Landscapes as Commons: Afforestation and the aesthetics of landscapes

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Abstract

Afforestation can change a landscape distinctively, partly due to the choice of tree species, partly due to the design of forest stands. Visible changes in a landscape can have a strong emotional effect on people as the main part of our perception of landscape occurs through the sense of sight. Furthermore, the contact to nature can be considered as a basic need of human beings. Landscapes and the aesthetics of landscapes should therefore be considered as valuable commons, and forest managers and landscape designers should be aware of their influence.
In this paper, afforestation is used as an example for cross-scale interactions of different interests, because afforestation activities in most countries are driven by many other than scenic aspects. An Icelandic study shows how interests of forestry and land reclamation could be combined with the interests of people in the beauty of the landscape. Due to radical deforestation in the first centuries of the settlement, Iceland has lost most of its forests, and people are generally used to the open landscape. For this reason, it is important to act sensitively when establishing the new forests that are highly needed in order to fight the ongoing soil erosion. Especially the exotic evergreen trees used in Icelandic afforestation programmes change the appearance of the Icelandic landscape. They catch the viewer's eye in winter time when the landscape is mostly brown during the absence of snow cover. A study on soil properties did not reveal major effects of tree species. Therefore, it is suggested that forest managers could neglect the effects on soil properties and base their decisions about the choice of trees species primarily on people's preferences.

Keywords: *afforestation, Iceland, landscape aesthetics, sensation, visual landscape management*

Introduction

Studies have shown that nature experiences can have a positive impact on people's social, mental and physical health (Kaplan and Kaplan 1998; de Vries et al. 2003). Therefore, landscape quality has gained increasing interest of decisions makers and the public. In this context, forests play a crucial role as they are outstanding landscape elements. The presence – or absence - of forests and the overall forest design has a great influence on the aesthetic perception of the scenery by people. As people tend to judge things on the basis of what they can see as much as or more that on what they know, the visual management of landscapes and the public perception of forests have attracted attention of forest managers and decision makers (e.g. Bell 2001; Tahvanainen et al. 2001; Zandersen et al. 2007). An increasing focus of forest managers on landscape quality and related recreational forest functions is also due to a general change in forest management. Timber production is no longer the main goal, and many timber-dependent communities

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have to find alternative income and benefits that can be gained from forests. This has resulted in a multifunctional use of forests with the aim to combine economic concerns with aspects of ecology, conversation and recreation (Farrell et al. 2000). It is suggested that landscape quality is considered as part of this.

Landscape quality as commons

The positive effect on our lives makes landscape quality it to an important resource that should be managed sustainably. The difficulty hereby is that scenic beauty is not owned by anybody, and that it is hard to put a price on it in order to regulate its exploration. Many decisions in landscape planning are based upon aspects that have little to do with aesthetic questions. Changes in the landscape may or may not be intended, and scenic beauty can be lost to the advantage of economic gain or even ecological aspects. In the management of global commons, it has been acknowledged that social norms, economic incentives and ecological processes have to be considered equally in order to achieve a sustainable management (Folke 2007). Afforestation is a good example for this kind of cross-scale interaction. The location of new forests and the choice of tree species are typically based on either ecological, social or economical decisions, but the assessments of the effects has to consider interactions as well. In addition to this, and independent of the overall goal, the planning and evaluation of forest establishment should always include visual changes and possible impacts on landscape quality. In a world that puts more and more pressure on available land resources to fulfil needs of food production, housings and transport, it is important to maintain landscape quality where possible in order to ensure its positive impact on our lives. The visual aesthetic quality of landscapes should therefore be considered as a valuable common. Forest management and especially afforestation activities can, when carried out in the right way, be a powerful tool to manage landscape quality.

