REPORT from the conference (Summary/Discussion)

The role of large herbivores in north-west European vegetation

Copenhagen, 5 – 6 May 2001

Photo: Hans Kampf

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The role of large herbivores in north-west European vegetation

-Symposium on the vegetation structure and species composition of the 'natural' environment in northwest Europe under influence of large herbivores in the past and the present, combined with perspectives for the management of Danish nature:

Host organisations: *Geological Survey of Denmark and Greenland (GEUS), WWF Denmark and Nepenthes:*

Date:	*5. – 6. 2001, 8:30– 18:15 both days.*
Place:	*Geocenter, Øster Voldgade 10, 2100 Copenhagen*

There is a general agreement among researchers that north European virgin forest was a dynamic system which included populations of large mammals. There are competing hypotheses as to whether or not large herbivores had a regional influence on vegetation and could maintain 'wood pasture' conditions over large areas. The issue has relevance for how we manage nature today. It is an issue of importance for the current development of the Danish natural forest programme and the action plan for protection of biodiversity.

Purpose of day 1:
To discuss a reference model for the natural environment of north western Europe covering the structure and composition of the vegetation, the types and numbers of large herbivores and the interaction between these where humans were not a decisive factor:
The outcome of the day should be a clarification of the question: What did the “original Danish nature” look like?

Purpose of day 2:
To clarify the current state of management of Danish nature in relation to the reference model and to suggest ideas about how the model might be integrated into the management of Danish nature.

Conference topics include:
- *Was 'natural' Danish vegetation wood pasture or closed forest?*
- *Which animals belong to the 'natural' Danish fauna?*
- *Were large mammals key species and should we therefore re-introduce them into selected areas?*
- *Do we have space for dynamic, large-scale nature in Denmark. If so where? Should agriculture, forestry and hunting be restricted in these areas?*
- *How can the general public be included in nature conservation?*
- *Which theory of virgin forest is best supported by current experience with browsing and forest succession?*

Programme for day 1:
Chairmen: Prof. George Peterken & Ph.d. Alistair J. Bath

08:30	*Coffee/tea*
09:00 – 09:30	*Welcome and official opening with Chairman of the Parliament Committee of Environment Jørn Jespersen.*
	Grazers of the past
09:30 – 10:15	*Dr. Adrian Lister, University College London*
10:15 – 10:30	*Coffee/tea*
	Vegetation of the past - structure and composition
10:30 – 11:00	*Dr. Richard Bradshaw, GEUS*
11:00 – 11:30	*Prof. Shinya Sugita, Ehime University, Japan*
	Grazing Ecology and Forest History - a model
11:45 – 12:30	*Dr. Frans Vera, Ministry of Agriculture, The Netherlands*
12:30 – 13:30	*Lunch*
13:30 - 13:45	*MSc. in Forestry Peter Friis Møller, GEUS*
13:45 – 14:15	*Discussion about the past*
	Present-day herbivore-forest relationships
14:15 - 14:45	*Dr. Jonas Bergqvist, SLU, Sweden*
14:45 - 15:15	*Rita Merete Buttenschøn, KVL*
15:25- 15:40	*Coffee/tea*
	Bringing it all together
15:40-16:10	*The Danish Landscape, Ph.d. Rasmus Ejrnæs, DMU*
16:10-16:40	*The British Landscape, Prof. George Peterken, Oxford University*
16:40 -18:15	*General Discussion and summation of the day, George Peterken*
19:00	*Conference Dinner*

Programme for day 2:
Chairmen: Chef adviser to the Government on the Environment Peder Agger, Danish Council for Nature & Secretary General Kim Carstensen, WWF Denmark

08:30	*Coffee/tea*
09:00 – 09:15	*Peder Agger: Introduction to the topics and conclusions of day 2 and explanation of the relevance of the topics and conclusions in relation to the outcome of day 1.*
09:15 – 10:05	***Status of Danish natural vegetation types*** *Forest and Nature Management Agency, Denmark.*
10:05 – 10:55	***Status of Danish nature management in relation to species- and habitat development (redlists), EU-legislation, international agreements*** *Director Torben Klein, ATV.*
10:55 – 11:10	*Coffee/tea*
11:10 – 12:00	***Organizing dynamic nature - Dutch experiences*** *Senior Policy Advisor Hans Kampf, Dutch Ministry for Agriculture, Fisheries and Naturemanagement.*
12:00 – 13:00	*Lunch*
13:00 – 13:50	***Managing dynamic nature - Dutch experiences*** *Mr. Jan Gorter , Natuurmonumenten. Dutch regional planning*
13:50 – 14:40	***Practical experiences with Danish grazing regimes:*** *Mag.scient. Poul Hald-Mortensen, Aage V. Jensen's fund*
14:40 – 14:55	*Coffee/tea*
14:55 – 15:45	***How to create public and political focus on the subject dynamic nature?*** *Ph.d. Alistair J. Bath, University of Newfoundland, Canada*
15:45 – 16:35	***Combining economic incentives with Nature management - Panparks as a solution?*** *Co-ordinator Joep W. G. van de Vlasakker, Panpark Vesteuropa*
16:35 – 16:45	*Coffe/tea*
16:45 – 17:00	***Large-scale dynamic nature in Denmark: Utopia or real possibility?*** *Jacob Andersen, President of Nepenthes.*
17:00 – 18:15	*General discussion and summation of the conference: Peder Agger, Director of the Danish Council for Nature*

The history of large harbivores in northwest Europe: Models for today?
Dr. Adrian Lister

The history of large herbivores in northwest Europe: models for today?

The history of the mammal fauna of Europe over the past 500,000 years is one of dramatic changes. The major cycles are between glacial and intergacial cycles on a roughly 100,000 year cyclicity. Interglacials saw a rich mammal fauna including elephants, rhinoceroses, hippopotami, up to six species of deer and two large bovids (see Table), plus big cats and hyaenas, as well as more familiar small mammals and carnivores. There was a general decline in species richness through the interglacials in the interval 500-100,000 years ago, but even the Last Interglacial (c. 120,000 years ago) saw an extensive megafauna, much of it now extinct, so cannot provide a meaningful model for today's 'natural' ecosystem in Europe. The interglacials also differed one from the other, e.g. the penultimate interglacial, c. 200,000 years ago, had a markedly savannah-like aspect, at least as reflected in its mammal fauna, while the Last Interglacial seems to have had a higher proportion of forest habitat. It is likely that a mixture of open and closed habitats was favourable to the high mammalian diversity, and according to some scholars was partly maintained by the activities of herbivores themselves.

Countries at the latitude of Britain, The Netherlands and Denmark showed the most extreme turnover in mammal faunas between glacial and interglacial stages, because their latitude makes them very sensitive to movements in the polar front. The mammal fauna of the Last Cold Stage (c. 100,000 - 10,000 years ago) included species now extinct (e.g. mammoth), those today typical of tundra (e.g. reindeer), and those of steppic grasslands (e.g. ground squirrels).

The Last Cold Stage also saw a major extinction event of large mammals across the globe. In Europe, these can be divided into two waves. Interglacial megafauna, such as the straight-tusked elephant and interglacial rhinoceros, retreated into southern Europe where they became extinct before or during the Last Glacial Maximum (maximum extent of the ice sheets, c. 20,000 years ago). Extant species such as hippopotamus also became regionally extinct from a European point of view. In the second wave, between about 12-10,000 years ago, cold-adapted megafauna such as mammoth and woolly rhinoceros became globally extinct. Explanations for this event are divided between those which favour human hunting ('overkill'), and those which point to the major change in vegetational structure (specifically, loss of the mosaic 'mammoth steppe' environment), ultimately driven by climate change. Combined vegetational and hunting hypotheses are also possible.

By the early Holocene, 9,000 years ago, the forests of NW Europe had been recolonised not only by species still surviving in our countries, such as red and roe deer, but also elk, aurochs, bear, wolf, lynx, beaver and others. However, this fauna was seriously impoverished compared to previous interglacials, specifically in large herbivores and carnivores (see Table). The 12 or so species of herbivorous large mammals of the previous interglacials had become reduced to only five, and it is unlikely that they exerted as high a grazing pressure.

Moreover, the 10,000 years of the Holocene have seen their own natural climatic and vegetational changes, so how much can even the early Holocene fauna be considered a correct model for today, if we could recreate today's natural habitats? Some species left the region long ago, due to natural Holocene changes, such as horse and pond tortoise; others are now extinct, such as aurochs, unless one follows the path of 'recreating' them genetically.

Most of the other species, however, disappeared after the Neolithic agricultural revolution or even in very recent centuries, as a result of habitat clearance and hunting. In theory, these species still 'belong' in our region. Models for their persistence in a reasonably aboriginal ecosystem exist to the east, in Poland and Russia. However, crucial to the survival of these communities is the fact that they are embedded in very large areas of habitat (particularly, the Russia taiga), so the mammals form a semi-natural metapopulation which can survive as a whole even if local areas are squeezed for various reasons. Could isolated patches of this marvellous ecosystem survive in small countries such as Britain, The Netherlands or Denmark, with their high-density agriculture and urbanisation? 'Artificial' nature may be the best we can achieve, but it is far better than nothing at all. In this case, a mosaic vegetational environment such as wood-pasture, with the habitat variety which promoted high mammalian diversity at times in the Pleistocene, may be a more suitable model than closed forest, which can support relatively fewer types of large mammalian herbivores.

Ungulate faunas from British Interglacials

STAGE	17	15	13	11	9	7	5e	1
Cervidae								
Megaloceros verticornis	X	X	X					
M. savini	X	X						
M. dawkinsi		X	X					
M. giganteus				X	X	X	X	
Alces latifrons	X		X					
A. alces								X
Cervus elaphus	X	X	X	X	X	X	X	X
Dama dama	X	X	X	X	X		X	
Capreolus capreolus	X		X	X	X	X	X	X
Bovidae								
Bison schoetensacki	X	X						
B. priscus			X			X	X	
Bos primigenius				X	X	X	X	X
Suina								
Hippopotamus amphibius		X	X				X	
Sus scrofa	X	X		X	X	X	X	X
Rhinocerotidae								
Stephanorhinus hundsheimensis	X	X	X					

S. kirchbergensis				**X**	**X**	**X**		
S. hemitoechus				**X**	**X**	**X**	**X**	
Equidae								
Equus ferus	**X**	**X**	**X**	**X**	**X**	**X**		
E.altidens/hydruntinus	**X**	**X**		**X**				
Proboscidea								
Palaeoloxodon antiquus		**X**	**(X)**	**X**	**X**	**X**	**X**	
Mammuthus trogontherii	**X**	**X**	**(X)**					
M. primigenius						**X**		
TOTAL	**12**	**13**	**12**	**11**	**10**	**11**	**10**	**5**

Vegetation of the past – structure and composition
Dr. Richard Bradshaw

Past vegetation reconstructed from the fossil record

Richard Bradshaw

Geological Survey of Denmark and Greenland

A conservation problem

Much of the present-day, non-intervention, old-growth, temperate, mixed deciduous forest found in north-west Europe and north-eastern USA is closed in structure with little light reaching the forest floor. Light-demanding species, including trees and shrubs such as *Quercus* and *Corylus* and other species linked to forest habitats cannot cope with these conditions and are declining in abundance. At the same time much valuable biodiversity is linked to open habitats even though, at present, these can only be created and maintained by cultural activities. Vera (2000) has suggested that contemporary forests significantly differ in structure and dynamics to forests occurring earlier in the Holocene. At that time he proposes that large herbivores were sufficiently abundant to maintain open structures, permitting the survival of light-demanding species within forests. I refer to this hypothesis as the 'wood pasture' hypothesis. In his book he challenges the contrasting 'high forest' hypothesis for early-mid Holocene forests that can be loosely associated with the work of Firbas, Iversen and Godwin.

Types of palaeoecological data

Palaeoecological data contain the only information we have about Holocene forest development. These data can yield incomplete species lists and estimates of abundance, but forest structure can be only indirectly inferred. There is a broad range of data that can be obtained from sediment preserved in basins of various sizes. Pollen and plant macrofossils give direct information about former vegetation but remains of vertebrates, insects, molluscs are also relevant to this discussion. Charcoal and the records of minerals transported by erosional processes yield important information about fire history and the extent of former vegetation cover on the landscape. Large lakes and peat deposits gather information from large catchments covering many km^2, while small forest hollows primarily sample the surrounding c.50m and thus give rather detailed insight into stand-scale composition and structure.

I will assess the two contrasting hypotheses in the light of existing palaeoecological data. Both hypotheses show a number of strengths and weaknesses when matched to the data suggesting that a complete theory should incorporate elements of each hypothesis (Table 1).

Wood pasture hypothesis	**High forest hypothesis**
Strengths	***Strengths***
Explains Holocene persistence of *Quercus, Pinus, Corylus* etc.	Consistent with multi-proxy palaeoecological data e.g. pollen, macrofossils, insects, molluscs, mineral erosion
Provides former habitat for current light-demanding herbs and insects of high conservation value	Modern analogues in non-intervention forests
Provides ecological role for large mammals	
Weaknesses	***Weaknesses***
Lack of palaeoecological evidence	Weak pollen-based reconstruction of herbaceous vegetation
Ireland lacked large native mammals but had abundant *Quercus, Pinus, Corylus* etc.	Blind spots in the fossil record
Small forest hollows e.g. Suserup, Denmark	Where were all the light-demanding species?
Lack of non-intervention modern analogues	How did *Quercus* etc. regenerate?

Table 1. Comparisons of competing hypotheses about former forest structure.

The wood pasture hypothesis

The wood pasture hypothesis has at least three major strengths. Vera uses the hypothesis to propose a potential mechanism for the regeneration of *Quercus* and *Corylus* in a forested environment. His suggestion can apply to a broad range of woody species. The shifting mosaic of open and wooded habitat proposed by the hypothesis provides suitable conditions for a wide range of light-demanding insects, herbs and bryophytes of high conservation value. The hypothesis also gives large mammals an important ecological role in forest ecosystems – a role that has probably been under-estimated by many Holocene palaeobotanists.

However the attractions of the wood pasture hypothesis must be balanced against the absence of supporting evidence in the palaeoecological record, apart from the persistence of *Quercus* and *Corylus* mentioned above. The hypothesis implies large populations of herbivores, particularly aurochs, bison and wild horse, for which there is no direct evidence. Indeed Ireland almost certainly lacked these species entirely during the Holocene, yet *Quercus* and *Corylus* were as abundant here as in regions that have fossil remains of these large mammals. The pollen and macrofossil records

from small forest hollows such as that from Suserup Skov, Denmark (Hannon *et al.*, 2000) show a diverse forest in the mid-Holocene with *Quercus* and *Corylus*, but with very low abundance of herbs and grasses. Small sites such as this record the local herbaceous vegetation far more faithfully than do traditional 'regional' sites – particularly in the macrofossil record. Again at this time in eastern Denmark there is no evidence for aurochs, bison or wild horse. Finally the only modern analogues for wood pasture are in managed systems with large numbers of domestic animals. In some cultural landscapes such systems have operated for hundreds to thousands of years and are now under threat, but they are most definitely anthropogenic systems and not good analogues for how the landscape would function in the absence of human intervention.

The high forest hypothesis

The high forest hypothesis has developed from the study of contemporary European forests. These are often dominated by shade-tolerant species such as *Fagus* and *Picea* that were not important in forests of the early-mid Holocene. However the theory has received support from palaeoecological studies that consistently lack evidence for significant abundance of grasses and herbaceous species prior to the development of agriculture. Accurate estimation of the former abundance of these open-ground species is notoriously difficult using pollen data alone, but the picture of a landscape chiefly dominated by high forest is further supported by the fossil record of molluscs and insects. Gedda (1999) has studied sequences of molluscs from southern Scandinavia and found that species characteristic of shaded woodlands dominated during the mid-Holocene. Species characteristic of open conditions were very rare. Ponel (1995) studied insect remains from the last inter-glacial period in France and found that tree-dependent species were the most abundant. Insects associated with large mammals such as dung beetles were only common during the coldest periods when the pollen record indicated tundra-like conditions.

Analyses of minerogenic material that have eroded into lake sediments indicating soils that are not stabilised by the root systems of trees or are under cultivation, always show a close correspondence with the ratio of tree:herbaceous pollen. The record from Dallund Sø, Denmark is a good example with peaks of erosion and loss of tree cover at 3000 BC, 2000 BC, 500 BC and 1100 AD illustrating the long period of time that human agricultural activities have affected the Danish landscape (Rasmussen & Bradshaw 1999).

The wood pasture hypothesis requires large populations of large herbivores. Population size is difficult to reconstruct from the mammal fossil record, but all the evidence that exists suggests that populations of domestic animals and recently deer and moose far exceed the likely population sizes

of wild ungulates during the early-mid Holocene in temperate forest areas (Bradshaw & Mitchell 1999).

Finally, as mentioned above, the modern analogues of 'natural' forest, namely present-day, non-intervention, old-growth, temperate, mixed deciduous forest found in north-west Europe and north-eastern USA, are chiefly closed in structure with little light reaching the forest floor. Important variation does exist however with more open conditions occurring, for example, on sandy, infertile soils and in seasonally waterlogged areas. Odgaard (*pers. comm.*) has demonstrated a strong past relationship between decreasing soil clay percent and abundance of non-arboreal pollen. This shows that even regional pollen data can detect the more open forest structure characteristic of sandy soils in western Denmark.

The major problems with the high forest hypothesis include the dominating influence of tree pollen in the fossil pollen record and the consequently weaker statistical basis for the accurate reconstruction of non-forest vegetation. In addition there are always blind spots in the patchy fossil record. Certain taxa are rarely or never recorded, taxonomic resolution may be poor, certain habitats are under-represented and always absence of evidence cannot be taken as evidence of absence. Furthermore there is no fully satisfactory mechanism proposed for the long-term maintenance of *Quercus* and *Corylus* in closed forests and where did all the light-demanding species survive that are such a feature of contemporary cultural landscapes? Clearly the high forest hypothesis alone does not provide the perfect model for forest conditions earlier in the Holocene.

A possible resolution

A partial resolution of the problem posed by these competing hypotheses can be reached by a fresh appraisal of former disturbance regimes in which browsing animals play an integral part. The high forest hypothesis assumes that much of the landscape is under mature forest and regeneration takes place in gaps created by the death of single trees. Recent palaeoecological and neoecological studies have stressed the role of disturbance in creating more open forest structures. Fire, represented by charcoal in sediments is characteristic of most areas of north-west Europe prior to the spread of Fagus *and* Picea *(Bradshaw* et al.*, 1997). Fire, both natural and cultural, in conjunction with animal browsing may have created appropriate conditions for regeneration of* Quercus, Corylus *and* Pinus *without the development of a persistent or shifting mosaic of non-forest habitat.*

Certainly the pollen record has underestimated the importance of herbaceous vegetation in the past, but the wood pasture hypothesis as proposed by Vera may well be an over-estimate. Forests were open on sandy soils. Seasonal flooding was more widespread in the past and waterlogging far more widespread than in our present, heavily drained landscapes. Browsing animals and storms were also factors contributing to open conditions, but it would be wrong to emphasise one factor to the exclusion of the others. Palaeoecological data stress the widespread importance of fire in the past, but some regions, for example south-west Sweden were virtually fire-free. The disturbance factors acted together to create a varied landscape that housed a great diversity of species. The balance of the palaeoecological evidence however indicates that the landscape was primarily a closed forest matrix containing some open areas rather than *vice versa*.

There is no doubting the importance to conservation of the wood pasture habitat today. Many of our threatened forest species occur in this type of habitat. This is probably a consequence of its long cultural history in close association with less managed forest areas and the extreme rarity today of fully functional forest ecosystems. Many of the surviving large, old trees in north-west European temperate forest are found in wood pasture rather than in high forest and these trees are of considerable importance as habitat for forest species. We can argue for the protection of wood pasture on the basis of their existing high biodiversity without having to use the probably incorrect argument that they are 'natural' and not a product of former cultural activities.

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Large herbivores and the regeneration of trees - oak and hazel as example[1]
By Frans Vera

Introduction

It is a general accepted theory that in the natural state - in a sense that is if there had been no human intervention - the lowlands of Central and Western Europe, with their temperate climate would have been covered with a closed canopy forest in places where trees can grow. Regeneration of these forests would have taken place in gaps in the canopy according to the gap-phase model of Watt (1947) or the cyclical model of Leibundgut (1959; 1978). In these models gaps are created when one tree dies or several trees die or are windblown. In these gaps the tree species forming the forest regenerate.

In both models large herbivores are supposed to have no significant influence on the regeneration of the trees meaning that they do not prevent the regeneration of the natural forest. This assumption is based on the knowledge that livestock and wild ungulates if present in certain densities are able to prevent the regeneration of the trees in the forest, by trampling and eating the young trees. The forest then degrades into a park-like landscape, and finally into grassland and heathland as a result of retrogressive succession (see Moss, 1910, p. 36; Watt, 1919; Tansley, 1953, pp. 129-130; Ellenberg, 1986, p. 43). The potential threat formed by large ungulates for the regeneration of forests is proven by parts of such forests that are fenced and show prolific regeneration of trees (see Peterken and Tubbs, 1965; Putman *et al.*, 1989; Mountford *et al.*, 1999). Therefore large ungulates are supposed to have been present in the primeval vegetation in very low densities (Tansley, 1953, p. 143, 487). According to this theory a forest degraded by grazing of cattle will revert to its natural situation - a closed canopy forest - once grazing is stopped, as has been done in many forest reserves in the lowlands of central en western Europe.

The theory that the natural vegetation in the lowlands in the temperate zone of Europe was a closed canopy forest is generally accepted in European nature conservation circles, including botanists (see for instance Ellenberg, 1986, pp. 20). They say that man enriched nature by cultivating the primeval forest, creating open habitats like grasslands. This should have started with the introduction of agriculture by Neolithic people by opening the primeval forest by cutting trees. For this reason, there is an argument for allowing or encouraging certain forms of agriculture - in particular of extensive agriculture - to continue in order to ensure the conservation of the richness of nature.

The problem

It follows that all species of trees and shrubs which pollen studies have shown to be present in the undisturbed prehistoric forest will survive in spontaneously developing forests, so-called forest reserves, and regenerate spontaneously when gaps in the canopy are formed. However, this does not apply in these forest reserves to pedunculate oak (*Quercus robur*), sessile oak (*Q. petraea*) and hazel (*Corylus avellana*). They are disappearing. There is a progressive replacement of these light-demanding species by shade-tolerant tree species like lime (*Tilia platyphyllos and T. cordata*), elm (*Ulmus glabra* and *U. laevis*), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) (see Koop, 1981; Lemée, 1985; Malmer *et al.*, 1978; Lödl *et al.*, 1977; Emborg *et al.*, 1996; Vera, 2000, pp. 189-286). This is not in agreement with pollen diagrams from the

[1] This paper is based on the book: F.W.M. Vera (2000) Grazing Ecology and Forest History. CABI Publishing, Wallingford. The number of references in this paper has been restricted. The full number can be found in the book. The book can be looked into on the following Internet address:
<http://www.cabi.org/Bookshop/ReadingRoom/0851994423.asp>

primeval vegetation. They show that both oak and hazel were very well represented in this vegetation for many thousands of years and therefore successfully regenerated (see for instance Firbas, 1934; 1935; 1949; Iversen, 1941; 1960; 1973; Huntley and Birks, 1983; Peglar, 1993; Hannon *et al.*, 2000; Vera, 2000, p. 7). On the other hand, oak and hazel do regenerate very well in the presence of the above mentioned shade-tolerant tree species in so-called wood-pastures. These are park-like landscapes where domesticated large herbivores like cattle and domestic horse, graze the vegetation in combination with wild ungulates like deer. Such a landscape consists of grassland, scrub, solitary trees and groves. Shrubs mark the transition of the grassland to the grove and form the so-called mantle and fringe vegetation on the outline of the groves.

In the wood-pastures trees regenerate successfully not within the forest, but outside it, in thorny shrubs that emerge in the grassland and may form the mantle and fringe vegetation (see figure 1).

Figure 1

A grazed park-like landscape in the French Jura. Left and right on the foreground is the mantle and fringe vegetation with sloe (*Prunus spinosa*), hawthorn (*Crataegus monogyna*) and hazel (*Corylus avellana*) on the transition between grassland. There tree species like pedunculate oak (*Quercus robur*), hornbeam (*Carpinus betulus*) and small-leafed lime (*Tilia cordata*) regenerate (Photo Frans Vera taken from Vera 2000).

These shrubs protect them against the large ungulates. These thorny species establish themselves in grassland thanks to the grazing of specialised grazers among the large ungulates, namely cattle and horse (see Vera, 2000, pp 141-155). On richer soils seedlings and young trees are protected by species like blackthorn (*Prunus spinosa*) and hawthorn (*Crateagus*) even in the presence of high densities of large herbivores (cattle, horse and deer) up to a biomass of 180 kg per ha (Rackham, 1980, pp. 185; Vera, 2000, p. 148). On poorer soils bramble (*Rubus spp*.) and juniper (*Juniperus communis*) give protection to the young trees. So, the question arises, can wood-pastures be considered as being more or less analogues to the primeval vegetation and cattle and horse as modern analogues of their wild ancestor, the aurochs (*Bos primigenius*) and the tarpan (*Equus przewalski gmelini*) the wild ancestor of domestic horse? Those species roamed and grazed the primeval vegetation in combination with the other wild indigenous ungulates European bison (*Bison bonasus*), red deer (*Cervus elaphus*), elk (*Alces alces*), roe deer (*Capreolus capreolus*) (Degerbøl, 1964; Degerbøl and Iversen, 1945; Aaris-Sørensen, 1980; Aaris-Sørensen *et al.*, 1990; Auguste and Patou-Mathis, 1994).

The theory of the closed canopy forest as the climax vegetation

The theory of the closed canopy forest is to a significant extent based on two arguments. The first is the spontaneous development of the vegetation into a closed canopy forest on abandoned arable fields and meadows where man withdrew with his livestock (see Cotta, 1865, pp. v; Forbes, 1902; Tansley, 1911, pp. 7-8; 1953, pp. 293-294; Clements, 1916, pp. 145, 151, 155; Watt, 1919; 1947). The idea behind this is that man disturbed nature by creating fields for crops and introducing livestock into the primeval vegetation. If agriculture is ended nature would take its course again, starting a spontaneous development of the vegetation ending with a so-called climax vegetation. On places where trees can grow this climax vegetation would be a closed canopy forest. This is based on the succession theory, which states that under certain climatological, soil and hydrological conditions bare ground develops into a plant community of a particular type. This is dominated by the largest and tallest plants, which are able to thrive in the prevailing climatological conditions because they are the strongest in the competition for light (Clements, 1916, pp. 3, 63, 80, 99, 125; Tilman, 1985). If these are trees – like in the lowlands of Europe – the final stages is a forest. If the climax forest disappears as a result of some form of human intervention, like the introduction of livestock, the climax will spontaneously develop again. This happens by means of secondary succession, once the intervention has ceased, so if man withdraws livestock (Clements, 1916, pp. 60, 63, 107, 176; Tansley, 1953, pp. 130, 293-295, 487). In the lowlands of Europe the climax vegetation is supposed to be a broad-leaved closed canopy forest. It would have consisted of species like oak (*Quercus robur* and *Q. petraea*), lime (*Tilia cordata* and *T. platyphyllos*), elm (*Ulmus spp.*), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) with a shrub layer with among them hazel (see Vera, 2000, p. 3).

The results of pollen studies are said to confirm this theory. The most used argument is that up to 90% of the pollen originates from the above mentioned deciduous forest trees and the shrub hazel (*Corylus avellana*). These pollen are interpreted as originating from a mixed deciduous closed canopy forest with hazel being part of the shrub layer in the forest (see Von Post, 1916; Firbas, 1934; 1935; 1949, pp. 1; Godwin, 1934a,b; Iversen, 1960). The palaeoecologists based their interpretation of prehistorically pollen on the theories about succession as mentioned above (see Godwin, 1934b; Iversen, 1941, pp. 21, 36, 44, 47; 1960, pp. 6, 26-27; Vera, 2000, pp. 13-60, 70-75).

Bones that are found show that at that times a fauna of large ungulates existed. The species are European bison, red deer, elk, roe deer and the wild progenitor of domestic horse, the tarpan and domestic cattle, the aurochs. Palaeoecologists assume that the indigenous wild ungulates have had no effect on the regeneration of the primeval forest, because otherwise the primeval vegetation could not have been a closed canopy forest. Therefore the animals should have occurred naturally in very low numbers (see Iversen, 1960, p. 26; 1973, pp. 72-73).

On the basis of pollen analysis, Iversen (1941; 1960) formulated the theory that man as a farmer opened the primeval forest by cutting down trees in the primeval forest in order to make fields to raise crops and meadows to feed his livestock. This is called the Landnam theory (Iversen, 1941; 1960). Therefore openness and grassland are considered to be the result of human activity. The presence of the many plant and animal species that are connected with grassland in open and half open landscapes are therefore considered to be the result of the introduction of agriculture in the primeval forest (see for instance Berglund *et al.*, 1991).

The second argument in favour of the theory of the closes canopy forest comes from the interpretation of historical sources, especially those concerning the regulations for cattle grazing in the last wildernesses in the lowlands of Europe from the beginning of the Middle Ages onwards. Foresters use this argument to show how people in the Middle Ages took measurements in order to

preserve the last original present forests. They would have done so, because of their dependence of forest in those times for firewood and timber (see Hausrath, 1898, p. 101; 1982, pp. 39, 206-209; Bühler, 1922, pp. 300-301, 339, 610; Meyer, 1931, pp. 345, 386; Dengler, 1935, pp. 75-84). The interpretation of these historical sources by foresters worked on in the interpretation of pollen diagrams by palynologists (see Von Post, 1916; Berstch, 1929; 1932; 1949, p. 4; Tschadek, 1933; Firbas, 1934; 1935; 1949, p. 1; Godwin, 1934a,b; Iversen, 1941, p. 21, 36, 44, 47; 1960, pp.6- 7, 26-27).

