual precipitation total) and one must question in what way this will influence the development of the Woodrush-Beech habitat in the future.



**Figure 3:** Distribution of forest types over the soil gradient within the Luzulo-Fagetum area. LF typ.: Luzulo-Fagetum typicum; LF-mil.: Luzulo-Fagetum milietosum; QF: Querco-Fagetea ("rich" broad-leaved forests). In this figure all relevés of the Luzulo-Fagetum are included (incl. less clearly developed examples).

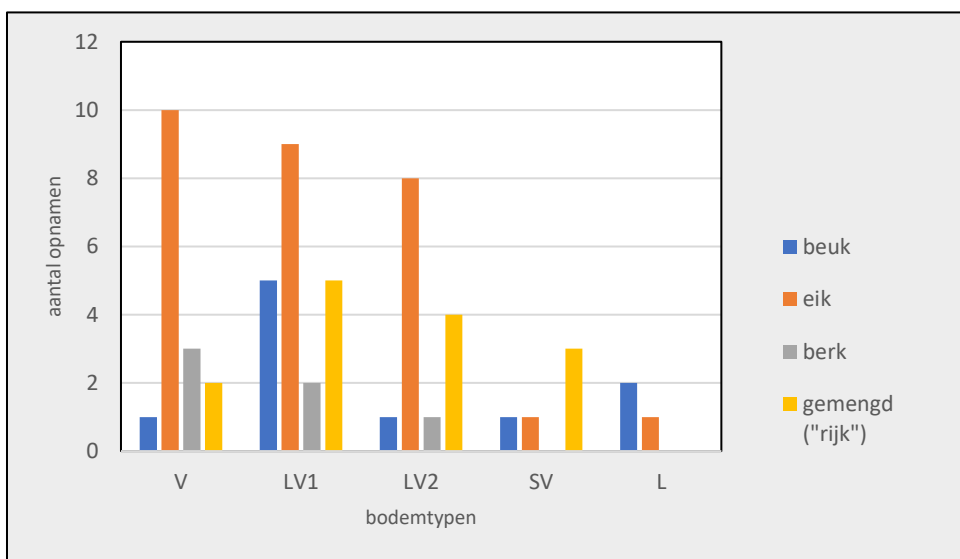


**Figure 4:** Limitations for the growth of beech based on weighted averages of the suitability classes for the various non-generalized soil types (suitability classes after: Mekkink en Kleijer, 1986). diepte vuursteen: flint depth, aeratie: aeration, vocht: moisture, zuurgraad: acidity.



**Figure 5:** Differences in botanical diversity of the herb layer of the *Luzulo-Fagetum* in South-Limburg in different stand types (dominating tree species).

Beuk: beech; eik: oak; berk: birch; gemengd: mixed forests with species producing easily decomposable litter (cover > 25%). Alle niet-houtige soorten (ook excl. bramen) = all non-woody species (excl. brambles) / soorten van zomen en open plekken = species borders and open locations / bossoorten = tree species / oud-bossoorten = older tree species



**Figure 6:** Relation between stand type (dominant tree species) and soil type.

beuk = beech / eik = oak / berk = birch / gemengd = mixed / bodemtypen = soil types

V = flint-eluvium / LV1 = loess on flint 40-80 / LV2 = loess on flint 80-120 / SV = eroded flint eluvium / L = loess loam soils.



## **Strategy spontaneous development**

Creating favorable and robust zones that allow for spontaneous development is preceded by a once-only conversion of intermediate, planted forest stands. These may concern coniferous stands (which in fact implies an extension of the habitat type) or relatively recently planted mono-cultures of broadleaved forest. A number of concrete recommendations, aimed at achieving the greatest possible variety of development phases (spread across the soil gradient) have been formulated for the conversion planted broadleaved forest to spontaneous developing forest:

- guaranteeing a sufficiently open forest canopy (through thinning and selective cutting) in order to promote the establishment of pioneer species (such as birch and possibly domestic oak and wild cherry as well);
- thinning by means of ring-barking may be considered to create standing dead wood, but thicker older trees should be spared;
- where it concerns cutting down trees, it is recommended to spare any suppliers of rich and easily decomposable litter that may be present (sycamore, hazel, common aspen, grey poplar, wild cherry and lime);
- remove all exotic, non-indigenous species;
- suppress beech and favor sessile oak above pedunculate oak insofar as relevant;
- finally, the once-only planting of small groups of trees is recommended in some of the (regeneration) clearings within the (future) cores with spontaneous development, such with an aim to (1) stimulate the development of forest stands that are dominated by (sessile) oak and (2) to create in the course of time the availability of seed sources for shadow-tolerant trees (other than beech) that may in time permanently establish themselves and that have a positive impact on the litter quality (and consequently the forest flora).

## **Strategy active management**

Within the zones in which active management (periodical intervention) is observed, the emphasis should also be on spontaneous development. Which means that (1) the aim should be robust units that cover the soil gradient as much as possible, (2) spontaneously developed forest sections found spread out through the zone should be left intact as much as possible, (3) the coniferous stands within these zones should be converted into broadleaved forest and (4) relatively young mono-cultures of broadleaved forest should be converted as described above.

Unlike the procedure in the zones with fully spontaneous development, maintaining relatively open forests with pioneer species and (sessile) oak requires constant care. In addition, space should be reserved to allow for the (periodical) development of other valuable (competing) vegetation types other than Woodrush-Beech. Concretely, the recommendations are:

- ensure an extra open vegetation structure locally on shallow flint soils, by coppicing or the development of heath vegetation;
- push back the fringe of the wood along roads and pathways such that the development of bramble bush and rough herbage is stimulated;
- create temporary open spaces within the forest – possibly facilitating the establishment of birch and oak - by means of periodically felling small groups of trees;
- if the rejuvenation of oak is considered to be insufficient, plant small groups of around 40 (preferably sessile) oak trees;
- it is furthermore recommended to pay extra care to the removal of coniferous trees and treelets in a buffer zone of 50-100 m around the boundary of the zone with fully spontaneous development.
- observe a long-term plan, avoiding any ad hoc management as much as possible.



**Photograph 3:** Felled area on shallow flint-eluvium in the Belgian part of the Malensbos.

The extension of habitat type H9110 is by definition restricted to the potential area of the Woodrush-Beech forest. This potential area is described above. It is important in this respect that our definition of the Woodrush-Beech forest and habitat type includes all broadleaved forests that are characterized by a dominance of indigenous tree species and that are found on long-existing flint eluvium-based soils. The most significant possibility for expanding the habitat type lies in the conversion of coniferous stands within the present forest regions. It is recommended that the working method involves the simultaneous felling of all coniferous trees, the removal of the litter layer (not where the undergrowth is well-developed, heath berry for example) and (repeated) cutting of coniferous regeneration. Depending upon local conditions, one option can be to keep the felled areas open with active management, to facilitate the development of heathland (at locations where the flint eluvium layer is very shallow), barren grasslands (on less shallow soils) and species-rich forest edges (particularly on the plateau fringes facing the south). One may opt elsewhere for spontaneous forest development, which starts with the establishment of pioneer species such as goat willow. At locations that lack a (sufficient) supply of seed for shade-tolerant broad-leaved tree species - other than beech - that may possibly play a role in future forest development phases, such species can be planted locally in groups on the felled areas. This concerns sycamore, common hornbeam, small-leaved lime and possibly wych elm.



**Photograph 4:** Norway spruce as roadside trees in the Kerperbos.

A second possibility towards enlarging the area of habitat type H9110 is reforestation, either by active planting on or allowing for spontaneous development of agricultural land on the flint plateaus. The best opportunities in that respect are present in the area between the valleys of Geul and Gulp, near the villages of Eperhei and Heijenrath. Creating a forest corridor on the plateau there, in between the present forests covering the valley slopes, will mainly be of significance for the fauna. Due to the nutrient rich arable soils, the potentials for developing botanically valuable forest are very limited, even for the medium range. However, if valuable non-forest vegetation types could be developed on the plateau, the extension zone would still qualify as (moderately developed) habitat type, provided that it is connected to the present Woodrush-Beech forests.

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