Aesthetics, understanding and sensation

The definition of aesthetics reaches back to the early explanation of *veritas aestetica* as opposed to *veritas logica* given by Baumgartner in his *Aesthetica* (1750). From the 18th century onwards, with the development of modern sciences, nature becomes more and more object, judged upon purpose and technical use. This cumulates in Kant's transcendental philosophy and the view that man creates his surrounding world simultaneously with the development of his cognitive faculties. The Danish Philosopher Løgstrup (1905-1981) settled with Kant's transcendental philosophy. As a Phenomenologist, Løgstrup tried to identify the human phenomena and attributes which existed before we ourselves came into being and which impose their conditions on man. With other words, the universe is – despite all the knowledge that we have achieved – still the source of our lives. Løgstrup defines the human consciousness as being part understanding and part sensation (not perception). Sensation is something that describes our lack of distance to our surroundings. In contrast, it is understanding that creates our material needs and thereby places us in a distance to nature. This gives us the ability to make tools to satisfy these needs. The negative side is that these tools and mechanisms can bring our existence in danger (Løgstrup 1984). Sensation can be the factor to fend off this danger. Løgstrup claims that the importance of sensation is ignored in the modern western culture, and that the development of further tools has not ceased, although our basic needs have been satisfied. He questions if it is right that we reject the idea that natures should exist for its own sake and that the duty of human beings is to take care of nature for nature's sake only (Løgstrup 1984). Løgstrup was one of the

philosophers that first drew attention to the fact that the ongoing use of resources and material goods, necessary to maintain the modern way of life, is connected to expenses that cannot be defined in terms of money. These expenses are ignored for a long time, and only gradually accepted when they reveal a direct or indirect monetary value. (Madsen and Werner 1990).
In contrast to Løgstrup's assumption, that landscape unlike health and the environment is not related to monetary values and hence not considered in the assessment of the use of resources, the current development in landscape management has shown that landscape quality indeed can be related to expenses – mainly through an impact on recreational functions, human health and well-being, ecology or conservation. Perhaps a part of this impact can be attributed to the importance of sensation in our lives. Therefore, it may be worthwhile reflecting on Løgstrup's idea of the importance of sensation as part of our consciousness and thus considering landscape aesthetics as something important; not because of possible indirect economic impacts, but simply because landscape aesthetics appeal to sensation and may help remove our distance to nature again. If this is the case, it would concern anybody's life, and landscape quality should therefore be treated and managed as a common resource, equal to common resources that satisfy our material needs.
This paper wants to elaborate why it is important to consider visual landscape quality as a common value. It is discussed how afforestation contributes to a change in the landscape, and how decisions in forest management could be combined with people's perceptions of landscapes. A case study from Iceland is used to shows how ecological decisions on the choice of tree species could be combined with the public attitude towards trees in a formerly almost completely deforested land.

1. Afforestation in Europe

Forest management in Europe has become multifunctional: In addition to the economic concerns of timber production, other aspects and benefits of forests have gained increasing interest (Piussi and Farrel 2000). The positive effect of forests on human health and well-being is now widely accepted and has led to a strengthening of the recreational use of forests (Hill and Courtney 2006). Forests and forest related services can contribute to the development of rural societies (Elands and Wiersum 2003). The concern about increasing carbon dioxide (CO_2) concentrations in the atmosphere has put focus on the possibilities of carbon sequestration in forests (Nijnik and Bizikova 2008). Other environmental functions of forests include the protection of water, soil, biodiversity, and the conservation of natural heritage. Hence, the concept of forest management comprises concerns about economy as well as ecology, conservation and recreation. The achievement of these different goals can be challenged by diverse ideas of forest managers and policy makers or the public opinion about forestry. The growing concerns about the coherence between forest policies and forest related activities have, for EU Member States, resulted in the EU Forest Action Plan that was adopted in 2006. The Action Plan puts focus on the ecological and socio-economic aims of forest management. Its four main objectives are (1) to improve long-term competitiveness; (2) to improve and protect the environment; (3) to contribute to the quality of life; and (4) to foster coordination and communication. (European Commission) In addition to this have several European countries developed their own forest programmes and strategies [e.g. Miljøministeriet 2002). A central part of these forest programmes is the decision

to enhance afforestation activities. This decision is based upon the expected multiple benefits from forests and forest related services. Another point is that agricultural land use has become less favorable for farmers in the European Union due to the reduction in agricultural subsidies, stricter environmental regulations, and generally low food prices on the world market. Until recently, the trend was to convert agricultural land to forests. However, if this trend will continue under the current development in world food prices and the ongoing discussion of using crops as bio fuels is uncertain.

Afforestation activities

Forest cover differs widely among European countries, and even within one country it can differ from one region to another. The four most forested countries are Finland (86% of the total land is forest), Sweden (57% of the total land is forest) and Austria (47% of the total land is forest). At the other end of the scale is Denmark with little more than 11%, the United Kingdom (11%), The Netherlands (9%) and Ireland (8%). Iceland has less than 2% forest cover and is the least forested country of Europe. Consequently, afforestation activities vary between these countries, and also their socio-economic and ecological impact is different.