Regulating the use of the wilderness

From the 7th century onwards charters are known in which Merovingian and Frankish kings declared the uncultivated wilderness as “forestis nostra”, our “forestis”. The theory, which is most widely supported about the origin of the concept “forestis”, is that it is derived from the Latin “foris” or “foras”. These mean “outside”, “outside it”, and “outside the settlement” (see Kaspers, 1957, p. 24; Hesmer, 1958, p. 408; Buis, 1985, p. 26 *et seq.*; Muller and Renkema, 1995, p. 363; see figure 2). So it concerned the area outside the cultivated, the settlement, the fields of arable land and the hay-fields. It was the area that according to the legal order in those times had no clear owner. It was the so-called “bona vacantis” that according the royal prerogative, based on Roman Law, the Codex Iustinianus X, 10, belonged to the “government”, the king (De Monté Verloren and Spruit, 1982, p. 123).
“Forestis” was a legal concept, which described or confirmed the royal rights (Kaspers, 1957, pp. 23-25; Buis, 1985, pp. 26; Mantel, 1990, pp. 63-67). It applied to the wilderness in general, and to trees, shrubs, wild animals, water and fish in particular (Kaspers, 1957, pp. 24-30; Hesmer, 1958, p. 408; Mantel, 1980, p. 1005; Buis, 1985, pp. 25-26, 223 *et seq.*). In other words, in a “forestis”, every individual tree, as well as every wild animal, belonged to the king. It also meant that only the king had the right to make use of these. Without his express consent, others were not permitted to graze their livestock, cut or collect firewood, fell trees, create fields for crops or to hunt animals in the “forestis” (Kaspers, 1957, pp. 23-26, 39-40). When the wilderness was declared to be a “forestis” it was subject to the “ius forestis”. In German this was called “Waldrecht” and in Dutch “woudrecht” (translated in English “forest law”, not to be confused with the Forest Law, later on in the 11th century introduced in Britain by William the Conqueror from the continent to England when he became king there). The king passed the administration and management of the “forestis” to officials he appointed, so-called “forestarii”. They regulated the use and dealt with the infringements of the regulations. They did so in a legal forum, a court, in accordance with the "ius forestis", the "iura forestarorium" or the "ius nemoris" (Kaspers, 1957, p. 32-39, 50; Buis, 1985, p. 223, 225; Buis, 1993, p. 41). According to these regulations, the king allowed local communities to use the “forestis” as common land for pasturing cattle and pigs and collecting leaf-fodder for livestock, firewood and getting timber.

The oldest rules concerning the management of the “forestis” date from the 6th century. Up to the 13th century they were concerned only with the payments by commoners to the lord for the pannage of pigs in the “forestis” and the protection of so-called fruitful trees. The fruitful trees were oak, wild apple (*Malus sylvestris*), wild pear (*Pyrus pyraster*) and wild cherry (*Prunus avium*). They were protected according to the “ius forestis” or “forest law” (see Kaspers, 1957, pp. 166; Rackham, 1975, pp. 27; Tubbs, 1964, pp. 96; Hart, 1966, pp. 95; Flower, 1977, pp. 26; Hausrath, 1982, pp. 28-29; Buis, 1985, pp. 304-305). These trees provided fruits (acorns, pears, apples and cherries), called mast, for pasturing pigs that were fattened with them. The most important mast consisted of acorns. In Anglo-Saxon acorn meant “æcer” (in Saxon “Acker”). Pigs were fattened on the “æcer” or “Acker”. The “Acker” was also the place where the acorns were found. So, the “Acker”, was named after what it provided, namely: “Acker” (acorns, mast, and pannage). The

"Acker" was therefore also the place in the wilderness where light-demanding oaks and other fruit bearing (all light-demanding) trees grew (see Vera, 2000, pp. 123-126).

During the Middle Ages, the cutting of foliage was increasingly regulated in the sense of restricted. Eventually it became entirely prohibited because of the damage, which was caused to the trees. It prevented for instance the trees from flowering and therefore producing fruit (Endres, 1888, p. 54; Mantel, 1980, pp. 103-104, 696, 934, 941, 969, 977, 984, 992; Vera, 2000, p. 103, 111, 123, 129-130). The foliage was called in German and Dutch "weide", from the Frankish concept "weide", which meant "food" "collecting food", "looking for food" and "the place where food was found" (De Vries, 1970, p. 249; Van Veen and Van der Sijs, 1991, p. 817). Animals who collect food "weiden", that means they are pasturing. So in the Middle Ages a tree was a pasture, a place with food, not only for cattle, but also for the pigs. The acorn, the "Acker" was their pasture. Therefore an oak was a pasture. So, in the Middle Ages no distinction was made between grassland and trees as is done nowadays by speaking of wood and pasture. In the Middle Ages it made no sense to do so, because trees and grasses were all pasture for animals.

The word "forestis" evolved in German to "Forst", in French to "forêt", in English to "forest" and in Dutch to "foreest", "voorst" and "vorst". The "forestis" was called in the common language in German "Wald and "Wold", in Dutch "wold", "wald" and "woud" and in Anglo-Saxon "weald" (Borck, 1954; Kaspers, 1957, pp. 154-156, 166-188; Trier, 1963, pp. 45 and see figure 2).

Figure 2

Living on the countryside. A settlement in the Middle Ages. Merovingian and Frankish kings declared from the 6th century onwards the outside that means the uncultivated land outside the settlement where the deer can be seen, as their "forestis" (forestis nostra). This word is most probable derived from the Latin "foras" or "foris", which means "outside". In common language the uncultivated outside was called in German "Wald" or "weld", in Dutch "wald", "wold" or "woud" and in Anglo-Saxon "weald" (wood-cut from 1517, taken from Ten Cate, 1972).

These words nowadays mean: vast areas of closed forest, but in those days they all meant implicitly pasture for livestock. Therefore open grassland with flowering herbs (pasture for bees) were an integral part of the "forestis" and the "Wald". Grassland was not mentioned as an entity separate from trees speaking of pasture and wood as nowadays is done. What is nowadays called wood was also pastured. Sometimes a "Wald" was described as being extremely suitable for pasturing livestock (see Vera, 2000, pp. 109-112). It was said that the livestock visited the flowers in the "Wald" or in the "forestis", which meant that it grazed in grasslands with flowering herbs to keep them alive, so it was there in the summer time (see Vera, 2000, pp. 103-115). Wood was also delivered by the "Wald" and the "forestis", because there grew trees and shrubs. What delivered the wood (the material) was called in German "Holz" and "holt", in Dutch "holt" and "hout" and in Anglo-Saxon "holt". So, the "forestis", the "Wald" contained pasture and "holt". The "holt" (wood

as material) could be delivered by single trees or trees that grew close together, forming a “bush” of trees that distinguished itself clearly from the environment as an entity. Areas in the “forestis” or “Wald” where wood was gathered were named after what they provided for human use, namely the material “wood” (as in English in: a wooden house).
There were no regulations whatsoever that indicate that trees were removed in order to create pastures in the modern sense of the word. On the contrary, the rule was that it was strictly forbidden to fell trees. Only for making fields to raise crops permission was given to grub up trees. Besides that trees were only allowed to be felled for building houses, especially oak, but only as much one needed and with the express consent of the court. After the consent was given a forester pointed the trees and marked them. There are even more indications that open treeless areas were part of both the “forestis” and the “Wald”. In the Middle Ages the “forestis” concerned areas with trees as well as treeless areas like open water. Raised bogs were called “Wald” or “Wold” (see Ligtendag, 1995, pp. 39, 41, 57, 65, 74, 77, 88, 176). The thing that those areas had in common with areas where trees grew is that it was the uncultivated land outside the cultivated.

The pitfall with the language is that we nowadays read texts dating from the Middle Ages with the modern meaning of those concepts in our heads, namely a closed canopy forest. So we translate those texts onto a closed canopy forest, while that is not what the people in the Middle Ages meant (see Vera, 2000, pp. 109-111).

Cattle grazing and the regeneration of trees

People also got permission to cut firewood in the “forestis”. This was called coppicing. The earliest regulations on cutting firewood date from the 13th century. They refer mostly to the cutting of thorns, hazel and holly (Haustrath, 1898, p 44; 1928; Tubbs, 1964; 1988, p. 154; Hart, 1966, pp. 29-30, 46-47, 128, 180-181, 308; Streitz, 1967, p. 52; Flower, 1977, pp. 27, 63, 73). When firewood was cut a certain number of saplings and young trees, especially of fruitful trees like oak and wild fruit, had to be spared for every unit of area. They were chosen and marked by a “forestarius” or forester according to the “ius forestis” (see Kaspers, 1957, pp. 166; Tubbs, 1964, pp. 96; Hart, 1966, pp. 95; Wartena, 1968; Rackham, 1975, pp. 27; Flower, 1977, pp. 26; Hausrath, 1982, pp. 28-29; Buis, 1985, pp. 304-305). These saplings and young trees had to grow up in order to provide the mast for pannaging pigs.

The place where the firewood was cut was called “vorholt” and “ vorholtz” in German, “ voorhout” in Dutch (meaning the wood in front of the trees), “underwood”, “brushwood” and “shrubbery” in English, “hage” in Anglo-Saxon and “petit taille et bordure” in French (Vera, 2000, pp. 139). Virtually all these names as well as the regulations concerning the saving of the young trees can be read as descriptions of mantle and fringe vegetation where young trees grow up. This can still be observed in wood-pastures (Vera, 2000, p. 139; see also Trier, 1952, pp. 97, 115, 116; figure 1). Such a landscape consists of a mosaic of grassland, scrub, solitary trees and groves.

The stools of the thorny shrubs like blackthorn and of hazel do sprout after being cut. This “*spring*” could be browsed by the roaming cattle, as could the spared young trees, because they were robbed from their thorny protectors. Therefore they had to be protected against the animals. This is what in my opinion the regulation form the 13th century up to the 18th century say. They all tell that what has been cut had to be closed for grazing until the new sprouts on the stools reached beyond the reach of the beaks of the animals (see Vera, 2000, pp 132-144). It explains why grazing of livestock commonly was forbidden only for 3 up to 6 years. The sprouts on the stool of blackthorn do not bear thorns until the end of the first growing season. After one growing season those sprouts as well as those of hazel reach up to 2 meters high. After three years they are surely out of danger of the animals. If it were for the regeneration of seedlings within the forest, as foresters and ecologists

claim, a prohibition for at least 20 years would have been necessary (see Cotta, 1865, pp. 84-85; Turbang, 1954; Flower, 1977, pp. 198; Mayer, 1992, pp. 198). So the regulation of cattle grazing in woods was not to protect seedlings in closed forests, but to protect the vegetative regeneration of scrub and the seedlings and saplings of trees which grew up in the mantle and fringe vegetation of park-like grazed landscapes. None of these regulations on grazing livestock were aimed at regulating of livestock in general. They even clearly state that the coppicing should be organised in such a way that it obstructed the rights to graze livestock as little as possible (see Vera, 2000, p. 136).

As mentioned above the regulations concerning the grazing of livestock corresponds with the regeneration of trees in wood-pastures. Thorny shrub and hazel mark in wood-pastures the transition of the grassland to groves, the so-called mantle and fringe vegetation. Trees do come up there in the thorny scrub. Young trees, particularly oaks, grow on the periphery of the scrub. This mantle and fringe vegetation advances into the grassland in a rate that is equal to the rate the outer edge of the scrub, the fringe, extends into the grassland especially by blackthorn advancing into grassland by underground rootstocks (see Watt, 1934; Burrichter *et al.,* 1980; Pott and Hüppe, 1991). The trees grow up in the thorny scrub and join the grove that is surrounded by the mantle and fringe vegetation.

The jay and the oak

The jay (*Garrulus glandarius*) collects and plants acorns. Thereby it has a special preference for a transitional area of short to long vegetation. These are the transition between short and long grass, short and long herbs, grasses and herbs and the outer edge of hedges. The jay prefers also the base of the stem of a hawthorn and fringes of thorny scrub of blackthorn among them the mantle vegetation bordering groves (Clettleburgh, 1952; Bossema, 1979, pp. 35, 45-47, 51, 57, 59). Because of the jay oaks form a major part of the regenerating trees forming a grove. Therefore the oak has a high performance in wood-pastures. The groves were called in Anglo-Saxon “bush”, in German “Bush” and in Dutch a “bos” (a bunch or bouquet of trees, analogue to a “bos” flowers, a bunch, a bouquet of flowers). Because hawthorn lacks vegetative reproduction this shrub will mostly protect a solitary oak that will ultimately result in a open grown tree.

The crowns of the trees in the grove form a closed canopy. Because of the shade cast by the canopy, the scrub disappears. Within the groves no regeneration of trees takes place because of the shade cast by the canopy and the effects of the presence of large ungulates. If a gap is formed – most probable in the centre of the grove where the oldest trees are - grasses will establish there and attract large herbivores. Their grazing and trampling will prevent any tree seedling from coming up there. So they prevent the regeneration of trees in gaps of the canopy. As more trees die or are windblown, the surface of grassland increases. In this way, ultimately the grove degrades from the centre onwards into grassland, as is well known and described as retrogressive succession. In the long run, light-demanding thorny shrubs will establish in the grassland, protecting young trees against the large herbivores.

From the regulations concerning the grazing of cattle and cutting firewood it becomes clear that a “forestis” or “Wald” in written sources from the Middle Ages onwards was not a closed forest. It was the uncultivated wilderness consisting of grassland, trees and shrubs (inter alia light demanding trees like oak, wild pear, wild cherry and wild apple and light demanding shrubs like hawthorn and blackthorn and hazel) and even lakes and rivers. It was a park-like landscape like a wood-pasture consisting of grassland, scrub trees and groves. The trees regenerated in thorny scrub. The jay played in my opinion a major role in the establishment of oak in this landscape. The oldest reference to this landscape comes from the Roman Tacitus in a description from Germania dating

from AD 98. Germania was the territory on the other side of the river Rhine, which formed the border of the Roman Empire. He wrote: “Terra, etsi aliquanto specie differt, in universum tamen aut silvis horrida aut paludibus foeda”. It means, “The land, even though it is quite diverse, is generally either thorny in groves (ablatives limitationes) or swampy in marshes ” (A.J. van Wolferen, Doorn, 1998, personal communication). Freely translated, it means: “The land looks very different in many places, but in general, it is covered with thorny (bristling) woods (either thorny trees or thorny groves) and unhealthy marshes.

Foresters, and forest- and plant ecologists in the 19th century and the first half of the 20th century based their theory of the closed canopy forest being the uncultivated wilderness on an interpretation of these sources that is in my opinion not correct. The same goes for the palynologists who on their turn build further on this interpretation with their interpretation of the pollendiagrams of the prehistoric vegetation.

From coppice with standards to high forest with natural regeneration

When firewood was cut, no all the young trees were spared, because the “forestarii” didn’t mark them all. The reason they did so was that trees growing at some distance from each other form big crowns, flower and fruit more profusely and therefore produces more mast (acorns, peras, apples and cherries) for the pigs. So, some thinning among the young trees took place (see Vera, 2000, pp. 157-158). So, beside the stools of shrubs also stools of trees came into existence that sprouted and ultimately formed part of the coppice. From these stools trees could be grown afterwards by sparing only one sprout on the stool. In this way during the Middle Ages out of scrub and mantle and fringe vegetation coppices with standards evolved (see figure 3).

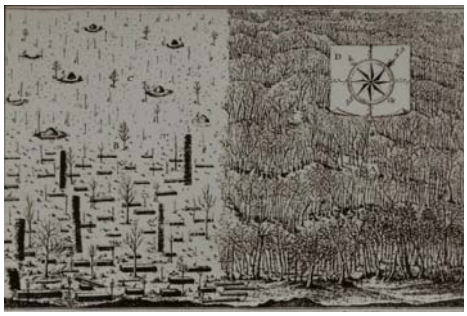

Figure 3

Coppice with standards from an anonymous 14th century manuscript from north Italy. The standard is clearly an oak with acorns under which the pigs are pannaged. The shrub vegetation is used for firewood cutting (taken from Ten Cate, 1972)

The standards were the trees spared because of the “forest law” and therefore belonging to the lord. At first the standards were especially fruitful trees like oak, wild apple (*Malus sylvestris*), wild pear (*Pyrus pyraster*) and wild cherry (*Prunus avium*). These standards had to grow upwards in order to provide mast for foraging pigs, called pannaging, that is to fatten pigs on acorns and the fruits of the wild fruit species. The trees were also used for timber. Later on also other tree species like for instance hornbeam became standards (see Vera, 2000, pp. 157-159). The woodlands that served the production of firewood were called in Anglo-Saxon “holt”, in English “wood”, in German “Holt” and “Holtz” and in Dutch “hout”. So, as mentioned earlier, areas in the “forestis” or “Wald” where wood was gathered were named after what they provided for human use, namely the material “wood” (as in English in: a wooden house).

In the 18th century the demand for firewood changed. Instead of bundles of fagots people wanted the firewood to be delivered in blocks. Therefore coppice rotation was extended from up to 10 years in the Middle Ages towards 30, 50 and even 80 years in the 18th century (Vanselow, 1926, pp. 153; Schubart, 1966, pp. 98-99, 108, 126-127; Mantel, 1990, pp. 366). As the rotation times extended the coppice with standards changed from brushwood with standards successively into pole forest with standard and eventually into a high wood, the woods we know today as timber wood (see figure 4).

Figure 4

Coppice with standards on the left and on the right the coppice with standards changed into a high wood as a consequence of longer rotations in the 18th century. This is the wood we know today as "wood" (taken from Jahn and Raben, who on their turn it from Cramer, 1766).

In contrast to when stools are cut in short rotations, stools cut after 80 years do not sprout again. To obtain a new generation of trees, young trees had to be planted. Especially beech was favoured, because it was suitable for firewood in households and it produced the best charcoal asked by industry. The demand for charcoal by industry raised strongly because of the industrial revolution. Beech flower from the age of 20 to 30 years, so with a rotation longer of this number beech flowered and formed seed. Seeds fell from the trees developed and into saplings. If the standing trees were gradually cut, the seedlings got more and more light. They could grow upwards successfully and form the new generation of trees two replace the harvested one. This was found out and applied in the lowlands of Central and Western Europe at first in the German region Hessen in the first half of the 18th century. It formed the basis for the forestry techniques today known as shelterwood cutting and selective cutting (see Bühler, 1922, pp. 306, 324, 331, 353; Schubart, 1966, pp. 101; Mantel, 1990, pp. 361-362). These techniques were called "natural" regeneration. They were opposite to artificial regeneration (see Cotta, 1865, pp. 2; Vanselow, 1949, pp. 17; Dengler, 1990, pg. 47). The natural aspect is that the seedlings forming the new generation of trees emerge form seed that has fallen spontaneously from the standing trees, while the artificial aspect is that seeds were sown or young trees were planted. Ploughing the ground in order to get a good seed bed and removing undesirable species of trees, shrubs, herbs and grasses were all part of the natural regeneration. Calling this technique "natural" regeneration is therefore misleading. It was not analogous to the regeneration of trees in nature in the lowlands of Central and Northwest Europe.

The technique of "natural" regeneration was first developed with the shade-tolerant beech and very successful, because the beech seedlings thrive well under the shelter of the old trees. They are shade-tolerant. Later on the technique was applied to the light-demanding oak as well. However

during three-quarters of a century all efforts to regenerate oak “naturally” failed. By trial and error one found out that oak needed much more daylight than beech and therefore the seedlings should be in full daylight much earlier than those of beech. In the case of beech in took about 40 years to have all the old trees successively removed and replaced by a new generation. With oak this has to take place within 10 years. Then the seedlings have to be in full daylight, because otherwise they perish. However, after that time much human assistance is necessary to have the seedlings successfully gown up. Then oak has to be protected against shade-tolerant tree species, such as beech, lime and elm. Without this human interference the “natural” regeneration of oak is doomed to fail, because the oaks will be ousted by the shade-tolerant species (Vanselow, 1926, pp. 63, 87-88; Krahl-Urban, 1959, pp. 146; Dengler, 1990, pp. 294). This empirical evidence from forestry shows that oak cannot regenerate spontaneously in a closed canopy forest if shade-tolerant species are present.

With the application of this technique in the “forestis” and the “Wald” in the 18th and 19th century the grazing was considered to be a great problem for the regeneration of the trees. The reason is that within the forest the young trees cannot be protected by thorny species, because these cannot thrive under the conditions of shade (zie Vera, 2000, pp. 168-178). Foresters propagated the separation of pasture for livestock and the production of wood. This became possible after the development of the so-called New Agriculture propagated by the fysiocrats. This development involved the introduction of the potato, fertilising with the cultivation of clover. In almost all of Europe this led in the course of the 18th and the 19th century to an agricultural reform (Hobe, 1805, p. 113; Grossmann, 1927, p. 29; Buis, 1985, pp. 389, 520-521, 590; Vera, 2000, pp. 170-176). The “modern” agriculture eventually led to the abolition of the commons in general and the abolition of grazing of the commoners in the “forestis” or “Wald” in particular.

The way of regeneration of trees developed by the technique of “natural” in modern forestry - the regeneration of trees within the forest – became the baseline for the effect of large ungulates on the regeneration of trees in general in the lowlands of Western and Central Europe. As in forestry and in palaeoecolgy the forest is considered as the reference for the natural vegetation in the lowlands of Western and Central Europe. Therefore it is thought that in general the grazing of large ungulates is harmful for the survival of the generation of trees and as a consequence for the regeneration of the postulated original forest.

The spontaneous development of forests

It follows that if the primeval vegetation was a closed canopy forest, all species of trees and shrubs which pollen studies have shown to be present in prehistoric times up to the introduction of agriculture will survive in spontaneous developing closed canopy forests. They have to regenerate there spontaneously when there are gaps in the canopy. This is supposed to happen in forest reserves, like La Tillaie and Le Gros-Fouteau in the Forêt de Fontainebleau in France, Hassbruch, Neuenburger Urwald and Rohrberg in Germany, Dalby Söderskog in Sweden, The National Park Bialowieza in the Forest of Bialowieza In Polen and Suserup Skov and Draved Skov in Denmark. In these reserves there is a progressive replacement of the light-demanding pedunculate oak (*Quercus robur*), sessile oak (*Q. petreae*) and hazel (*Corylus avellana*) by shade-tolerant tree species like beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*), elm (*Ulmus glabra* an *U. laevis*), lime (*Tilia platyphyllos and T. cordata*) and hornbeam (*Carpinus betulus*) (see figure 5).

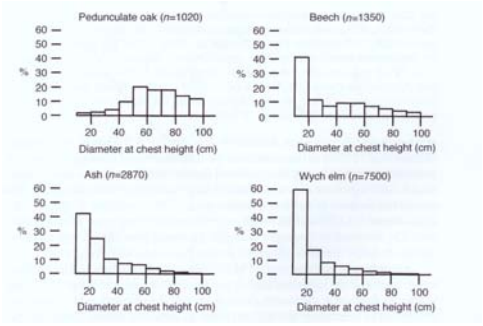

Figure 5
The percentage distribution per species of tree in diameter categories per species of pedunculate oak (*Quercus robur*), beech (*Fagus sylvatica*), ash (*Fraximus excelsior*) and wych elm (*Ulmus glabra*) in Dalby Söderskog, Sweden. Only trees with a trunk diameter of >10 cm at chest height are included (redrawn from Malmer *et al.*, 1978, p. 20, taken from Vera 2000)

The light-demanding oak isn't able to regenerate neither in small or large gaps nor in windblown areas of more than a hectare created by storms of outstanding intensity. Such storms release the advanced regeneration of shade-tolerant species, so that oak does not stand a change against them (Pigott, 1975; Derkman and Koop, 1989; Lödl et al. 1977; Malmer *et al.*, 1978; Koop, 1981; 1989; Aaby, 1983; Lemée, 1985; Emborg *et al.*, 1996; Peltier *et al.*, 1997; Pontailler *et al.*, 1997; Houtzagers *et al.*, 2000; Vera, 2000, pp. 189-286).

Regeneration in a natural way of oak- that is without human interference - is supposed to take place in The National Park Bialowieza in the forest of Bialowieza. This forest reserve is supposed to be the most original vegetation in the lowlands of Central and Western Europe under the prevailing climatological conditions. It lies on either side of the border between Poland and Byelorussia (see Vera, 2000, pp. 245 *et seq.*). However, in this forest reserve as in others there is no replacement of oaks. Shade-tolerant lime and hornbeam replace them. This is not in agreement with pollen diagrams from this area that indicate that oak and hazel were present during the whole of the Holocene in the presence of these shade-tolerant species (see Dabrowski, 1959 in Vera, 2000, pp. 248-249; Mitchell, 1998; Mitchell and Cole, 1998).
All oaks present in this reserve date from the period when wild or domestic cattle grazed in the forest. In fact it is a former wood-pasture. In the period 1860-1971, cattle formed 15-80% of the numbers and 37-87% of the total biomass of all ungulates in the Bialowieza forest (Jedrzejewska *et al.*, 1997). In the National Park grazing ceased in 1923 when the Park was established. According to a map of the National Park and the rest of the forest dating from 1830 (Eichwald, 1830) the landscape consisted of groves and grassland instead of a closed forest (see figure 6).

Figure 6

Part of a map of the forest of Bialowieza, published by Eichwald in 1830. The map shows that the forest was composed of concave-shaped groves with open areas between them, which were almost certainly grassland (photo K. Peters, taken from Vera 2000).

Pollen-diagrams from this period show that in such a landscape the percentage of tree pollen exceeds 90%. According to the same pollen-diagrams oak regenerated in this period in the presence of shade-tolerant species like lime, hornbeam and elm (see Mitchell, 1998; Mitchell and Cole, 1998). Draved Skov in Denmark is another important forest concerning the theory about the original vegetation in the lowlands of Central and Western Europe under the prevailing climatological conditions. It is used in palynology as a reference forest for the prehistoric situation (see Iversen, 1958; Andersen, 1970) It is also a former wood-pasture where the regeneration of oak dates back to the period of grazing and is now disappearing after grazing has ended (see Aaby, 1983; Vera, 2000, p. 275-276).

The presence of oak in closed canopy forest reserves is in my opinion a result of the history of these reserves. Nowadays these areas accommodate a mixture of two systems. The first system is the wood-pasture where grazing large ungulates had a great influence. From this period oak in the presence of shade-tolerant dates back. The second system is a closed canopy forest where the influence of large grazing ungulates is excluded or minimised. In this system only the shade-tolerant tree species do regenerate and oak fails to do so. The combination results nowadays in the presence of old oaks with big shade-tolerant species like lime, elm and only new generations of shade-tolerant trees. The combination of tree species in the present-day forest reserves therefore does not reflect the succession within a closed canopy forest. Therefore in the forest reserves one does not see what one thinks to see, namely a closed canopy forest where oak is and will be present in the future.

Oak and hazel in pollen-diagrams in central and Western Europe

The process of the replacement of oak and hazel by shade-tolerant species like lime, elm, beech and hornbeam is not in agreement with pollen-diagrams from the primeval vegetation. They show that both oak and hazel were very well represented in the primeval vegetation during the Atlanticum that is considered to be the period when the primeval forest was optimal developed. They did so for many thousands of years (see *inter alia* Firbas, 1934; 1935; 1949, p. 1; Iversen, 1941; 1960; 1973; Godwin, 1975; Van Gel *et al.*, 1981; Huntley, 1986; 1988; Huntley and Birks, 1983; Delcout and Delcourt, 1987; Bennett, 1988a,b,c; Berglund, 1991; Bradshaw, 1993; Hannon *et al.*, 2000).

As mentioned earlier, the light-demanding oak and hazel, together with the other shade-tolerant tree species mentioned do regenerate very well in wood-pastures, park-like landscapes where large

typical grazers like cattle and horse, graze the vegetation. In this landscape the trees regenerate outside the forest in the mantle and fringe vegetation bordering the grove, forming the transition between grassland and grove. Inside the grove there is no regeneration because of the shade cast by the canopy and the grazing and trampling by the large ungulates.

It can be argued however that wood-pastures are man-made systems, because the main actors in the processes steering the system are domesticated animals introduced by man. As far as their feeding habits are concerned (see Hofmann, 1973; 1976; 1985), there is nevertheless no difference in principle between these domestic ungulates in the wood-pastures and the undomesticated wild fauna (see figure 7).

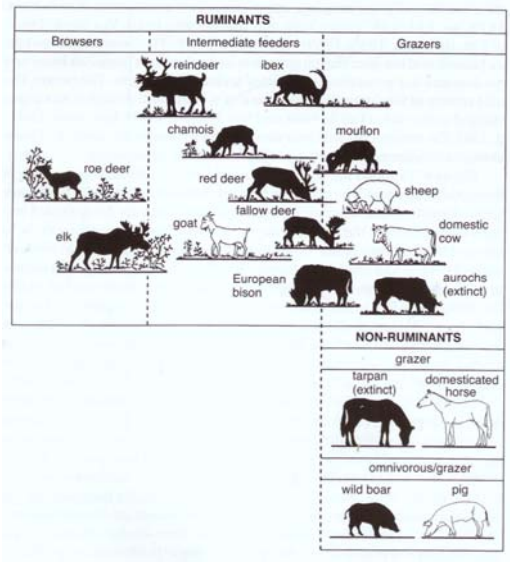

Figure 7

The different species of large ungulates indigenous in Europe, classified according to their feeding strategy. The domesticated species are shown in white. The indigenous species of the lowlands of Central and Western Europe include the aurochs, tarpan, European bison, red deer, elk, roe deer and wild boar (redrawn from Hofmann, 1973; 1976; 1985; Van de Veen and Van Wieren, 1980, taken from Vera 2000).

Cattle and domestic horse are descendants of respectively aurochs and tarpan, species that were part of the wild fauna and have the same feeding strategy. In wood pastures livestock like cattle lived more or less like wild fauna, that is roaming freely (Vera, 2000, pp. 348-349). According to the old regulations it was forbidden to import or export fodder or animals from one common to another (Endres, 1888, pp. 13, 52; Sloet, 1911, pp. 118; Buis, 1985, pp. 81). Therefore, the density of the domestic animals in wood pastures cannot have been beyond the carrying capacity of the wilderness, as must have been the case with the wild ungulates. Both the number of wild herbivores and that of livestock were regulated by the food supply. For the vegetation, this means that the presence and densities of livestock that made the establishment of trees and shrubs possible can be seen as a modern analogy of this process in the past in the presence of the wild ungulates. The wild large ungulates must therefore have had densities that made the regeneration of oak and hazel possible. This densities much have been reached in the presence of large predators as wolf *(Canis lupus*), lynx (*Lynx lynx*) and brown bear (*Ursus arctos*), because otherwise the continued presence of oak and hazel in the primeval vegetation cannot be explained (Vera, 2000, p. 349-350).

So, in conclusion, domestic livestock, which lived together with wild ungulates like deer and wild boar in wood pastures, have to be considered as a modern analogy of the wild fauna including the wild progenitors of the domesticated species in the primeval vegetation. The related vegetation - the wood pasture - has therefore to be considered as the closest modern analogy of the original vegetation. This primeval park-like landscape must have been characterised by a high diversity of species of plants and animals, as is in wood pastures nowadays.

What about the low percentage of arboreal pollen in pollen-diagrams?

If the primeval vegetation was a park-like landscape, it must be responsible for pollen-diagrams with up to 90% of tree pollen, the percentage that according to the current theory originates from a closed forest. After all, pollen diagrams constitute the factual information. If the primeval vegetation was a park-like landscape there must be an explanation for the low percentage of herbs and grasses in these pollen diagrams. The following facts may explain the phenomenon.