The state of European forest cover is highly human induced, a result of clearances that started with the development of agriculture in the Neolithic Period. Throughout history, most European counties have experienced periods of high deforestation, and in some countries this has resulted in an almost complete removal of the forest cover. However, deforestation is mostly followed by afforestation activities at some point in time. The passage from deforestation or forest shrinkage to afforestation has been described as forest transition, and the turning point when the trend reverses and forest cover again increases again, as the forest transition point (Mather and Needle 1998). The forest transition point differs between countries and can be associated with different factors, where issues like agricultural reforms, rural exodus and urbanization, wood scarcity and evolving land use policies often play an important role. The Nordic countries provide different examples of forest transition. In Sweden and Finland, where forest-based industries are key economic activities, the primary aim of current afforestation programmes is to release land from less productive agriculture. Norway has a substantial forest cover, but e.g. in regions on the West coast significant forest transition has taken place in recent history. Extensive areas were afforested during the post war period with the aim of rural development (Petursson and Ritter 2007). In Denmark, the forest transition point was reached in 1805 when the forest cover was about 2-3%. The first official afforestation activities were initiated and forest cover increased successfully. In 1989, a governmental resolution was signed with the aim to double Denmark's forest cover within the next tree generation (80-100 years) to about 20-25%. (Miljøministeriet 2002). Iceland started afforestation activities as late as in the beginning of the last century and went through the transition point as late in the 1990s. The aim of the government is to increase the present forest cover to at least 5% in the lowland areas.

Effects of afforestation

Effects of afforestation are manifold. They can be related to ecological, social or economical concerns, as indicated above. Afforestation contributes to carbon sequestration in biomass and the soil of the forest stands or to changes in other soil properties, like soil pH, nutrient content and availability and mychorrizal communities (Jug et al. 1999; Vesterdal et al. 2002; Hagen-Thorn et al. 2004; Kahle et al. 2005).

Changes in water fluxes are discussed as well as the effect of afforestation on water quality, especially the leaching of nitrate (Bastrup-Birk and Gundersen 2004). Biodiversity of forests depends highly on forest management practices that influence the light regime in the forest, the structure of the forest, the choice of tree species, etc. (Spiecker 2003). Direct economical effects are often related to wood production and employment in timber industries. Also the production of non-wood products including the traditional collection of mushrooms and berries, have gained renewed interest (Pouta et al. 2006; Palacin et al. 2008). In addition to these direct effects, other services, e.g. the tourist business, profit indirectly from forest establishment. The presence of the forests may attract visitors or settlers and creates the need of certain services, which in turn contribute to the development of rural areas (Illeris 2005). Another indirect effect can be the improvement of the local infrastructure. Roads, originally built for forest industry purposes, make rural areas more accessible, attract visitors or encourage people to live in the countryside and commute to their work in town.

Whatever the major interest is for increasing the forest cover, there is a basic decision that has to be made. It is the choice of tree species and the way of planting the trees. Historically, the choice of tree species is based upon the need of timber as building material and fuel, i.e. fast growing and productive tree species were preferred. From the end of the 13th century and more extensively during the last 200 years, conifers have been used in forest management. This has resulted in a widespread establishment of monocultures of coniferous forests (Burschel and Huss 1997). Spruce is growing faster than many broadleaved species, rotation length is shorter, and the timber is attractive for many purposes. However, this economically based decision has already shown a negative side. Many of the coniferous stands are located on sites naturally dominated by broadleaved tree species, and the conifers revealed a higher susceptibility to storm fall, attacks of fungi and insects, and a higher mortality under drought. Bark beetle attacks have became a widespread problem in European forests (Wermelinger 2004). The risk for storm fall is generally higher for e.g. spruce than for beech (Schütz et al. 2006). The last catastrophic storm fall in December 1999 caused more than 190 million m^3 of storm damage in Western Europe (Drouineau et al. 2000). Learned from these lessons, the choice of tree species in afforestation activities is no longer only based on short-term economic profit. Ecological and environmental processes have come into focus, such as the effect of tree species on C sequestration, soil acidification and biodiversity (e.g. Oostra et al. 2006; Barbier et al. 2008). A mixed, uneven-aged forest offers more different habitats to other plants and animals than an even-aged monoculture. This is not only of importance for red list species, but has also for the impact on forest amenity values and hence the attraction of forests to visitors. It has been stated that the aesthetic experience of landscapes has an impact on people's mental and emotional state (Kaplan and Kaplan 1989). Many forest managers have reconsidered the choice of tree species in their management plans and more often decide to plant native tree species (e.g. Mason 2007)

The choice of tree species is an important decision of forest managers. It has also an impact on the landscape's visual quality. However, together with the location of the forests stands in the landscape, the visual impact of tree species is seldom considered in depth in the discussion of afforestation activities or forest management in general. The evaluation of landscape quality should become a natural part of forest management and the planning of afforestation activities.

2. Landscape Quality

The evaluation of landscapes quality is typically based on visible features, also described as the landscape's *scenic beauty* or simply *visual quality* (Daniel 2001). Daniel (2001) argues that the target of these evaluations could best be termed the assessment of the *visual aesthetic quality* of a landscape. They would typically not include the assessment of utilitarian values, e.g. forests for timber or shelter and seldom the direct evaluation of other biophysical analyses such as sounds, smells or touches. Lothian (1999) suggests furthermore, that the scientific assessment and classification of landscape quality can be carried according to two paradigms; the objectivist (physical) paradigm assumes that the quality of landscapes is an intrinsic attribute, while the subjectivist (psychological) paradigm considers it as a human construct. Also these approaches are based on the visual appearance of the landscapes – one is '*viewing beauty in the physical scene in front of one's eyes*', the other paradigm '*judges beauty from the interpretation by the mind behind the eyes*' (Lothian 1999). Since forests are outstanding landscapes elements, because of their height compared to other vegetation cover, they have a distinct impact on landscape quality. It is therefore important that forest managers and landscape designers consider public perceptions of landscapes in their work and aim to create a positive and aesthetic landscape picture. In recent years, landscape planning has more and more made use of different methods of visualization via computer simulation or photographs to evaluate the impact of forest management methods on the perception of people (e.g. Karjalainen and Tyrväinen 2002; Ribe 2005).

Landscape perceptions and preferences

The perception of landscape quality can be traced back to the 14th century, when *Petrarca* decided to scale Mount Ventoux in 1335. His only motivation was to find out how it looked like from the top of the mountain. Ritter (1963) argues in his essay *Landscape*, that *Petrarca's* decision to climb the mountain becomes epoch-making as he is the first known man of modern times who gets in contact with nature in a way that has nothing to do with knowledge or examination. *Petrarca* perceives and enjoys the scenic beauty of the landscape lying in front of his eyes without any practical purpose. This was completely different to the way local peasants perceived their surroundings. Nature was part of their working lives, it had a practical purpose and was evaluated as either useful or useless; the forests for timber, the soil for agriculture, and the rivers for fishing. Ritter (1963) climes that nature becomes landscape for those who go into nature without judging its utility values, who want to be like nature and become part of it. *Petrarca's* ascent of the mountain is therefore constitutive for our aesthetic relationship to nature as landscape.

The idea of being part of the nature in which we walk reminds of the idea of 'lack of distance' that Løstrup describes with sensation. At the same time, Løgstrup says that it is understanding that interprets what is sensed and thereby creates a distance that can influence nature negatively. However, understanding can also help us having a positive influence on landscapes. This is seen in the fact that landscape perception is influenced by education (knowledge) about the benefits of a certain management practice. Studies have shown that preferences of certain visual impacts on landscapes, e.g. by different harvesting techniques in forest management, can be influenced by information about their benefits. While the public tends to prefer dispersed individual tree retention, resulting in a more fragmented landscape, to aggregated harvest blocks, the acceptance of the less fragmented harvest blocks was shown to increase after informing the people about ecological benefits of this

harvesting method (Meitner et al. 2005). Differences in preferences seem to be a function of differences in how people interpret the scene. While professionals interpret the landscape in terms of management, other groups may respond to the aesthetics of the scene or processes perceived to be damaging to the landscape (Bradley and Kearney 2007). Another important point is the conflict between intended changes in the landscape and traditional public ideas about how a landscape should look like, i.e. the socio-cultural environment and history of the people (Tarrant and Cordell 2002).