At first, in a park-like landscape such as wood pasture, thickets of blackthorn, hawthorn and hazel act as barriers to pollen of grasses and herbs. They prevent their horizontal movement of pollen from grasses and herbs by wind to raised bogs further on, where pollen samples have been taken. What contributes further to the prevention of the horizontal movement of pollen of grasses and herbs is that those thickets are arranged in a mosaic (see figure 1 and 6). So, pollen that pass the first hurdle ends up in the second or third.

At second, large herbivores that graze the grass in park-like landscapes, at least partially prevent the grass from flowering and therefore from producing pollen. This means that the higher the densities of large grazing ungulates are, the lower the production of grass pollen per unit of area will be. A low percentage of grass pollen in pollen diagrams may therefore be an indication of a high density of large grazing ungulates. As a consequence a raise of grass pollen in pollen diagrams may not mean an increase of the surface of grassland, but may be the result of a decrease in the number of grazing ungulates by disease or starvation.

At third, in this park-like landscape, hazel in mantle vegetation and trees reaches high into the air and flower abundantly, producing many pollen. These can be picked up by air currents and transported over tens of kilometres to raised bogs from which pollen diagrams are derived.

All these factors separately may not explain why pollen of grasses and herbs are found in very low percentages in pollen diagrams of the primeval vegetation compared with those of trees if the primeval vegetation was a wood-pasture-like landscape. But they may do so by their accumulated effect. So, the combined effect of the first and the second fact can contribute to a low percentage of pollen of grasses and herbs, while the third fact combined with the combination of the other two will contribute to an overrepresentation of tree pollen and pollen of the shrub hazel compared to the pollen of grasses an herbs (see Vera, 2000, pp. 85-95). However, this theory should be tested. This can be done by modern pollen analyses of wood-pastures. There are a few modern pollen samples taken in such landscapes and some models made for areas with open spaces in a forest. They show, the percentage of non-arboreal pollen (NAP) is a unreliable measure for the openness of the landscape in a sense that very open areas give spectra of pollen that are normally interpreted as being descended from closed canopy forests (see Broström *et al*., 1998; Gaillard *et al.*, 1998; Sugita *et al*., 1999).

The forests in the eastern United States

The forests in the eastern United States has been included in this study (see Vera, 2000, pp. 30-34, 38-44, 95-96, 176-182, 276-281, 359-363, 369-378). This is done because those forests are considered to be an analogy of the untouched vegetation of the lowlands of Central and Western Europe (see Jones, 1945; Whitmore, 1982; Peterken, 1996, p. 230; Pontailler *et al.*, 1997). In the vegetation of the eastern United States one is confronted with the same problem concerning the regeneration of oak as in Europe. Light demanding oak species do not regenerate in closed canopy forest reserves (see Vera, 2000, pp. 276-281).

In the east of the United States there are 30 species of oak (Smith, 1993; Abrams, 1996). Most of them are light demanding, like white oak (*Q. alba*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*) and northern red oak (*Q. rubra*). The most wide spread species is the white oak (Q. alba). Only two species are shade tolerant, namely coast live oak (*Q. agrifolia*) and canyon live oak (*Q. chrysolepis*) (see for example Ross *et al.*, 1986; Smith, 1993; Abrams, 1996; Arthur *et al.*, 1998).

In forest reserves there is a lack of regeneration and a gradual disappearance of light-demanding oak species. Oaks are ousted by shade tolerant species like American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), basswood (*Tilia americana*) and white ash (*Fraxinus americana*) (see for instance Cho and Boerner, 1991; Lorimer *et al.*, 1993; 1994; Brose *et al.*, 1999a,b; McCarthy *et al.*, 2001; Vera, 2000, pp. 276-281; see figure 8).

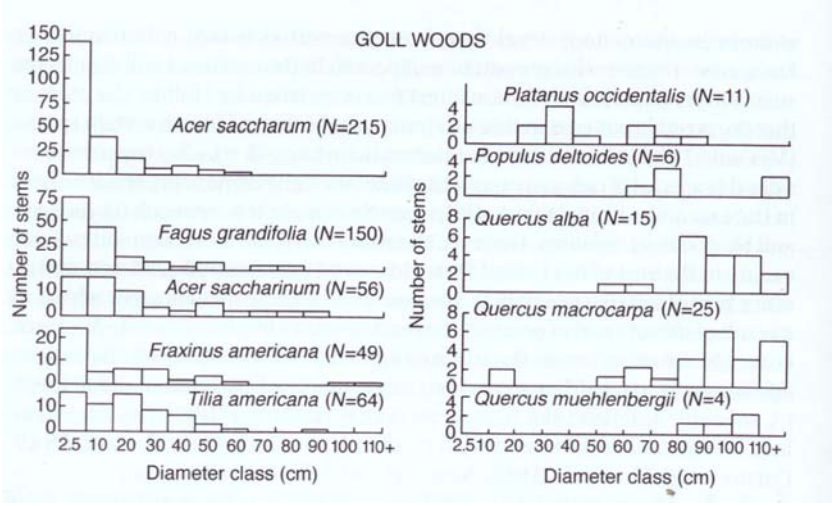

Figure 8

The distribution in 10-cm diameter classes of the various tree species over the thickness classes at chest height in Goll Woods in Ohio. The two bur oak (*Quercus macrocarpa*) trees in the 10-20 cm diameter class were both in a large gap in the canopy (redrawn after Cho and Boerner, 1991, p. 12, taken from Vera 2000).

Nor small and large gaps neither windblown areas covering hundreds of hectares offer oak any solace to produce a new generation of trees (see Ehrenfeld, 1980; Barden, 1981; McGee, 1984; Ward and Parker, 1989; Clinton *et al.*, 1993; Lorimer *et al.*, 1994). After windthrow as a result of hurricanes it is young trees from the advance regeneration of shade-tolerant species that were present under the canopy that grows up successfully. They are released and suppress the oak (Spurr, 1956; Hibbs, 1983; Peterson and Picket, 1995).

In North America, as in Europe, the ratio tree pollen to pollen of grasses and herbs is in the Holocene 90% to 10% respectively. As in Europe this is considered evidence for a closed canopy forest being the primeval vegetation (see *inter alia* Watts, 1979; Delcourt and Delcourt, 1987; 1991, pp. 90-91; Webb, 1988; Roberts, 1989, pp. 72-74; Barnes, 1991; Peterken, 1996, pp. 45-53). Compared to central and western Europe the percentage of pollen of oak forms a much higher portion in the pollen diagrams than in Europe, namely 40 up to 70% (Davis, 1967; Wright, 1971; Watts, 1979; Delcourt and Delcourt, 1987; 1991, pp. 90-91; Clark, 1997). Noteworthy is that American beech reached the northern limit of its distribution after the ending of the Last Ice Age not very long after oak. In this the American beech differs highly from the beech in Europe. The explanation of this phenomenon is probably that contrary to the beech in Europe, the American beech has a vector that transports beech nuts as well as acorns. This vector is the blue jay (*Cyanocitta cristata*) (Darley-Hill and Johnson, 1981; Johnson and Adkinson, 1985; Johnson and Webb, 1989; Delcourt and Delcourt, 1991, pp. 27-28). It means that in the eastern United States oak lived side by side with beech for almost the whole of the Holocene.

According to the pollen diagrams the genus oak (*Quercus*) survived many generations next to shade-tolerant genera like beech (*Fagus*), elm (*Ulmus)*, ash (*Fraxinus*), lime (*Lime*) and maple (*Acer*). Its is suggested that fire might have been responsible for that coexistence, because the lack of fire nowadays coincidences with the failure of oak to regenerate (see *inter alia* Crow *et al.*, 1994; Abrams, 1996; Abrams and Seichab, 1997; Clark, 1997). According to the so-called fire and oak hypothesis (Abrams, 1992) fire would have eliminated the shade-tolerant species in favour of the regeneration of oak. However experiments show that fire is equally bad for all young trees, including oak (Korstian, 1927; Whitney and Davis, 1986; Huddle and Pallardy, 1996; Barnes and Van Lear, 1998). Besides palaeoecologists pointed out oak appears to have maintained itself for thousands of years next to the shade-tolerant genera that nowadays oust oak in forest reserves without clear palaeoevidence of fire (see Clark and Royall, 1995; Clark, 1997). These findings make it necessary, according to Clark (1997), to look for other factors, which allowed for the subsistence of oak in the long term, without fire. Such a factor may be grazing by large ungulates. Up till now this factor has not been taken into account. The reason is that in North America, as in Europe, grazing is considered to be a factor that prevents the regeneration of trees. It therefore should degrade forests to park-like landscapes and finally to open grassland (DenUyl, 1945; 1962; DenUyl *et al.*, 1938; Parker *et al.*, 1985; Whitney and Somerlot, 1985; Peterken, 1996, pp. 237-238).

It cannot be excluded that the presence of oak has been under influence of grazing of large ungulates especially by the true grazer, the American bison (*Bison bison*). Concerning its feeding strategy this species can be considered as an analogy of the European aurochs and its domesticated descendants cattle. Contrary to what often is thought the distribution of this species was not confined to the prairies. Up to 19th century it lived in eastern United States where a closed canopy forest is postulated as the natural vegetation (see Vera, 2000, p. 33, see figure 9).

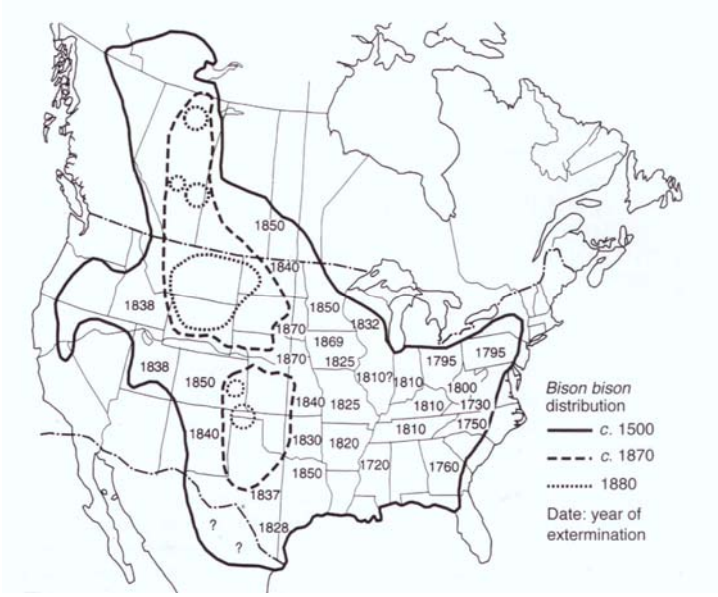

Figure 9

Distribution map of the American bison (*Bison bison*) from AD 1500 in North America. The years given are the years in which the species became extinct in the various regions (based on McDonald, 1981, p. 104; Semken, 1983, p. 186; Hodgson, 1994, p. 70, taken from Vera 2000).

Thorny shrubs are present as well. For example, it is within the distribution area of more than 30 species hawthorn of which most are thorny (see Britton and Brown, 1947), compared with two in Europe. If oak regenerated under the influence of a true grazer the American bison, this should happen in grassland that is grazed by cattle as well. Although cattle is an alien species for the eastern United States its feeding strategy isn't. As a true grazer it can be considered an an analogy of the food strategy of the American bison. Oak species do indeed regenerate in the eastern United States in grassland grazed by cattle. They do so in the grassland itself and in unpalatable and thorny bushes that emerge in these grasslands (see Scot, 1915; Bromley, 1935; DenUyl *et al.*, 1938; Marks, 1942; Steinbrenner, 1951; Darley-Hill and Johnson, 1981; Harrison and Werner, 1982; Jokela and Sawtella, 1985, cited in Crow *et al.*, 1994; Crow *et al.*, 1994; McCarthy, 1994; Stover and Marks, 1998). This is due to the blue jay who collects and plants acorns (Darley-Hill and Johnson, 1981; Harrison and Werner, 1982; Johnson and Atkinson, 1985).

Many historical descriptions from the period when the bison was found in the east of the United States give an impression of open woodland and park-like landscapes. In these landscapes, open grassland played a major role (see *inter alia* Bromley, 1935; Day, 1953; Gordon, 1969; Whitney and Davis, 1986; Covington and Moore, 1994; Vera, 2000, pp. 176-182, 359-363). This means that regeneration of trees could have taken place analogous to the regeneration of trees in grasslands in park-like landscapes in Europe. On the other hand burning by Native Americans has put forward as an explanation for the presence of open landscapes (see Day, 1953; Rusell, 1983; Abrams and Seichab, 1997). Whether this can explain the historical openness of the landscape is under debate. Russell (1953) states that there is no historical evidence for large scale burning in eastern United States and that the openness in itself as such is used as the evidence op large-scale burning. Because there was openness everywhere, there must have been burning everywhere, because otherwise the phenomenon cannot be explained. If we assume that large ungulates were responsible for the openness of the landscape, this does not mean that burning by Native Americans could not have had effects on the landscape. The landscape might have become more open than it already was by nature.

In any way the forests in the eastern United States do not give an answer on the question of how light-demanding oak regenerates in a closed canopy forests. The opposite is true, they confirm what happens in Europe namely that light-demanding oak species are ousted by shade-tolerant species in forest reserves in the absence of large ungulates especially the true grazers. It can even be stated

that in the east of the United States all components of a park-like landscape analogue to the wood-pastures in Europe were present.

Synthesis

The development of the primeval vegetation may be summarised as follows:
In grazed park-like landscapes oaks and other tree species grow up in scrub or in the mantle and fringe vegetation of groves emerging in those grasslands, forming groves with a closed canopy. The grove advances into the grasslands at the speed of blackthorn advancing into grassland by underground rootstocks. Solitary trees will come up together with solitary hawthorns. Oak advances in such a landscape because jays plant the acorns at great distances from the fruiting oaks, right on the edge of shrubs. Seeds of other species are spread by the wind. The seedlings emerging from those can only survive if they come up in the direct vicinity of protective shrubs. On poorer soils trees can grow up in shrubs like juniper and bramble. Within the groves no regeneration of trees takes place because of the shade cast by the canopy and the effects of the presence of the large ungulates. If a gap is formed, grasses will establish there and attract large herbivores. Their grazing and trampling will prevent seedlings from coming up there. So they prevent the regeneration of trees in gaps of the canopy. As more trees die or are windblown, the surface of grassland increases. In this way, ultimately the grove degrades from the centre onwards into grassland, as is known and described as retrogressive succession. At the same time the front of the grove will advance into the grassland. In the long run, light-demanding thorny shrubs will establish in the newly developed grassland, protecting young trees against the large herbivores. In this way a new grove emerges from the grassland. As has been shown earlier the view that large ungulates like cattle prevent the regeneration of trees does not apply as a general hypothesis. They facilitate the establishment in open grassland and prevent the regeneration in closed canopy forest. In fact they induce a non-linear succession, namely: grassland → thorny shrubs → grove → grassland → thorny shrub → grove etc. I called this theory ***the cyclical turnover of vegetation*** (Vera, 2000, pp. 376-378)**.**

This process started after the ending of the Last Ice Age, when the steppe-tundra from the Ice Age came under modern temperatures, because of a rapid change of the climate (see Coope, 1994; Dansgaard *et al.*, 1989). From this open land dominated by grasses and herbs, the fauna of the Ice Age like mammoth (*Mammuthus primigenius*) moved away, while the fauna we nowadays know as the indigenous fauna of wild ungulates of the Holocene, including wild oxen, the aurochs and wild horse, the tarpan, moved in. So the whole cyclical process started in an (almost?) open landscape.

Conclusions

The conclusion is that on places where large ungulates like aurochs including large grazers like aurochs and tarpan could roam the primeval vegetation was not a closed canopy forest. It was a prak-like landscape with a very high diversity of biotopes and therefore a very high diversity of wildlife. Therefore the species diversity in traditional agricultural land - and in particular in grassland - is not the result of the introduction of agriculture. This diversity is the result of natural processes in which large herbivores, especially grass-eaters like cattle and horse played an essential role. They induced a non-linear succession, which resulted in an enormous diversity of biotopes. This resulted in a park-like landscape with a very high diversity of species. Much of this diversity survived since prehistoric times, even after the disappearance of the original large herbivores in wood pastures, because livestock in combination with the surviving wild ungulates formed more or less a modern analogue of original situation in which the wild fauna steered the succession. The landscape and the underlying processes were therefore preserved as well as the wildlife that was connected with the natural park-like landscape. However, over centuries, farming practice and

forestry have developed in a way that is increasingly different from natural processes. The species diversity that was naturally found in a single interrelated system with large ungulates gradually became fragmented and distributed in all sorts of different types of agricultural land. An example of that fragmentation is the separation of pasture and wood - the first becoming the modern grassland for milk and beef production, the latter the high woods and high forests for the production of wood - to the detriment of scrub and mantle and fringe vegetation and the large wild ungulates. The latter were ousted by agriculture or diminished by hunting to unnatural low densities in order to protect the so-called “natural” regeneration within the forests.

In view of the aims of nature conservationists - and botanists in particular - to retain the natural heritage, it might be necessary to retain the natural processes, or to redevelop them. This may mean agricultural land either being abandoned or taken out of production. There the interdepence and the interactions between large herbivores and the vegetation will have to be restored. Cattle, horse, red deer, elk, European bison, roe deer and wild boar will have to be able to live there as wild animals again. This means that cattle and horses will have to be rehabilitated as species living in the wild. Without these ungulates living in the wild the survival of the natural diversity will be impossible on the long run.

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Grazing Ecology and Forest History – a model
MSc. in Forestry Peter Friis Møller

Other factors of importance in Danish forest landscapes from past to present

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There are several nature protection issues to deal with or at least think about in the forests of today. For only to mention a four of them:

- Why don't the oak regenerate successfully inside the forests?
- Why are so many forest-, wood- and tree living species on the red list and why are many of them still declining?
- Are the dynamic processes and structures of non-intervention forests of to day comparable to those of the virgin forest?
- How is former human impacts influencing forests of today?

Numerous factors are involved and interacting in the development and dynamics of forest ecosystems in space and time, e.g.:

* Grazing/browsing pressure
* Climatic oscillations and changes
* Fragmentation
* New barriers for immigration and spreading of species
* Change (Reduction) in forest area
* (Changes in) human impact (land use)
* Broken continuity in key factors (megatrees, deadwood, etc.)
* (Changes in) soil conditions
* (Changes in) fire frequencies
* (Changes in) hydrology
* (Changes in) tree species composition
* (Changes in) forest structure
* Etc.

The role of the large mammals is in focus in this conference, but many of the other factors have to be taken in consideration in understanding the past as well as the background for the present situation.
This contribution will - due to the very limited time - focus on two of many: hydrology and tree species composition, particularly the role of beech, *Fagus sylvatica*.

Hydrology
In forest ecosystems with natural hydrology, the ground water level is a very important dynamic and controlling factor, determining extension of forest cover and the species distribution as illustrated in fig. 1. Often only a few decimeters difference in water table (and occurence or frequency of "high water table episodes" or flodings) causes a significant change in vegetation - even changes main tree species from alder to beech.

Geological soil maps of Denmark indicates a previous much wetter situation in the landscape. In e.g. NE- Sjælland organogenic sediments (peat, gyttja etc.) covers 25 % of the land surface (+ 6 % lakes). But the area where water level /hydrology was a controlling factor or had an important influence was much larger, since only a minor part of the water-level impacted soils was sediment producing - e.g. humid clay soils. It is estimated that the hydrology in the past was an important dynamic and to some degree controlling factor on a regional scale in Denmark at between 10 and 40-95% of the area - depending on soil texture and topography (Møller 2000).

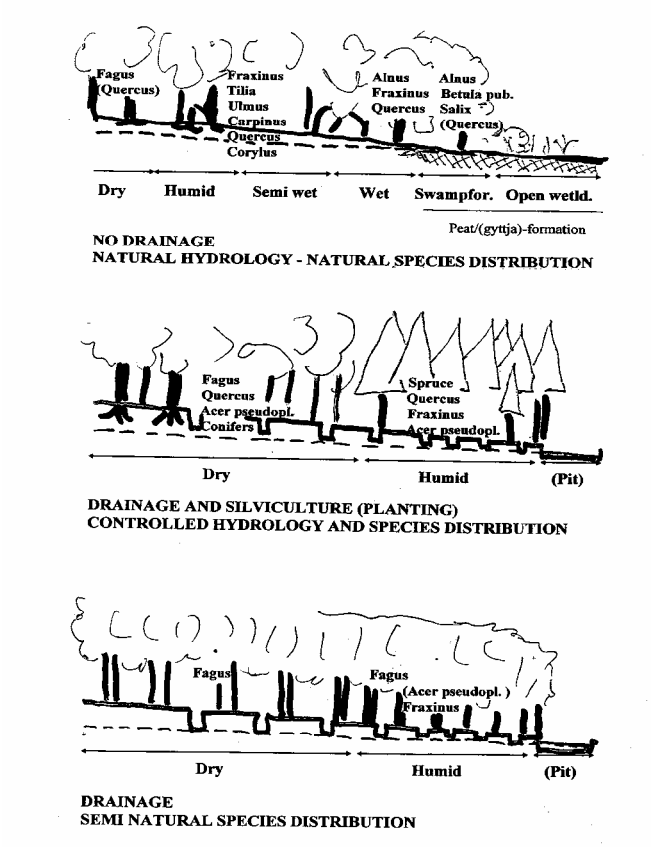

Fig. 1
The role of hydrology as a tree species distributing factor.

The beech (*Fagus sylvatica***)**
The beech is the most important deciduous tree species (17% of the area) in the present Danish woods. Beech is also the most shady and shade tolerant deciduous forest tree species in DK - and the most sensitive to a high water table and changes in it.
Beech was not present in the Atlantic virgin forests in Denmark, but immigrated later, in the bronze age, around 1500 BC.
Beech in Denmark was indirectly benefited by first the wild boar and the pig keeping in the woods and later enormously by the silvicultural management including the artificial drainage by ditching since particular 1830.

Changes in forest conditions
The Danish forest situation changes dramatically around 1800.
According to numerous sources about Danish forests in the past - from at least 1200 to around 1800 the Danish forest was intensively used for grazing of cattle and horses and for feeding of pigs. Goats was already forbidden in the forests before 1600.

Around 1800 AD strong forest acts lead to an abrupt end of cattle grazing in most Danish forests and at the same time intensification of the silvicultural management, including massive drainage and introduction and planting of conifers lead to increasing stand density and tree cover - leading to significant changes in many of the basic conditions in almost all present day forests.
Some of the changes are outlined in fig. 2.

9000 BC 3800 BC/1200 AD 1780/1820 2000

"Virgin Forest" landscape	**Pasture wood -agric. landscape**	**Silvicultural forest- agric. - city landscape**
Uncertain? low-high? local? varying? Grazing-browsing pressure	High - very high grazing pressure	No grazing, but deer browsing
Natural hydrology High groundwater level	+/- Natural hydrology +/- High groundwater level	Hydrology totally changed Low ground water level
(5-) 20-50% wetland (10-) 40-95% of the area influenced by water level		2-5% wetland <3-8 % of the area influenced by water level
NO Fagus present until 1500 BC	Fagus present	Fagus Acer pseudoplatanus Conifers (e.g. Picea, Abies)
Gradients and mosaics of 'light', 'open' to 'closed' forest and open wetlands	'Open' conditions prevailing	'Closed' conditions prevailing Dominance of shady and shade tolerant species

9000 BC 3800 BC/1200 AD 1780/1820 2000

Fig. 2
Comparison of conditions in the Atlantic virgin forest, in the human influenced forests in the historical "pasture land woods" and in the silvicultural forests of today in Denmark.

Conclusions

- Even without any impacts from large mammals, the Atlantic virgin forest landscape undoubtedly was much more open than the forests of today. A high proportion - probably around 20% -of the forest area was open simply due to the prevailing high ground water table and a higher amount or share of open wetlands due to the stage of gyttja and peat formation. The forests was in large part of the country undoubtedly a mosaic of structures - including open areas, wetlands, swamp woods, shrubs and more dense stands and stages of succession in gaps of different origin etc.
- In Denmark almost every single square meter in the forest is impacted by drainage. Even our most valuable natural forests with "virgin forest like" structures are directly influenced by drainage (e.g. Draved, Longelse, Eldrup, Haveskov, Høstemark) or indirectly by ground water exploitation in the surroundings (Suserup).
- Except for short periods of total openness due to clear-cuts or storm events, the Danish forests of today are more or less totally dominated by shadow species. According to forest statistics stands of light species as Quercus, Fraxinus and Pinus sylvestris only covers approx. 10-15 % of the forest area.
- Dominant shadow-species such as *Fagus sylvatica, Acer pseudoplatanus, Picea* spp. , *Abies* spp. and other conifers (except a small amount of *Taxus*) was not present in the forests. But lime (*Tilia*) and elm (*Ulmus*) until the elm decline was.

- The regeneration possibilities for oak appears to be better in non-intervention woods with natural or close to natural hydrology due to openness and the prevailing wet and semi wet conditions and the high proportion of edges. But the amount of oak shown in the pollen diagrams in former periods appears to be much higher than obtainable today.
- Due to management there is almost a total absence of large trees (mega trees) and dead wood in the present day forest ecosystems.
- The regeneration of hazel in non-intervention woodlands with natural or close to natural hydrology (e.g. Draved Skov) is fairly good.
- Natural succession do not always lead to higher biodiversity. The immigration of the very shade bearing and shade tolerant and on the dry soil very competitive beech might in that perspective be considered as an ecological disaster - like *Picea* in parts of northern Scandinavia.

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Present-day herbivore-forest relationships
Rita Merete Buttenschøn

Present day woodland grazing with farmed animals in Denmark.

Introduction

Only a limited amount – in all about 2,000 hectares - of Danish woodland is grazed today. Most of the grazed woodlands with a long unbroken history of grazing are deer enclosures, e.g. Jægersborg Dyrehave and Tofte Skov. Where grazing with farm animals is concerned we most often lack concise and continuous information on management history. However, the basic systems of woodland grazing are known and in some areas the grazing has been continued up until recent times.

Animal	Mode of grazing	**Present day sites**	**Comments to site**
Cattle	Generalist grazers that rip off tussocks of vegetation with the tongue; limited browse	Skovbjerg, Mols Bjerge Kollemorten Krat Bjerre Skov Klinteskoven Hammersholm	Old fragmented woodland and oak shrub Oak shrub with coppice Copice woodland with oak, hazel and alder Fragmented beech woodland Woodland with ash, oak and wild cherry
Horses and ponies	Selective grazers that bite off vegetation very close to the soil surface; very limited browse	Langå Egeskov	Ancient oak shrub
Sheep	Selective grazers and (less) browsers, using tongue and lower incisives	Rebild Bakker Halskov Vænge	Dwarf shrub heath with aspen and beech shrub Open mixed woodland re-established around a group of burial mounds
Goats	Selective browsers and grazers, using tongue and lower incisives	Slotslyngen Møn	Dwarf shrub heath on rocky ground with fragments of birch and oak shrub
Pigs	Omnivores eating small animals, fungi, seeds, fruits, roots and grass	Toft Skov	Wild pig and red deer
Roe deer	Selective browsers (>80% browse) and grazers	Kalø Skovene	Mixed beech woodland, not enclosed
Red, sika and fallow deer	Selective browsers and grazers (30-70% of diet browse)	Jægersborg Dyrehave Høstemark Slotved Skov Esbjerg Dyrehave	Fallow and red deer; fragmented mixed beech woodland Red deer; mixed broad leaf conifer woodland Ancient deer enclosure with fallow deer Sika deer

Table 1. Some examples of grazed woodland in Denmark.

Traditionally the opinion was that farmed animals destroyed the woodlands. However, at the time when the Danish legislation abolishing agricultural grazing in woodlands was put into force the view WAS more varied and the role of the farm animals in connection with woodland appreciated. At this time the farms were restructured and common farming was abandoned and most of the commons with their fragmented woodland were divided into lots. Some decades later the dairy

industry was intensified. In conjunction to the restructuring, the pork production was intensified and the mast pork production was given up, pig feeds largely being based on grain and whey.

Today there is a renewed interest in woodland grazing with farm animals, but now the focus is on creating more varied and diverse woodlands of better amenity value.

Grazing may result in more light-open and varied woodland with higher diversity in the field layer and more margins within the woodlands. Grazing creates gradients between open pastureland, fragmented woodland or shrub to closed woodland, diversifying the structural elements in the habitats available for the flora and fauna that are especially associated with light-open woods. The higher influx of light enhances the natural regeneration of the woodlands.

In analysis plots in the oak shrub at Skovbjerg there were recorded 55 species of vascular plants in the cattle grazed part, whereas only 39 were recorded in the ungrazed part in 2000, 12 years after the initiation of grazing. In contrast to this trend of development Tybirk & Strandberg (1997) describes the change in light influx in Hald Ege after abandonment of grazing being reduced from a spectrum of 12-32% in 1916 to only 0.5-8.5% in 1995. Similarly, 14 of the 19 main vascular plant species decreased in importance and the total species number was reduced from 61 to 45 over this span of time.

The bio-diversity depends on the age and size of the woodland, the grazing impact, the grazing animal species and the management history. Whereas the woodlands formerly were grazed with more farm animal species, the present woodland grazing are almost exclusively based on one species only. This makes the impact more uniform in accordance with the traits of the grazing animal species, confer with table 1.

The effect of farm animal grazing on woodland development

In the studies of long-term development of grazing on semi-natural pastureland and woodland ecosystems we have used cattle, horses and sheep as grazing animals. My focus will be on cattle grazing as cattle immediate a structural and botanical more diverse woodland development than the two other species.

The grazers

The three species are predominantly grazers, but ranking sheep over cattle over horse browse is a part of the feed selection, and ranked similarly the animals impede woodland development on open pastureland. The amount of browse taken appears also to be racial as well as phenotypical traits within the animal species.

Cattle graze preferably on the open, light exposed parts and margins of the woodlands, whereas the movement of the cattle mainly influences the closed woodland. Buttenschøn & Buttenschøn (2000) showed that there is a marked gradient of browsing activity going from open pastureland over the margins to the closed woodland and that browsing of most woody species is a non-selective trait, integrated into the general grazing activity. Being generalist grazers, the cattle select their feed on the plant society/sub-society level, largely governed by the freshness of the vegetation. The result is the development and maintenance of intermingled patches of heavily grazed lawns and less grazed, tussocky vegetation, but seldom leaves larger parts of the vegetation untouched Buttenschøn. The pattern facilitates establishment of woody species in the less grazed patches spatially distributed throughout the pasture. Cattle prefer taste neutral and acidic vegetation to acrid. Thus grasses,

sedges and certain herbs are their choice feed, whereas acrid herbs like some Composites and Ranunculi are avoided.