Afforestation and visual landscape management

The visual landscape must be considered as one of the major realms where the work of forest planners, designers, and managers directly interacts with public perceptions and expectations (Bell 2001). Crowe (1978) developed guidelines for landscape design in British forestry in which she recommended adjusting afforestation and forest design to landscape features in order to achieve a balance between function and beauty of landscapes. Although her principles have allegedly been adopted by the Forestry Commission policy on landscape design, negative and daunting examples of forest design can still be found in Britain – as much as elsewhere. Afforestation activities in most countries have until recently mainly been driven by other than scenic aspects, and aims such as soil reclamation and timber production will possibly always stay in the first place. However, forest managers have started to consider the effect of forest use and management strategies on landscape aesthetics, and slowly more focus has been put on the effect of visual change in landscapes caused by afforestation (Jensen, F.S. 1993; Tahvanainen et al. 2001). Hence, while the value of forests is traditionally related to their utility value, the importance of scenic beauty and the amenity values of forests have come into focus. Forest managers can change a landscape by two major actions: the arrangement of the forests stands in the landscape and the choice of tree species. The location of forest stands can be described with respect to topographic features and with respect to each other. In hilly or mountainous areas, the location of forests with respect to the elevation determines the overall visual impression of a landscape. Given the same topography, forests can be found either on the top of the hills, on hill slopes, or in valleys. Often, poor soils or bad accessibility has resulted in remnant forest patches (Forman 1995) on tops of hills, while the valleys are subject to agriculture with little more than hedgerows or groves. In other regions, forest may stretch along the foot of the hill, while the top plateau is left to pasture and grazing. Similarly, afforestation can result in landscapes that are characterised by, e.g. forest covered hills and open valleys; forest covered valley slopes and open plateaus; or forest covered and open hills next to each other or forest covered valley bottoms (Cowe 1978).

Another visual feature of landscapes is its degree of fragmentation, and also here forests play an important role. Fragmentation has become an important subject in landscape ecology (Forman 1995). It may cause the loss of connectivity between landscape elements or reduce larger connected areas that are important for certain species that prefer the forest interior to its edges. However, the eye of the human being perceives a fragmented landscape as attractive and friendly, and forest managers should carefully consider these conflicting interests in their management methods (Meitner et al. 2005). In many plantations, forest stands are arranged in rectangular forms. The regular forms are often advantages in the management and application of machines, but irregular patches will be perceived as more ‘natural’ by

people. The reason for this is that straight lines are immediately caught by the eye and are mostly related to non-natural structures. They should be avoided both during planting, but also during felling. Large rectangular clear cuts on visible slopes are as undesirable as the planting of trees in linear rows that point downhill towards the viewer on the foot of a hill. The latter is made even worse when species of different colour are planted next to each other. Fortunately, many of these mistakes of the past can be removed by the right application of felling (Bell 2001).
A visual effect strongly determined by the choice of tree species is the colour of the forests throughout the year. Differences between tree species are most obvious outside the summer season, i.e. during autumn, winter and spring. While deciduous trees, including the coniferous larch, contribute to a change in colour, evergreen trees have the advantage of keeping the landscape green even in winter. Evergreen trees represent a continuity that may be appreciated by some people as much as the change in leaf colour is by others. The right choice of tree species can also contribute to deliberate contrasts or smooth transition in the landscape. Dark conifers can give depth and contrast, or light coloured species may smooth the transition between conifer plantations and softer, unplanted hillside (Cowe 1978). In contrast to urban forestry or horticulture, this visual effect is seldom used deliberately in forestry and landscape management.
Numerous studies have investigated the effect of forest management on soil properties, rural development, forest aesthetics and public preferences. A recently finished project has summarised these different effects of afforestation for the Nordic countries (Halldorsson et al. 2008). However, little has been done on combining results of different studies. While the same afforestation strategy could be positive in terms of soil amelioration, it could be negative for recreational aspects or vice versa. It would be helpful to investigate if forest management methods can be combined with the visual management of the landscape. Under the assumption that ecological quality as well as the visual beauty of a landscape will gain society and therefore should be considered as commons, interdisciplinary studies could help improve the use of landscapes as commons. In the last part of this paper, a first approach to this idea is given by relating the results of a study of the effects of afforestation on soil properties to the results of a survey on people's attitudes to and preferences of forests in Iceland.

3. Ecological interests and visual impact of afforestation in Iceland

In the following, an example from Iceland is discussed that may show how ecological and visual concerns about afforestation activities can be merged. In the Icelandic afforestation debate the visual impact of tree species on the landscape and their invisible impact on soil properties are seldom combined. However, an unwanted forest picture may influence the public opinion negatively and hamper the establishment of more forests, although afforestation is highly needed for soil protection. This part should shed light on the possibility of a multipurpose judgment of afforestation plans by combining considerations about tree species with respect to their influence on soil properties and their acceptance by people, respectively. The example is based on two independent studies: an investigation of changes in soil properties after afforestation (Ritter 2007; Ritter, unpublished data) and a survey on the public opinion about forests (IMG Gallup 2004). By linking the information of both studies, it is aimed to obtain helpful knowledge for the decision making processes in afforestation in Iceland.

Afforestation in Iceland
Iceland is known for its open landscape. Hardly any vegetation blocks the view. There is little vegetation in the first place (ca. 25% of the land area), and even less high enough to be a true obstacle for the viewer. Most of the native birch (*Betula pubescens)* forests are tucked away along the feet of mountains or in valleys. These birch forests cover ca. 1.2% of the land area (Sigurdsson et al. 2005), but only ca. 2% of them reach a height of 8 to 12 m (Blöndal 1987). However, afforestation takes place in Iceland and adds another ca. 0.3% to the country's forest cover (Sigurdsson et al. 2005). The major motivation for afforestation activities in Iceland has been the reclamation of highly degraded soils. Since human settlement in 874, deforestation has enhanced soil erosion and resulted in severe loss of fertile soil. It is estimated that soil erosion so far has caused a loss of 120 to 500 x 10^6 Mg soil organic carbon (C), and that the current loss is about 50-100 x 10^3 Mg C yr^{-1} (Óskarsson et al. 2004). To fight the ongoing desertification and to restore damaged ecosystems, afforestation was started slowly in the first two decades of the last century. Since then, afforestation has become a central tool for land reclamation and an important political subject.
About 80% of the afforestation is carried out by farmers in cooperation with state-run Regional Afforestation Projects, while the remaining 20% is by forestry societies, individuals and state agencies (Gunnarson 2004). Afforestation areas have increased with ca. 215 km^2 since 1990 to a total area of 289 km^2 in 2005 according to estimates from the number of seedlings planted annually (Sigurdsson et al. 2005). Hence, the face of the landscape is changing gradually. This is not only due to the increase in forest cover, but also because of the introduction of exotic tree species. That there is only one native forest forming tree species on Iceland, namely birch, does not mean that other trees cannot survive in this country. Rather, the geographical isolation of the island hampered the migration of new species after the ice age. In fact, almost 80% of afforestation has been based on introduced species during the last years (Gunnarsson 2006). They are used for wood production, recreation, horticulture or shelterbelts (Blöndal 1987). The remaining part of the annually planted trees is made up by the native birch. Birch forests are mainly of interest for summer house areas. It is especially the use of evergreen trees that change the appearance of the Icelandic landscape since they catch the viewer's eye in winter time when, during the absence of snow cover, the landscape is mostly brown.

Ecological considerations
Afforestation in Iceland has to face many problems. In addition to the harsh climate, the major difficulty for tree growth in Iceland is the nutrient limitation in the degraded, volcanic soils. Weathering of volcanic ash leads to the formation of amorphous materials. Most soil phosphorus (P) reacts rapidly with these weathering products, forms insoluble metal-phosphorus compounds or is converted to physically stable organic forms (Walker and Syers 1976). Availability of P is therefore likely to decrease as weathering proceeds, and P is typically the growth-limiting element even in young Andosols of unfertilized ecosystems (Shoji et al. 1993). Also nitrogen (N) is yield limiting in volcanic soils; although Andosols are characterised by a high accumulation of organic C and N in organic matter, an important source for these nutrients, it was found that organic N is fairly resistant to microbial decomposition and the release of inorganic N is low (Saito 1990, in Poudel and West 1999). Atmospheric N deposition in Iceland is much lower than in other areas due to the

remote location of the country with a low population density. Annual wet N deposition is typically less than 1 kg N ha^{-1} yr^{-1} (Kleemola and Forsius 2006). Hence, N and P availability is reduced, and trees planted on andic soils are prone to suffer of P and N deficiency. While the nutrient supply of young seedlings during the early phase of forest establishment is improved by fertilization during planting (Óskarsson and Sigurgeirsson 2001), application of fertilizers in later phases of afforestation is usually not practiced in Iceland. It is therefore of high interest to understand natural changes in nutrient pools and nutrient availability with time after afforestation and to include the effects on nutrient supply to the maturing trees in the long-term planning of afforestation activities.