The horse has a grazing behaviour that is quite similar to that of cattle. The lawns and less grazed areas, however, are kept on a larger scale, so that the structural pattern is more open. The horse browses less than cattle and conifers are left untouched even at the seedling stage, resulting in a rapid development of conifer woodland where seed sources are available (Buttenschøn 1997b). Climax woody species like oak is also browsed less and woodland encroachment is in general more rapid than under cattle grazing. The extensive movement of the horse promotes wear on the pasture and results in erosion as well as soil compaction, depending on the surface inclination and soil character.

Sheep graze selectively on a small-scale pattern. Herbs are preferred to coarse grasses and sedges and nutrient content and plant phenology determine the grazing pattern more obviously than with the two aforementioned species. The result is, by comparison, more species poor vegetation. Sheep grazing results in lawn development, but is often associated with the promotion of large stands of totally avoided species, e.g. Nardus stricta. The structural diversity of the vegetation is less pronounced than that seen in connection with cattle and horse. Sheep browse more than cattle and may, dependent on the species in question and the magnitude of the seed rain prevents woodland development. Conifers and juniper are exempted. Sheep have grazed in many of the oak shrubs on heaths in Jutland.

Establishment of woody species at different sward production levels

Over a longer temporal scale grazed semi-natural pastureland will develop into woodland. The development is quicker on nutrient poor soils. The production is lower and the possible utilisation ratio of the above ground productivity is accordingly less. Figure 1 shows model graphs on the connection between above ground productivity and good husbandry utilisation ratio. The resulting relative stocking rate is shown on an index-basis. Besides allowing more light to the soil surface the probability of any particular part of the low productive areas, e.g. heaths and mires, would be grazed once, where any part of the high productive meadows would be grazed some five times. As mentioned browse by cattle on most woody species occurs as an integrated part of the grazing, meaning that the grazing intensity per se would render a woody species seedling or sapling at a five times as high risk in the high productive pasture as compared to the low productive. If account also is taken of the higher and denser sward of the high productive sward the changes of seedling success are extremely low in the high productive pasture.

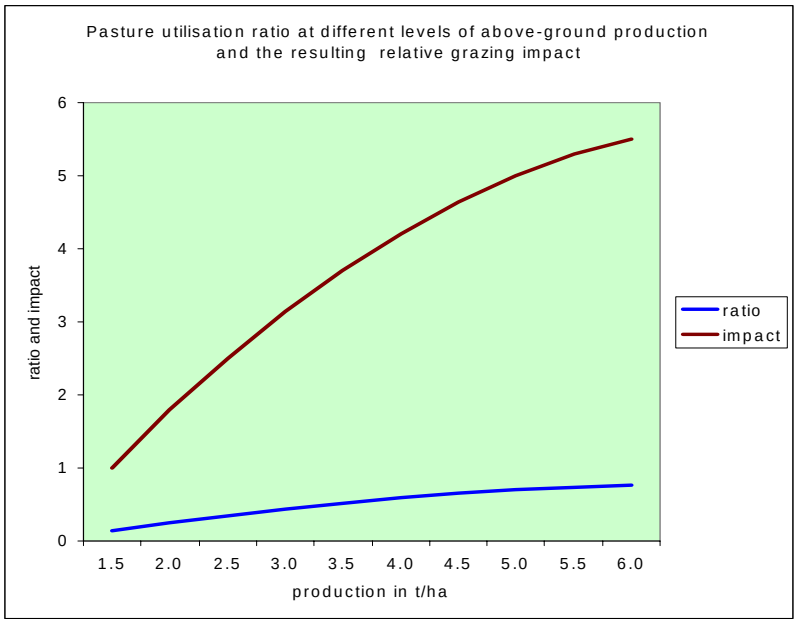

Figure 1.
Pasture utilisation at different levels of above-ground production and the resulting relative grazing impact. It is preconditioned that the amount of above-ground dry matter left at the end of the grazing season is approximately the same.

Chronology of woody species establishment

Buttenschøn & Buttenschøn (1985) have applied three terms to groups of woody species reflecting their relationship to the management of the pastureland and the succession chronology of woodland development, the grazing pioneer – disturbance and stress tolerant species sensu Grime (1977) – the abandonment pioneer – competitors – and the climax species – stress tolerant.

The main trait connected to the grazing pioneer species is the protective agents, thorns (Rosa spp.), thorn-adapted twigs (Malus sylvestris, Prunus spinosa, Prunus cerasifera, Crataegus spp.) or needle-like leaves (Juniperus communis) and their regenerative dependency on animals – birds and mammals. Birds play a variable role in the dissemination of all mentioned species, but three species or species groups in particular are adapted to mammal herbivores that do not grind the feed fully, cattle (bovidae) and horses (equidae). The three species are Malus sylvestris (Buttenschøn & Buttenschøn 1998), Rosa spp. and Juniperus communis. The two former are to a large extend dispersed parenterally by cattle and horses (Buttenschøn & Buttenschøn 1998, unpublished), whereas the latter being light and soil insertion dependent is promoted by the grazing and the treading of the animals.

The abandonment pioneers are largely wind spread and depend on widespread dispersal, amounts and, conditionally if amounts are limited, on not being disturbed in the early life stages (Buttenschøn & Buttenschøn 1985). They colonise non-grazed areas successfully when sufficient light reaches the soil surface, e.g. in the semi-shadow of a previously established generation of the same or a similar species. Under grazed conditions the success depends largely on the amount seedlings and the grazing impact. This implies that they are more successful under a low than high productive setting.
The climax species are relatively shade tolerant and may emerge under canopies of pioneer species (Buttenschøn & Buttenschøn 1985). Under grazing they utilise the protected space within the grazing pioneers and eventually grow through the “nursing” species. Similarly, they may establish in thickets of abandonment pioneers and eventually out-grow and out shadow these.

The trends described here are summarising. It is important to point out that there often is a notable spatial difference between the woodland development on grazed and non-grazed pastureland. Under grazing the development is widespread, being dependent on the mosaic of heavily and less heavily grazed spots, lawn and more or less tussocky areas. The latter are the most probable establishment sites. Under non-grazing the first main event leading to colonisation is the abandonment period where there is a high influx of light. In the high productive systems this may prove to be the only establishment for decades. Else, semi-shadow of growing generations of woody species will allow sufficient light for establishment in sequences separated by some 8-12 years. The establishment is more perimetrical apposition to existing woodland than the spatially widespread mentioned in connection with grazing. The two modes of development has a large influence on the three-dimensional spatial diversity, grazing giving a very large amount of boundaries and interfaces, non-grazing giving mainly a progressively expanding boundary.

Relationship between woodland development and the age of the pastureland

There is a difference in the trend of woodland development along the temporal dimension of succession. To illustrate this we have compiled graphs showing the development in density and cover-index of the grazing pioneer and climax species on young (40 years off arable), open pastureland and ancient, pastureland, closed by woodland fragments.

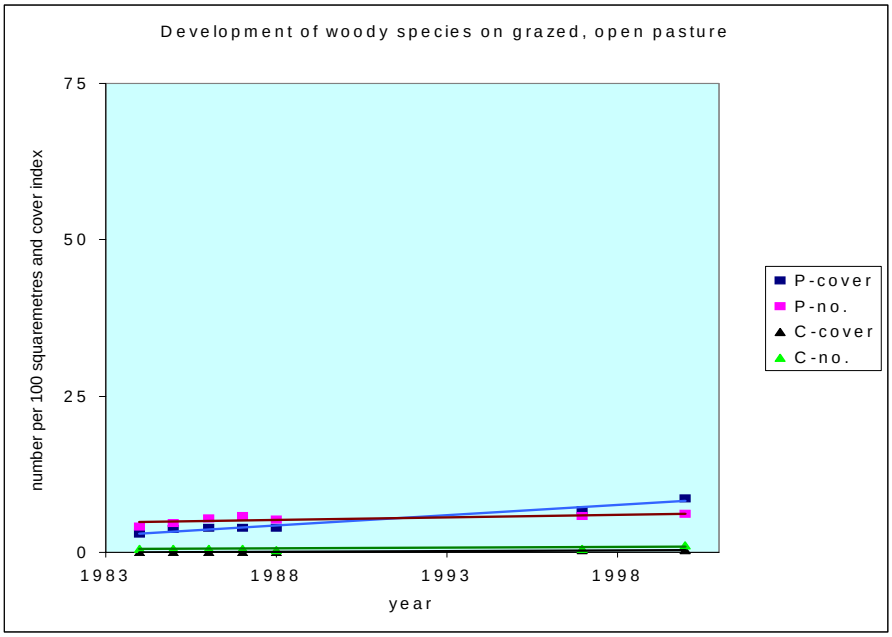

Figure 2.

Density and cover–index of two groups of woody species, the grazing pioneer and climax species, on pastureland, which has developed on former arable over some 40 years. Grazing was initiated 26 years ago. The density is expressed as number of individuals per 100 square metres. The cover index is a relative cover measurement of the vertical projection of the woody species derived from the size groups defined for the analysis of the woody species, c.f. Buttenschøn & Buttenschøn (1978, 1985). The number of grazing pioneers is stable, but there is a slow increase in the cover-index. The climax species remain unchanged in cover, but increase slightly in number. They are represented by a small number of heavily browsed individuals, some being recruited, others dying off. There is no safe space in this early stage of woodland development. The production is between 2 and 2.5 tonnes/ha.

On the new grassland the grazing pioneers expand in number and cover (figure 2). The main species here are juniper and rose species. As there is no safe space available for the climax species only seedlings and succumbed sapling are present in this sward. The rate of increase is slow, but apparently steady

In the fragmented woodland of the ancient grassland the grazing pioneer species decline in number as well as cover (figure 3). A number of the individuals, be it sapling or larger individuals, are either shadowed or grazed out. The overall woody species density is high.

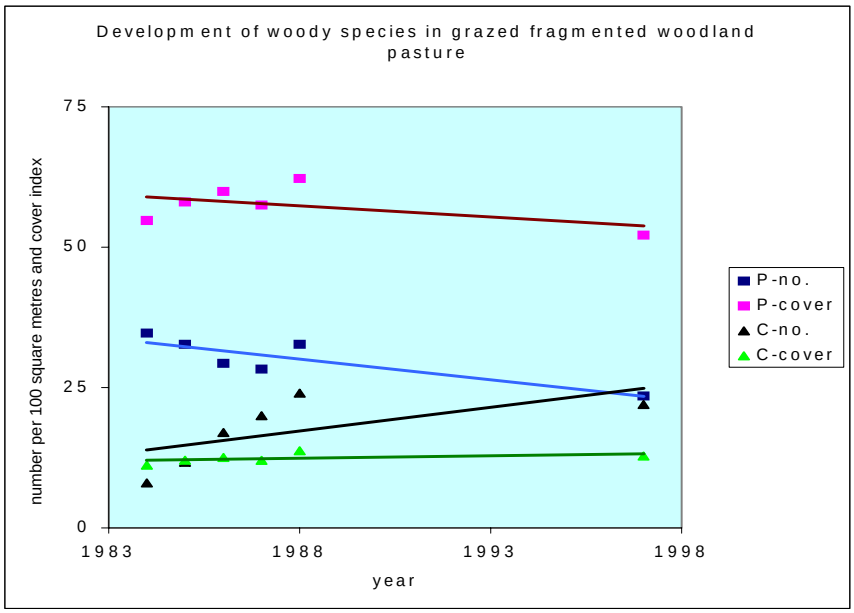

Figure 3.
Density and cover-index of grazing pioneers and climax species in a densely wooded, fragmented woodland pasture. The grazing pioneer species decline in density and cover. This is partly due to increasing shading by climax species, partly due to fluctuation in the sapling population size. There is a notable increase in the density of climax species as more establish within the safe space of the grazing pioneers. There is a less marked increase in cover-index of these species. The production is between 2 and 2.5 tonnes/ha.

The climax species increase markedly in number and slightly in cover. The safe sites are abundant and the climax species saplings emerge here. The increase in cover indicates that a number of individuals succeed and eventually will grow above the reach of the grazing animals.

The just mentioned pasture is low-productive. Another part of the same enclosure is higher in productivity, a sedge-grass meadow sward. The development here supports the model assumptions on success in relation to productivity (figure 4): higher exposure to browsing combined with lower influx of light. The grazing pioneers decrease in number, but expand cover. The few individuals above browsing height expand, whereas a large number of the saplings succumb to the summarised impact of years of browsing. By and large, the climax species occur only as a transient population sapling, establishing and surviving a few years of high impact browse. However, circumstantial evidence from that sward implies that even this situation on the long run will result in woodland development as a result of safe sites being established for the climax species.

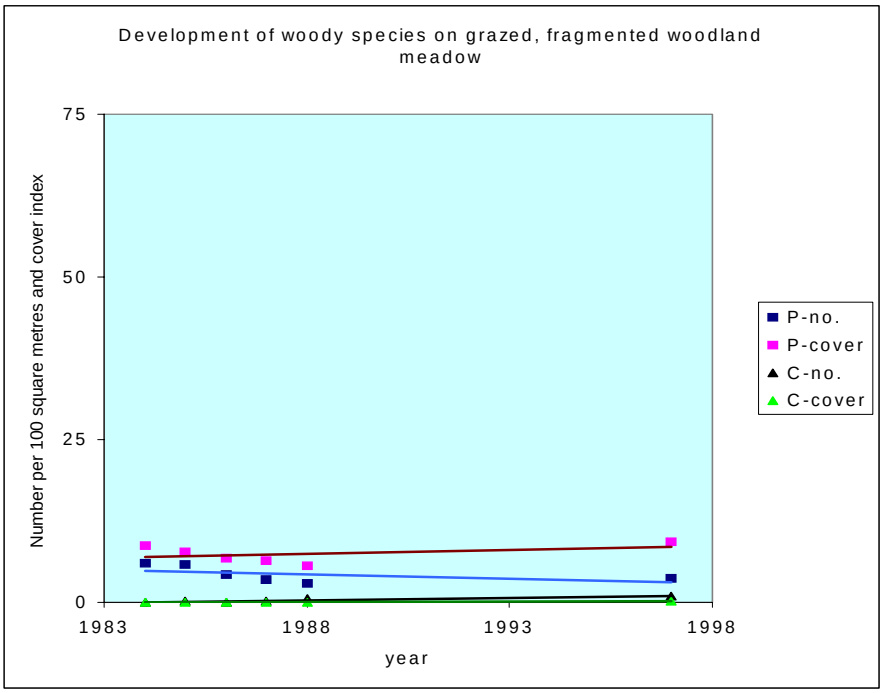

Figure 4.
Density and cover-index of grazing pioneers and climax species in a fragmented woodland meadow. The meadow is within the same enclosure as the pasture in figure 3. The trends are similar as those seen in figure 3, but the level of woodland encroachment is only about one tenth of the one on the pasture. The production on the meadow is about 3,5 tonnes/ha, and accordingly, the grazing impact is close to twice as high. This influences survival of woody species greatly.

Conclusions

Grazing by grazers of open, semi-natural pastureland will result in the development of fragmented, eventually closing woodland. The speed of development is stocking rate dependent. The stocking rate will also determine the structural- and bio-diversity. High stocking rates prolong the development, but will also greatly influence the structural build-up of the woodland under-story and field layer and diminish the biodiversity. In contrast to this low stocking will result in a very varied three-dimensional structure and light influx in the over- and under-story, facilitating a high biodiversity. The diversity of woody species is very high in the woodlands that have developed under grazing by grazers, as the grazing pioneer species are abundant, mainly in the under-story. These species are infrequent or lacking in ungrazed woodland and woodland developed under grazing by browsers.

Recommendations

- The traditions of grazing of woodland by farm animals should be re-instituted as a means of conserving and optimising bio-diversity
- Sites of ancient, grazed woodland should be given highest priority
- Succession development of open pasturelands to fragmented and closed woodland should contribute to the stabilising of the specific flora and fauna elements particular to the grazed woodland
- Grazing should be considered as a management tool in connection with the establishment of new woodlands, in particular in areas where the primary objectives of the woodlands are promotion of bio-diversity, recreation and ground water preservation.

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The Danish landscape - and its nature qualities

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The fact that large grazers such as wild horse, rhinos and aurochs were part of a prehistoric Danish fauna does not in itself justify a de-domestication of cattle and horses in nature reserves. In order to justify this we need to answer the question: do we improve the biological qualities of the habitats and landscape by introduction of large, wild animals?

Although I work as a researcher in the National Environmental Research Institute, this contribution to the conference should not be considered a presentation of a national policy, but rather a personal view on the issue.

The Danish landscape is an intensively cultivated landscape. Remnant patches of natural and semi-natural habitats are fragmented and isolated (fig. 1). Denmark has no mountains (max. altitude < 200 m) and the soils are generally deep and fertile or at least easily accessible for agriculture. Semi-natural habitats such as grassland (fig 2), heathland and meadows have declined dramatically during the past 200 years and considerable efforts are being made today to conserve the remnant fragmented patches by legislative protection against agricultural improvements and by subsidising farmers in order to maintain extensive grazing by domestic animals.

The thesis of this presentation is that a nature management policy for the Danish landscape not only depends on a scientific quantitative representation of this landscape but as much on the human perception and interpretation of the landscape. For example, the interpretation of the grassland landscape in figure 2 will inevitably depend very much on the perspective.

From a cultural perspective the semi-natural grasslands, heathland and meadows are interpreted as the result of historical processes with focus on the centuries or millennia of human exploitation and grazing by domesticated animals (fig. 3). Consequently the conservation of these habitats and their biological diversity is believed to depend on a continuation of traditional agricultural practices. Connected to this perspective is a vocabulary derived from agriculture: the dry grasslands are called "overdrev", which is best translated to "rough ground, only occasionally ploughed, and where domestic animals were grazing". The term generally used for semi-natural habitats is "halvkultur", which may be translated directly to "half-culture", meaning areas not suitable for intensive cultivation. The cultural perspective has been prevailing in Denmark, and also in UK and Sweden.

From a biological perspective the semi-natural habitats are interpreted as the result of evolution, migration and ecological processes, including the interaction between vegetation, herbivores and carnivores (fig. 4). From this perspective the semi-natural grassland represents a relict of the natural flora and fauna in Denmark. The biological perspective forces us to consider the natural prerequisites for this grassland, including large wild herbivores, and other disturbing factors such as erosion and wildfires. The biological perspective receives increasing attention in Denmark (e.g. Thomsen 2000, Buchwald 2000). Management for wildness is already implemented in the Dutch nature management policy (cf. Kampf, proceedings from the conference).

But what are the biological qualities that we want to manage, conserve or protect?

A recent Danish research project had as its main objective to develop a useful terminology and methodology for implementation of tools for prioritising methods and objectives in nature management (Nygaard et al. 1999). In order to explain the results of this project, it may be useful first to present some of the considerations behind.

The qualities of our living environment may be divided into critical and unique resources. Critical resources (or material qualities) include ecosystem services and medical discoveries. Erhlich & Erhlich (1981), in their book about extinctions, considered the causes and consequences of the disappearance of species. They compared ecosystems and aeroplanes and found that both have limited redundancy. Small parts may be removed without serious damage because remaining parts still cover all essential functions. At a certain point however, a critical part is lost and the plane crashes or the ecosystem brakes down. Clearly this idea has had much impact on the political attention devoted to the conservation of biological diversity. Likewise it has stimulated research activities attempting to prove the critical importance of biological diversity and to estimate the economical values of ecosystem services provide by our living environment.

The global value of ecosystem services has been estimated to approx. 33 trill. dollars (Constanza et al. 1997 in Nature), but this enormous figure is not directly related to the amount of available biological diversity. More specifically, number of large experiments has been carried our to investigate the importance of diversity for ecosystem productivity (e.g. Naeem et al. 1994, Tilman and Downing 1994), and based on some early promising results, Kareiva (1994) suggested that diversity begets productivity. Some years later, Huston (1997) examined the results of several of the published results, and revealed several confoundings caused by hidden treatments. Huston found evidence that functional diversity (the presence of one or more critical functional types in a given environment) matters rather than species diversity. Grime (1997) supports the interpretation of Huston, and although he further hypothesises that future global changes may expose the ecological role of species that are functionally insignificant today, the notion of biological diversity as a critical resource today and in the foreseeable future have limited scientific support.

Unique resources do not relate to our physical survival but rather to our mental well being. Among these resources we may count "intellectual qualities", such as opportunities for recreation, education and research. Even more importantly we should remember the ethical qualities related to the protection of species, habitats and landscapes with high biological integrity. Although this ethical imperative is more complicated to deal with than animal welfare, I believe that it lies behind much of our concern for biological diversity.

Based on the notion that the value of our natural environment and its diversity mainly belongs to the unique resource dimension, four fundamental criteria for nature quality were defined (Nygaard et al. 1999):

> Originality **– When we conserve native species, and natural habitats and landscapes we also conserve the history of evolution. As an example, ancient natural bogs or newly formed white dunes are worth more than plantations of exotic coniferous species.**
>
> Wildness **– When we allow natural processes to occur without human intervention we achieve opportunities for ecological insight and recreational experiences, which cannot be found in anthropogenically controlled environments. Irrespective of continuity and originality, wild species and**

spontaneous processes (growth, competition, predation) are preferred over domesticated species and cultivated land.

Continuity (temporal and spatial) **– Natural processes and many species demand large areas and plenty of time. Furthermore, ancient habitats and populations are valued as storytellers of the local natural and cultural history.**

Authenticity **– When we consciously neglect natural reconstructions, we conserve the authenticity of habitats and landscapes. Spontaneous occurrences are preferred for human constructions. This is because, not only the physical elements, but also the history and the processes are considered valuable.**

Diversity and rarity is not mentioned among the major criteria for nature quality, and the reason for this is that although diversity and rarity are sometimes good indicators of originality, continuity and wildness, they do not themselves guarantee a high biological integrity or good opportunities for recreation, education and research. Valuable and original features such as raised bogs cannot be considered biological diverse, so diversity should also be used with great caution. Rarity is commonly used for prioritising conservation actions. But this is because we risk loosing what is rare and not because rare features are worth more than common features.

If we evaluate the idea of re-introduction of large herbivores in a nature quality perspective we may conclude that

1) The originality **may be argued to increase, if humans caused local extinctions. The originality of domesticated cows and horses may be questioned (as opposed to e.g. local re-introductions of red deer), but the functional role in present ecosystems is clearly missing from an originality perspective.**

2) The continuity **may or may not be affected by substituting domestic grazers with de-domesticated grazers. If this substitution brings about major successional changes such as expansion of forest and scrubs at the expense of semi-natural habitats, temporal continuity will decrease. If on the other hand large nature reserves, with free ranging animals, substitute small fragmented and fenced patches of privately owned and managed habitats, spatial continuity will increase.**

3) The wildness **will surely increase by substitution of domestic grazers with wild grazers – especially if it is accompanied by creation of large areas with free and uncontrolled succession and abiotic dynamics (erosion, wildfires, hydrological fluctuations).**

4) The authenticity **will definitely decrease, as re-introduction should be considered a human construction.**

An important emergent notion from this evaluation is that no matter how we define nature quality, politicians and managers will face dilemmas when they are going to manage for biological diversity and integrity in an intensively exploited and biologically impoverished cultural landscape. This situation should not lead to desperation or anarchist management, but rather to greater care in case-specific formulation of conservation objectives.

It should be acknowledged that large, wild herbivores could never graze a major part of the isolated patches of semi-natural habitats in Denmark. For this purpose, a strategy involving nation-wide collaboration with landowners is needed. But, nature reserves with free-ranging wild and de-domesticated grazers may develop simultaneously as important resources for public recreation, biological understanding and ethical well being. So, why not?

The Danish tradition for multi-purpose nature management and for an understanding of habitats and landscapes as the results of human interaction with nature may be considered the major obstacle to the implementation of wildness as one of the major management objectives. Therefore multi-purpose natural parks are much more likely to appear in the future than nature reserves.

The difference between the biological and the cultural perspective is profound, and these perspectives may really be considered different paradigms. The biological paradigm sees humans and human intervention as the major impediment to biological diversity and integrity whereas this is absurd from a cultural perspective. Underlying these profound disagreements is the question whether Homo sapiens is so different from other living creatures that it makes sense to base nature management on a dichotomy between culture and nature.

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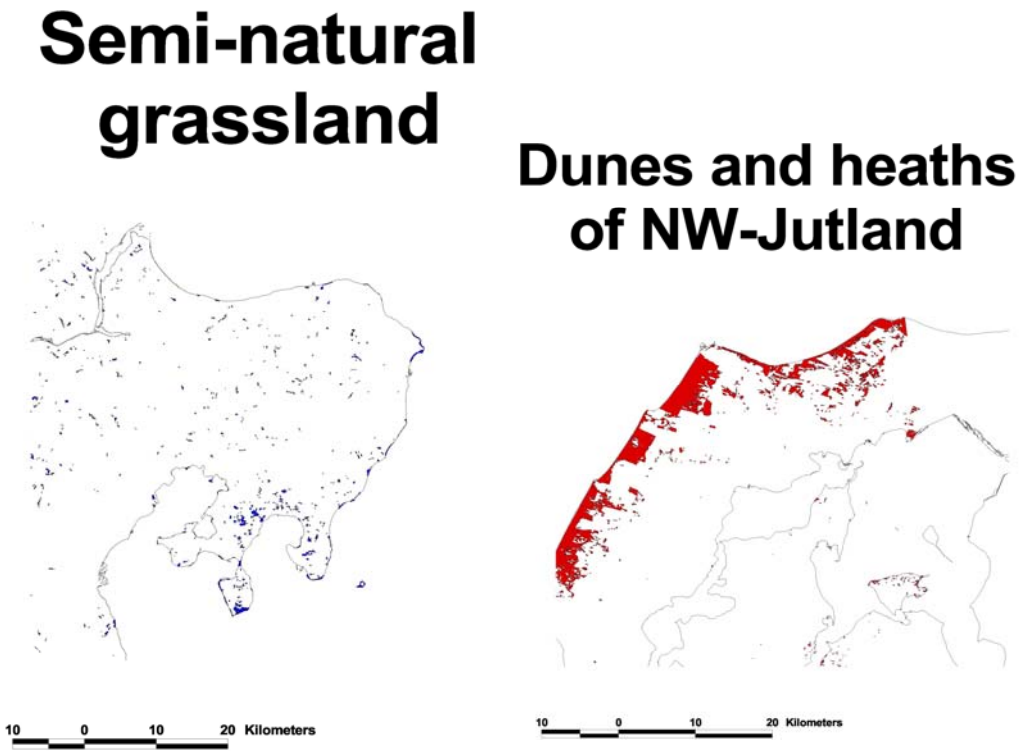

Figure 1.
Natural and semi-natural habitats are isolated and fragmented in the Danish landscape today. The maps show semi-natural grassland in a part of eastern Jutland and dunes and heaths in a part of north-western Jutland. Both areas are near to the coast and comparatively rich in semi-natural habitats.

Figure 2.
A semi-natural grassland on the western coast of Helgenæs, eastern Jutland.

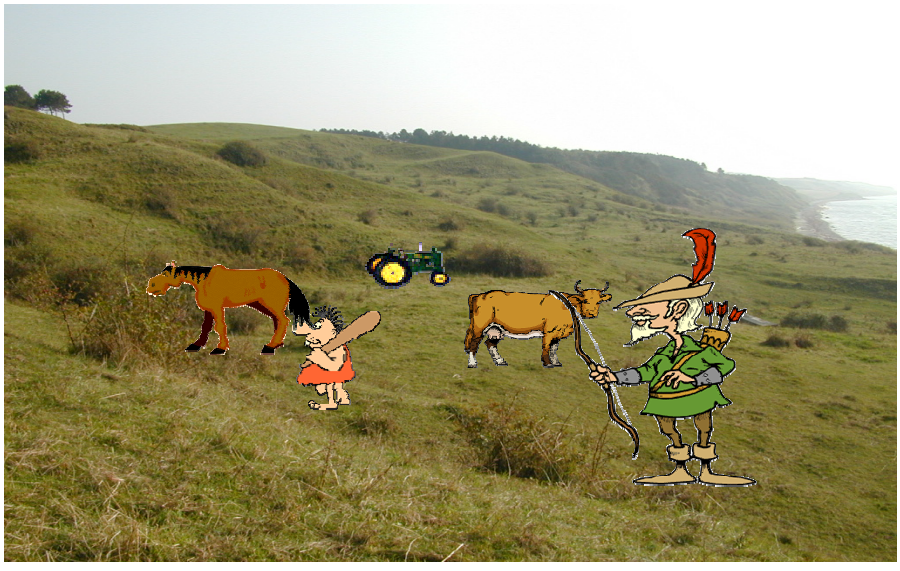

Figure 3.
The semi-natural grassland interpreted from a cultural perspective.

Figure 4.
The semi-natural grassland interpreted from a biological perspective.
The deer, photoes by Hans Kampf.

Forest-Grazing Interactions: Practical Lessons For Nature Reserves In Britain
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The publication of the wood-pasture hypothesis about the character of natural, temperate woodland (Vera 2000) has implications for both the understanding of primitive environments and practical conservation. This paper considers some of the practical implications, in so far as they affect nature conservation in Britain.

The UK has well-developed forest and conservation policies based on integrating nature conservation with other benefits of forestry in all forms of woodland, from strict nature reserves to commercial forests. Where nature conservation is a dominant objective, the rationale is usually based on (i) permitting natural processes and conditions, (ii) maintaining traditional practices and conditions, or (iii) designing management to suit particular species or features. Where timber production, landscape and/or recreation are the dominant objectives, management for nature conservation usually represents a compromise.

The usual assumption has been that natural woodland normally took the form of closed high forest, but, if this is displaced by the wood-pasture hypothesis, there are bound to be changes in rationale and practice on the ground, at least in those places where nature conservation objectives are dominant and natural conditions are the objective. There may also be changes in the values placed on particular habitats. The question considered here is: what changes will be required if we accept the wood-pasture hypothesis in its entirety?

The wood-pasture hypothesis

The wood-pasture hypothesis indicates that natural woodland comprised four components linked by a circular succession between (i) open grassland, (ii) scrub, (iii) groves, that take the form of closed high forest, and (iv) degenerating, open groves. Today, these are recognised as components of wood-pastures, which are maintained by domestic stock, not wild herbivores. Thus, although modern wood-pastures represent the best surviving approximations to natural woodland, there is no suggestion that they are identical with natural woodland.

The simple circular succession seems unlikely to represent the full complexity of natural woodland under the wood-pasture hypothesis. Several elaborations may be worth considering:

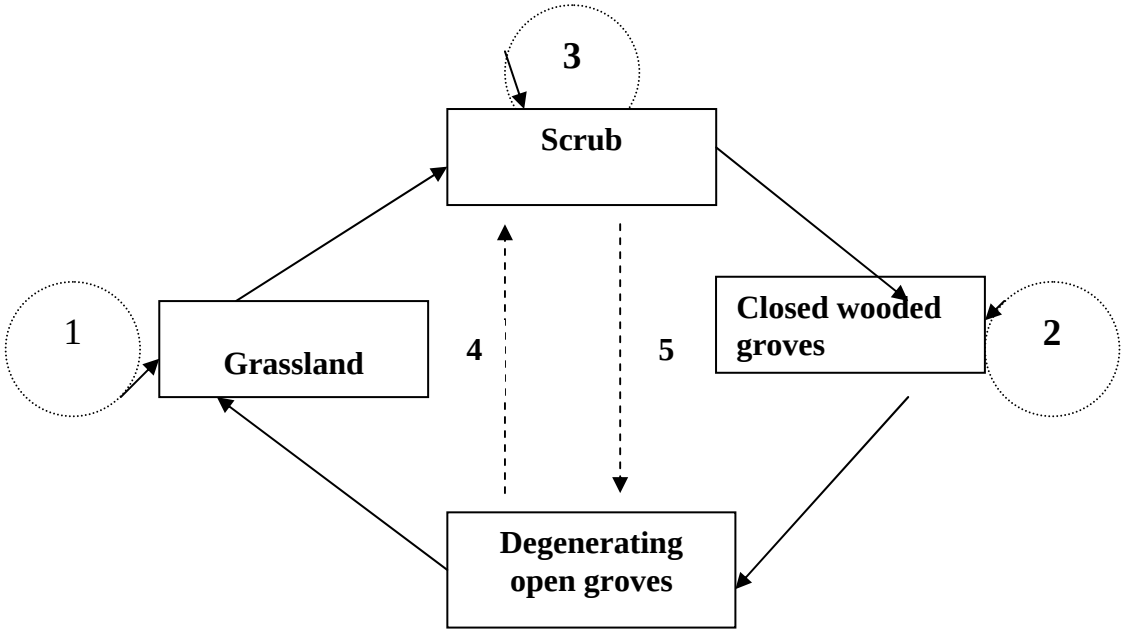

Figure 1.
The vegetation succession at the core of the wood-pasture hypothesis about the structure and dynamics of natural, temperate woodland, and some suggested elaborations.

1. That grassland on some sites will be so heavily grazed that it remains grassland permanently, or almost permanently.

2. That groves on some sites would be so lightly grazed that gap-phase dynamics dominate, thereby allowing the ground to remain densely wooded. This corresponds with the high forest hypothesis, i.e., the dominant perception of how natural woodlands functioned.

3. That some kinds of scrub may be able to regenerate as scrub (e.g. hazel), thereby allowing some scrubs to be more-or-less permanent.

4. That direct change from degenerating grove to scrub may be possible by regeneration within grazed groves.

5. That the reverse change from scrub directly to open groves may be possible when the density of trees established within the scrub is low.

The effect of these elaborations would be a natural woodland in which the turnover between the components is less than it would be without the elaborations, and the total area of wooded ground might be higher.

It is easy to read Vera's case in simplistic terms: wood-pasture is natural, high forest is not. In practice, there is a need to evaluate the evidence, consider the possible elaborations of the basic model, attempt to quantify the components, define the scale of the natural patchwork, and define how conditions might vary from one site type to another.

Management systems

Implications for reserves or any other forest can be summarised in terms of the main management structures.

Wood-pasture.

There is already a good case for maintaining remaining wood-pastures as examples of traditional management, and places for specialised, mostly saproxylic species. The case is enhanced if the system is deemed to be close to natural, even if the herbivores are domestic.

The case for expansion of wood-pasture is already being made, even though many specialised species would be very slow to expand into new habitat. We need more wood-pasture, more farming-forestry integration, and we need to generate forest habitat networks without covering the landscape in closed forests. In Britain the case for wood-pasture expansion is particularly strong in oceanic districts of Scotland, where wood-pasture was once widespread, and epiphytes are particularly important for conservation.

The danger is that the case for wood-pasture might be pushed too far - into historically coppiced ancient woodlands - just because they have old trees.

Coppice

This is the other traditional system. It is not totally different from wood-pasture: many coppices were grazed intermittently, and most included pollard trees and old coppice stools. Taking GB as a whole, a continuum exists from parkland without underwood to coppice without large trees.

The case for having some grazing within coppice management may be enhanced. Open space habitats – rides – can be seen as more than just artificial diversifying features. However, it is difficult to control domestic stock in coppiced woodlands. In any case, we already have burgeoning deer populations, which are either preventing coppice management or forcing managers to fence coupes. Deer are reducing the diversity of coppice ground flora.

High forest

Traditionally this was rare, but it is the staple of modern forestry. The case for high forest in nature reserves is presumably reduced, but Vera does not rule out patches of closed forest in his natural landscape. Again, there seems little need for change. High forest is only one of the structures in woodland, and increasingly we have the deer.

Grassland – woodland mosaics

Intimate mixtures of semi-natural grassland, woodland, hedges and large, non-woodland trees developed in many circumstances. They characterise the fringes of upland districts, such as Dartmoor and along the Welsh borders. At a local scale, they characterise the fringes of ancient woodlands, where the later woodland clearances were left as small fields with the old wood margins as hedges. They are also characteristic of former common woods, that have been enclosed into a patchwork of small fields, e.g., around the Lower Wye Valley. These mosaics are not wood-pastures, but they include the same habitat components. Acceptance of the wood-pasture hypothesis would raise the nature conservation valuations placed on such landscapes.

Nature reserves

Minimum intervention woodland reserves

This is where Vera's case requires us to reconsider our rationale. We justify these reserves as examples of near-natural woodland, and as places where we can assess the direct impacts of people by comparisons with managed woodland and other managed land. Most MI reserves take the form of high forest most of the time, so if high forest is artificial the basis of these reserves is undermined.

One answer is that I do not accept that closed high forest is unnatural. I will accept that it is one of several possible natural states. In Britain we are considering recognising both a series of high forest MI reserves and a parallel set of wood-pasture MI reserves (Peterken 2000). This may not be a natural pattern, but it is the best we can do in the short- and medium-term.

Another answer is that I recognise different types of naturalness, original-, inherited- and future (Peterken 1996). I had applied this to composition, but Vera's case implies I should apply it to structure as well. Thus, wood-pasture would be original-natural, high forest would be inherited-natural, and we await the development of deer populations to see whether wood-pasture or high forest proves to be future-natural.

In practice, the high forest MI reserves are increasingly grazed by deer. Ingress of deer has undoubtedly had an impact on biodiversity, most obviously on ground vegetation, and on stand dynamics. We have regarded such impacts as damaging , but perhaps we should revise that assessment in the light of Vera's case. The practical issue is whether we should fence out the deer: at present the choice lies between too many deer (leading to floristic impoverishment and lack of regeneration) and too few (leading to complete loss of open-space habitats).

Managed woodland reserves

These are mostly small and isolated. We have to keep the species now present going where they are, because we cannot assume that local extinctions would be made good by recolonisation. We cannot afford the local biodiversity losses that might follow converting hitherto coppiced woods into wood-pastures. In any case, management of stock is difficult in woodland, and we already have the deer.

Of course, where reserves have a history of wood-pasturage the case is different. Restoration or continuation of pasturage may be essential to retain the species now present.

Grassland reserves

Vera reinforces the arguments for grassland reserves. They have been established as examples of semi-natural vegetation and to maintain overall biodiversity, but they have been seen as artificial habitats. Now we can claim that they, too, may be relicts of original-natural conditions.

In practice, I doubt that much will change. The case for them is already strong. Grazing in them will still be a matter of domestic stock management. However, where the scale permits, there will be a case for allowing limited tree and scrub colonisation.

Large reserves

This is where I see Vera's arguments making a big difference. Whitbread and Jenman (1995) made the case for very large reserves in lowland England, and their paper is proving to be prescient. After a visit to the Oostvarderplassen, they advocated turning large tracts of mixed countryside over to free-range grazing by semi-domestic stock. This follows ancient precedent: the New Forest was formed that way 1000 years ago, and the outcome of any new initiative might be a new New Forest.

With the current crisis in farming, opportunities may arise for such reserves, though they are more likely to be on the fringes of upland Britain.

Habitat networks

Conservationists are recognising the need to expand surviving good wildlife habitats and re-connect them at a landscape scale, and some thought has been given to forest habitat networks in Britain (Kirby 1995, Peterken et al 1995). A component of any network is the node, or the Core Forest Areas in a Forest Habitat Network. In Britain, these have been conceived as large areas (thousands of hectares) in which woodland occupies at least 30% of the ground. The 'woodland' in this context could either be semi-natural or plantations of introduced conifers, but in most places would be a mixture of both. The mosaic of habitats that would be maintained by an intimate mix of forestry and farming with cattle and other herbivores would be entirely suitable for a CFA, and would conform with the wood-pasture hypothesis.

Conclusion

We should congratulate Vera for stating the case for wood-pasture as a natural state with such conviction, but on present evidence I would accept the hypothesis only with elaborations. If we do accept it as it stands or with modifications, the principal implications for nature conservation in Britain would be in large-scale conservation, i.e. large reserves, creating large tracts of new native woodland, and in developing habitat networks. Wood-pastures would gain further significance, but the main change in valuation may be an increasing recognition of the importance of surviving intimate wood-hedge-grassland landscapes. Minimum intervention reserves would take the form of both high forest and/or wood-pasture.

Thanks

To Richard Bradshaw and Keith Kirby for useful discussions about the validity and implications of Frans Vera's ideas.

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Danish nature management – institutional and economic challenges for the management of dynamic nature.

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You can get a picture of the institutional and economic challenges for the management of dynamic nature in Denmark, through looking on the frames for our nature mangement, which are:

- The international obligations.
- Our national goals.
- Our operative instruments.
- Our resources.

The questions are, do we:

- Have adequate instruments,
- Have sufficient resources,
- Have sufficient insight,
- Really want dynamic nature.

Obligations

It is pathetic to talk about obligations for the Danish State, as the ”obligations” are the results of that Denmark, together with a number of other countries, of its own free will, have agreed to set up some more or less committing goals for nature-protection

But the political reality is that as soon as the ink has dried up on the international agreement, the national governments do their outmost to wriggle out of the most burdensome parts of it. That’s a general trend – the Danish government is not special in this regard.

I will not go through all nature relevant commitments that Denmark is subject to, but only, in brief, mention the Natura-2000 directives and the Rio-convention, that both are of special relevance to dynamic nature.

Natura 2000 – directives

The purposes of these directives are to contribute to the protection of biodiversity through protection and restoration of the habitats and the populations of wild animals and plants. It commits the member states to establish a coherent European ecological network of special areas of conservation, named The Natura 2000 Network, and to take the necessary steps to establish a strong

protection of a group of animals and plants within their natural area of distribution. The purpose of this network is to secure the natural migration-dynamics for plants and animals.

It is a significant improvement, compared to the existing Danish legislation, that the directive commits the member states to actively to secure a favourable conservation status for species and habitats. If a species or a habitat does not fulfil this demand, the Member State is obliged to actively restore the desired status.

The directive therefore, is not conservative but proactive.

Denmark shall, due to the directive, study the desirability of re-introducing of those species of community interest in need of strict protection that are native to the Danish territory, where this might contribute to their conservation

The Rio-convention

An international co-ordination and sharing of the tasks to fulfil the spirit as well as the obligations following the Rio-convention, would from an ecological point of view, and, as underlined by the Danish Economic Council also from an economic point of view, be appropriate. Each country will contribute most efficient to the conservation and improvement of the global biodiversity, through protection and restoration of that part of the global natural heritage that is characteristic for the country in question.

The national effort to the protection of the global biodiversity, will be less optimal, if Denmark focus on conservation of species and habitats, that due to specific cultural conditions are able to exist in small populations or restricted areas in this country, but in other territories have stable populations within their natural area of distribution.

With its biogeographic, topographic, edaphic and hydrologic basis Denmark can make a difference through protection and restoration initiatives within the shallow coast areas, the fresh wetlands and the natural forests, in particular the last two in combination.

Whereas the Danish Natura 2000-proposal to a wide extent covers the shallow coast areas, it takes no steps to a remarkable protection and restoration of the fresh wetlands or the natural forests.

A look at the Danish *Red List* would show that exactly these types of nature, and in particular the natural forests, should be subject to the biggest effort: 54 % of the species from the *Red List* have their natural habitats in the natural forest. Restoration of natural forests would be one of the most efficient means to protect and restore biodiversity. One can not meaningful argues that Denmark can fulfil its contribution to the global biological diversity without restoring natural forest ecosystems.

By definition the concept *biodiversity* comprises both the diversity of species and the diversity and ecological interactions between the biotic and the abiotic components of the ecosystem. Thus a significant character of biodiversity is a strong biotic and abiotic based dynamic. Nature areas protected according to the Natura 2000-directives or the Rio-convention therefore has to be of a geographic size that not only allows species that demands large territories to live there but also leaves room for their impact on the ecosystem.

It will not fulfil the purpose of the Rio-convention or the Natura 2000-directives only to protect and restore the semi-natural habitats dominated by perennial herbs or create a number of delimited

habitats for threatened species in forests with a nature friendly silviculture. We will not fulfil the goals until the Natura 2000-strategy also include restoration of natural dynamics in forests and wetlands.

National goals for nature management

Concerning national goals for nature management, the Danish government has settled the *Wilhjelm-committee* to propose a new national strategy on nature management and protection. It seems, as there is a broad interest for the establishment of large National Park areas. That would be a benefit regarding restoration of dynamic nature that demands large areas.

The question will be whether there will be room for dynamic nature in these large areas, or they will be occupied by well-managed semi-natural habitats.

In the national strategy for biodiversity the government has set up a number of goals that, it is assumed, are still unaffected by other policies:

Before 2025

- 8.000 ha saltmeadows,
- 2.000 ha heaths in dunes,
- 30.000 ha lakes and rivers,
- 250.000 ha permanent grassland,
- 150.000 ha forestry,
- 5.000 ha natural forest,
- 4.000 ha forests with traditional silvicultural systems,

should be restored

These goals are only to a very limited extent concerned with dynamic nature. The 5.000 ha of natural forests are realised to day through the protection of small plots, most of them 50 – 100 ha, that already did exist as uncultivated marginal plots.

Instruments for the nature management

The State has a number of specific and very focused instruments pursuant to the Nature Protection Act:

- NPA, § 3, which imply that all semi-natural areas outside city- and cottage-areas are protected against deliberate changes.
- NPA, § 20, which imply that public construction works shall respect landscape and nature protection.

- NPA, § 33 etc. on Nature conservation.

- NPA, § 55 on nature management and restoration.

- NPA, § 60 on expropriation for naturerestoration purposes.

NPA, § 20 allow the minister for the environment to stop or alter public construction works that conflict with nature protection. The provision has been used regularly to reduce impact on nature from construction works. In particular the fragmentation of the landscape due to the large traffic constructions have a paramount negative impact on populations of animals and plants. This provision therefore is decisive for the protection of biological dynamics within the Natura 2000-network of habitats.

The purpose of the nature conservation provision is to protect the interests of common good in nature protection. The decision to protect or not is taken by a nature-conservationboard presided by a judge, a construction that guarantees a fair ”trial”.

It is the opinion among the judges of the nature conservation boards, that that concept ”interests of common good” by definition include actions to which Denmark is under treaty obligation to take. Thus if protection or restoration actions are necessary to ensure that a habitat area fulfil the demands of the Habitat Directive, the action can by definition be realised through a conservation order.

NPA, § 55 gives the provision to buy and operate areas subject to nature restoration. § 60 gives the provision to expropriate property of significant importance for nature restoration.

NPA lack corresponding provisions and instruments for restoration of populations of extinct species, a.m.o. through re-introduction. This action is today regulated through § 31, which prohibit re-introduction of not naturally occurring species unless the Minister for Environment gives a special permission.

The state of the forests is regulated through the Forest Act that abundantly establishes that forests shall be cultivated. The Forest Act provides no protection of plots with natural forest. Only an exemption clause within § 18 makes it possible for the minister, if agreed by the owner of the forest, to allow a plot of biological value not to be cultivated.

Resources

The National budget 2001 – 2004, according to the appropriation act 2001:

- 650 Mio DKr for Nature management.

- 300 Mio DKr for wetland restoration.

- 420 Mio DKr for private forest planting.

- 30 Mio DKr (in 2001) for Nature conservation.

In total: 1.4 billion DKr, over the next 5 years, or 280 – 300 Mio DKr per year.

Are the instruments adequate?

The Danish State has the efficient instruments to fulfil its obligations and to establish areas with dynamic nature, except regarding the protection of forest nature that is insufficient and the lack of provisions and instruments for re-introduction and restoration of populations of extinct species.

Are the resources sufficient?

The efficiency of the instruments depends a.m.o. on the will to use them and the will and means to find resources for them. The situation is commonplace. There is a huge gap between the goals and the resources allocated for them.

No official calculation exists on the costs of fulfilling the obligations and goals for nature protection. Therefore it only can be estimated with uncertainty.

Five years ago it was estimated that the costs due to the Habitat Directive would amount 1 - 2 billion DKr. This estimate did not include the establishment of a coherent network of ecological corridors that probably will be as expensive as the habitats. Since then the number of habitat areas is increased by 25 %. An estimated cost of app. 4 billion DKr is hardly unrealistic.

In 2006 Denmark shall report to EU on the Danish fulfilment of the directive. If Denmark intend to do so, which seems unrealistic, the costs will be app. 700 Mio DKr each year.

During the first 10 years with nature management in Denmark app. 8.000 ha of nature and 6.000 ha of forests has been established. The goals from the Danish strategy on biodiversity would imply that app. 280.000 ha of nature areas and 142.000 ha of forest should be established during the next 25 years. The prize would be app. 23 billion DKr, or app. 925 Mio DKr each year.

The cost estimates are not additive, as there will be some overlap between the actions.

These estimates can be made in different ways leading to more optimistic or more pessimistic results. But no matter what, the difference between goal and means is overwhelming.

Is insight and interest sufficient?

The most important challenges are,however, to raise the level of insight and inspire the interest. If there is no understanding of or interest in dynamic nature the questions of obligations and lack of resources is without importance.

As it is a well-established fact that dynamic nature is the type of nature that is most threatened in Denmark, the question is: Is it lacks of money or lack of insight and/or interest that will decide whether there will be room for dynamic nature?

For a number of years a strong anthropocentric view on nature has become prevailing, reflecting neither a good understanding on how nature works or interest in making room for dynamic nature.

It is not unusual to meet the point of view that man has developed to a state where we create the nature surrounding us. Even one of the most talented minds of this world, the sociologist *Anthony Giddens* has written: ”Our community is in a state beyond the termination of nature”.

This staggering self-overrating is closely related to the prevailing view on nature as being an area with animals and plants. An area that has to be managed properly to avoid it to develop into an unpleasant state. As an argument for the view that man creates the nature it is often mentioned that i.a. the heath would not be heath without the human activities.

The Nature Protection Act reflects and adopts in principle this view on nature. The general provisions for protection in § 3 deals with the protection of specific nature types defined through the composition of the vegetation on a specific area. This expresses a static view on nature and provides no protection of dynamic interactions within and evolution of ecosystems.

The Act supports, unintentionally, the misbelieve that man creates nature. Everybody can learn from the Act that if a meadow is not managed, the vegetation that it has to have, according to the definition in the NPA on the nature of meadows, will disappear. But does that imply that man creates nature?

Take as an example a meadow and look at the factors deciding its appearance. Climate is a basic factor: radiation, humidity, temperature, has man created that? We affect it but do not create it. The diurnal and annual cycles of variation are basic for the nature of the meadow. Has man created them? Water flow in the soil, precipitation and physiology of plants and animals is strongly influenced by gravity. Has man created gravity? No, we don't even have a theory to understand its nature. The genetic basis for the evolution of the different species has man created that? No, we can reallocate some of the genes, but we are not able to create them.

Man has only established a fence and led some cattle into the area. It has changed the appearance from swamp forest to grassed meadow. If the honour should be ascribed to anyone it should be to the cattle, but no one would argue that cattle create nature.

The Norwegian attitude to the populations of wolves is another example on the anthropocentric view on nature.

The ambition of the multi-corporation Syntega to get IPRI of the rice genome, is a further current manifestation of this self-overrating. Syntega has not created the genome of rice, but only mapped it, reallocated part of it, and inserted a few existing genes.

And the self-overrating does not stop there. In Canada the Court of Ottawa, Ontario, did 1½ month ago establish that Monsanto's right to the round-up resistant canola plant implies that one is to pay a licence not only if one deliberately is cultivating it, but also if specimens of the plant by chance is spread to ones farm.

The decision of Judge MacKay says:

[92] Thus a farmer whose field contains seed or plants originating from seed spilled into them, or blown as seed, in swaths from a neighbour's land or even growing from germination by pollen carried into his field from elsewhere by insects, birds, or by the wind, may own the seed or plants on his land even if he did not set about to plant them. He does not, however, own the right to the use of the patented gene, or of the seed or plant containing the patented gene or cell.

(signed) W. Andrew MacKay
JUDGE
OTTAWA, Ontario
March 29, 2001

Thus if you go to Canada and find a specimen of canola in a roadside, then do not touch it. It might be the intellectual property of Monsanto, and you may risk to be sued for infringement if you pick it up.

Why this discussion on view on nature? It is not to discuss the ethics of the view, but to note that the prevailing view on nature implies a relativism and reductionism that prevents understanding of nature. It reduces nature to some biology on an area that we create ourselves, which is wrong. When this misunderstanding constitute a part of the basis for the NPA, nature protection will not focus on nature but a segment of it, the functionality of which it even seems to misunderstand.

That leads to research programmes where researchers try to establish criteria for the quality of nature. Criteria that afterwards will be the basis for planning of nature protection.

It leads researchers and nature managers to claim that a well-nursed common is more valuable than an unmanaged wetland. Because the common holds a higher number of species and the wetland left over to its own dynamics will grow wild.

It bring along that if one gather together a group of nature managers to discuss threads against nature, they rather quickly will agree upon that over-growing is one of the major threads against nature. Although over-growing is something quite naturally. We also name it succession.

There is a line from Judge MacKay, Monsanto and Syntega to Giddens, the nature managers, the conception of nature quality, static nature protection and the anthropocentric Danish view on nature. It is crucial that this line will not continue into the work with dynamic nature.

The traditional biological ”nurse-instinct” from the view on semi-natural biotopes should not be transferred to the view on management of dynamic nature, and promote ”scientific” based descriptions of the optimum organisation and operation of dynamic nature.

Take as example beaver meadows. When the beaver after 15 – 20 years leaves its territory the beaver-dam will decay. As a result the pond eventually disappear and a wet, nutrient rich sediment will lie open for colonisation by sedges, grasses and herbs. Within a few decades the meadow will be colonised by trees. But sometimes the beaver meadows do not follow this pattern and persists as a tree-less meadow for a century. We do not know why. But if we found the explanation on this, would we then use this insight to promote the tree-less conditions in order to have more light-open plots in the natural forests? No we would not, because it then would no longer be dynamic but regulated nature.

The discussion on ecology of former forests should not take place in the hope that science will provide support for the idea that dynamic forest has been just as light and open as we would prefer it to be. That would be unscientific and reflect a need to be certain on that dynamic nature do have the desired composition structure and function before we would make room for it.

When dealing with nature management we also should be careful not to forget the practical frames, and though it is exiting, not to end up in discussions like how many angels will be able to stand on the point of a needle. Because the subject of our discussions is a world where

- Increased level of greenhouse gasses in the atmosphere is changing climate. That will have significant impact on the biotic and abiotic conditions and makes it meaningless to talk about a

reference model for future dynamic nature in this country. In last weeks issue of Nature a paper presented data showing that all ready the existing climatic fluctuations due to the North Atlantic Oscillation have impact on the populations of the large herbivores.

- Agricultural production brings along severe eutrophication of the terrestial nature areas, due to precipitation of ammonia. In Denmark this amounts 75.000 tonnes each year. One of many impacts is that the natural dynamics of our raised bogs develop a significant different type of nature from what it used to do.

- The environment is exposed to several 10.000 xenobiotics, the impact of which is unknown. We have a.m.o. seen wild animals that, after exposal to xenobiotics, have changed sex, have lost it or even have got an extra.

These and many other impacts on nature makes it less important to try to establish a reference-model for future nature based on paleobiological descriptions. But we can use the historical analysis to try to understand the general functionality of nature. As Stephen J. Gould express it:

The challenge is not to understand the history of nature but to understand the nature of history.

Which are two basically different ways of understanding nature. The task is to understand – not how nature *is*, because nature *is* not, it is not static – but as Per Bak says, *how nature works*.

In 1993 three physicists at South Danish University threw some thousand frozen potatoes against a wall, whereby the potatoes where shattered into fragments of different size. They collected the fragments, divided them into weight classes and counted the numbers of fragments in each class. The fragments ranged from 100-gram pieces to pieces at milligram size. The interesting result was that there was no typical size of fragment. But there was that regularity, that every time you move from one weight-class to the weight-class twice as heavy, the number of fragments is reduced by a factor 6. And similarly the other way.

It means that no matter what level you look at there always will be the same relative distribution of fragment sizes. Metaphorically spoken: Imagine that you were able to change size as you wanted and you changed into the size of a fragment of 1 gram. If you looked around you would find a landscape of potato fragments where each time there were 6 fragments of your size there would 36 fragments half your size and 1 fragment twice your size etc. If you now changed into other sizes the landscapes you would find would look exactly similar.

This reflects *scale invariance* in natural processes and that normal or typical size does not exist within natural processes. Processes and incidents of any size will be possible (off course within certain limits – i.a. the fragments could not be larger than the potatoes), but that the frequency decline as an inverse power law.

In 1987 the physicists Bak, Tang and Weisenfeld carried out a computer study on the dynamics of sand-piles. By dropping sand grains one by one a sand pile was build up, growing still steeper until the next grain triggered an avalanche, the pile collapsed, only to be built up again by falling sand grains. Again there could not be found any typical size of the Avalanches. They followed the potato-pattern; All sizes of avalanches occurred, but the larger the size the less frequent did they occur.

This is remarkable as all grains were of the same size and did fall in the same way. None the less the system did organise itself in different ways, giving rise to avalanches of different and unpredictable sizes. The experiment reflects the concept selforganized criticality; i.e. that

selforganizing systems, like natural forests, develop complex structures of increasing criticality until reaching the critical state, where an incident is triggered by the system itself. How often and how big the incidents will be is unpredictable, but it follows the potato-pattern.

Malamud, Morein and Turcotte studied the distribution and sizes of fires in the Yellowstone Nationalpark. They recorded the same pattern for the fires as for the potatoes although these fires are influenced by a huge number of factors like level of precipitation before the fire, wind condition, the amount and age of wood, vegetation, and the cause of the fire.

The large mass-extinction during the history of world seems to show the same pattern. During the app. 600 Mio years with multicellular organisms a number of catastrophic mass-extinction have occurred. The most comprehensive app. 225 Mio years ago (Perm-Trias), where 95 % of the species seems to have disappeared within only 10.000 years. In addition there have been four mass-extinction´s, a little smaller, but still enormous, and further a number of smaller extinction's. The less comprehensive the more frequent.

Studies on earthquakes, populations of bird's etc. show the same pattern.

And we do not need to puzzle with why some beaver meadows last for hundred years whereas others only last for a few decades. Because of the scale invariance of incidents in natural systems there will neither be a typical size or a typical age for beaver meadows or any other clearings in natural forests. They will occur in all sizes and ages, but the large and old ones will be less frequent than the smaller ones.

It seems to be a fundamental characteristic of nature, that the incidents and processes it creates occur unpredictably, and in any size. The larger the incidence the less frequent. The probability for larger upheavals increases if the number of incidents is increased. This can be achieved through looking at the system over a longer period, or by increasing the size of the self-organising system.

Thus if a large part of the upheavals of natural dynamics should occur in for instance dynamic nature in a nationalpark, as when co-occurring stochastic incidents create large-scale break-down´s in the natural forests, large flooding´s etc., then the area has to be increased.

Challenges

The challenges for a dynamic nature management therefore are:

- Make room.
- Raise money.
- Generate insight and knowledge.
- Inspire interest

Room

Dynamic nature needs plenty of room. Not only the minimum area demands of the key species among the mammals should be fulfilled, but room enough to make it likely that the diversity of

interactions between species and ecosystem (*ref. Rio-convention*) – which a.o. are the upheavals triggered by selforganised criticality – will occur, is necessary.

Such areas can only be found in the areas for agriculture and forestry. When an economic understanding shall be established on the need for allocation of land from these two sectors to dynamic nature, it might be useful for the reasoning to remember that:

- Danish agriculture is subsidised with 11.3 billion DKr each year, on the basis of which it only creates a Gross Factor Income of 25.9 billion DKr each year. If the externalities should be internalised the 14.6 billion DKr should probably be reduced with 7.5 billion DKr corresponding to the environmental costs due to agriculture.

- Abolition of the subsidy to agriculture would, according to OECD, reduce agricultural production in Europe 15 – 50 %, and according to The Danish Appropriation Act 2001 increase global GNP with 0.4 % and the Danish GNP with 4.7 billion DKr each year. Furthermore this would reduce use of fertilizers and pesticides with 7 % and 9 % respectively.

- The State Forestry has a yearly deficit on the production of 50 – 70 Mio DKr.

Thus it should be possible to both find space and save money for the society through reduction of agriculture, if this can be done through changes in the Common Agricultural Policy of EU. Similar the Danish State could save money by leaving large areas of forestry to dynamic nature.

Money
In addition a part of the means spend by the State each year on planting of new forests could be converted to the establishing of large natural forests through natural succession. About half of the costs for the raising of new forests are used for planting. We therefore would have twice as much forests for the same money in this way. As there is a surplus of wood on the European market, it is for recreational, nature and environmental reasons, and not for the wood production new forests are raised. And these goals will be better fulfilled through natural self-grown forests.

Insight
The institutional frames, in particular the legislation, need to be revised:

- The Nature Protection Act reflects the scientific basis from the 1960´s. The act should be revised and reflect the scientific development during the last 30 – 40 years. In particular the static view on nature should be replaced by a dynamic view.

- The focus on *the area* in the rules of the NPA should be supplemented with rules focusing on biotic and abiotic processes.

- The focus on *the area* in the rules on nature-restoration should be extended with a focus on species and natural dynamics. The NPA should contain warrant, instruments and motivation for restoration of a.m.o. populations of extinct species, i.a. through re-introduction of species.

- The Forest Act is a *forestry act* that does not protect existing natural forests. NPA § 3 should be extended to protect these forests.

- The Danish strategy for the natural forests should be revised. In its present form natural forest is defined only by the provenience of the trees. The basic ecological characteristics of natural deciduous forests are not a part of the conceptual basis for the strategy. It is remarkable that the larger mammals, which are key-species in the natural forests, play no role in the definition. The revised strategy must reflect that the concept biodiversity by definition comprises both the diversity of species and the diversity of ecological processes.