Changes in soil properties after afforestation

The aim of the soil study carried out by Ritter (2207) was to obtain knowledge of changes in soil nutrients after afforestation with two of the most used tree species in Iceland, birch and larch. Results should contribute to the decision on which kind of tree species should preferably be used for future afforestation activities with the major aim of soil reclamation. The chronosequence study was carried out in one of the largest forest areas in Iceland, Fljótsdalshérad in east Iceland (14˚44'W, 65˚5'N).The study plots comprise two stands of native birch (*Betula pubescens*) and four stands of introduced Siberian larch (*Larix sibirica*). The forest stands were between 14 and 97 years old, and a plot of a treeless heathland represented the initial nutrient status in the soils. Soils were Andosols derived from basaltic material and rhyolitic volcanic ash. Investigations included among others changes in total C, N and P as well as soil base cations and available P in soil (0-10 and 10-20 cm depth). For further description see Ritter (2007).

An effect of time after afforestation was only found for some of the soil nutrients investigated, and results did not support a clear difference between tree species. Changes in soil C were less obvious than expected and did not support the hypothesis of a significant change in soil C within the time span of this chronosequence. The only significant effect was higher soil C concentrations in 0-10 cm depth in forest stands older than 30 years (Ritter 2007). This was attributed to a slow accumulation of organic matter. Soil C stocks changed less on an annual basis than reported for reclamation of degraded soils with grasses. However, the forest soils had already been on a moderate C level prior to forest establishment compared to other Icelandic Andosols, and changes may therefore be less pronounced. Total N, total P and the base cation potassium (K) were not affected by stand age in either soil depth (Ritter 2007, Ritter unpublished data). The lack of change in soil N despite the low N deposition and the uptake and accumulation of soil N in standing biomass in the older forest stands may be explained by an improved N availability of the present N pools. It is suggested that uptake of N and P from organic matter by plant roots is enhanced by ectomycorrhizal fungi that were present in the forest stands. The only significant changes in soil nutrients were found for soluble P and the soil base cations calcium (Ca), magnesium (Mg) and natrium (Na) (Ritter, unpublished data). Soluble P increased with stand age in the top 10 cm of the mineral soil, indicating an improving P availability. The base cations Ca and Mg decreased with time in both soils layers, Na only in the upper soil layer. The latter may be caused by a tendency of a decrease in soil pH found in the stands, while an increase in soluble P was attributed to the role of mychorrizal fungi in organic and inorganic transformations of P compounds. An effect of tree species was only found for K, with birch stands having significantly higher values, and indicated for Mg with higher

values for larch. The other nutrients did not clearly confirm an effect of tree species on soil nutrients. A study comprising more plots of both tree species at similar stand ages is suggested to confirm or exclude the lack of an effect of tree species on soil parameters.