Interest
The work with people's view on nature will be the most important challenge. To make room for large areas with dynamic nature will have a fundamental impact on the Danish landscape. It seems to lie deep in most people, that nature has to be regulated. Not least among biologists and other nature managers.

The question is, if the need to regulate nature is so deep, that we do not really want nature to behave in a way not planned by us. Whether we have so specific demands on the way nature should behave, that have to fence it in to keep it on the right site, to ensure the right grazing level, to get the right species and the right distribution of clearings.

If there will be no understanding for, that dynamic nature might create fascinating incidents beyond even the desk-fantasies of biologists, if there will be no accept for make room for something we cannot predict or control, and if the nature managers cannot put their entrepreneur-instinct on the shelf for a while, then the theme of this conference probably rather should have been deer parks instead of dynamic nature.

THE ROLE OF LARGE HERBIVORES IN NORTH-WEST EUROPEAN VEGETATION
ORGANIZING DYNAMIC NATURE – DUTCH EXPERIENCES
by Hans Kampf

There is a lot to say about the challenges (but also constraints) in Dutch nature policy, but in discussion with the organizers of this workshop we selected the following issues:

- our Dutch Nature policy plan with the inspiring title "Nature for people - People for nature"
- towards an ecological network with large ecosystems and strong, robust ecological corridors
- from domestication to dedomestication, a new chance for extinct cattle and horses
- challenging grazing systems and legislation

Challenges

Large mammals in Europe, but also in other parts of the world, such as red deer actually live in ecological prisons, because of their fragmented habitats. When they succeed in escaping their prison, they have to fear the death penalty with the hunters as their hangman or serious accidents, caused by traffic on busy roads, railways, etc. everywhere. This slide shows an example in Germany, Bavaria near the Austrian border, where during winter about 85 red deer live in a fenced area of about 30 ha to avoid damage in private forests.

Looking to the written materials of the Convention on Biodiversity, the CBD, I miss attention for large mammals; in my opinion a missed chance, and– it is still not too late –also a chance for future to develop a clear international policy for this group of animals, even for crowded areas in Europe.

Must we except fragmented landscapes for ever? I don't think so, on this slide you'll see a somewhat creative and ambitious picture of what we should actually be striving for to build sound ecosystems that go beyond national borders. This slide was made by ecologist Geert Groot Bruinderink from Alterra, a research institute which is part of the Agricultural University in Wageningen. It shows how a coherent ecosystem could be realised from Hamburg to the Vosges via the Netherlands. Therefore he chose the red deer, as one of our biggest mammals as a guiding species. We have an informal working group now with colleagues from Belgium and Germany as a place to discuss such ideas and to bring them forward.

One of the recent questions we had to discuss with our German neighbours was how to see the red deer: as an important key, red list species for large, well connected ecosystems or only as a hunting species? For me personally, this was a moment of learning how one can look at such questions from a total different point of view. But also that you can only develop a sustainable nature policy in close co-operation with your neighbouring countries. Nature does not stop at frontiers.

In our nature policy plan, besides the semi-natural nature we would like to give space to processes as natural as possible. Natural nature, wilderness nature in our overcrowded countries, would that be possible? This brings me to what I think is a very interesting phenomenon, towards in what I would like to call a de-domestication process, opposite to domestication.

For the descendants of extinct animals seem able to play a significant ecological role once again – a role which has not been filled since their ancestors died out. I will come back on this later.

Are these ideas pies-in-the-sky fantasy or a real hope for future?

Chances

Chances can be commanded by playing the correct play. We have an increasing lot of support of our Nature Policy Plan, which first edition has been published in 1990. It is part of our Nature Protection Act, which provides a periodical evaluation and renewal every 8 years.

Its objective was to design an Ecological Network, composed of core areas and nature development areas, and to aim at higher nature values on farms, military sites, recreation areas, and so on. The Network would also include ecological corridors connecting the various areas. You may see the arrows on the map.
Why do we need these challenges and chances and where can we find the possibilities? I like it very much to give some insight in the steps we have taken.

Those of you who visited some of the nature areas in the Netherlands, may have got an idea of the difficulties involved. We are a small country with a strong economy and a growing population of 460 people per square kilometre. It is the most densely populated country in the world.

Nature areas and forests in our country have declined from 900,000 to about 450,000 hectares over the last century. That's down to 2,500 square metres for every Dutch person, but this also includes large municipal areas without any nature at all.
That is not much, especially not for a country that is making a transition from an agricultural and industrial economy into a service and knowledge-based economy. If the Netherlands wants to attract highly skilled labour, we have to compete with countries such as Switzerland with its beautiful mountains, or Denmark with its friendly open landscape, the flowers in the fields, forests, dunes and shorelines.

The 1990 Nature Policy Plan aimed at variety and diversity in nature, with (as an example) lots of - breeding and migrating - birds. We wanted to increase the land for nature purposes from 450,000 hectares to at least 700,000 ha over a period of 30 years. This is to include 100,000 ha for extra nature reserves, 50,000 ha for nature development and more than 100,000 ha for nature management on farms. You can see from this diagram, that since 1990 the downward-sloping line is turning upwards. These figures are from the first Nature Policy Plan; our recent second Plan is even more ambitious.

three-track approach
The Dutch national ecological network is based on existing nature areas and forests. Dutch nature will expand from this base. To decide where and how this expansion should take place, the three-track approach was developed:

TRACK A (which is the most challenging one) aims at:

1. to provide more room for naturalness
2. to expand the target types in the "natural" categories
3. where the management is passive, that means only directed at improving ecological processes (hands-off policy)

The other tracks are directed on semi-natural nature and nature on other possible places, for instance in combination with agriculture, military training areas, recreation areas, along infrastructure, etc.

An example is nature development along the rivers. Since 1990 more than 2000 ha of floodplains (in the past in sometimes heavy agricultural use) are changed to nature, like this area, de Blauwe Kamer near Wageningen. The final goal- to be paid by my ministry and the Ministry of Traffic and Waters - is about 5000 ha of nature development in flood plain areas.

Two goals will become achieved:
- more strong and robust nature and
- more room for high waters, what means safety for men.

The design of such nature development plans, and after that the management, have to fit with the following statement:
"*dynamic ecosystems have to be managed in a dynamic way".*

The first evaluation by the Nature Planning Office showed where the realisation of our nature policy gave problems:
- policy efforts achieved too little, too late;
- land prices were continuously rising;
- the environmental quality aimed at had not been achieved;
- linking zones, connecting the nature areas, had not come off the ground;
- the results were more quantitative than qualitative.

As a conclusion - biodiversity is still declining, nature is still far away for people in the cities and the number of species and ecosystems is still going down. In our policy this is seen as not acceptable.

Nature for people, people for nature'
In July 2000, a new memorandum was submitted to Parliament. It is called 'Nature for people, people for nature', with the subtitle "Nature, Forest and Landscape in 21st century".

This policy memorandum, which will be a cornerstone for the 5th Memorandum on Spatial Planning and for the 4th National Environmental Policy Plan, works out in detail the following policy plans:
- the Nature Policy Plan from 1990,
- the Landscape Memorandum from 1994,
- the Forest Policy Plan (1992)
- the Strategic Action Plan for Biodiversity (1998).

Integration has been chosen, from the viewpoint, that forest, landscape, biodiversity are all part of the ecological system. A policy, directed on segregation seems less profitable to us.

At the same time, the Minister of Agriculture, Nature Management and Fisheries published the memorandum on Food Production and Rural Areas, which considers the quality of food production and the quality of rural areas. These two memoranda form the policy framework for our rural areas for the next 10 years, and further away.

It is a chance, because this policy plan, past January established by our parliament and officially monitored by our Nature Planning Office (yearly reporting to parliament and the press), contains clear goals and annual budgets for the period until 2020. This policy will be realised in close co-operation with the provinces and local communities.
ambitions
What are our ambitions (our major themes) now?
- we want an environment that is pleasant to live and work in (liveability)
- we want effective protection for plants, animals and characteristic areas (diversity)
- we want the sustainable use of vital resources, like water, space and biodiversity (wise use).

On the basis of this, the government has the following objective for our nature policy :

Conservation, rehabilitation, development and sustainable use of nature and landscape, as an essential contribution to a liveable and sustainable society.

This main objective must be seen in an international context and must emphatically also be seen as a cultural challenge. What it means is that nature and landscape must be **for** the people and **of** the people.

The government wants:

- regarding **Nature**
  to continue to work on the realisation of the ecological network, which fits in the Natura 2000 policy
- regarding **Landscape**
  to adopt an active approach to landscape conservation and development
- regarding **Forests**
  to work on high-quality rural zones around cities
- regarding **Biodiversity**
  to ensure an effective international nature policy

Our government will not steer any longer on the realisation of more forest outside the ecological network, but on high quality forest near the cities, so that the wishes of people can be taken into account.

Seen the European context, there will not be any longer a production target for timber. The government will guarantee sustainable timber harvest on 70% of the forest area on the same level as during recent years. Timber is an important sustainable and renewable material.

Our new nature policy objectives translate into five perspectives for a more natural Netherlands in 2020. These are:

- **International nature**
  increasing efforts to integrate international nature policy.
- **Large-scale nature**
  strengthening the national ecological network.
- **Wet nature**
  making best use of opportunities, improving the typical Dutch wet nature, an ecological fountain of life.
- **Rural nature**
  enhancing the quality and identity of rural areas by involving farmers as stewards of biological diversity within the production systems.
- **Urban nature**
  creating enough nature in and around the cities.

GOALS AND TASKS

As indicated earlier, clear goals have been set for the implementation of the new nature policy. I will mention a few of them, but there are many more:

- The National Ecological Network (in fact a skeleton) will be completely defined and spatially secured by 2005 at the latest.
- In 2020 the possibilities for migration within or between units will be secured by the elimination of the physical barriers.
- In 2020 7 new strategic, strong and robust ecological corridors (arteries) will be completed.
- In 2020 environmental quality will be such, that it does not form a barrier to the quality goals to be achieved within the National Ecological Network.

As an example this map:
I have to apologize for this slide which can be found in the new policy plan, it is not so clear to understand. But perhaps it is on purpose, to avoid a big public debate in a too early stage because of the NIMBY-effect: not in my back yard.

The green (terrestrial) and bluish (wetlands) spots capture the realised and potential nature areas. To connect large nature areas and to enlarge these units, a number of robust corridors will be created, creating an additional 27,000 hectares of nature (the reddish lines). This will improve the physical coherence at the national level and dovetails with international ecological networks. This is important for mobile species such as the bittern, otter (in marshland areas, the Water Link), red deer and pine marten (in sandy areas), but also for species that are still at risk of dying out despite their habitats being in the National Ecological Network. The new robust links do not only have an ecological function. They also enhance the landscape and strengthen regional cultural-historical identity, they bring nature closer to the cities, and contribute to sustainable water management and better recreational opportunities.

The green spots along our borders symbolise the connection with our neighbour countries, with whom we have – as I just said – an improving co-operation now.
I will show you, as an example, one of more than 20 sketches which were made. You can see the *Veluwe* on the right (an area of about 100.000 ha) is linked up with the *Utrechtse Heuvelrug* area on the left (about 45.000 ha), both of which have links – the thick arrows - to the rivers IJssel and Rhine, with its restored floodplains and a link to the Oostvaardersplassen. Jan Gorter will focus in his next talk on the Veluwe area.
Seven of the sketches, including this one, were selected last year for the new nature policy plan "Nature for people, people for nature".

Back to practice, recently the province of Gelderland published its strategic policy plan: Veluwe 201o, a quality impulse. For the Southern Veluwezoom they designed a Large Natural Unit of about 30.000 ha, of which the area of the last slide is part of Jan Gorter's playing field.
It will be for from not simple – and Jan will agree – in fact a hell of a job, but also a real challenge for a lot of regional parties to turn these long term ideas into reality. It really demands staying-power.

Is this also a pie in the sky or a real option? Only time will tell, but it is certain that the government has incorporated this picture in the new Nature Policy Plan.

financial aspects

I am asked by the organisation of this symposium to give you some insight in a number – not too much - figures and costs. This slide shows some figures we have to realise in the next 20 years. The column with the title "present size" – the title is not quite correct - shows the ambitions which have to be realised by 2020. A goal approaching 1,000,000 ha, this is about 25% of the area of our country. The ambitions are clear: 340,000 ha in the next 20 years, or 17,000 ha per year. I am very much looking forward to the results.

Regarding the realisation of nature, we have a policy to stimulate private organisations and persons. Therefore we have the disposal of a budget for land acquisition, nature management and management agreements, nature development etc. The subsidies (up to 100%) are being calculated on real or norm costs.

To give you some insight in the state budget- this small dog is explaining our stakeholders the situation - (I am sorry not having the figures on a text slide):

but there is available:

- for land acquisition (state and private nature management):
    - € 170,000,000
    - for about 6000 ha per year,
    - average prices for nature areas € 10,000 / ha and
    - for agriculture land € 40.000 / ha
- for management by Staatsbosbeheer, NGOs or private owners:
    - € 80,000,000, exclusive management agreements for farmers.
- as well as an reasonable amount for private owners of nature and forests.

For the next 20 years we got an extra € 45.000.000 per year for the next 20 years, and – besides that - every year we have a new budget round, as well as every 4 years we have new elections which will give new chances for negotiating.

But for now there is total amount available of at least € 300.000.000, a large sum, but not more than € 50 per Dutch inhabitant.

POPULATION DEVELOPMENT OF LARGE HERBIVORES

In the beginning of my talk I mentioned you our three track approach, of which track A – to provide more room for nature which is as natural as possible – is for me the most interesting one. I would like to show you how large herbivore populations can develop.
So far, we have had positive results in nature areas in the Netherlands where cattle and horses live in a kind of wilderness. Here is an example from the area known as the *Oostvaardersplassen*: the surface area for grazers has increased (as you can see from the white, red dotted line), and the population is also growing very fast, maybe too fast since there are no natural predators, what their role may be.

The grazing area is situated in Southern Flevoland, a polder in the former Zuiderzee in the middle of our country. This wetland is about 6,000 ha; the grazing area is about 2,500 ha. The rest is water and marshland.

It is a young area, until 1965 the lake was used for fishing. The polder was reclaimed in 1968. Originally, the area that is now the *Oostvaardersplassen* was planned as an industrial area. Because of the economic recession in the 1970s, the area was left to itself and nature proliferated. The area is now highly acclaimed: it has even been awarded the European Diploma of the Council of Europe.

In 1983 about 35 Heck cattle were introduced; more were introduced in 1987 and 1989. The first years were rather difficult, as you can see from the yellow line. Accidents have a greater impact on small populations than on large ones. Since 1986 the Heck cattle population has been growing constantly, doubling itself about every 4 years. In the last few years it appears to have stabilised somewhat.

The Konik horse population also got off to a slow start (the blue line). It took about 7 years before the population began to grow rapidly. However, there are indications that the growth rate of the population will decline as the area becomes overpopulated (decreasing birth rate). This is an interesting point for further ethological research. I have more information and figures about this subject on my website.

The purple line shows the development of the red deer population. Those animals, a mixed population from Scotland, the Netherlands and the Czech Republic, seem to have had no problems with their new home. From the beginning this population grew very rapidly and recently exceeded the number of horses. For red deer a large, yet unused marshy area is still available.
The introduction of red deer had a negative impact on roe deer, as the green line shows. Causes are a change in vegetation (more elder - Sambucus nigra) and a higher water level after 1998.

The discussion now is how to deal with the growing numbers of animals to avoid unacceptable suffering in relation with public acceptance. It seems clear that the steering factor for the large herbivores is food and especially severe circumstances with lack of food. Predators doesn't seem to play a key role, only for keeping animals moving from one area to another and to select the weaker animals. We expect a decline of the numbers by a natural decreasing of the numbers of births.

Another area with the same status is a large forest and heathland area the Veluwezoom, north of Arnhem, an area with the offspring of the Vikings. Both areas have been visited last year by a group from your country.

INTRODUCTION TO GRAZING

I already made a beginning with saying a few words about the large herbivores and grazing. This is the second part of my talk.

The majority of Dutch nature areas is man-made and mainly the result of agricultural activities. Nature protection came up about a century ago. Developments in management are much younger and still continuing. In our country there is – as said before - a growing tendency to reduce human influence on nature. This is reflected in our approach to nature policy, which is based on the three tiers, self-sustaining nature being preferred to semi-natural nature.

Mechanical management versus management by grazing

Large herbivore grazing is a management tool very suitable to decrease management intensity. Grazing is not only favourable to nature, but also cheaper and environment-friendlier than management with (large) machines.

Grazing as a management tool

Besides, grazing results in a different and more natural pattern than mechanical management. Grazing will produce mosaic-like patches, whereas mechanical management will create a coarser-grained pattern with less micro contrasts.

Whether grazing is an option depends on:

- objectives for nature and nature target types to be realised,
- type and size of the site. It is preferred that a combination of different site types is available (e.g. dry / wet, nutrient-poor / more nutrient-rich),
- quality and quantity of feed available,
- the type of grazing: year-round or seasonal,
- but also: the individual animal characteristics,
- and the dynamics in grazer populations in a specific area.

Natural grazing demands low stocking rates, for instance:
one animal per 5 - 30 ha, some more, sometimes less animals per hectare, very much depending on the abiotic circumstances.

Year-round and seasonal grazing
In year-round grazing the animals are kept throughout the year within fences. Seasonal grazing is during a specified part of the year, generally summer. In winter the animals are elsewhere. It is possible to combine the two, e.g.

- cattle and horse grazing in summer and only horse grazing in winter
- more intensive cattle grazing in summer and less intensive in winter;
- summer grazing in richer areas, e.g. flood plains, and winter grazing in drier areas, e.g. heathlands and dunes.

Grazing areas, connected or apart
The choice for year-round or seasonal grazing or a mix is heavily dependent on the conditions of the site (feed quantity and quality; scale of the area; barriers as roads and cities), objectives for the site and the manager.
When a flood plain borders on a large heathland expectations are that the animals will create a pattern of their own, their behaviour in winter differing from that in summer.

The problem in the Netherlands is that such transitions are often cut through by busy roads, or that building has interfered with the original transition from low to high. Transitions can be restored at only a few locations in the Netherlands. A (theoretical) solution is to create combined grazing areas. In summer the animals will graze the nutrient-rich areas, in winter a much larger nutrient-poor area.

The advantage of year-round grazing is that the animals are better able to come to a site-specific and animal-specific grazing pattern, resulting in differentiation: a mosaic of open spots, thickets and woodland (to compare with the cyclical vegetation turn-over as developed by Frans Vera). This makes the site suitable for other - smaller - grazers, insects and insect feeders. It also results in a natural herd composition. The larger the site, the more species it will be suitable for and the more natural the processes will be in the herd.

HISTORICAL ROLE OF EXTINCT CATTLE AND HORSES

Long ago, wild herbivores took care of open spots in the forests. They prevented trees from becoming too dominant, and so created places where other species could live - the species we find in grasslands today.

Hunting and agriculture pushed these wild herbivores back to more remote areas. Often they became locally or totally extinct and live on in cave paintings, arms, like that of the City of Auerbach in Bavaria or even on mugs.

For centuries agriculture developed in a way which did not harm biodiversity. But even though the variation in species and in landscape types was maintained or even increased, less and less space was available for large animals and natural processes.

Nowadays the situation is totally different. In large parts of Europe, agriculture is so intensive that almost all the positive effects on biodiversity have disappeared; even rapidly in your country where a lot of biodiversity in agricultural land is disappearing.

Furthermore, agriculture is becoming more marginal in many other areas of Europe. Rural areas are being abandoned and this affects biodiversity and ecological processes. Since areas are no longer grazed, rich vegetations are being overgrown by scrub and covered by litter (such as thick layers of dead grasses), for instance on former state farms in Estonia.

In these areas, two options are available to maintain biodiversity:

- European subsidies for farmers, who manage their farms in an environmentally friendly manner. This is an option under Regulation 2078 (the Rural Development Regulation);
- Another option is to adopt a new type of management using grazing herds. This option is particularly valuable in areas where agriculture is too intensive or where agriculture is disappearing altogether.

It is interesting to look at the role large herbivores can play in both approaches. Here I want to stress the opportunities for large herbivores outside normal agricultural practices.

FROM DOMESTICATION TO DE-DOMESTICATION

Recent experiences have shown that some breeds of domestic cattle and horses can be bred to suit wild, natural conditions. The theory is that it must be possible to de-domesticate animals which are now domestic. An example is the Heck cattle bred by the Heck brothers who managed the Berlin and Munich zoos in the 1920s. Heck cattle are a mix of many European cattle breeds.

In different places practical ideas are being worked out to cross different breeds. Heckcattle are being crossed with longer limbed or taller breeds, like here in Germany in the Lippe area (North Rhine-Westphalia), under the management of the German ABU (Working group for Biological Environment Protection). In that region they made an interesting find - this 6000-year-old Aurochs head, about a meter across. It is the proud chair who is showing this skull, together with some members of the Large herbivore Initiative.

My theory is that each of the large herbivores has their own specific ecological niche. Since wild cattle and horses are extinct, their ecological niches are vacant, but indispensable and very important for the processes and species.
This raises a number of questions, such as:

- Is it possible to de-domesticate domestic animals such as primitive cattle and horse breeds? Some old breeds still have their wild ancestors' characteristics.
- Will they fill their ancestors' original ecological niche?
- Which breeds are most suitable for de-domestication in central and eastern Europe?
- Are Heck cattle and Konik horses the most suitable types?
- Are other old breeds available, such as the Estonian horse? (we must made an inventory).
- It is said that the volume of the brain shrinks by 15-35% during the domestication process. How might this affect the de-domestication process?
- The decline in brain volume has also been found in Przewalski horses, which have been in captivity from the beginning of the 20th century. Crossing in 1906 with one Mongolian stallion and strong inbreeding may have affected these horses' brain pan. Would brain

volume increase with de-domestication? Following the dedomestication process in practice should a challenge for research too!

HOW TO SET UP A GRAZING SYSTEM

There are a number of questions to ask if you are considering grazing in your area, such as what kind of animals to use and which grazing system to develop.

The choice of animals depends on the defined nature targets. The choice of nature targets in turn depends on climate and local conditions (such as size of the area, vegetation, abiotic conditions) and local aspects such as interest of local farmers and demand for the animal's products. Costs for animals themselves play an important role, plus fences, drinking water, supplemental food and shelters if needed, and costs of staff.

The types of grazing differ as to the amount of human intervention, some examples for the discussion:

- the wilderness system:
  animals live free and roam through the wilderness. Like game animals, in fact no one owns them. Management on the level of the whole population. No individual healing, except euthanasia (mercy killing).
- the "New Forest" system:
  animals also live free and roam about in a somewhat wild environment. Every animal has an owner, but they live together. Every autumn the surplus of animals is harvested. Every animal is known. (other words: communeaux in France, haciendas in Spain, Almende in Germany).
- the agricultural system:
  every owner has his animals fenced in. Harvesting surplus depends on the requirements of the farmer.

Time for an example with some results:
In The Netherlands the greylag geese have returned and now breed so successfully that local farmers are starting to complain. The goose has complex environmental demands; essentially, it must have a moulting area and sufficient grasslands. During moulting, they prefer to live in reed beds, where they can eat the sugar-laden reed sprouts or *Senecio palustris*, like here in the Oostvaardersplassen.

This prevents the water from becoming overgrown with reeds, and keeps the habitat suitable for water birds and fish. Fish like stickleback are an important food for heron species, like spoonbill and white egrets, which are increasing. In the spring of 2000, 10 breeding pairs of the great white egret and 6 of the little egret were counted.
We will have wet years and dry years; some birds will disappear (albeit temporarily) if their habitat becomes less than suitable. This happened with the spoonbill a few years ago. In the *Oostvaardersplassen* it went from 130 breeding pairs to zero - a dynamic process indeed. The result however was that these birds suddenly appeared in many other places, as far away as Denmark. Our official policy goal of 1200 breeding pairs was thus attained earlier than expected.
The *Oostvaardersplassen* seem to function as a sort of overflow area for other potential breeding areas, at least for birds.

ANIMAL WELFARE

A number of questions will always recur in discussing animal health and welfare, such as:

- when is an animal ill from natural causes, and when is human intervention required?
- what are the obligations of the manager?

- what are the rights of the animals?
- when does the owner of the animal have legal or social responsibility to intervene?
- are there risks of poaching?
- what is the relationship with large carnivores?

In the Netherlands (and certainly in other countries) animal welfarists and population managers often clash. This slide is meant to distinguish the two. A distinction should be made between so-called natural nature and semi-natural nature, or, ethically speaking, between animal ethics and eco-ethics.

The situation of semi-natural areas is above the red dotted line, where animals should be seen on the individual level. Below this line animals are part of the ecosystem. Management should focus on the population; the individual animals are of less importance than the population itself. To survive, a population must be as genetically strong as possible. The negative general influence of weaker animals should be minimised.

This means that such issues as which animals mate with which and which animals can survive in the harsh conditions will be left to nature. Stressful events like birth, hard winters and dry periods are factors of life or death. In our country we have had heated arguments about people's responsibilities. Dutch law states that anyone encountering a suffering animal must help that animal.

But taking the legal text literally means, that this applies to earthworms and mice as well. It is hard to believe that this was the aim of the legislation.

ASSISTANCE, HELPLESSNESS

We have now started working on an animal welfare policy specific to nature areas. It distinguishes between natural and unnatural suffering, for instance. Animals do have the right to be born, grow up, live, be ill and die. An example is the foal abandoned by its mother. Such a foal is doomed. What is to be done, and what are a manager's obligations. When abandoned it is left to die under a shrub .Accepting this researcher as its guardian (you may recall the picture of Professor Lorenz with a row of goose chicks swimming behind him) is neither a solution. Animal welfare in nature areas is looking for a balance; a balance of "good times and bad times".

Every animal in a nature area is taken care of. What this care amounts to, depends on the nature of the site, the circumstances and the extent of the animals' de-domestication.
Since there is a distinction between farmed and non-farmed animals there is a difference in the way they are taken care of. Under wild circumstances animals can take care for them selves: the manager has always to wonder about unnecessary suffering and unacceptable pain. If this is not the case, he should not interfere.

VETERINARY mEaSUReS

The EU requires that Member States take requisite measures when there is an outbreak of such infectious diseases as Food and Mouth Disease (*Regeling aanwijzing besmettelijke dierziekten*). In such an event, Member States can also - depending on the situation - introduce extra measures to contain the disease. The Animal Health and Welfare Act provides for such measures.

The Oostvaardersplassen and Veluwezoom are at some distance from farms (resp. 700 m and some kilometres). The risk that an infection in the area would spread from the large herbivores to the animals on the neighbouring farms is negligible since large herbivores are only taken from or brought to the area in exceptional cases and contacts between persons and transport vehicles from the area and the farms do not take place. Nevertheless a monitoring programme is in place to check

for the presence of an animal disease in both areas. But honestly said, I really think that nature managers have to be more afraid for agricultural animals (transported several times during lifetime, than in the opposite case). This is proven by the recent Foot and Mouth Disease outbreaks in The Netherlands, until now on some distance from the most important nature areas. For safety purposes the management organisations closed these areas for public, as has been done with all the nature areas, where large herbivores (deer, boar, cattle, horses, etc.) live. Even public roads near such important areas have been closed for public. It is a policy to avoid movements of wild herbivores in case of infection to avoid spreading of the viruses, in stead of hunting them.

SUPPLEMENTARY FEED

Policy

In large nature reserves in principle large herbivores are not given supplementary feed. This can lead to disputable situations: here a weak cow with a strong calve at the end of a long, wet winter. Is this unnecessary suffering, or a part of life – or of good times, bad times?

This policy also implies that individual animals are not given supplementary feed. This bull and these red deer lived under the same circumstances, but are in perfect condition (both pictures are from April 3rd 1999).

There are two exceptions to this rule:

- when essential nutrients (such as minerals) are not available;
- when there is a danger of a population crash through force majeur (e.g. flooding)

This konik horse is perfectly able to survive on reed during winter time, having no problems with the temperature of the water: a hardly known natural behaviour.

In other nature areas:

the animals are taken care of and given supplementary feed when necessary; but not necessarily like this cow, eating a rabbit to collect supplementary minerals.

carrion

I did not spoke about the ecological value of dead animals, which – talking about reintroduction - we also have to reintroduce.

We stand at the beginning of a sweeping reform of European agriculture, especially with respect to food quality, animal ethics and the market.

We have to face many economic questions, but also ecological ones such as “will there be room again in Europe for vultures or other carrion eaters as an almost forgotten part of biodiversity?”.

A few months ago, this dead horse in Spain was removed by the farmer the next day, because it is forbidden having dead animals in the field. Really exiting to see about 50 vultures in Europe above and around their dish, some of them to heavy to fly away.

But we also want an increasing biodiversity and more exiting area to live in. The role of wild boar in this is evident, as well as the role of eagles in your country during winter time.

DestructiON ACT.

Dead bodies of large herbivores (cattle, horses, sheep and goats) must be destroyed under the Dutch Destruction Act . The Act however does not apply to animals in the wild, such as red deer, roe deer and wild boar.

In the Oostvaardersplassen and Veluwezoom an exemption to the Destruction Act for leaving dead bodies in the field as carrion was withdrawn as there was no legal basis for doing so.

The dead bodies of cattle and horses must be removed because of the risk they pose to:

- the environment,
- public health

- nearby farms
- and for legal reasons

Given the conditions of the nature reserves, however, it is not always possible for site managers and not good for the ecosystem to remove dead bodies. The manager must always, whatever the circumstances, take steps to eliminate the risk of infection.

Researchers of ID-Lelystad have shown that the risks of dead animals in the field in so far as they have not died from a contagious disease are slight and can easily be managed. They do however warn for the possible risk of botulism which easily develops in dead organic material in hot weather. The *Clostridium botulinum* bacteria may in certain conditions secrete botulin which is highly toxic.
This will only happen when the dead animal was a carrier of the bacteria and only when temperatures are high. Botulism has not been found in dead bodies of large herbivores in our nature areas to date.
Thus, except botulism, a dead animal, not died because of a contagious disease, can't fell ill after its death.

Seen the value of carrion for biodiversity we should have to change the European and national Destruction legislation in such a way that– under special circumstances - ecological destruction processes are also seen as sufficient and safe.

SOCIO-ECONOMIC ASPECTS OF GRAZING BY LARGE HERBIVORES

Grazing by large herbivores may have a number of socio-economic benefits for the region. Greater knowledge of the costs and benefits would influence the decision whether or not to choose this type of grazing.
Large herbivores in a semi-wilderness area could generate extra income from (sustainable) tourism, and their meat may be a highlight of menus of local restaurants.