People's perception of forests in Iceland

The major aspect for afforestation in Iceland is the reclamation of eroded or degraded soil areas and the amelioration of soil properties, namely the content of soil organic carbon (Arnalds 2005). These invisible, subsurface, changes in the landscape caused by afforestation must be considered crucial. They determine the sustainability of the soils, and this alone should be reason enough to support afforestation activities. Nevertheless, the acceptance of afforestation by the people is highly dependent on their acceptance of the visual change in the landscape, as aesthetic experience has an impact on their mental and emotional state (Kaplan and Kaplan 1989). If a tree species is very suitable for the desired change in soil properties, but not appreciated in the landscape picture, an extensive use of this tree would only influence the general attitude towards afforestation negatively. In Iceland, where trees and forests had literally been erased from the landscape, it is therefore important to act sensitively when establishing new forests. For example, while the boreal regions are naturally dominated by monocultures of conifer trees, their presence is alien in Iceland. An introduction means a great change in the landscape, especially in winter. In Iceland, 25% of the vegetation is grassland that turns brown at the end of the summer. Planting evergreen conifer trees brings patches of green into the landscape that contrast highly with the matrix. Although well adapted to the climate, these alien tree species should be planted with care in terms of design and placement of forest stands. Forest managers should take into account the view and aesthetic of the landscape - and hence the perception of the people. The right choice of tree species and thus colours can help accentuate landforms and support interesting landscape features. In contrast, a bad arrangement of different coloured trees, e.g. planted in strips within a forest stand or as clear blocks of different colours, can give a very artificial picture and will be perceived negatively by people. In 2004, a survey was carried out among the Icelandic population on their attitudes towards forests, afforestation and the general use of nature (IMG Gallup 2004). The survey has revealed that 52% of the people would prefer birch as the major tree species to be planted, followed by a preference of pine (23%). Larch was the fourth most liked tree species. A negative impact of afforestation on the landscape was only expected by 24% of the people questioned. However, this is still a higher percentage than people who expected a possible negative impact on birds (3%) or other animal and tree species (10%). This indicates that the visible change is indeed important for people, more so than concerns about wildlife or certain species. Hence, both aspects, the visible and the invisible, the ecological and the societal induced, have to go hand in hand in the decision-making process of afforestation in Iceland.

Combining interests

The results of the soil study did not reveal the expected influence of tree species on soil nutrients, except from K and possibly Mg. For C sequestration and the two most important nutrients, N and P, no effect of tree species was found. This may be because both tree species are deciduous and hence have a similar pattern in their growth and loss of leaves. With respect to a change in soil properties, the choice of tree species can therefore be assumed to be less relevant than expected. It is suggested that soil nutrient changes, that is the invisible effects occurring

belowground, can be separated from the evaluation of visible impact of birch and larch, respectively. The choice between these two tree species in afforestation programmes may primarily be based on aspects other than soil properties, like the use of the trees or their visual appearance in the landscape. After all, 84.6% of the people in Iceland wish an increase in forest cover (IMG Gallup 2004). Caution should therefore be taken in the right choice of tree species. Although the percentage of all larch species seedlings planted annually (in 2005) (22%) is similar to that of birch (23%) (Gunnarsson 2006), larch is only in fourth place of the tree species that people suggest should be planted. Birch is the most preferred tree species in this context (IMG Gallup 2004). It should be considered positive that both species, birch and larch. Despite a different growth, height and general use in forestry on Iceland, they have a similar impact on the scenic view of the landscape. The visible impact of evergreens would be much stronger. Nevertheless pine has been rated the second most wanted tree species (IMG Gallup 2004). An additional comparison between native birch and introduced evergreen conifer trees would be necessary to complete the considerations addressed in this paper. Furthermore, aspects like the economic advantage of either tree species for timber production or recreational functions should be included in the evaluation. Birch forests are mainly used for summer house areas, which can create further needs for services and have an impact on socio-economic aspects. Larch is mostly used for timber production, but since the forest industry in Iceland is small, especially compared to tourism, and slowly developing, the recreational functions may be rated higher.

Conclusion

In this paper it is suggested to consider the visual aesthetic quality of landscapes as a valuable common resource. This suggestion is based on two major aspects: i) landscape quality can have a positive impact on the social, mental and physical health of people, which can have economic consequences in terms or reduced costs for public health, etc. and ii) contact to nature plays an important role in our lives and fulfils the basic need of sensation – as opposed to understanding. Both aspects express a general interest in the protection of landscape quality as a common. However, the management of landscape and the protection of scenic beauty are difficult, because many decisions are mainly based on (direct or indirect) economic benefits. It is emphasised in this paper that an impact on landscape quality should not be based on monetary values alone.

Using afforestation as an example for cross-scale interactions of different interest it is shown how forests can change landscapes and what forest managers should be aware of in their decisions on e.g. the choice of tree species and location of forest stands. The case study from Iceland reveals that ecological aims can be united with people's expectations of forests, even in a country that is used to treeless landscapes. Forest manager should learn to combine knowledge about ecological (or other) effects with knowledge about people's preferences. In this present case, forest managers could neglect the (minor) effects on soil properties and hence base their decisions about the choice of trees species primarily on people's preferences. Generally, forest managers and landscape designers should be aware of the impact that their work can have on a common resource, landscape quality, as a bad visual landscape management can influence all people who come to perceive the landscape.

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