SOME LAST WORDS

Our policy Nature for people, people for nature is a challenging step for the long term nature conservation.
For the robust, strong ecosystems are the large herbivores are a very interesting subject, both as a management tool and - more importantly - as an integral part of extended and different ecosystems. The concept of grazing by large herbivores is still in its infancy.

I hope that our discussions, talks and excursions will encourage further development of existing ideas about more complete ecosystems.

I have said a lot, may be to much; I have not spoken about the relation with public. A real important aspect is to raise public awareness by education and information. Like this father, probably trying to learn his son horse riding on the back of a semi-wild konik horse, asking for problems.

I also hope that more policy makers will become convinced of the possibilities in Europe of completing the living environment with strong, robust ecosystems, well connected with each other, where large herbivores and carnivores and all the other organisms, dependent on large ecosystems can live in.

Large mammals in Europe are a forgotten group of biodiversity: I have not found a policy for this group species in the meeting reports (COP's) of the Convention on Biodiversity: there is work to do!

But there are already results, as I already showed you and as we can see on this picture. About a year ago we met a group of red deer in the evening quietly eating on a distance of less than 30 m, not afraid of people. This is what many people want to experience.
For you a well known picture, seen your wonderful experiences at Dyrehave, north of Copenhagen where millions of people can enjoy these mammals under relatively wild, natural circumstances.

What I have said is not necessarily always the idea of my minister, but it is a more than serious sketch of our ideas and challenges. What seems impossible to day, might be possible tomorrow.

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some websites about Dutch nature policy and grazing in nature reserves:

- pictures:
  http://www.home.zonnet.nl/hanskampf/index.html
- Internet article in English:
  http://www.lapla-net.de/kampf
- summary in German:
  http://www.home.zonnet.nl/hanskampf/Graser_Deutsch.html
- summary in French:
  http://www.home.zonnet.nl/hanskampf/Oostvaardersplassen_french.html

Managing dynamic nature – Dutch experiences
Jan Gorter

The Veluwe: vastness, borderless, fenceless;
creating dynamic nature

Lecture for the grazing conference, 5-6 May, Copenhagen

J. Gorter, ProgrammeManager Veluwe
Vereniging Natuurmonumenten
April 2001

Introduction

Ladies and gentlemen,

I am honored to be invited to share our Dutch experiences with you. My story is about the implementation of the national policy into day to day practice.

- In short I'll introduce you to Natuurmonumenten, the biggest Dutch NGO, for which I am working, and (very briefly) the other nature conservation organisations.
- I'll introduce you to the area of The Veluwe, which is by far the biggest Dutch nature reserve on land in Holland.
- Then I'll focus on the problems we have to deal with in the Veluwe-area, and the national and regional policy to tackle those problems.
- I'll show you what happens in reality.
- And I'll go into the process we have following to reach the point we are now, and the role of Natuurmonumenten as an important player in the field.
- And I'll conclude with a few recommendations to you, as a starting point for discussion.

About Natuurmonumenten

1. Slide Dutch NM-properties map	**Natuurmonumenten is the biggest NGO organisation for nature conservation in Holland. It was founded in 1905, in order to save The Naardermeer from becoming a garbage-dump by acquiring the lake-area. Since then, buying land is one of our main strategies to conserve nature.** Now we manage some 80,000 hectares of natureareas. Each year we aquire an additional 2000 hectares. Among these all types of nature you can imagine in our country, varying from large Waddensea and island areas, to large and small woodlands, heather and moorlands, sands, and boggy moor areas, and agricultural landscapes of different types, and estates with monumental buildings.
2. Slide showing increasing memberships	**We are a society of members, nearly one million families are members of Natuurmonumenten, which is rather high for a population of only 16 million people. We have evolved the last ten years from a quiet nature management organisation with a relatively low profile to a leading voice for nature, with a much higher profile. This profile is based on a higher recreational and communicative content (we produce nice things for the people, marketed in our full colour magazine with the myth of endless nature areas where you can find peace, silence, nature, in our crowded country. Our membership has grown to nearly one million member families.** **But we have also gained importance as the voice for nature, for instance in country planning issues as the building of a new suburb of Amsterdam in the IJmeer, the creation of the new seaport area Maasvlakte near Rotterdam, and the development plans of several high-speed train-connections. And a host of other, less important issues.** We have changed our organisation (our culture, our structure, less emphasis on biological aspects of nature management, more communication, more recreation, more interference with urbanization plans). In short: we work on a higher profile.
3. Slide showing finance	**Our expenditures exceed 100 million Euro each year, 86 per cent of which goes into management and acquiring lands. And 12% goes into provision of information, communication, publicity and public awareness. The costs of managing our nature areas is some 300 Euro per hectare each year, the government gives us only some 70 Euro per hectare each year, so there is an exploitation deficit of 230 Euro per hectare each year. The schemes on this slides show how we deal with this problem. Our revenues come from:** • Subsidies: 29%: Our acquisitions of land and properties is subsidized for 50% by the Ministry of Agriculture, Nature and Fisheries, and for 50% by the Provincial authorities. And we get some 70 Euro per hectare each year for the management. • Income from assets 28%. • Income from third parties, mainly the National Postalcode Lottery 17% • Income from memberships, gifts: 27% • Income from land and buildingmanagement: 7% (contracts with farmers etc.)
4. Slide showing employees	**There are some 650 people working for Natuurmonumenten, 150 at our headquarters, and 500 'in the field'.**
5. Textslide	Something about the nature conservation landscape of Holland, because this is really confusing. I'll skip the details but we have the following big natureconservation organisations, which all manage nature reserves: • Natuurmonumenten, which is a bit 'opinion-leader'. • The State ForestryService, which is quite strong, but not much of an opinion leader. They own twice as many nature reserves as Natuurmonumenten. • In each Province there is a Provincial Landscape Foundation, which is a regional colleague-organisation, a NGO, and is very much like Natuurmonumenten. After World War II it was founded by Natuurmonumenten to bring nature conservation closer to the people and to the regional government. The Provincial Landscape Foundations vary with regard to the extent of their power, but in general they do not wield at great deal of power. They have a relatively low profile. But in size they manage an area equal to that of Natuurmonumenten. In our Province of Gelderland we are working closely together with both the State Forestry Service and the Geldersch Landschap. • Besides these organisations, we have the WorldWildlife Fund, Greenpeace, Friends of the Earth, and the Society for Nature and Environment, an important NGO-lobby-organisation on national level in Holland, with connected organisations on a regional

	level, but I'll skip all these in this presentation.
6. Slide of myself	Enough about Natuurmonumenten. Now about myself: I am programme manager for the Veluwe, and in short it is my task to develop the Veluwe into one large nature area, to reduce threats, to create chances to improve the area, even to enlarge the area by connecting it to surrounding natureareas , like the floodplanes of the rivers Rhine and IJssel, and the wetlands of the Oostvaardersplassen. And my task is to develop synergy and cooperation in order to achieve these goals. I have done this for one and a half years now, so I am quite 'fresh' in the job. My type of function is also a new one: I am not concerned with nature management, but with the development of a specific area with great interests for nature conservation as a whole, not only for Natuurmonumenten! **A short warning for you: I am not knowledgeable in the grazing business, nor in the veterinarian business, so for those type of questions, please ask my colleagues Hans Kampf and Frans Vera. I will tell you about the challenging task of turning sweet ecological dreams into tough economic reality.**

Video clip

Now for the dreams first.
We'll start off with a video-clip which will introduce you to the character and values of the Veluwe.

Start Video clip.

We have made this video together with the large landowners of the Veluwe, The Provincial LandscapeOrganisation of Gelderland, the State Forestry Service, the private estate-owners, and the National Park Hoge Veluwe, the latter also a NGO.

I will go on with the position of the Veluwe in the Nature Policy Plan of our Ministry of Agriculture, Nature and Fisheries.

Introduction to the Veluwe and the Nature-policy plan

7. Slide EHS-map LNV	**This is the map of the ecological network in our Dutch Policy Plan from 1990, already shown by Hans Kampf. This concept of enlarging and interconnecting nature areas in Holland has not lost any momentum since 1990, and in fact it is still our goal today, broadly accepted during all those years, and we want to keep it that way. This is really special, because in Holland we tend to change our policy-concepts continuously. In this case, the concept (with a working period of thirty years!) is so strong, that it has survived different economic periods, different ideas about types of nature. Our first message to you is: Try to establish an ecological network-policy in Denmark too, because it is very powerful!** **In Yellow you see the Veluwe as our biggest existing nature reserve in the central-east part of Holland.**
8. Slide EHS-map Province	**The realisation of this national ecological network is worked out by the Province, our regional public authority.** **The Veluwe has specific ecological values because of the vast scale of the area, besides the deer and the wild boars, the badgers, a lot of smaller species such as reptiles, and a lot of insects, like this (what we call) flying deer, and night jar. The ecological and recreational values reflect the large diversity in ecosystems, varying from**

9. Slide Riverflood-plains	
10. Slide sands	**Big drifting sands;**
11. Slide leemkuilen	**Heather and moorlands**
12. Slide estates	**Estates**
13. Slide stream	**Small streams**
14. Slide hydrologic relations	**And there is an important hydrologic relation between the Veluwe and the surrounding agricultural areas, and we want to reinforce that relation. It is always very special if you realize that it has taken this water 200 years to go the course from high to low, where the springsare. So what we see now, at the borders of the Veluwe is 200 years old non-polluted water. Nature takes its time. The pollution of land by the modern intensive agricultural methodsis under way, but this is for future generations to solve**
15. Slide Beekbergerwoud	**An example of the surrounding areas, this is managed by Natuurmonumenten.**
16. Slide IJsselflood-plains	**And very special situation: The Veluwe is connected over quite a distance to the river floodplains: we have here the rare combination for Dutch circumstances of 'high' hills, and low lying river floodplains.**

Problems to solve

17. Slide fences	Now about the problems: Country of a thousand fences
18. Slide deer and fence	**This is a relatively low fence, most of them are higher. But this type also causes accidents.**
19. Slide map of properties	**This has to do with the different properties, each owner looking after his own garden, without any concern for the area as a whole. There are the different natureorganisations like Natuurmonumenten, Geldersch Landschap and the State Forestry Service, there are also the private estate owners, there is the military complex, and the royal estates of our queen. But also large ownerships of local communities.**
20. Slide tank	**In many areas intensive military activities are taking place.**
21. Slide military map	**The yellow areas are military areas. Among them there is our mobile airbrigade, with big Chinook-helicopters for fast intervention abroad.**
22. Slide Deelen	**There is the military airport of Deelen, situated amidst one of our most rural parts of the Veluwe**
23. Slide Terlet	**And there is airport Terlet, in use by the National Dutch gliderclub, not really very noisy or disturbing, but nevertheless fenced. And there are more and more gliders nowadays which are pulled up into the air with motorplanes, in order to get higher, In that area motorplanes can often be heard.**
24. Slide highway A 50	**There are three highways crossing the Veluwe. The traffic is increasing continuously. Everywhere the noise penetrates.**
25. Slide N 224	**There are many provincial roads, and the traffic is also increasing continuously. This is the biggest source of modern day noise.**
26. Slide Posbank	**Even some very small roads in our own National Park Veluwezoom are so popular that they are often congested with traffic jams.**
27. Slide bungalow	**We have more recreational bungalow complexes in the Veluwe than there are in the whole country of Switzerland. This causes huge problems, because 20 years ago they were nice small campsites, after that caravans were more profitable. And caravans turned into small chalets and bungalows. Some of them became inhabited all the year around. And the latest development is that a project developer buys up the old parks, builds new luxury houses on it, and sells them one by one, each one fenced. What results is an illegal small new town, permanently inhabited, and no recreational area left. This is "the eating up" of the Veluwe from the inside.**
28. Slide map bungalows	**On this map you see the huge expanse of recreational bungalow complexes, often inhabited permanently.**
29. Slide villages and cityies	**Another problem: many villages and cities are built on the borders of the Veluwe, and our economy is fast growing. Every city and every village (every community) wants to grow, build houses, build industrial sites, and roads to accommodate the**

	accompanying car-mobility. So there is a threat that the Veluwe becomes a nature island in a growing city-scape. How do we keep the connections between the Veluwe and its surrounding nature areas open in the future?
30. Slide NUON advertise-ment	**The Veluwe is an enormous collector of non –polluted rainwater. Instead of letting the water infiltrate and feed our springs and rivers and low-lying nature reserves, there is a lot of water distracted by the water Board, so we lose a lot of water. Some streams have fallen a meter because of this type of use. And besides that the water companies advertise about their Veluwe water quality. They earn money, but the loss is left for nature.**
31. Slide map problems	**This is the summary of our problems: fences (the black lines), military use (black-lined areas), private not accessible or paid accessible and fenced properties (in blue squares), many growing bungalow complexes (in red), increasing traffic congestionon highways and other roads, and a sharp separation between the nature area and the surrounding areas.. Now we go on to the policy for the future. The public authorities want to stop this continuous growth of barriers, and make the Veluwe one big area for nature and recreation. We need a central quality mission for this, which we call: National Park. We want the Veluwe to be designated as a huge National Park. At this moment there is much discussion going on about it, but we'll work on that. The next slide shows what we can accomplish with a National Park strategy.**

What are we to do? A policy for the future!

32. Slide map provincional Veluwe-policy	**This is the summary of the provincial policy on the Veluwe. This is the vision of the Veluwe in 2010, we have another nine years to accomplish this image. It is not an official map, but it is drawn by two visionary public servants one of the Province of Gelderland, and the other of the Ministry of Agriculture, Nature and Fisheries, and it comes very close to the summary of the proposed policy.** • **No fences left, exept for one low wild boar fence.** • **Fewer cars on the provincial roads, symbolised by traffic signs. Even closing down of a few large roads. This is of course the most controversial subject of this map. And we shall only begin to talk about it prudently. But we will persist. No more military areas, except for the two military headquarters. Concentration of the Chinooks.** • **Fewer bungalow parks in the centre, but more room for bungalows on the 'outskirts'. Selective growth on the periferal zones, and removal away from the centre.** • **Farmlands in the border zones returned to nature, the Veluwe enlarges!** • Large green connections between the Veluwe and the floodplains of the river IJssel in the east, the floodplains of the Rhine in the south, the Utrechtse Heuvelrug in the west, and the Oostvaarderplassen in the north. • 20 ecopassages across highways. • Special new nature-education centre in former military buildings • And, last but not least: The Veluwe should become one large National Park covering 100,000 hectares, instead of having no special status, other than the two privately owned National Parks of 5000 hectares each. This will take a huge amount of capital investments, ranging from 250 to 500 million Euro.
33. Slide Gathering	**Now I have to admit to you: this is really a breakthrough for Holland. Until now we have been talking for more than 20 years, or longer, without accomplishing anything special. We call this 'our Poldermodel'. In Holland the public authorities are not in the position to achieve great things , because everybody is a bit in charge in Holland, everybody has got his finger in the pie. Everybody argues and discusses continuously. If you don't like something, you begin a political party, we have some thirty of them. So most things are being done interactively, with all partners around the table. From that point of view our ecological network is a miracle. And the large consensus about the future of the Veluwe is also a miracle. The message to you in Denmark is: keep talking, take your time, a large amount of time to talk is quite normal for big challenges. But at the end of the day, clear long term decisions will have to be made!** **For the Veluwe we have had twenty years of one step forward, two steps back. Now we have this new policy, and we hope to take each time at least two steps forward and not more than one step back. If this is so, then, in 50 years' time, Holland will**

	perhaps one big urban township, but the Veluwe will remain our green heart.

What's happening in reality

34. Slide Zandpad	**We have already had some small results over the past twenty years: many small non-bituminous roads are closed for cars.**
35. Slide cycleways	**Many new cyclepaths have been created.**
36. Slide ecoduct	**Three ecoducts have been realised, which work very well for a large number of animals varying from deer, wild boars, badgers, and a numerous small species.**
37. Slide Winkelman	**But now for the first time we see signs of a breakthrough in our big ambitions: Different public authorities have agreed upon removing a huge military building complex, and, as we say "giving it back to the rabbits". The costs are some 10 million Euro.**
38. Slide Stakenberg	**And five kilometers away from this location, the public authorities are buying a huge bungalow complex for the same amount of money, 10 million Euro, in order to prevent the development of another 300 new bungalows. They will give it to the State ForestryService as a nature reserve, without fences, and we will look for possibilities to remove the existing 60 bungalows on the terrain. In this case, Natuurmonumenten has been the initiator of the process, so I am proud to say that we have succeeded. First example of selective grow and decline strategy for such bungalow complexes.**
39. Slide industrial estate	**On another location, The Ministerial, the Provincal and the Municipal Authorities are studying the transfer of a huge factory complex to another location outside the Veluwe. The costs will be 20-40 million. Success is not yet assured however, but serious discussions are being held.**
40. Slide Masten Kootwijk	**Planological conservation is very important, to prevent unwanted new developments. This is a role for the local communities, but, as practice has shown, also for local action groups and private nature organisations like Natuurmonumenten and the Provincial Landscape Foundations, and more and more also the State Forestry Service (which has become an independant public authority). Practice shows that we have a very close cooperation together, and that we have gained a lot, like no new broadcasting towers of 300 meter sticking in the air, no waste processing plants, no lighting of highways, no expansion of many the bungalow complexes, no MacDonald in the centre of the Veluwe, etc. etc. People begin to understand that the Veluwe needs protection.**
41. Slide Wisselse Veen	**This is an astonishing nature-restoration project on former farmland, on the borders of the Veluwe, called the Wisselse Veen. Here some small streams well up, and within a few years there will be an abundance of rare flowers. Now the speed with which this type of nature-restoration is realised, needs to be increased significantly. And this is really important because it lies at the heart of creating the ecological network of the nature policy plan. Although it is the responsibility of the Ministry and the Province and a specific department of the public authorities, charged with the acquisition of land or farmers' commitments, there are continuously problems about finance, mandate, and responsibilities. NGO's like Natuurmonumenten are essential to define the problems , to toll the bells, or even buy areas themselves, to show that there are opportunities to acquire land for nature in certain difficult regions.** **The topic of finding another method of producing water for households and industrial use is carried out by the Province, which forces the water companies to use such other methods, such as infiltration of river water to compensate for the water collection from the Veluwe. The result of this is the type of wetland restoration you can see in this slide.**
42. Slide fence	**Removing of fences**
43. Slide ecopassage	**Lobby for more ecopassages across highways**
44. Slide Hierdensche beek	**Active restructuring of Veluwe'gateways', and creation of large ecocorridors.**
45. Slide map South Veluwe	**Something about the cohesion of all these measures. At this moment there are many activities on the south Veluwe to arrive at a nature area without barriers. Natuurmonumenten is an important actor in this playing field. From the campaign "Deer in the Ijssel floodplains" to the "Deer in the Rhinefloodplains" campaign).** • **Plan Deer at the Ijssel and Deer at the Rhine**

	• Connecting Veluwezoom and Deelerwoud • Removing the fences • Reduce traffic congestion on the road Arnhem-Hoenderloo • Reducing fences Airport Deelen and nature management military area • Reducing fences National Park Hoge Veluwe • Returning agricultural enclaves to nature • Studying tunneling N 224 • Transferring factorycomplex • Naturedevelopment Heelsumse and Renkumse Beek
46. Slide grazing	**As this is a grazing conference, I 'd like to apologize here for not talking about grazing, but as you have seen, grazing is not a political issue here, now. Locally it is, because we want to expand our Highland cattle grazing at Veluwezoom, and sometimes we succeed. However, there is opposition from specific landowners, we have, for instance, discussions about the influence of our cattle on the density of their deer population (leading to decreasing wood rejuvenation, and less income from wood production, and that type of difficult questions), but they are simply not important enough now. One remark on this picture: these cows are not wild animals (they need care to a certain extent, and we are not allowed to shoot them and to sell the meat for consumption). But they are not allowed to enter the farmers'scene either. They have no earmarks, and they are not allowed to be transported to other areas, are not allowed to have contact with other cattle, and we are not allowed to sell their meat like farmers do. This causes a lot of problems at the moment, because they are reproducing fast, and their numbers will sooner or later have to be controlled. We still do not have a solution to this problem, but we are working on it, together with Hans Kampf. The solution has to be a European one, so this will take some time.**

Strategic approach Natuurmonumenten

47. Slide text	**The first strategic and important choice to be made is to detail a person (in this case me) wholly to this special mission, in this case the Veluwe without putting up any barriers. This is a strong signal to authorities and colleague-organisations that the Veluwe-policy is of major importance for nature and nature conservation organisations.** **In the years that follow such a person can be a spider in a large web of nature conservation efforts!**
48. Slide text slide	**Our subtrategy is determined by** • What we want **(ambitions, you heard about them, we mostly are very good at ambitions)** • **What we are able to do** (money and people, in this case reasonably much) • **What we are allowed to do** (within the limits of our 'context'. This is our 'weak spot, blind spot', mostly we do too much, are sometimes a bit too arrogant, and then we often fail, or inadvertently we organise our own opposition). In order to prevent this, we have made a

49. Slide text	**SWOT analysis (strong and weak points, opportunities and threats). In this case our conclusion was that in this area now is the time for large ambitions, but that all things to be accomplished are beyond our own means. We are dependent on other landowners, and on many public authorities. So our motto is: seek cooperation in order to accomplish avast, borderless and fenceless Veluwe.**
50. Slide document Eindeloze Veluwe	**Therefore, cooperation with the other landowners is crucial. We started by inviting the different landowner categories, even the military, to write with us our own policy, in which we bring our mutual interests together. For instance we do not write down that we want to get rid of the military (we do this in the Hague, where the Ministry of Defense are working on their country planning policy), but we are more or less seducing them to manage their lands in a more natural fashion. And not without good results: they've agreed to transform their woods into natural woods, without interference by man, and we agreed with them on a new grazing system using Highland cattle for some very large woodland and heather areas. And we drew up a planning vision which is very much in line with the Veluwe 2010-plan of the public authorities.**
51. Slide National Park	**I have to say a few words on the National Parkpolicy. The different landowners are strongly divided about designating the Veluwe as a large National Park. The natureorganisations like Natuurmonumenten, the State Forestry Service, and Geldersch Landschap are in favour, but the private estate owners are not. They fear foreign interference in what they see as private property. Then there is the Crown, who fear the same: their woods are the only areas where our Queen can ride on horseback unseen, where she can find privacy, and where it is possible to hunt in the way she wishes. They also see the coming of a National Park as a loss of privacy. Then there is the National Park Hoge Veluwe. Being the National Park with fenced-in wildlife with a high visibility they earn money, so they want to keep it that way. Because this is all about fears, and names, and not so much about what is good for nature, Natuurmonumenten has taken the initiative to look for a compromise. We found out that we agreed largely about the contents of the new status, and we agreed about the name National Landscape being a good one. Wihin this Landscape we can work on growing National Parks. The name National Landscape allows more room for functions as forestation, cultural landcapes and heritageitems, and possibly involves less interference from public authorities.**
52. Slide Veluwe 2010	**Because of the leading role of Natuurmonumenten in all these discussions, I was invited to become a member of the Provincial programme-team for the Veluwe. And this has proven to be a really good working concept. Natuurmonumenten is now, together with the State ForestryService, the linking pin between the large owners and the authorities.**

Questions

Summary

Natuurmonumenten is the biggest NGO organisation for nature conservation in Holland, founded in 1905. Natuurmonumenten manages some 80.000 hectares of nature area's, and has 950.000 family-memberships, 650 people working for the club, and expenditures up to 100 million Euro each year. Natuurmonumenten evolves to a higher profile, as an opinionleader for nature conservation issues. For instance by setting free programme managers and project managers for specific challenges, like creating a large Veluwe National Park.

The importance of the Ecological Network, according to the Dutch Nature Policy Plan is emphasized. The Veluwe is the largest nature-reserve on land in Holland.

The Veluwe-policy is discussed. In brief:

- **No more fences.**
- **Fewer cars on the provincial roads, symbolised by traffic signs. Even closing down of a few large roads.**
- **Less Military, concentration of the Chinooks.**
- **Fewer bungalow parks in the centre, but more room for bungalows on the 'outskirts'. Selective growth on the periferal zones, and removal away from the centre.**
- **Farmlands in the border zones returned to nature, the Veluwe enlarges!**
- Large green connections between the Veluwe and the floodplains of the river IJssel in the east, the floodplains of the Rhine in the south, the Utrechtse Heuvelrug in the west, and the Oostvaarderplassen in the north.
- 20 ecopassages across highways.
- Retention of water, in order to get wetlands.
- Special new national nature-education centre in former military buildings.
- And, last but not least: The Veluwe should become one large National Park covering 100,000 hectares, instead of having no special status, other than the two privately owned National Parks of 5000 hectares each.

There are signs of a breakthrough:

- The first three ecopassages across highways have been realised.
- The first military building complex is being removed.
- There is an agreement for the buying of a huge hotel- and bungalowcomplex to prevent the building of 300 new bungalows. In fact the area will be given to the State Forestry as a new nature reserve.
- The transfer of a huge factorycomplex is in serious discussion.
- Many developments are cancelled in favour of nature.
- The acquirement of agricultural lands in order to become naturereserves has shown some fine results.
- The first fences have been removed.
- And there is installed a special commission on giving a special status to the Veluwe, as a National Park.

The strategic approach of Natuurmonumenten is discussed.
The strategy is based on a SWOT-analysis. The outcome is that Natuurmonumenten is needed as a key player inthe field, and that we are supposed to have large ambitions, but they will only succeed by cooperation. In the first place with the other landowners, in the second place with the different public authorities, in the third place with other parties and organisations. Therefore a specific programme manager is set free.

The message is that succes cannot be obtained without a clear and offensive nature policy by the public authorities. But to achieve this, and to implement this, an offensive role of nature conservation organisations is very essential!

J. Gorter
Vereniging Natuurmonumenten
April 2001

PAN Parks

-Improving nature conservation through sustainable tourism in Europe's protected areas-

Co-ordinator Joep W.G. van de Vlasakker

Organisation

The "PAN (Protected Area Network) Parks" concept was initiated under the umbrella of WWF's European Forest Programme by the World Wide Fund for Nature in 1997. Co-operating partners are the WWF, the Molecaten Group (a Dutch leisure company) and various protected area authorities. Based on a wide consultative process, in 2001 the PAN Parks Supervisory Board endorsed Principles and Criteria for certifying a protected area as a PAN Park. The PAN Parks Organisation assists with gathering financial support for the sustainable use of natural heritage by implementing joint marketing and communication activities and with establishing a local organisation responsible for implementation.

Development of PAN Parks

In the first phase of the project, Principles and Criteria were developed to set guidelines as to which protected areas can earn the PAN Parks label. The draft was formulated based on literature, comments of experts, input from protected area managers and by examples of good practice. The third draft of Principles and Criteria was tested by 18 protected areas in 15 European countries that filled out questionnaires of *self-assessment*. The data was summarised in a report highlighting good practice, weak points and advise for future development. On these grounds and with the help of experts, Principles and Criteria 1 (Natural Values), 2 (Habitat Management) and 3 (Visitor Management) were finalised in 2 workshops and finally approved by the PAN Parks Supervisory Board in 2001.
Recently Principle 4 (Sustainable Tourism Development Strategy) and Principle 5 (Business partners) were finalised and approved by PAN Parks Supervisory Board.

Candidate PAN Parks

Currently 7 protected areas have signed a letter of intent assuming the status of *Candidate PAN Park*, committing them to achieve PAN Parks certification by 2006. A further 5 protected areas have been designated *Prospective Candidate PAN Parks*, with certification expected by 2011. Candidates and Prospects fall within one of four European regions: Northern, Central and Eastern, Southern, and Western Europe. In 2001 the PAN Parks Organisation aims to designate a total 8 Candidate PAN Parks (2 per region) and 10 Prospective Candidate PAN Parks. The PAN Parks Organisation will focus its resources in working with Candidates to realise certification; upon certification, the best Prospect in that region will jump up to the position of Candidate. By using this three-tiered system (verified PAN Parks, Candidate PAN Parks and Prospective Candidate PAN Parks), the PAN Parks Organisation can better manage the growing network, and also sets strong incentives for improvement of park management. The first PAN Park certified by the PAN Parks Organisation is expected by 2002.

Candidate PAN Parks	
Finland	Oulanka National Park
Italy	Abruzzo National Park
Poland	Bieszczady National Park
Slovakia	Slovensky raj National Park
Slovenia	Triglav National Park
Sweden	Fulufjällets Nature Reserve
France	Mercantour National Park
	Prospective Candidate PAN Parks
Greece	Dadia Forest Reserve
Hungary	Duna-Dráva National Park
Poland	Bialowieza National Park
	Biebrza National Park
Romania	Retezat National Park

Once the network will be created, i.e. the first labels are actually awarded, full promotion, marketing and communication, organised by the PAN Parks Organisation, will follow.

PAN Parks' objectives
The PAN Parks label intends to highlight large European protected areas with a minimum surface of 20 000 hectares, which are outstanding in terms of their natural values and management, as well as in their quality nature-orientated tourism products.

The PAN Parks Organisation is to lead to joint communication and marketing of these areas. The objective is to raise awareness and appreciation for European natural heritage and thus foster acceptance and financial and political support for conservation issues. Moreover the creation of sustainable tourism products should help regional economic development in the surroundings of the protected area.

The PAN Parks Organisation wishes to invite tourism businesses and other private sector organisations into the network as co-operating partners who then can use the label.

PAN Parks Certification
For a protected area to be certified by the PAN Parks Organisation, it must first undergo independent verification in accord with PAN Parks Principles and Criteria. A team of independent consultants will be appointed by the PAN Parks Organisation to carry out verification. A protected area must first submit an application form for verification to the PAN Parks Organisation, providing basic information such as management plans, and sustainable tourism development strategies. The independent verification body will perform a desk evaluation of the application form, and if deemed a quality applicant, will then visit the park and conduct field verification. The verification body will provide a report on the field verification to the PAN Parks Organisation, including a recommendation supporting or not supporting certification. The PAN Parks Organisation will certify a protected area based on the recommendation.

The PAN Parks Organisation is currently developing a verification manual, including checklist, which will outline regulations and steps to follow when conducting field-verification.

Principles to follow
Protected areas and partners wishing to receive the PAN Parks label have to follow 5 guiding Principles split up into further Criteria and Indicators, in summary:

Principle 1: Natural values

PAN Parks are large protected areas, representative of Europe's natural heritage and of international importance for wildlife and ecosystems.

Criterion 1.3
The minimum size of the protected area is 20 000 hectares.

Principle 2: Habitat management

Design and management of the PAN Park aims to maintain and, if necessary, restore the area's natural ecological processes and its biodiversity.

Criterion 2.3
The protected area has a management plan that is actively implemented. Regular monitoring and assessment of the plan are carried out and there is provision for updating and monitoring the plan in light of the results.

Criterion 2.5
If the protected area is zoned, there is an unfragmented core zone of at least 10 000 hectares where no extractive use is permitted and where the only management interventions are those aimed at maintaining or restoring natural ecological processes.

Criterion 2.6
If the protected area is not zoned, management of the whole area aims to maintain and, if necessary, restore key natural ecological processes.

Principle 3: Visitor management

Visitor management safeguards the natural values of the PAN Park and aims to provide visitors with a high-quality experience based on the appreciation of nature.

Criterion 3.1.
The protected area has a visitor management plan, which safeguards the natural values and is actively implemented. Regular monitoring and assessment of the plan are carried out and there is provision for updating and modifying the plan in light of the results.

Criterion 3.4
The protected area has a visitor centre, for which clear goals and a policy are set out in the visitor management plan.

Principle 4: Sustainable Tourism Development Strategy

The Protected Area Authority and its relevant partners in the PAN Parks region aim at achieving a synergy between nature conservation and sustainable tourism by developing and jointly implementing a Sustainable Tourism Development Strategy.

Criterion 4.2.
An Executive PAN Park Organisation (hereafter EPPO) or an existing forum for co-operation, which could assume responsibility for implementing PAN Parks, is established, whereby stakeholders formally confirm their support and commitment to the conservation goals of the protected area and PAN Parks Organisation.

Criterion 4.3.
The EPPO (or similar) formulates, implements and monitors a Sustainable Tourism Development Strategy (hereafter STDS) for the protected area and its surrounding region.

Principle 5: Business partners

PAN Parks' business partners as legal enterprises are committed to the goals of the protected area in their region and the PAN Parks Organisation, and actively cooperate with other stakeholders to effectively implement the region's Sustainable Tourism Development Strategy as developed by the local EPPO (see Principle 4).

Criterion 5.4
Business partners actively participate in the implementation of Sustainable Tourism Development Strategy as developed by EPPO and verified by PAN Parks Organisation.

PAN Parks and Europarc
The PAN Parks Organisation is currently investigating the possibility of using the Europarc Federation's "European Charter for Sustainable Tourism in Protected Areas" as part of its verification system. Both the PAN Parks Organisation and the Europarc Federation recognise the potential benefits fo joining efforts on sustainable tourism targeting European protected areas. An opportunity for co-operation also lays in setting common criteria for certification of local partners in and around protected areas. Talks between the organisations are ongoing following the autumn signature of a "Common Strategy under Parks for Life".

Target oriented approach
In order to establish a network of outstanding parks on the European scale, PAN Parks is following a target oriented approach: a protected area will be required to meet all Criteria set under the Principles before earning the PAN Parks label and the associated rights and obligations of certification. The Principles and Criteria set strict guidelines for member parks so to 1) guard the quality of the PAN Parks label; 2) establish long-term, committed partnerships between parks and communities; 3) preserve, restore and add economic value to European nature.

Earning PAN Parks certification requires serious commitment from a protected area and surrounding communities. The PAN Parks Organisation has hired regional co-ordinators tasked with working with Candidate PAN Parks and local communities to improve their conservation and

visitor management and sustainable tourism development so to meet the Principles and Criteria by 2006. (www.panparks.org)
If you have any questions on PAN Parks you can contact the regional co-ordinators

Case study - E-commerce pilot project in Bialowieza NP (PL)

Prospective Candidate PAN Park Bialowieza National Park was established in 1921 and covers 10 502 hectares. It is famous for its rich primeval forests and the reintroduction of the European Bison. The park gets nearly 100 000 visitors a year who visit educational facilities as The Bison Breeding Centre and the Museum and the strict reserve obligatory under guidance of a local guide.

In autumn 1999, 30 local stakeholders became local Candidate PAN Park partners of Bialowieza NP, and thus become actively involved in the park's sustainable tourism development. As candidate partners they have signed a contract which obliges them to support the set Principles and Criteria, to seek to full-fill them and to take part in the development of a shared sustainable tourism strategy. The contract includes a yearly fee to the PAN Parks Organisation. The candidate partners show their commitment by using the PAN Parks sign

The current e-commerce pilot project "PAN Parks E-Passport to Bialowieza" will help partners to profit from the network. A jointly developed website will advertise tourism sector services offered by the partners. Visitors have the opportunity to book accommodation and activities in advance and to get information on the region. Apart from the booking system, the website contains news, maps, and a regional calendar of events ongoing in the park. The overall goal of the project is to strengthen support amongst park authorities and local communities for the future certification of Bialowieza National Park as a PAN Park.

The website is found at www.poland.panparks.org. In the long term, PAN Parks wishes to develop websites for all certified PAN Parks and their partners.

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Presentation at the conference: The role of large herbivores in north-west European vegetation
By Jacob Andersen, President of Nepenthes.

In Denmark we have a century long tradition for preservation of nature. Preservation through preservation agreements (fredning) and in the last few decades also preservation secured by law. Many areas – mostly small areas have been preserved. They are lying around in the country as small Noah's arks trying to sustain the rich nature of the past.

We have been able to curb the replacement of nature by roads, urban areas, agriculture etc. – to some extent. And nature managers have in those preserved areas tried hard to stop time – to keep the area in one exact state. The natural dynamics is seen as an enemy towards achieving the preservation goals – keeping the area as a pasture, heath land or something else.

This strategy has helped a lot but not enough. Nature is still on retreat and the red data book has thousands of species – threatened by an increasingly intensive land use. To reverse the negative

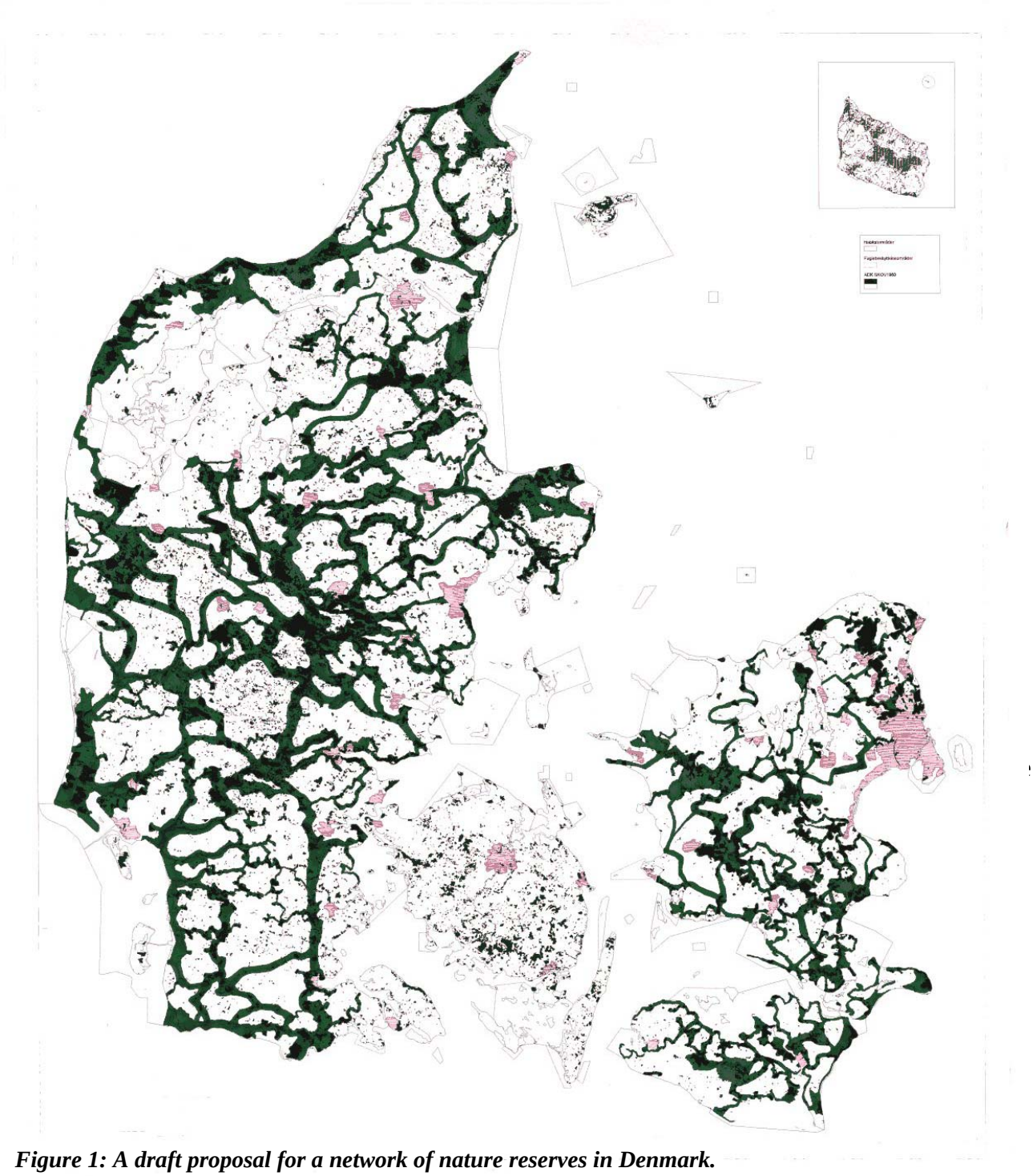

Figure 1: A draft proposal for a network of nature reserves in Denmark.

Nepenthes promote the idea of developing a network that includes all important nature areas and all types of nature – forests, wetlands, coastal areas etc. The core areas has to be so large that there is room for large grazing animals in sustainable populations – as well as natural processes such as forest fires, wind throws, natural hydrology, floods etc.

Our vision is that it should be possible to walk from Skagen to the border of Germany within a few generations.

Nepenthes has made this draft of a green network for Jylland and Sjælland. It is based on information about existing forest areas, areas set aside for afforestation, international nature protection areas, areas protected by the nature conservation act, military training grounds, bogs, infrastructure, towns, etc., etc.

The entire network is not untouched nature – far from. The network here includes core areas as well as a number of different zones. Not one zone as it appears on the map but several different zones ranging from large core areas with no forestry, limited hunting etc. to areas that are managed and used in a close-to-nature way.

Some may argue that it is not possible to create such an ambitious network. They may say that:

- the country is too densely populated,
- there is to many conflicting interests,
- there is not enough money available,
- or that it is not technically feasible.

In our opinion none of these objections are really valid. If they can do it in the Netherlands where the population density is more that 3 times higher – so can we. It is purely a question of prioritization and political will! Furthermore the population density varies a lot from region to region and that can be taken into consideration when planning the network.

It is true that a green network will be expensive but Denmark is one of the richest countries in the world and the bill will not have to be paid at one time – it can be paid over several decades. It can not be true that it is not technically feasible. When we can make a bridge from Sjælland to Fyn we can also make the necessary fauna passages and fences around high ways etc.

It is important for us to stress, that we see it as a priority for the whole society. This means that farmers and forest owners should not pay more to the project than other groups. With regard to ownership we see no problems in ownership staying private. Private land owners can become nature managers.

It is also important to stress that these new ideas about large nature reserves and a coherent green network in Denmark should not be seen as an alternative to the current standards of nature protection of nature types but as an extension and a strengthening of this.

Another important principle is that the public should have free access to the green network and the large reserves. As a general principle there should only be limited access to the areas included network where nature is particularly vulnerable.

The network should not stop at the border but extend into Germany and the rest of Europe. The network should be designed to match the network on the other side of the border so that it truly can be part of a pan-European green network.

Nepenthes see a national green network as a monument for the future generations with huge potential for great experiences with nature for the public in Denmark. Something that we can be proud of and a gift to nature and to the future generations.

Storvildt i dansk natur?
Om samspillet mellem store planteædere og vegetationen i nordvesteuropæisk natur.
Konference 5.-6. maj 2001, Geocenter, København.

Resumé af konferencens diskussioner

Af Jonna Odgaard, miljøjournalist

Lørdag den 5. maj 2001:
Fortidens skove var et mosaikpræget skovlandskab

Hvis man skal beskrive, hvordan Nordvesteuropas skove så ud i fortiden, er det allerførste, man skal gøre at skifte ordet skove ud med skovlandskaber.

For de forskere, der på konferencens første dag fremlagde deres viden om fortidens skove i Nordvesteuropa, var i store træk enige om, at de oprindelige skove i Nordvesteuropa ikke var tætte, lukkede højskove, men mosaik-landskaber af lukkede højskove, vådområder, enge med græsning og buskads.

Der var derimod ikke enighed om, hvilke faktorer, der havde størst betydning for skabelsen af dette mosaik-landskab: Om det var de store planteædere, skovbrande eller vådområder. Men der var enighed om, at alle disse faktorer har medvirket i større eller mindre grad, sammen med jordbundsforhold og klimatiske forhold til at skabe et varieret skovlandskab.

Frans Vera understregede, at vilde og tamme græssere har samme fødevalg og derfor samme funktion i skovlandskabet, så hvis husdyr erstatter vilde dyr i skovene, gør det ingen større forskel for skovene.

Adrian Lister mente derimod ikke, at tamkvæg kan spille samme rolle i skovlandskabet som eksempelvis uroksen, bla. fordi vilde dyr bevæger sig mere rundt i landskabet og derfor tillader regeneration af træerne.

Georg Peterken advarede - med henvisning til New Forest i England, hvor der ikke har været regeneration i 30 år pga. alt for mange planteædere - mod at ekstrapolere fra det, man ser ved græsning i dag og til fortiden, fordi der dengang var masser af fluktuation.
Han fremhævede, at England efter mund- og klovsygen står i den situation, at megen landbrugsjord må opgives og at dette kan give mulighed for at etablere græsningsskove (woodpastures), eksempelvis i nord-vest England, hvor der kan vise sig mulighed for at etablere nogle af de store, urørte (minumum intervention) områder. Jeg tror, de store, urørte områder kan have meget at tilbyde, men de skal evalueres nøje, understregede han.

Urban Emanuelson, WWF Sverige oplyste, at man i Sverige har stor folkelig opbakning til græsningsskovene og plejen af halv-kulturområderne. Folk er stolte af, at de genetableres, fordi de er en del af Sveriges historie.

Erik Buchwald, Skov- og Naturstyrelsen fremhævede, at vi ser meget på omkostnings-effektivitet, når det gælder biodiversitet. Er det sandt, at græsningsskove (woodpastures) som New Forest er "hot-spots" for biodiversitet, spurgte han.

George Peterken: New Forest er 3000 ha. Derfor er det ikke så mærkeligt, at biodiversiteten er høj. Der er mange rekorder. Men eksempelvis har vi p.t. et stort fald i bestandene af sommerfugle pga. for

høj græsningsintensitet. Jeg tror, at hvis man tager 100 ha stævningsskov og ændrer det til urørt skov, så vil man miste 50-60 procent af karplanterne. Så vil man ryge ned i artsantal før man på meget langt sigt går op igen. Men vi har det sådan, at hvis et område er stævningsskov, så forbliver det stævningsskov og hvis det er højskov, så forbliver det højskov.
George Peterken tegnede som optakt til den afsluttende debat en cirkel, der skulle beskrive udviklingen i et givent område: Fra græsningsområde over buskads til skov og videre til skov-sammenfald. Spørgsmålet er, sagde han, om der vil være elementer af stabilitet i systemet frem for konstant dynamik i en cyklus.

Björn Berglund, Lunds Universitet fremhævede, at klimaet for 10.000-8.000 år siden var meget tørrere end nu.

Frans Vera var enig i dette, men spørgsmålet er, om det ændrer min hypotese, sagde han. Han fremhævede, at han i udarbejdelsen af sin hypotese havde kigget meget på Europas ældste egeskove i Frankrig, dvs. et område, der har et varmere klima end i Nord-Europa.

Adrian Lister advarede mod en akademisk diskussion om, hvorvidt græsningsskove (woodpasture) var den oprindelige habitat. Det bliver en halv-naturlig habitat, fordi vi er, hvor vi er, dvs. under alle omstændigheder et helt andet sted end dengang, og det er OK, mente han.

Frans Vera mente ikke, at debatten om hvorvidt græsningsskoven er oprindelig kun er af akademisk interesse. Den er vigtigt, fordi genskabelse af græsningsskove vil skabe en masse modstand. Det her handler meget om politik, sagde han.

Urban Emanuelsson, WWF Sverige: Der er forskellige kulturer og forskellige forudsætninger i de forskellige lande. Vi har i Sverige hundredetusindevis af velholdte græsningsområder, som passes af landmænd. Vi har knækket kurven. Vi mener, at landmænd er det vigtigste redskab til at pleje græsningsskove (woodpastures). Vi mener, at EU's landbrugsstøtte kan bruges til at fremme denne type landbrug og derfor må vi stå sammen om at påvirke og give råd til EU's landbrugskommissær.

Frans Vera mente, at natur skal være så lidt "på støtten" som muligt, fordi naturen ellers bliver meget sårbar overfor skiftende politiske strømninger. På EU-plan ser jeg, at naturfredere mener, det er skidt at opgive landbruget i store områder, for så gror alt til i skov. Men det er forkert. Der er en tredie mulighed. Og lige nu er der store muligheder pga. mund- og klovsygen.

Michael Stoltze, DN: Vi ser ingen konflikt mellem den model, svenskerne har og den hollandske model. Vi har brug for støtte nu til naturbeskyttelse. Men i det lange løb er støtte ikke et gode. Vi har diskuteret det meget i Wilhjelm-udvalget. Diskussionen i dag er meget akademisk. Men vi må også arbejde praktisk.

Frans Vera: Jeg er enig. Vi kan sagtens betale landmændene for at sørge for græsning.

En deltager fra Lunds Universitet spurgte, om fortalerne for genindførelse af de store planteædere også vil reintroducere de rovdyr, der præderer på planteæderne.

Frans Vera påpegede, at det stadig diskuteres, om rovdyrene regulerer de store dyr. De store planteædere reguleres først og fremmest af adgangen til føde, påpegede han. Spørgsmålet er så, om vi vil acceptere, at de dør af sult i et givent naturområde.

Erik Buchwald, Skov- og Naturstyrelsen: Vi må lave nogle forsøg, hvor vi prøver det. Det vil også være cost-effective, fordi man i mindre områder godt kan have mange forskellige økosystemer. Og det vil befolkningen også gerne have. Vi synes, teorien er meget inspirerende og hjælper meget.

Peder Agger konkluderede den følgende dag lørdagens oplæg og diskussioner ved bla. at fastslå:
Danske skove er halv-natur. Og vi skal have flere planteædere i vore skove.

Søndag den 6. maj 2001:
Enighed om store, sammenhængede naturområder i Danmark

Sten Asbirk, Skov- og Naturstyrelsen oplyste, at styrelsen til Wilhjelm-udvalget foreslår 5 konkrete områder udlagt som store, sammenhængende naturområder. Det er områder, der repræsenterer fem forskellige, prioriterede naturtyper, nemlig:
1) Hede/klitter: Thy - 20.000 ha
2) Ovedrev/skov: Mols Bjerge - 6000 ha
3) Skov/søer: Gribskov - 7.400 ha
4) Marin ø-hav: Sydfynske ø-hav - 67.000 ha
5) Klippe/skov/overdrev: Møn - 3.000 ha
På længere sigt forestiller Skov- og Naturstyrelsen sig, at man også kunne udlægge følgende områder:
Mose/skov: Lille Vildmose
Skov/åer: Gudenåens kilder
Moser/enge/søer/vandløb: Åmosen
Tanken er, at udvikle forvaltningsplaner for de 5 områder.
4 af de 5 foreslåede områder indeholder store skovområder, som giver potentialet for store områder med urørt skov, store områder med hjemmehørende, store planteædere, ekstensiv drift og skift fra nål til løv.

Torben Klein understregede i sit indlæg, at Habitat-direktivet pålægger staterne at gøre en indsats for både arter og habitater, dvs. også reintroduktion af mistede arter.
Efter hans opfattelse vil restaurering af naturskov være ét af de vigtigste bidrag, danskerne kan yde til den globale biodiversitet. Men i den danske naturskovsstrategi er der ikke udlagt arealer til fri dynamik.
Efter hans vurdering er der i Danmark både økonomiske ressourcer og lovgivningsmæssigt rammer til at leve op til Habitat-direktivet, men der mangler lovgivningsmæssige rammer til reintroduktion af tabte arter.
Han påpegede, at vi i Danmark har et meget nyttepræget og antropocentrisk natursyn. Vi må gøre op med den opfattelse, at mennesker skaber naturen, sagde han. Den fremherskende natursyn, mente han, reducerer naturen til noget biologi, som vi skaber og vi omsætter naturkvalitet til videnskabelige tabeller.
Som kommentar til konferencens emne sagde han:
"The challenge is not to understand the history of nature, but to understand the nature of history".

Han mente, at én af de store udfordringer i forbindelse med etablering af store områder med fri dynamik - udover at skaffe penge - vil være at skaffe opbakning i befolkningen.
Jeg tror, arbejdet med befolkningens natursyn vil være den allervigtigste faktor, sagde han.
Under debatten understregede **Torben Klein** sine synspunkter med følgende spørgsmål:
Ønsker vi dynamisk og vild natur? Er vi rede til at acceptere naturens udvikling? Kan vi acceptere andre nøglearter end dem, vi selv placerer?

En deltager fra Ribe Amt påpegede, at reintroduktion af store planteædere kunne skabe konflikter med omgivelserne.

Torben Klein svarede: Der er ingen nemme løsninger. Dyrene vil komme i konflikt med trafikken, landbruget, borgerne, lodsejerne. Det vil kræve høj accept af lokalbefolkningen. Med mindre man indhegner området.

Hans Kampf påpegede i sit indlæg, at udsætning af store planteædere rejste en række dyrevelfærdsspørgsmål.

Bjarne Clausen, dyrlæge, Dyrenes Beskyttelse spurgte Hans Kampf: Kan du overbevise befolkningen om, at f.eks. en stor tyr ikke er farlig? Jeg tror ikke, det er muligt.
Bjarne Clausen henviste også til den aktuelle mund- og klovsyge og risikoen for smitte fra fritgående græsædere til husdyr. Kan du overbevise regeringen om, at I kan holde dyrene indenfor hegnet?

Hans Kampf svarede: Dyr er farlige. Men det er biler også. Og ridning. Folk i vore lande har glemt at leve sammen med de vilde dyr. Det skal de lære igen.
Både den hollandske regering og parlamentet er enige om vores naturplaner. For 10 år siden var der i Holland en masse avisskriverier om et dyr med sår. Men den offentlige debat om naturparkerne med dyr er meget mere positiv nu.
Folk i vore samfund bliver mere og mere bange, mente han. At få accepteret naturområder med fritlevende, store dyr er et spørgsmål om oplysning og uddannelse. Folk skal lære om fordelene ved det, og lære af egne erfaringer med det.

Frans Vera (til Bjarne Clausen)**:** Vi skal da overbevise regeringerne om, at dyrene er farlige. En tyr kan nemt veje 800 kg.
Og ja: Der er risiko for mund- og klovsyge. Vi lavede en øvelse for nogle år siden, hvor vi simulerede en situation med mund- og klovsyge. Resultatet af den øvelse var, at vi blev nødt til at udrydde de fritlevende dyr. Nu er situationen med mund- og klovesyge her.
Nu svarer vi: "Vi svarer ikke på hvad-nu spørgsmål".
Vi kan risikere, at al vort arbejde bliver udslettet af landbrugspolitikerne.
Danmark og UK har i relation til mund- og klovsyge gennemtvunget en ikke-vaccinationspolitik i EU. Den politik kan risikere at ødelægge alle planer om udsættelse af store planteædere. Mund- og klovsygen og risikoen for den, har enorm betydning.
Jan Gorter, Natuurmonomentum oplyste, at der i løbet af de 10 års arbejde med etableringen af et sammenhængende net af større naturområder i Holland var skabt stor opbakning til dette netværk, både politisk og i befolkningen. Græsning er blevet en institution i Holland, sagde han, det er ikke et emne, der diskuteres. Hans råd til Danmark lød: Prøv at etablere sådan et netværk. Det er et meget stærkt instrument.
Hvis I har brug for en partner fra et andet EU-land for at søge EU-midler til sådanne projekter, så stiller vi os gerne til rådighed, sagde han.

Alistar Bath understregede gang på gang i sit indlæg, at det altafgørende for, om planer med store, sammenhængede naturområder i fri dynamik og især udsætning af store planteædere skal få succes er, at det har accept og opbakning i befolkningen. Selv ikke den bedste forvaltningsplan kan bruges til noget, hvis folk ikke støtter projektet, sagde han og tilføjede: Og forvaltningsplanen skal vel at mærke skabes sammen med lokalbefolkningen. Det handler om at afgive magt fra forvalterne til offentligheden. Nøgleordene er troværdighed, ejerskab og partnerskab.
På basis af egen forskning og erfaringer sagde han: Vi kan ændre holdninger i kraft af følelser, men det holder ikke længe. Men ændrer vi holdninger i kraft af facts, så holder det.

Joep W. G. van de Vlasakker mente, at der i den europæiske befolkning er et stort ønske om og efterspørgsel efter vild natur (wilderness).

Jacob Andersen præsenterede Nepenthes' vision om et netværk af beskyttede områder fra Grenen til grænsen. Når vi kan få råd til at bygge Storebælts- og Øresundsbroerne, så burde vi også kunne få råd til at bygge bio-broer (faunapassager over veje), sagde han. Dette netværk af naturområder skal være en gave, et monument til os selv, vore gæster og fremtidige generationer, sagde han.

Michael Stoltze, DN: Jeg kan godt lide Nepenthes vision. I Wilhjelm-udvalget har vi drøftet fordobling af både skov- og naturområderne, dvs. svarende til 40 procent af landets areal. Men jeg tror ikke, vi behøver en overordnet plan for at forbinde naturområderne. Det vil ske alligevel.

Peder Agger, Naturrådet: Det skelet, vi skal 'hænge' mere natur op på, skal være vandløb og deres oplande og kysterne. Kysterne er meget vigtige. Og den måde at tænke på skal bruges både nationalt, regionalt og lokalt.

Bjarne Clausen, dyrlæge, Dyrenes Beskyttelse: Jeg vil ikke anbefale fritlevende kvæg i Danmark. Landbrugsindustrien vil være voldsomt imod. Hold jer til vilde dyr som krondyr. Ellers må områderne være indhegnet som i Vejlerne. Det går ikke med fritlevende kvæg i Danmark.
På spørgsmål fra Kim Carstensen, WWF om, hvorfor det kan lade sig gøre i Holland svarede Bjarne Clausen, at det må være fordi man i Holland har haft en lang udvikling med tab af natur og en lang udvikling af konceptet med fritlevende kvæg.
Han mente, at tamdyr, der slippes løs som vilde dyr i naturen, hurtigt ville begynde at opføre sig som vilde dyr. Hvorfor kan I ikke holde jer til vilde dyr, spurgte han.

Frans Vera bemærkede, at han var chokeret over Bjarne Clausens holdning. Han mente ikke, der var så store problemer i forhold til publikums sikkerhed ved at slippe tamkvæg løs som fritlevende dyr. Kvæg bliver hurtigt lige så sky som vilde dyr, dvs. de flygter fra publikum, sagde han.

Bjarne Clausen understregede, at hans advarsel mod at slippe tamkvæg løs var et godt råd. Vi er kun ved starten af dette koncept, sagde han. Vi vil få megen modstand mod planerne fra landbruget og fra dyrlæger. Jeg råder til, at man søger at få succes for konceptet ved at begynde med vilde dyr som krondyr.

Alistair Bath (til Bjarne Clausen): Når vi diskuterer biologisk videnskab, beder vi altid om beviser for påstande. Hvilke videnskabelige beviser har du for, at reaktionerne vil være så voldsomme? Lad os skaffe videnskabelige beviser for det.
(Til Jakob Andersen): Spørsmålet til lokalebefolkningen i forbindelse med dit netværk af naturområder skal ikke være: Hvor skal korridorerne være? Spørgsmålet skal være: Hvordan ønsker du, landskabet skal være? Du skal sige: Jeg vil gerne kunne gå fra den ene ende af landet til den anden i naturområder. Jeg vil gerne se dyr. Du skal udpege kærne-værdier og så få dem diskuteret, få folks reaktioner på dem.

Martin Schneekloth: Tror ikke på Michael Stoltzes påstand om, at et sammenhængende netværk vil opstå af sig selv. Tror mere på Peder Aggers 'skelet-model'.

Joep W. G. van de Vlasakker: Nøgle-elementet til offentlig accept af områderne er gode model-projekter at vise frem for folk. Et af områderne i Holland er specielt populært, fordi der er en restaurant. Det er ikke særligt stort, men overskueligt. Her kan vi overbevise og undervise folk.
Vi har også haft stor modstand i Holland. Den hollandske historie handler jo om, at vi i århundreder har tæmmet vandet, floderne. Da vi slap floderne løs, var der også voldsomme protester. Men folk opdagede, at vi bedre kan styre en fritløbende flod.

Søren Ibsen (til Bjarne Clausen): Jeg tror, det er en refleks-handling hos danskerne, at vi skal kontrollere naturen. Jeg synes, vi skulle slippe kvæget løs og tage debatten med landbruget offentligt.

Tommy Dybbro, WWF: Vi må huske, at hver gang en ny naturbeskyttelseside kommer op, vækker den en masse modstand. For 10 år siden var der modstand mod urørt skov. Nu har vi en plan, som siger 10 procent urørt skov på sigt. Jeg vil da gerne præsentere Nepenthes vision i Wilhjelm-udvalget som et diskussionsoplæg.

Hans Kampf: Det er vigtigt at have en vision og en drøm. Pyt med problemerne. Hver ulempe har sine fordele. Vær ikke bange for problemer. Visioner kan skabe debat og opmærksomhed.

Jacob Andersen: Det ville være oplagt at lave en 'demonstrations-model' i Lille Vildmose og skabe forbindelse herfra til Rold Skov.

Peder Agger sagde i sin afsluttende resumé bla:
Torben Klein stillede spørgsmålet: Ønsker vi virkelig vild natur på dens egne præmisser?
Sten Asbirk støtter etablering af store naturområder og indførelse af nøgle-arter som kronhjort, bæver og - vil jeg tilføje for egen regning skarven.
Hans Kampf påpegede, at vi har brug for stor-skala eksperimenter.
Poul Hald pegede på, at er var forkert, at Oxbøl-området ikke er med på listen over mulige store, sammenhængende naturområder.
Jan Gorter skabte nysgerrighed efter at vide, hvordan organisationen Natuurmonumenten er vokset så dramatisk i medlemstal og har fået så stor en folkelig appel.
Hans oplæg gav også anledning til at overveje, om vi skal til at fjerne sommerhuse og hegn i naturområderne.
Nepenthes vision er jeg stort set enig i.

Peder Agger afsluttede konferencen med følgende konklusion:
Det er vigtigt at have en vision. Det er vigtigt at tænke langsigtet og at tænke stort.